AN ABSTRACT OF THE THESIS OF

Heather L. Petcovic for the degree of Master of Science in Geology presented on July 7, 2000. Title: Partial Melting of Tonalite at the Margins of a Columbia River Basalt Group Dike, Wallowa Mountains, Northeastern Oregon.

Abstract approved: Redacted for privacy

Anita L. Grunder

Columbia River Basalt Group dikes cut the tonalite-granodiorite Wallowa Batholith in northeastern Oregon, providing a natural setting in which to examine partial melting. Many dikes have up to 5 m-wide zones of quenched partially melted wallrock at their margins. This paper examines the progressive partial melting reactions in biotite- and hornblende-bearing tonalite at the margin of a near-vertical Grande Ronde dike in the vicinity of Maxwell Lake. Paleodepth at the time of dike emplacement is estimated at 1-2 km, and dike temperature was about 1140°C. Samples collected from the dike margin represent five successive stages of melt reaction over a distance of about 5 m from unmolten wallrock (Stage 1) to about 40 volume percent (vol%) quenched melt (Stage 5). This melt is now represented by about 31 vol% silicic glass that has undergone little to no devitrification and about 9 vol% plagioclase, pyroxene, and Fe-Ti oxide quench crystals. Whole rock major and trace element bulk compositional data are nearly identical to unmolten rock at each stage, suggesting that the melt did not separate from the restite and each stage represents essentially a chemically closed system.

With progressive melting, primary hornblende, biotite, and orthoclase are entirely consumed but residual plagioclase, quartz, Fe-Ti oxides and apatite persist in the restite. Hornblende dehydration initially produces a dusty intergrowth of augite, pigeonite, lesser enstatite, and sparse Fe-Ti oxides. Initial biotite dehydration produces titaniferous magnetite and lesser ilmenite aligned in bands in an intergrowth of enstatite and plagioclase. Andesine plagioclase develops a spongy texture as the albite component is

lost to the melt. Reaction of hornblende, quartz, and feldspar produces sparse tonalitic (high-Ca) glass, while the reaction of biotite, quartz, and feldspar produces abundant granitic (high-K) glass. The two glass types are irregularly distributed around mafic reaction sites and in up to 2 mm seams on quartz-feldspar contacts. With progressive melting, replacement phases become compositionally more homogeneous, clinopyroxene is consumed, the proportion of plagioclase decreases, and glasses become slightly more mafic. Granitic and tonalitic glasses persist in just over 31 vol% glass suggesting that deformation is required to mix these melt types.

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Partial Melting of Tonalite at the Margins of a Columbia River Basalt Group Dike, Wallowa Mountains, Northeastern Oregon

by

Heather L. Petcovic

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APPROVED:

Redacted for privacy

Major Professor, representing Geology

Redacted for privacy

Chair of Department of Geosciences

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Heather L. Petcovic, Author

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CONTRIBUTION OF AUTHORS

Dr. Anita L. Grunder was involved in the design of this project and assisted with data interpretation and analysis as well as writing and revision of the manuscript. Microprobe analyses were performed in the laboratory of Dr. Roger L. Nielsen who also assisted with data collection and interpretation.

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Partial Melting of Tonalite at the Margins of a Columbia River Basalt Group Dike, Wallowa Mountains, Northeastern Oregon

Introduction

Although there is broad consensus that basalt injection is fundamental in crustal melting, there are few places where stages of the interaction can be directly sampled. The Wallowa Mountains of northeastern Oregon, however, provide a natural "laboratory" in which to examine shallow crustal melting. In this area, thousands of Columbia River Basalt Group (CRB) feeder dikes cut granitoids of the Wallowa batholith. The batholith is a biotite- and hornblende-bearing tonalite to granodiorite, a common lithology that approximates bulk "andesitic" continental crust (c.f., Taylor and McLennan, 1985). Many dikes have developed partially melted contact zones at their margins with up to 50 volume percent (vol%) quenched melt. This melt is now represented by slightly devitrified silicic glass plus plagioclase, pyroxene, and Fe-Ti oxide quench crystals. We have examined the partially melted zone in tonalite at the margin of a Grande Ronde dike where up to about 31 vol% glass is preserved over a distance of 5 m from the dike margin.

Recent experimental work (Le Breton and Thompson, 1988; Rutter and Wyllie, 1988; Vielzeuf and Holloway, 1988; Beard and Lofgren, 1991; Rapp et el., 1991; Rushmer, 1991; Wolf and Wyllie, 1991; Skjerlie and Johnston, 1992; Skjerlie and Johnston, 1993; Vielzeuf and Montel, 1994; Wolf and Wyllie, 1994; Patiño Douce and Beard, 1995; Singh and Johannes, 1996a & 1996b; Skjerlie and Johnston, 1996) has shown that dehydration melting plays a vital role in crustal magmatism. Dehydration melting, also called fluid- or vapor-absent melting, is the incongruent reaction of a hydrous phase such as biotite or amphibole with other minerals to form melt plus residual minerals. Most experiments involve a single hydrous phase (either biotite or amphibole), but both biotite and amphibole are present in the Wallowa tonalite. In general, partial melting of granitoid protoliths (plagioclase + quartz + biotite and/or hornblende ± alkali feldspar) at pressures less than 10 kbar produce granitic to tonalitic melt and a restite of

clinopyroxene + orthopyroxene + plagioclase + quartz + Fe-Ti oxides ± alkali feldspar. At pressures greater than 10 kbar, garnet is a crucial phase in the restite. Dehydration reactions appear to be dependent on mode of minerals and temperature and are insensitive to pressure up to about 8 kbar (Singh and Johannes, 1996a), which enables comparison between experimental phase relations at a range of pressures and partial melt reactions in the Wallowa samples (pressure < 1 kbar).

Several studies document partial melt in both partially melted dike and sill margins and partially melted xenoliths in intrusions. All note disequilibrium melting textures and compositions (Naslund, 1985; Kitchen, 1988; Kaczor et al., 1989; Eklund and Lindberg, 1992; Philpotts and Asher, 1993; Green, 1994). Multiple compositionally distinct glasses were documented by Kaczor et al. (1989): a high-silica clear glass attributed to the breakdown of biotite and initial melting of quartz and feldspar, and a more mafic brown glass attributed to continued melting. Brown and clear glass were also noted by Green (1994) in partially melted granodiorite xenoliths. Philpotts and Asher (1993) noted abundant disequilibrium melting textures, such as sieve-textured feldspar. Melting of wallrock was determined to have taken place on grain boundaries between quartz and feldspar, especially when fluxed by water released from biotite breakdown. The Wallowa study differs from other natural examples in that the paleodepth is shallow (and therefore glasses are better preserved) and the protolith is tonalite containing abundant hydrous mafic phases.

The Natural Laboratory

The Wallowa Batholith and CRB Group Dikes

The Wallowa Mountains are largely composed of the Wallowa Batholith (Figure 1), a series of Late Jurassic intrusions (140-160 Ma; Armstrong et al., 1977) related to the accretion of island arc terranes onto the former margin of North America. The batholith is composed of biotite- and hornblende-bearing tonalite to granodiorite. In the Miocene, Columbia River flood basalt erupted from vents primarily in northeastern Oregon and covered portions of western Idaho, northern Oregon and central, southern, and eastern Washington. Feeder dikes of both the Imnaha Basalt (16.8-17.3 Ma; Hooper and Hawkesworth, 1993) and the Grande Ronde Basalt (15.6-16.8 Ma; ibid.) lace the batholith. Uplift and Pleistocene glaciation have resulted in exposure of both the Wallowa Batholith and the CRB Group dikes. The dikes are exposed at a fortuitous paleodepth because they are deep enough to represent crustal reactions yet still shallow enough so that quenching has preserved reaction textures when basalt flow ceased (Grunder and Taubeneck, 1997).

Individual basalt dikes extend up to several km, are up to 50 m wide, are steeply dipping (average 70°), and strike N55°W to N30°E (Browne et al., 1998). Dikes have one or more of the following morphologies: dikes with quenched margins and no interaction with the wallrock, dikes with partially melted wallrock at their margins, dikes that have eroded their wallrock, and dikes containing whole to disaggregated crustal xenoliths (Grunder and Taubeneck, 1997). The presence of a melted zone in the wallrock correlates with a thin or absent quenched edge of the dike and larger grain size in the CRB dike (Browne et al., 1998). In general, melted margins are typically one quarter of the width of the dike, and in cases where dikes are not vertical, the hanging wall has a thicker melted zone (Grunder and Taubeneck, 1997). The melted zone may be up to 5 m wide and contain as much as 50 vol% quenched melt.

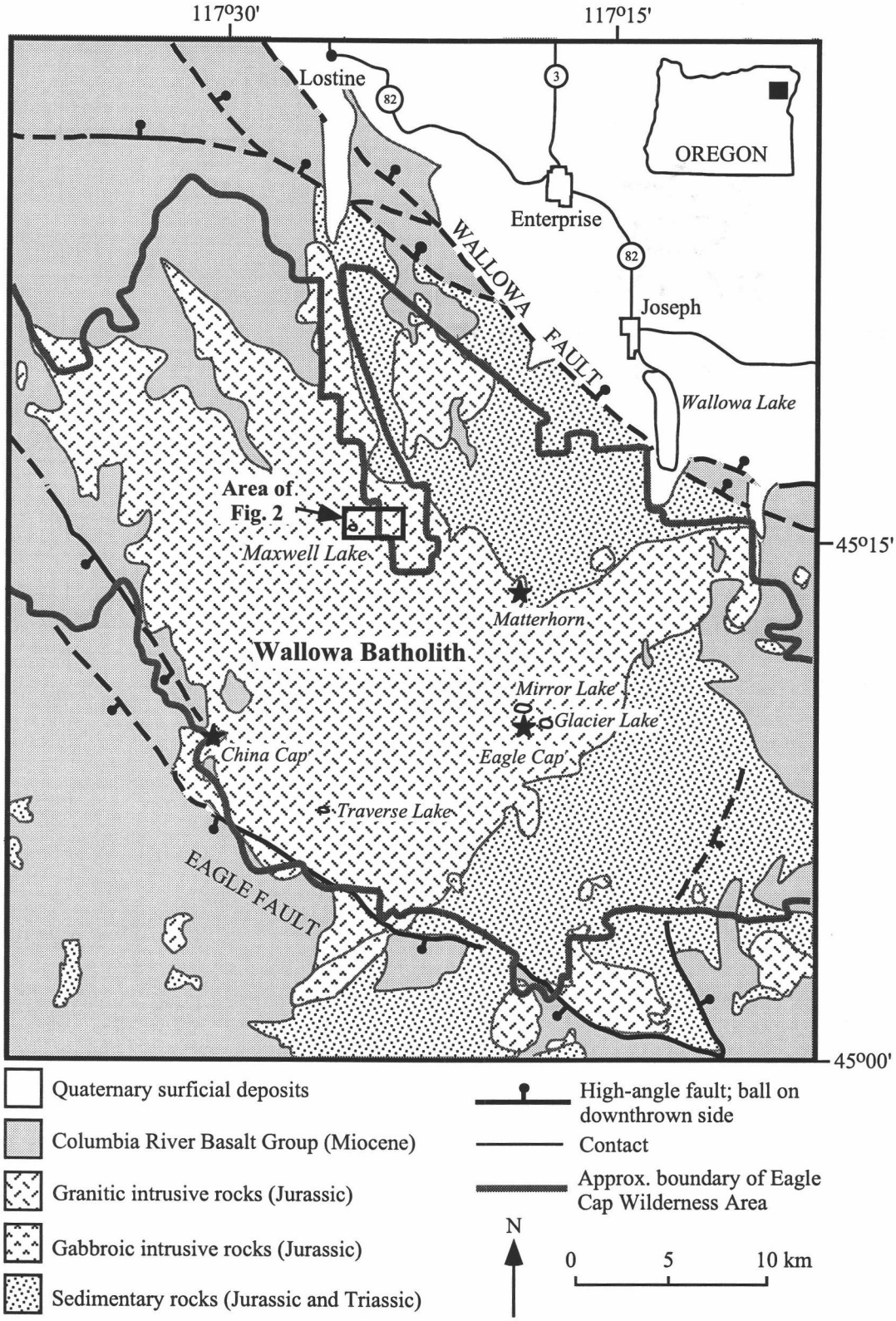


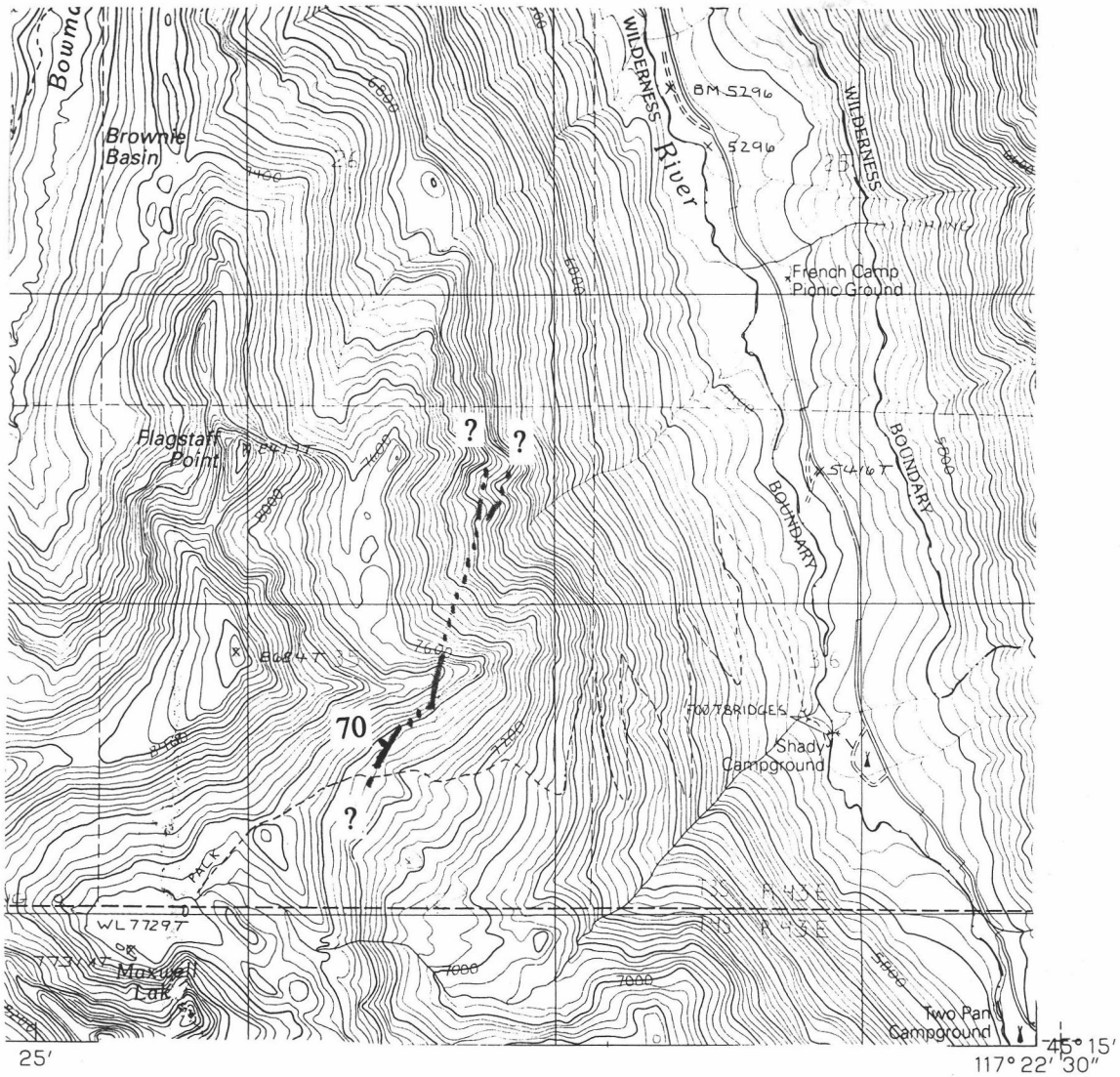
Figure 1. Location and regional geologic setting of the Wallowa Batholith (modified after Taubeneck, 1995).

The Maxwell Lake Dike

The Wallowa Mountains contain hundreds to thousands of dikes with partially melted wallrock at their margins. This study focuses on a single, well-exposed Grande Ronde basalt dike of that type. Located within the Eagle Cap Wilderness Area, the dike is exposed on the western side of the Lostine River Valley about 750 m northeast of Maxwell Lake adjacent to the Maxwell Lake hiking trail (Figure 2). It extends along strike for at least a km. The outcrop we examined consists of the dike and partially melted tonalite along its margins; it is about 45 m long, 20 m wide, and 10 m high (Figures 3, 4a, and 4b). The dike strikes about N20°E, dips steeply to the west (about 75°), and is from 2.7 to 8.1 m wide.

The partial melt margin along the hanging wall (western margin) of the dike is generally 2 to 2.5 m wide but reaches 5 m wide at the southern end of the outcrop (Figure 3). The thickness of the western partial melt margin varies slightly with dike thickness and is 1/4 to 1/2 the width of the dike. The contact between partially melted tonalite and the western edge of the dike is exposed along the entire length of the outcrop (Figures 3 and 4a). The dike is medium-grained and the contact is diffuse (Figure 4c). Exposure of the eastern margin (footwall) is patchy, and the partial melt margin is about 1.5 m wide, thinner than the hanging wall partial melt margin (Figure 3). The thickness of the footwall partial melt margin also varies slightly with dike thickness. The contact between the eastern edge of the dike and partially melted tonalite is exposed in a few locations; at the southern end of the outcrop the contact and dike are texturally similar to the western margin, but where the dike becomes narrower it is finer grained and the basalt-tonalite contact is sharper (Figures 4d and 4e). A dense network of blue-gray veins cut through the partially melted tonalite at the southern end of the outcrop (Figure 4f). Vein density is highest closer to the dike, and partially melted tonalite at this end of the outcrop has a cataclastic texture.

The partially melted margin on either side of the Maxwell Lake dike is sub-divided into three zones based on field characteristics (Figure 3). From unmelted wallrock to dike margin, these zones are the mafics-out zone, the mottled zone, and the mush zone. Each of these zones is parallel to the dike, and individual zones are 10 cm to



KEY

Strike and dip of the Maxwell Lake Dike (area of Figure 3)

Extent of the Maxwell Lake Dike (dashed where inferred)

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Figure 2. Location of the Maxwell Lake Dike on the North Minam Meadows USGS 7.5 minute topographic quadrangle.

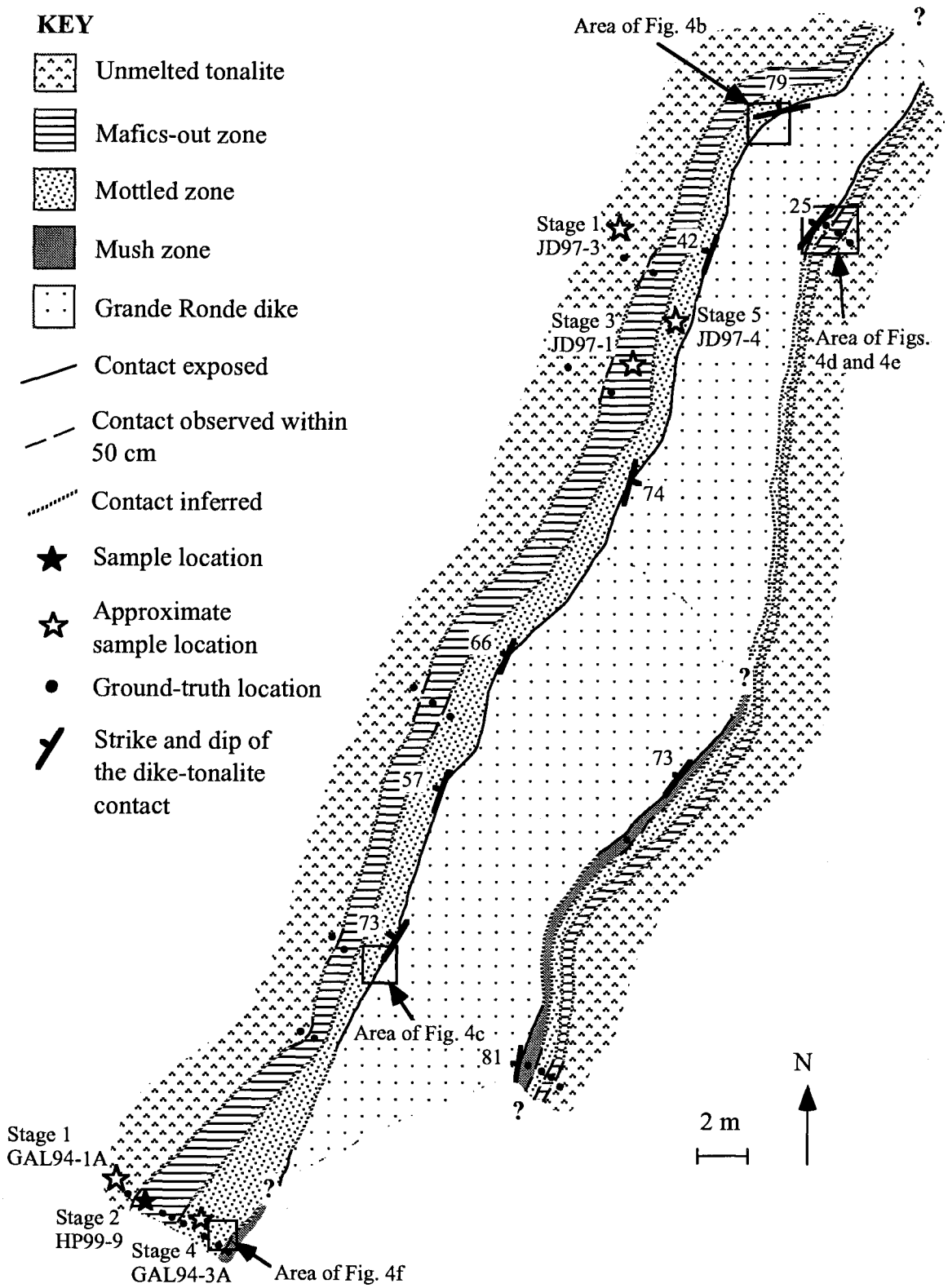

Figure 3. Map of Maxwell Lake Dike with sample names and locations.

Figure 4a. Outcrop of steeply west-dipping Grande Ronde basalt dike and quenched partially melted tonalite margin near Maxwell Lake. View is to the north.

Figure 4b. The northern portion of the Maxwell Lake Dike's western margin. View is to the north.

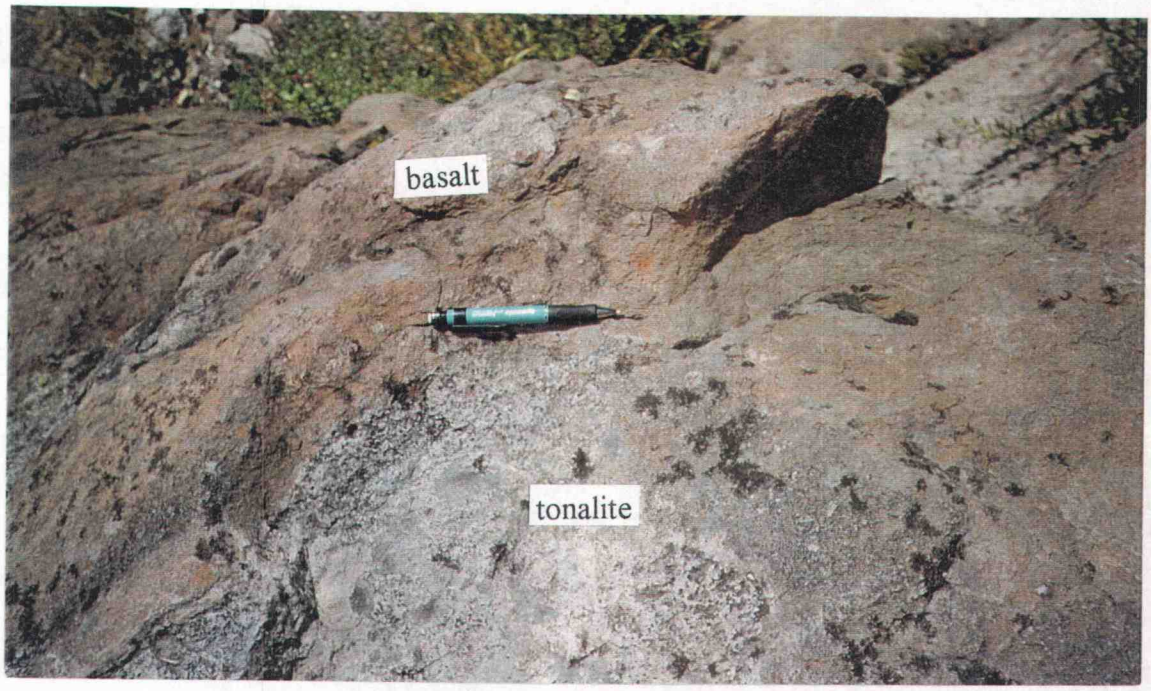

Figure 4c. Contact between basalt and quenched partially melted tonalite at the dike's western margin. North is to the left in this photograph. Pencil is about 12 cm long.

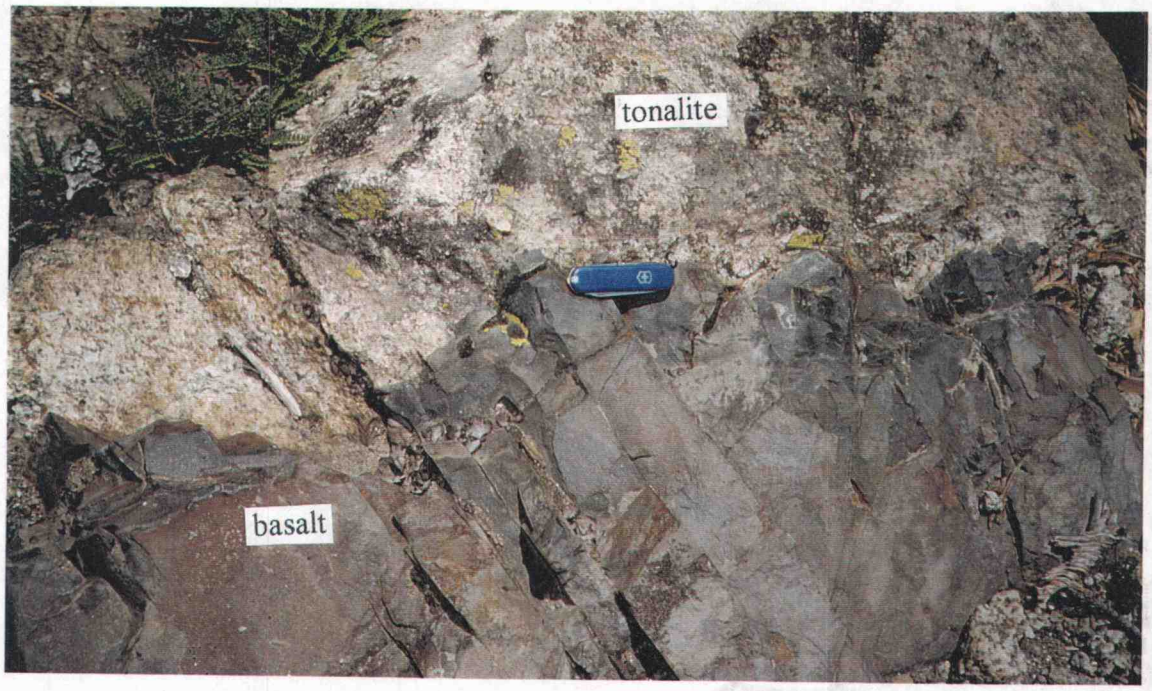

Figure 4d. Contact between basalt and quenched partially melted tonalite at the dike's eastern margin. North is to the left in this photograph. Pocket knife is about 5 cm long.

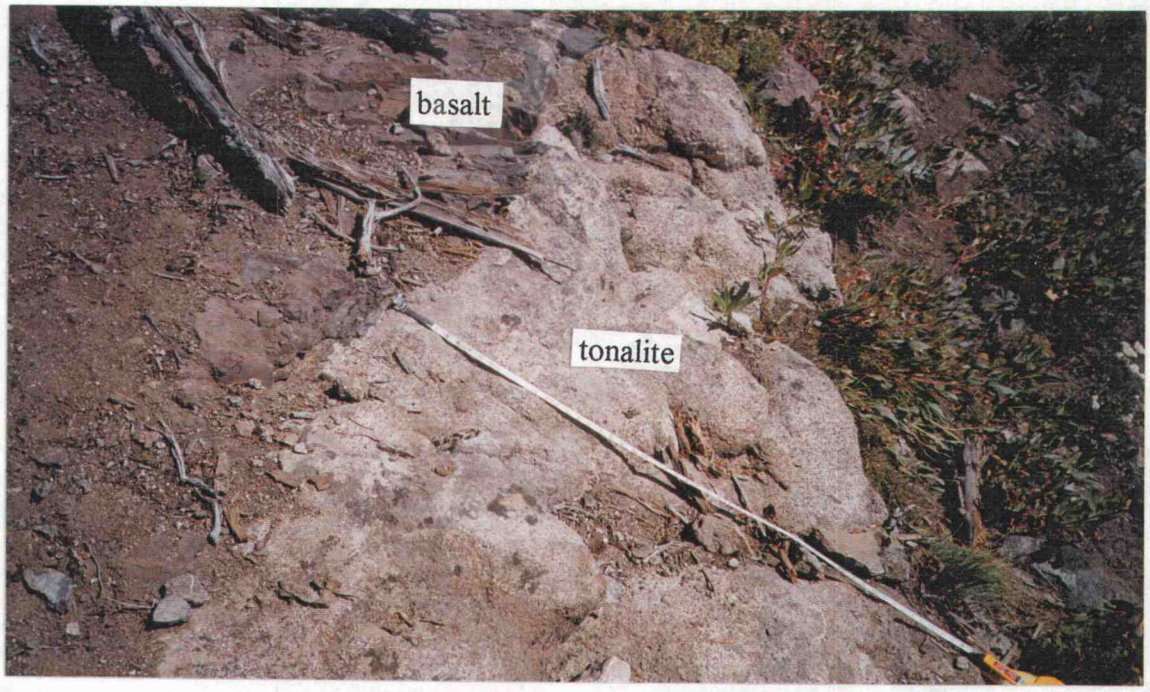

Figure 4e. Eastern contact (at the end of the tape measure) between dike and quenched partially melted tonalite. View is to the north.

Figure 4f. Cataclastic zone containing blue-gray veins and brecciated groundmass at the southern end of the outcrop. View is to the north. Pocket knife is about 5 cm long.

about 2 m wide. Like the partially melted margin overall, individual zones are thicker on the hanging wall than on the footwall. Transitions between one zone and the next are gradual and occur over a distance of about 50 cm. Unmelted parent rock is found 2 to 5 m from the dike margin. The mafics-out zone is 1 to 2 m wide and characterized by the reaction of mafic silicates to fine-grained alteration products (predominantly pyroxene and Fe-Ti oxides). Alteration products pseudomorph original minerals, and replacement ranges from incipient (preserved biotite cleavage) to complete with increasing alteration towards the dike margin. Quartz and feldspar are unaltered and glass may be present as thin seams around felsic grains. Sparse thin (1 to 2 mm) white veins cut through this zone. The mottled zone is characterized by a blue-gray mottled texture and is generally 1 to 2 m wide. Biotite and hornblende are entirely replaced, and mafic reaction sites often lack distinct margins. The rims of residual quartz and feldspar crystals are also indistinct and brown glass seams commonly surround these grains. The mush zone is a discontinuous, 10 to 50 cm wide zone paralleling the dike margin. This zone contains sparse amorphous blebs of quartz and feldspar in a fine-grained blue-gray groundmass. The presence of the mush zone appears to correlate with thicker areas of the dike.

Conditions of Melting

We have chosen to examine the Maxwell Lake dike in part because of the excellent exposure and in part because the "experimental conditions" are constrained. Six samples collected from the western margin of the Maxwell Lake dike represent progressive stages of melt reaction from unmelted tonalite to about 31 vol% glass (for locations see Figure 3). At the time of eruption of Grande Ronde basalt, about 1 km of Imnaha basalt covered the paleosurface of the Wallowas. An additional 1 km of relief is exposed below the unconformity between Imnaha flows and the Maxwell dike, making the depth at the time of dike emplacement at most 2 km (< 1 kbar). Finally, the initial temperature of the wallrock may be estimated from an average continental geotherm. Assuming a geotherm of 15°C per km, the pre-dike emplacement temperature of the Maxwell Lake area would be about 55°C. Liquidus and solidus estimates for Grande

Ronde basalts are 1140°C and 1050°C (Murase and McBirney, 1973; McKinley and Rawson, 1985). Temperature at each successive melt reaction stage may be estimated from experimental phase relationships and measured using common geothermometers.

Analytical Methods

Petrography

Modal proportions of the major phases (plagioclase, quartz, alkali feldspar, amphibole, biotite, pyroxene, glass, and Fe-Ti oxides) were determined by point count. Phases were counted on a 1 mm grid with about 500 points counted per thin section. A hand sample of unaltered tonalite was stained for alkali feldspar and phases were counted on a 2 mm grid.

Electron Microprobe

Major element analyses of crystals and glass were performed using the CAMECA SX-50 Electron Microprobe at Oregon State University. Analyses of amphibole, pyroxene, feldspar, biotite, and apatite were performed using a beam current of 30 nA, an accelerating voltage of 15 kV, and a 3 to 5 μm beam. Core to rim traverses were performed on large crystals to look for compositional zoning and crystal heterogeneity. Glass was analyzed using the same conditions and a broad (20 μm) beam. Na was counted first in glass and crystals due to its susceptibility to beam damage. Analyses of Fe-Ti oxides were performed using a beam current of 50 nA and a beam size of 1 μm. Major elements were counted for 10-20 seconds, while elements in low concentrations required counting times of 30 seconds for S and Ba and 60 seconds for Cl, Sr, and Ce. A list of standards used in calibration is provided in Appendix A. Analytical precision determined from microprobe counting statistics and limits of detection are provided in Appendix B. Comprehensive lists of microprobe data are provided in Appendices C through I.

X-Ray Fluorescence

Whole rock bulk analyses were performed using the Rigaku 3370 x-ray fluorescence (XRF) spectrometer at Washington State University's GeoAnalytical Laboratory. Approximately 1 kg of each sample was crushed with a hammer, reduced to pea-sized gravel using a jaw crusher, then prepared for XRF analysis by the method of Johnson et al. (1999). This method includes mixing the sample in 1:2 proportions with lithium tetraborate, using a fused bead for both major and trace element analysis, and using constant voltage (50 kV, 50 mA) on a Rh target for all elements.

Analytical Results

The Stages of Melting

Six samples collected from the western margin of the Maxwell Lake dike represent progressive stages of melt reaction from unmelted tonalite (Stage 1) to about 31 vol% glass (Stage 5). Two samples representing Stage 1 (GAL94-1A) and Stage 4 (GAL94-3A) were collected by Anita Grunder, Lang Farmer, and George Bergantz with the assistance of Bill Taubeneck in 1994. Three samples representing Stage 1 (JD97-3), Stage 3 (JD97-1) and Stage 5 (JD97-4) were collected in 1997 by Brandon Browne, Jesse Dickinson, Anita Grunder, and Heather Petcovic. A final sample representing Stage 2 (HP99-9) was collected in 1999 by Heather Petcovic with the assistance of Michael Winkler. The samples representing Stages 2 and 3 were collected from the mafics-out zone, while the samples representing Stages 4 and 5 were collected from the mottled zone (Figure 3). Samples collected from the southern end of the outcrop (Stages 2 and 4) have a cataclastic texture and are cut by blue-gray to white veins. Modal proportions were determined by point count on thin sections and are presented in Figure 5 and Table 1.

Stage 1

The unmelted parent rock (Stage 1) is a medium-grained, hypidiomorphic granular granodiorite-tonalite (see Table 1 for mode). Modally, the parent rock is classified as a granodiorite, but by chemical composition classification it is a tonalite (see bulk compositional results); we will refer to it as a tonalite. Modes of the two samples representing Stage 1 (samples GAL94-1A and JD97-3) are nearly identical, however, one sample has a slightly smaller overall grain size (Figures 6a and 6b). The ratio of biotite to hornblende is roughly 1:1 in this Stage overall, however, in individual thin sections the ratio ranges from 2:1 to 3:4, suggesting that the distribution of these phases is inhomogeneous. Quartz and feldspars appear to have a more homogeneous distribution.

Table 1. Modal (volume) percentages of phases by Stage.

		Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
Total Counts		1390	418	1092	954	1142
Primary/Relict	Plagioclase*	42.9	49.0	52.3	59.4	43.3
	Quartz	19.3	19.6	8.2	2.5	3.0
	Orthoclase	8.0	5.7	1.7	0	0
	Hornblende	14.7	15.3	0	0	0
	Biotite	14.0	9.3	0	0	0
	Fe-Ti oxide	1.0	1.0	1.0	0.6	0.1
Hornblende site	Pyroxene	0	0	12.5	7.4	8.8
Biotite site	Pyroxene	0	0	6.5	7.1	2.9
	Plagioclase	0	0	1.3	1.5	1.1
	Fe-Ti oxide	0	0	2.1	2.4	1.5
Glass	Brown	0	trace	12.3	4.3	30.1
	Clear	0	0	0.1	3.9	1.1
	Devitrified	0	0	0.0	10.0	0.0
Quench crystals	Plagioclase	0	0	0.5	0.3	5.3
	Pyroxene	0	0	1.0	0.3	1.9
	Fe-Ti oxide	0	0	0.3	0.2	0.9

All Stages contain trace (<0.5 vol%) apatite, zircon, and titanite. Stage 1 is represented by two samples. All other Stages are represented by a single sample. Point counts were performed on multiple thin sections (one thin section for Stage 2). Error is +/- 1% for most counts and may be higher (3-5%) in Stages 2 and 4.
*Plagioclase data include plagioclase plus spongy rims containing trapped melt.

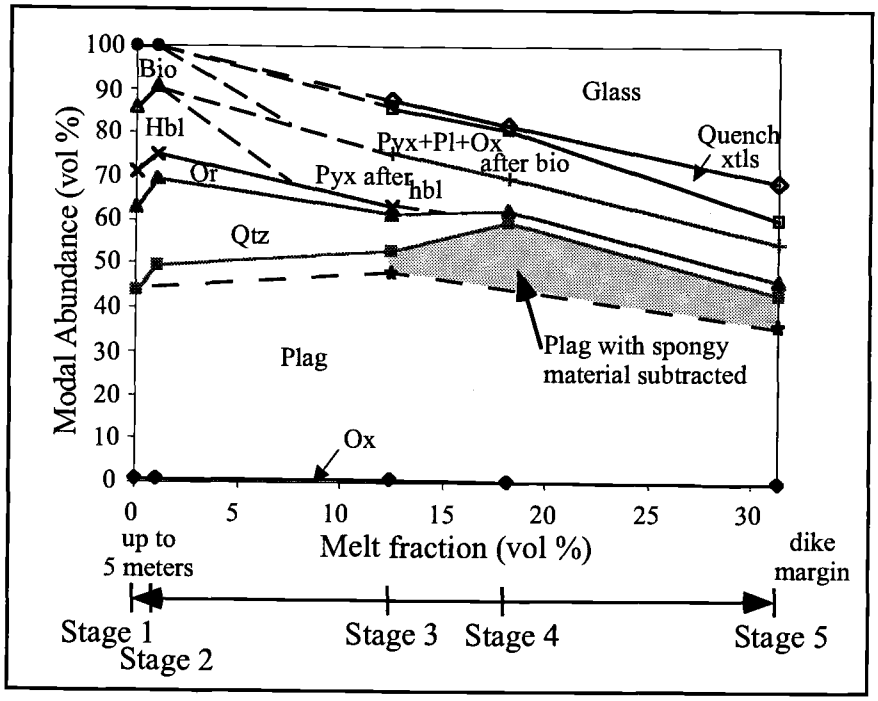

Figure 5. Modal (volume) percentages of phases by Stage.

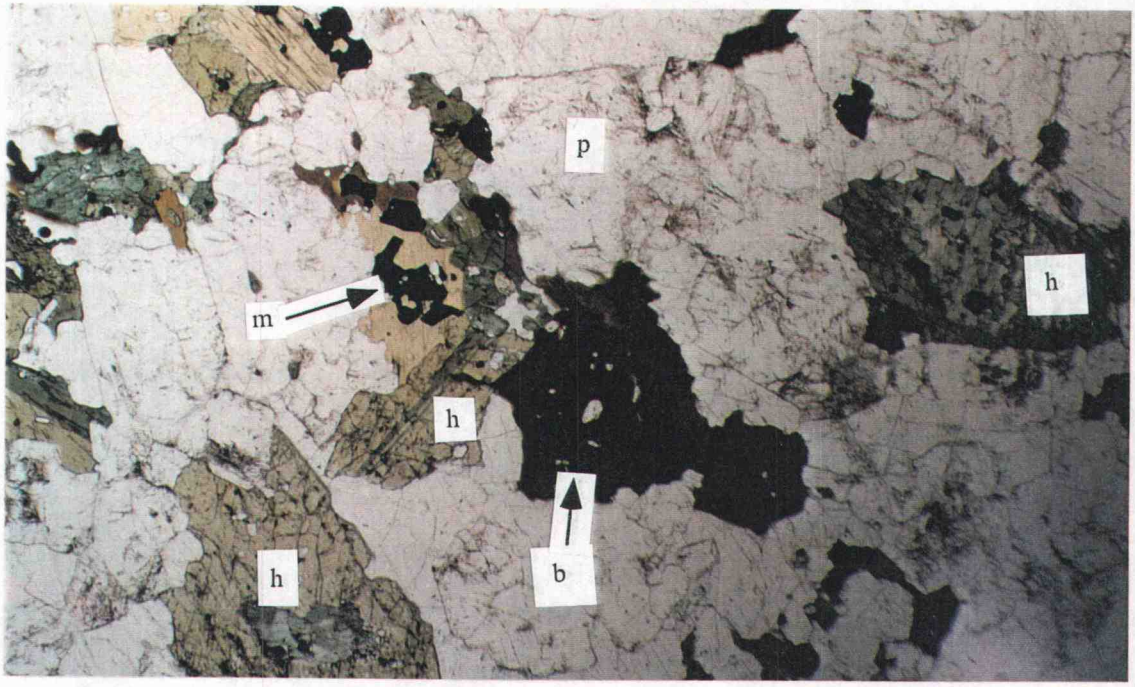

Figure 6a. View of Stage 1 tonalite with plagioclase (p), quartz (q), biotite (b), hornblende (h), magnetite (m), and apatite (a). Plane-polarized light. Field of view (FOV) = 6.7 mm.

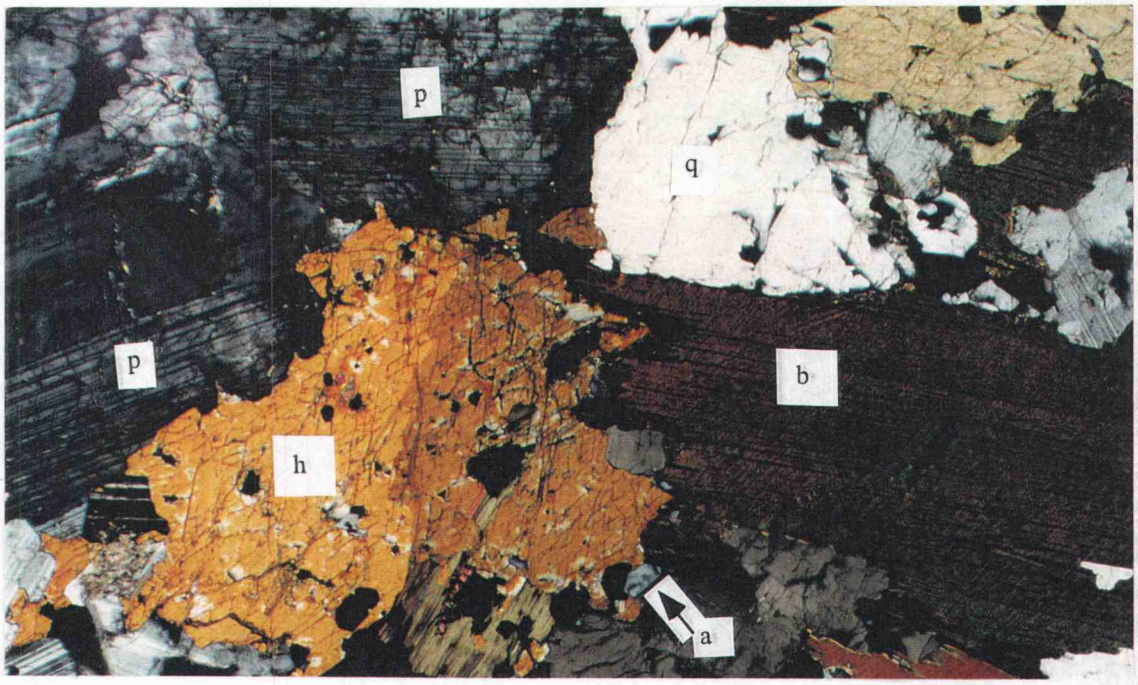

Figure 6b. Biotite and hornblende surrounded by plagioclase and quartz in Stage 1 (labels same as in Figure 6a). Cross-polarized light. FOV = 6.7 mm.

Subhedral biotite grains average 1 to 2 mm and may be as long as 5 mm with grain rims commonly altered to chlorite. Euhedral hornblende grains are 1 to 2 mm long and often contain small quartz blebs; clinopyroxene cores occur in several hornblende grains. Biotite and hornblende occur in clumps, commonly with Fe-Ti oxides, apatite, and zircon. Apatite and zircon also are enclosed in biotite, whereas titanite occurs between grain boundaries of the felsic phases. Tabular plagioclase may be as long as 5 mm and has oscillatory zonation. Anhedral quartz and subhedral orthoclase are typically smaller (1 mm length).

Stage 2

The overall texture of the sample representing Stage 2 (sample HP99-9; Figure 7a) is similar to that of Stage 1. However, the sample has a cataclastic overprint as evidenced by minute fractures, offset twinning in plagioclase, and abundant brown weathering products (Figure 7b). A brown vein cuts several hornblende and biotite crystals and contains broken fragments of quartz and feldspar (Figure 7c). Because of the cataclastic texture, orthoclase may have been overlooked or mistaken for plagioclase thus accounting for the apparent decrease in orthoclase and increase in plagioclase from Stage 1 to Stage 2 (Table 1, Figure 5). The modal proportion of hornblende is similar to that of Stage 1, but the proportion of biotite has decreased slightly (Table 1). While this sample is incipiently reacted, the apparent volume change in biotite is likely due to inhomogeneity of the parent rock or to the smaller number of points counted for this sample.

Amphibole contains sub-microscopic dusty reaction products that cause patchy, irregular extinction (Figure 7d). Biotite is incipiently altered to dusty opaque reaction minerals along cleavage planes and up to 0.5 mm bands at crystal edges (Figure 7e). Plagioclase retains its oscillatory zonation. No glass is present on quartz-feldspar boundaries, but sparse, thin seams of glass were observed at the margins of two biotite crystals (Figure 7f). Glass seams are commonly less than 100 μm wide and are yellow-brown in color.

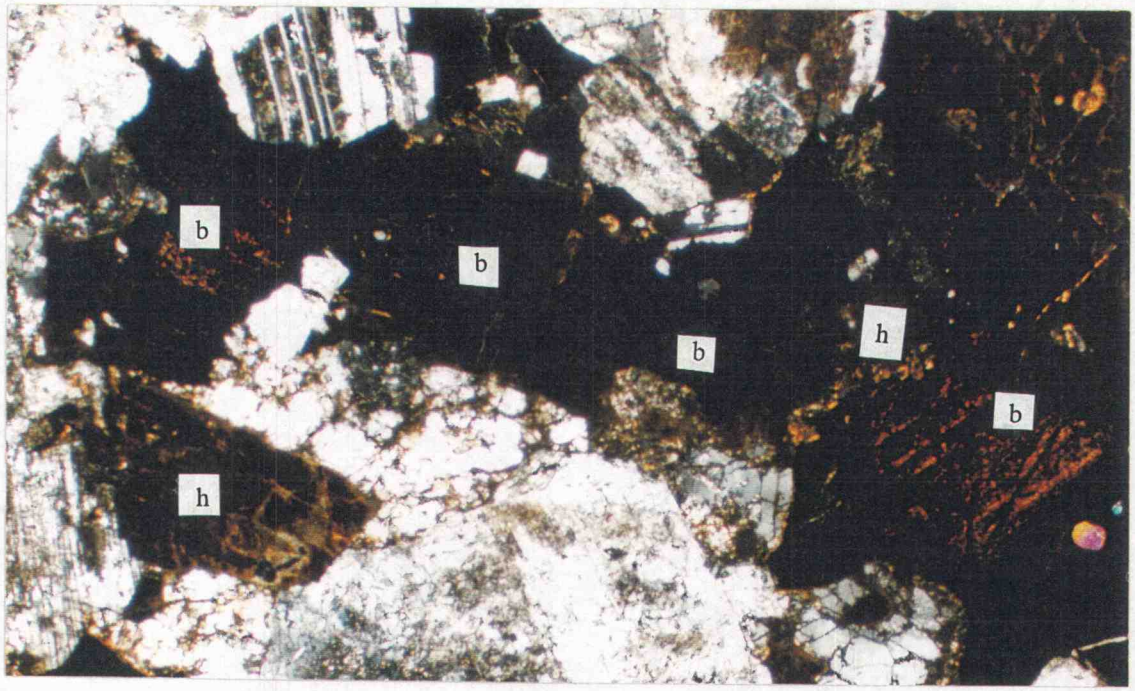

Figure 7a. General view of Stage 2 with incipiently reacted biotite and hornblende in the center (labels same as Figure 6a). Plane-polarized light. FOV = 6.7 mm.

Figure 7b. Fractures and brown weathering products in plagioclase indicating cataclastic overprint of Stage 2. Plane-polarized light. FOV = 1.3 mm.

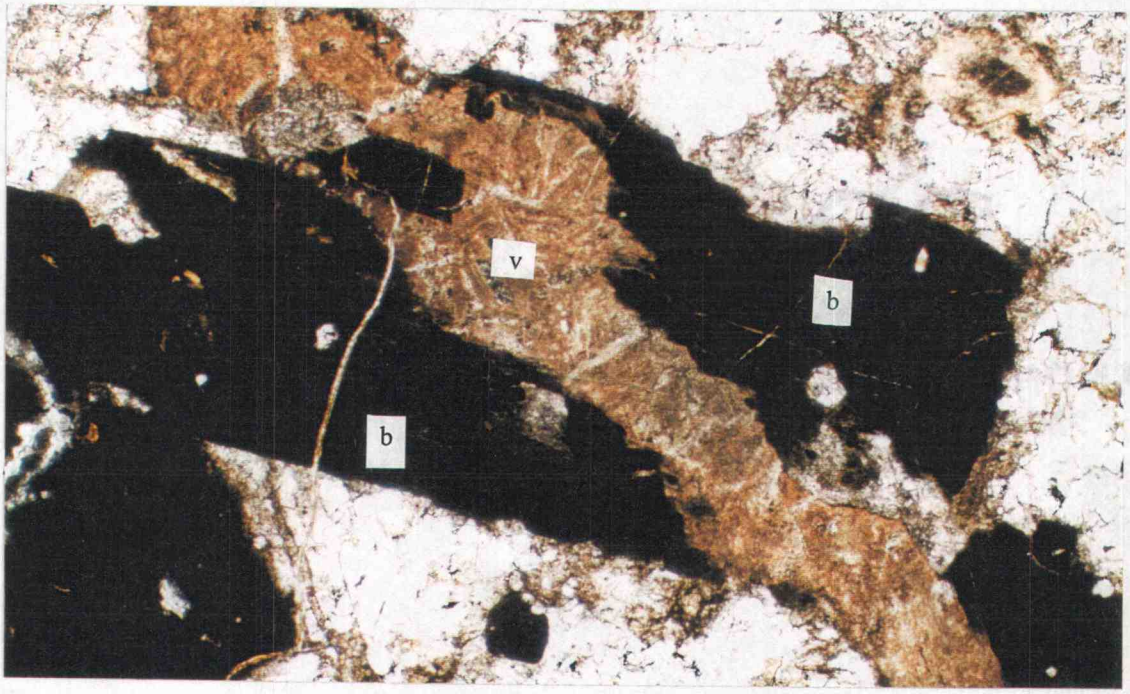

Figure 7c. Brown vein (v) cutting biotite crystal (b), Stage 2. Plane-polarized light. FOV = 3.3 mm.

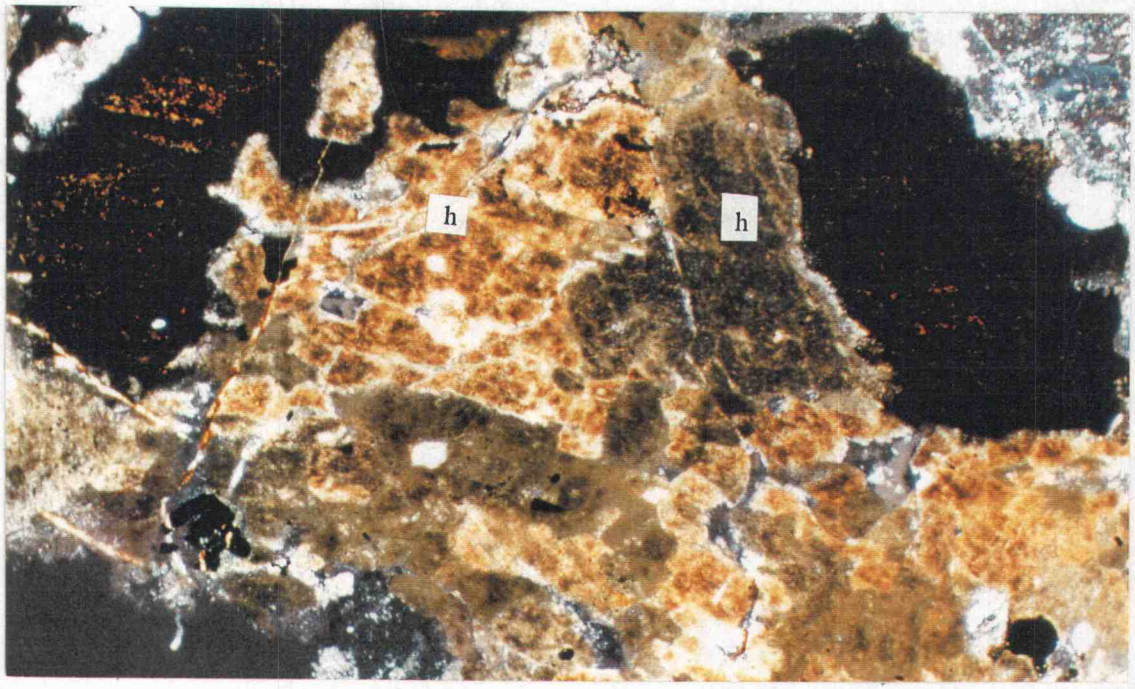

Figure 7d. Reacted hornblende (h) with patchy extinction caused by dusty reaction products, Stage 2. Cross-polarized light. FOV = 3.3 mm.

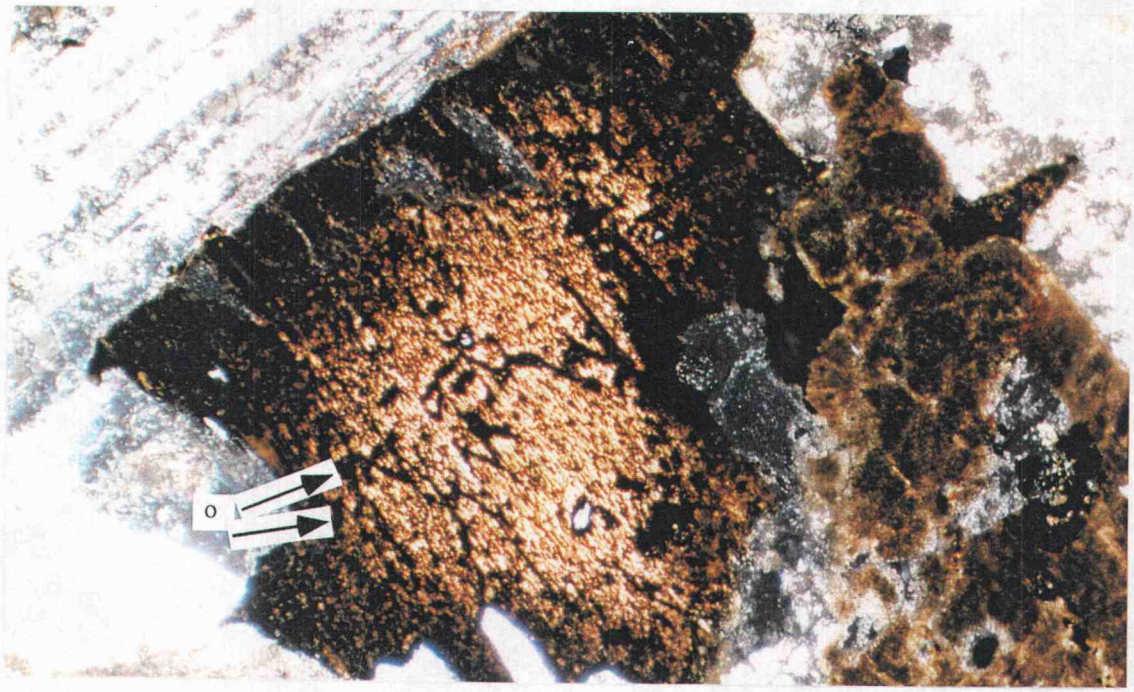

Figure 7e. Incipiently reacted biotite with Fe-Ti oxides (o) aligned along cleavage planes. Plane-polarized light. FOV = 3.3 mm.

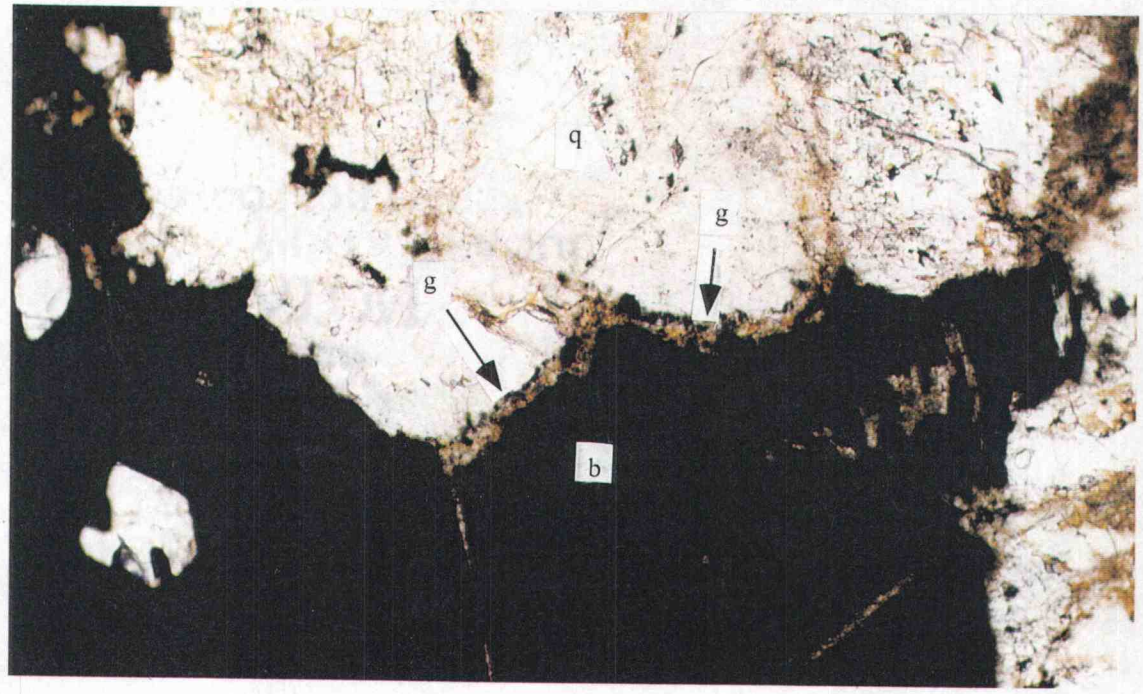

Figure 7f. Thin seam of yellow-brown glass (g) at the contact between biotite (b) and quartz (q), Stage 2. Plane-polarized light. FOV = 1.3 mm.

Stage 3

Stage 3 (sample JD97-1) is most conspicuously characterized by the first appearance of continuous glass seams and the complete reaction of both amphibole and biotite (Figure 8a). About 12 vol% glass is present in this Stage. The modal proportion of quartz has decreased by half, and less than 2 vol% orthoclase remains (Table 1, Figure 5). The proportion of plagioclase has increased relative to Stage 1 (Table 1), however, as much as 25 vol% of the plagioclase has a spongy texture in which an additional 25% glass may exist (Figure 5). Reaction products of both amphibole and biotite occupy less volume than the original minerals with a 20% volume decrease for hornblende and a 35% volume decrease for biotite (Table 1).

Dusty brown reaction products rimmed by optically aligned pyroxene grains replace hornblende (Figure 8b). Biotite sites are occupied by a fine-grained intergrowth of glass, dusty Fe-Ti oxides, orthopyroxene, and feldspar, with silicates outnumbering oxides by nearly 4:1 (Figure 8c). Replacement Fe-Ti oxides are oval to acicular, 10 to 20 μm in diameter, and aligned in parallel bands that presumably mimic original cleavage. Replacement silicates are slightly larger but irregularly shaped. Replacement minerals become finer to dusty along edges of biotite sites. Relict quartz grains are embayed and surrounded by glass; glass seams commonly mimic the shape of the quartz grain. When in contact with glass, plagioclase has spongy texture and poorly developed fritted margins, but plagioclase-plagioclase boundaries are intact (Figure 8d). Individual cells in spongy plagioclase are rounded and filled with brown glass. Occasional isolated pockets of glass are present within plagioclase crystals. Plagioclase retains its oscillatory zonation. Abundant glass seams trace to mafic sites but commonly surround quartz and plagioclase along grain boundaries. Seams are as thin as 10s of microns and as thick as 1 mm. Along grain boundaries, the glass is brown and slightly fibrous, containing radial bunches of quenched plagioclase, equant Fe-Ti oxides, and acicular pyroxene (Figure 8d). Acicular feldspar crystals in the glass display quench textures, including swallow tails and hollow crystals (hopper crystals). A trace amount of clear glass that lacks quench crystals is present in this Stage.

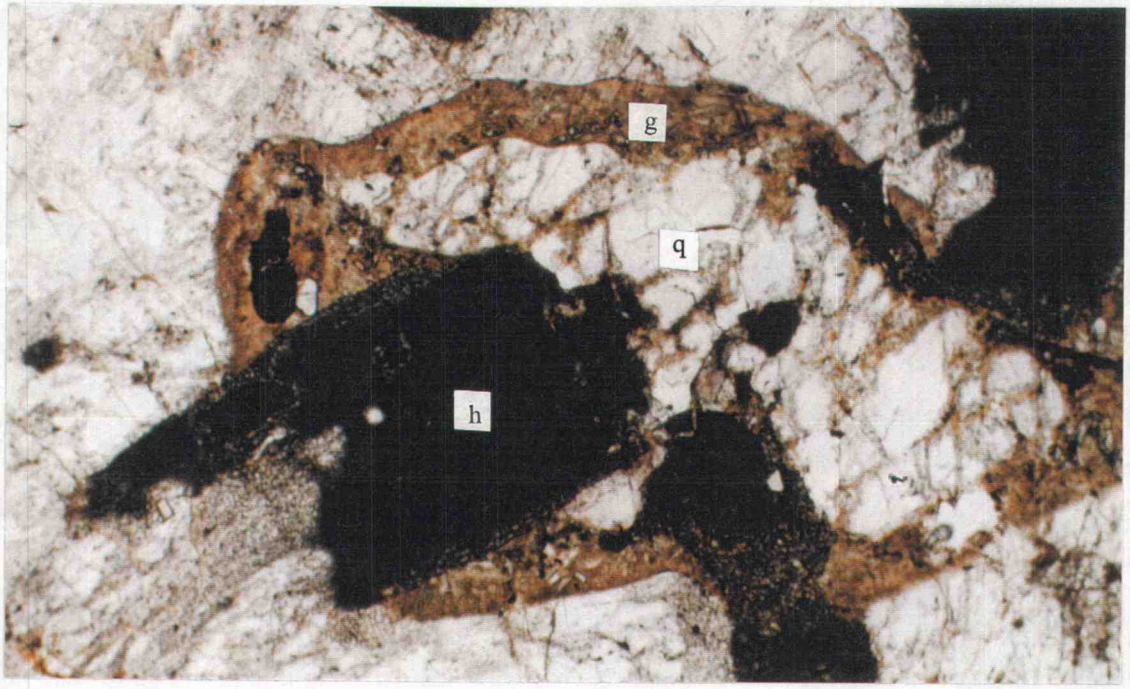

Figure 8a. General view of Stage 3 with a brown glass (g) seam surrounding embayed quartz (q) and a reacted hornblende (h) site. Plane-polarized light. FOV = 3.3 mm.

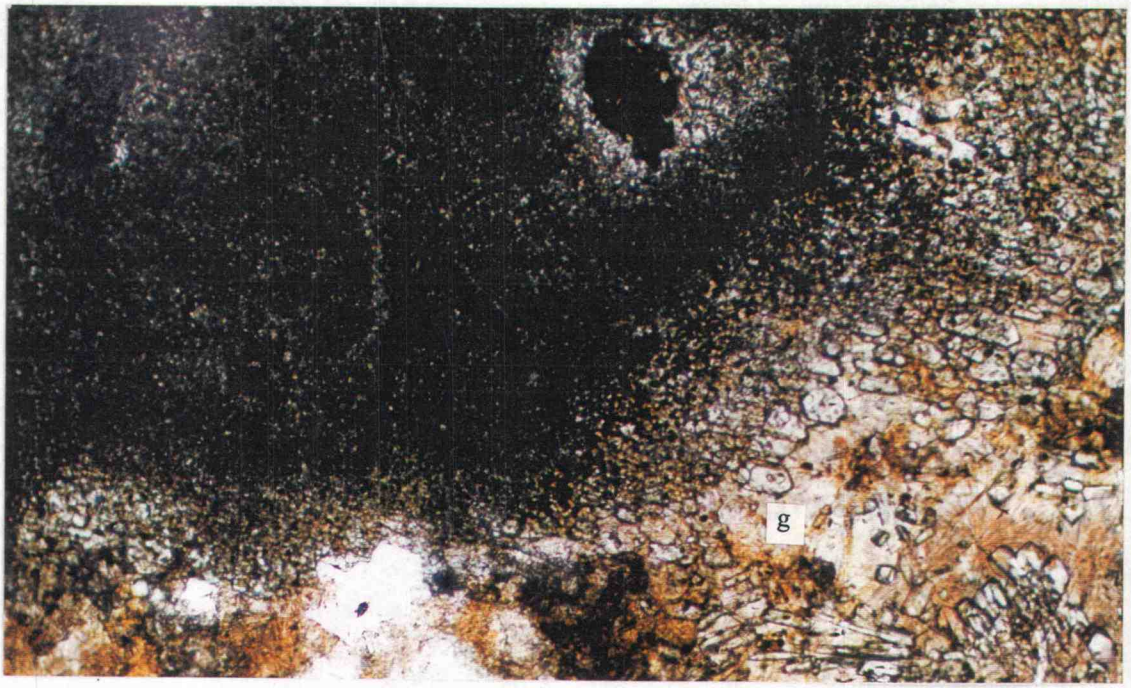

Figure 8b. Dusty brown pyroxene, Fe-Ti oxides, and glass (g) with coarser pyroxene fringe replacing hornblende, Stage 3. Plane-polarized light. FOV = 1.3 mm.

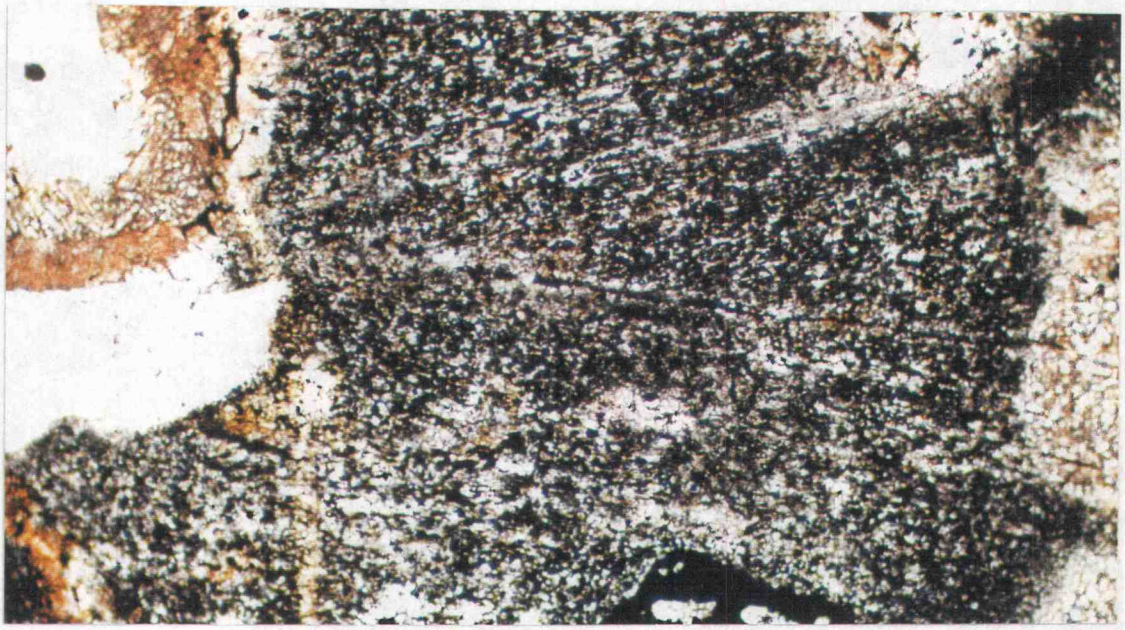

Figure 8c. Aligned Fe-Ti oxides in an intergrowth of orthopyroxene, feldspar, and glass replacing biotite, Stage 3. Plane-polarized light. FOV = 1.3 mm.

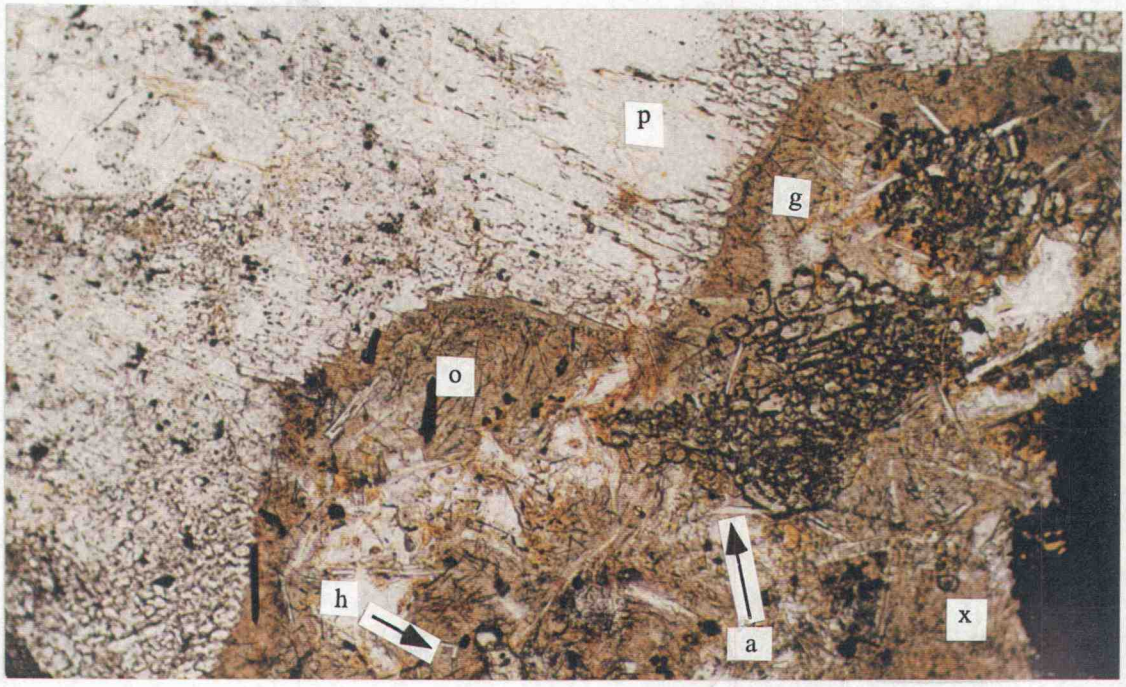

Figure 8d. Spongy plagioclase (p) in contact with glass (g), Stage 3. Glass contains hopper plagioclase (h), acicular plagioclase (a), Fe-Ti oxide (o), and pyroxene (x) quench crystals. Plane-polarized light. FOV = 6.7 mm.

Stage 4

The sample representing Stage 4 (sample GAL94-3A) has a cataclastic overprint as evidenced by brecciated crystal fragments, microscopic fractures in crystals, and offset twinning in plagioclase (Figure 9a). Oxide bands in biotite reaction sites are "wavy" and offset; however, amphibole reaction products appear unaffected by deformation. This sample lacks orthoclase and the modal proportion of quartz is less than 3 vol% (Table 1). The modal proportion of plagioclase has increased by almost 20 vol% relative to Stage 1, but as in Stage 2 the cataclastic texture of this sample obscures mineral textures, making phase identification difficult. This is the only Stage in which biotite replacement products are more abundant than hornblende replacement products, but again due to the cataclastic texture, pyroxene in hornblende sites may have been overlooked. This sample contains about 18 vol% glass.

Hornblende has recrystallized to small (10 to 100 μm long) pyroxene crystals that are optically aligned with their c-axes presumably following the c-axis of the original hornblende (Figure 9b). Pyroxene crystals in the center of amphibole reaction sites are commonly smaller than those on the edges of the sites, and Fe-Ti oxides are concentrated towards the center of the hornblende site. The intergrowth of glass, Fe-Ti oxides, orthopyroxene, and feldspar replacing biotite remains fine-grained. Fe-Ti oxides in biotite sites remain aligned, and a thin (<1 mm wide) dusty rim surrounds reaction sites (Figure 9c). Plagioclase and quartz are minutely brecciated, giving these phases a mottled texture. Plagioclase retains the oscillatory zonation. Abundant clear glass in addition to brown glass is present in this Stage (Figure 9d), whereas other samples contain predominantly brown glass. Glass is restricted to areas around reacted mafic sites; the cataclastic overprint obscures any glass that may occur around quartz and feldspar grains. Three glass types occur in Stage 4: a clear, colorless to gray glass with sparse quench Fe-Ti oxides (Figure 9d), a medium-brown glass with similar sparse oxides (Figure 9d), and a dark brown devitrified glass containing abundant quench oxides, orthopyroxene, and quartz. The first two glasses commonly occur together near mafic sites, while the latter glass is found in cataclastic areas and veins within crystals.

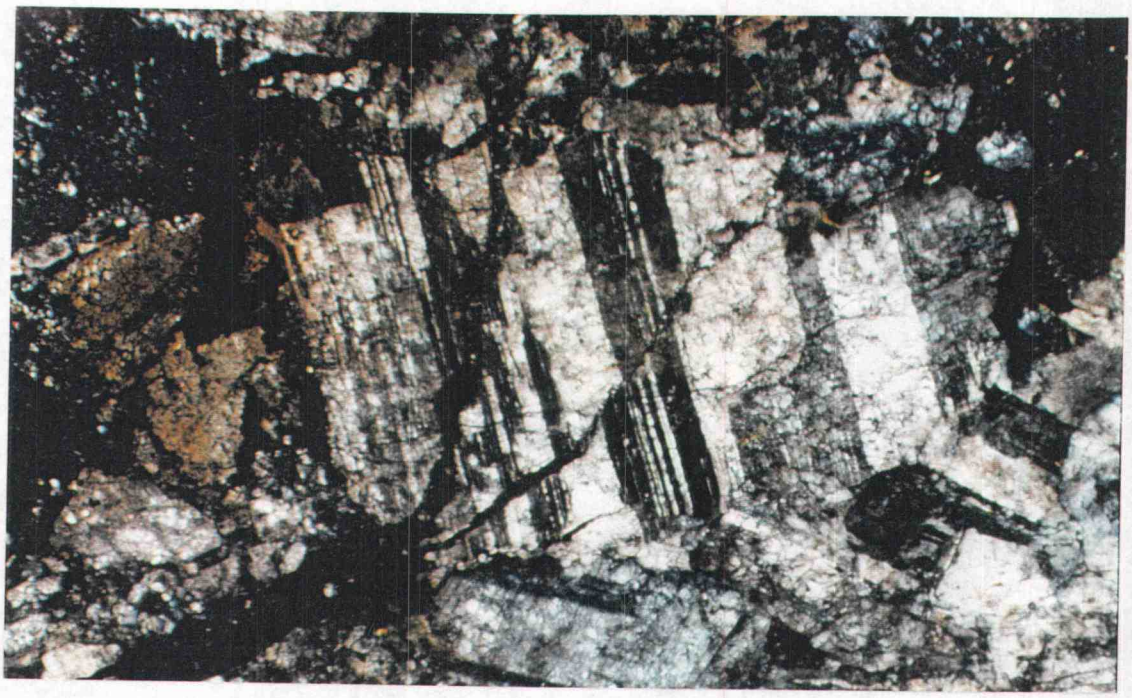

Figure 9a. Fractured plagioclase crystal, Stage 4. Cross-polarized light. FOV = 1.3 mm.

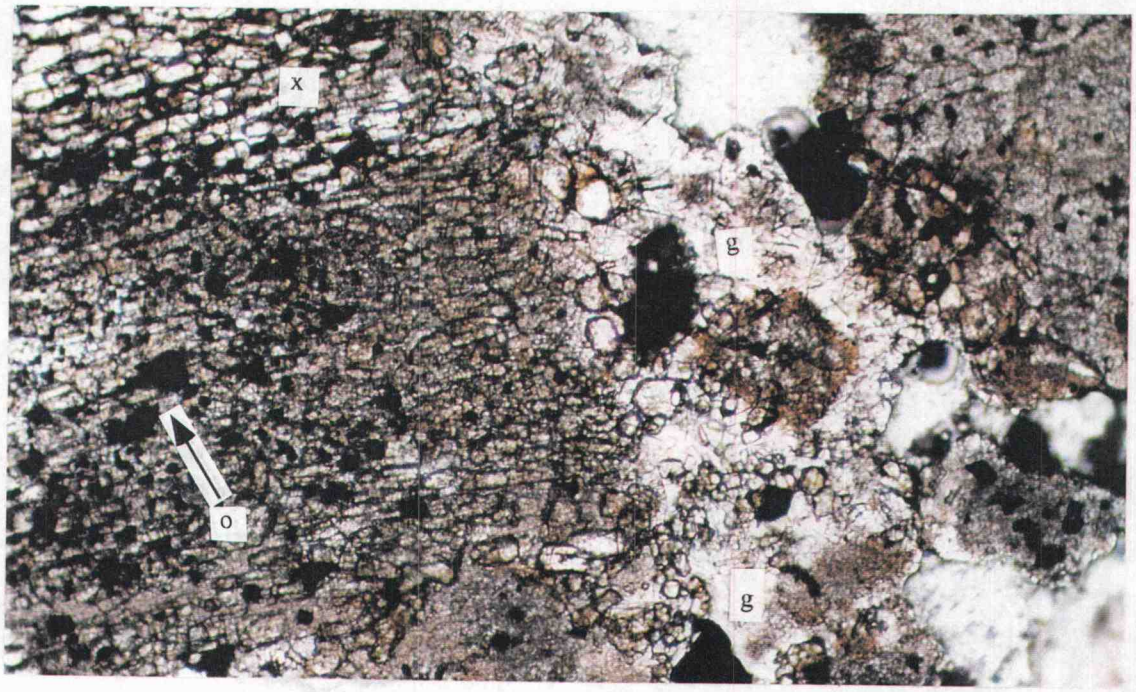

Figure 9b. Optically aligned pyroxene (x) and Fe-Ti oxides (o) in glass (g) replacing hornblende, Stage 4. Plane-polarized light. FOV = 1.3 mm.

Figure 9c. Wavy, aligned Fe-Ti oxides in a matrix of orthopyroxene, feldspar, and glass replacing biotite, Stage 4. Reaction sites have a thin, dusty rim. Plane-polarized light. FOV = 3.3 mm.

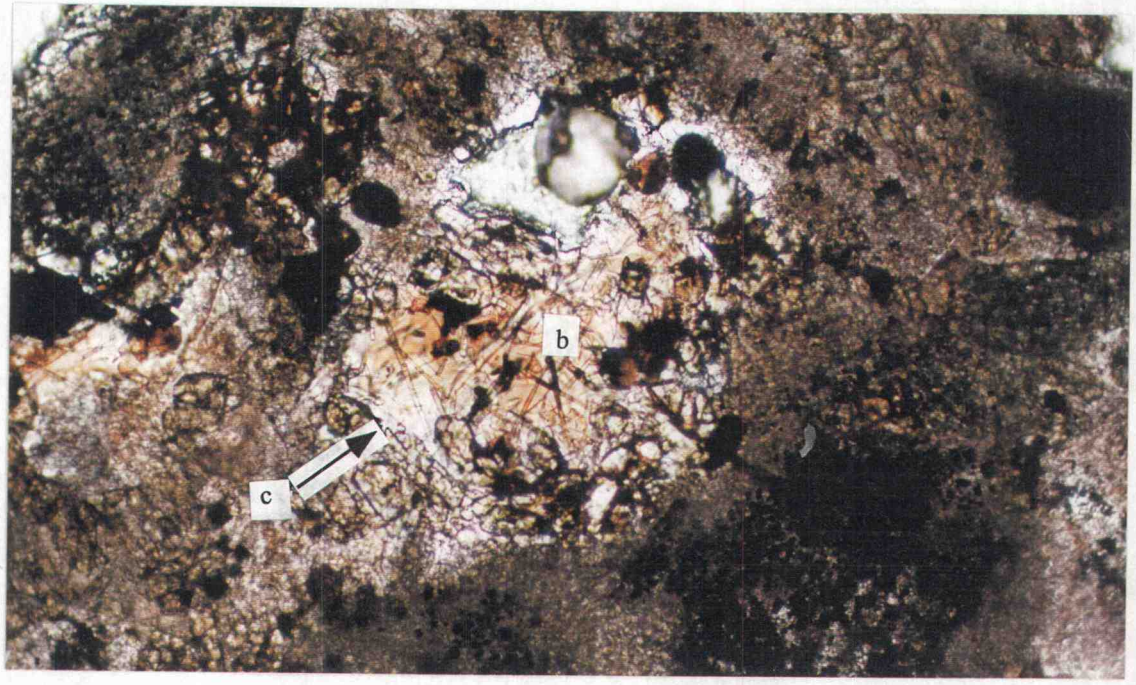

Figure 9d. Patch of clear (c) and brown (b) glass adjacent to a biotite reaction site, Stage 4. Plane-polarized light. FOV = 1.3 mm.

Stage 5

Stage 5 (sample JD97-4) represents the maximum degree of partial melting at the Maxwell Lake locality and contains about 31 vol% glass (Table 1, Figure 5). Orthoclase, biotite, and hornblende have been entirely reacted. Residual quartz is 3 vol% of the mode, and the proportion of plagioclase has decreased relative to Stages 3 and 4. Spongy textured plagioclase may contain up to 7 vol% glass (Figure 5). The intergrowth of glass, orthopyroxene, feldspar and Fe-Ti oxides replacing biotite is slightly more coarse, but the proportion of these phases have decreased relative to other Stages. The proportion of pyroxene in hornblende sites has increased slightly relative to Stage 4. The abundance of quench crystals has also increased; up to 25% of glass volume may be occupied by quench crystals (Figure 5).

The overall texture of Stage 5 consists of residual plagioclase and quartz and reacted mafic sites surrounded by clear brown glass (Figure 10a). Hornblende is recrystallized to optically aligned pyroxene with minor Fe-Ti oxides (Figure 10b). Fe-Ti oxides replacing biotite are up to 10 μm in length and remain aligned in bands (Figure 10c) interspersed among anhedral interstitial pyroxene and feldspar. Relict quartz crystals are rounded and embayed, and may be surrounded by pyroxene reaction halos; glass seams often mimic the shape of the quartz grain (Figure 10d). No glass is present on plagioclase-plagioclase or quartz-quartz boundaries. Plagioclase crystals in contact with glass have well-developed spongy texture, fritted margins, and a thin (< 25 μm wide) optically distinct rim (Figure 10e). As in Stage 3, individual cells in spongy plagioclase are irregularly shaped to rounded and are filled with brown glass. Relict plagioclase is occasionally oscillatory zoned. Abundant brown glass commonly contains quench crystals of acicular and hopper plagioclase (up to 500 μm long), opaques (average 50 μm long), subrounded pyroxene (100 μm diameter), and sparse quartz and apatite (Figures 10e and 10f). Quench crystals are irregularly distributed in the glass. A minor amount of clear glass containing few to no quench crystals was found in this Stage. Glass seams occur between quartz and plagioclase and are thickest (up to several mm) around mafic reaction sites.

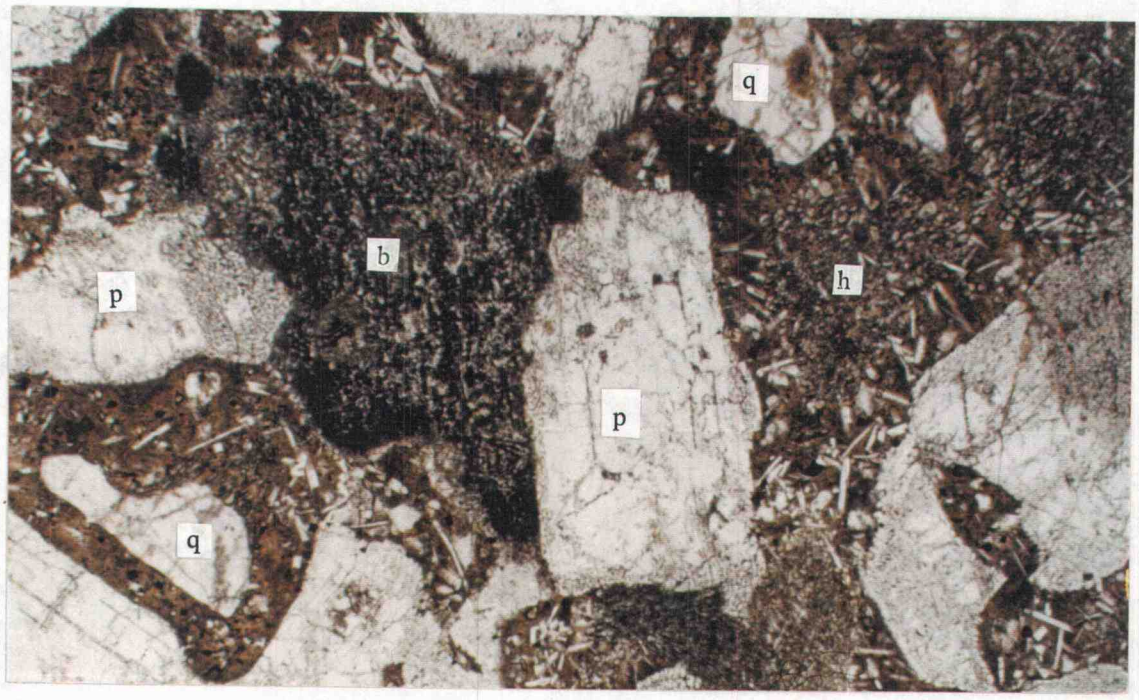

Figure 10a. View of Stage 5 with reacted hornblende and biotite sites, quartz, and plagioclase surrounded by brown glass (labels same as Figure 6b). Plane-polarized light. FOV = 6.7 mm.

Figure 10b. Optically aligned pyroxene crystals (x) after hornblende, Stage 5. Cross-polarized light. FOV = 3.3 mm.

Figure 10c. Aligned Fe-Ti oxides in a matrix of orthopyroxene, plagioclase, and glass, Stage 5. Plane-polarized light. FOV = 3.3 mm.

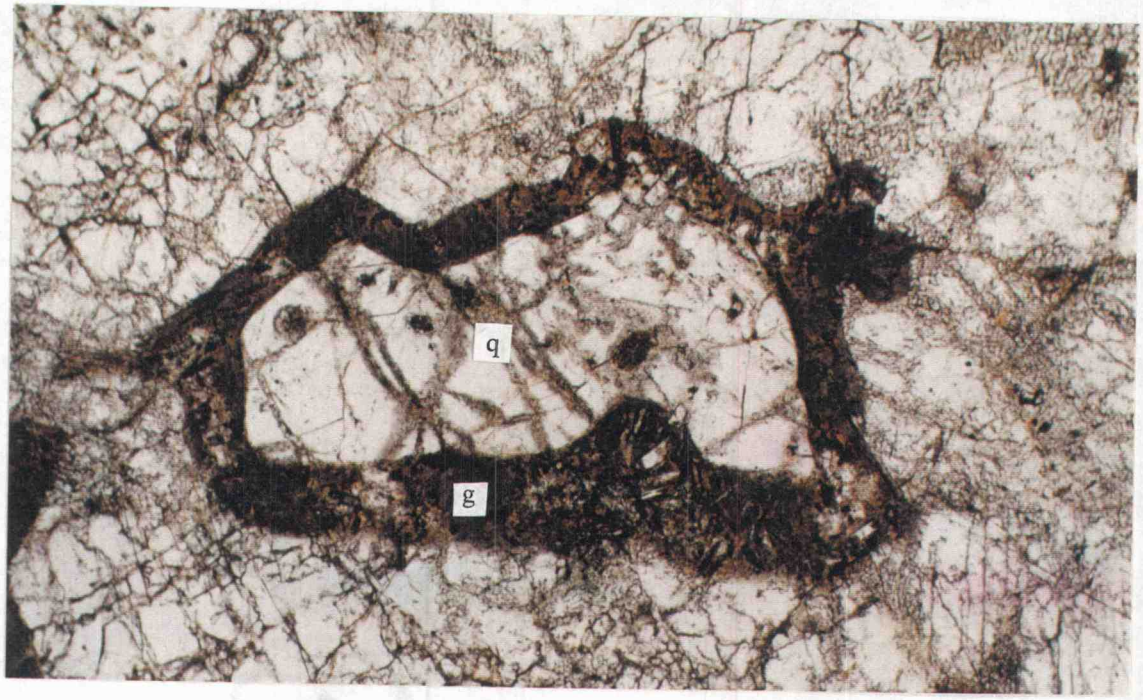

Figure 10d. Glass seam (g) surrounding embayed quartz (q), Stage 5. Seam mimics the quartz shape and contains quench crystals. Plane-polarized light. FOV = 3.3 mm.

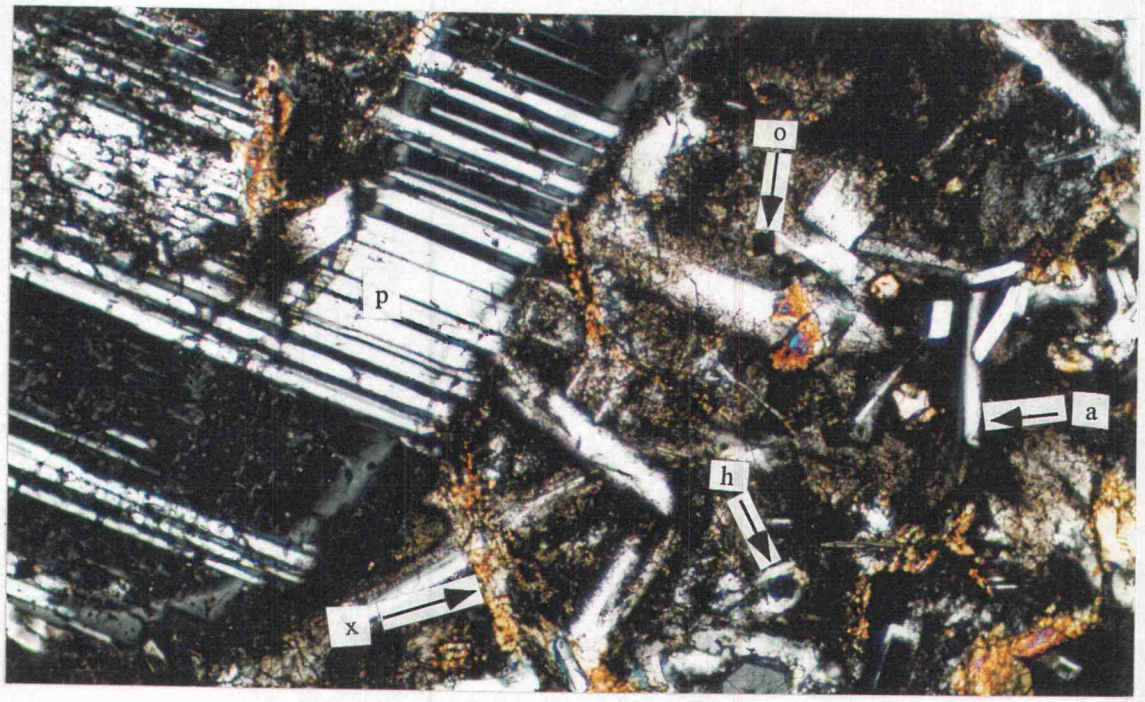

Figure 10e. Fritted margin and optically continuous rim on plagioclase (p) in contact with glass, Stage 5. Glass contains hopper (h) and acicular (a) plagioclase, pyroxene (x), and Fe-Ti oxide (o) quench crystals. Cross-polarized light. FOV = 1.3 mm.

Figure 10f. Spongy plagioclase in contact with brown glass containing quench crystals, Stage 5 (labels same as Figure 10e). Plane-polarized light. FOV = 1.3 mm.

Bulk Rock Compositions

Bulk rock chemical data indicate that the Wallowa batholith wallrock adjacent to the Maxwell Lake dike has an andesitic composition (60 wt% SiO_2, 4 to 5 wt% Na_2O + K_2O; Table 2). Stage 1 parent rock is metaluminous (lacking corundum in the CIPW norm) with about 11 wt% normative quartz, 10 wt% normative hypersthene, 8 wt% normative orthoclase, and 3 wt% normative diopside. Albite and anorthite are the dominant normative phases in the parent rock and partially melted samples.

Concentrations of nearly all 28 major and trace elements analyzed in bulk rock from each Stage fall within 10-15% of the unmelted sample, indicating that each Stage is essentially a chemically closed system (Figure 11). F and Cl data are not available for bulk samples. For all partially melted Stages, Na_2O and Sr are slightly lower than the unmelted parent, suggesting modest loss of these elements. Concentrations of La, Ce, and Th are greater in the partially melted samples than in the parent tonalite, possibly because the sample from Stage 1 was not representative for a trace phase (or phases) rich in these elements. Cu is both enriched (in Stage 3) and depleted (in other Stages) relative to bulk unmelted rock; we attribute this disparity to contamination during sample preparation or an analytical problem. Major and trace element concentrations in Stage 2 (and to a lesser extent Stage 4) are commonly depleted relative to Stage 1. Loss of elements in Stages 2 and 4 is likely related to the cataclastic overprint of these samples, either by removal of mass from the system during deformation or by introducing fractures along which weathering could take place. Overall, however, the process of partial melting from Stage 1 to Stage 3 to Stage 5 can be considered essentially a chemically closed system.

Table 2. Bulk rock compositional data.

Oxide (wt%)	Stage 1	Stage 2	Stage 3	Stage 4**	Stage 5
SiO_2	59.32	62.61	60.02	61.05	61.15
TiO_2	0.70	0.50	0.59	0.64	0.73
Al_2O_3	17.97	17.09	17.32	18.03	17.00
FeO*	5.35	4.23	5.24	4.77	5.17
MnO	0.10	0.07	0.12	0.08	0.10
MgO	3.84	2.59	3.93	3.25	3.89
CaO	6.45	7.28	7.52	7.06	6.07
Na_2O	4.12	1.84	3.21	2.49	3.48
K_2O	1.35	1.18	1.23	1.58	1.58
P_2O_5	0.18	0.13	0.18	0.16	0.19
Total	99.37	97.53	99.35	99.09	99.36
Ni (ppm)	39	23	48	26	33
Cr	65	28	61	37	45
Sc	17	15	13	14	18
V	124	99	117	126	147
Ba	504	371	332	495	492
Rb	25	21	22	30	32
Sr	626	586	453	524	541
Zr	125	84	123	171	117
Y	20	11	22	14	17
Nb	5	5.4	3.9	4.2	4.7
Ga	18	17	19	17	17
Cu	34	22	1133	26	15
Zn	44	44	67	48	66
Pb	4	1	4	0	4
La	8	0	21	16	22
Ce	21	28	42	43	41
Th	1	3	8	3	3
CIPW Norm (wt%)					
Q	11.0	27.4	15.4	20.0	16.0
Or	8.0	7.0	7.3	9.3	9.3
Ab	34.9	15.6	27.2	21.1	29.4
An	26.6	34.9	29.2	33.3	26.1
Di	3.4	0.3	5.5	0.5	2.2
Hy	10.3	8.4	9.8	10.3	11.2
Mt	3.8	2.9	3.6	3.2	3.5
Il	1.3	1.0	1.1	1.2	1.4
Ap	0.4	0.3	0.4	0.4	0.4

All analyses by XRF. No F or Cl data available. * indicates all Fe as FeO.

** indicates value is average of two analyses.

Error is +/- 10% for all except Ba, Zr, Y, Nb (+/- 15%) and Al, Si (+/- 0.5 wt%).

CIPW norm calculated with 0.45 of FeO* as $Fe_2O_3/(FeO+Fe_2O_3)$. CIPW norm abbreviations are: Q, quartz; C, corundum; Or, orthoclase; Ab, albite; An, anorthite; Di, diopside; Wo, wollastonite; Hy, hypersthene; Mt, magnetite; Il, ilmenite; Ap, apatite.

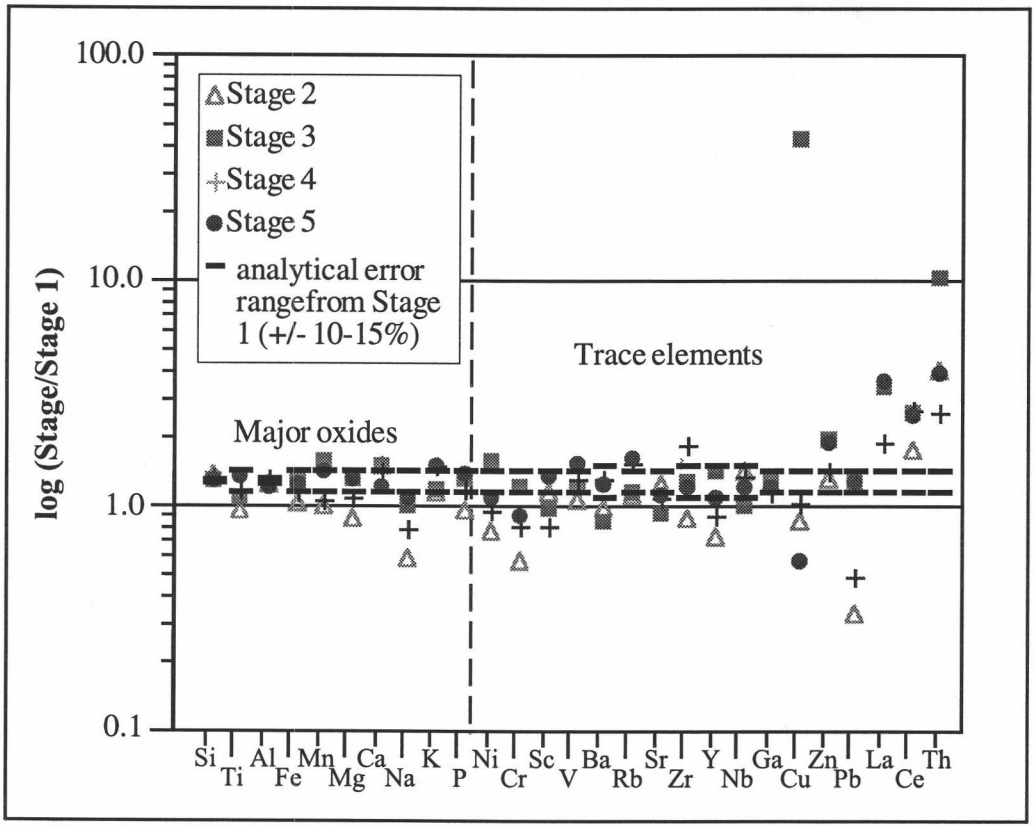

Figure 11. Gains and losses of oxides and elements in each Stage relative to Stage 1. Oxides and elements are normalized to 100 wt%.

Phase Compositions

Hornblende

Amphibole is present only in Stages 1 and 2 (compositional data presented in Table 3). Amphibole composition in both Stages is hornblende (Figure 12a), but Stage 2 hornblende is compositionally more heterogeneous than Stage 1 hornblende. There is no compositional distinction between hornblende cores and rims in either Stage 1 or Stage 2. Unreacted (Stage 1) hornblende is Mg# 63-74 with F and Cl as high as 0.67 and 0.12 wt%, respectively. Although incipiently reacted, Stage 2 hornblende (Mg# 61-67) is stoichiometrically similar to Stage 1 hornblende. Whereas there is a positive correlation between FeO and MgO in Stage 1 hornblende, Stage 2 hornblende has a widely scattered negative correlation (Figure 12b). Total Al_2O_3 concentration in Stage 2 is slightly less than in Stage 1, but Stage 2 hornblende contains a wide range of Al^{VI} (0 to 1 cation per 23 oxygen) compared to Stage 1 for a similar range of tetrahedral Al (Figure 12c). CaO and A-site occupancy in Stage 2 hornblende have increased, but K_2O is depleted in Stage 2 relative to Stage 1 (Figures 12a, 12d, and 12e). Stage 1 hornblende has up to ten times the Cl concentration of Stage 2 hornblende, but only slightly higher F (Figure 12f).

Biotite

Like hornblende, biotite is only present in Stages 1 and 2 (Table 4) and Stage 2 biotite is both incipiently reacted and compositionally more heterogeneous than Stage 1 biotite. Biotite from Stage 2 (Mg#24-74) has a wide compositional range in total FeO, MgO, Na_2O and TiO_2 compared to the tightly clustered data in Stage 1 (Mg#58-60). The MgO concentration of Stage 2 biotite ranges from 3 to 17 wt% whereas FeO concentration ranges from 6 to nearly 35 wt% (Figure 13a). Both Na_2O and CaO increase from Stage 1 to Stage 2, whereas K_2O is slightly depleted (Figures 13b and 13c). Total Al_2O_3 decreases from Stage 1 to Stage 2, but the proportion of Al^{VI} increases up to

Table 3. Representative amphibole compositions.

Oxide (wt%)	Stage 1	Stage 2
No. of analyses	69	23
SiO_2 (0.13)	49.28	49.52
TiO_2 (0.02)	0.80	0.62
Al_2O_3 (0.05)	6.37	5.77
Cr_2O_3 (0.01)	--	--
FeO* (0.09)	13.52	13.45
Fe_2O_3 (calc)	7.25	7.03
FeO (calc)	6.88	7.13
MnO (0.03)	0.45	0.39
MgO (0.08)	14.55	14.48
CaO (0.06)	11.67	11.54
Na_2O (0.03)	0.69	0.74
K_2O (0.01)	0.34	0.13
H_2O (calc)	2.00	2.04
F (0.02)	0.18	--
Cl (0.01)	0.04	--
Total	100.43	99.42
O=F	0.07	0.03
O=Cl	0.01	0.00
cations Si	7.06	7.16
Ti	0.09	0.07
Al/Al IV	0.94	0.84
Al VI	0.14	0.14
Cr	0.00	0.00
Fe^{3+} (calc)	0.78	0.76
Fe^{2+} (calc)	0.83	0.86
Mn	0.06	0.05
Mg	3.11	3.12
Ca	1.79	1.79
Na	0.19	0.21
K	0.06	0.02
Total cations	15.05	15.02
OH	1.91	1.97
F	0.08	0.03
Cl	0.01	0.00
Mg#	66	66

* indicates all Fe as FeO.

-- indicates concentration below detection limit.

Number in parentheses indicates analytical precision determined from microprobe counting statistics. Amphibole stoichiometry calculated on basis of 23 oxygen equivalents. Representative sample information and additional amphibole composition data are presented in Appendix C.

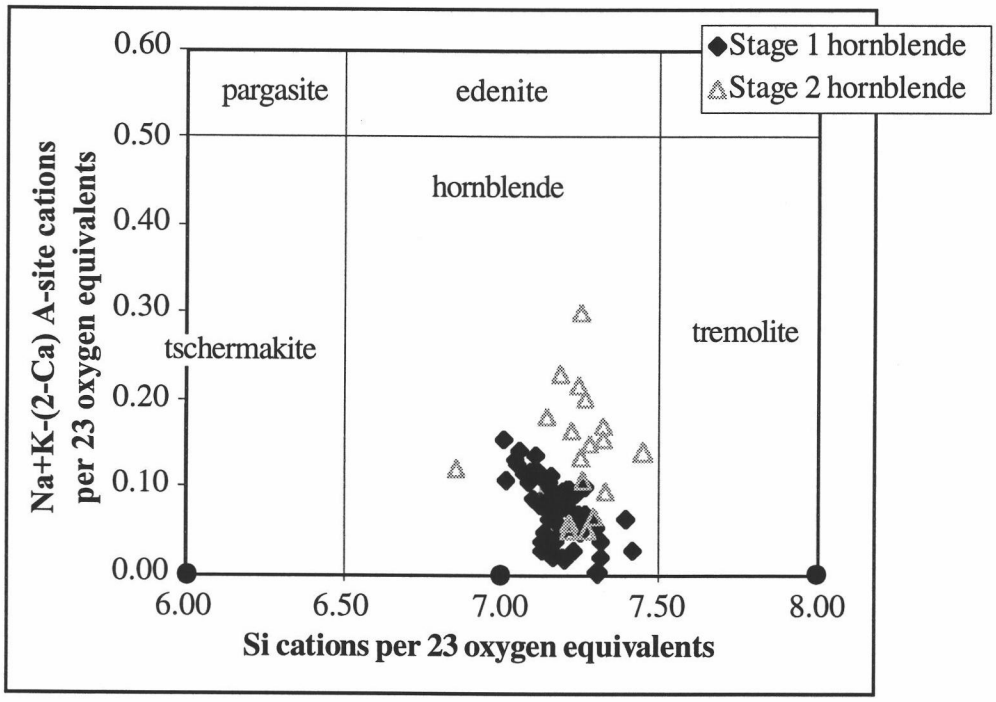

Figure 12a. Amphibole nomenclature after Deer et al. (1992). Stage 2 hornblende has increased A-site occupancy compared to Stage 1 hornblende.

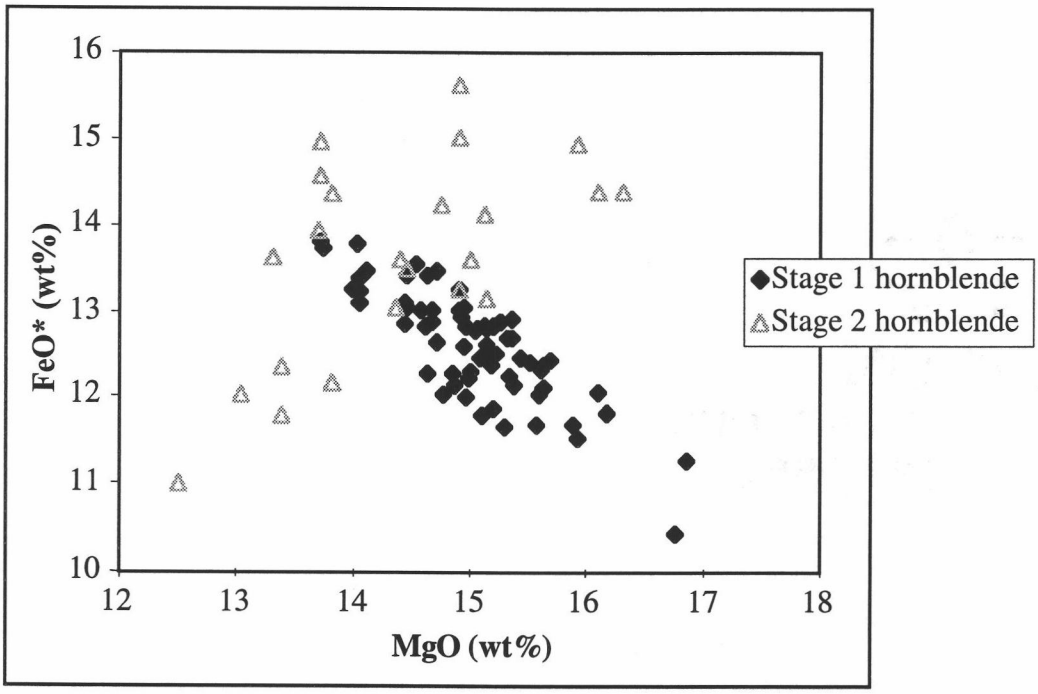

Figure 12b. FeO* vs. MgO in Stage 1 and 2 hornblende.

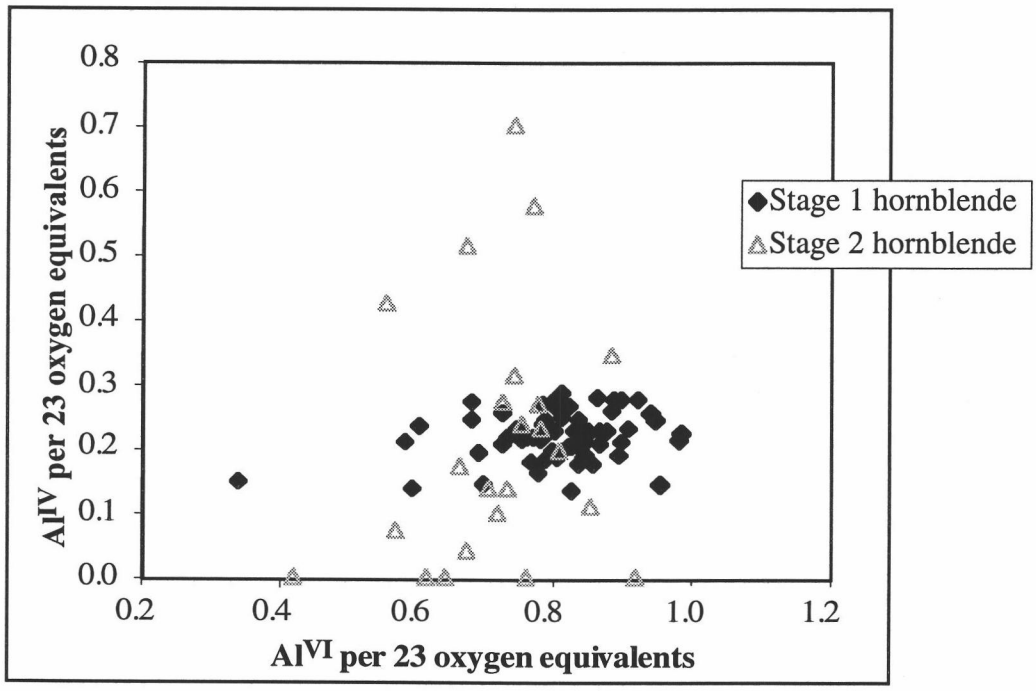

Figure 12c. Tetrahedral Al (Al^{IV}) vs. octahedral Al (Al^{VI}) in Stage 1 and 2 hornblende.

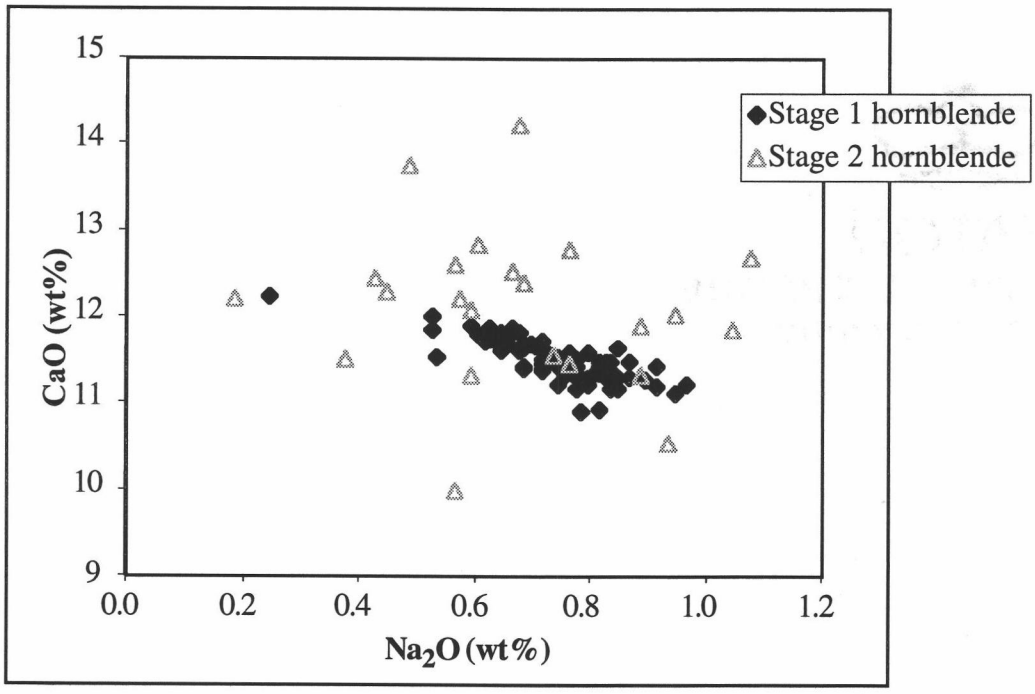

Figure 12d. CaO vs. Na_2O in Stage 1 and 2 hornblende.

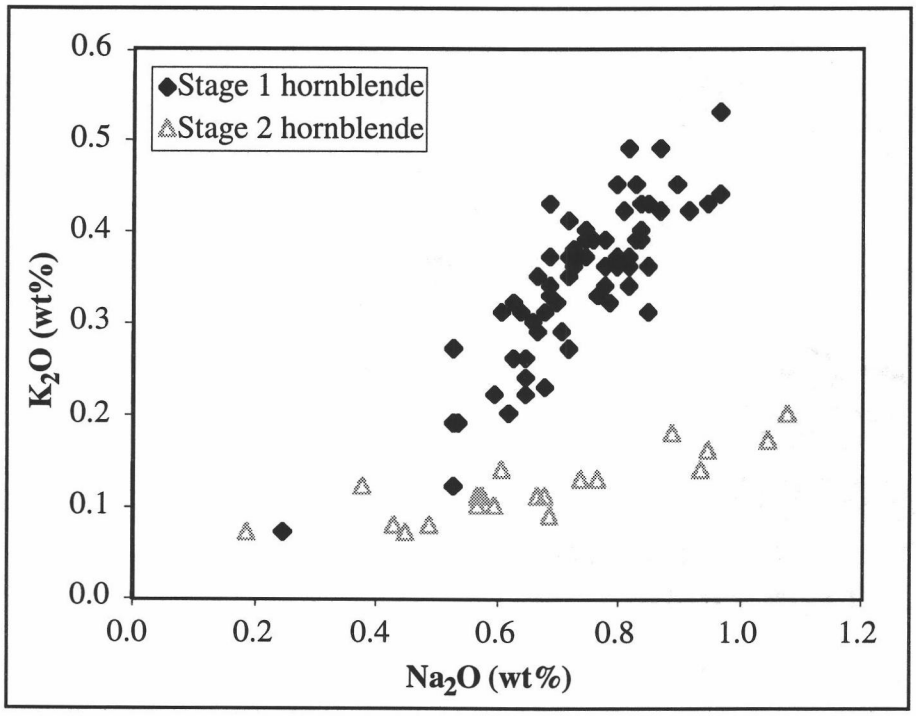

Figure 12e. K_2O vs. Na_2O in Stage 1 and 2 hornblende.

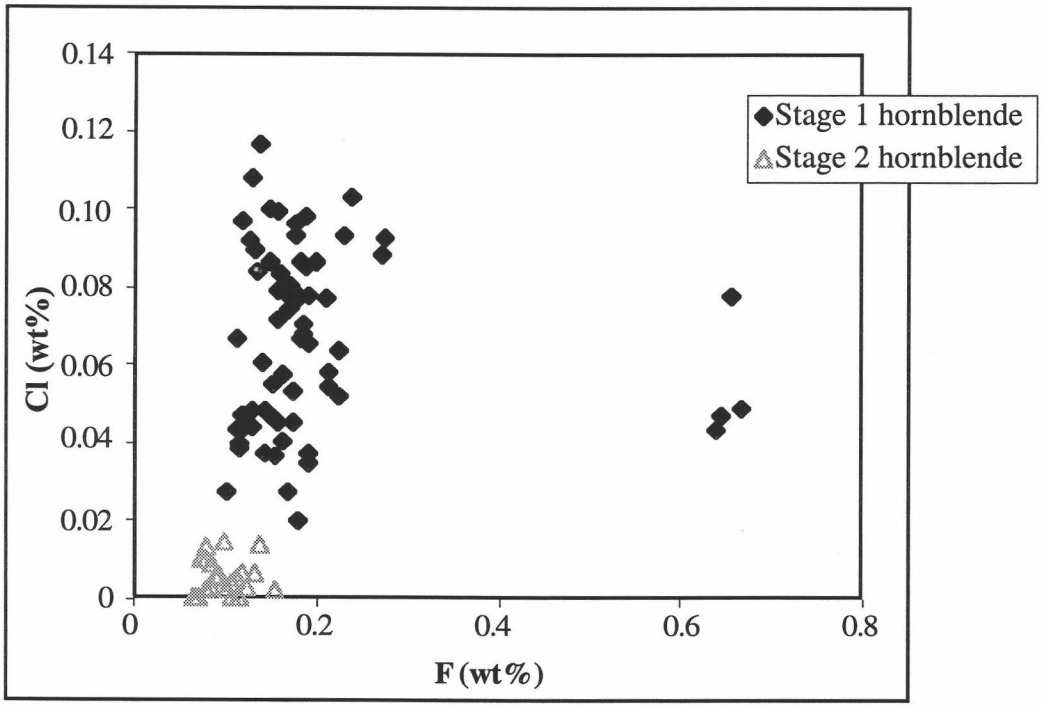

Figure 12f. Cl vs. F in Stage 1 and 2 hornblende.

Table 4. Representative biotite compositions.

Oxide (wt%)	Stage 1	Stage 2
No. of analyses	43	26
SiO_2 (0.12)	36.54	43.16
TiO_2 (0.03)	3.21	3.97
Al_2O_3 (0.07)	14.40	14.18
FeO* (0.09)	16.45	13.19
MnO (0.03)	0.14	--
MgO (0.07)	13.36	11.82
CaO (0.01)	--	0.50
Na_2O (0.02)	0.12	0.73
K_2O (0.05)	8.98	7.32
H_2O (calc)	3.74	3.80
F (0.02)	0.28	0.67
Cl (0.01)	0.11	0.08
Total	97.21	99.26
O=F	0.12	0.28
O=Cl	0.03	0.02
cations Si	5.62	6.25
Ti	0.37	0.43
Al/Al IV	2.38	1.76
Al VI	0.23	0.66
Fe^{2+}*	2.12	1.60
Mn	0.02	0.02
Mg	3.06	2.55
Ca	0.01	0.08
Na	0.04	0.21
K	1.76	1.35
Total cations	15.60	14.89
OH	3.84	3.67
F	0.13	0.31
Cl	0.03	0.02
Mg#	59	62
Oct	5.80	5.26
Int	1.80	1.64

* indicates all Feas FeO.
-- indicates concentration below detection limit.
Number in parenthases indicates analytical precision determined from microprobe counting statistics.
Biotite stoichiometry calculated on basis of 22 oxygen equivalents. Representative sample information and additional biotite composition data are presented in Appendix D.

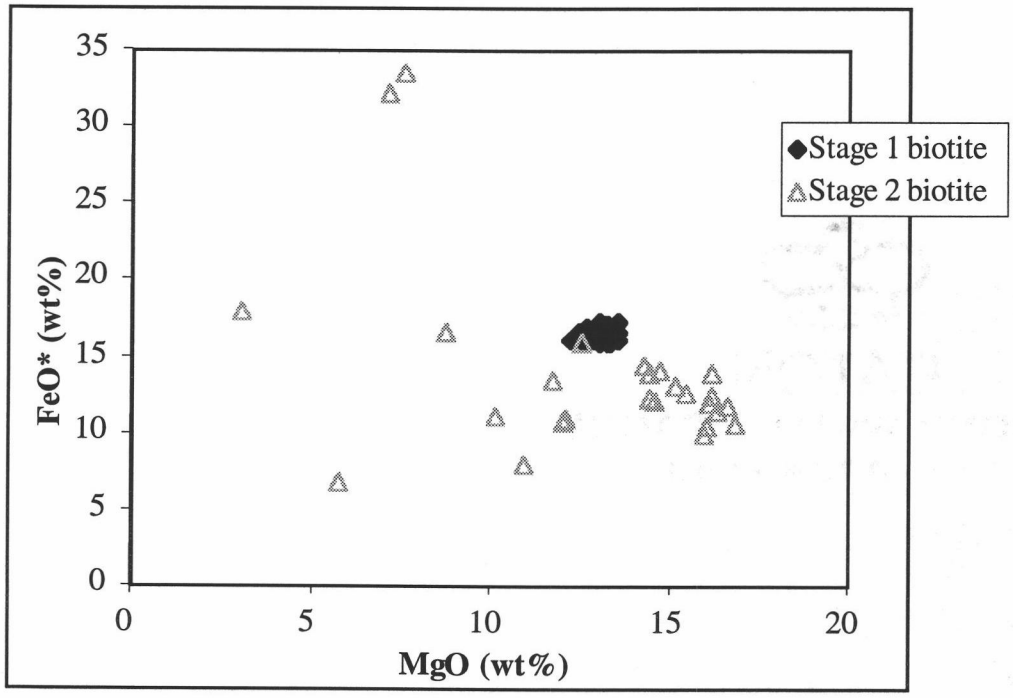

Figure 13a. FeO* vs. MgO in biotite from Stages 1 and 2.

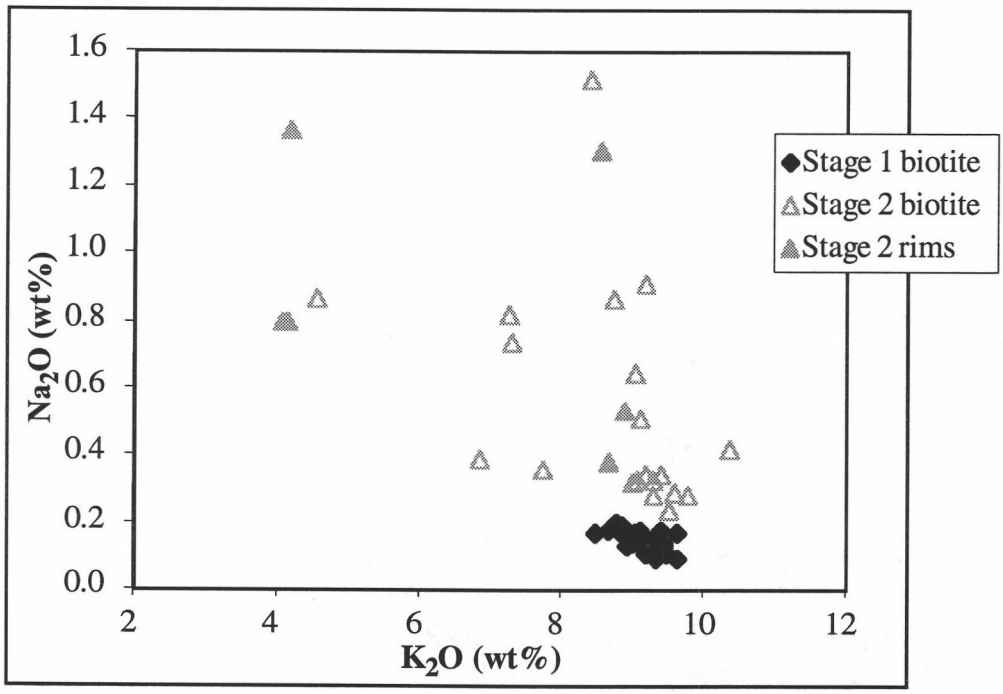

Figure 13b. Na_2O vs. K_2O in biotite from Stages 1 and 2.

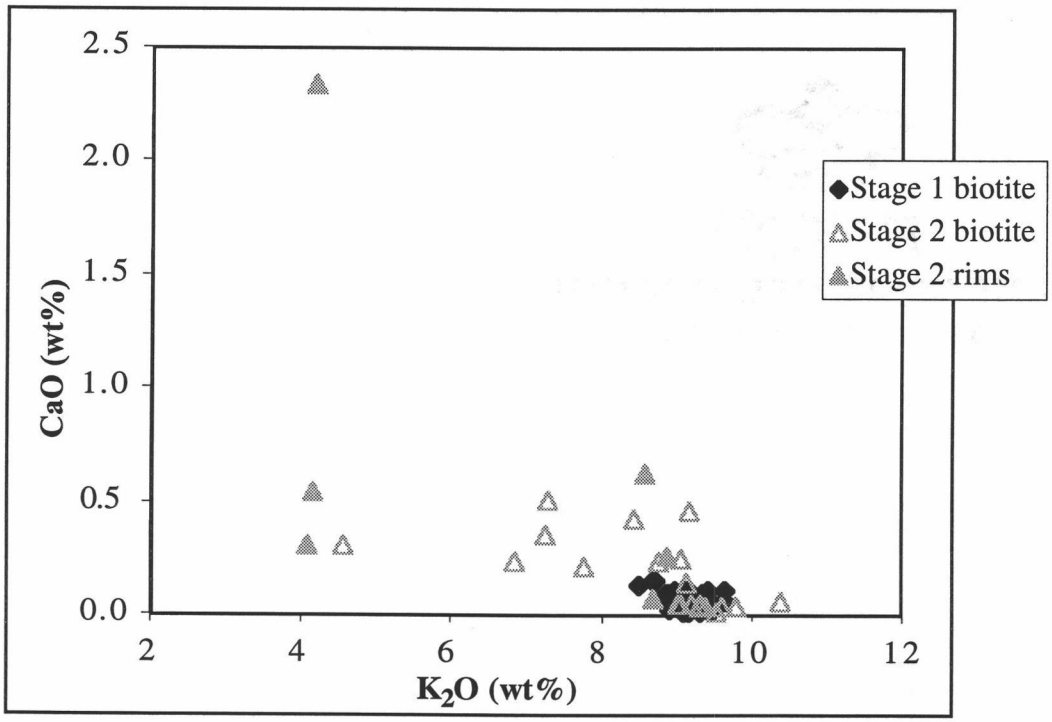

Figure 13c. CaO vs. K_2O in biotite from Stages 1 and 2.

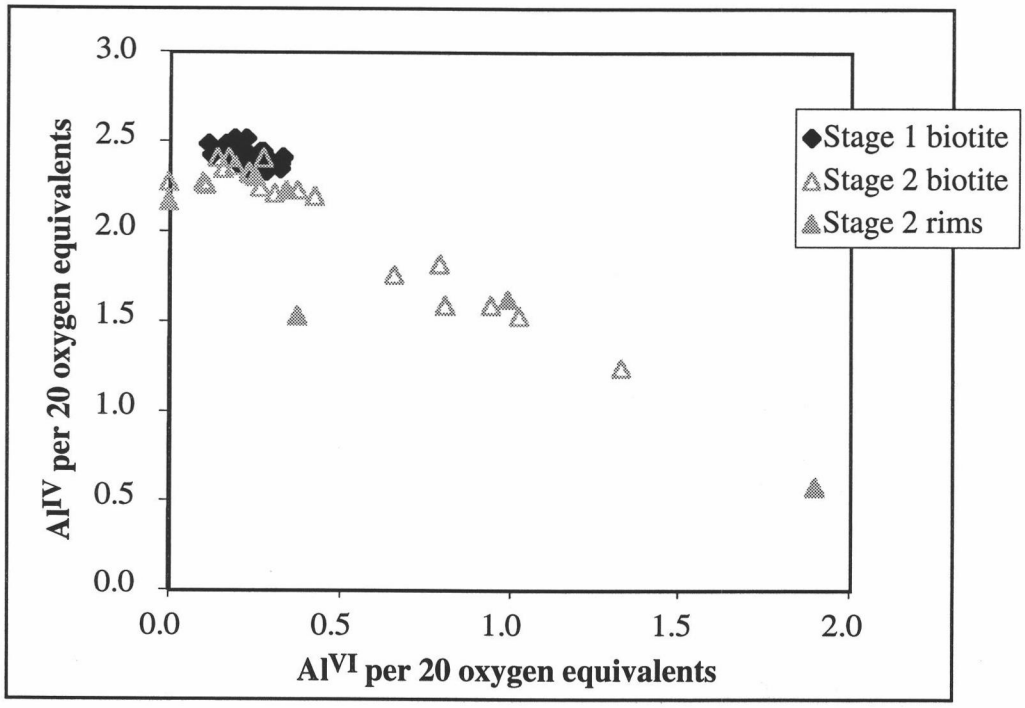

Figure 13d. Tetrahedral Al (Al^{IV}) vs. octahedral Al (Al^{VI}) in biotite from Stages 1 and 2.

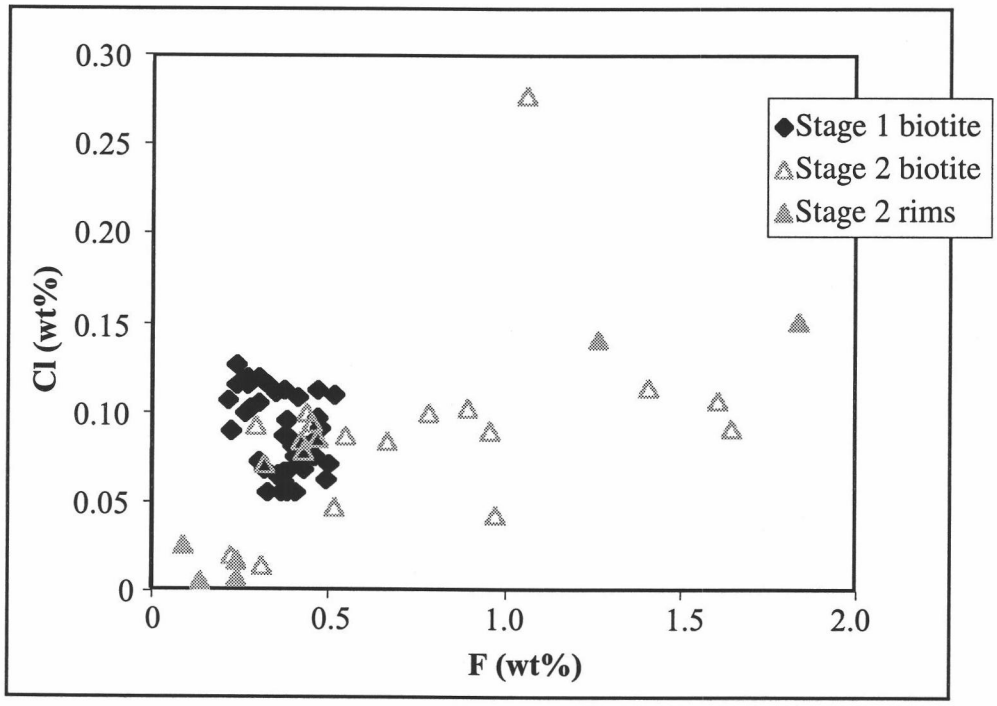

Figure 13e. Cl vs. F in biotite from Stages 1 and 2.

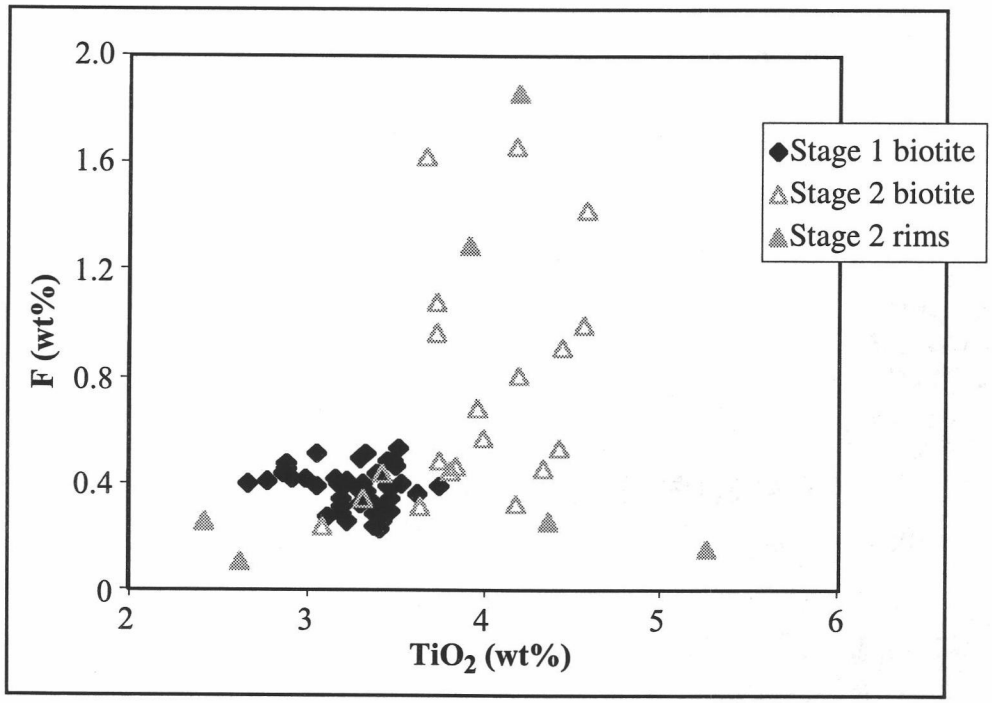

Figure 13f. F vs. TiO_2 in biotite from Stages 1 and 2.

almost 2 cations per 20 oxygen; tetrahedral Al is less than 2.5 cations per 22 oxygen equivalents (Figure 13d). Stage 2 biotite may contain up to ten times as much F as Stage 1 biotite for a wide range of Cl (undetectable to 0.28 wt%; Figure 13e). There is also a correlation between high F and higher TiO_2 in the Stage 2 biotite (Figure 13f). In general there is no chemical distinction between biotite cores and rims from either Stage, although Stage 2 rims may contain slightly less K_2O, Cl, and F (Figures 13b and 13e).

Orthoclase and Plagioclase Feldspar

Like biotite and amphibole, orthoclase feldspar is consumed during the early stages of melting and is absent from the restite assemblage by Stage 4 (Table 5). Stage 2 orthoclase (Or_{74-80}) is more sodic and less potassic than Stage 1 orthoclase (Or_{94-97}) (Figure 14a); Stage 2 orthoclase also contains up to ten times more Ba (Figure 14d). In general, orthoclase contains ten times as much Ba as plagioclase (Figure 14d).

Plagioclase feldspar makes up the bulk of the mode in all Stages and is present as a primary phase in Stage 1, as a residual phase in Stages 2 through 5, as quench crystals in Stages 3 through 5, and as interstitial material in biotite sites in Stages 3 though 5 (Table 5). With increased melting, residual plagioclase becomes more potassic (Figures 14a and 14c) and FeO and MgO concentrations increase slightly (Figure 14e). Plagioclase in Stages 1 and 2 is andesine ($An_{32-50}Or_{0-1}$ in Stage 1; $An_{35-49}Or_{6-14}$ in Stage 2), whereas plagioclase in Stage 3 ($An_{34-56}Or_{2-7}$), Stage 4 ($An_{40-64}Or_{2-19}$), and Stage 5 ($An_{38-58}Or_{2-4}$) is andesine to labradorite. Stage 2 and Stage 4 residual plagioclase is the most chemically heterogeneous as well as the most potassic, containing up to 2.7 wt% K_2O. These samples have a cataclastic overprint and were collected from the highly veined southern end of the outcrop (Figure 4f). There is no chemical distinction between residual plagioclase cores and rims until Stage 5. Rims of Stage 5 relict plagioclase are both optically distinct (see discussion of Stage 5 texture) and contain higher FeO, MgO, and CaO than the interior of crystals (Figures 14b and 14e).

Plagioclase feldspar occupies reacted biotite sites in Stages 3 through 5 and is predominantly labradorite ($An_{48-69}Or_{2-4}$) (Table 5). Plagioclase replacing biotite is

Table 5. Representative plagioclase and orthoclase feldspar compositions.

Oxide (wt%)	Stage 1		Stage 2		Stage 3			Stage 4			Stage 5		
	Primary plag	Primary kspar	Relict plag	Relict kspar	Relict plag	Plag after bio	Quench plag	Relict plag	Plag after bio	Quench plag	Relict plag	Plag after bio	Quench plag
No. of analyses	57	14	19	5	31	**	1	14	**	**	38	**	16
SiO_2 (0.14)	59.34	64.03	58.18	63.01	57.42	53.00	56.18	55.32	51.56	57.32	56.59	53.80	54.81
Al_2O_3 (0.09/0.07)	26.10	18.07	25.52	18.89	26.33	28.35	26.23	26.92	29.24	25.23	26.64	27.75	27.12
FeO* (0.03/0.02)	--	0.12	0.21	--	0.23	0.73	1.00	0.98	1.29	1.04	0.23	1.25	1.31
MgO (0.01)	--	--	--	--	--	0.05	0.08	0.11	0.16	0.09	--	0.22	0.12
CaO (0.05/0.01)	7.74	--	8.00	0.37	8.55	10.74	9.52	10.61	12.93	10.22	9.51	10.43	10.47
BaO (0.01/0.02)	--	0.45	--	1.58	--	0.59	--	--	--	0.13	--	0.15	--
Na_2O (0.06/0.03)	7.01	0.43	5.54	1.92	5.77	4.40	5.40	4.24	3.22	3.53	5.42	4.74	4.88
K_2O (0.02/0.07)	0.10	15.56	1.38	12.20	0.61	0.55	0.55	0.63	0.42	1.16	0.40	0.62	0.33
Total	100.39	98.69	98.91	98.05	98.95	98.39	98.99	98.86	98.87	98.73	98.90	98.97	99.07
cations Si	2.62	3.00	2.64	2.96	2.60	2.45	2.56	2.53	2.38	2.61	2.57	2.47	2.51
Al	1.38	1.00	1.36	1.05	1.40	1.54	1.41	1.45	1.59	1.36	1.43	1.50	1.46
Fe^{2+}*	0.00	0.00	0.01	0.00	0.01	0.03	0.04	0.04	0.05	0.04	0.01	0.05	0.05
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.01	0.01
Ca	0.37	0.00	0.39	0.02	0.41	0.53	0.46	0.52	0.64	0.50	0.46	0.51	0.51
Ba	0.00	0.01	0.00	0.03	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na	0.60	0.04	0.49	0.18	0.51	0.39	0.48	0.38	0.29	0.31	0.48	0.42	0.43
K	0.01	0.93	0.08	0.73	0.04	0.03	0.03	0.04	0.02	0.07	0.02	0.04	0.02
Total	4.99	4.98	4.97	4.97	4.97	4.99	4.99	4.95	4.98	4.90	4.97	5.01	4.99
An	38	0	41	2	43	55	48	56	67	56	48	53	53
Ab	61	4	51	19	53	41	49	40	30	36	50	44	45
Or	1	96	8	79	4	3	3	4	3	8	2	4	2

* indicates all Fe as FeO. **indicates average of two analyses. -- indicates concentration below detection limit.

Number in parentheses indicates analytical precision determined from microprobe counting statistics. First number refers to precision for plagioclase feldspar, second number for orthoclase feldspar. Feldspar stoichiometry calculated on basis of 8 oxygen. Representative sample information and additional feldspar composition data are provided in Appendix E.

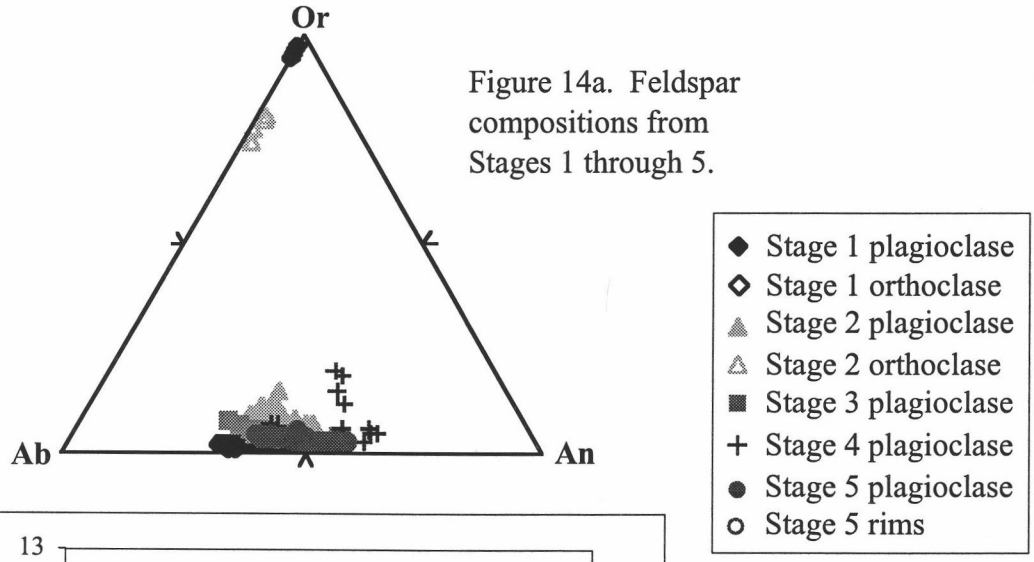

Figure 14a. Feldspar compositions from Stages 1 through 5.

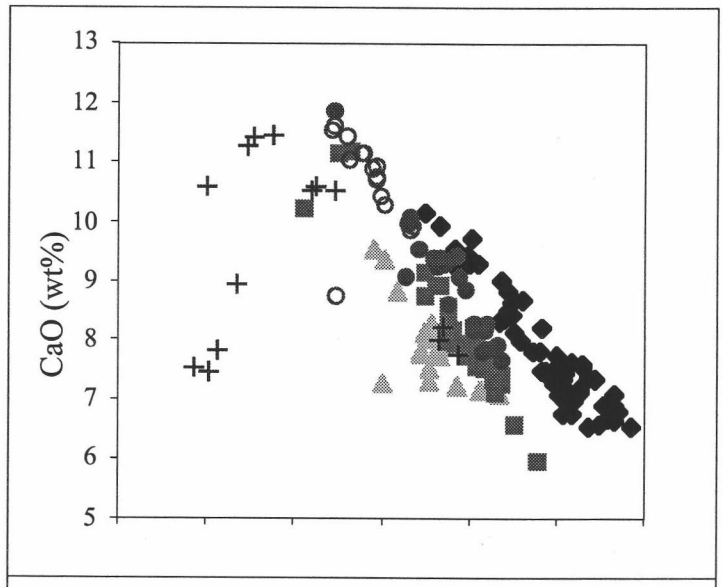

Figure 14b. CaO vs. Na_2O in plagioclase from Stages 1 through 5.

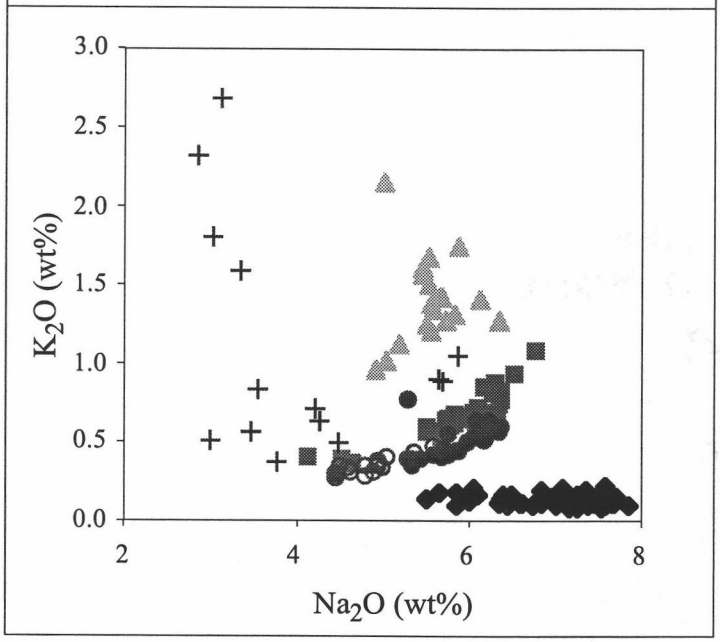

Figure 14c. K_2O vs. Na_2O in plagioclase from Stages 1 through 5.

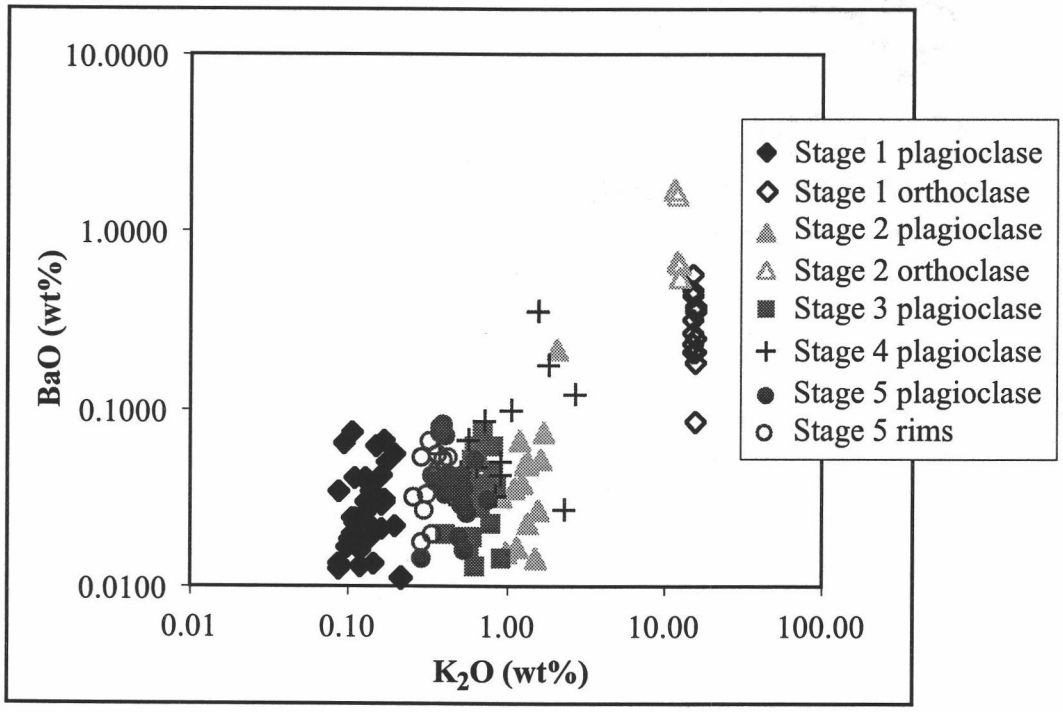

Figure 14d. BaO vs. K_2O in orthoclase and plagioclase feldspar from all Stages.

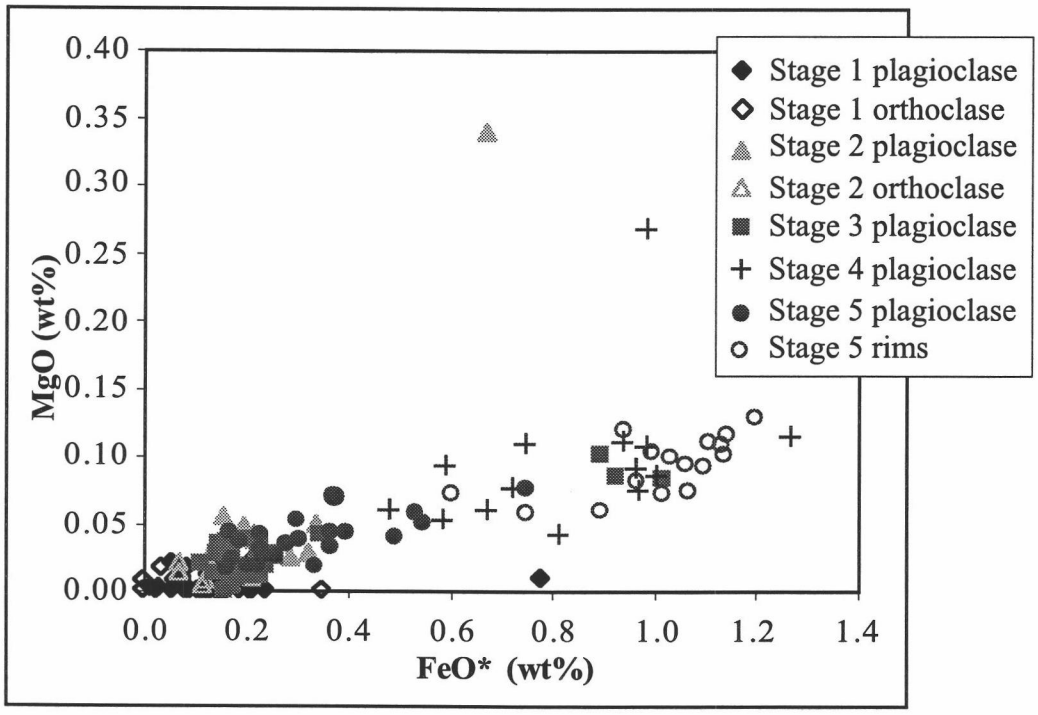

Figure 14e. MgO vs. FeO* in orthoclase and plagioclase feldspar from all Stages.

generally more calcic than residual plagioclase, and Stage 4 replacement feldspar is the most calcic (An_{65-69}). Replacement plagioclase contains less than 1 wt% K_2O. MgO and FeO concentrations are slightly higher than in residual plagioclase (up to 0.34 wt% MgO and 1.54 wt% FeO in Stage 5), and concentrations of these oxides increase with increased melting. Plagioclase replacing biotite may contain up to 0.52 wt% BaO.

Andesine to labradorite quench crystals were analyzed in Stages 3 through 5 ($An_{48-63}Or_{1-3}$) (Table 5). One slightly potassic ($An_{49}Or_{14}$) quench plagioclase was analyzed in Stage 4. The compositional range of quench plagioclase is similar to that of relict plagioclase, but quench crystals may be slightly less potassic than relict crystals. Like in other types of feldspar, FeO and MgO concentrations in quench plagioclase increase slightly with increased melting; Stage 5 quench crystals contain up to 0.13 wt% MgO and 1.31 wt% FeO. Quench plagioclase are typically Ba poor.

Clinopyroxene and Orthopyroxene

By Stage 3, hornblende and biotite dehydration has produced reaction products that include the first occurrence of pyroxenes. Orthopyroxene is the lone pyroxene in biotite reaction sites whereas orthopyroxene and clinopyroxene occur in hornblende reaction sites.

Early pyroxene crystals replacing hornblende have heterogeneous compositions, but pyroxene compositions become more homogeneous with increased melting. For example, whereas Stage 3 augite may contain up to 10 wt% Al_2O_3 and 2 wt% Na_2O, Stage 5 enstatite contains less than 3 wt% Al_2O_3 and 0.2 wt% Na_2O (Figures 15c and 15d). With increased degree of melting CaO, FeO, Na_2O, and Al_2O_3 concentrations in all pyroxenes decrease whereas MgO concentrations increase (Figures 15a, 15b, 15c, and 15d). In Stage 3, augite ($En_{44-52}Wo_{25-43}$) and pigeonite ($En_{64-69}Wo_{5-11}$) are twice as abundant as enstatite ($En_{66-73}Wo_{3-4}$). Clinopyroxene occurs more frequently in the center of hornblende reaction sites, but clinopyroxene and orthopyroxene occur in equal abundance at the rim of the reaction sites. In Stage 4, enstatite ($En_{65-71}Wo_{1-4}$) is about twenty times as abundant as pigeonite ($En_{57-69}Wo_{5-16}$). Sparse augite ($En_{43-44}Wo_{39-40}$)

Table 6. Representative pyroxene compositions.

Oxide (wt%)	Stage 3				Stage 4					Stage 5				
	cpx after hbl	pigeon. after hbl	opx after hbl	opx quench	cpx after hbl	pigeon. after hbl	opx after hbl	opx after bio	opx quench	pigeon. after hbl	opx after hbl	opx after bio	cpx quench	opx quench
No. of analyses	34	5	17	**	**	14	32	1	**	1	51	**	3	6
SiO_2 (0.10/0.09)	52.53	53.86	54.57	53.17	52.33	51.94	53.44	50.77	51.91	52.78	53.71	52.96	52.37	53.27
TiO_2 (0.02)	0.41	0.30	0.19	0.26	0.64	0.37	0.47	0.49	0.34	0.41	0.26	0.56	0.46	0.45
Al_2O_3 (0.02)	2.49	2.86	1.11	0.83	3.77	2.42	1.52	3.67	1.75	1.43	1.20	3.30	1.47	1.72
Cr_2O_3 (0.01)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FeO* (0.10/0.08)	10.23	15.82	17.30	18.57	13.38	17.31	17.70	18.43	18.22	14.51	15.48	14.42	10.18	16.10
MgO (0.10/0.08)	15.64	23.23	25.15	23.92	19.58	22.67	25.03	22.49	24.29	22.22	26.20	28.03	15.67	25.92
MnO (0.03)	0.41	0.46	0.62	0.54	0.35	0.47	0.46	0.44	0.37	0.37	0.40	0.39	0.37	0.46
CaO (0.03/0.07)	18.03	2.54	2.00	1.34	10.53	2.74	1.97	1.43	1.13	7.53	1.74	0.47	18.68	1.67
Na_2O (0.02)	0.46	0.40	--	--	0.15	0.19	--	0.18	--	0.12	--	--	0.26	--
Total	100.22	99.47	101.00	98.70	100.74	98.12	100.66	97.90	98.06	99.37	99.03	100.15	99.46	99.63
cations Si	1.94	1.96	1.97	1.98	1.91	1.94	1.94	1.91	1.94	1.95	1.96	1.90	1.96	1.94
Ti	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01
Al	0.11	0.12	0.05	0.04	0.16	0.11	0.07	0.16	0.08	0.06	0.05	0.14	0.06	0.07
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe^{2+}*	0.32	0.48	0.52	0.58	0.41	0.54	0.54	0.58	0.57	0.45	0.47	0.43	0.32	0.49
Mg	0.86	1.26	1.35	1.33	1.06	1.26	1.36	1.26	1.35	1.22	1.43	1.50	0.87	1.41
Mn	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Ca	0.71	0.10	0.08	0.05	0.42	0.11	0.08	0.06	0.05	0.30	0.07	0.02	0.75	0.07
Na	0.03	0.03	0.00	0.00	0.01	0.01	0.00	0.01	0.00	0.01	0.00	0.00	0.02	0.00
Total	4.01	3.98	4.00	4.00	4.00	4.00	4.01	4.01	4.01	4.00	4.00	4.02	4.01	4.01
En	46	68	69	68	56	66	69	66	69	62	72	77	45	72
Fs	17	26	27	30	22	28	27	31	29	23	24	22	16	25
Wo	38	5	4	3	22	6	4	3	2	15	3	1	39	3

* indicates all Fe as FeO. **indicates average of two analyses. -- indicates concentration below detection limit.
Number in parentheses indicates analytical precision determined from microprobe counting statistics. First number refers to precision for orthopyroxene, second number for clinopyroxene. Pyroxene stoichiometry calculated on basis of 6 oxygen. Representative sample information and additional pyroxene composition data are provided in Appendix F.

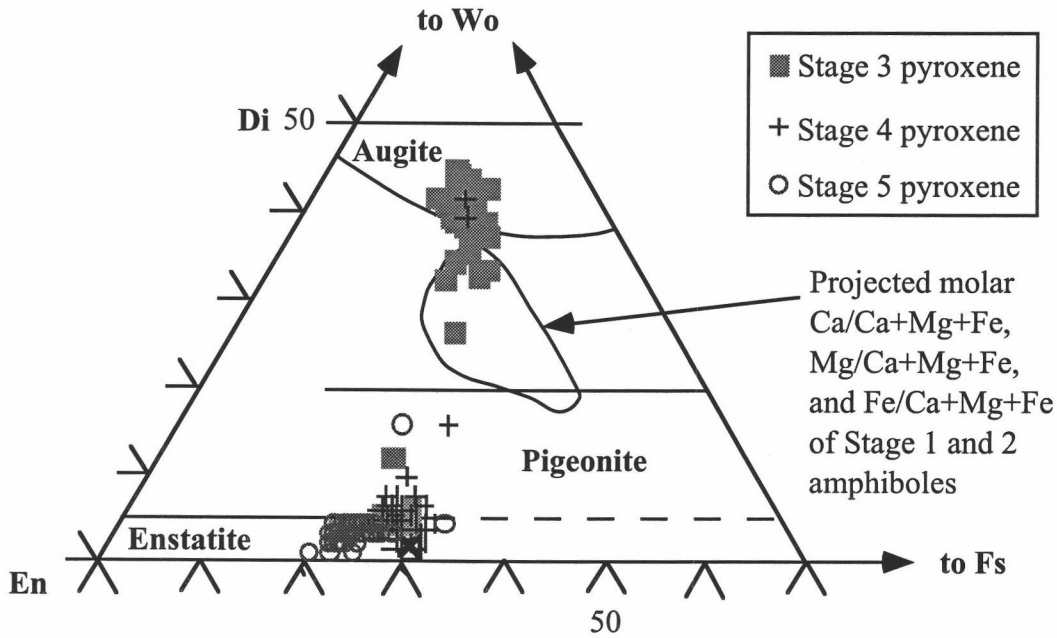

Figure 15a. Nomenclature of pyroxenes from Stages 3, 4, and 5.

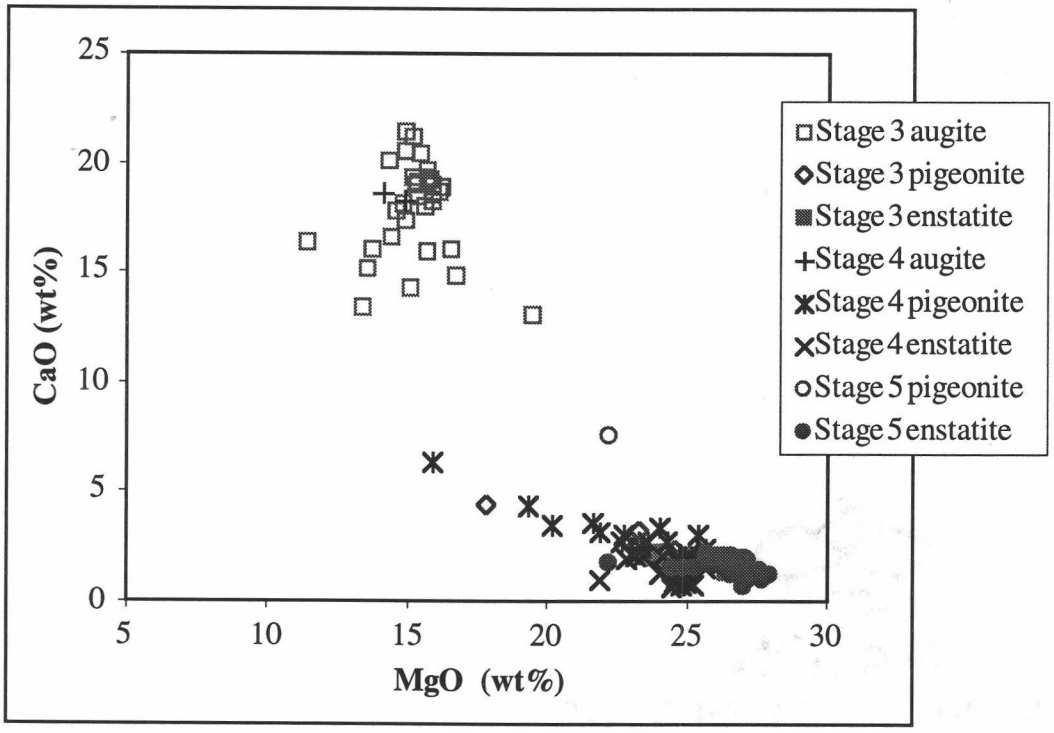

Figure 15b. CaO vs. MgO in pyroxene from Stages 3, 4, and 5.

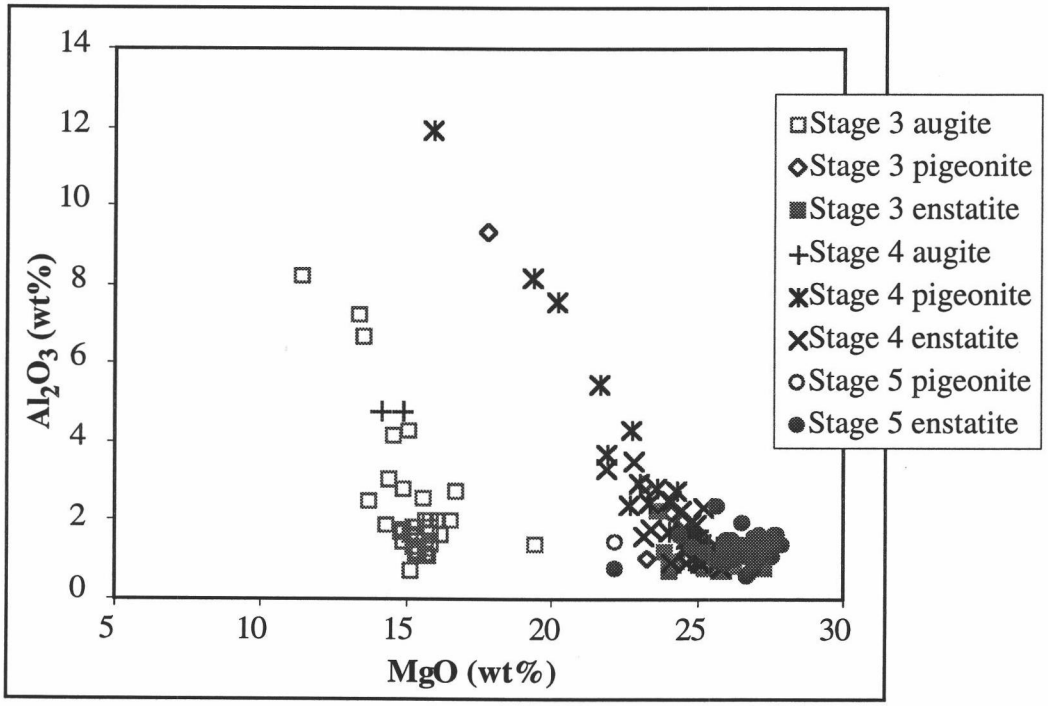

Figure 15c. Al_2O_3 vs. MgO in pyroxene from Stages 3, 4, and 5.

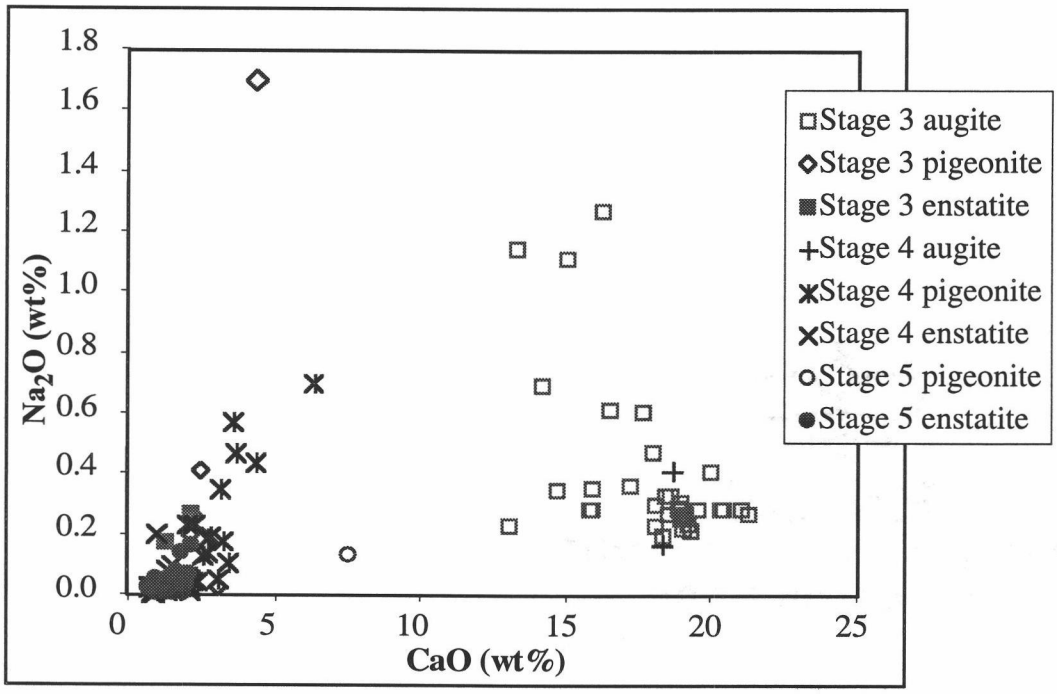

Figure 15d. Na_2O vs. CaO in pyroxene from Stages 3, 4, and 5.

also occurs in Stage 4. In Stage 5, nearly all of the pyroxene replacing hornblende is enstatite ($En_{64-75}Wo_{1-4}$; one Wo_{15}).

Orthopyroxene intergrown with plagioclase feldspar and Fe-Ti oxides occurs in biotite reaction sites in Stages 3 through 5 (Table 6). Enstatite ($En_{66-78}Wo_{1-3}$) replacing biotite is slightly more Mg-rich and Ca-poor than enstatite replacing hornblende and may contain up to 3.7 wt% Al_2O_3 and 0.2 wt% Na_2O. As with enstatite replacing hornblende, enstatite in biotite sites becomes more homogeneous with increased melting.

Enstatite quench crystals ($En_{65-76}Wo_{1-4}$) occur in Stages 3 through 5 (Table 5). Quench orthopyroxene contains less than less than 2.5 wt% Al_2O_3 and 0.1 wt% Na_2O. Several augite ($En_{42-46}Wo_{42-46}$) quench crystals were analyzed in Stage 5, containing up to 2 wt% Al_2O_3 and 0.3 wt% Na_2O. As with pyroxene replacing biotite and hornblende, quench pyroxene compositions become more homogeneous with increased stage of melting.

Fe-Ti Oxides

Primary or residual Fe-Ti oxides were distinguished from mafic site replacement oxides based on their larger size (typically near 100 μm in diameter) and embayed to resorbed texture. Residual magnetite is present in all Stages of melting, whereas Stages 3 and 5 also contain trace ilmenite (Table 7). A single grain containing microdomains of magnetite, ilmenite, and rutile was analyzed in Stage 1. In general, compositional heterogeneity increases in residual magnetite and ilmenite with increased melting, and there is no discernable compositional distinction between Fe-Ti oxide cores and rims. Low totals are likely due to the small size of the oxides (Table 7). Stage 1 magnetite (X_{mag}0.98-1.0) contains less than 1 wt% TiO_2 and trace amount of MgO and Al_2O_3 (Figures 16a and 16b). With increased melting, TiO_2 concentration of residual magnetite (X_{mag}0.54-0.93) increases to nearly 15 wt% in Stage 4 and 10 wt% in Stage 5. We will refer to magnetite with more than 5 wt% TiO_2 as titaniferous magnetite. MgO and Al_2O_3 concentrations of residual titaniferous magnetite also increase with increased melting (Figure 16b), whereas the concentration of calculated Fe_2O_3 decreases (Figure 16c).

Table 7. Representative Fe-Ti oxide compositions.

Oxide (wt%)	Stage 1	Stage 2		Stage 3					Stage 4			
	Primary mag	Relict Ti-mag	Ti-mag after bio	Relict Ti-mag	Relict ilm	Ti-mag after bio	Ilm after bio	Quench Ti-mag	Relict Ti-mag	Ti-mag after bio	Ilm after bio	Quench Ti-mag
No. of analyses	30	9	3	22	3	11	4	**	16	9	**	**
SiO_2 (0.01)	--	0.08	0.10	0.09	--	--	0.11	0.12	--	0.09	0.24	--
TiO_2 (0.07/0.21)	--	4.40	4.30	1.90	54.98	6.65	47.53	4.63	9.46	11.81	52.44	8.02
Al_2O_3 (0.02)	--	1.87	7.93	2.88	1.46	9.38	0.26	1.50	1.88	2.38	1.79	2.25
Cr_2O_3 (0.02/0.01)	0.38	0.13	--	0.30	--	0.16	--	--	0.42	0.16	--	0.32
V_2O_3 (0.01)	0.41	0.58	0.12	0.37	--	0.40	--	0.30	0.77	0.82	0.24	0.64
FeO* (0.22/0.15)	91.57	83.39	75.72	82.56	34.45	72.89	41.30	82.27	77.37	76.12	33.84	77.91
Fe_2O_3 (calc)	67.83	56.57	51.45	59.60	0	44.10	9.28	55.00	46.20	41.45	0	48.20
FeO (calc)	30.54	32.49	29.43	28.93	34.45	33.20	32.95	32.79	35.80	38.82	33.84	34.54
MnO (0.02/0.03)	--	0.26	0.87	0.25	--	0.36	0.58	0.54	0.30	0.19	--	0.31
MgO (0.02/0.03)	--	1.35	3.56	1.96	4.26	2.90	5.22	0.62	2.09	1.71	4.27	1.91
ZnO (0.03/0.02)	--	--	--	--	--	--	--	--	--	--	--	--
Total	99.32	97.79	97.88	96.43	95.30	97.26	95.98	95.65	96.98	97.62	93.52	96.31
Si	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Ti	0.00	0.13	0.12	0.06	1.06	0.18	0.90	0.14	0.27	0.34	1.02	0.23
Al	0.00	0.08	0.34	0.13	0.04	0.40	0.01	0.07	0.08	0.11	0.05	0.10
Cr	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01
V	0.01	0.02	0.00	0.01	0.00	0.01	0.00	0.01	0.02	0.02	0.01	0.02
Fe^{3+} (calc)	1.98	1.63	1.41	1.73	0.00	1.21	0.18	1.63	1.33	1.18	0.00	1.40
Fe^{2+} (calc)	0.99	1.04	0.90	0.93	0.74	1.01	0.70	1.08	1.15	1.23	0.73	1.11
Mn	0.00	0.01	0.03	0.01	0.00	0.01	0.01	0.02	0.01	0.01	0.00	0.01
Mg	0.00	0.08	0.19	0.11	0.16	0.16	0.20	0.04	0.12	0.10	0.17	0.11
Zn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	3.00	3.00	3.00	3.00	2.00	3.00	2.00	3.00	3.00	3.00	2.00	3.00
Xusp	0.00	0.13	0.14	0.06		0.26		0.14	0.29	0.37		0.25
Xmag	1.00	0.87	0.86	0.94		0.74		0.86	0.71	0.63		0.75
Xilm					1.00		0.90				1.00	
Xhem					0.00		0.10				0.00	

* indicates all Fe as FeO. **indicates average of two analyses. -- indicates concentration below detection limit. Low totals are due to the small size of the oxides. Number in parentheses indicates analytical precision determined from microprobe counting statistics. First number refers to magnetite, second number to ilmenite Magnetite/ilmenite recalculations by the method of Stormer (1983). Representative sample information and additional oxide composition data provided in Appendix G.

Table 7 continued.

Oxide (wt%)	Stage 5				
	Relict Ti-mag	Relict ilm	Ti-mag after bio	Ilm after bio	Quench Ti-mag
No. of analyses	3	1	11	3	5
SiO_2 (0.01)	--	--	0.09	0.08	--
TiO_2 (0.07/0.21)	9.12	55.45	11.51	52.97	9.46
Al_2O_3 (0.02)	2.07	2.66	4.37	1.83	1.44
Cr_2O_3 (0.02/0.01)	0.28	--	--	--	--
V_2O_3 (0.01)	0.59	0.21	0.34	0.23	0.66
FeO* (0.22/0.15)	78.66	31.97	71.77	34.39	80.14
Fe_2O_3 (calc)	47.11	0	41.28	0	47.32
FeO (calc)	36.27	31.97	34.62	34.39	37.56
MnO (0.02/0.03)	0.29	--	0.33	--	0.52
MgO (0.02/0.03)	1.66	4.97	4.38	4.67	0.97
ZnO (0.03/0.02)	--	--	--	--	--
Total	97.50	95.33	96.96	94.18	98.04
Si	0.00	0.00	0.00	0.00	0.00
Ti	0.26	1.05	0.32	1.02	0.27
Al	0.09	0.08	0.19	0.06	0.07
Cr	0.01	0.00	0.00	0.00	0.00
V	0.02	0.00	0.01	0.00	0.02
Fe^{3+} (calc)	1.35	0.00	1.15	0.00	1.36
Fe^{2+} (calc)	1.16	0.68	1.07	0.74	1.20
Mn	0.01	0.00	0.01	0.00	0.02
Mg	0.09	0.19	0.24	0.18	0.06
Zn	0.00	0.00	0.00	0.00	0.00
Total	3.00	2.00	3.00	2.00	3.00
Xusp	0.28		0.35		0.29
Xmag	0.72		0.65		0.71
Xilm		1.00		1.00	
Xhem		0.00		0.00	

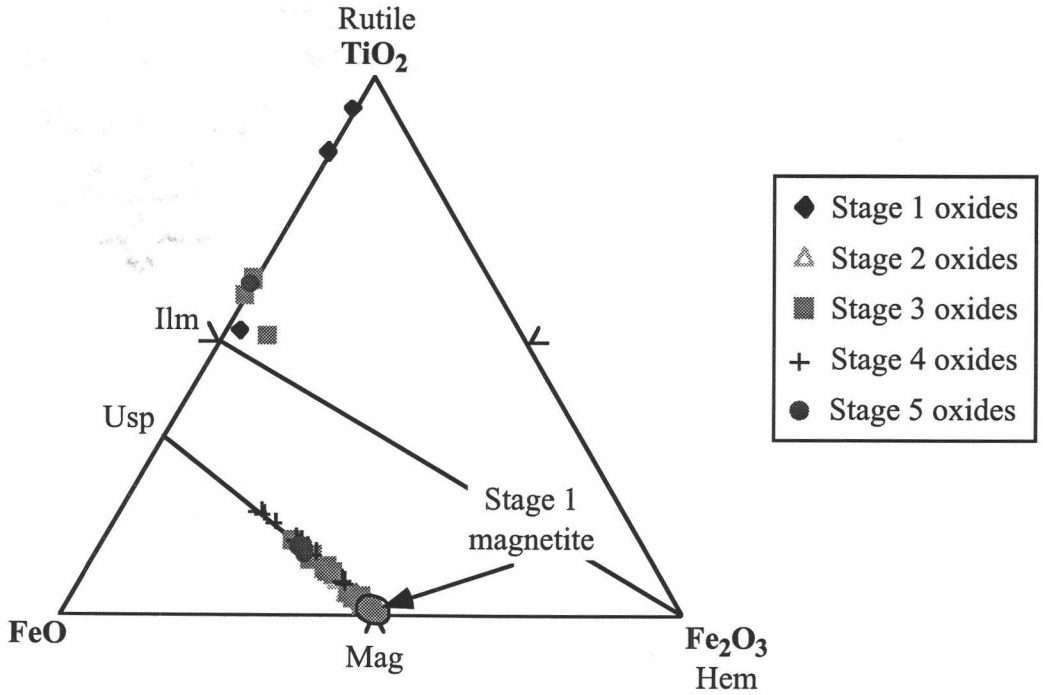

Figure 16a. Compositions of primary/relict Fe-Ti oxides from Stages 1 through 5.

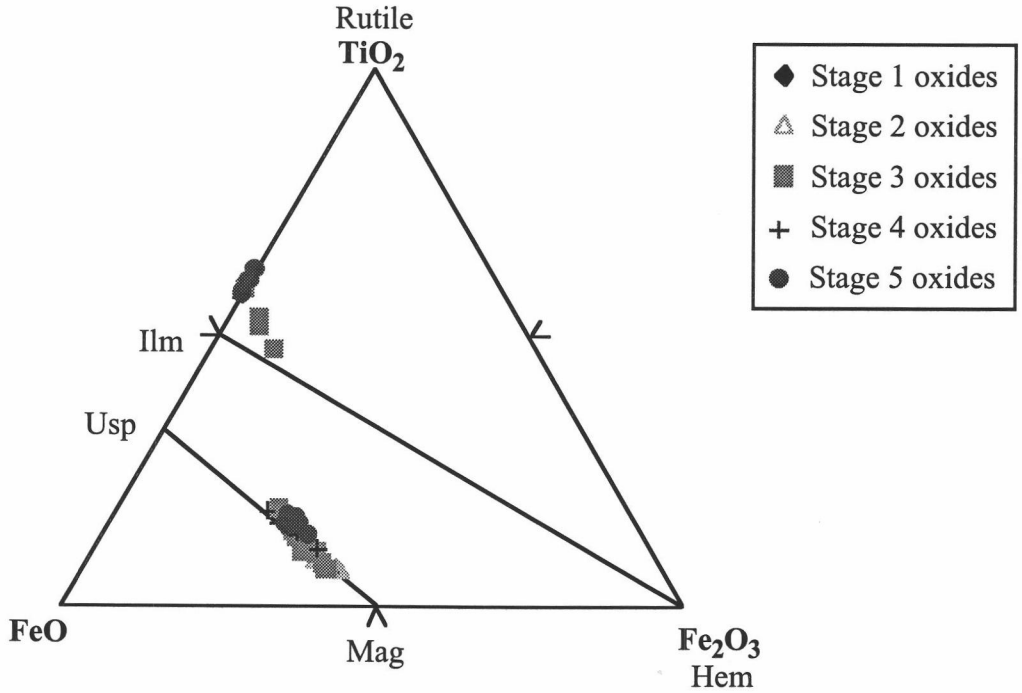

Figure 16d. Compositions of Fe-Ti oxides replacing biotite from Stages 2 through 5.

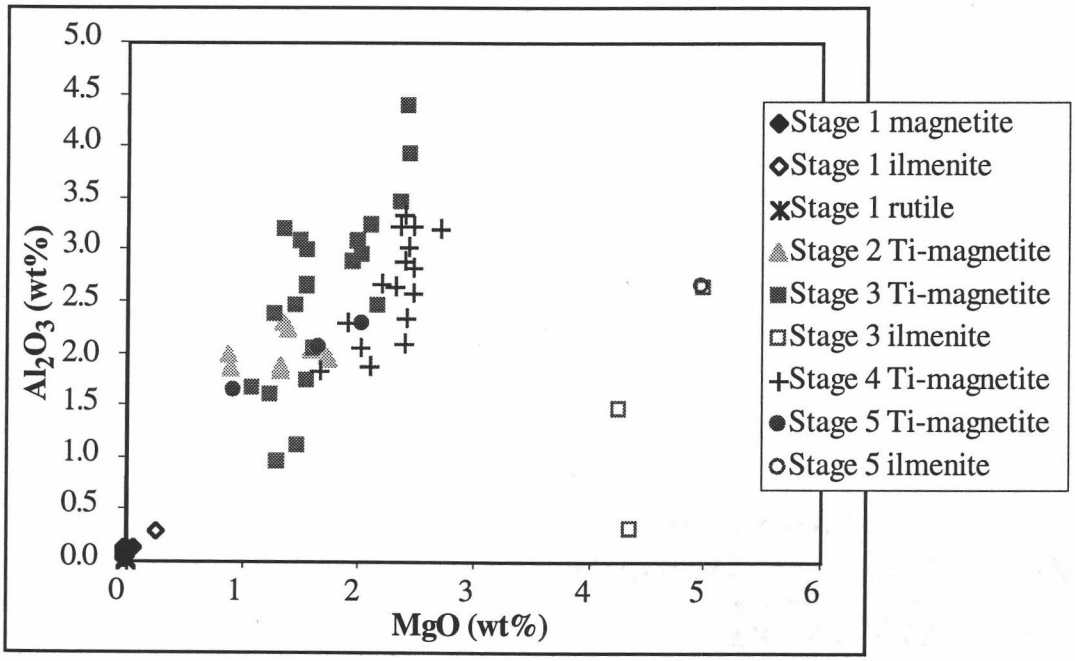

Figure 16b. Al_2O_3 vs. MgO in primary/residual titaniferous magnetite and ilmenite from all Stages.

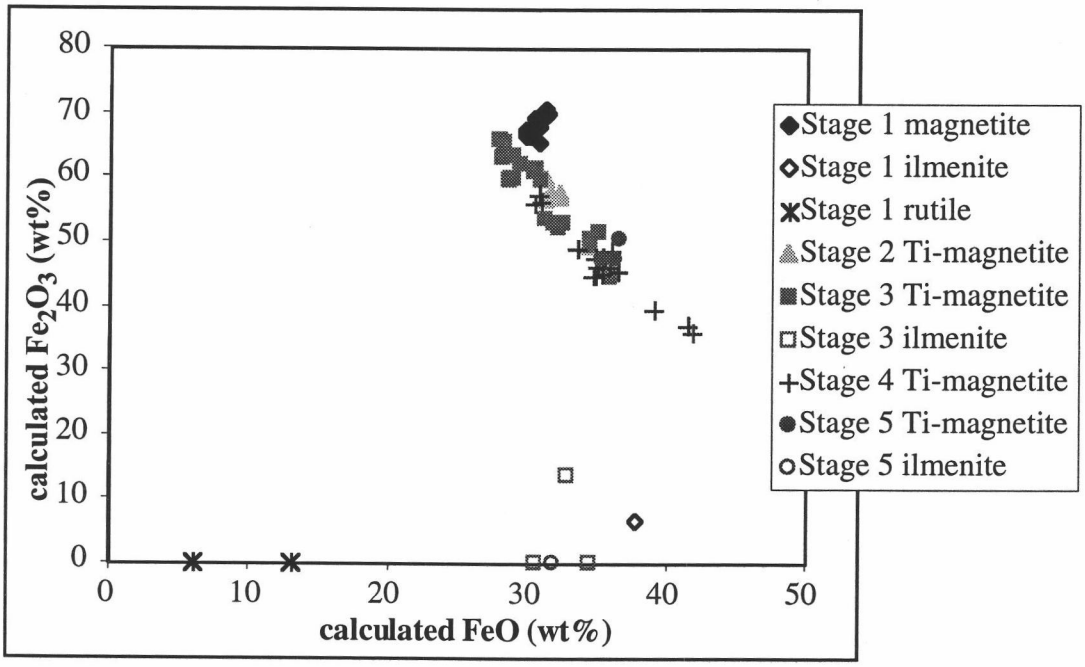

Figure 16c. Fe_2O_3 vs. FeO in primary/residual titaniferous magnetite and ilmenite from all Stages.

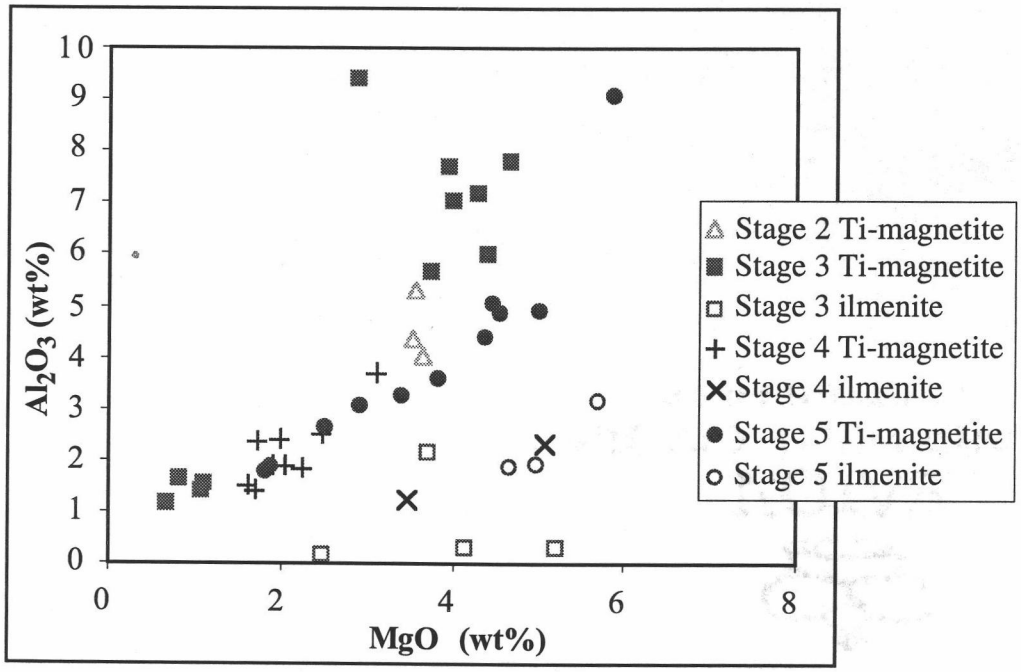

Figure 16e. Al_2O_3 vs. MgO in titaniferous magnetite and ilmenite replacing biotite from Stages 2 through 5.

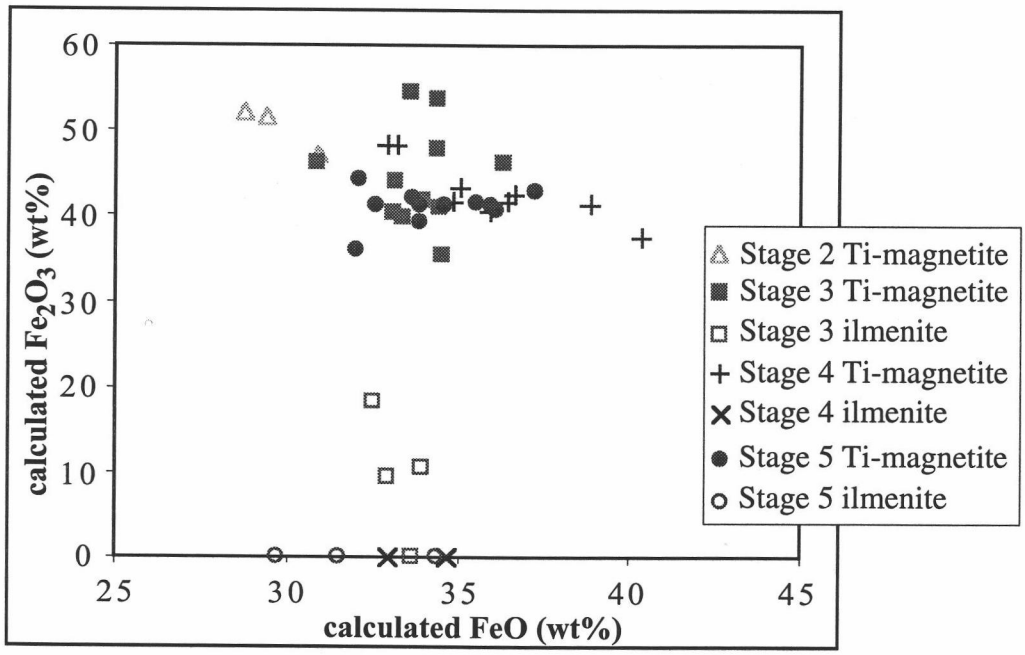

Figure 16f. Fe_2O_3 vs. FeO in titaniferous magnetite and ilmenite replacing biotite from Stages 2 through 5.

In Stages 3 through 5, biotite is entirely replaced by a fine-grained intergrowth of Fe-Ti oxides, orthopyroxene, plagioclase feldspar, and melt. Both titaniferous magnetite and lesser ilmenite occur as biotite reaction products. Several titaniferous magnetite (X_{mag}0.80-0.87) crystals enclosed in biotite were analyzed in Stage 2 (Table 7). In Stage 3, the ratio of titaniferous magnetite (X_{mag} 0.58-0.84) to ilmenite (X_{ilm}0.81-1.0) is about 3:1. In Stage 4, titaniferous magnetite (X_{mag}0.57-0.77) is six times as abundant as ilmenite (X_{ilm}1.0), and in Stage 5, titaniferous magnetite (X_{mag}0.61-0.73) is five times as abundant as ilmenite (X_{ilm}1.0). Concentrations of TiO_2, MgO, and Al_2O_3 increase with increased partial melting of the rock in both ilmenite and titaniferous magnetite (Figures 16d and 16e). However, Fe-Ti oxides replacing biotite may contain twice as much MgO and Al_2O_3 compared to residual oxides; replacement titaniferous magnetite contains up to 9 wt% Al_2O_3 and 6 wt% MgO whereas residual titaniferous magnetite contains less than 4.5 wt% Al_2O_3 and 3 wt% MgO (Figures 16b and 16e). Calculated Fe_2O_3 concentration decreases with increased melting in both titaniferous magnetite and ilmenite replacing biotite (Figures 16c and 16f).

All of the oxide quench crystals analyzed are titaniferous magnetite (X_{mag}0.66-0.89) with TiO_2 concentration up to 6 wt% in Stage 3, 11 wt% in Stage 4, and 10 wt% in Stage 5 (Table 7). Quench titaniferous magnetite contains up to 2.5 wt% Al_2O_3 and 2 wt% MgO. Unlike residual Fe-Ti oxides, quench crystal compositions become more homogeneous with increased stage of melting.

Fluorapatite

Although fluorapatite is a trace phase, it is an important host of P_2O_5, REEs (we used Ce to proxy for the REEs), and volatiles. With increased melting, the estimated abundance of fluorapatite decreases from about 0.3 wt% of the mode in Stage 1 to less than 0.1 wt% in Stage 5 (modal estimates by mass balance of P_2O_5). Crystal composition becomes more heterogeneous with increased melting (Table 8). With increased melting, CaO in residual fluorapatite decreases whereas P_2O_5 increases slightly (Figure 17a). Na_2O and MgO concentrations increase with increased melting; MgO is

Table 8. Representative fluorapatite compositions.

Oxide (wt%)	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
No. of analyses	25	14	15	3	6
MgO (0.02)	--	0.24	0.44	0.45	0.49
CaO (0.13)	55.31	54.20	52.93	53.15	52.84
SrO (0.01)	--	--	0.07	0.10	0.10
CeO (0.02)	0.14	0.23	0.15	--	--
Na_2O (0.01)	--	0.08	0.08	--	--
P_2O_5 (0.26)	41.38	41.25	41.84	42.30	41.92
S (0.01)	0.07	0.10	0.10	--	0.08
F (0.03)	2.29	2.58	3.09	3.49	3.57
Cl (0.01)	0.22	0.27	0.33	0.23	0.37
Total	98.62	98.00	97.80	98.40	98.03
O=F	0.96	1.08	1.30	1.47	1.50
O=Cl	0.05	0.06	0.08	0.05	0.08
cations Mg	0.00	0.06	0.11	0.11	0.12
Ca	9.65	9.81	9.63	9.64	9.66
Sr	0.01	0.01	0.01	0.01	0.01
Ce	0.01	0.02	0.01	0.01	0.01
Na	0.02	0.03	0.03	0.01	0.02
P	5.71	5.90	6.01	6.06	6.05
S	0.02	0.03	0.03	0.01	0.03
Total cations	15.41	15.85	15.82	15.86	15.90
F	1.53	1.38	1.66	1.87	1.92
Cl	0.06	0.08	0.10	0.06	0.11

-- indicates concentration below detection limit.

Number in parentheses indicates analytical precision determined from microprobe counting statistics.

Fluorapatite stoichiometry calculated on the basis of 25 oxygen equivalents. Representative sample information and additional fluorapatite composition data are provided in Appendix H.

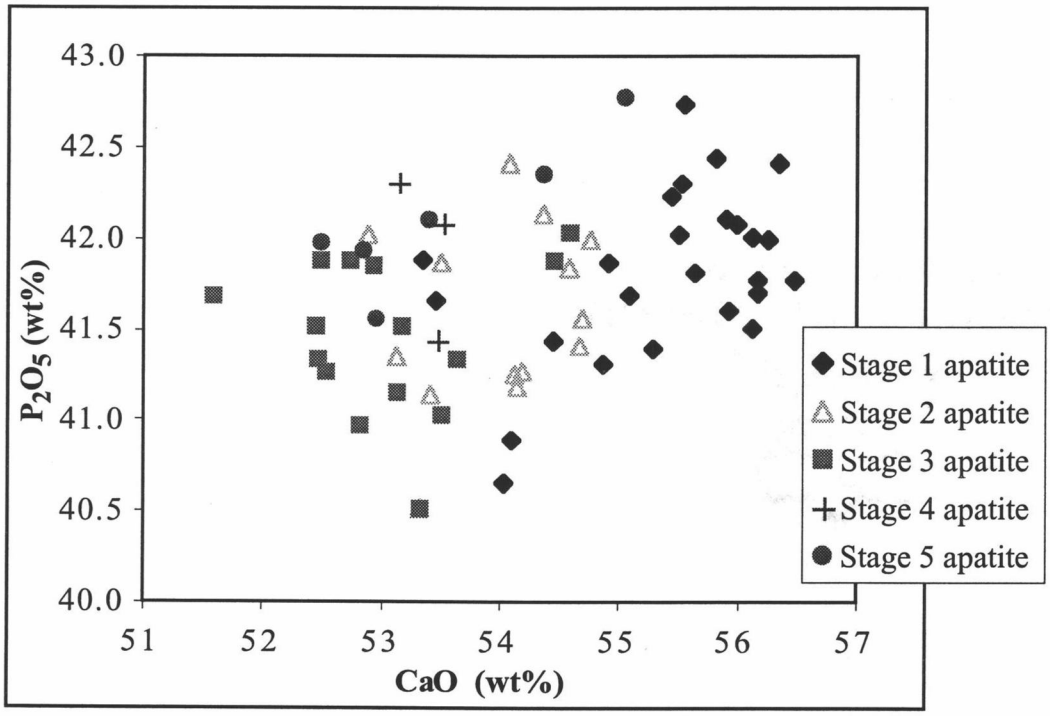

Figure 17a. P_2O_5 vs. CaO in fluorapatite from all Stages.

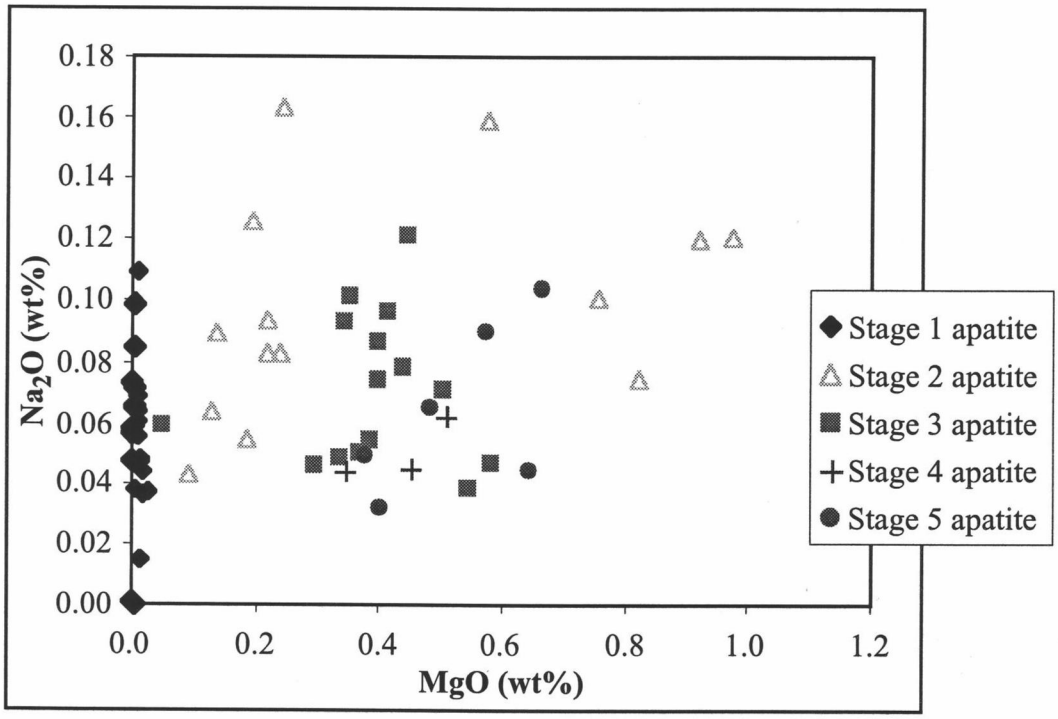

Figure 17b. Na_2O vs. MgO in fluorapatite from all Stages.

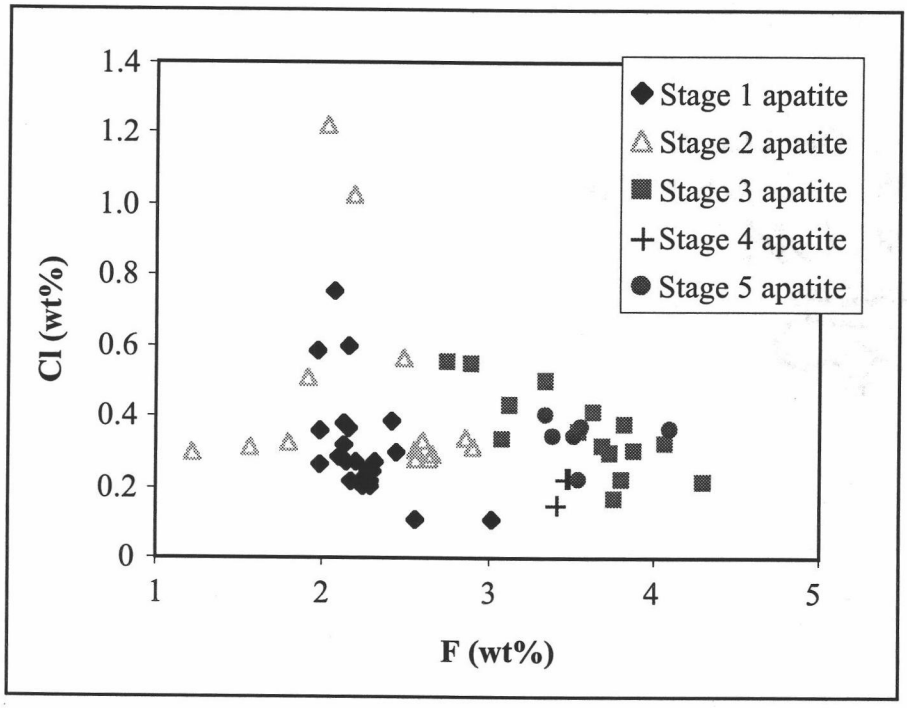

Figure 17c. F vs. Cl in fluorapatite from all Stages.

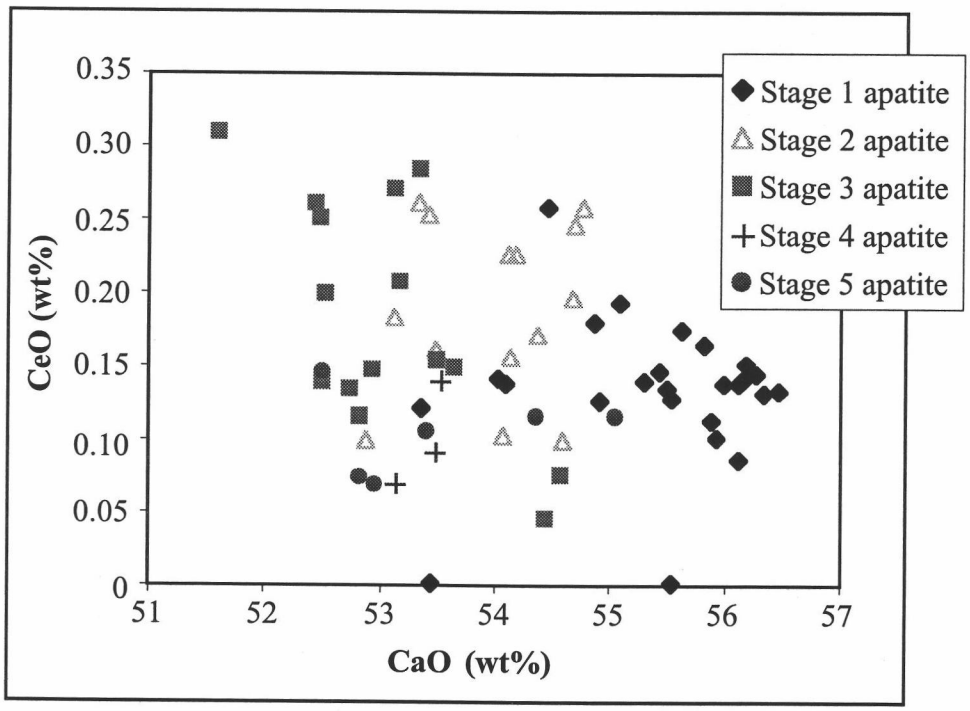

Figure 17d. CeO vs. CaO in fluorapatite from all Stages.

barely detectable in Stage 1 yet increases to nearly 0.65 wt% by Stage 5 (Figure 17b). The concentration of F in residual fluorapatite almost doubles with increased melting; in contrast, the concentration of Cl decreases slightly (Figure 17c). With increased melting, CeO concentration increases from Stage 1 through Stage 3 to a maximum of 0.3 wt%, then decreases in Stages 4 and 5 to a maximum of 0.15 wt% (Figure 17d).

Glass

Glass from Stages 2 through 5 ranges from tonalitic to granitic in composition and contains 65 to 80 wt% SiO_2 (Table 9, Figure 19a).

A single glass seam was analyzed in the sample representing Stage 2; this seam is located between biotite and quartz and partially within the embayed quartz grain (Figure 18). Three spots were analyzed on this seam, and each glass has a distinct composition. Glass in the seam between quartz and biotite (Point B) has the most mafic composition, with high MgO, FeO, TiO_2, and MnO compared to other Stage 2 glasses, whereas glass located within the quartz grain (about 150 μm from the biotite, Point C) has high SiO_2, CaO, and Cl (Table 9). High K_2O and Al_2O_3, as well as wt% oxide values intermediate between the other points, is characteristic of the glass about 50 μm from the biotite grain (Point A; Table 9). Stage 2 glass on the quartz-biotite boundary contains significantly more MgO and FeO than glass from any other Stage (Table 9).

Two types of glass were identified in Stages 3 through 5: a high Ca-Na, low K "tonalitic" glass, and a low Ca, high K "granitic" glass (Table 9, Figure 19a). Granitic glasses from Stages 3 through 5 generally have less than 7 wt% normative An and normative Or > Ab (Figure 19a). These glasses lie along the water-undersaturated, low P haplogranite cotectic (Figure 19b). Stage 5 glasses lie closer to the granite minimum than Stage 3 glasses. Most granitic glasses contain less SiO_2 and higher concentrations of mafic components (MgO, FeO, and TiO_2) than tonalitic glasses (Figures 19c and 19d). Tonalitic glasses from Stages 3 and 5 contain less than 5 wt% normative Or and normative Ab > An (Figure 19a). These glasses are displaced toward Q from the Ab-Q cotectic (Figure 19b). Stage 4 glass compositions are more variable than glass from other

Table 9. Representative glass compositions.

Oxide (wt%)	Stage 2[1]			Stage 3		Stage 4		Stage 5	
	Glass A	Glass B	Glass C	Tonalitic glass	Granitic glass	Tonalitic glass	Granitic glass	Tonalitic glass	Granitic glass
No. of analyses	1	1	1	15	38	7	36	8	50
SiO_2 (0.11)	69.31	65.72	74.84	74.18	75.99	76.19	72.73	78.90	76.26
TiO_2 (0.02)	0.15	0.61	--	0.21	0.49	0.78	0.74	0.58	0.87
Al_2O_3 (0.04)	13.79	12.19	10.60	11.49	11.62	11.40	10.46	11.46	11.02
FeO* (0.04)	1.15	4.41	0.85	0.49	0.44	0.89	0.97	0.56	0.95
MnO (0.02)	--	--	--	--	--	--	--	--	--
MgO (0.01)	0.86	3.84	0.74	--	--	0.14	0.14	--	0.05
CaO (0.02)	2.53	2.58	4.49	3.51	0.53	3.08	0.68	3.36	0.73
Na_2O (0.04)	1.24	1.40	0.83	3.15	2.17	2.88	2.64	3.51	2.81
K_2O (0.03)	6.70	4.47	1.45	0.31	6.21	1.50	4.40	0.33	5.35
P_2O_5 (0.03)	--	--	--	0.07	0.08	0.16	0.35	0.19	0.27
S (0.01)	--	--	--	--	--	--	--	--	--
F (0.02)	0.14	0.11	--	0.14	0.14	0.16	0.18	0.15	0.14
Cl (0.01)	--	--	0.08	0.02	--	--	0.04	0.02	--
Total	95.85	95.38	94.03	93.57	97.65	97.15	93.25	99.03	98.45
O=F	0.06	0.05	0.04	0.06	0.06	0.07	0.07	0.07	0.06
O=Cl	0.00	0.00	0.02	0.00	0.00	0.00	0.01	0.00	0.00
CIPW Norm (wt%)									
Q	29.0	25.9	53.4	47.1	38.7	47.3	39.6	50.7	38.4
C	0	0.4	0	0	0.6	0	1.0	0	0
Or	39.6	26.4	8.6	1.9	36.7	8.8	26.0	1.9	31.6
Ab	10.5	11.8	7.0	26.7	18.4	24.4	22.4	29.7	23.7
An	12.3	12.8	20.9	16.3	2.1	13.8	1.1	14.6	1.7
Di	0.2	0	1.0	0.6	0	0.4	0	0.3	0.2
Wo	0	0	0	0	0	0	0	0.2	0
Hy	4.0	16.8	2.8	0.3	0.1	0.6	0.9	0.0	0.4
Il	0.3	1.1	0.1	0.4	0.9	1.5	1.4	1.1	1.7
Ap	0	0	0.1	0.2	0.2	0.4	0.8	0.4	0.6

* indicates all Fe as FeO. -- indicates concentration below detection limit. [1]See Figure 18 for location of points. Number in parentheses indicates analytical precision determined from microprobe counting statistics. CIPW norm calculated with all Fe as FeO. CIPW norm abbreviations are same as used in Table 2. Representative sample information and additional glass composition data are provided in Appendix I.

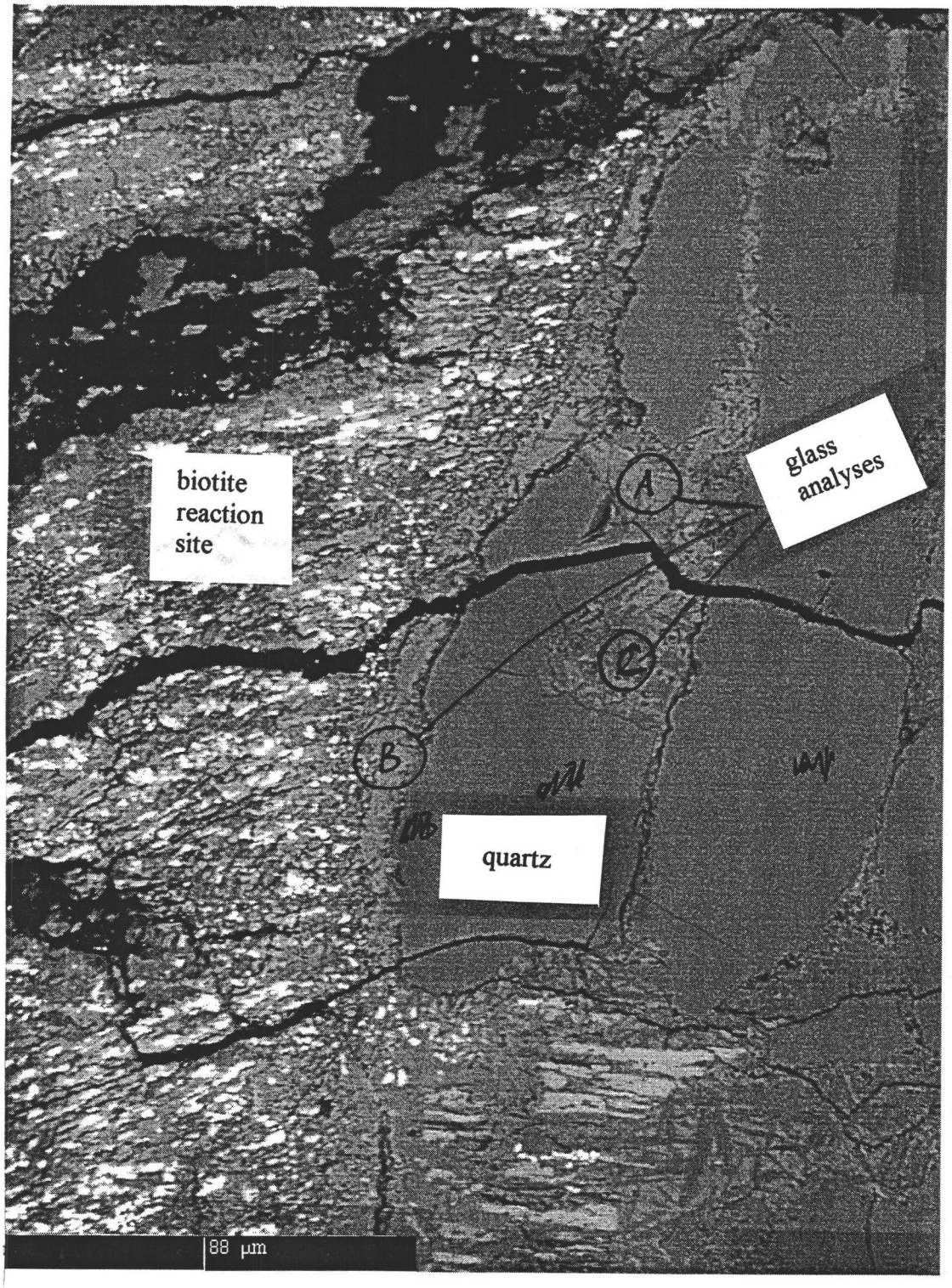

Figure 18. Backscatter electron image of a glass seam at the contact of reacted biotite and quartz, Stage 2. Points A, B, and C correspond to analyses in Table 9.

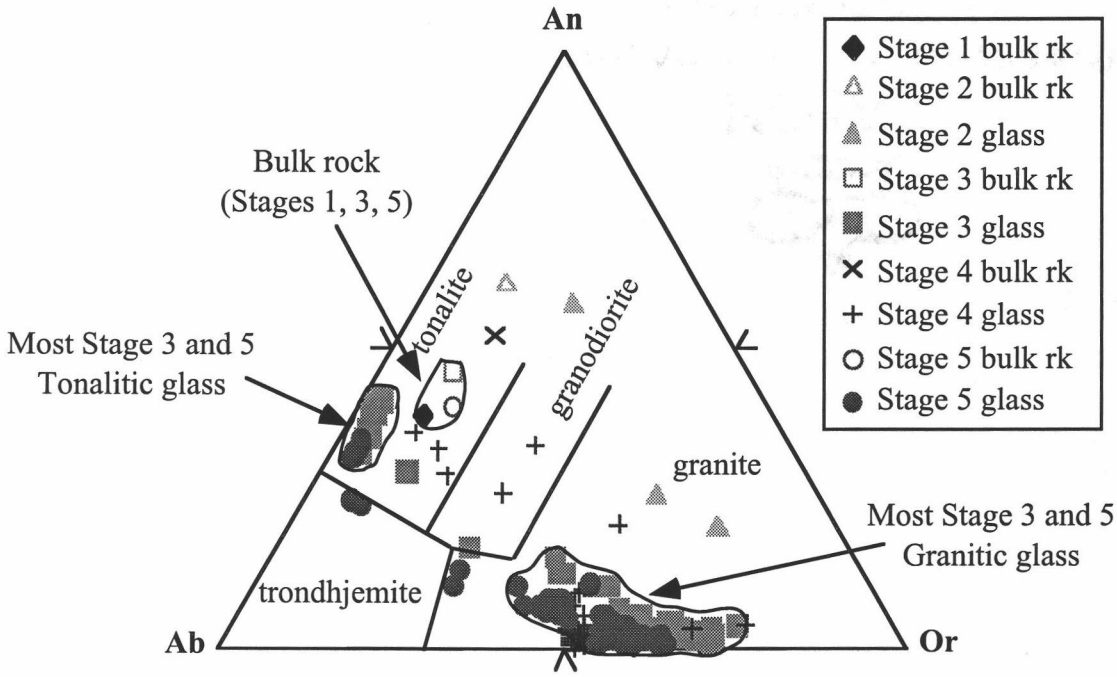

Figure 19a. Normative An-Ab-Or of glass from Stages 2 through 5. Fields after Barker (1979).

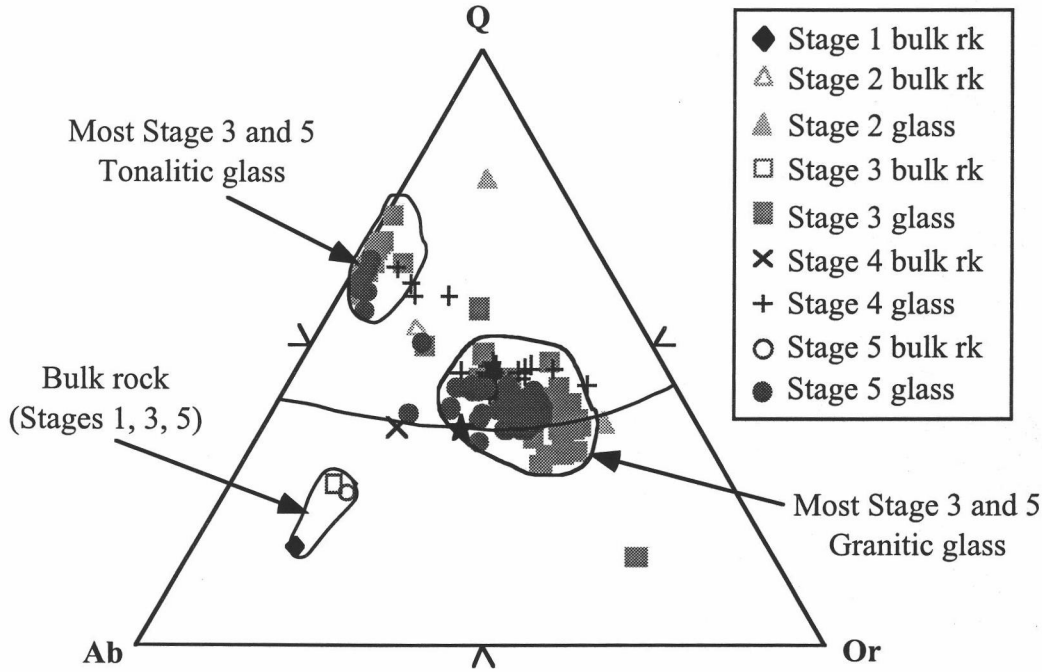

Figure 19b. Normative Q-Ab-Or of glass from Stages 2 though 5. Cotectic line for haplogranite system at 2 kbar and initial $X_{melt}(H_2O) = 0.7$ (water undersaturated) after Holtz et al. (1992). Dark star marks approximate position of the granite minimum.

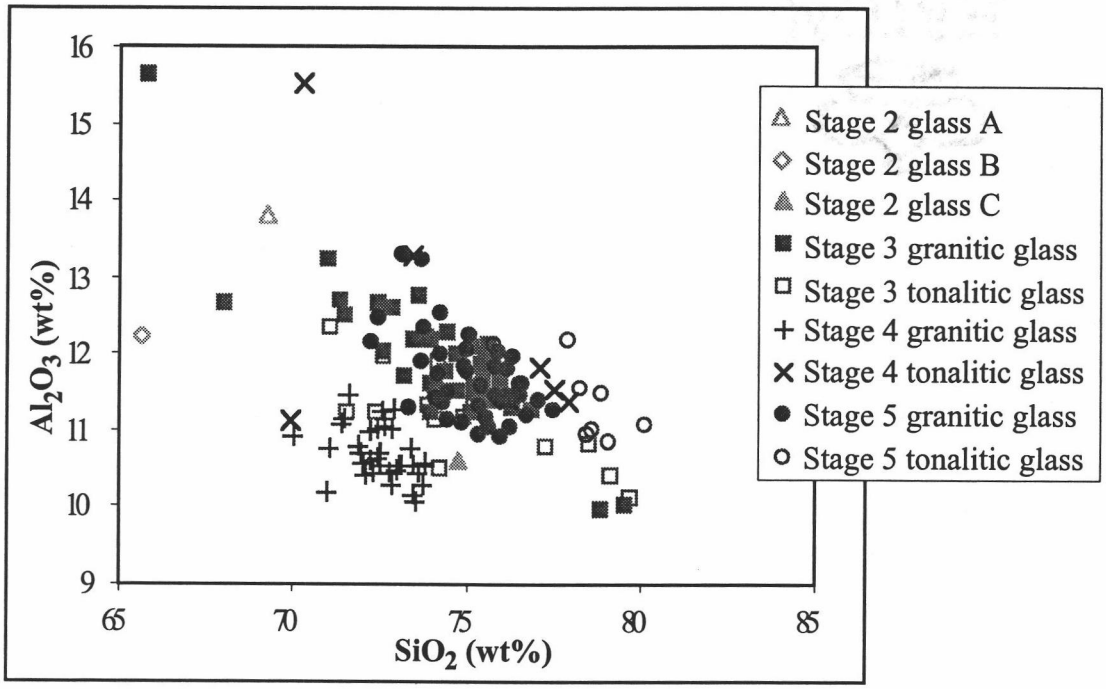

Figure 19c. Al_2O_3 vs. SiO_2 in glass from Stages 2 through 5. For locations of Stage 2 glasses refer to Figure 18.

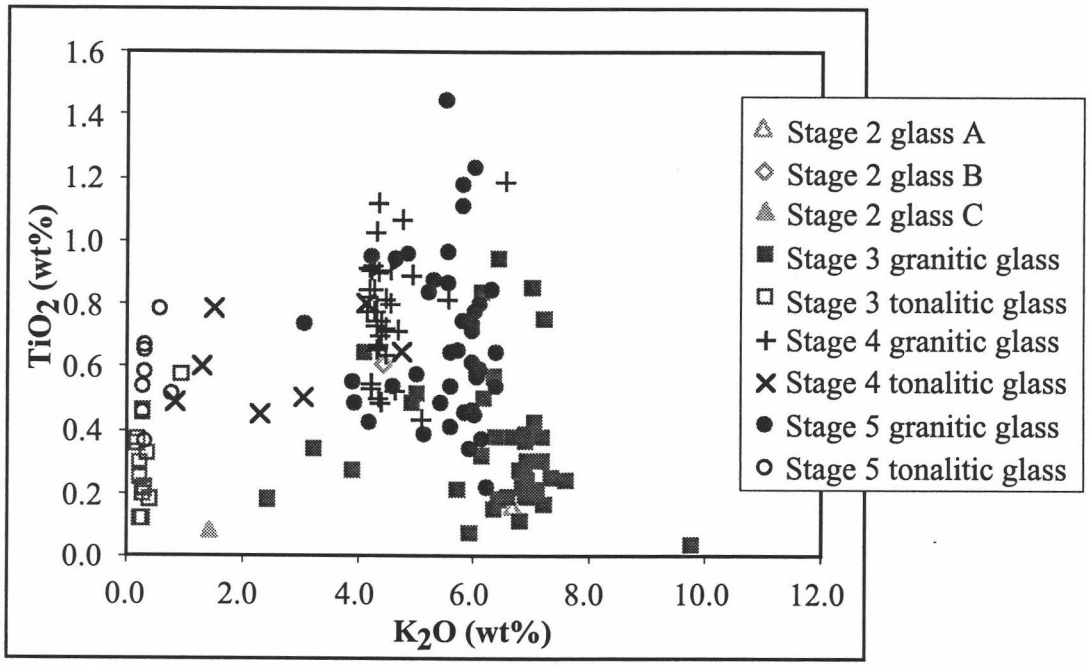

Figure 19d. TiO_2 vs. K_2O in glass from Stages 2 through 5. The behavior of FeO* and MgO are similar to TiO_2.

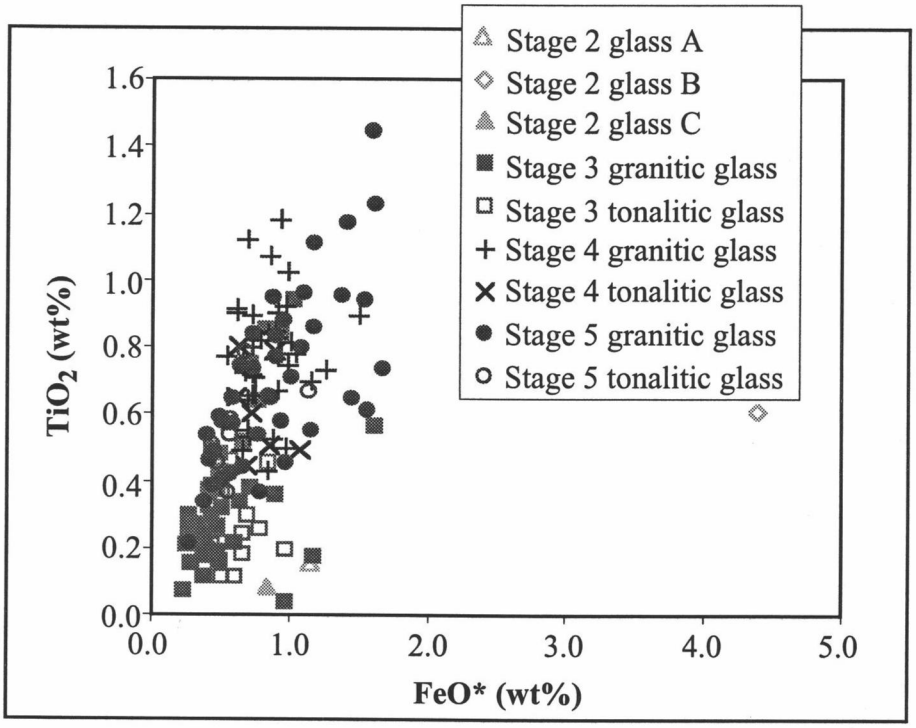

Figure 19e. TiO_2 vs. FeO* in glass from Stages 2 through 5. The behavior of MgO is similar to the behavior of these oxides.

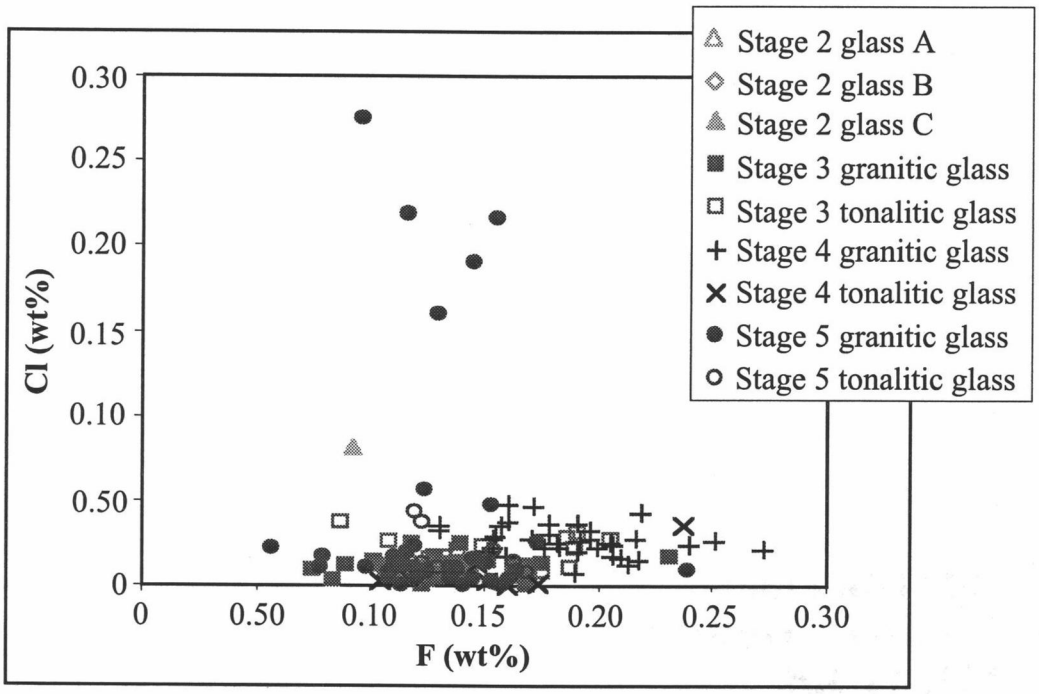

Figure 19f. Cl vs. F in glass from Stages 2 through 5.

Stages, both in granitic- and tonalitic-type glasses (possibly due to the cataclastic overprint of this sample). Stage 4 also includes a few glasses that lie in the granodiorite compositional field (Figure 19a). With increased melting (i.e., from Stage 3 to Stage 5), both tonalitic and granitic glasses move towards normative Ab but each glass type remains compositionally separate (Figure 19a). In both types of glass, TiO_2, FeO, and MgO concentrations increase with increased degree of melting, although mafic components remain below 1.5 wt% (Figure 19e). SiO_2 concentration increases slightly (Figure 19c). Several glasses from Stage 5 have FeO concentrations up to 1.7 wt% and Cl up to 0.28 wt% (Figures 19e and 19f).

In Stage 3, the granitic and tonalitic glasses form distinct light gray and dark gray irregular patches in electron backscatter images (Figure 20). Dark gray glass patches (tonalitic glass) frequently occur as seams along plagioclase edges and as tiny stringers within plagioclase sites, but dark gray glass also occurs near mafic reaction sites and near relict quartz. Light gray (granitic) glass occurs near and within biotite and amphibole reaction sites as well as in seams between quartz and plagioclase. We surmise that the granitic glass is a lighter shade in backscatter because of slightly higher concentrations of mafic oxides (MgO, FeO, TiO_2). In Stages 4 and 5, the two glass types remain irregularly distributed in plagioclase-quartz glass seams and around mafic sites.

Photomicrographs of Stage 4 reveal the presence of both colorless and brown glass (see discussion of Stage 4 textures and Figure 9d). All of the tonalitic glass analyzed in Stage 4 is brown in transmitted light, whereas the granitic glass is both brown and colorless to gray. However, there is no compositional distinction between the brown and colorless granitic glasses. In all Stages, there is no chemical distinction between granitic glass within or at the margins of mafic mineral reaction sites and granitic glass located elsewhere. An estimated 28 vol% of glass analyzed in Stage 3 is tonalitic; with increased melting, the proportion of tonalitic glass decreases to about 14 vol% in Stage 5 (Table 9).

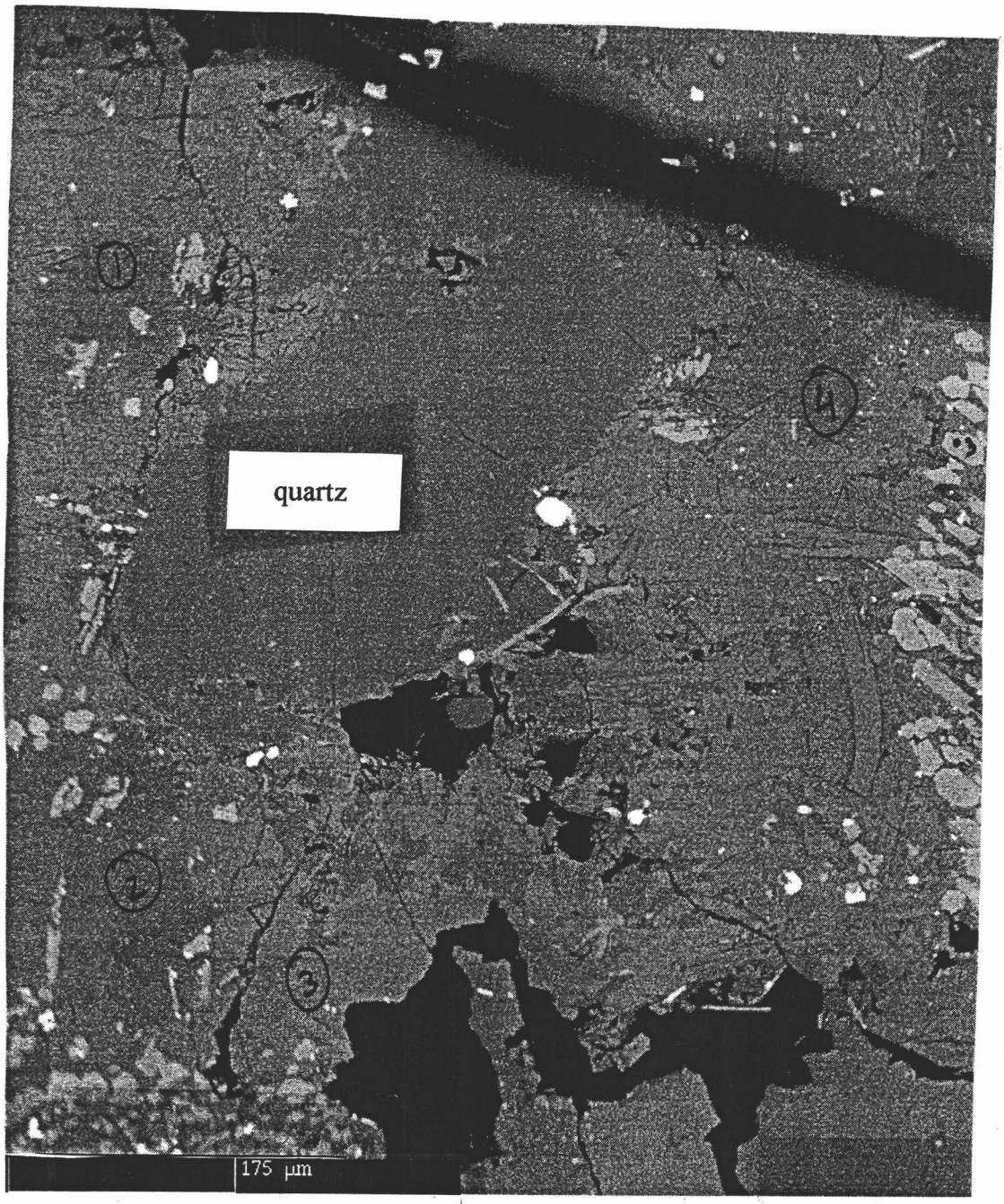

Figure 20. Backscatter electron image of glass in irregular patches around quartz near a hornblende reaction site. Points labeled 1, 2, and 4 represent analyses on dark gray (tonalitic) melt. Point 3 represents an analysis on light gray (granitic) melt.

Discussion

Closed System Dehydration Melting

Within the range of samples we have examined, there appears to be no exchange of mass between the CRB dike and partially melted wallrock. Nearly all major elements (as well as most trace elements) are conserved from Stage 1 to Stage 3 to Stage 5 (Figure 11), indicating that these samples represent a chemically closed system. Stages 2 and 4 are weighted less in this discussion because of the cataclastic overprint and bulk compositional differences from the other Stages.

Because samples were collected from different areas along the dike's western margin, modal differences may in part be due to local inhomogeneity in the parent tonalite. However, we think this is a minor effect. The two samples representing Stage 1 have nearly identical modal proportions of plagioclase, alkali feldspar, and quartz in multiple thin sections (although the proportions of hornblende and biotite vary; see discussion of Stage 1 petrography). It is therefore reasonable to assume that the unmelted parent at each Stage was modally similar to Stage 1.

Melt Modification

The presence of microlites within the glass in Stages 3 through 5 indicates that the glass now present is not compositionally equivalent to the original melt. Microlite textures are consistent with rapid growth and these crystals likely grew from the melt as it was quenched. Growth of plagioclase, orthopyroxene, clinopyroxene, and magnetite crystals (which make up almost 9 vol% of the mode in Stage 5) would modify the melt composition by removing Si, Ca, Na, Al, Mg, Fe, and Ti. The original melt is therefore compositionally equivalent to glass plus quench crystals. We argue this is true because: (1) the glass is devoid of vesicles which would indicate a volatile phase, (2) the glass lacks spherulites so devitrification is likely minimal, and (3) the presence of quench

crystals indicates rapid cooling so that there was little time to modify the original melt before it was quenched.

Mass balance calculations were used to estimate the melt composition before quenching took place in Stage 5 (Table 10). In order to perform the calculations, we assume that the density of both the tonalitic and granitic glasses is 2.3 g/cm^3 and that the quench crystals are homogeneously distributed between the two glass types. The concentrations of Al_2O_3, FeO, MgO, CaO, and TiO_2 increase in both the granitic and tonalitic calculated melts relative to the glasses (Table 10). The mixed melt (Table 10) is a calculated mixture of the granitic glass, tonalitic glass, and all plagioclase, pyroxene, and titaniferous magnetite quench crystals. The high FeO* and TiO_2 in the mixed melt is likely due to overestimation of magnetite in point counting. A low-magnetite (0.1 vol% quench magnetite) melt is also calculated (Table 10).

Table 10. Calculated compositions of Stage 5 tonalitic, granitic, and mixed melts.

	Stage 5					
Oxide (wt%)	Tonalitic glass[1]	Tonalitic melt[2]	Granitic glass[3]	Granitic melt[4]	Mixed melt[5]	Low mag mixed melt[6]
SiO_2	78.90	70.62	76.26	67.82	68.21	70.41
TiO_2	0.58	0.83	0.87	1.14	1.10	0.74
Al_2O_3	11.46	12.51	11.02	12.31	12.34	12.96
FeO*	0.56	4.73	0.95	5.80	5.65	2.52
MnO	0.00	0.05	0.05	0.09	0.09	0.07
MgO	0.04	1.76	0.05	1.57	1.60	1.81
CaO	3.36	4.50	0.73	2.52	2.80	2.89
Na_2O	3.51	3.31	2.81	2.80	2.87	2.94
K_2O	0.33	0.29	5.35	4.00	3.48	4.00
P_2O_5	0.19	0.14	0.27	0.20	0.19	0.20

[1]Stage 5 tonalitic glass, representative composition (as given in Table 9).
[2]Calculated melt composition by mass balance of Stage 5 tonalitic glass plus 0.7 vol% quench plagioclase (representative composition given in Table 5), 0.1 vol% quench clinopyroxene (Table 6), 0.2 vol% quench orthopyroxene, and 0.1 vol% quench magnetite (Table 7).
[3]Stage 5 granitic glass, representative composition (as given in Table 9).
[4]Calculated melt composition by mass balance of Stage 5 granitic glass plus 4.6 vol% quench plagioclase (representative composition given in Table 5), 0.5 vol% quench clinopyroxene (Table 6),1.1 vol% quench orthopyroxene, and 0.8 vol% quench magnetite (Table 7).
[5]Calculated melt composition by mass balance of Stage 5 tonalitic and granitic glasses plus all quench crystals in modal proportions given in Table 1.
[6]Melt composition calculated by same method as "Mixed melt" but with 0.1 vol% quench magnetite.

The Origin of Two Melt Types: Amphibole and Biotite Dehydration Reactions

During partial melting of tonalite by basalt, hornblende, biotite, and orthoclase are entirely consumed. The absolute modal abundance of plagioclase, quartz, apatite, and Fe-Ti oxides decreases, indicating that these phases are also consumed; however, these phases persist in the restite with as much as 40 vol% quenched melt (31 vol% glass and 9 vol% quench crystals). Orthopyroxene, clinopyroxene, sparse Fe-Ti oxides, and glass occupy decomposed hornblende sites, with pyroxene microlites aligned along the original amphibole c-axis. Biotite sites are occupied by aligned titaniferous magnetite and ilmenite in an intergrown matrix of orthopyroxene, plagioclase, and glass. Within 2 m of the dike margin, a trace amount to 31 vol% glass is preserved within and around decomposed mafic sites, and also as seams up to 2 mm thick between relict quartz and plagioclase crystals.

Two glasses are produced during partial melting: an abundant, high-K granitic glass, and a less abundant, high-Ca tonalitic glass. The distribution of glass types is highly irregular, with both glass types occurring in seams between quartz and plagioclase, adjacent to amphibole and biotite reaction sites, and within mafic reaction sites. In terms of major element composition and CIPW norm, the Wallowa granitic glass is most similar to melts produced from partial melting of biotite-bearing protoliths, whereas the tonalitic glass is most similar to melts produced from the reaction of amphibole-bearing protoliths (Figures 21a and 21b; see also comparison to other studies, below). Based on both chemical and textural considerations, the general breakdown reactions are:

hornblende + quartz + feldspar = orthopyroxene ± clinopyroxene + minor Fe-Ti oxides + tonalitic melt (tonalitic glass + quench crystals)

biotite + quartz + feldspar = orthopyroxene + plagioclase + titaniferous magnetite + ilmenite + granitic melt (granitic glass + quench crystals)

While orthoclase is clearly consumed during the breakdown reactions, textural data (spongy texture) suggests that a minor amount of plagioclase is consumed as well (see also plagioclase discussion, below). The tonalitic, amphibole-derived glass is less abundant than the granitic, biotite-derived glass, similar to the observations of Patiño

Douce and Beard (1995) on a synthetic amphibolite and biotite gneiss where amphibole dehydration initially produced only 1/3 as much melt as biotite dehydration over a range of temperatures and pressures.

The formation of plagioclase as a reaction product of biotite is curious because there is no local source of Ca and Na. However, biotite oxidation produces magnetite plus alkali feldspar, phases which are commonly observed during biotite reactions in experimental work (Vielzeuf and Montel, 1994; Patiño Douce and Beard, 1995; Singh and Johannes, 1996b). It is likely that alkali feldspar was initially formed during biotite breakdown. The alkali feldspar composition was then modified by diffusive exchange of K-Si for Ca-Al with either residual plagioclase or the melt. Alternatively, a coupled reaction with plagioclase and/or hornblende breakdown could add Ca and Na to the biotite reaction site so that plagioclase crystallized during biotite reaction.

We are unable to determine from textural data whether biotite or hornblende breaks down first, as both phases are present in Stage 2 and absent in Stage 3. Textural data from Stage 2 suggests that the amphibole may be more likely to break down first as it has a similar appearance to dusty clinopyroxene plus orthopyroxene that replace the amphibole in Stage 3. While the edges of biotite grains are clearly replaced by magnetite in Stage 2, the cores are relatively intact, with preserved birdseye texture and high order pleochroism. Additionally, increased F (coupled with high TiO_2 and low Al_2O_3) can increase the thermal stability of biotite (Le Breton and Thompson, 1988; see also Skjerlie and Johnston, 1993). Stage 2 biotite contains up to 0.19 wt% F, which may enable it to withstand slightly higher temperatures than the amphibole. On the other hand, in most low pressure (< 10 kbar) experiments, biotite breakdown occurs at lower temperatures than amphibole breakdown (see discussion of temperature estimates, below). Additionally, the first occurrence of glass seams is associated with biotite in Stage 2.

The Role of Plagioclase in Partial Melting

As plagioclase makes up the bulk of the mode in the parent tonalite, it is clearly an important factor in controlling melt composition and melting stoichiometry. By Stage

3, plagioclase has developed spongy zones along crystal margins, especially where crystals are in contact with glass. Up to 25 vol% of the plagioclase has a spongy texture in Stage 3 while up to 33 vol% is spongy in Stage 5. Cells and channels in the spongy zones are filled with brown glass, with up to 50 vol% of the spongy zone filled with glass by Stage 5. We estimate that glass trapped in spongy feldspar accounts for 4 vol% of the mode in Stage 3 and 7 vol% in Stage 5. Additionally, plagioclase becomes more calcic, indicating that the albite component is lost to the melt. This textural and compositional information suggests that a third reaction is an important source of melt:

Andesine plagioclase = labradorite plagioclase + melt

Although melt trapped within spongy plagioclase was not analyzed, we presume it is high in SiO_2, Al_2O_3, and Na_2O. This reaction is probably most important at higher temperatures as plagioclase abundance decreases sharply in Stage 5.

Mass Balance Limits on Reaction Stoichiometry

Because the breakdown reactions take place in a chemically closed system, mass balance calculations may be used to refine modal estimates of minerals and melt. Point counting introduces a significant error in modal estimates (as much as 5 vol%), especially in fine-grained biotite and hornblende reaction sites (notably Stages 3 and 4). The mass balance calculations use average mineral compositions and modal abundances to calculate a glass composition at each Stage. The calculated glass is compared to actual glass data and modal estimates are refined until the glasses match. While multiple solutions will allow the calculated and actual glass compositions to match, we assume that the largest error in modal estimates involves pyroxene, plagioclase, Fe-Ti oxides and glass in biotite and hornblende sites. These mass balance estimates suggest that glass was overlooked in fine-grained biotite and/or hornblende sites in Stages 3 and 4. In Stage 3, mass balance requires an additional 4 vol% glass (total of 16 vol%) at the expense of orthopyroxene and Fe-Ti oxides in biotite sites. In Stage 4, an additional 4 vol% (total of

22 vol%) glass is required, again at the expense of orthopyroxene and Fe-Ti oxides in biotite sites. Note that the original modal estimates are similar to the mass balance corrected modes. No changes were made to the modal estimates in Stage 5; the predicted glass was nearly identical to the actual glass, probably because replacement minerals are coarse enough in this Stage for accurate modal estimates.

The modal proportion of phases obtained from point counts, visual estimates of the volume of glass trapped in spongy plagioclase, and mass balance calculations may be used to place limits on progressive melting reaction stoichiometry. Reaction units are given in vol% of the whole rock (because the glass density is not known). The initial reactions are calculated by differences in mode between the subsolidus assemblage and Stage 3 assemblage. The higher temperature reaction is calculated from differences in mode between Stage 3 and Stage 5. By mass balance constraints, the initial melt-forming reaction is:

15 hornblende + 14 biotite + 11 quartz + 6 orthoclase + minor Ab from plagioclase = 9 clinopyroxene after hornblende + 4 orthopyroxene after hornblende + 4 orthopyroxene after biotite + 2 plagioclase after biotite + 1 Fe-Ti ox + 11 granitic glass + 4 tonalitic glass + 4 glass trapped in spongy plagioclase + 2 quench crystals

These reactions are terminal for both amphibole and biotite and occur between Stages 2 and 3. As the temperature increases between Stages 3 and 5, additional melt is produced from the following reaction:

12 plagioclase + 5 quartz + 2 orthoclase + 9 clinopyroxene + 1 Fe-Ti ox = 16 granitic glass + 7 glass trapped in spongy plagioclase + 6 quench crystals

This reaction is terminal for orthoclase and clinopyroxene.

Mineral and Melt Compositional Changes During Partial Melting

In addition to changing proportions of restite phases and glass, the composition of these phases and glasses change with increased degree of melting. The composition of

primary phases becomes more heterogeneous with increased temperature. In contrast, phases produced during partial melting tend to become more homogeneous with increased degree of melting. Biotite and hornblende become depleted in K_2O and Cl before breaking down by Stage 3. Biotite becomes more magnesian and enriched in CaO, Na_2O, TiO_2, and F with increased melting, while hornblende becomes more Fe-rich. Orthoclase becomes less potassic before being consumed by the melt by Stage 4. The Or and An components of plagioclase increases slightly with increased melting, and by Stage 5 plagioclase has developed high An, FeO, MgO, and TiO_2 rims. Apatite becomes enriched in Na_2O, MgO, and F and depleted in CaO, while primary magnetite becomes enriched in TiO_2, Al_2O_3, and MgO.

Amphibole dehydration produces augite, enstatite, and pigeonite in Stage 3; augite is consumed entirely by Stage 5 while enstatite becomes less aluminous and more magnesian. Biotite dehydration also produces enstatite, which becomes enriched in En with continued melting. Titaniferous magnetite and ilmenite are a product of biotite reaction in Stages 3 through 5; these phases are enriched in MgO, TiO_2, and Al_2O_3 relative to primary Fe-Ti oxides.

Because partial melting is taking place in a closed system, components released from phases that break down must be accommodated either in the restite or in the melt. The breakdown of amphibole to form clinopyroxene and orthopyroxene in Stage 3 releases water, halogens, and alkalis to the tonalitic melt. Since the tonalitic glass is high in SiO_2 and CaO, we assume that there is also input from fluxing along quartz-plagioclase boundaries. Initial breakdown of biotite to form Fe-Ti oxides, orthopyroxene, and plagioclase releases water, halogens, and alkalis into the granitic melt, which also fluxes quartz-feldspar boundaries. Although clinopyroxene disappears between Stages 3 and 5 and the abundance of plagioclase decreases, neither the tonalitic nor the granitic glass becomes more calcic. However, the abundance of plagioclase quench crystals increases from Stage 3 to 5, and presumably the excess CaO is hosted either there or in the An-rich rims on residual plagioclase in Stage 5. With increased melting, Na_2O, MgO, FeO, and TiO_2 concentration of both the tonalitic and granitic glasses increase, as Na_2O is removed from plagioclase rims and residual oxides and pyroxene becomes unstable.

Intensive Parameters: Estimates of Temperatures During Partial Melting

Temperatures recorded by minerals in the melt zone ideally reflect maximum temperature conditions under which partial melting took place. The maximum thermal gradient over the 2 m distance from unmelted wallrock to the Maxwell Lake dike was about 1100°C (wallrock at 55°C, dike at 1140°C). Mineral thermometry and comparison with experimental phase equilibria have been used to estimate the temperatures conditions represented by each Stage.

We attempted to use both Fe-Ti oxide and pyroxene thermometry to constrain the temperature represented by each Stage. Equilibrium pairs of magnetite and ilmenite (determined by Mg/Mn equilibria after Bacon and Hirschmann, 1988) were identified in Stages 3 and 4. Stage 3 magnetite-ilmenite equilibrium pairs suggest a temperature of about 830°C (range 745-970°C) whereas Stage 4 pairs suggest a temperature of 1060°C (range 990-1100°C) (calculations using the program of Ghiorso and Sack, 1991). Stage 5 contained no equilibrium pairs according to the Bacon and Hirschmann (1988) criteria. Pyroxene thermometry using Lindsley's (1983) graphical two pyroxene thermometer yielded a temperature estimate only for Stage 3; Stage 4 clinopyroxene contains high concentrations of non-ternary components, while Stage 5 quench pyroxene pairs did not yield equilibrium tie lines. The best estimate for Stage 3 pyroxene pairs is about 1100°C, however, we think this value is too high and reflects disequilibrium conditions.

Application of experimental phase equilibria from intermediate composition protoliths to the Wallowa rocks can constrain the temperature at which the initial melt-forming reactions take place and the temperature range over which biotite and hornblende break down. Since biotite and hornblende react out by Stage 3, this comparison can only determine temperatures early in the partial melting sequence. In a series of low pressure experiments designed to locate the solidus of a synthetic biotite tonalite, Singh and Johannes (1996a and 1996b) conclude that the onset of melting in biotite-bearing rocks may be as low as 700°C. This temperature is therefore a minimum estimate for Stage 2, in which the reaction of biotite produces thin glass seams. Under pressure conditions of ≤ 8 kbar, hornblende in most intermediate composition amphibolites reacts out between 850 and 925°C (Beard and Lofgren, 1991; Patino Douce and Beard, 1995). Biotite

dehydration in intermediate to silicic protoliths is initiated at a lower temperature but occurs over a slightly larger temperature interval, commonly 800-925°C (Vielzeuf and Montel, 1994; Patino Douce and Beard, 1995). Since Stage 3 lacks both biotite and hornblende, temperature at this location probably reached 925°C.

Fe-Ti oxide geothermometry and constraints imposed by experimental phase equilibria have been used to estimate the temperatures conditions represented by each Stage (Table 11). Unmelted (Stage 1) wallrock at 4 to 6 m from western Maxwell Lake dike margin was initially at about 55°C and probably remained at less than 700°C. At about 4 m from the western dike margin, the incipient reaction of biotite and hornblende in Stage 2 indicates temperatures of at least 700°C but not more than about 825°C (the temperature at which widespread biotite dehydration occurs). Biotite and hornblende have completely reacted out by Stage 3, indicating that the temperature was at least 950°C at about 2 m from the dike margin. Fe-Ti oxide thermometry suggests a temperature of about 830°C for Stage 3. Oxide thermometry for Stage 4 suggests a temperature of about 1060°C at about 1 m from the dike margin. While no temperature constraints can be placed on the phases in Stage 5, its proximity to the dike (less than 0.5 m from the dike margin) suggests temperature in excess of 1100°C.

Table 11. Estimates of temperature conditions represented by each Stage of melting.

Stage	Distance from western dike margin (m)	min T° C	estimate T° C	max T° C	method of T determination
1	4-6	55		700	phase relations
2	4	700		825-850	phase relations
3	2	950	830		phase relations, Fe-Ti oxide thermometry
4	1-2		1060		Fe-Ti oxide thermometry
5	0.5		>1100		proximity to dike margin

Comparison with Other Natural and Experimental Studies

Parent Rock Bulk Mineralogy and Composition

Recent crustal dehydration melting experiments can be divided into three types: those that melt an amphibole-bearing protolith, those that melt a biotite-bearing protolith, and those that melt protoliths containing both hydrous phases. Amphibolite-melting experiments have involved both mafic protoliths (olivine-normative with little to no quartz; compositions 466 and 571 of Beard and Lofgren, 1991; Rapp et al., 1991; ABA of Rushmer, 1991; Wolf and Wyllie, 1994) and intermediate amphibolites (quartz-bearing; compositions 555, 557, and 478 of Beard and Lofgren, 1991; IAT of Rushmer, 1991; SQA of Patiño Douce and Beard, 1995). Investigations of biotite dehydration have been performed on intermediate biotite tonalites (SBG of Patiño Douce and Beard, 1995; Singh and Johannes, 1996a & 1996b), a silicic biotite-bearing metagreywacke (Vielzeuf and Montel, 1994), and pelites (Le Breton and Thompson, 1988; Vielzeuf and Holloway, 1988). Only a few recent experiments have been performed at 10 kbar on protoliths with more than one hydrous phase, including investigations by Rutter and Wyllie (1988) and Skjerlie and Johnston (1996). Skjerlie and Johnston (1992 and 1993) investigated partial melting in a high-F biotite-hornblende gneiss.

Partial melting of natural rocks by basaltic dikes and/or sills has been examined in mafic to granitic protoliths. Naslund (1986) studied partial melting in ferrogabbros of the Skaergaard complex. Partially melted and disaggregated biotite-bearing granodiorite xenoliths were the subject of work by Green (1994). Partial melting in biotite-bearing granites has been examined by Kaczor et al. (1988), Kitchen (1989), and Eklund and Lindberg (1992) and, in one case, a biotite and amphibole-bearing granitic gneiss (Philpotts and Asher, 1993).

The Wallowa parent rock differs from most other experimental studies and natural examples because it contains equal proportions of two hydrous phases. Additionally, the Wallowa protolith contains 8 vol% alkali feldspar, a phase that is typically excluded from experimental studies but is abundant (up to 40 vol%) in the more granitic natural

examples. The most similar naturally melted protolith is Philpotts and Asher's (1993) granitic gneiss, although their modal proportions of phases are not given. The most similar experimental protolith is Skjerlie and Johnston's (1996) metavolcanoclastic which contains 16 vol% biotite, 15 vol% amphibole, plagioclase, and quartz. However, their protolith also contains 11 vol% epidote. From bulk compositional data, the Wallowa tonalite is intermediate between most amphibolites and biotite-bearing rocks (Table 12). Biotite-bearing rocks are typically higher in K_2O and SiO_2 than the Wallowa tonalite while amphibolites are higher in CaO, MgO, and FeO. The Wallowa tonalite contains more Al_2O_3 and less FeO than many of the other protoliths (Table 12).

Melt Composition and Texture

Melts from both amphibole- and biotite-bearing protoliths range in composition from trondhjemitic to granitic but are uniformly peraluminous, high in SiO_2 (> 60 wt%, typically 70-80 wt%), and low in FeO, MgO and TiO_2. Melts from amphibole-bearing protoliths are trondhjemitic, tonalitic, or granodioritic in normative An-Ab-Or, while melts from biotite-bearing protoliths are granodioritic to granitic (Figure 21a). With increased temperature (and thus increased degree of melting), both natural and experimental melts become slightly more mafic, more aluminous, less potassic and less silicic.

When compared to other experimental and natural melts, glasses from Stages 3 and 5 contain slightly more SiO_2 and less Al_2O_3, MgO, and FeO (Figures 21c and 21d). The concentrations of other major elements (including TiO_2) are comparable. Whereas the silicic nature of Wallowa glasses may suggest that they represent a smaller degree of partial melting, the proportion of glass in the Wallowa samples (trace to 31 vol%) is slightly lower than the volume of glass examined by Kaczor et al. (1988, 25-56%) and is within the range generated by experiments on comparable protoliths [2-50%, Beard and Lofgren (1991); 12-40%, Patiño Douce and Beard (1995); 10-26%, Singh and Johannes (1996b); 5-70%, Skjerlie and Johnston (1996); all are calculated wt%]. Additionally, the low mafic and Al_2O_3 concentration of our glasses cannot be due to differences in bulk

Table 12. Bulk compositional data for the Wallowa tonalite and other natural and experimental protoliths.

Protolith	Reference	Protolith comp.	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	Total
mafic amphibolite	Beard & Lofgren, 1991	hbl hornfels 466	49.48	1.18	17.76		12.49	0.26	4.74	10.90	1.96	0.15	0.30	99.22
		l. greenschist 571	51.39	1.55	15.82		12.23	0.26	4.42	8.95	3.30	0.37	0.30	98.59
	Rapp et al., 1991	amphibolite JOD-74	51.19	1.18	16.62		11.32	0.23	6.59	5.49	4.33	0.82		97.77
		amphibolite FSS	48.60	2.06	17.03		10.69	0.21	6.07	9.66	3.30	0.21		97.83
		amphibolite Barker's	48.30	0.72	15.30		10.70	0.19	8.40	12.60	2.27	0.08		98.56
		amphibolite WR-40	47.60	1.19	14.18		13.77	0.19	6.86	10.99	2.56	0.19		97.53
	Rushmer, 1991	meta alk basalt (ABA)	49.04	1.27	16.37	1.92	7.45	0.18	7.45	10.81	3.42	0.44	0.16	98.51
	Wolf & Wyllie, 1994	mafic amphibolite	48.40	0.40	14.60		8.40	0.20	10.70	14.30	1.00	0.10		98.10
intermed amphibolite	Beard & Lofgren, 1991	greenschist 557	57.02	0.60	15.39		8.01	0.17	5.52	9.20	2.54	0.44	0.18	99.07
		greenschist 555	55.11	1.66	14.94		11.28	0.21	4.01	6.07	4.29	0.03	0.30	97.90
		U. greenschist 478	52.47	1.74	15.29		11.79	0.22	5.29	9.21	2.55	0.16	0.29	99.01
	Rushmer, 1991	meta arc thol (IAT)	51.69	1.00	16.31	1.20	7.62	0.11	7.51	8.90	3.09	0.26	0.10	97.79
	Patino Douce & Beard, 1995	synth qz amphibolite	60.40	1.70	11.30		7.90	0.20	6.70	7.60	1.90	0.70		98.40
intermed bio-amp	Skjerlie & Johnston, 1996	GR242SF gneiss	59.03	1.12	15.12	3.70	9.17	0.16	2.48	5.31	3.28	1.64	0.20	101.21
	Wallowa tonalite	**Tonalite (Stage 1)**	**59.32**	**0.70**	**17.97**		**5.35**	**0.10**	**3.84**	**6.45**	**4.12**	**1.35**	**0.18**	**99.37**
biotite tonalite	Skjerlie & Johnston, 1992	tonalitic gneiss	68.28	0.52	14.89		4.67	0.06	1.73	2.93	4.47	2.05	0.15	99.75
	Patino Douce & Beard, 1995	synth biotite gneiss	63.60	2.50	12.30		7.60	0.10	4.60	2.10	1.90	3.60		98.30
	Singh & Johannes, 1996a&b	synth bio tonalite	66.63		15.75		4.76		2.60	4.66	2.99	2.27		99.66
biotite pelite	Vielzeuf & Holloway, 1988	pelite	64.35	0.82	18.13		6.26	0.09	2.44	1.52	1.66	2.56		97.83
biotite greywacke	Vielzeuf & Montel, 1994	metagreywacke	69.99	0.70	12.96	0.45	4.42	0.06	2.36	1.67	2.95	2.41	0.20	98.17
biotite granite	Kaczor et al., 1988	granite	71.96	0.31	14.39	2.31		0.05	0.53	1.77	3.62	4.44	0.12	99.50
	Kitchen, 1989	porphyritic granite	74.92	0.15	13.36	1.08		0.02	0.39	0.48	3.79	4.84	0.03	99.06

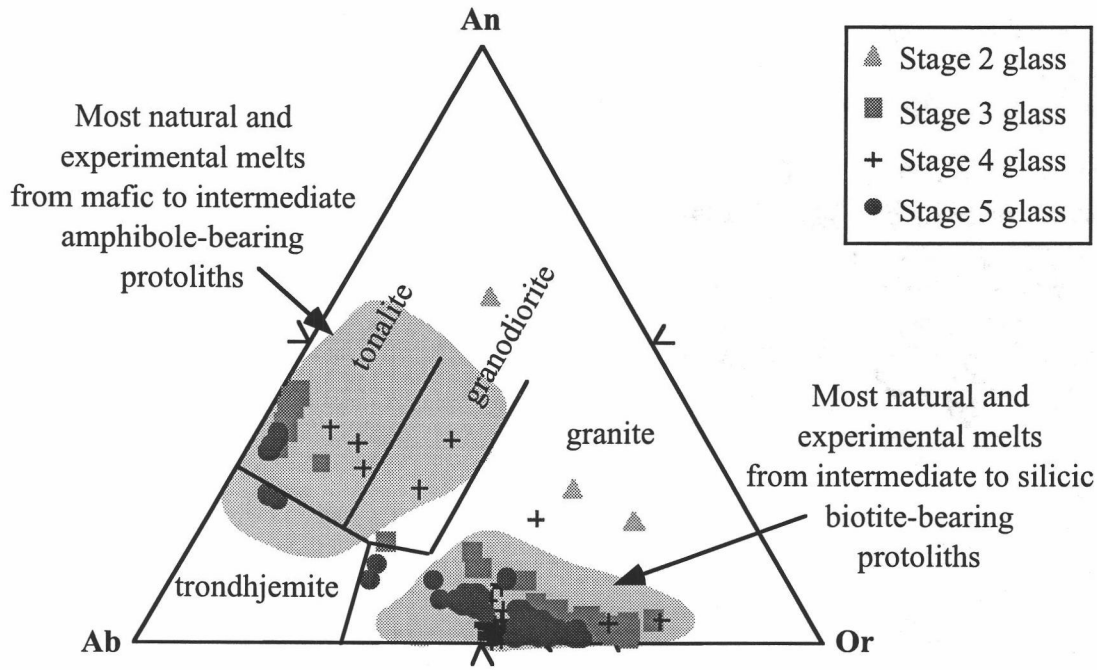

Figure 21a. Normative An-Ab-Or of glass from the Wallowas and melts from other natural examples and experimental studies.

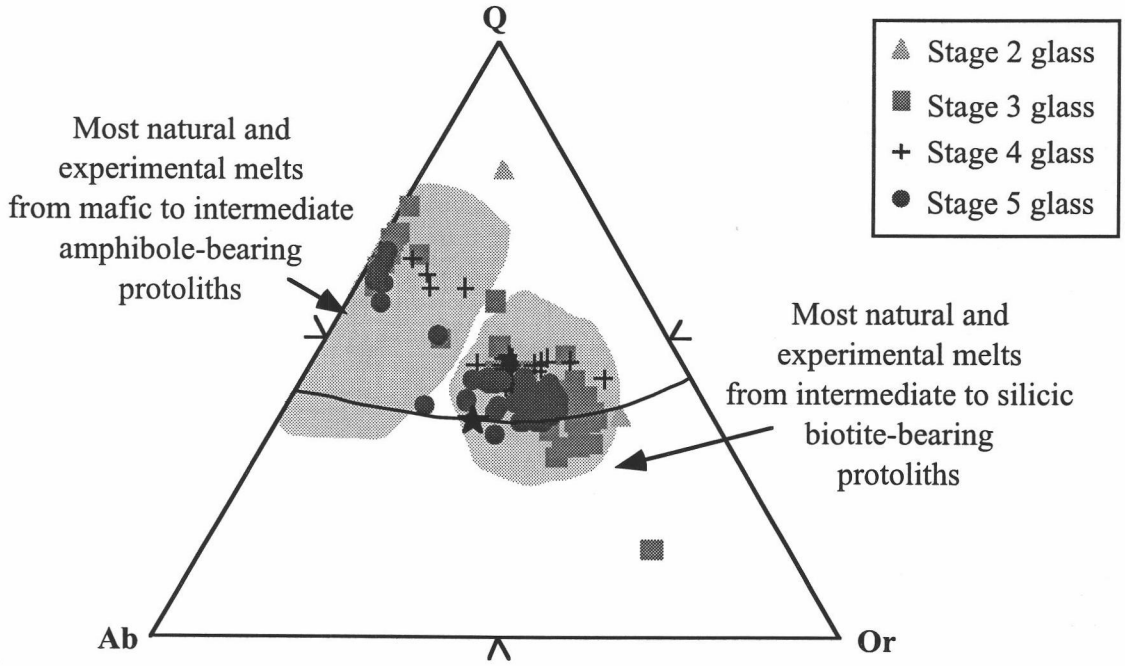

Figure 21b. Normative Q-Ab-Or of glass from the Wallowas and melts from other natural examples and experimental studies.

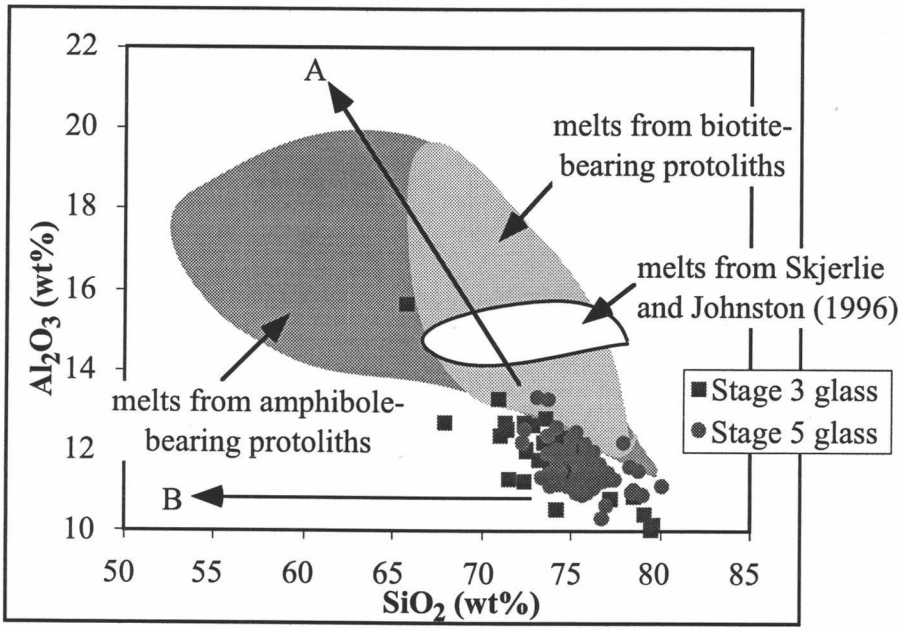

Figure 21c. Al_2O_3 vs. SiO_2 in Wallowa glasses and other natural and experimental melts. Trend line "A" indicates the direction of compositional change resulting from incorporation of plagioclase quench crystals into Stage 3 and 5 glasses. Trend line "B" indicates the compositional change that would result from incorporation of pyroxene quench crystals.

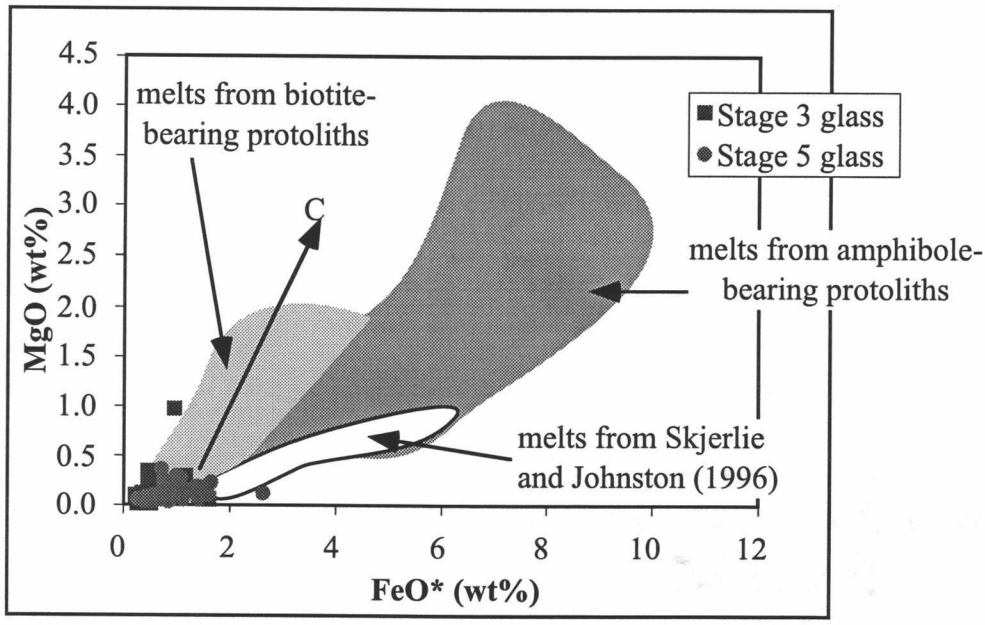

Figure 21d. MgO vs. FeO in Wallowa glasses and other natural and experimental melts. Trend line "C" indicates the direction of compositional change resulting from pyroxene quench crystal incorporation into Stage 3 and 5 glasses.

composition. When compared to other protoliths, bulk Wallowa tonalite is near the middle of the range for nearly all major oxide concentrations, except for containing higher Al_2O_3 and lower FeO (see bulk chemistry discussion and Table 12). The low abundance of Al_2O_3, MgO, and FeO in the Wallowa glasses is due to the presence of plagioclase, pyroxene, and titaniferous magnetite quench crystals that preferentially host these oxides (see melt modification discussion and Table 10). Adding the composition of the quench crystals to Stage 3 and 5 glasses creates melt compositions comparable to those observed in other natural and experimental studies (Figures 21c and 21d).

In the Wallowa samples and in other natural examples of partial melting, in-situ melt (in most cases preserved as glass) occurs as seams around crystals (Kaczor et al., 1988; Philpotts and Asher, 1993; Green, 1994). In Stages 3 and 5, glass is present on quartz-plagioclase boundaries and around decomposed hornblende and biotite sites. Similarly, glass in the 2-m-wide gneissic screens examined by Philpotts and Asher (1993) occurred as granophyre on quartz-feldspar boundaries, especially where decomposed biotite was present. In the pegmatite dike, granophyre glass seams up to 200 μm wide are present on quartz-orthoclase, quartz-oligoclase, and quartz-decomposed biotite boundaries (ibid.). Kaczor et al. (1988) observed up to 56 vol% glass distributed as an intergranular matrix, along fractures, and around inclusions within grains in naturally melted granites.

Whereas experimental studies rarely report coexisting chemically distinct glasses, the occurrence of more than one glass type is common is natural examples. Granitic and tonalitic glass coexist in the Wallowa samples; additionally, clear (granitic and tonalitic in composition) and brown (tonalitic) glass is present in Stage 4. Compositionally distinct clear and brown glass is reported by Green (1994), Kitchen (1989), and Kaczor et el. (1988). In the partially melted granite of Kaczor et al. (1988), clear glass localized around quartz is high in SiO_2, alkalis, and Rb, while high CaO, Al_2O_3, MgO, FeO, and TiO_2 brown glass is localized around oxides and spongy feldspar. Microlites and crystallites are common in both types of glass. Philpotts and Asher (1993) also report two distinct glass compositions: a high K_2O glass located between quartz and orthoclase, and a low K_2O glass between quartz and andesine.

Residual Alkali Feldspar

Most experimental studies contain little to no alkali feldspar, yet the Wallowa tonalite, granitic gneiss of Philpotts and Asher (1993), and partially melted natural granites of Kaczor et al. (1988) and Kitchen (1989) contain up to 40 vol% alkali feldspar in the protolith. In these natural examples, as in the Wallowa samples, alkali feldspar is consumed during partial melting. For example, 2-4 vol% relict microcline coexists with up to 56% quenched glass (Kaczor et al., 1988). Stage 2 orthoclase is less potassic than Stage 1 orthoclase; similarly, a low Or component in residual alkali feldspar cores was also reported by Kaczor et al. (1988).

Residual Plagioclase feldspar

Plagioclase forms part of the parent composition in all natural and experimental protoliths (ranging from An_{18-90}), and residual plagioclase is a major component of the restite under nearly all pressure-temperature conditions up to 10 kbar. The proportion of plagioclase decreases with increasing temperature, indicating that, as in the Wallowa rocks, plagioclase is consumed only at large extents of melting. Absorption textures are well-documented in naturally melted relict plagioclase. Relict Wallowa plagioclase through Stage 5 displays fritted margins and spongy textures when in contact with glass. Similar textures are observed by and Kaczor et al. (1988), Green (1994), and Philpotts and Asher (1993) where the fritted margins are attributed to melting along cleavage planes.

Wallowa plagioclase becomes more potassic with increased degree of melting, and in Stage 5 relict rims are high in An, FeO, and MgO. Vielzeuf and Montel (1994) also report an increase in the Or component of residual plagioclase. Like in Wallowa plagioclase cores, many studies (Kaczor et al., 1988; Beard and Lofgren, 1991; Philpotts and Asher, 1993; single crystal experiment, Singh and Johannes, 1996b) observed an increase in An in residual plagioclase relative to the starting plagioclase.

Amphibole Dehydration Reactions

In experimental and natural examples, amphibole is consumed during partial melting. Because amphibole breakdown takes place over about a 50°C interval, residual amphibole is commonly observed in low temperature experimental runs. In the Wallowa example, Stage 2 hornblende is heterogeneous with high FeO, CaO, A-site occupancy and lower K_2O, F, and Cl than Stage 1 hornblende. Increased compositional heterogeneity is observed in relict hornblende in synthetic amphibolite (SQA, Patiño Douce and Beard, 1995), in pargasitic hornblende in amphibolites (Beard and Lofgren, 1991), in pargasite from mafic amphibolites (Rushmer, 1991), and in ferro-pargasite from a biotite-amphibole tonalite (Skjerlie and Johnston, 1996). Increased A-site occupancy was observed in relict amphibole by Beard and Lofgren (1991). In contrast to the Wallowa residual hornblende, residual amphiboles of Beard and Lofgren (1991), Rushmer (1991), and Skjerlie and Johnston (1996) contain higher concentrations of MgO, TiO_2, and Al^{IV} than parent amphiboles. Additionally, Skjerlie and Johnston (1996) observed higher K_2O in residual amphibole while Patiño Douce and Beard (1995) observed higher F.

In the Wallowa rocks, the initial breakdown of hornblende produces clinopyroxene, orthopyroxene, Fe-Ti oxides, and glass. In experimental studies, clinopyroxene and lesser orthopyroxene were observed as amphibole reaction products under nearly all pressure-temperature conditions up to 10 kbar (Beard and Lofgren, 1991; Rapp et al., 1991; Rushmer, 1991; Patiño Douce and Beard, 1995). Beard and Lofgren (1991) observed enstatite (En_{53-65}), augite, and sparse pigeonite as amphibole reaction products, but their augite contains less than 5 wt% Al_2O_3. Wallowa augite may contain up to 12 wt% Al_2O_3. With increased degree of melting, augite and pigeonite are consumed by Stage 5 leaving enstatite as the lone mafic silicate. Most experimental studies do not exceed 1000°C so the behavior of clinopyroxene during high-temperature melting is not documented.

Biotite Dehydration Reactions

Biotite is consumed during partial melting over a slightly larger temperature range than amphibole (50-100°C). Stage 2 residual Wallowa biotite is higher in TiO_2, Na_2O, F and lower in Al_2O_3 than Stage 1 biotite. Increasing concentrations of TiO_2 with increasing temperature is observed by both Singh and Johannes (1996b) and Patiño Douce and Beard (1995); Singh and Johannes (1996b) also observed increases in Al_2O_3 and Na_2O. These authors as well as Green (1994) note increased MgO concentrations in residual biotite, but MgO is extremely heterogeneous in the Wallowa Stage 2 biotite. Residual biotite with higher F has been observed by Singh and Johannes (1996b), Patiño Douce and Beard (1995) and Skjerlie and Johnston (1992 and 1993). Increased F indicates that H_2O has been liberated into the melt through dehydration (Skjerlie and Johnston, 1992).

The breakdown of biotite in the Wallowa rocks produces orthopyroxene, plagioclase, titaniferous magnetite, lesser ilmenite, and glass. Orthopyroxene is observed as a product of biotite dehydration under nearly all experimental conditions, but clinopyroxene was only observed under restricted experimental conditions (Na-rich augite at 15 kbar and 900-1000°C by Patiño Douce and Beard, 1995; and augite to diopside at 850°C by Singh and Johannes, 1996a). Wallowa orthopyroxene composition is Ca-poor enstatite containing less than 5 wt% Al_2O_3, and En increases with increased degree of melting. In contrast to the Wallowa rocks, Patiño Douce and Beard (1995) observed Al-rich, Ca-poor hypersthene containing up to 16 wt% Al_2O_3 at low pressure. Like in the Wallowa rocks, Patiño Douce and Beard (1995) and Singh and Johannes (1996b) observed and increase in En component with increasing temperature. In naturally melted granite, Kaczor et al. (1988) observed Mg-cordierite and Fe-Ti oxides replacing biotite in their least melted sample. They attribute the presence of cordierite rather than orthopyroxene to an extremely aluminous parent biotite.

Biotite dehydration in the Wallowa tonalite produces plagioclase, however, this phase is not reported in other studies. In studies of biotite-bearing protoliths, alkali feldspar is a common reaction product of biotite oxidation and dehydration melting. Both Vielzeuf and Montel (1994) and Patiño Douce and Beard (1995) found minor alkali

feldspar as a reaction product at 7 kbar, while Singh and Johannes (1996b) found abundant orthoclase (Or_{82-98}) as a reaction product at 875°C and 2-8 kbar. Green (1994) noted Fe-Ti oxides enclosed in alkali feldspar and sparse orthopyroxene in reacted biotite sites in partially melted xenoliths. It is possible that alkali feldspar was an initial product of biotite dehydration in the Wallowa rocks but diffusively exchanged K-Si for Ca-Al with residual plagioclase or the melt (see discussion of biotite reaction).

Although minor amounts of Fe-Ti oxides are present in parent rocks (generally less than 2 wt%), oxides are commonly observed as melt reaction products. In experimental studies, the type of oxide observed depends on the composition of the starting material, the oxidation state of the parental biotite, the oxygen fugacity (fO_2) conditions under which the experiment occurred, and the type of experimental container used (Vielzeuf and Montel, 1994; Patiño Douce and Beard, 1995; Singh and Johannes, 1996b). Both titaniferous magnetite and lesser ilmenite replace biotite in the Wallowa rocks, with TiO_2, MgO and Al_2O_3 concentrations increasing with increased degree of melting. Experiments on biotite-bearing protoliths have produced ilmenite coexisting with minor Al-rich magnetite (Patiño Douce and Beard, 1995), magnetite (Skjerlie and Johnston, 1992; Vielzeuf and Montel, 1994), and ilmenite (Singh and Johannes, 1996b). In their studies of natural partial melts, Kaczor et al. (1988) found magnetite and minor ilmenite replacing biotite, while Philpotts and Asher (1993) observed magnetite rimmed by hercynite in biotite sites. Green (1994) observed euhedral ilmenite and titaniferous magnetite aligned along cleavage planes in reacted biotite.

Implications

Implications for Crustal Melting and Production of Granitoid Magmas

Although the origin of granitoid magmas has been debated since the 1930's, petrologists have reached a general consensus on several main points: most (if not all) granites and granitoids are partial melts of crustal lithologies, most crustal rocks contain little to no pore water so crustal melting takes place under (nearly) fluid-absent conditions, basaltic underplating (predominantly as sills) plays an important role and may be essential in the initiation of crustal melting (Huppert and Sparks, 1988), and intermediate biotite- and hornblende-bearing protoliths can be extremely fertile granitoid source rocks (Clemens and Vielzeuf, 1987). The Wallowa batholith is an excellent location in which to test ideas about crustal melting because the above criteria are met. The protolith is of intermediate composition with multiple hydrous phases, there is abundant evidence for fluid-absent melting, and there is obvious basaltic input.

Partial melting of the Wallowa tonalite produces two compositionally distinct melts. When compared to "average" tonalites and granites (Table 13), the calculated and mixed melts from Stage 5 appear somewhat compositionally similar. The Stage 5 calculated tonalitic melt (tonalitic glass plus quench crystals, see Table 10) is higher in SiO_2 and lower in Al_2O_3 and CaO than the representative tonalite, but has similar concentrations of other oxides. However, the amount of tonalitic melt generated is small (limited by the amount of amphibole in the starting mode) and probably could not be extracted without mixing with the granitic melt. Stage 5 calculated granitic melt (granitic glass plus quench crystals, see Table 10) is metaluminous with major oxide concentrations somewhat similar to average metaluminous granite, except that the Stage 5 granitic melt is slightly more mafic (Table 13). The low-magnetite calculated mixture of granitic and tonalitic melts has a composition that is somewhat similar to that of an average metaluminous granite (Table 13). However, the Stage 5 mixed melt is slightly more calcic and mafic than a true granite, and if crystallized as a batholith would likely be classified as a granodiorite.

Table 13. Compositions of Stage 5 granitic and tonalitic melts compared to "average" granites and tonalites.

Oxide (wt%)	Stage 5 Tonalitic melt[1]	Peninsular Range Tonalite[2]	Stage 5 Granitic melt[3]	Stage 5 Low-mag melt[4]	Peraluminous Biotite Granite[5]	Sierra Nevada Granite[6]
SiO_2	70.6	62.5	67.8	70.4	77.0	71.7
TiO_2	0.8	1.0	1.1	0.7	0.2	0.2
Al_2O_3	12.5	17.1	12.3	13.0	11.8	14.9
FeO*	4.7	4.5	5.8	2.5	1.4	1.5
MgO	1.8	1.8	1.6	1.8	0.0	0.4
CaO	4.5	5.5	2.5	2.9	0.6	1.9
Na_2O	3.3	3.9	2.8	2.9	3.1	4.0
K_2O	0.3	1.7	4.0	4.0	5.0	4.2

[1]calculated melt, see Table 10.
[2]from Hill, 1984
[3]calculated melt, see Table 10.
[4]calculated low-magnetite melt, see Table 10.
[5]from Collins et al., 1982
[6]from Bateman and Chappell, 1979

Forming a granitoid batholith requires extraction of that magma from the source region. The critical melt fraction, or amount of melt required to destabilize the restite crystal matrix enough to allow melt flow, is commonly regarded as 30-50% (Huppert and Sparks, 1988). In Stage 5, partial melting of the tonalite produces just over 31 vol% glass, just within the range of values commonly given for the critical melt fraction. Yet there is no evidence of flow in Stage 5. The southern end of the Maxwell Lake dike outcrop, however, is slightly brecciated and cut by white and blue-gray veins, suggesting textural evidence of flow. Additionally, flow may explain the greater degree of homogenization in Stage 4 glasses (Figures 18a and 18b). The wider range of glasses in Stage 4 could result from mechanical mixing of the granitic and tonalitic melts. Dynamic force, whether fracturing or ductile shearing, is required to both extract melt and homogenize melts of different compositions.

Heat input from dikes may be an effective means of generating large volumes of partial melt, especially in the shallow crust. At low pressure, source rocks produce more melt from a given reaction as the reaction takes place at lower temperature (Clemens and Vielzeuf, 1987). However, shallow melts are easily quenched when the heat source is

removed, as we have observed in the Wallowas. While dikes clearly can generate large volumes of partial melt in the shallow crust, this melt may not be extractable. Deeper in the crust, dikes are likely less effective at generating partial melt than are sills. Experiments (Huppert and Sparks, 1988) and thermal modeling (Bergantz, 1989) have shown that basaltic sills can generate large volumes of melt in overlying crust. Additionally, Eklund and Lindberg (1992) observed larger volumes of melt at the margin of sills in southwestern Finland than at the margins of dikes.

Implications for Contamination and Emplacement Rates of the CRB

While this study is limited to the melt-forming reactions in the tonalite wallrock, a logical outgrowth of this work could examine to what extent wallrock melt contaminates the CRB dike. Although no interaction between the dike and wallrock melts occurs in the samples we have examined, there is field evidence at this and many other locations in the Wallowas that interaction takes place at the margins of many dikes. This interaction takes one or more of the following forms: a static zone of diffusive exchange between dike and wallrock, entrained wallrock xenoliths within the dike, or eroded partially melted margins. A thin (< 10 cm) gray to white aphanitic zone occurs along many CRB dike margins and may be similar to the hybrid zone described by Blichert-Tort et al. (1992) that is the result of diffusive exchange between wallrock melt and dike magma. Other CRB dikes have small shear zones of tonalitic melt at their margins that entrain reacted mafic grains. Field evidence of basalt-wallrock melt interaction was documented by both Green (1994) and Philpotts and Asher (1993) who observed felsic wisps of wallrock melt (Philpotts and Asher, 1993) or brownish xenolith melt (Green, 1994) extending into a dike.

In recent years, emplacement rates of CRB Group flows has been a subject of much controversy (c.f., Martin, 1999; Reidel, 1998; Thordarson and Self, 1998; Ho and Cashman, 1997). Martin (1999) and Reidel (1998) suggest rapid emplacement rates of days to months based on geochemical evidence, flow characteristics, and textural features of the Ginkgo basalt and several Saddle Mountain Basalt members. Alternately, from a

study of intraflow structures in the Roza flow, Thordarson and Self (1998) suggest emplacement rates of greater than 14 years. Because we have related the process of partial melting to distances from the Maxwell Lake dike, a thermal model of partial melting could be developed. A model of conductive heat transfer could predict the amount of time needed to heat wallrock to the observed reaction temperatures. This model could predict the amount of time the dike was actively feeding CRB flows and hence the rate of flow emplacement.

Summary and Conclusions

Partially melted tonalite at the margins of a CRB Group dike in the Wallowa Mountains provides a unique opportunity to examine the progress of partial melting. Samples collected from the western margin of the Maxwell Lake dike represent progressive stages of partial melting over a distance of about 5 m from unmelted tonalite (Stage 1) to about 40% quenched melt (Stage 5). The original melt composition was modified during quenching by the formation of quench crystals so that the original melt is now represented by glass plus quench crystals. Concentrations of most major and trace elements analyzed in bulk rock from each Stage fall within 10-15% of the unmelted sample, indicating that there was minimal chemical interaction between the dike and wallrock. Major and trace element concentrations in Stages 2 and 4 are commonly depleted relative to Stage 1, which is likely related to the cataclastic overprint of these samples. Overall, however, the process of partial melting from Stage 1 to Stage 3 to Stage 5 can be considered essentially a chemically closed system.

Paleodepth at the time of dike emplacement was 1 to 2 km, and the dike liquidus temperature was about 1140°C. The dike dips steeply to the west and extends for at least a km along strike. The dike is divided into three zones (mafics-out zone, mottled zone, and mush zone) based on field characteristics. Individual zones are 10 cm to 2 m wide with gradational transitions from one zone to the next. Partial melt zones parallel the dike along strike, vary in thickness with dike thickness, and are wider along the western margin (hanging wall) than the eastern margin. A cataclastic zone cut by veins at the southern end of the outcrop provides field evidence that melts in this area have flowed.

Unmelted (Stage 1) tonalite is composed of 42.9 vol% plagioclase (An_{32-50}), 19.3 vol% quartz, 8.0 vol% orthoclase (Or_{94-97}), 14.7 vol% hornblende (Mg#63-74), 14.0 vol% biotite (Mg#58-60), 1 vol% magnetite (X_{mag}0.98-1.00), and trace fluorapatite, titanite, and zircon. From Stage 1 to Stage 2, biotite, hornblende, orthoclase, and plagioclase are incipiently reacted but modal proportions of these phases remains more or less unchanged. This sample has a cataclastic texture as expressed in extensively fractured quartz and plagioclase. Stage 2 orthoclase is less potassic than Stage 1

orthoclase, but Stage 2 plagioclase is slightly more potassic than Stage 1 plagioclase. Hornblende is dusted with sub-microscopic reaction products and has become compositionally heterogeneous with depletions in K_2O, Cl, and F. Fe-Ti oxides occupy cleavages and rims of biotite, which is depleted in K_2O and Cl but enriched in TiO_2 and F relative to Stage 1 biotite. Reaction of biotite has produced at least one thin (<50 μm wide) glass seam on a biotite-quartz contact. The initial wallrock temperature was probably about 55°C at 4-6 m from the dike margin (location of Stage 1 sample), but temperatures at 4 m from the dike margin were in excess of 700°C.

Between Stages 2 and 3, widespread dehydration of biotite and hornblende has produced 12-16 vol% glass around reacted mafic sites and as < 1 mm seams on feldspar-quartz contacts. Modal proportions of orthoclase and quartz have decreased significantly, and the spongy texture of plagioclase indicates that a minor amount of this phase has also been consumed. Spongy-textured plagioclase may contain up to 4 vol% glass, and plagioclase composition is more calcic than in Stage 1 indicating that Ab is lost to the melt. Hornblende is replaced by dusty, Al_2O_3- and Na_2O-rich augite and pigeonite, lesser enstatite, and glass, while biotite is replaced by aligned Fe-Ti oxides in an intergrown matrix of enstatite, plagioclase, and glass. The biotite breakdown reaction initially produced alkali feldspar which was modified by diffusive exchange with the melt or residual plagioclase. The initial melt-forming reactions are:

hornblende + quartz + orthoclase = orthopyroxene + clinopyroxene + minor Fe-Ti oxides + tonalitic glass + quench crystals

biotite + quartz + orthoclase = orthopyroxene + plagioclase + titaniferous magnetite + ilmenite + granitic glass + quench crystals

andesine plagioclase = labradorite plagioclase + melt trapped in spongy plagioclase

Abundant granitic glass is higher in K_2O, Al_2O_3, MgO, FeO, and TiO_2 than the less abundant tonalitic glass, which is higher in CaO and SiO_2. The two glass types are irregularly distributed in mafic reaction sites and in seams on quartz-feldspar contacts.

Partial melting at Stage 3, about 2 m from the dike margin, occurred at a minimum temperature of 950°C.

The interval from Stage 3 to Stage 4 is characterized by the complete reaction of orthoclase and the creation of an additional 6-7 vol% glass. The abundance of augite in hornblende reaction sites has decreased and enstatite is enriched in MgO. Concentrations of TiO_2, Al_2O_3, and MgO in Fe-Ti oxides replacing biotite have also increased. While both granitic and tonalitic glass is preserved in Stage 4, this sample also contains glasses which may be hybrids of these endmembers. The heterogeneity of Stage 4 glasses may be due to mechanical mixing from entrainment in veins. This is the only sample with textural and chemical evidence of flow in the wallrock melts. Fe-Ti oxide thermometry suggests temperatures of about 1060°C at about 1 m from the dike margin.

By Stage 5, a total of about 31 vol% glass was produced by the reaction of clinopyroxene and consumption of plagioclase. Stage 5 plagioclase is slightly higher in K_2O than Stage 1 plagioclase and has well-developed spongy texture and high An, FeO, and MgO rims when in contact with glass. As much as 7 vol% glass may be trapped in spongy feldspar. Optically aligned, homogeneous enstatite is the lone pyroxene in hornblende reaction sites. Biotite sites remain occupied by aligned titaniferous magnetite and lesser ilmenite in a slightly coarser matrix of plagioclase and enstatite. Tonalitic glass becomes less abundant relative to Stage 3 and Na_2O, MgO, FeO, and TiO_2 concentration increases. Granitic glass becomes more abundant and Na_2O, MgO, FeO, TiO_2 concentrations increase while K_2O concentration decreases slightly. Although the amount of Stage 5 glass is within the critical melt fraction, there is no evidence of flow. At Stage 5, partial melting conditions were likely in excess of 1100°C at about 0.5 m from the dike margin based on the inferred temperature of the dike.

The compositions of melts and restites are comparable to those generated by experimental dehydration melting and those observed in natural settings. Wallowa glasses are depleted in Al_2O_3, MgO, and FeO compared to other glasses. The difference in composition is due to abundant quench crystals in the Wallowa glasses that host these oxides. Stage 5 granitic and tonalitic calculated melts are somewhat similar to natural granites and tonalites, but a calculated mixture of granitic glass, tonalitic glass, and quench crystals in Stage 5 has a granodioritic composition. Glass is largely in-situ except

at the southern end of the outcrop where veins show evidence of flow. While dikes may generate large volumes of granitic melt in the upper crust, the rapid quenching that occurs after dike flow ceases makes it unlikely that such melt could be extracted to form plutonic bodies. However, it is clear that intermediate composition, biotite- and hornblende-bearing tonalite is a fertile source for granitoid melts in the shallow crust and that sustained mafic input (likely as sills) could generate large plutonic bodies.

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APPENDICES

Appendix A. List of Standards Used in Microprobe Analyses.

Abbreviation	Standard Name	Number	Calibrated Elements						
			amphibole	pyroxene	biotite	feldspar	glass	apatite	Fe-Ti oxides
kaug/kaugbas	Kakanui Augite	USNM 122142	Si, Fe, Mg, Ca	Si, Fe, Mg, Ca	Fe, Ca	Mg, Fe	Mg	Mg	
kano	Kakanui Anorthoclase	USNM 133868	Na	Na	Na	Si, Na	Na	Na	
basl	Makaopuhi Basaltic Glass	USNM 113498/1	Ti	Ti	Ti		Ti, Fe, Ca		
labr	Lake County Labradorite	USNM 115900	Al	Al	Al	Al, Ca			
flap	Fluoroapatite	USNM 104021					P	Ca, P, F	
rhyo	Yellowstone Rhyolitic Glass	USNM 72854					Si, Al		
crom	Chromite	USNM 117075	Cr	Cr					Mg, Cr
magt	Minas Gerais Magnetite	USNM 114887							Fe
gahn	Gahnite	USNM 145883							Zn
coru	Synthetic 4 Corundum	USNM 6575							Al
pymn	Pyroxmangite #245	32.06 wt% Mn	Mn	Mn	Mn		Mn		Mn
sani	Sanidine	10 wt% K	K			K, Ba	K		
flog	Synthetic Fluorophlogopite	9 wt% F, 9 wt% K	F		Si, Mg, K, F		F		
tugt	Tugtapite	7 wt% Cl	Cl		Cl		Cl	Cl	
ruti	Rutile	59 wt% Ti							Ti
chal	Chalcopyrite	34.94 wt% S					S		
anhy	Anhydrite	23.55% S, 29.38%Ca						S	
sron	Strontianite NMNH R10065	57.23 wt% Sr						Sr	
hfrest								Ce	
qtz	Quartz	46.74 wt% Si							Si
v									V

Appendix B. Analytical Precision and Limits of Detection for Microprobe Analyses.

Analytical precision[1]	Wt% oxides																Wt% elements		
	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	V_2O_3	FeO*	MnO	MgO	ZnO	CaO	SrO	BaO	CeO	Na_2O	K_2O	P_2O_5	S	F	Cl
amphibole	0.13	0.02	0.05	0.01		0.09	0.03	0.08		0.06				0.03	0.01			0.02	0.01
biotite	0.12	0.03	0.07			0.09	0.03	0.07		0.01				0.02	0.05			0.02	0.01
plagioclase feldspar	0.14		0.09			0.03		0.01		0.05		0.01		0.06	0.02				
alkali feldspar	0.14		0.07			0.02		0.01		0.01		0.02		0.03	0.07				
clinopyroxene	0.09	0.02	0.02	0.01		0.08	0.03	0.08		0.07				0.02					
orthopyroxene	0.10	0.02	0.02	0.01		0.10	0.03	0.10		0.03				0.02					
magnetite	0.01	0.07	0.02	0.02	0.01	0.22	0.02	0.02	0.03										
ilmenite	0.01	0.21	0.02	0.01	0.01	0.15	0.03	0.03	0.02										
fluorapatite								0.02		0.13	0.01		0.02	0.01		0.26	0.01	0.03	0.01
glass	0.11	0.02	0.04			0.04	0.02	0.01		0.02				0.04	0.03	0.03	0.01	0.02	0.01
Limit of detection[2]																			
amphibole	0.12	0.07	0.09	0.06		0.12	0.14	0.09		0.07				0.09	0.05			0.11	0.04
biotite	0.12	0.07	0.12			0.12	0.14	0.09		0.06				0.09	0.06			0.11	0.04
plagioclase feldspar	0.12		0.12			0.14		0.05		0.07		0.09		0.11	0.05				
alkali feldspar	0.12		0.12			0.11		0.04		0.05		0.10		0.10	0.05				
clinopyroxene	0.09	0.07	0.06	0.05		0.12	0.14	0.10		0.08				0.09					
orthopyroxene	0.09	0.07	0.06	0.05		0.12	0.14	0.11		0.06				0.08					
magnetite	0.08	0.13	0.08	0.07	0.05	0.19	0.12	0.07	0.19										
ilmenite	0.07	0.20	0.06	0.04	0.01	0.16	0.12	0.07	0.10										
fluorapatite								0.08		0.10	0.06		0.09	0.07		0.19	0.04	0.14	0.04
glass	0.09	0.10	0.06			0.15	0.09	0.05		0.07				0.09	0.04	0.15	0.02	0.11	0.02

[1]Analytical precision calculated from microprobe counting statistics.

[2]Six sigma limit of determination.

Appendix C. Amphibole Compositional Data.

Label	Code	Wt% oxides							
		SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO*	Fe_2O_3(c)	FeO (c)	MnO
STAGE 1 amphibole									
GAL94-1A.1_1	C	49.56	0.99	6.01	0.04	12.67	8.44	4.97	0.42
GAL94-1A.1_2		49.77	0.92	6.00	0.05	12.80	7.99	5.51	0.45
GAL94-1A.1_3	R	49.97	0.55	6.28	0.02	12.46	6.88	6.17	0.40
GAL94-1A.2_1	C	50.76	0.51	5.45	0.06	12.29	6.59	6.25	0.36
GAL94-1A.2_2		49.93	1.00	5.91	0.01	12.89	8.67	4.98	0.48
GAL94-1A.2_3	R	49.04	1.00	6.38	0.02	12.85	7.09	6.37	0.44
GAL94-1A.3_1	C	50.48	0.85	5.84	0.01	12.02	9.32	3.54	0.48
GAL94-1A.3_2		50.03	0.90	6.72	0.01	12.52	8.14	5.09	0.49
GAL94-1A.3_4	R	50.56	0.95	5.85	0.05	12.39	8.90	4.28	0.56
GAL94-1A.4_1	C	49.67	0.73	5.91	0.00	12.62	5.84	7.26	0.47
GAL94-1A.4_2		49.53	0.97	5.97	0.00	12.48	8.10	5.09	0.43
GAL94-1A.4_3		48.07	1.11	6.87	0.06	13.37	8.34	5.75	0.43
GAL94-1A.4_4[1]	R	49.28	0.80	6.37	0.00	13.52	7.25	6.88	0.45
GAL94-1A.5_1	C	50.03	1.09	6.19	0.05	12.47	8.06	5.12	0.53
GAL94-1A.5_2		49.90	0.90	6.17	0.03	12.90	6.36	7.08	0.37
GAL94-1A.5_3	R	49.14	0.93	6.16	0.03	13.02	6.19	7.34	0.41
GAL94-1A.6_1	C	49.76	0.88	6.04	0.05	12.86	8.31	5.28	0.46
GAL94-1A.6_2		49.66	0.91	6.15	0.03	12.81	7.03	6.38	0.42
GAL94-1A.A.1_1	C	49.71	0.85	5.94	0.01	12.22	7.26	5.58	0.46
GAL94-1A.A.1_2		49.90	0.86	6.07	0.03	12.08	7.69	5.05	0.45
GAL94-1A.A.1_4	R	50.18	0.82	5.65	0.00	12.39	7.35	5.67	0.48
GAL94-1A.C.1_1	C	51.50	0.48	4.99	0.02	11.79	7.27	5.15	0.45
GAL94-1A.C.1_2		50.89	0.55	5.59	0.02	12.35	7.04	5.91	0.38
GAL94-1A.C.1_3		50.53	0.52	5.50	0.00	12.43	6.62	6.37	0.44
GAL94-1A.C.1_4	R	50.64	0.72	5.73	0.01	12.99	5.91	7.56	0.38
GAL94-1A.E.1_1	C	52.11	0.53	4.30	0.02	11.25	8.28	3.71	0.47
GAL94-1A.E.1_2		49.86	0.80	5.64	0.03	12.68	9.69	3.85	0.65
GAL94-1A.F.1_1	C	49.11	1.25	6.45	0.05	12.81	6.07	7.24	0.40
GAL94-1A.F.1_2		49.40	0.91	6.25	0.02	12.36	6.86	6.08	0.46
GAL94-1A.F.1_3		49.23	1.26	6.30	0.01	12.43	7.09	5.95	0.50
GAL94-1A.F.1_4	R	49.37	1.09	6.12	0.02	12.56	7.03	6.12	0.43
GAL94-1A.G.1_1	C	48.58	1.46	6.35	0.02	12.58	7.89	5.38	0.43
GAL94-1A.G.1_4	R	50.70	0.45	5.15	0.06	12.01	5.88	6.62	0.40
GAL94-1A.A.A.1_4	R	48.96	0.85	5.93	0.00	11.63	7.02	5.31	0.49
GAL94-1A.A.B.1_1	C	48.09	1.08	6.26	0.01	12.29	9.15	4.05	0.52
GAL94-1A.A.B.1_2		48.31	0.91	6.20	0.00	11.99	7.36	5.36	0.47
GAL94-1A.A.B.1_3		48.41	0.82	6.07	0.02	12.11	7.11	5.71	0.46
GAL94-1A.A.B.1_4	R	50.69	0.30	4.59	0.03	11.65	6.31	5.97	0.30
GAL94-1A.A.G.2		48.50	1.09	6.11	0.02	11.76	7.07	5.40	0.51
GAL94-1A.A.G.4	R	48.80	0.89	5.92	0.03	12.24	7.01	5.94	0.51
GAL94-1A.A.H.1_1	C	48.50	1.02	6.24	0.00	12.00	6.43	6.21	0.40
GAL94-1A.A.H.1_3		48.32	1.02	6.18	0.04	12.20	7.93	5.06	0.48
GAL94-1A.A.H.1_4	R	50.06	0.61	5.36	0.05	11.67	7.02	5.36	0.41

Label	MgO	CaO	Na_2O	K_2O	H_2O (c)	F	Cl	Total	O=F
STAGE 1 amphibole									
GAL94-1A.1_1	15.33	11.26	0.78	0.39	1.95	0.27	0.09	100.36	0.11
GAL94-1A.1_2	15.21	11.27	0.83	0.45	1.95	0.28	0.09	100.62	0.12
GAL94-1A.1_3	15.11	11.72	0.63	0.26	2.03	0.13	0.04	100.12	0.06
GAL94-1A.2_1	15.62	11.79	0.68	0.23	2.02	0.17	0.03	100.46	0.07
GAL94-1A.2_2	15.37	11.34	0.72	0.35	2.01	0.16	0.10	100.94	0.07
GAL94-1A.2_3	14.68	11.39	0.75	0.40	1.98	0.18	0.08	99.71	0.07
GAL94-1A.3_1	16.11	11.19	0.80	0.37	2.02	0.19	0.07	101.18	0.08
GAL94-1A.3_2	15.20	11.32	0.78	0.34	2.02	0.17	0.08	101.20	0.07
GAL94-1A.3_4	15.71	11.13	0.85	0.36	2.02	0.18	0.10	101.40	0.08
GAL94-1A.4_1	14.73	11.63	0.71	0.29	1.99	0.15	0.05	99.36	0.06
GAL94-1A.4_2	15.24	11.20	0.75	0.37	2.00	0.15	0.09	99.79	0.06
GAL94-1A.4_3	14.48	11.28	0.85	0.43	1.98	0.16	0.08	99.80	0.07
GAL94-1A.4_4[1]	14.55	11.67	0.69	0.34	2.00	0.18	0.04	100.43	0.07
GAL94-1A.5_1	15.20	11.14	0.78	0.39	2.00	0.19	0.08	100.76	0.08
GAL94-1A.5_2	14.95	11.80	0.67	0.35	2.00	0.17	0.07	100.74	0.07
GAL94-1A.5_3	14.48	11.50	0.75	0.39	1.95	0.23	0.06	99.46	0.10
GAL94-1A.6_1	15.28	11.28	0.87	0.42	1.99	0.20	0.09	100.80	0.08
GAL94-1A.6_2	14.99	11.41	0.82	0.49	1.98	0.19	0.10	100.46	0.08
GAL94-1A.A.1_1	15.35	11.34	0.84	0.43	1.98	0.18	0.09	99.94	0.08
GAL94-1A.A.1_2	15.64	11.45	0.82	0.37	1.99	0.23	0.05	100.49	0.09
GAL94-1A.A.1_4	15.53	11.55	0.73	0.38	1.77	0.66	0.08	100.55	0.28
GAL94-1A.C.1_1	16.18	11.69	0.62	0.20	1.81	0.64	0.04	100.76	0.27
GAL94-1A.C.1_2	15.64	11.73	0.65	0.22	1.80	0.65	0.05	100.84	0.27
GAL94-1A.C.1_3	15.45	11.80	0.65	0.26	1.77	0.67	0.05	100.34	0.28
GAL94-1A.C.1_4	14.93	11.87	0.60	0.22	2.02	0.16	0.04	100.71	0.07
GAL94-1A.E.1_1	16.87	11.50	0.54	0.19	2.05	0.16	0.04	100.69	0.07
GAL94-1A.E.1_2	15.37	10.89	0.79	0.32	1.96	0.24	0.10	100.06	0.10
GAL94-1A.F.1_1	14.63	11.55	0.80	0.45	1.99	0.15	0.10	100.15	0.06
GAL94-1A.F.1_2	15.19	11.60	0.85	0.31	2.00	0.16	0.07	100.07	0.07
GAL94-1A.F.1_3	15.09	11.49	0.78	0.39	2.01	0.14	0.08	100.25	0.06
GAL94-1A.F.1_4	14.97	11.43	0.72	0.35	2.02	0.11	0.07	99.80	0.05
GAL94-1A.G.1_1	15.15	11.18	0.97	0.53	2.00	0.13	0.11	100.10	0.06
GAL94-1A.G.1_4	15.61	11.98	0.53	0.19	1.99	0.19	0.04	99.70	0.08
GAL94-1A.A.A.1_4	15.32	11.32	0.82	0.36	1.95	0.19	0.08	98.51	0.08
GAL94-1A.A.B.1_1	15.01	10.91	0.82	0.34	1.94	0.21	0.08	98.37	0.09
GAL94-1A.A.B.1_2	14.98	11.30	0.78	0.36	1.95	0.19	0.07	98.14	0.08
GAL94-1A.A.B.1_3	14.88	11.28	0.80	0.36	1.94	0.21	0.05	98.02	0.09
GAL94-1A.A.B.1_4	15.89	11.81	0.53	0.12	1.99	0.18	0.02	98.67	0.08
GAL94-1A.A.G.2	15.12	11.17	0.92	0.42	1.93	0.23	0.09	98.48	0.10
GAL94-1A.A.G.4	14.86	11.29	0.76	0.39	1.96	0.17	0.07	98.49	0.07
GAL94-1A.A.H.1_1	14.78	11.37	0.69	0.43	1.95	0.18	0.08	98.19	0.08
GAL94-1A.A.H.1_3	15.00	11.15	0.84	0.40	1.96	0.16	0.08	98.55	0.07
GAL94-1A.A.H.1_4	15.58	11.37	0.72	0.27	1.96	0.21	0.06	98.93	0.09

Label	O=Cl	Cations							
		Si	Ti	Al/Al IV	Al VI	Cr	Fe^{3+}	Fe^{2+}	Mn
STAGE 1 amphibole									
GAL94-1A.1_1	0.02	7.07	0.11	0.93	0.08	0.00	0.91	0.59	0.05
GAL94-1A.1_2	0.02	7.09	0.10	0.91	0.10	0.01	0.86	0.66	0.06
GAL94-1A.1_3	0.01	7.14	0.06	0.86	0.20	0.00	0.74	0.74	0.05
GAL94-1A.2_1	0.01	7.22	0.06	0.78	0.13	0.01	0.71	0.74	0.04
GAL94-1A.2_2	0.02	7.08	0.11	0.92	0.07	0.00	0.93	0.59	0.06
GAL94-1A.2_3	0.02	7.07	0.11	0.94	0.15	0.00	0.77	0.77	0.05
GAL94-1A.3_1	0.01	7.10	0.09	0.90	0.07	0.00	0.99	0.42	0.06
GAL94-1A.3_2	0.02	7.06	0.10	0.94	0.18	0.00	0.87	0.60	0.06
GAL94-1A.3_4	0.02	7.12	0.10	0.89	0.09	0.01	0.94	0.50	0.07
GAL94-1A.4_1	0.01	7.18	0.08	0.83	0.18	0.00	0.63	0.88	0.06
GAL94-1A.4_2	0.02	7.10	0.10	0.90	0.11	0.00	0.87	0.61	0.05
GAL94-1A.4_3	0.02	6.94	0.12	1.06	0.11	0.01	0.91	0.69	0.05
GAL94-1A.4_4'	0.01	7.06	0.09	0.94	0.14	0.00	0.78	0.83	0.06
GAL94-1A.5_1	0.02	7.10	0.12	0.90	0.13	0.01	0.86	0.61	0.06
GAL94-1A.5_2	0.02	7.12	0.10	0.89	0.15	0.00	0.68	0.84	0.05
GAL94-1A.5_3	0.01	7.11	0.10	0.89	0.16	0.00	0.67	0.89	0.05
GAL94-1A.6_1	0.02	7.08	0.09	0.92	0.09	0.01	0.89	0.63	0.06
GAL94-1A.6_2	0.02	7.10	0.10	0.90	0.14	0.00	0.76	0.76	0.05
GAL94-1A.A.1_1	0.02	7.12	0.09	0.88	0.12	0.00	0.78	0.67	0.06
GAL94-1A.A.1_2	0.01	7.10	0.09	0.91	0.11	0.00	0.82	0.60	0.05
GAL94-1A.A.1_4	0.02	7.15	0.09	0.85	0.10	0.00	0.79	0.68	0.06
GAL94-1A.C.1_1	0.01	7.27	0.05	0.73	0.10	0.00	0.77	0.61	0.05
GAL94-1A.C.1_2	0.01	7.21	0.06	0.79	0.14	0.00	0.75	0.70	0.05
GAL94-1A.C.1_3	0.01	7.21	0.06	0.79	0.13	0.00	0.71	0.76	0.05
GAL94-1A.C.1_4	0.01	7.21	0.08	0.79	0.17	0.00	0.63	0.90	0.05
GAL94-1A.E.1_1	0.01	7.33	0.06	0.67	0.04	0.00	0.88	0.44	0.06
GAL94-1A.E.1_2	0.02	7.12	0.09	0.89	0.06	0.00	1.04	0.46	0.08
GAL94-1A.F.1_1	0.02	7.06	0.14	0.94	0.15	0.01	0.66	0.87	0.05
GAL94-1A.F.1_2	0.02	7.08	0.10	0.92	0.13	0.00	0.74	0.73	0.06
GAL94-1A.F.1_3	0.02	7.05	0.14	0.96	0.11	0.00	0.76	0.71	0.06
GAL94-1A.F.1_4	0.01	7.09	0.12	0.91	0.13	0.00	0.76	0.74	0.05
GAL94-1A.G.1_1	0.02	6.97	0.16	1.03	0.05	0.00	0.85	0.65	0.05
GAL94-1A.G.1_4	0.01	7.27	0.05	0.73	0.14	0.01	0.63	0.79	0.05
GAL94-1A.A.A.1_4	0.02	7.11	0.09	0.89	0.12	0.00	0.77	0.64	0.06
GAL94-1A.A.B.1_1	0.02	7.00	0.12	1.01	0.07	0.00	1.00	0.49	0.06
GAL94-1A.A.B.1_2	0.02	7.05	0.10	0.95	0.12	0.00	0.81	0.66	0.06
GAL94-1A.A.B.1_3	0.01	7.08	0.09	0.92	0.13	0.00	0.78	0.70	0.06
GAL94-1A.A.B.1_4	0.00	7.32	0.03	0.68	0.10	0.00	0.69	0.72	0.04
GAL94-1A.A.G.2	0.02	7.06	0.12	0.94	0.11	0.00	0.77	0.66	0.06
GAL94-1A.A.G.4	0.02	7.11	0.10	0.89	0.12	0.00	0.77	0.72	0.06
GAL94-1A.A.H.1_1	0.02	7.08	0.11	0.92	0.16	0.00	0.71	0.76	0.05
GAL94-1A.A.H.1_3	0.02	7.03	0.11	0.97	0.09	0.01	0.87	0.62	0.06
GAL94-1A.A.H.1_4	0.01	7.21	0.07	0.79	0.13	0.01	0.76	0.65	0.05

Label	Mg	Ca	Na	K	Total cations	OH	F	Cl	Mg#
STAGE 1 amphibole									
GAL94-1A.1_1	3.26	1.72	0.22	0.07	15.01	1.86	0.12	0.02	68
GAL94-1A.1_2	3.23	1.72	0.23	0.08	15.03	1.85	0.13	0.02	68
GAL94-1A.1_3	3.22	1.79	0.17	0.05	15.01	1.93	0.06	0.01	69
GAL94-1A.2_1	3.31	1.80	0.19	0.04	15.03	1.92	0.08	0.01	70
GAL94-1A.2_2	3.25	1.72	0.20	0.06	14.99	1.91	0.07	0.02	68
GAL94-1A.2_3	3.15	1.76	0.21	0.07	15.04	1.90	0.08	0.02	67
GAL94-1A.3_1	3.38	1.69	0.22	0.07	14.97	1.90	0.09	0.02	71
GAL94-1A.3_2	3.20	1.71	0.21	0.06	14.99	1.91	0.08	0.02	69
GAL94-1A.3_4	3.30	1.68	0.23	0.06	14.98	1.90	0.08	0.02	69
GAL94-1A.4_1	3.17	1.80	0.20	0.05	15.05	1.92	0.07	0.01	68
GAL94-1A.4_2	3.26	1.72	0.21	0.07	15.00	1.91	0.07	0.02	69
GAL94-1A.4_3	3.11	1.74	0.24	0.08	15.06	1.91	0.07	0.02	66
GAL94-1A.4_4[1]	3.11	1.79	0.19	0.06	15.05	1.91	0.08	0.01	66
GAL94-1A.5_1	3.21	1.69	0.21	0.07	14.98	1.90	0.09	0.02	69
GAL94-1A.5_2	3.18	1.80	0.19	0.06	15.05	1.91	0.08	0.02	68
GAL94-1A.5_3	3.12	1.78	0.21	0.07	15.07	1.88	0.10	0.02	67
GAL94-1A.6_1	3.24	1.72	0.24	0.08	15.03	1.89	0.09	0.02	68
GAL94-1A.6_2	3.19	1.75	0.23	0.09	15.06	1.89	0.09	0.02	68
GAL94-1A.A.1_1	3.28	1.74	0.23	0.08	15.05	1.90	0.08	0.02	69
GAL94-1A.A.1_2	3.31	1.75	0.23	0.07	15.04	1.89	0.10	0.01	70
GAL94-1A.A.1_4	3.30	1.76	0.20	0.07	15.03	1.69	0.30	0.02	69
GAL94-1A.C.1_1	3.41	1.77	0.17	0.04	14.97	1.70	0.29	0.01	71
GAL94-1A.C.1_2	3.30	1.78	0.18	0.04	15.00	1.70	0.29	0.01	69
GAL94-1A.C.1_3	3.29	1.80	0.18	0.05	15.03	1.69	0.30	0.01	69
GAL94-1A.C.1_4	3.17	1.81	0.17	0.04	15.02	1.92	0.07	0.01	67
GAL94-1A.E.1_1	3.54	1.73	0.15	0.03	14.91	1.92	0.07	0.01	73
GAL94-1A.E.1_2	3.27	1.67	0.22	0.06	14.94	1.87	0.11	0.03	69
GAL94-1A.F.1_1	3.14	1.78	0.22	0.08	15.09	1.91	0.07	0.02	67
GAL94-1A.F.1_2	3.24	1.78	0.24	0.06	15.07	1.91	0.07	0.02	69
GAL94-1A.F.1_3	3.22	1.76	0.22	0.07	15.05	1.92	0.06	0.02	69
GAL94-1A.F.1_4	3.21	1.76	0.20	0.06	15.03	1.93	0.05	0.02	68
GAL94-1A.G.1_1	3.24	1.72	0.27	0.10	15.09	1.91	0.06	0.03	68
GAL94-1A.G.1_4	3.33	1.84	0.15	0.03	15.02	1.90	0.09	0.01	70
GAL94-1A.A.A.1_4	3.31	1.76	0.23	0.07	15.06	1.89	0.09	0.02	70
GAL94-1A.A.B.1_1	3.26	1.70	0.23	0.06	15.00	1.88	0.10	0.02	69
GAL94-1A.A.B.1_2	3.26	1.77	0.22	0.07	15.05	1.90	0.09	0.02	69
GAL94-1A.A.B.1_3	3.24	1.77	0.23	0.07	15.06	1.89	0.10	0.01	69
GAL94-1A.A.B.1_4	3.42	1.83	0.15	0.02	15.00	1.91	0.08	0.01	71
GAL94-1A.A.G.2	3.28	1.74	0.26	0.08	15.08	1.87	0.11	0.02	70
GAL94-1A.A.G.4	3.22	1.76	0.21	0.07	15.05	1.90	0.08	0.02	68
GAL94-1A.A.H.1_1	3.22	1.78	0.20	0.08	15.06	1.90	0.08	0.02	69
GAL94-1A.A.H.1_3	3.25	1.74	0.24	0.08	15.05	1.91	0.08	0.02	69
GAL94-1A.A.H.1_4	3.35	1.76	0.20	0.05	15.01	1.89	0.10	0.01	70

Label	Code	Wt% oxides							
		SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO*	Fe_2O_3(c)	FeO (c)	MnO
GAL94-1A.A.I.1_3		50.68	0.52	5.60	0.01	11.51	7.28	4.96	0.41
GAL94-1A.A.I.1_4	R	48.63	0.88	6.31	0.00	12.23	6.48	6.41	0.40
JD97-3.A.A.1_1	C	48.30	1.36	6.95	0.02	13.36	7.06	7.00	0.47
JD97-3.A.A.1_2		47.89	1.12	6.72	0.02	13.05	6.64	7.08	0.39
JD97-3.A.A.1_3		49.71	0.75	5.64	0.00	12.79	7.04	6.46	0.42
JD97-3.A.B.1_1	C	47.66	1.53	6.82	0.00	13.22	6.71	7.18	0.41
JD97-3.A.B.1_2		48.15	1.50	6.57	0.02	13.43	7.34	6.83	0.45
JD97-3.A.B.1_3		47.89	1.34	6.89	0.02	13.69	6.49	7.85	0.50
JD97-3.A.B.1_4	R	48.09	0.92	6.68	0.02	13.21	6.00	7.81	0.39
JD97-3.A.F.1	C	49.72	0.62	5.51	0.03	12.79	7.24	6.28	0.44
JD97-3.A.F.2		49.32	0.64	5.65	0.00	12.78	7.15	6.35	0.39
JD97-3.A.F.3		49.18	0.65	5.84	0.06	13.01	7.71	6.07	0.47
JD97-3.A.F.4	R	49.29	0.68	5.75	0.01	13.43	6.99	7.15	0.42
JD97-3.A.G.1	C	49.51	0.80	5.75	0.01	13.21	7.72	6.26	0.44
JD97-3.A.G.2		48.96	1.01	6.15	0.04	13.38	7.63	6.52	0.47
JD97-3.A.G.3		47.46	1.51	6.96	0.01	13.78	6.65	7.80	0.48
JD97-3.A.G.4	R	48.34	0.95	6.59	0.02	13.76	7.31	7.19	0.51
JD97-3.A.H.1	C	51.00	0.52	4.91	0.04	12.11	5.04	7.57	0.45
JD97-3.A.H.2		49.72	0.66	5.71	0.05	11.85	5.59	6.81	0.48
JD97-3.A.H.3		49.78	0.75	5.63	0.00	12.76	7.01	6.45	0.47
JD97-3.A.H.4	R	48.96	0.81	5.94	0.00	12.99	7.08	6.62	0.51
JD97-3.A.L.1_1	C	48.81	0.79	6.16	0.00	13.06	6.69	7.04	0.40
JD97-3.A.L.1_2		48.74	0.76	6.14	0.01	12.98	7.34	6.38	0.44
JD97-3.A.L.1_3		48.69	0.67	6.02	0.05	12.82	6.30	7.15	0.38
JD97-3.A.L.1_4	R	52.81	0.20	2.86	0.03	10.39	4.00	6.79	0.40
average Stage 1 amphibole		49.45	0.87	5.95	0.02	12.57	7.15	6.09	0.45
standard deviation		1.05	0.28	0.64	0.02	0.63	0.97	1.01	0.05
STAGE 2 amphibole									
HP99-9.D.1	C	46.11	3.62	3.67	0.00	14.92	11.18	4.86	0.33
HP99-9.D.3		48.60	1.32	5.57	0.01	13.57	4.67	9.37	0.43
HP99-9.D.4	R	48.62	1.07	3.50	0.04	14.98	8.49	7.34	0.54
HP99-9.E.2		50.30	0.45	4.15	0.02	13.13	1.26	12.00	0.36
HP99-9.E.4		50.91	0.48	2.45	0.00	14.37	10.51	4.91	0.50
HP99-9.E.5	R	51.21	0.29	5.71	0.02	12.15	0.00	12.15	0.37
HP99-9.F.1	C	49.18	0.60	4.99	0.01	14.56	2.82	12.02	0.35
HP99-9.F.2		49.66	0.30	3.63	0.00	14.09	9.19	5.81	0.26
HP99-9.F.3		49.80	0.67	4.76	0.03	13.58	5.33	8.78	0.35
HP99-9.F.4	R	49.15	0.67	5.70	0.03	12.34	0.00	12.34	0.31
HP99-9.H.1	C	49.91	0.78	6.16	0.00	13.92	4.22	10.12	0.44
HP99-9.H.2		49.80	0.75	7.87	0.03	12.01	0.00	12.01	0.35
HP99-9.H.3	R	50.15	0.70	4.93	0.02	14.19	7.19	7.72	0.51
HP99-9.K.1[1]	C	49.52	0.62	5.77	0.00	13.45	7.03	7.13	0.39
HP99-9.K.2		49.46	0.87	6.08	0.04	14.95	7.88	7.86	0.45
HP99-9.K.3		50.09	0.54	4.84	0.02	13.24	5.62	8.18	0.42
HP99-9.K.4	R	50.25	0.52	8.47	0.02	10.98	0.00	10.98	0.33
HP99-9.L.1	C	48.70	2.17	7.15	0.04	13.58	7.23	7.07	0.47
HP99-9.L.2		50.36	0.71	6.93	0.02	11.77	0.00	11.77	0.42
HP99-9.L.3		47.67	1.27	5.25	0.00	15.59	13.54	3.41	0.37
HP99-9.L.4		49.44	1.11	5.87	0.01	13.02	2.29	10.96	0.38

Label	MgO	CaO	Na_2O	K_2O	H_2O (c)	F	Cl	Total	O=F
GAL94-1A.A.I.1_3	15.93	11.58	0.65	0.24	2.01	0.19	0.03	99.99	0.08
GAL94-1A.A.I.1_4	14.65	11.40	0.69	0.37	1.95	0.19	0.07	98.33	0.08
JD97-3.A.A.1_1	14.07	11.19	0.97	0.44	1.98	0.17	0.08	99.97	0.07
JD97-3.A.A.1_2	14.07	11.32	0.81	0.42	1.94	0.18	0.09	98.59	0.08
JD97-3.A.A.1_3	15.13	11.77	0.61	0.31	2.00	0.15	0.05	99.96	0.06
JD97-3.A.B.1_1	14.00	11.24	0.90	0.45	1.97	0.12	0.10	99.01	0.05
JD97-3.A.B.1_2	14.12	11.09	0.95	0.43	1.99	0.13	0.09	99.59	0.05
JD97-3.A.B.1_3	13.75	11.39	0.92	0.42	1.96	0.17	0.08	99.59	0.07
JD97-3.A.B.1_4	14.06	11.70	0.72	0.41	1.95	0.18	0.07	98.90	0.08
JD97-3.A.F.1	15.15	11.68	0.64	0.31	2.01	0.15	0.04	99.73	0.06
JD97-3.A.F.2	15.08	11.67	0.70	0.32	2.01	0.12	0.04	99.37	0.05
JD97-3.A.F.3	14.97	11.56	0.77	0.33	2.00	0.15	0.05	99.73	0.06
JD97-3.A.F.4	14.72	11.84	0.63	0.32	2.01	0.12	0.04	99.91	0.05
JD97-3.A.G.1	14.92	11.49	0.72	0.37	2.01	0.13	0.05	100.13	0.06
JD97-3.A.G.2	14.64	11.44	0.84	0.39	1.99	0.16	0.06	100.23	0.07
JD97-3.A.G.3	13.74	11.45	0.87	0.49	1.96	0.14	0.12	99.56	0.06
JD97-3.A.G.4	14.05	11.45	0.83	0.39	1.98	0.13	0.09	99.75	0.06
JD97-3.A.H.1	15.38	11.97	0.53	0.27	2.03	0.10	0.03	99.79	0.04
JD97-3.A.H.2	15.22	11.84	0.67	0.29	2.01	0.11	0.04	99.14	0.05
JD97-3.A.H.3	15.06	11.65	0.66	0.30	2.00	0.14	0.06	99.90	0.06
JD97-3.A.H.4	14.68	11.61	0.69	0.33	1.98	0.16	0.05	99.33	0.07
JD97-3.A.L.1_1	14.45	11.50	0.73	0.36	2.00	0.12	0.05	99.03	0.05
JD97-3.A.L.1_2	14.59	11.39	0.78	0.34	1.97	0.17	0.05	99.03	0.07
JD97-3.A.L.1_3	14.46	11.58	0.68	0.31	1.96	0.17	0.04	98.37	0.07
JD97-3.A.L.1_4	16.78	12.21	0.25	0.07	2.02	0.12	0.04	98.51	0.05
average Stage 1 amphibole	15.04	11.48	0.74	0.35	1.97	0.20	0.07	99.73	0.08
standard deviation	0.62	0.26	0.12	0.09	0.05	0.12	0.02	0.86	0.05
STAGE 2 amphibole									
HP99-9.D.1	15.94	12.42	0.43	0.08	2.03	0.09	0.01	100.71	0.04
HP99-9.D.3	14.41	12.49	0.67	0.11	2.02	0.08	0.01	99.72	0.03
HP99-9.D.4	14.93	12.27	0.45	0.07	2.00	0.09	0.00	99.38	0.04
HP99-9.E.2	15.16	13.72	0.49	0.08	2.01	0.10	0.01	100.06	0.04
HP99-9.E.4	16.32	12.18	0.19	0.07	2.04	0.12	0.01	100.63	0.05
HP99-9.E.5	13.83	12.37	0.69	0.09	2.01	0.11	0.00	98.81	0.05
HP99-9.F.1	13.74	12.82	0.61	0.14	1.99	0.11	0.01	99.35	0.05
HP99-9.F.2	15.13	11.49	0.38	0.12	1.98	0.13	0.01	98.04	0.06
HP99-9.F.3	15.02	12.57	0.57	0.10	2.02	0.13	0.00	100.06	0.05
HP99-9.F.4	13.41	14.18	0.68	0.11	1.99	0.09	0.01	98.62	0.04
HP99-9.H.1	13.72	11.86	0.89	0.18	2.04	0.09	0.01	100.38	0.04
HP99-9.H.2	13.06	12.00	0.95	0.16	2.02	0.09	0.00	99.07	0.04
HP99-9.H.3	14.77	12.06	0.60	0.10	2.04	0.12	0.00	100.86	0.05
HP99-9.K.1'	14.48	11.54	0.74	0.13	2.04	0.07	0.00	99.42	0.03
HP99-9.K.2	13.74	11.29	0.89	0.18	2.05	0.08	0.00	100.83	0.03
HP99-9.K.3	14.92	12.17	0.58	0.11	2.02	0.11	0.00	99.57	0.05
HP99-9.K.4	12.52	12.65	1.08	0.20	2.03	0.08	0.01	99.11	0.03
HP99-9.L.1	13.33	10.51	0.94	0.14	2.02	0.14	0.01	99.87	0.06
HP99-9.L.2	13.40	11.82	1.05	0.17	2.03	0.07	0.00	98.71	0.03
HP99-9.L.3	14.93	11.29	0.60	0.10	2.01	0.16	0.00	100.54	0.07
HP99-9.L.4	14.37	12.75	0.77	0.13	2.04	0.07	0.00	100.15	0.03

Label	O=Cl	Cations							
		Si	Ti	Al/Al IV	Al VI	Cr	Fe^{3+}	Fe^{2+}	Mn
GAL94-1A.A.I.1_3	0.01	7.21	0.06	0.79	0.15	0.00	0.78	0.59	0.05
GAL94-1A.A.I.1_4	0.02	7.09	0.10	0.91	0.18	0.00	0.71	0.78	0.05
JD97-3.A.A.1_1	0.02	6.97	0.15	1.03	0.15	0.00	0.77	0.85	0.06
JD97-3.A.A.1_2	0.02	7.00	0.12	1.00	0.16	0.00	0.73	0.87	0.05
JD97-3.A.A.1_3	0.01	7.14	0.08	0.86	0.09	0.00	0.76	0.78	0.05
JD97-3.A.B.1_1	0.02	6.95	0.17	1.05	0.13	0.00	0.74	0.88	0.05
JD97-3.A.B.1_2	0.02	6.98	0.16	1.02	0.10	0.00	0.80	0.83	0.06
JD97-3.A.B.1_3	0.02	6.96	0.15	1.04	0.14	0.00	0.71	0.96	0.06
JD97-3.A.B.1_4	0.01	7.02	0.10	0.98	0.17	0.00	0.66	0.95	0.05
JD97-3.A.F.1	0.01	7.15	0.07	0.85	0.09	0.00	0.78	0.76	0.05
JD97-3.A.F.2	0.01	7.13	0.07	0.87	0.09	0.00	0.78	0.77	0.05
JD97-3.A.F.3	0.01	7.09	0.07	0.91	0.08	0.01	0.84	0.73	0.06
JD97-3.A.F.4	0.01	7.11	0.07	0.89	0.09	0.00	0.76	0.86	0.05
JD97-3.A.G.1	0.01	7.11	0.09	0.89	0.08	0.00	0.83	0.75	0.05
JD97-3.A.G.2	0.01	7.04	0.11	0.96	0.08	0.01	0.83	0.78	0.06
JD97-3.A.G.3	0.03	6.92	0.17	1.08	0.11	0.00	0.73	0.95	0.06
JD97-3.A.G.4	0.02	7.00	0.10	1.00	0.13	0.00	0.80	0.87	0.06
JD97-3.A.H.1	0.01	7.32	0.06	0.68	0.15	0.00	0.54	0.91	0.05
JD97-3.A.H.2	0.01	7.18	0.07	0.82	0.16	0.01	0.61	0.82	0.06
JD97-3.A.H.3	0.01	7.15	0.08	0.85	0.10	0.00	0.76	0.78	0.06
JD97-3.A.H.4	0.01	7.09	0.09	0.91	0.11	0.00	0.77	0.80	0.06
JD97-3.A.L.1_1	0.01	7.09	0.09	0.91	0.15	0.00	0.73	0.86	0.05
JD97-3.A.L.1_2	0.01	7.08	0.08	0.92	0.13	0.00	0.80	0.77	0.05
JD97-3.A.L.1_3	0.01	7.12	0.07	0.88	0.16	0.01	0.69	0.87	0.05
JD97-3.A.L.1_4	0.01	7.60	0.02	0.41	0.08	0.00	0.43	0.82	0.05
average Stage 1 amphibole	0.02	7.11	0.09	0.89	0.12	0.00	0.77	0.73	0.05
standard deviation	0.01	0.11	0.03	0.11	0.03	0.00	0.10	0.13	0.01
STAGE 2 amphibole									
HP99-9.D.1	0.00	6.69	0.39	0.63	0.00	0.00	1.22	0.59	0.04
HP99-9.D.3	0.00	7.07	0.14	0.93	0.03	0.00	0.51	1.14	0.05
HP99-9.D.4	0.00	7.12	0.12	0.60	0.00	0.01	0.94	0.90	0.07
HP99-9.E.2	0.00	7.31	0.05	0.69	0.02	0.00	0.14	1.46	0.04
HP99-9.E.4	0.00	7.28	0.05	0.41	0.00	0.00	1.13	0.59	0.06
HP99-9.E.5	0.00	7.45	0.03	0.55	0.43	0.00	0.00	1.48	0.05
HP99-9.F.1	0.00	7.23	0.07	0.77	0.09	0.00	0.31	1.48	0.04
HP99-9.F.2	0.00	7.28	0.03	0.63	0.00	0.00	1.01	0.71	0.03
HP99-9.F.3	0.00	7.20	0.07	0.80	0.01	0.00	0.58	1.06	0.04
HP99-9.F.4	0.00	7.25	0.07	0.75	0.24	0.00	0.00	1.52	0.04
HP99-9.H.1	0.00	7.19	0.09	0.81	0.24	0.00	0.46	1.22	0.05
HP99-9.H.2	0.00	7.23	0.08	0.77	0.58	0.00	0.00	1.46	0.04
HP99-9.H.3	0.00	7.18	0.08	0.82	0.01	0.00	0.77	0.93	0.06
HP99-9.K.1[1]	0.00	7.16	0.07	0.84	0.14	0.00	0.76	0.86	0.05
HP99-9.K.2	0.00	7.09	0.09	0.91	0.12	0.01	0.85	0.94	0.05
HP99-9.K.3	0.00	7.25	0.06	0.76	0.07	0.00	0.61	0.99	0.05
HP99-9.K.4	0.00	7.26	0.06	0.74	0.71	0.00	0.00	1.33	0.04
HP99-9.L.1	0.00	7.00	0.24	1.00	0.21	0.01	0.78	0.85	0.06
HP99-9.L.2	0.00	7.33	0.08	0.67	0.52	0.00	0.00	1.43	0.05
HP99-9.L.3	0.00	6.85	0.14	0.89	0.00	0.00	1.47	0.41	0.05
HP99-9.L.4	0.00	7.16	0.12	0.84	0.16	0.00	0.25	1.33	0.05

Label	Mg	Ca	Na	K	Total cations	OH	F	Cl	Mg#
GAL94-1A.A.I.1_3	3.38	1.77	0.18	0.04	14.99	1.91	0.09	0.01	71
GAL94-1A.A.I.1_4	3.19	1.78	0.20	0.07	15.05	1.90	0.09	0.02	68
JD97-3.A.A.1_1	3.03	1.73	0.27	0.08	15.08	1.90	0.08	0.02	65
JD97-3.A.A.1_2	3.07	1.77	0.23	0.08	15.08	1.90	0.08	0.02	66
JD97-3.A.A.1_3	3.24	1.81	0.17	0.06	15.04	1.92	0.07	0.01	68
JD97-3.A.B.1_1	3.04	1.76	0.25	0.08	15.09	1.92	0.06	0.02	65
JD97-3.A.B.1_2	3.05	1.72	0.27	0.08	15.07	1.92	0.06	0.02	65
JD97-3.A.B.1_3	2.98	1.78	0.26	0.08	15.11	1.90	0.08	0.02	64
JD97-3.A.B.1_4	3.06	1.83	0.20	0.08	15.11	1.90	0.09	0.02	65
JD97-3.A.F.1	3.25	1.80	0.18	0.06	15.03	1.93	0.07	0.01	68
JD97-3.A.F.2	3.25	1.81	0.20	0.06	15.06	1.94	0.05	0.01	68
JD97-3.A.F.3	3.22	1.79	0.21	0.06	15.06	1.92	0.07	0.01	67
JD97-3.A.F.4	3.17	1.83	0.18	0.06	15.07	1.94	0.05	0.01	66
JD97-3.A.G.1	3.19	1.77	0.20	0.07	15.04	1.93	0.06	0.01	67
JD97-3.A.G.2	3.14	1.76	0.24	0.07	15.07	1.91	0.07	0.01	66
JD97-3.A.G.3	2.98	1.79	0.25	0.09	15.12	1.91	0.07	0.03	64
JD97-3.A.G.4	3.03	1.78	0.23	0.07	15.08	1.92	0.06	0.02	65
JD97-3.A.H.1	3.29	1.84	0.15	0.05	15.04	1.95	0.05	0.01	69
JD97-3.A.H.2	3.28	1.83	0.19	0.05	15.07	1.94	0.05	0.01	70
JD97-3.A.H.3	3.23	1.79	0.18	0.05	15.03	1.92	0.07	0.02	68
JD97-3.A.H.4	3.17	1.80	0.19	0.06	15.05	1.92	0.07	0.01	67
JD97-3.A.L.1_1	3.13	1.79	0.21	0.07	15.06	1.93	0.05	0.01	66
JD97-3.A.L.1_2	3.16	1.77	0.22	0.06	15.05	1.91	0.08	0.01	67
JD97-3.A.L.1_3	3.15	1.81	0.19	0.06	15.07	1.91	0.08	0.01	67
JD97-3.A.L.1_4	3.60	1.88	0.07	0.01	14.96	1.94	0.05	0.01	74
average Stage 1 amphibole	3.22	1.77	0.21	0.06	15.04	1.89	0.09	0.02	68
standard deviation	0.11	0.04	0.03	0.02	0.04	0.05	0.05	0.01	1.9
STAGE 2 amphibole									
HP99-9.D.1	3.44	1.93	0.12	0.01	15.07	1.96	0.04	0.00	66
HP99-9.D.3	3.13	1.95	0.19	0.02	15.16	1.96	0.04	0.00	65
HP99-9.D.4	3.26	1.92	0.13	0.01	15.07	1.96	0.04	0.00	64
HP99-9.E.2	3.29	2.14	0.14	0.02	15.29	1.95	0.05	0.00	67
HP99-9.E.4	3.48	1.87	0.05	0.01	14.93	1.95	0.05	0.00	67
HP99-9.E.5	3.00	1.93	0.20	0.02	15.13	1.95	0.05	0.00	67
HP99-9.F.1	3.01	2.02	0.17	0.03	15.22	1.95	0.05	0.00	63
HP99-9.F.2	3.30	1.81	0.11	0.02	14.94	1.94	0.06	0.00	66
HP99-9.F.3	3.24	1.95	0.16	0.02	15.12	1.94	0.06	0.00	66
HP99-9.F.4	2.95	2.24	0.19	0.02	15.29	1.96	0.04	0.00	66
HP99-9.H.1	2.95	1.83	0.25	0.03	15.11	1.96	0.04	0.00	64
HP99-9.H.2	2.83	1.87	0.27	0.03	15.16	1.96	0.04	0.00	66
HP99-9.H.3	3.15	1.85	0.17	0.02	15.03	1.95	0.05	0.00	65
HP99-9.K.1[1]	3.12	1.79	0.21	0.02	15.02	1.97	0.03	0.00	66
HP99-9.K.2	2.94	1.73	0.25	0.03	15.01	1.96	0.04	0.00	62
HP99-9.K.3	3.22	1.89	0.16	0.02	15.07	1.95	0.05	0.00	67
HP99-9.K.4	2.70	1.96	0.30	0.04	15.13	1.96	0.04	0.00	67
HP99-9.L.1	2.86	1.62	0.26	0.03	14.91	1.93	0.06	0.00	64
HP99-9.L.2	2.91	1.84	0.30	0.03	15.16	1.97	0.03	0.00	67
HP99-9.L.3	3.20	1.74	0.17	0.02	14.93	1.93	0.07	0.00	63
HP99-9.L.4	3.10	1.98	0.22	0.02	15.22	1.97	0.03	0.00	66

Label	Code	Wt% oxides							
		SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO*	Fe_2O_3 (c)	FeO (c)	MnO
HP99-9.P.3		48.70	2.28	4.39	0.00	14.35	15.95	0.00	0.39
HP99-9.P.5	R	48.82	0.93	5.83	0.00	14.32	7.23	7.81	0.46
average Stage 2 amphibole		49.41	0.99	5.38	0.02	13.61	5.72	8.46	0.40
standard deviation		1.09	0.77	1.43	0.01	1.17	4.57	3.23	0.07

[1] indicates points selected as representative compositions and presented in the main text.

* indicates all Fe as FeO.

Code as follows: C, point analyzed in core of a crystal; R, point analyzed at the rim of a crystal.

Amphibole stoichiometry calculated on the basis of 23 oxygen equivalents.

Label	MgO	CaO	Na_2O	K_2O	H_2O (c)	F	Cl	Total	O=F
HP99-9.P.3	16.11	9.96	0.57	0.11	2.08	0.08	0.01	100.59	0.03
HP99-9.P.5	13.84	11.43	0.77	0.13	2.01	0.10	0.00	99.34	0.04
average Stage 2 amphibole	14.39	12.08	0.68	0.12	2.02	0.10	0.00	99.73	0.04
standard deviation	1.00	0.92	0.22	0.04	0.02	0.02	0.01	0.79	0.01

Label	O=Cl	Cations							
		Si	Ti	Al/Al IV	Al VI	Cr	Fe^{3+}	Fe^{2+}	Mn
HP99-9.P.3	0.00	6.90	0.24	0.73	0.00	0.00	1.70	0.00	0.05
HP99-9.P.5	0.00	7.10	0.10	0.90	0.10	0.00	0.79	0.95	0.06
average Stage 2 amphibole	0.00	7.16	0.11	0.76	0.16	0.00	0.62	1.03	0.05
standard deviation	0.00	0.17	0.08	0.14	0.21	0.00	0.49	0.40	0.01

Label	Mg	Ca	Na	K	Total cations	OH	F	Cl	Mg#
HP99-9.P.3	3.41	1.51	0.16	0.02	14.72	1.96	0.03	0.00	67
HP99-9.P.5	3.00	1.78	0.22	0.03	15.02	1.95	0.05	0.00	63
average Stage 2 amphibole	3.11	1.88	0.19	0.02	15.07	1.95	0.05	0.00	65
standard deviation	0.21	0.15	0.06	0.01	0.13	0.01	0.01	0.00	1.6

Appendix D. Biotite Compositional Data.

Label	Code	Wt% oxides						
		SiO_2	TiO_2	Al_2O_3	FeO*	MnO	MgO	CaO
STAGE 1 biotite								
GAL94-1A.2_1	C	36.59	3.33	14.62	16.85	0.14	13.30	0.03
GAL94-1A.2_2		36.75	2.93	14.79	17.06	0.19	13.67	0.12
GAL94-1A.2_3		36.12	3.55	14.34	16.83	0.17	13.34	0.05
GAL94-1A.2_4		36.39	3.37	14.44	16.87	0.21	13.29	0.02
GAL94-1A.2_5	R	36.25	3.07	14.72	16.81	0.16	13.36	0.05
GAL94-1A.3_1	C	35.59	3.76	14.27	16.95	0.15	13.12	0.03
GAL94-1A.3_2		36.11	3.64	14.00	17.16	0.12	13.13	0.04
GAL94-1A.3_3		35.74	3.46	15.18	16.98	0.16	13.16	0.08
GAL94-1A.4_1	C	36.32	3.23	14.52	16.69	0.18	13.45	0.04
GAL94-1A.4_2		36.13	3.19	14.54	16.59	0.17	13.41	0.02
GAL94-1A.4_3		36.04	3.07	14.33	16.67	0.15	13.28	0.07
GAL94-1A.4_4	R	36.28	2.78	15.05	16.76	0.16	13.28	0.05
GAL94-1A.B.1_1	C	35.43	3.18	14.79	16.54	0.21	13.43	0.10
GAL94-1A.B.1_2		35.90	3.21	14.70	16.88	0.19	13.55	0.08
GAL94-1A.B.1_3		35.78	3.22	14.87	16.65	0.15	13.29	0.09
GAL94-1A.B.1_4	R	36.29	3.30	14.74	16.70	0.17	13.34	0.09
GAL94-1A.A.G.1_1	C	36.27	3.51	13.97	15.99	0.22	13.05	0.06
GAL94-1A.A.G.1_2		36.48	3.50	14.26	15.86	0.20	13.34	0.04
GAL94-1A.A.G.1_3		36.23	3.34	14.30	15.88	0.14	13.17	0.05
GAL94-1A.A.H.1_1	C	36.37	2.90	14.31	15.82	0.17	13.36	0.02
GAL94-1A.A.H.1_2		36.97	2.90	14.57	15.94	0.19	13.62	0.14
GAL94-1A.A.H.1_3		36.24	3.01	14.37	15.68	0.17	13.44	0.08
GAL94-1A.A.H.1_4	R	36.07	2.88	14.38	16.20	0.18	12.91	0.05
GAL94-1A.A.J.1_1	C	36.95	3.48	14.15	15.83	0.21	13.17	0.02
GAL94-1A.A.J.1_2		36.30	3.34	14.10	15.98	0.14	13.16	0.00
GAL94-1A.A.J.1_3		36.71	3.21	14.36	15.93	0.18	13.45	0.05
GAL94-1A.A.J.1_4	R	36.35	2.68	14.66	15.95	0.12	12.96	0.09
JD97-3.A.A.1_1	C	36.45	3.39	14.23	16.50	0.24	12.56	0.08
JD97-3.A.A.1_2		36.20	3.41	14.58	16.45	0.21	12.98	0.04
JD97-3.A.A.1_3		36.28	3.39	14.98	16.79	0.20	12.75	0.00
JD97-3.A.B.1_1	C	36.58	3.44	14.51	16.79	0.18	12.79	0.01
JD97-3.A.B.1_2		36.80	3.42	14.50	16.96	0.24	13.12	0.00
JD97-3.A.B.1_3		36.52	3.45	14.41	16.69	0.19	13.11	0.00
JD97-3.A.B.1_4	R	36.14	3.48	15.04	15.94	0.24	12.35	0.07
JD97-3.A.E.1_1	C	36.23	3.40	14.58	16.04	0.18	12.69	0.03
JD97-3.A.E.1_4	R	36.31	3.31	14.86	15.83	0.17	12.69	0.10
JD97-3.A.I.1_2		36.90	3.48	14.63	16.45	0.16	13.65	0.02
JD97-3.A.I.1_3		36.35	3.46	14.23	16.35	0.22	13.22	0.05
JD97-3.A.I.1_4	R	36.81	3.53	14.45	15.76	0.24	12.73	0.10
JD97-3.A.N.1_1	C	36.68	3.24	14.45	16.53	0.21	13.41	0.01
JD97-3.A.N.1_2[1]		36.54	3.21	14.40	16.45	0.14	13.36	0.03

Label	Na_2O	K_2O	H_2O (c)	F	Cl	Total	O=F	O=Cl
STAGE 1 biotite								
GAL94-1A.2_1	0.10	9.53	3.73	0.39	0.05	98.49	0.16	0.01
GAL94-1A.2_2	0.16	8.53	3.73	0.41	0.05	98.21	0.17	0.01
GAL94-1A.2_3	0.10	9.39	3.70	0.39	0.09	97.88	0.16	0.02
GAL94-1A.2_4	0.13	9.45	3.75	0.32	0.07	98.16	0.14	0.02
GAL94-1A.2_5	0.13	9.26	3.66	0.50	0.06	97.81	0.21	0.01
GAL94-1A.3_1	0.14	9.35	3.67	0.38	0.09	97.31	0.16	0.02
GAL94-1A.3_2	0.14	9.16	3.69	0.35	0.11	97.48	0.15	0.02
GAL94-1A.3_3	0.16	8.95	3.66	0.48	0.10	97.88	0.20	0.02
GAL94-1A.4_1	0.17	9.46	3.70	0.40	0.08	98.06	0.17	0.02
GAL94-1A.4_2	0.10	9.51	3.69	0.39	0.07	97.63	0.16	0.01
GAL94-1A.4_3	0.11	9.24	3.67	0.38	0.07	96.91	0.16	0.01
GAL94-1A.4_4	0.08	9.67	3.71	0.40	0.08	98.13	0.17	0.02
GAL94-1A.B.1_1	0.17	9.16	3.66	0.41	0.07	96.96	0.17	0.02
GAL94-1A.B.1_2	0.16	9.39	3.73	0.34	0.05	98.03	0.14	0.01
GAL94-1A.B.1_3	0.13	9.47	3.70	0.38	0.06	97.63	0.16	0.01
GAL94-1A.B.1_4	0.16	9.66	3.74	0.37	0.06	98.44	0.15	0.01
GAL94-1A.A.G.1_1	0.19	8.81	3.62	0.46	0.08	96.01	0.19	0.02
GAL94-1A.A.G.1_2	0.18	8.89	3.64	0.47	0.11	96.76	0.20	0.03
GAL94-1A.A.G.1_3	0.14	9.05	3.61	0.51	0.07	96.24	0.21	0.02
GAL94-1A.A.H.1_1	0.14	9.12	3.62	0.47	0.07	96.14	0.20	0.02
GAL94-1A.A.H.1_2	0.17	8.72	3.69	0.44	0.08	97.22	0.19	0.02
GAL94-1A.A.H.1_3	0.16	8.90	3.65	0.41	0.08	96.00	0.17	0.02
GAL94-1A.A.H.1_4	0.10	9.35	3.62	0.43	0.07	96.04	0.18	0.01
GAL94-1A.A.J.1_1	0.10	9.22	3.71	0.37	0.05	97.10	0.16	0.01
GAL94-1A.A.J.1_2	0.14	9.13	3.67	0.36	0.06	96.22	0.15	0.01
GAL94-1A.A.J.1_3	0.14	9.10	3.74	0.30	0.07	97.11	0.13	0.02
GAL94-1A.A.J.1_4	0.11	9.44	3.66	0.39	0.06	96.29	0.16	0.01
JD97-3.A.A.1_1	0.13	9.15	3.71	0.28	0.12	96.68	0.12	0.03
JD97-3.A.A.1_2	0.12	9.37	3.72	0.31	0.10	97.34	0.13	0.02
JD97-3.A.A.1_3	0.12	9.49	3.78	0.23	0.09	97.98	0.10	0.02
JD97-3.A.B.1_1	0.14	9.18	3.76	0.24	0.12	97.62	0.10	0.03
JD97-3.A.B.1_2	0.12	9.21	3.80	0.22	0.11	98.39	0.09	0.02
JD97-3.A.B.1_3	0.11	9.33	3.76	0.27	0.10	97.80	0.11	0.02
JD97-3.A.B.1_4	0.08	9.37	3.71	0.29	0.10	96.67	0.12	0.02
JD97-3.A.E.1_1	0.15	9.12	3.64	0.42	0.11	96.40	0.18	0.02
JD97-3.A.E.1_4	0.13	9.02	3.62	0.49	0.09	96.39	0.20	0.02
JD97-3.A.I.1_2	0.16	9.09	3.77	0.33	0.11	98.60	0.14	0.03
JD97-3.A.I.1_3	0.14	9.10	3.68	0.38	0.11	97.10	0.16	0.02
JD97-3.A.I.1_4	0.14	9.18	3.62	0.52	0.11	96.93	0.22	0.02
JD97-3.A.N.1_1	0.15	8.94	3.77	0.25	0.11	97.61	0.10	0.03
JD97-3.A.N.1_2[1]	0.12	8.98	3.74	0.28	0.11	97.21	0.12	0.03

Label	Cations Si	Ti	Al/Al IV	Al VI	Fe^{2+}	Mn	Mg	Ca
STAGE 1 biotite								
GAL94-1A.2_1	5.58	0.38	2.42	0.21	2.15	0.02	3.02	0.00
GAL94-1A.2_2	5.59	0.34	2.41	0.25	2.17	0.02	3.10	0.02
GAL94-1A.2_3	5.55	0.41	2.45	0.15	2.16	0.02	3.06	0.01
GAL94-1A.2_4	5.57	0.39	2.43	0.18	2.16	0.03	3.03	0.00
GAL94-1A.2_5	5.56	0.36	2.44	0.23	2.16	0.02	3.06	0.01
GAL94-1A.3_1	5.51	0.44	2.49	0.12	2.20	0.02	3.03	0.01
GAL94-1A.3_2	5.58	0.42	2.43	0.12	2.22	0.02	3.02	0.01
GAL94-1A.3_3	5.48	0.40	2.52	0.23	2.18	0.02	3.01	0.01
GAL94-1A.4_1	5.57	0.37	2.44	0.19	2.14	0.02	3.07	0.01
GAL94-1A.4_2	5.56	0.37	2.44	0.20	2.14	0.02	3.08	0.00
GAL94-1A.4_3	5.59	0.36	2.42	0.20	2.16	0.02	3.07	0.01
GAL94-1A.4_4	5.56	0.32	2.44	0.28	2.15	0.02	3.03	0.01
GAL94-1A.B.1_1	5.49	0.37	2.51	0.19	2.15	0.03	3.10	0.02
GAL94-1A.B.1_2	5.51	0.37	2.49	0.17	2.17	0.03	3.10	0.01
GAL94-1A.B.1_3	5.51	0.37	2.49	0.21	2.15	0.02	3.05	0.01
GAL94-1A.B.1_4	5.54	0.38	2.46	0.20	2.13	0.02	3.04	0.02
GAL94-1A.A.G.1_1	5.64	0.41	2.36	0.21	2.08	0.03	3.03	0.01
GAL94-1A.A.G.1_2	5.63	0.41	2.37	0.22	2.05	0.03	3.07	0.01
GAL94-1A.A.G.1_3	5.62	0.39	2.38	0.24	2.06	0.02	3.05	0.01
GAL94-1A.A.H.1_1	5.65	0.34	2.35	0.27	2.06	0.02	3.09	0.00
GAL94-1A.A.H.1_2	5.66	0.33	2.34	0.29	2.04	0.02	3.11	0.02
GAL94-1A.A.H.1_3	5.63	0.35	2.37	0.26	2.04	0.02	3.11	0.01
GAL94-1A.A.H.1_4	5.63	0.34	2.37	0.28	2.12	0.02	3.00	0.01
GAL94-1A.A.J.1_1	5.68	0.40	2.32	0.24	2.03	0.03	3.02	0.00
GAL94-1A.A.J.1_2	5.64	0.39	2.36	0.22	2.08	0.02	3.05	0.00
GAL94-1A.A.J.1_3	5.64	0.37	2.36	0.24	2.05	0.02	3.08	0.01
GAL94-1A.A.J.1_4	5.65	0.31	2.35	0.33	2.07	0.02	3.00	0.02
JD97-3.A.A.1_1	5.65	0.40	2.35	0.25	2.14	0.03	2.90	0.01
JD97-3.A.A.1_2	5.58	0.40	2.42	0.23	2.12	0.03	2.98	0.01
JD97-3.A.A.1_3	5.56	0.39	2.44	0.27	2.15	0.03	2.91	0.00
JD97-3.A.B.1_1	5.62	0.40	2.38	0.24	2.16	0.02	2.93	0.00
JD97-3.A.B.1_2	5.61	0.39	2.39	0.22	2.16	0.03	2.98	0.00
JD97-3.A.B.1_3	5.60	0.40	2.40	0.21	2.14	0.03	3.00	0.00
JD97-3.A.B.1_4	5.59	0.41	2.41	0.34	2.06	0.03	2.85	0.01
JD97-3.A.E.1_1	5.62	0.40	2.38	0.29	2.08	0.02	2.93	0.01
JD97-3.A.E.1_4	5.62	0.39	2.38	0.33	2.05	0.02	2.93	0.02
JD97-3.A.I.1_2	5.59	0.40	2.41	0.21	2.09	0.02	3.09	0.00
JD97-3.A.I.1_3	5.61	0.40	2.39	0.20	2.11	0.03	3.04	0.01
JD97-3.A.I.1_4	5.67	0.41	2.33	0.29	2.03	0.03	2.92	0.02
JD97-3.A.N.1_1	5.62	0.37	2.38	0.23	2.12	0.03	3.06	0.00
JD97-3.A.N.1_2[1]	5.62	0.37	2.38	0.23	2.12	0.02	3.06	0.01

Label	Na	K	Total cations	OH	F	Cl	Mg#	Oct	Int
STAGE 1 biotite									
GAL94-1A.2_1	0.03	1.85	15.67	3.80	0.19	0.01	58	5.78	1.89
GAL94-1A.2_2	0.05	1.66	15.60	3.79	0.20	0.01	59	5.88	1.72
GAL94-1A.2_3	0.03	1.84	15.68	3.79	0.19	0.02	59	5.80	1.88
GAL94-1A.2_4	0.04	1.85	15.68	3.83	0.16	0.02	58	5.79	1.89
GAL94-1A.2_5	0.04	1.81	15.68	3.74	0.24	0.02	59	5.82	1.86
GAL94-1A.3_1	0.04	1.85	15.69	3.79	0.19	0.02	58	5.80	1.90
GAL94-1A.3_2	0.04	1.80	15.65	3.80	0.17	0.03	58	5.80	1.85
GAL94-1A.3_3	0.05	1.75	15.65	3.74	0.23	0.03	58	5.83	1.81
GAL94-1A.4_1	0.05	1.85	15.70	3.79	0.19	0.02	59	5.80	1.91
GAL94-1A.4_2	0.03	1.87	15.70	3.79	0.19	0.02	59	5.80	1.90
GAL94-1A.4_3	0.03	1.83	15.68	3.80	0.19	0.02	59	5.81	1.87
GAL94-1A.4_4	0.02	1.89	15.72	3.79	0.19	0.02	59	5.80	1.92
GAL94-1A.B.1_1	0.05	1.81	15.72	3.78	0.20	0.02	59	5.84	1.88
GAL94-1A.B.1_2	0.05	1.84	15.73	3.82	0.16	0.01	59	5.83	1.90
GAL94-1A.B.1_3	0.04	1.86	15.72	3.80	0.19	0.02	59	5.80	1.92
GAL94-1A.B.1_4	0.05	1.88	15.72	3.81	0.18	0.02	59	5.77	1.95
GAL94-1A.A.G.1_1	0.06	1.75	15.57	3.75	0.23	0.02	59	5.75	1.81
GAL94-1A.A.G.1_2	0.05	1.75	15.57	3.74	0.23	0.03	60	5.76	1.81
GAL94-1A.A.G.1_3	0.04	1.79	15.60	3.73	0.25	0.02	60	5.76	1.84
GAL94-1A.A.H.1_1	0.04	1.81	15.63	3.75	0.23	0.02	60	5.78	1.85
GAL94-1A.A.H.1_2	0.05	1.70	15.57	3.77	0.21	0.02	60	5.79	1.78
GAL94-1A.A.H.1_3	0.05	1.76	15.61	3.78	0.20	0.02	60	5.79	1.82
GAL94-1A.A.H.1_4	0.03	1.86	15.66	3.77	0.21	0.02	59	5.76	1.90
GAL94-1A.A.J.1_1	0.03	1.81	15.56	3.81	0.18	0.01	60	5.72	1.84
GAL94-1A.A.J.1_2	0.04	1.81	15.61	3.81	0.18	0.02	60	5.75	1.85
GAL94-1A.A.J.1_3	0.04	1.78	15.60	3.83	0.15	0.02	60	5.77	1.83
GAL94-1A.A.J.1_4	0.03	1.87	15.65	3.80	0.19	0.02	59	5.73	1.92
JD97-3.A.A.1_1	0.04	1.81	15.58	3.83	0.14	0.03	58	5.72	1.86
JD97-3.A.A.1_2	0.04	1.84	15.64	3.82	0.15	0.03	58	5.76	1.88
JD97-3.A.A.1_3	0.04	1.86	15.64	3.87	0.11	0.02	58	5.75	1.89
JD97-3.A.B.1_1	0.04	1.80	15.59	3.85	0.12	0.03	58	5.75	1.84
JD97-3.A.B.1_2	0.04	1.79	15.61	3.87	0.11	0.03	58	5.78	1.83
JD97-3.A.B.1_3	0.03	1.83	15.63	3.84	0.13	0.03	58	5.77	1.86
JD97-3.A.B.1_4	0.02	1.85	15.57	3.83	0.14	0.03	58	5.68	1.88
JD97-3.A.E.1_1	0.05	1.81	15.58	3.77	0.21	0.03	59	5.72	1.86
JD97-3.A.E.1_4	0.04	1.78	15.55	3.74	0.24	0.02	59	5.71	1.84
JD97-3.A.I.1_2	0.05	1.76	15.61	3.81	0.16	0.03	60	5.80	1.81
JD97-3.A.I.1_3	0.04	1.79	15.61	3.79	0.18	0.03	59	5.77	1.84
JD97-3.A.I.1_4	0.04	1.80	15.54	3.72	0.25	0.03	59	5.68	1.86
JD97-3.A.N.1_1	0.04	1.75	15.60	3.85	0.12	0.03	59	5.81	1.79
JD97-3.A.N.1_2[1]	0.04	1.76	15.60	3.84	0.13	0.03	59	5.80	1.80

Label	Code	Wt% oxides						
		SiO_2	TiO_2	Al_2O_3	FeO*	MnO	MgO	CaO
JD97-3.A.N.1_3		36.27	3.12	14.42	16.90	0.18	13.35	0.04
JD97-3.A.N.1_4	R	36.38	3.32	14.88	16.04	0.21	13.01	0.02
average Stage 1 biotite		36.33	3.28	14.52	16.43	0.18	13.18	0.05
standard deviation		0.34	0.24	0.28	0.44	0.03	0.30	0.03
STAGE 2 biotite								
HP99-9.A.1	C	37.17	4.35	14.44	12.48	0.17	15.53	0.00
HP99-9.A.2		38.88	3.43	14.31	11.81	0.12	16.17	0.04
HP99-9.A.3		37.81	3.75	14.25	12.22	0.18	16.31	0.04
HP99-9.A.4		37.02	4.01	14.52	14.34	0.15	14.38	0.02
HP99-9.A.6		39.25	4.46	13.71	13.79	0.20	16.27	0.22
HP99-9.A.7		45.42	4.44	14.45	10.54	0.15	12.11	0.34
HP99-9.A.8	R	55.52	2.63	15.77	6.57	0.18	5.85	0.61
HP99-9.A.9		42.73	3.33	15.32	10.80	0.15	12.20	0.05
HP99-9.A.10		38.85	3.66	14.84	11.98	0.13	14.64	0.02
HP99-9.A.12	R	38.48	3.93	14.70	11.31	0.02	16.39	0.06
HP99-9.B.1	C	37.51	3.83	14.50	13.90	0.18	14.81	0.03
HP99-9.B.2		37.80	3.76	14.56	12.89	0.12	15.23	0.03
HP99-9.B.3		37.90	3.85	14.44	13.85	0.16	14.52	0.02
HP99-9.B.4		39.58	4.20	14.65	10.29	0.11	16.11	0.13
HP99-9.B.5	R	46.12	5.28	11.52	15.81	0.31	12.61	0.53
HP99-9.G.2		39.63	3.75	15.19	12.13	0.07	14.49	0.23
HP99-9.G.3		37.83	3.69	15.45	10.42	0.12	16.96	0.02
HP99-9.G.5		38.73	4.59	13.63	11.66	0.09	16.75	0.20
HP99-9.G.6	R	44.69	2.44	15.55	16.50	0.17	8.83	2.32
HP99-9.I.2[1]		43.16	3.97	14.18	13.19	0.12	11.82	0.50
HP99-9.I.4	R	39.36	4.21	14.84	9.82	0.03	16.08	0.25
HP99-9.N.1	C	35.11	4.19	12.26	31.98	0.28	7.23	0.30
HP99-9.N.2		46.12	3.10	14.96	17.81	0.10	3.11	0.41
HP99-9.N.3		44.60	4.21	15.01	10.88	0.12	10.22	0.22
HP99-9.N.4		45.97	4.58	15.44	7.85	0.02	11.04	0.45
HP99-9.N.5	R	34.29	4.38	11.62	33.33	0.23	7.63	0.30
average Stage 2 biotite		40.75	3.92	14.39	13.78	0.14	12.97	0.28
standard deviation		4.62	0.61	1.09	6.07	0.07	3.79	0.45

[1] indicates points selected as representative compositions and presented in the main text.

* indicates all Fe as FeO.

Code as follows: C, point analyzed in core of a crystal; R, point analyzed at the rim of a crystal.

Biotite stoichiometry calculated on the basis of 22 oxygen equivalents.

Label	Na_2O	K_2O	H_2O (c)	F	Cl	Total	O=F	O=Cl
JD97-3.A.N.1_3	0.16	8.96	3.74	0.26	0.12	97.38	0.11	0.03
JD97-3.A.N.1_4	0.10	9.34	3.72	0.31	0.12	97.29	0.13	0.03
average Stage 1 biotite	0.13	9.20	3.70	0.37	0.09	97.29	0.16	0.02
standard deviation	0.03	0.25	0.05	0.08	0.02	0.75	0.03	0.01
STAGE 2 biotite								
HP99-9.A.1	0.23	9.55	3.76	0.44	0.10	98.01	0.19	0.02
HP99-9.A.2	0.31	9.05	3.82	0.43	0.08	98.25	0.18	0.02
HP99-9.A.3	0.32	9.10	3.54	0.96	0.09	98.14	0.40	0.02
HP99-9.A.4	0.28	9.62	3.69	0.56	0.09	98.4	0.23	0.02
HP99-9.A.6	0.38	6.88	3.65	0.90	0.10	99.41	0.38	0.02
HP99-9.A.7	0.81	7.29	3.99	0.52	0.05	99.87	0.22	0.01
HP99-9.A.8	1.30	8.60	4.44	0.09	0.02	101.55	0.04	0.01
HP99-9.A.9	0.41	10.41	3.97	0.33	0.07	99.6	0.14	0.02
HP99-9.A.10	0.27	9.83	3.87	0.30	0.09	98.35	0.13	0.02
HP99-9.A.12	0.37	8.70	3.41	1.28	0.14	98.22	0.54	0.03
HP99-9.B.1	0.32	9.33	3.77	0.43	0.08	98.48	0.18	0.02
HP99-9.B.2	0.33	9.23	3.76	0.47	0.08	98.05	0.20	0.02
HP99-9.B.3	0.27	9.33	3.76	0.46	0.09	98.43	0.19	0.02
HP99-9.B.4	0.50	9.16	3.30	1.65	0.09	99.04	0.69	0.02
HP99-9.B.5	0.79	4.18	4.20	0.14	0.00	101.42	0.06	0.00
HP99-9.G.2	0.64	9.09	3.52	1.07	0.28	99.57	0.45	0.06
HP99-9.G.3	0.33	9.43	3.27	1.61	0.11	98.56	0.68	0.02
HP99-9.G.5	0.35	7.78	3.36	1.42	0.11	98.05	0.60	0.03
HP99-9.G.6	1.36	4.23	4.08	0.24	0.01	100.31	0.10	0.00
HP99-9.I.2[1]	0.73	7.32	3.80	0.67	0.08	99.26	0.28	0.02
HP99-9.I.4	0.52	8.91	3.17	1.84	0.15	98.38	0.78	0.03
HP99-9.N.1	0.86	4.60	3.66	0.32	0.01	100.65	0.13	0.00
HP99-9.N.2	1.51	8.45	3.98	0.23	0.02	99.69	0.10	0.00
HP99-9.N.3	0.86	8.79	3.78	0.79	0.10	99.23	0.33	0.02
HP99-9.N.4	0.90	9.21	3.79	0.98	0.04	99.86	0.41	0.01
HP99-9.N.5	0.79	4.11	3.67	0.24	0.02	100.5	0.10	0.00
average Stage 2 biotite	0.61	8.16	3.73	0.71	0.08	99.20	0.30	0.02
standard deviation	0.36	1.87	0.29	0.50	0.06	1.05	0.21	0.01

Label	Cations							
	Si	Ti	Al/Al IV	Al VI	Fe^{2+}	Mn	Mg	Ca
JD97-3.A.N.1_3	5.59	0.36	2.41	0.21	2.18	0.02	3.06	0.01
JD97-3.A.N.1_4	5.59	0.38	2.41	0.29	2.06	0.03	2.98	0.00
average Stage 1 biotite	5.59	0.38	2.41	0.23	2.12	0.02	3.03	0.01
standard deviation	0.05	0.03	0.05	0.05	0.05	0.00	0.06	0.01
STAGE 2 biotite								
HP99-9.A.1	5.58	0.49	2.42	0.14	1.57	0.02	3.48	0.00
HP99-9.A.2	5.76	0.38	2.24	0.27	1.46	0.02	3.57	0.01
HP99-9.A.3	5.65	0.42	2.35	0.16	1.53	0.02	3.63	0.01
HP99-9.A.4	5.59	0.46	2.41	0.17	1.81	0.02	3.24	0.00
HP99-9.A.6	5.74	0.49	2.26	0.11	1.69	0.03	3.55	0.04
HP99-9.A.7	6.41	0.47	1.59	0.82	1.24	0.02	2.55	0.05
HP99-9.A.8	7.42	0.26	0.58	1.90	0.73	0.02	1.17	0.09
HP99-9.A.9	6.19	0.36	1.81	0.80	1.31	0.02	2.63	0.01
HP99-9.A.10	5.78	0.41	2.22	0.38	1.49	0.02	3.25	0.00
HP99-9.A.12	5.69	0.44	2.31	0.25	1.40	0.00	3.61	0.01
HP99-9.B.1	5.63	0.43	2.37	0.20	1.75	0.02	3.32	0.01
HP99-9.B.2	5.66	0.42	2.34	0.24	1.62	0.02	3.40	0.01
HP99-9.B.3	5.68	0.43	2.32	0.24	1.74	0.02	3.25	0.00
HP99-9.B.4	5.79	0.46	2.22	0.31	1.26	0.01	3.51	0.02
HP99-9.B.5	6.47	0.56	1.53	0.38	1.86	0.04	2.64	0.08
HP99-9.G.2	5.80	0.41	2.20	0.43	1.49	0.01	3.16	0.04
HP99-9.G.3	5.59	0.41	2.41	0.27	1.29	0.02	3.73	0.00
HP99-9.G.5	5.73	0.51	2.27	0.10	1.44	0.01	3.69	0.03
HP99-9.G.6	6.38	0.26	1.62	0.99	1.97	0.02	1.88	0.35
HP99-9.I.2[1]	6.25	0.43	1.76	0.66	1.60	0.02	2.55	0.08
HP99-9.I.4	5.78	0.46	2.23	0.34	1.21	0.00	3.52	0.04
HP99-9.N.1	5.52	0.50	2.27	0.00	4.20	0.04	1.69	0.05
HP99-9.N.2	6.75	0.34	1.25	1.33	2.18	0.01	0.68	0.06
HP99-9.N.3	6.41	0.46	1.59	0.95	1.31	0.01	2.19	0.03
HP99-9.N.4	6.47	0.49	1.53	1.03	0.92	0.00	2.32	0.07
HP99-9.N.5	5.43	0.52	2.17	0.00	4.42	0.03	1.80	0.05
average Stage 2 biotite	5.97	0.43	2.01	0.48	1.71	0.02	2.85	0.04
standard deviation	0.47	0.07	0.45	0.46	0.82	0.01	0.85	0.07

Label	Na	K	Total cations	OH	F	Cl	Mg#	Oct	Int
JD97-3.A.N.1_3	0.05	1.76	15.65	3.84	0.13	0.03	59	5.83	1.81
JD97-3.A.N.1_4	0.03	1.83	15.61	3.82	0.15	0.03	59	5.74	1.86
average Stage 1 biotite	0.04	1.81	15.63	3.80	0.18	0.02	59	5.78	1.86
standard deviation	0.01	0.05	0.05	0.04	0.04	0.01	1	0.04	0.04
STAGE 2 biotite									
HP99-9.A.1	0.07	1.83	15.60	3.76	0.21	0.03	69	5.70	1.90
HP99-9.A.2	0.09	1.71	15.51	3.78	0.20	0.02	71	5.70	1.81
HP99-9.A.3	0.09	1.73	15.59	3.52	0.45	0.02	70	5.76	1.83
HP99-9.A.4	0.08	1.85	15.63	3.71	0.27	0.02	64	5.69	1.94
HP99-9.A.6	0.11	1.28	15.28	3.56	0.42	0.03	68	5.86	1.43
HP99-9.A.7	0.22	1.31	14.68	3.76	0.23	0.01	67	5.10	1.59
HP99-9.A.8	0.34	1.47	13.98	3.96	0.04	0.01	61	4.09	1.89
HP99-9.A.9	0.12	1.92	15.17	3.83	0.15	0.02	67	5.12	2.05
HP99-9.A.10	0.08	1.87	15.49	3.84	0.14	0.02	69	5.54	1.95
HP99-9.A.12	0.11	1.64	15.46	3.37	0.60	0.04	72	5.71	1.76
HP99-9.B.1	0.09	1.79	15.60	3.78	0.21	0.02	66	5.71	1.88
HP99-9.B.2	0.10	1.76	15.56	3.75	0.22	0.02	68	5.69	1.86
HP99-9.B.3	0.08	1.79	15.54	3.76	0.22	0.02	65	5.67	1.87
HP99-9.B.4	0.14	1.71	15.42	3.22	0.76	0.02	74	5.55	1.87
HP99-9.B.5	0.21	0.75	14.50	3.94	0.06	0.00	59	5.46	1.04
HP99-9.G.2	0.18	1.70	15.41	3.44	0.49	0.07	68	5.50	1.92
HP99-9.G.3	0.10	1.78	15.59	3.22	0.75	0.03	74	5.72	1.88
HP99-9.G.5	0.10	1.47	15.36	3.31	0.66	0.03	72	5.76	1.60
HP99-9.G.6	0.38	0.77	14.63	3.89	0.11	0.00	49	5.13	1.50
HP99-9.I.2[1]	0.21	1.35	14.89	3.67	0.31	0.02	62	5.26	1.64
HP99-9.I.4	0.15	1.67	15.39	3.11	0.86	0.04	75	5.53	1.86
HP99-9.N.1	0.26	0.92	15.45	3.84	0.16	0.00	29	6.43	1.23
HP99-9.N.2	0.43	1.58	14.62	3.89	0.11	0.01	24	4.55	2.07
HP99-9.N.3	0.24	1.61	14.79	3.62	0.36	0.02	63	4.91	1.88
HP99-9.N.4	0.25	1.65	14.72	3.55	0.44	0.01	72	4.75	1.97
HP99-9.N.5	0.24	0.83	15.50	3.87	0.12	0.00	29	6.77	1.12
average Stage 2 biotite	0.17	1.53	15.20	3.65	0.33	0.02	62	5.49	1.74
standard deviation	0.10	0.35	0.45	0.24	0.23	0.01	14	0.54	0.27

Appendix E. Feldspar Compositional Data.

Label		Wt% oxides						
		SiO_2	Al_2O_3	FeO*	MgO	CaO	BaO	Na_2O
STAGE 1 feldspar								
GAL94-1A.3_1	KC	64.30	18.47	0.00	0.01	0.00	0.55	0.61
GAL94-1A.3_2	KC	65.53	18.82	0.03	0.02	0.00	0.36	0.62
GAL94-1A.3_3	KR	65.30	18.71	0.13	0.01	0.00	0.18	0.66
GAL94-1A.F.2_1	KC	64.41	18.25	0.08	0.01	0.00	0.08	0.54
GAL94-1A.F.2_2	KR	64.38	18.38	0.09	0.00	0.00	0.34	0.59
GAL94-1A.A.B.1_1	KR	63.98	17.72	0.08	0.00	0.00	0.24	0.32
GAL94-1A.A.B.1_2	KC	63.93	18.01	0.12	0.00	0.02	0.21	0.37
GAL94-1A.A.B.1_3	KR	63.73	17.92	0.15	0.00	0.03	0.20	0.42
GAL94-1A.A.E.1_1[1]	KC	64.03	18.07	0.12	0.00	0.02	0.45	0.43
GAL94-1A.A.E.1_2	KR	63.85	18.16	0.35	0.00	0.02	0.42	0.35
GAL94-1A.A.L.1_1	KC	64.25	18.01	0.00	0.00	0.00	0.26	0.43
GAL94-1A.A.L.1_2	K	63.78	17.95	0.03	0.00	0.01	0.36	0.38
GAL94-1A.A.L.1_3	K	64.00	18.22	0.02	0.00	0.03	0.31	0.40
GAL94-1A.A.L.1_4	KR	64.10	18.19	0.00	0.00	0.04	0.23	0.44
average Stage 1 kspar		64.25	18.21	0.09	0.00	0.01	0.30	0.47
standard deviation		0.54	0.30	0.09	0.01	0.01	0.12	0.11
GAL94-1A.1_1	PR	59.73	25.95	0.18	0.01	7.56	0.02	7.29
GAL94-1A.1_4	P	58.14	26.73	0.14	0.00	8.66	0.04	6.61
GAL94-1A.1_5	P	58.16	27.05	0.21	0.02	8.99	0.03	6.38
GAL94-1A.1_6	PC	57.35	27.40	0.15	0.01	9.43	0.06	5.97
GAL94-1A.2_1[1]	PR	59.34	26.10	0.08	0.00	7.74	0.00	7.01
GAL94-1A.2_2	P	59.71	25.80	0.02	0.00	7.33	0.02	7.45
GAL94-1A.2_3	P	58.79	26.52	0.06	0.00	7.19	0.00	7.26
GAL94-1A.2_4	PC	59.68	26.02	0.09	0.00	7.63	0.03	7.19
GAL94-1A.A.1_1	PC	60.25	25.58	0.14	0.01	7.11	0.07	7.26
GAL94-1A.A.1_2	P	60.70	25.26	0.17	0.02	6.88	0.07	7.65
GAL94-1A.A.1_3	P	59.75	25.98	0.15	0.00	7.61	0.03	7.08
GAL94-1A.A.1_4	PR	60.29	25.53	0.78	0.01	7.07	0.03	7.66
GAL94-1A.D.1_1	PC	60.64	24.84	0.08	0.01	6.55	0.01	7.84
GAL94-1A.D.1_2	P	60.02	25.26	0.05	0.02	6.89	0.00	7.53
GAL94-1A.D.1_3	P	60.15	25.49	0.15	0.01	6.70	0.01	7.58
GAL94-1A.D.1_4	PR	60.63	25.78	0.13	0.01	6.80	0.00	7.70
GAL94-1A.E.1_1	PC	56.44	27.47	0.21	0.02	9.70	0.05	6.04
GAL94-1A.E.1_2	P	55.35	27.41	0.22	0.02	9.91	0.05	5.67
GAL94-1A.E.1_3	P	58.12	26.19	0.15	0.02	8.20	0.01	6.84
GAL94-1A.E.1_4	PR	59.57	24.76	0.17	0.01	6.65	0.00	7.67
GAL94-1A.F.1_1	PC	59.85	25.72	0.13	0.01	7.38	0.00	7.37
GAL94-1A.F.1_2	P	60.66	25.32	0.09	0.02	6.88	0.01	7.58
GAL94-1A.F.1_3	P	59.75	26.01	0.07	0.01	7.57	0.01	7.29
GAL94-1A.F.1_4	P	60.33	25.37	0.15	0.01	6.76	0.03	7.66
GAL94-1A.A.B.2_1	PC	58.62	25.59	0.15	0.00	7.04	0.01	7.14
GAL94-1A.A.B.2_2	P	57.63	26.22	0.19	0.00	7.79	0.02	6.74
GAL94-1A.A.B.2_3	P	57.22	25.86	0.19	0.00	8.14	0.02	6.52
GAL94-1A.A.B.2_4	PR	59.16	24.90	0.21	0.00	6.98	0.01	7.20
GAL94-1A.A.D.1_1	PC	57.46	25.91	0.15	0.00	8.00	0.02	6.60

Label			Cations					
	K_2O	Total	Si	Al	Fe^{2+}	Mg	Ca	Ba
STAGE 1 feldspar								
GAL94-1A.3_1	15.70	99.64	2.98	1.03	0.00	0.00	0.00	0.01
GAL94-1A.3_2	16.01	101.39	2.98	1.03	0.00	0.00	0.00	0.01
GAL94-1A.3_3	16.16	101.14	2.97	1.02	0.00	0.00	0.00	0.00
GAL94-1A.F.2_1	16.10	99.47	2.98	1.01	0.00	0.00	0.00	0.00
GAL94-1A.F.2_2	15.97	99.75	2.98	1.02	0.00	0.00	0.00	0.01
GAL94-1A.A.B.1_1	15.83	98.18	3.01	0.98	0.00	0.00	0.00	0.00
GAL94-1A.A.B.1_2	15.81	98.46	3.00	1.00	0.00	0.00	0.00	0.00
GAL94-1A.A.B.1_3	15.64	98.10	3.00	1.00	0.01	0.00	0.00	0.00
GAL94-1A.A.E.1_1[1]	15.56	98.69	3.00	1.00	0.00	0.00	0.00	0.01
GAL94-1A.A.E.1_2	15.59	98.74	2.99	1.00	0.01	0.00	0.00	0.01
GAL94-1A.A.L.1_1	15.78	98.73	3.01	0.99	0.00	0.00	0.00	0.00
GAL94-1A.A.L.1_2	15.81	98.33	3.00	1.00	0.00	0.00	0.00	0.01
GAL94-1A.A.L.1_3	15.66	98.64	3.00	1.01	0.00	0.00	0.00	0.01
GAL94-1A.A.L.1_4	15.60	98.59	3.00	1.00	0.00	0.00	0.00	0.00
average Stage 1 kspar	15.80	99.13	2.99	1.01	0.00	0.00	0.00	0.01
standard deviation	0.20	1.04	0.01	0.01	0.00	0.00	0.00	0.00
GAL94-1A.1_1	0.11	100.86	2.63	1.37	0.01	0.00	0.36	0.00
GAL94-1A.1_4	0.11	100.43	2.58	1.42	0.01	0.00	0.42	0.00
GAL94-1A.1_5	0.14	100.97	2.57	1.43	0.01	0.00	0.43	0.00
GAL94-1A.1_6	0.15	100.52	2.54	1.46	0.01	0.00	0.46	0.00
GAL94-1A.2_1[1]	0.10	100.39	2.62	1.38	0.00	0.00	0.37	0.00
GAL94-1A.2_2	0.10	100.43	2.64	1.37	0.00	0.00	0.35	0.00
GAL94-1A.2_3	0.08	99.89	2.61	1.41	0.00	0.00	0.35	0.00
GAL94-1A.2_4	0.09	100.74	2.63	1.38	0.00	0.00	0.37	0.00
GAL94-1A.A.1_1	0.17	100.58	2.65	1.35	0.01	0.00	0.34	0.00
GAL94-1A.A.1_2	0.11	100.86	2.67	1.33	0.01	0.00	0.33	0.00
GAL94-1A.A.1_3	0.13	100.72	2.63	1.37	0.01	0.00	0.37	0.00
GAL94-1A.A.1_4	0.13	101.49	2.64	1.34	0.03	0.00	0.34	0.00
GAL94-1A.D.1_1	0.09	100.06	2.68	1.32	0.00	0.00	0.32	0.00
GAL94-1A.D.1_2	0.09	99.86	2.66	1.34	0.00	0.00	0.33	0.00
GAL94-1A.D.1_3	0.22	100.29	2.66	1.35	0.01	0.00	0.32	0.00
GAL94-1A.D.1_4	0.15	101.20	2.65	1.36	0.00	0.00	0.32	0.00
GAL94-1A.E.1_1	0.20	100.13	2.52	1.47	0.01	0.00	0.47	0.00
GAL94-1A.E.1_2	0.18	98.80	2.51	1.49	0.01	0.00	0.49	0.00
GAL94-1A.E.1_3	0.20	99.72	2.59	1.40	0.01	0.00	0.40	0.00
GAL94-1A.E.1_4	0.11	98.93	2.67	1.33	0.01	0.00	0.33	0.00
GAL94-1A.F.1_1	0.09	100.56	2.64	1.36	0.00	0.00	0.36	0.00
GAL94-1A.F.1_2	0.09	100.64	2.67	1.34	0.00	0.00	0.33	0.00
GAL94-1A.F.1_3	0.09	100.80	2.63	1.37	0.00	0.00	0.36	0.00
GAL94-1A.F.1_4	0.13	100.44	2.66	1.34	0.01	0.00	0.33	0.00
GAL94-1A.A.B.2_1	0.12	98.68	2.65	1.36	0.01	0.00	0.34	0.00
GAL94-1A.A.B.2_2	0.10	98.67	2.61	1.40	0.01	0.00	0.38	0.00
GAL94-1A.A.B.2_3	0.13	98.08	2.61	1.39	0.01	0.00	0.40	0.00
GAL94-1A.A.B.2_4	0.15	98.61	2.67	1.33	0.01	0.00	0.34	0.00
GAL94-1A.A.D.1_1	0.11	98.25	2.61	1.39	0.01	0.00	0.39	0.00

Label	Na	K	Total	An	Ab	Or
STAGE 1 feldspar						
GAL94-1A.3_1	0.05	0.94	5.01	0	5	95
GAL94-1A.3_2	0.05	0.95	5.01	0	5	95
GAL94-1A.3_3	0.06	0.96	5.02	0	6	94
GAL94-1A.F.2_1	0.05	0.97	5.02	0	5	95
GAL94-1A.F.2_2	0.05	0.96	5.02	0	5	95
GAL94-1A.A.B.1_1	0.03	0.95	4.99	0	3	97
GAL94-1A.A.B.1_2	0.03	0.95	4.99	0	3	96
GAL94-1A.A.B.1_3	0.04	0.94	4.99	0	4	96
GAL94-1A.A.E.1_1[1]	0.04	0.93	4.98	0	4	96
GAL94-1A.A.E.1_2	0.03	0.93	4.99	0	3	97
GAL94-1A.A.L.1_1	0.04	0.94	4.99	0	4	96
GAL94-1A.A.L.1_2	0.03	0.95	4.99	0	4	96
GAL94-1A.A.L.1_3	0.04	0.94	4.98	0	4	96
GAL94-1A.A.L.1_4	0.04	0.93	4.98	0	4	96
average Stage 1 kspar	0.04	0.95	5.00	0	4	96
standard deviation	0.01	0.01	0.02	0.1	0.9	0.8
GAL94-1A.1_1	0.62	0.01	5.00	37	63	1
GAL94-1A.1_4	0.56	0.01	5.00	42	57	1
GAL94-1A.1_5	0.54	0.01	4.99	44	55	1
GAL94-1A.1_6	0.51	0.01	4.99	47	52	1
GAL94-1A.2_1[1]	0.60	0.01	4.99	38	61	1
GAL94-1A.2_2	0.63	0.01	5.00	36	64	1
GAL94-1A.2_3	0.62	0.00	5.00	36	64	0
GAL94-1A.2_4	0.61	0.01	4.99	37	62	1
GAL94-1A.A.1_1	0.62	0.01	4.98	35	64	1
GAL94-1A.A.1_2	0.65	0.01	4.99	34	66	1
GAL94-1A.A.1_3	0.60	0.01	4.99	38	62	1
GAL94-1A.A.1_4	0.65	0.01	5.01	34	65	1
GAL94-1A.D.1_1	0.67	0.01	4.99	32	68	1
GAL94-1A.D.1_2	0.64	0.01	4.99	34	65	1
GAL94-1A.D.1_3	0.64	0.01	5.00	33	66	1
GAL94-1A.D.1_4	0.65	0.01	5.00	33	66	1
GAL94-1A.E.1_1	0.52	0.01	5.01	47	52	1
GAL94-1A.E.1_2	0.49	0.01	5.00	49	50	1
GAL94-1A.E.1_3	0.59	0.01	5.00	40	59	1
GAL94-1A.E.1_4	0.66	0.01	5.00	33	67	1
GAL94-1A.F.1_1	0.63	0.01	4.99	36	63	1
GAL94-1A.F.1_2	0.64	0.01	4.99	34	66	1
GAL94-1A.F.1_3	0.62	0.01	4.99	37	63	1
GAL94-1A.F.1_4	0.65	0.01	5.00	33	66	1
GAL94-1A.A.B.2_1	0.62	0.01	4.99	35	64	1
GAL94-1A.A.B.2_2	0.59	0.01	4.99	39	61	1
GAL94-1A.A.B.2_3	0.58	0.01	4.99	41	59	1
GAL94-1A.A.B.2_4	0.63	0.01	4.98	35	65	1
GAL94-1A.A.D.1_1	0.58	0.01	4.99	40	60	1

Label		Wt% oxides						
		SiO_2	Al_2O_3	FeO*	MgO	CaO	BaO	Na_2O
GAL94-1A.A.D.1_2	P	58.02	25.45	0.14	0.00	7.43	0.04	6.89
GAL94-1A.A.D.1_3	P	59.17	24.72	0.16	0.00	6.77	0.02	7.08
GAL94-1A.A.D.1_4	PR	57.96	25.31	0.24	0.00	7.47	0.03	6.96
GAL94-1A.A.E.2_1	PC	58.95	25.19	0.09	0.00	6.76	0.00	7.17
GAL94-1A.A.E.2_3	P	56.86	26.41	0.13	0.00	8.32	0.02	6.34
GAL94-1A.A.E.2_4	PR	59.01	24.97	0.21	0.00	6.98	0.00	7.11
GAL94-1A.A.K.1_1	PC	57.92	25.54	0.11	0.00	7.46	0.03	6.87
GAL94-1A.A.K.1_2	P	58.96	25.16	0.16	0.00	7.13	0.02	7.15
GAL94-1A.A.K.1_3	P	59.09	24.91	0.14	0.00	7.00	0.04	7.13
JD97-3.A.B.1_2	P	56.72	27.37	0.12	0.00	9.25	0.03	6.10
JD97-3.A.B.1_3	P	59.39	25.55	0.16	0.00	7.32	0.02	7.08
JD97-3.A.B.1_4	PR	60.02	25.00	0.12	0.00	6.59	0.03	7.49
JD97-3.A.G.1_1	PC	59.10	25.61	0.08	0.00	7.45	0.04	7.10
JD97-3.A.G.1_2	P	56.34	27.34	0.08	0.00	9.19	0.06	5.86
JD97-3.A.G.1_3	P	60.04	24.85	0.11	0.00	6.53	0.00	7.37
JD97-3.A.G.1_4	PR	59.05	25.54	0.09	0.00	7.27	0.00	6.97
JD97-3.A.H.1_1	PC	57.69	27.20	0.12	0.00	8.79	0.01	6.44
JD97-3.A.H.1_2	P	57.66	27.09	0.12	0.00	8.62	0.02	6.49
JD97-3.A.H.1_3	P	56.72	27.58	0.14	0.00	9.28	0.02	6.00
JD97-3.A.H.1_4	PR	57.52	26.52	0.09	0.00	8.40	0.00	6.48
JD97-3.A.I.1_1	PC	56.33	27.34	0.16	0.00	9.52	0.03	5.85
JD97-3.A.I.1_2	P	55.29	28.00	0.12	0.00	10.14	0.00	5.50
JD97-3.A.I.1_3	P	59.37	25.12	0.11	0.00	7.12	0.00	7.12
JD97-3.A.I.1_4	PR	57.52	26.07	0.13	0.00	8.47	0.01	6.45
JD97-3.A.L.1_1	PC	57.48	25.92	0.16	0.00	8.34	0.04	6.39
JD97-3.A.L.1_2	P	58.91	25.40	0.11	0.00	7.08	0.01	7.03
JD97-3.A.L.1_3	P	58.00	26.04	0.06	0.01	7.79	0.02	6.80
JD97-3.A.L.1_4	PR	58.30	25.31	0.03	0.00	7.46	0.02	6.84
average Stage 1 plag		58.61	25.94	0.14	0.00	7.74	0.02	6.91
standard deviation		1.38	0.85	0.10	0.01	0.96	0.02	0.57
STAGE 2 feldspar								
HP99-9.M.1[1]	KC	63.01	18.89	0.07	0.02	0.37	1.58	1.92
HP99-9.M.2	K	63.81	18.57	0.11	0.00	0.21	0.65	2.04
HP99-9.M.3	K	64.49	18.26	0.12	0.01	0.38	0.54	1.87
HP99-9.T.1	KC	63.63	19.07	0.07	0.01	0.37	1.69	2.48
HP99-9.T.2	KR	64.71	18.61	0.17	0.00	0.25	0.68	2.31
average Stage 2 kspar		63.93	18.68	0.11	0.01	0.31	1.03	2.13
standard deviation		0.68	0.31	0.04	0.01	0.08	0.56	0.26
HP99-9.C.1	PC	58.31	25.11	0.13	0.02	7.14	0.02	6.12
HP99-9.C.2	P	58.82	24.92	0.21	0.02	7.10	0.04	6.35
HP99-9.C.3	PR	58.80	25.38	0.33	0.03	7.21	0.07	5.87
HP99-9.M.4	P	58.65	25.36	0.17	0.01	7.76	0.03	5.46
HP99-9.M.5	PR	58.79	24.48	0.67	0.34	7.26	0.21	5.02
HP99-9.M.6	PC	58.29	25.37	0.17	0.03	7.81	0.01	5.45
HP99-9.M.7	P	58.46	25.17	0.16	0.04	7.52	0.00	5.54
HP99-9.O.1	PC	56.22	26.91	0.20	0.05	9.52	0.03	4.91
HP99-9.O.2	P	56.46	26.99	0.16	0.03	9.34	0.01	5.04
HP99-9.O.3[1]	P	58.18	25.52	0.21	0.02	8.00	0.05	5.54
HP99-9.O.4	P	58.03	25.69	0.16	0.05	8.13	0.07	5.50
HP99-9.O.5	PR	59.32	25.00	0.29	0.02	7.30	0.05	5.54
HP99-9.S.1	PC	56.70	26.49	0.22	0.03	8.82	0.04	5.18

Label			Cations					
	K_2O	Total	Si	Al	Fe^{2+}	Mg	Ca	Ba
GAL94-1A.A.D.1_2	0.16	98.14	2.64	1.36	0.01	0.00	0.36	0.00
GAL94-1A.A.D.1_3	0.17	98.08	2.68	1.32	0.01	0.00	0.33	0.00
GAL94-1A.A.D.1_4	0.13	98.09	2.64	1.36	0.01	0.00	0.36	0.00
GAL94-1A.A.E.2_1	0.08	98.24	2.67	1.34	0.00	0.00	0.33	0.00
GAL94-1A.A.E.2_3	0.11	98.19	2.59	1.42	0.00	0.00	0.41	0.00
GAL94-1A.A.E.2_4	0.15	98.44	2.67	1.33	0.01	0.00	0.34	0.00
GAL94-1A.A.K.1_1	0.15	98.09	2.63	1.37	0.00	0.00	0.36	0.00
GAL94-1A.A.K.1_2	0.11	98.68	2.66	1.34	0.01	0.00	0.35	0.00
GAL94-1A.A.K.1_3	0.13	98.44	2.67	1.33	0.01	0.00	0.34	0.00
JD97-3.A.B.1_2	0.17	99.75	2.55	1.45	0.00	0.00	0.45	0.00
JD97-3.A.B.1_3	0.20	99.71	2.66	1.35	0.01	0.00	0.35	0.00
JD97-3.A.B.1_4	0.17	99.42	2.69	1.32	0.00	0.00	0.32	0.00
JD97-3.A.G.1_1	0.13	99.51	2.65	1.35	0.00	0.00	0.36	0.00
JD97-3.A.G.1_2	0.10	98.98	2.55	1.46	0.00	0.00	0.45	0.00
JD97-3.A.G.1_3	0.19	99.10	2.69	1.31	0.00	0.00	0.31	0.00
JD97-3.A.G.1_4	0.14	99.07	2.65	1.35	0.00	0.00	0.35	0.00
JD97-3.A.H.1_1	0.14	100.38	2.57	1.43	0.00	0.00	0.42	0.00
JD97-3.A.H.1_2	0.14	100.14	2.58	1.43	0.00	0.00	0.41	0.00
JD97-3.A.H.1_3	0.12	99.86	2.55	1.46	0.01	0.00	0.45	0.00
JD97-3.A.H.1_4	0.16	99.18	2.59	1.41	0.00	0.00	0.41	0.00
JD97-3.A.I.1_1	0.17	99.40	2.54	1.46	0.01	0.00	0.46	0.00
JD97-3.A.I.1_2	0.14	99.21	2.51	1.50	0.00	0.00	0.49	0.00
JD97-3.A.I.1_3	0.17	99.02	2.67	1.33	0.00	0.00	0.34	0.00
JD97-3.A.I.1_4	0.10	98.75	2.61	1.39	0.00	0.00	0.41	0.00
JD97-3.A.L.1_1	0.16	98.48	2.61	1.39	0.01	0.00	0.41	0.00
JD97-3.A.L.1_2	0.12	98.65	2.66	1.35	0.00	0.00	0.34	0.00
JD97-3.A.L.1_3	0.12	98.84	2.62	1.39	0.00	0.00	0.38	0.00
JD97-3.A.L.1_4	0.11	98.08	2.65	1.36	0.00	0.00	0.36	0.00
average Stage 1 plag	0.13	99.50	2.62	1.38	0.01	0.00	0.37	0.00
standard deviation	0.03	0.99	0.05	0.05	0.00	0.00	0.05	0.00
STAGE 2 feldspar								
HP99-9.M.1[1]	12.20	98.05	2.96	1.05	0.00	0.00	0.02	0.03
HP99-9.M.2	12.71	98.10	2.98	1.02	0.00	0.00	0.01	0.01
HP99-9.M.3	12.60	98.27	3.00	1.00	0.00	0.00	0.02	0.01
HP99-9.T.1	11.75	99.08	2.96	1.05	0.00	0.00	0.02	0.03
HP99-9.T.2	12.12	98.85	2.99	1.01	0.01	0.00	0.01	0.01
average Stage 2 kspar	12.27	98.47	2.98	1.03	0.00	0.00	0.02	0.02
standard deviation	0.39	0.46	0.02	0.02	0.00	0.00	0.00	0.01
HP99-9.C.1	1.41	98.26	2.66	1.35	0.00	0.00	0.35	0.00
HP99-9.C.2	1.27	98.72	2.67	1.33	0.01	0.00	0.34	0.00
HP99-9.C.3	1.74	99.42	2.65	1.35	0.01	0.00	0.35	0.00
HP99-9.M.4	1.60	99.03	2.65	1.35	0.01	0.00	0.38	0.00
HP99-9.M.5	2.15	98.92	2.67	1.31	0.03	0.02	0.35	0.00
HP99-9.M.6	1.56	98.71	2.65	1.36	0.01	0.00	0.38	0.00
HP99-9.M.7	1.50	98.39	2.66	1.35	0.01	0.00	0.37	0.00
HP99-9.O.1	0.95	98.79	2.56	1.44	0.01	0.00	0.46	0.00
HP99-9.O.2	1.01	99.05	2.56	1.44	0.01	0.00	0.45	0.00
HP99-9.O.3[1]	1.38	98.91	2.64	1.36	0.01	0.00	0.39	0.00
HP99-9.O.4	1.25	98.87	2.63	1.37	0.01	0.00	0.39	0.00
HP99-9.O.5	1.67	99.19	2.68	1.33	0.01	0.00	0.35	0.00
HP99-9.S.1	1.13	98.60	2.58	1.42	0.01	0.00	0.43	0.00

Label	Na	K	Total	An	Ab	Or
GAL94-1A.A.D.1_2	0.61	0.01	4.99	37	62	1
GAL94-1A.A.D.1_3	0.62	0.01	4.97	34	65	1
GAL94-1A.A.D.1_4	0.61	0.01	4.99	37	62	1
GAL94-1A.A.E.2_1	0.63	0.00	4.98	34	65	0
GAL94-1A.A.E.2_3	0.56	0.01	4.98	42	58	1
GAL94-1A.A.E.2_4	0.62	0.01	4.98	35	64	1
GAL94-1A.A.K.1_1	0.61	0.01	4.99	37	62	1
GAL94-1A.A.K.1_2	0.63	0.01	4.98	35	64	1
GAL94-1A.A.K.1_3	0.63	0.01	4.98	35	64	1
JD97-3.A.B.1_2	0.53	0.01	4.99	45	54	1
JD97-3.A.B.1_3	0.61	0.01	4.98	36	63	1
JD97-3.A.B.1_4	0.65	0.01	4.98	32	67	1
JD97-3.A.G.1_1	0.62	0.01	4.99	36	63	1
JD97-3.A.G.1_2	0.51	0.01	4.98	46	53	1
JD97-3.A.G.1_3	0.64	0.01	4.98	32	66	1
JD97-3.A.G.1_4	0.61	0.01	4.98	36	63	1
JD97-3.A.H.1_1	0.56	0.01	4.99	43	57	1
JD97-3.A.H.1_2	0.56	0.01	4.99	42	57	1
JD97-3.A.H.1_3	0.52	0.01	4.99	46	54	1
JD97-3.A.H.1_4	0.57	0.01	4.99	41	58	1
JD97-3.A.I.1_1	0.51	0.01	4.99	47	52	1
JD97-3.A.I.1_2	0.48	0.01	4.99	50	49	1
JD97-3.A.I.1_3	0.62	0.01	4.98	35	64	1
JD97-3.A.I.1_4	0.57	0.01	4.99	42	58	1
JD97-3.A.L.1_1	0.56	0.01	4.98	42	58	1
JD97-3.A.L.1_2	0.62	0.01	4.98	35	64	1
JD97-3.A.L.1_3	0.60	0.01	4.99	39	61	1
JD97-3.A.L.1_4	0.60	0.01	4.98	37	62	1
average Stage 1 plag	0.60	0.01	4.99	38	61	1
standard deviation	0.05	0.00	0.01	4.7	4.7	0.2
STAGE 2 feldspar						
HP99-9.M.1[1]	0.18	0.73	4.97	2	19	79
HP99-9.M.2	0.19	0.76	4.98	1	19	80
HP99-9.M.3	0.17	0.75	4.96	2	18	80
HP99-9.T.1	0.22	0.70	4.98	2	24	74
HP99-9.T.2	0.21	0.71	4.96	1	22	76
average Stage 2 kspar	0.19	0.73	4.97	2	20	78
standard deviation	0.02	0.02	0.01	0.4	2.4	2.4
HP99-9.C.1	0.54	0.08	4.98	36	56	8
HP99-9.C.2	0.56	0.07	4.98	35	57	8
HP99-9.C.3	0.51	0.10	4.98	36	53	10
HP99-9.M.4	0.48	0.09	4.96	40	51	10
HP99-9.M.5	0.44	0.12	4.96	38	48	14
HP99-9.M.6	0.48	0.09	4.96	40	51	10
HP99-9.M.7	0.49	0.09	4.96	39	52	9
HP99-9.O.1	0.43	0.06	4.96	49	45	6
HP99-9.O.2	0.44	0.06	4.97	47	46	6
HP99-9.O.3[1]	0.49	0.08	4.97	41	51	8
HP99-9.O.4	0.48	0.07	4.96	42	51	8
HP99-9.O.5	0.48	0.10	4.95	38	52	10
HP99-9.S.1	0.46	0.07	4.97	45	48	7

Label		Wt% oxides						
		SiO_2	Al_2O_3	FeO*	MgO	CaO	BaO	Na_2O
HP99-9.S.2	P	58.05	25.63	0.22	0.04	8.26	0.02	5.56
HP99-9.S.3	P	57.74	25.67	0.18	0.02	8.12	0.01	5.57
HP99-9.S.4	PR	58.43	25.94	0.17	0.02	7.85	0.00	5.65
HP99-9.T.3	PC	58.19	25.87	0.21	0.01	7.92	0.00	5.72
HP99-9.T.4	P	58.49	25.90	0.22	0.04	7.91	0.05	5.82
HP99-9.T.5	PR	58.91	25.66	0.34	0.05	7.71	0.05	5.68
average Stage 2 plag		58.15	25.63	0.23	0.05	7.93	0.04	5.55
standard deviation		0.84	0.64	0.12	0.07	0.69	0.05	0.36
STAGE 3 feldspar								
JD97-1.A.E.1	P	56.77	26.71	0.23	0.04	8.74	0.03	5.50
JD97-1.A.E.2	P	58.04	25.66	0.20	0.04	8.37	0.02	5.76
JD97-1.A.E.3	PR	58.17	25.77	0.18	0.01	8.13	0.00	5.75
JD97-1.A.F.1	P	59.16	25.19	0.16	0.04	7.74	0.06	5.98
JD97-1.A.F.2	PR	54.16	27.75	0.93	0.09	11.14	0.04	4.51
JD97-1.A.F.3	P	57.16	26.40	0.17	0.01	8.93	0.04	5.67
JD97-1.A.G.1	P	58.54	25.39	0.17	0.01	7.97	0.01	5.73
JD97-1.A.H.2	PR	54.17	27.79	1.01	0.08	11.16	0.00	4.65
JD97-1.A.H.3[1]	P	57.42	26.33	0.23	0.03	8.55	0.02	5.77
JD97-1.A.I.1	P	58.15	25.62	0.35	0.04	7.95	0.06	6.00
JD97-1.A.J.2	P	59.25	25.48	0.89	0.10	10.19	0.02	4.12
JD97-1.A.N.1	P	58.34	25.04	0.14	0.03	8.16	0.03	5.82
JD97-1.A.N.2	PR	59.03	24.91	0.17	0.02	7.67	0.06	6.17
JD97-1.A.O.1	PR	58.61	24.82	0.17	0.02	7.56	0.07	6.09
JD97-1.A.O.3	P	59.01	24.64	0.14	0.01	7.52	0.05	6.32
JD97-1.A.Q.1	P	58.39	25.33	0.14	0.03	8.13	0.05	5.79
JD97-1.A.Q.2	PR	58.12	25.25	0.21	0.02	7.95	0.04	5.83
JD97-1.A.R.1	P	58.19	25.44	0.16	0.01	7.96	0.00	6.07
JD97-1.A.R.2	PR	58.34	25.45	0.23	0.01	7.70	0.03	6.13
JD97-1.B.A.1	P	58.22	25.49	0.17	0.02	7.82	0.04	6.24
JD97-1.B.A.2	PR	60.39	24.06	0.15	0.00	6.59	0.01	6.53
JD97-1.B.A.3	P	56.67	26.61	0.17	0.02	8.93	0.01	5.63
JD97-1.B.C.1	P	56.74	26.92	0.11	0.02	9.14	0.04	5.50
JD97-1.B.C.3	P	57.64	26.16	0.21	0.02	8.21	0.03	6.05
JD97-1.B.D.1	P	58.84	25.23	0.16	0.02	7.39	0.03	6.38
JD97-1.B.D.2	PR	59.18	25.32	0.17	0.00	7.26	0.04	6.38
JD97-1.B.D.3	PR	59.03	25.34	0.26	0.03	7.51	0.06	6.18
JD97-1.B.E.1	P	59.32	25.19	0.24	0.02	7.33	0.02	6.27
JD97-1.B.E.2	PR	59.53	24.97	0.21	0.01	7.10	0.04	6.31
JD97-1.B.H.1	P	60.82	23.73	0.22	0.03	5.98	0.00	6.78
JD97-1.B.H.2	PR	58.31	25.03	0.25	0.03	7.45	0.01	6.33
average Stage 3 relict plag		58.18	25.58	0.26	0.03	8.14	0.03	5.88
standard deviation		1.43	0.91	0.23	0.02	1.12	0.02	0.57
JD97-1.A.A.2	B	52.95	28.44	0.81	0.03	10.73	0.59	4.45
JD97-1.A.A.3	B	53.05	28.26	0.65	0.07	10.74	0.54	4.36
average Stage 3 plag after bio		53.00	28.35	0.73	0.05	10.74	0.56	4.40
standard deviation		0.07	0.13	0.12	0.03	0.01	0.03	0.07
JD97-1.A.H.1[1]	Q	56.18	26.23	1.00	0.08	9.52	0.04	5.40
STAGE 4 feldspar								
GAL94-3A.A.C.1	P	64.97	20.57	0.74	0.11	7.53	0.03	2.85
GAL94-3A.A.C.2	PR	55.36	27.25	0.93	0.11	11.43	0.03	3.52
GAL94-3A.A.I.1	P	54.88	26.99	1.26	0.12	10.52	0.09	4.19

Label			Cations					
	K_2O	Total	Si	Al	Fe^{2+}	Mg	Ca	Ba
HP99-9.S.2	1.20	98.97	2.63	1.37	0.01	0.00	0.40	0.00
HP99-9.S.3	1.34	98.64	2.62	1.38	0.01	0.00	0.40	0.00
HP99-9.S.4	1.42	99.48	2.63	1.38	0.01	0.00	0.38	0.00
HP99-9.T.3	1.27	99.19	2.63	1.38	0.01	0.00	0.38	0.00
HP99-9.T.4	1.31	99.74	2.63	1.37	0.01	0.00	0.38	0.00
HP99-9.T.5	1.41	99.80	2.64	1.36	0.01	0.00	0.37	0.00
average Stage 2 plag	1.40	98.98	2.63	1.37	0.01	0.00	0.38	0.00
standard deviation	0.27	0.42	0.03	0.04	0.00	0.00	0.03	0.00
STAGE 3 feldspar								
JD97-1.A.E.1	0.57	98.58	2.58	1.43	0.01	0.00	0.43	0.00
JD97-1.A.E.2	0.59	98.66	2.63	1.37	0.01	0.00	0.41	0.00
JD97-1.A.E.3	0.65	98.67	2.63	1.37	0.01	0.00	0.39	0.00
JD97-1.A.F.1	0.65	98.97	2.67	1.34	0.01	0.00	0.37	0.00
JD97-1.A.F.2	0.39	99.00	2.48	1.50	0.04	0.01	0.55	0.00
JD97-1.A.F.3	0.48	98.85	2.59	1.41	0.01	0.00	0.43	0.00
JD97-1.A.G.1	0.63	98.45	2.65	1.36	0.01	0.00	0.39	0.00
JD97-1.A.H.2	0.36	99.23	2.47	1.50	0.04	0.01	0.55	0.00
JD97-1.A.H.3[1]	0.61	98.95	2.60	1.40	0.01	0.00	0.41	0.00
JD97-1.A.I.1	0.66	98.83	2.63	1.37	0.01	0.00	0.39	0.00
JD97-1.A.J.2	0.41	100.47	2.64	1.34	0.03	0.01	0.49	0.00
JD97-1.A.N.1	0.62	98.20	2.65	1.34	0.01	0.00	0.40	0.00
JD97-1.A.N.2	0.66	98.68	2.67	1.33	0.01	0.00	0.37	0.00
JD97-1.A.O.1	0.71	98.06	2.67	1.33	0.01	0.00	0.37	0.00
JD97-1.A.O.3	0.64	98.33	2.68	1.32	0.01	0.00	0.37	0.00
JD97-1.A.Q.1	0.61	98.47	2.65	1.35	0.01	0.00	0.40	0.00
JD97-1.A.Q.2	0.68	98.09	2.65	1.36	0.01	0.00	0.39	0.00
JD97-1.A.R.1	0.57	98.40	2.64	1.36	0.01	0.00	0.39	0.00
JD97-1.A.R.2	0.68	98.55	2.64	1.36	0.01	0.00	0.37	0.00
JD97-1.B.A.1	0.69	98.69	2.64	1.36	0.01	0.00	0.38	0.00
JD97-1.B.A.2	0.94	98.67	2.72	1.28	0.01	0.00	0.32	0.00
JD97-1.B.A.3	0.57	98.60	2.58	1.43	0.01	0.00	0.43	0.00
JD97-1.B.C.1	0.59	99.05	2.57	1.44	0.00	0.00	0.44	0.00
JD97-1.B.C.3	0.69	99.00	2.61	1.39	0.01	0.00	0.40	0.00
JD97-1.B.D.1	0.76	98.81	2.66	1.34	0.01	0.00	0.36	0.00
JD97-1.B.D.2	0.83	99.19	2.66	1.34	0.01	0.00	0.35	0.00
JD97-1.B.D.3	0.86	99.25	2.66	1.34	0.01	0.00	0.36	0.00
JD97-1.B.E.1	0.81	99.19	2.67	1.34	0.01	0.00	0.35	0.00
JD97-1.B.E.2	0.88	99.05	2.68	1.33	0.01	0.00	0.34	0.00
JD97-1.B.H.1	1.08	98.63	2.74	1.26	0.01	0.00	0.29	0.00
JD97-1.B.H.2	0.75	98.16	2.65	1.34	0.01	0.00	0.36	0.00
average Stage 3 relict plag	0.66	98.77	2.63	1.37	0.01	0.00	0.39	0.00
standard deviation	0.15	0.46	0.06	0.05	0.01	0.00	0.06	0.00
JD97-1.A.A.2	0.48	98.49	2.44	1.55	0.03	0.00	0.53	0.01
JD97-1.A.A.3	0.62	98.29	2.45	1.54	0.03	0.01	0.53	0.01
average Stage 3 plag after bio	0.55	98.39	2.45	1.54	0.03	0.00	0.53	0.01
standard deviation	0.10	0.14	0.01	0.01	0.00	0.00	0.00	0.00
JD97-1.A.H.1[1]	0.55	98.99	2.56	1.41	0.04	0.01	0.46	0.00
STAGE 4 feldspar								
GAL94-3A.A.C.1	2.32	99.12	2.90	1.08	0.03	0.01	0.36	0.00
GAL94-3A.A.C.2	0.84	99.48	2.52	1.46	0.04	0.01	0.56	0.00
GAL94-3A.A.I.1	0.72	98.76	2.52	1.46	0.05	0.01	0.52	0.00

Label	Na	K	Total	An	Ab	Or
HP99-9.S.2	0.49	0.07	4.97	42	51	7
HP99-9.S.3	0.49	0.08	4.97	41	51	8
HP99-9.S.4	0.49	0.08	4.97	40	52	9
HP99-9.T.3	0.50	0.07	4.97	40	52	8
HP99-9.T.4	0.51	0.08	4.98	40	53	8
HP99-9.T.5	0.49	0.08	4.96	39	52	9
average Stage 2 plag	0.49	0.08	4.97	40	51	8
standard deviation	0.03	0.02	0.01	3.5	2.8	1.8
STAGE 3 feldspar						
JD97-1.A.E.1	0.48	0.03	4.96	45	51	3
JD97-1.A.E.2	0.51	0.03	4.96	43	53	4
JD97-1.A.E.3	0.50	0.04	4.95	42	54	4
JD97-1.A.F.1	0.52	0.04	4.95	40	56	4
JD97-1.A.F.2	0.40	0.02	4.99	56	41	2
JD97-1.A.F.3	0.50	0.03	4.97	45	52	3
JD97-1.A.G.1	0.50	0.04	4.94	42	54	4
JD97-1.A.H.2	0.41	0.02	4.99	56	42	2
JD97-1.A.H.3[1]	0.51	0.04	4.97	43	53	4
JD97-1.A.I.1	0.53	0.04	4.97	41	55	4
JD97-1.A.J.2	0.36	0.02	4.88	56	41	3
JD97-1.A.N.1	0.51	0.04	4.95	42	54	4
JD97-1.A.N.2	0.54	0.04	4.96	39	57	4
JD97-1.A.O.1	0.54	0.04	4.96	39	57	4
JD97-1.A.O.3	0.56	0.04	4.96	38	58	4
JD97-1.A.Q.1	0.51	0.04	4.95	42	54	4
JD97-1.A.Q.2	0.51	0.04	4.95	41	55	4
JD97-1.A.R.1	0.53	0.03	4.96	41	56	3
JD97-1.A.R.2	0.54	0.04	4.96	39	57	4
JD97-1.B.A.1	0.55	0.04	4.98	39	57	4
JD97-1.B.A.2	0.57	0.05	4.95	34	61	6
JD97-1.B.A.3	0.50	0.03	4.98	45	51	3
JD97-1.B.C.1	0.48	0.03	4.97	46	50	4
JD97-1.B.C.3	0.53	0.04	4.98	41	55	4
JD97-1.B.D.1	0.56	0.04	4.97	37	58	5
JD97-1.B.D.2	0.56	0.05	4.97	37	58	5
JD97-1.B.D.3	0.54	0.05	4.96	38	57	5
JD97-1.B.E.1	0.55	0.05	4.96	37	58	5
JD97-1.B.E.2	0.55	0.05	4.96	36	58	5
JD97-1.B.H.1	0.59	0.06	4.96	31	63	7
JD97-1.B.H.2	0.56	0.04	4.98	38	58	5
average Stage 3 relict plag	0.52	0.04	4.96	42	54	4
standard deviation	0.05	0.01	0.02	5.9	5.1	0.9
JD97-1.A.A.2	0.40	0.03	4.99	55	42	3
JD97-1.A.A.3	0.39	0.04	4.99	55	41	4
average Stage 3 plag after bio	0.39	0.03	4.99	55	41	3
standard deviation	0.01	0.01	0.00	0.1	0.6	0.6
JD97-1.A.H.1[1]	0.48	0.03	4.99	48	49	3
STAGE 4 feldspar						
GAL94-3A.A.C.1	0.25	0.13	4.75	49	33	18
GAL94-3A.A.C.2	0.31	0.05	4.93	61	34	5
GAL94-3A.A.I.1	0.37	0.04	4.96	56	40	5

Label		Wt% oxides						
		SiO_2	Al_2O_3	FeO*	MgO	CaO	BaO	Na_2O
GAL94-3A.A.I.2	PR	59.81	23.68	0.72	0.08	8.96	0.36	3.33
GAL94-3A.A.I.4	P	54.61	27.49	0.58	0.05	10.54	0.04	4.47
GAL94-3A.A.L.3	P	58.40	24.90	0.48	0.06	7.76	0.10	5.85
GAL94-3A.A.L.5	P	64.30	20.43	0.98	0.27	7.49	0.18	3.02
GAL94-3A.A.L.6	PR	62.56	21.71	0.81	0.04	7.82	0.12	3.12
GAL94-3A.A.M.1	P	57.44	25.47	0.59	0.09	8.24	0.05	5.69
GAL94-3A.B.E.2	PR	54.30	27.39	1.00	0.09	11.46	0.06	3.76
GAL94-3A.B.G.1	P	58.06	25.43	0.66	0.06	8.03	0.04	5.63
GAL94-3A.B.G.3	P	55.97	26.22	0.96	0.09	11.29	0.07	3.46
GAL94-3A.B.G.4[1]	PR	55.32	26.92	0.98	0.11	10.61	0.05	4.24
GAL94-3A.B.I.3	P	59.29	24.55	0.96	0.08	10.61	0.03	3.00
average Stage 4 relict plag		58.23	24.93	0.83	0.10	9.45	0.09	4.01
standard deviation		3.58	2.48	0.21	0.05	1.60	0.09	1.05
GAL94-3A.B.F.1	B	52.74	28.17	1.45	0.18	12.11	0.05	3.27
GAL94-3A.B.F.2	B	50.39	30.30	1.14	0.14	13.74	0.05	3.17
average Stage 4 plag after bio		51.56	29.24	1.29	0.16	12.93	0.05	3.22
standard deviation		1.67	1.50	0.22	0.02	1.15	0.00	0.07
GAL94-3A.A.L.7	Q	62.08	22.06	0.96	0.08	7.91	0.21	3.31
GAL94-3A.B.J.2	Q	52.55	28.41	1.12	0.10	12.53	0.05	3.75
average Stage 4 quench plag		57.32	25.23	1.04	0.09	10.22	0.13	3.53
standard deviation		6.74	4.48	0.11	0.02	3.27	0.11	0.32
STAGE 5 feldspar								
JD97-4.A.A.1	P	57.33	26.46	0.30	0.05	9.05	0.03	5.88
JD97-4.A.A.2	P	59.85	25.19	0.17	0.02	7.80	0.04	6.16
JD97-4.A.A.3	PR	54.80	27.57	0.94	0.12	10.90	0.03	4.90
JD97-4.A.A.5	P	59.33	25.52	0.16	0.02	7.84	0.02	6.21
JD97-4.A.A.6	PR	63.22	22.99	0.90	0.06	8.72	0.04	4.49
JD97-4.A.C.1	P	56.31	26.69	0.36	0.03	9.34	0.04	5.76
JD97-4.A.H.5	PR	56.24	26.50	1.01	0.07	9.39	0.00	5.59
JD97-4.A.H.6	P	59.23	25.15	0.33	0.02	7.65	0.00	6.38
JD97-4.A.I.1	P	57.45	25.98	0.37	0.07	9.06	0.03	5.28
JD97-4.A.I.2	P	58.19	25.64	0.49	0.04	8.28	0.03	6.06
JD97-4.A.I.3	PR	54.04	27.37	1.20	0.13	11.02	0.03	4.62
JD97-4.A.J.1	P	58.17	25.87	0.30	0.04	8.14	0.04	6.18
JD97-4.A.J.2	PR	55.58	26.74	1.06	0.09	9.83	0.08	5.33
JD97-4.A.S.1[1]	P	56.59	26.64	0.23	0.03	9.51	0.08	5.42
JD97-4.A.S.2	PR	55.30	26.96	1.00	0.10	10.40	0.06	4.99
JD97-4.A.T.1	P	57.45	26.95	0.19	0.04	9.22	0.07	5.65
JD97-4.A.T.2	PR	54.64	27.34	1.03	0.10	11.12	0.02	4.78
JD97-4.A.T.3	P	57.40	26.91	0.23	0.04	9.33	0.03	5.58
JD97-4.A.T.4	PR	54.85	27.41	1.10	0.09	10.74	0.04	4.93
JD97-4.A.U.1	P	58.76	25.75	0.54	0.05	8.57	0.03	5.76
JD97-4.A.U.2	PR	56.51	26.52	0.96	0.08	9.91	0.05	5.36
JD97-4.B.B.1	P	56.36	27.77	0.22	0.02	9.96	0.07	5.29
JD97-4.B.B.2	P	55.52	27.49	0.53	0.06	10.06	0.04	5.32
JD97-4.B.B.3	PR	54.85	27.30	1.14	0.10	10.27	0.05	5.04
JD97-4.B.G.1	P	57.70	26.49	0.24	0.03	8.83	0.02	5.97
JD97-4.B.G.2	P	59.21	25.44	0.20	0.02	7.92	0.03	6.33
JD97-4.B.G.3	PR	54.85	27.03	1.13	0.11	10.71	0.04	4.95
JD97-4.B.G.4	P	57.02	26.84	0.39	0.04	9.41	0.04	5.86
JD97-4.B.G.5	PR	54.14	27.48	1.06	0.07	10.91	0.05	4.93

Label			Cations					
	K_2O	Total	Si	Al	Fe^{2+}	Mg	Ca	Ba
GAL94-3A.A.I.2	1.59	98.52	2.72	1.27	0.03	0.01	0.44	0.01
GAL94-3A.A.I.4	0.50	98.29	2.51	1.49	0.02	0.00	0.52	0.00
GAL94-3A.A.L.3	1.06	98.61	2.65	1.33	0.02	0.00	0.38	0.00
GAL94-3A.A.L.5	1.82	98.47	2.89	1.08	0.04	0.02	0.36	0.00
GAL94-3A.A.L.6	2.70	98.87	2.82	1.15	0.03	0.00	0.38	0.00
GAL94-3A.A.M.1	0.89	98.46	2.62	1.37	0.02	0.01	0.40	0.00
GAL94-3A.B.E.2	0.37	98.42	2.49	1.48	0.04	0.01	0.56	0.00
GAL94-3A.B.G.1	0.90	98.83	2.63	1.36	0.03	0.00	0.39	0.00
GAL94-3A.B.G.3	0.57	98.64	2.56	1.41	0.04	0.01	0.55	0.00
GAL94-3A.B.G.4[1]	0.63	98.86	2.53	1.45	0.04	0.01	0.52	0.00
GAL94-3A.B.I.3	0.51	99.02	2.67	1.30	0.04	0.01	0.51	0.00
average Stage 4 relict plag	1.10	98.74	2.64	1.34	0.03	0.01	0.46	0.00
standard deviation	0.72	0.32	0.14	0.14	0.01	0.00	0.08	0.00
GAL94-3A.B.F.1	0.58	98.55	2.43	1.53	0.06	0.01	0.60	0.00
GAL94-3A.B.F.2	0.26	99.18	2.32	1.65	0.04	0.01	0.68	0.00
average Stage 4 plag after bio	0.42	98.87	2.38	1.59	0.05	0.01	0.64	0.00
standard deviation	0.23	0.44	0.08	0.08	0.01	0.00	0.06	0.00
GAL94-3A.A.L.7	1.91	98.53	2.80	1.17	0.04	0.01	0.38	0.00
GAL94-3A.B.J.2	0.41	98.93	2.42	1.54	0.04	0.01	0.62	0.00
average Stage 4 quench plag	1.16	98.73	2.61	1.36	0.04	0.01	0.50	0.00
standard deviation	1.06	0.28	0.27	0.26	0.00	0.00	0.17	0.00
STAGE 5 feldspar								
JD97-4.A.A.1	0.45	99.55	2.58	1.41	0.01	0.00	0.44	0.00
JD97-4.A.A.2	0.56	99.79	2.67	1.33	0.01	0.00	0.37	0.00
JD97-4.A.A.3	0.31	99.58	2.49	1.48	0.04	0.01	0.53	0.00
JD97-4.A.A.5	0.54	99.62	2.66	1.35	0.01	0.00	0.38	0.00
JD97-4.A.A.6	0.35	100.77	2.78	1.19	0.03	0.00	0.41	0.00
JD97-4.A.C.1	0.42	98.96	2.56	1.43	0.01	0.00	0.45	0.00
JD97-4.A.H.5	0.47	99.28	2.56	1.42	0.04	0.01	0.46	0.00
JD97-4.A.H.6	0.59	99.36	2.66	1.33	0.01	0.00	0.37	0.00
JD97-4.A.I.1	0.77	99.00	2.60	1.39	0.01	0.00	0.44	0.00
JD97-4.A.I.2	0.52	99.26	2.63	1.36	0.02	0.00	0.40	0.00
JD97-4.A.I.3	0.31	98.72	2.48	1.48	0.05	0.01	0.54	0.00
JD97-4.A.J.1	0.52	99.26	2.62	1.37	0.01	0.00	0.39	0.00
JD97-4.A.J.2	0.39	99.11	2.53	1.44	0.04	0.01	0.48	0.00
JD97-4.A.S.1[1]	0.40	98.90	2.57	1.43	0.01	0.00	0.46	0.00
JD97-4.A.S.2	0.34	99.15	2.52	1.45	0.04	0.01	0.51	0.00
JD97-4.A.T.1	0.42	99.97	2.58	1.42	0.01	0.00	0.44	0.00
JD97-4.A.T.2	0.29	99.33	2.49	1.47	0.04	0.01	0.54	0.00
JD97-4.A.T.3	0.42	99.96	2.58	1.42	0.01	0.00	0.45	0.00
JD97-4.A.T.4	0.36	99.51	2.50	1.47	0.04	0.01	0.52	0.00
JD97-4.A.U.1	0.55	100.02	2.63	1.36	0.02	0.00	0.41	0.00
JD97-4.A.U.2	0.44	99.83	2.55	1.41	0.04	0.01	0.48	0.00
JD97-4.B.B.1	0.39	100.08	2.53	1.47	0.01	0.00	0.48	0.00
JD97-4.B.B.2	0.36	99.39	2.52	1.47	0.02	0.00	0.49	0.00
JD97-4.B.B.3	0.40	99.16	2.50	1.47	0.04	0.01	0.50	0.00
JD97-4.B.G.1	0.51	99.77	2.59	1.40	0.01	0.00	0.43	0.00
JD97-4.B.G.2	0.57	99.72	2.65	1.34	0.01	0.00	0.38	0.00
JD97-4.B.G.3	0.37	99.20	2.51	1.46	0.04	0.01	0.52	0.00
JD97-4.B.G.4	0.44	100.04	2.56	1.42	0.01	0.00	0.45	0.00
JD97-4.B.G.5	0.38	99.03	2.48	1.48	0.04	0.01	0.54	0.00

Label	Na	K	Total	An	Ab	Or
GAL94-3A.A.I.2	0.29	0.09	4.84	53	36	11
GAL94-3A.A.I.4	0.40	0.03	4.96	55	42	3
GAL94-3A.A.L.3	0.52	0.06	4.97	40	54	6
GAL94-3A.A.L.5	0.26	0.10	4.75	50	36	14
GAL94-3A.A.L.6	0.27	0.16	4.82	47	34	19
GAL94-3A.A.M.1	0.50	0.05	4.97	42	53	5
GAL94-3A.B.E.2	0.33	0.02	4.94	61	36	2
GAL94-3A.B.G.1	0.50	0.05	4.96	42	53	6
GAL94-3A.B.G.3	0.31	0.03	4.91	62	34	4
GAL94-3A.B.G.4[1]	0.38	0.04	4.95	56	40	4
GAL94-3A.B.I.3	0.26	0.03	4.82	64	33	4
average Stage 4 relict plag	0.35	0.06	4.90	53	40	8
standard deviation	0.09	0.04	0.08	8.0	7.7	5.7
GAL94-3A.B.F.1	0.29	0.03	4.96	65	32	4
GAL94-3A.B.F.2	0.28	0.02	5.00	69	29	2
average Stage 4 plag after bio	0.29	0.02	4.98	67	30	3
standard deviation	0.01	0.01	0.03	3.3	1.8	1.5
GAL94-3A.A.L.7	0.29	0.11	4.81	49	37	14
GAL94-3A.B.J.2	0.34	0.02	4.99	63	34	2
average Stage 4 quench plag	0.31	0.07	4.90	56	36	8
standard deviation	0.03	0.06	0.13	10.1	1.9	8.2
STAGE 5 feldspar						
JD97-4.A.A.1	0.51	0.03	4.98	45	53	3
JD97-4.A.A.2	0.53	0.03	4.95	40	57	3
JD97-4.A.A.3	0.43	0.02	4.99	54	44	2
JD97-4.A.A.5	0.54	0.03	4.96	40	57	3
JD97-4.A.A.6	0.38	0.02	4.82	51	47	2
JD97-4.A.C.1	0.51	0.02	4.99	46	51	2
JD97-4.A.H.5	0.49	0.03	4.99	47	50	3
JD97-4.A.H.6	0.56	0.03	4.97	38	58	4
JD97-4.A.I.1	0.46	0.04	4.96	46	49	5
JD97-4.A.I.2	0.53	0.03	4.97	42	55	3
JD97-4.A.I.3	0.41	0.02	4.99	56	42	2
JD97-4.A.J.1	0.54	0.03	4.97	41	56	3
JD97-4.A.J.2	0.47	0.02	4.99	49	48	2
JD97-4.A.S.1[1]	0.48	0.02	4.97	48	50	2
JD97-4.A.S.2	0.44	0.02	4.98	52	46	2
JD97-4.A.T.1	0.49	0.02	4.97	46	51	2
JD97-4.A.T.2	0.42	0.02	4.99	55	43	2
JD97-4.A.T.3	0.49	0.02	4.97	47	51	3
JD97-4.A.T.4	0.44	0.02	5.00	53	44	2
JD97-4.A.U.1	0.50	0.03	4.96	44	53	3
JD97-4.A.U.2	0.47	0.03	4.99	49	48	3
JD97-4.B.B.1	0.46	0.02	4.97	50	48	2
JD97-4.B.B.2	0.47	0.02	4.99	50	48	2
JD97-4.B.B.3	0.45	0.02	5.00	52	46	2
JD97-4.B.G.1	0.52	0.03	4.98	44	53	3
JD97-4.B.G.2	0.55	0.03	4.97	39	57	3
JD97-4.B.G.3	0.44	0.02	5.00	53	45	2
JD97-4.B.G.4	0.51	0.03	4.99	46	52	3
JD97-4.B.G.5	0.44	0.02	5.01	54	44	2

Label		Wt% oxides						
		SiO_2	Al_2O_3	FeO*	MgO	CaO	BaO	Na_2O
JD97-4.B.H.1	P	58.63	25.58	0.17	0.04	8.15	0.05	6.06
JD97-4.B.H.2	P	58.66	25.66	0.28	0.03	8.27	0.00	6.21
JD97-4.B.H.3	PR	54.45	27.81	0.60	0.07	11.15	0.00	4.78
JD97-4.B.K.1	P	56.29	26.76	0.26	0.03	9.39	0.00	5.67
JD97-4.B.K.2	PR	53.17	28.10	1.11	0.11	11.61	0.03	4.44
JD97-4.B.M.1	P	53.46	28.57	0.75	0.08	11.86	0.01	4.47
JD97-4.B.M.2	PR	53.57	27.74	1.14	0.12	11.53	0.05	4.44
JD97-4.B.N.3	PR	53.88	28.08	0.75	0.06	11.42	0.02	4.59
JD97-4.B.N.4	P	56.92	27.10	0.36	0.04	9.28	0.04	5.70
average Stage 5 relict plag		56.58	26.67	0.61	0.06	9.65	0.04	5.40
standard deviation		2.17	1.07	0.37	0.03	1.21	0.02	0.60
JD97-4.B.J.1	B	53.14	28.87	0.95	0.09	11.55	0.16	4.40
JD97-4.B.J.2	B	54.46	26.63	1.54	0.34	9.31	0.15	5.08
average Stage 5 plag after bio		53.80	27.75	1.25	0.22	10.43	0.16	4.74
standard deviation		0.93	1.58	0.42	0.17	1.59	0.00	0.48
JD97-4.A.A.4	Q	59.25	24.35	0.94	0.09	8.92	0.04	5.07
JD97-4.A.H.1	Q	55.92	26.73	1.09	0.13	9.97	0.04	5.39
JD97-4.A.H.2[1]	Q	54.81	27.12	1.31	0.12	10.47	0.02	4.88
JD97-4.A.H.3	Q	54.11	27.52	1.08	0.12	11.11	0.02	4.63
JD97-4.A.H.4	Q	53.41	28.19	1.02	0.12	11.77	0.02	4.36
JD97-4.A.J.3	Q	53.77	27.71	1.25	0.13	11.32	0.07	4.57
JD97-4.B.B.4	Q	55.22	27.03	0.98	0.12	10.17	0.02	5.10
JD97-4.B.C.1	Q	54.05	27.79	0.96	0.10	11.38	0.01	4.60
JD97-4.B.C.2	Q	55.45	26.91	0.96	0.10	9.91	0.04	5.40
JD97-4.B.I.1	Q	53.96	28.04	1.04	0.12	11.83	0.02	4.44
JD97-4.B.I.2	Q	53.87	27.94	1.11	0.10	11.48	0.03	4.50
JD97-4.B.I.3	Q	53.71	28.30	1.01	0.11	11.58	0.06	4.55
JD97-4.B.L.1	Q	54.19	27.30	1.11	0.11	11.18	0.03	4.74
JD97-4.B.M.4	Q	53.61	27.81	1.23	0.13	11.49	0.06	4.52
JD97-4.B.N.1	Q	56.11	26.86	0.74	0.07	9.83	0.04	5.35
JD97-4.B.N.2	Q	55.06	27.31	1.08	0.13	10.43	0.01	5.02
average Stage 5 quench plag		54.78	27.31	1.06	0.11	10.80	0.03	4.82
standard deviation		1.46	0.93	0.14	0.02	0.86	0.02	0.36

[1] indicates points selected as representative compositions and presented in the main text.

* indicates all Fe as FeO.

Code as follows: K, primary/residual alkali feldspar; P, primary/residual plaigoclase feldspar; C, point analyzed in core of a crystal; R, point analyzed at the rim of a crystal; B, plagioclase feldspar replacing biotite; Q, plagioclase feldspar quench crystal.

Feldspar stoichiometry calculated on the basis of 8 oxygen.

Label			Cations					
	K_2O	Total	Si	Al	Fe^{2+}	Mg	Ca	Ba
JD97-4.B.H.1	0.64	99.33	2.64	1.36	0.01	0.00	0.39	0.00
JD97-4.B.H.2	0.63	99.75	2.63	1.36	0.01	0.00	0.40	0.00
JD97-4.B.H.3	0.35	99.22	2.48	1.49	0.02	0.00	0.54	0.00
JD97-4.B.K.1	0.41	98.81	2.56	1.43	0.01	0.00	0.46	0.00
JD97-4.B.K.2	0.27	98.83	2.44	1.52	0.04	0.01	0.57	0.00
JD97-4.B.M.1	0.30	99.49	2.44	1.54	0.03	0.01	0.58	0.00
JD97-4.B.M.2	0.30	98.88	2.46	1.50	0.04	0.01	0.57	0.00
JD97-4.B.N.3	0.34	99.15	2.46	1.51	0.03	0.00	0.56	0.00
JD97-4.B.N.4	0.47	99.92	2.56	1.44	0.01	0.00	0.45	0.00
average Stage 5 relict plag	0.44	99.44	2.56	1.42	0.02	0.00	0.47	0.00
standard deviation	0.11	0.45	0.08	0.07	0.01	0.00	0.06	0.00
JD97-4.B.J.1	0.54	99.70	2.43	1.55	0.04	0.01	0.56	0.00
JD97-4.B.J.2	0.71	98.23	2.52	1.45	0.06	0.02	0.46	0.00
average Stage 5 plag after bio	0.62	98.97	2.47	1.50	0.05	0.01	0.51	0.00
standard deviation	0.12	1.04	0.06	0.07	0.02	0.01	0.07	0.00
JD97-4.A.A.4	0.39	99.05	2.67	1.30	0.04	0.01	0.43	0.00
JD97-4.A.H.1	0.36	99.63	2.54	1.43	0.04	0.01	0.48	0.00
JD97-4.A.H.2[1]	0.33	99.07	2.51	1.46	0.05	0.01	0.51	0.00
JD97-4.A.H.3	0.28	98.88	2.48	1.49	0.04	0.01	0.55	0.00
JD97-4.A.H.4	0.24	99.13	2.45	1.52	0.04	0.01	0.58	0.00
JD97-4.A.J.3	0.25	99.08	2.46	1.50	0.05	0.01	0.56	0.00
JD97-4.B.B.4	0.36	99.01	2.52	1.45	0.04	0.01	0.50	0.00
JD97-4.B.C.1	0.29	99.18	2.47	1.50	0.04	0.01	0.56	0.00
JD97-4.B.C.2	0.44	99.20	2.53	1.45	0.04	0.01	0.48	0.00
JD97-4.B.I.1	0.29	99.74	2.46	1.50	0.04	0.01	0.58	0.00
JD97-4.B.I.2	0.32	99.36	2.46	1.50	0.04	0.01	0.56	0.00
JD97-4.B.I.3	0.31	99.62	2.45	1.52	0.04	0.01	0.57	0.00
JD97-4.B.L.1	0.35	99.00	2.48	1.47	0.04	0.01	0.55	0.00
JD97-4.B.M.4	0.26	99.10	2.46	1.50	0.05	0.01	0.56	0.00
JD97-4.B.N.1	0.42	99.42	2.54	1.44	0.03	0.00	0.48	0.00
JD97-4.B.N.2	0.39	99.44	2.51	1.46	0.04	0.01	0.51	0.00
average Stage 5 quench plag	0.33	99.24	2.50	1.47	0.04	0.01	0.53	0.00
standard deviation	0.06	0.26	0.06	0.05	0.01	0.00	0.04	0.00

Label	Na	K	Total	An	Ab	Or
JD97-4.B.H.1	0.53	0.04	4.97	41	55	4
JD97-4.B.H.2	0.54	0.04	4.98	41	55	4
JD97-4.B.H.3	0.42	0.02	4.99	55	43	2
JD97-4.B.K.1	0.50	0.02	4.99	47	51	2
JD97-4.B.K.2	0.40	0.02	5.00	58	40	2
JD97-4.B.M.1	0.39	0.02	5.00	58	40	2
JD97-4.B.M.2	0.40	0.02	5.00	58	40	2
JD97-4.B.N.3	0.41	0.02	4.99	57	41	2
JD97-4.B.N.4	0.50	0.03	4.98	46	51	3
average Stage 5 relict plag	0.47	0.03	4.98	48	49	3
standard deviation	0.05	0.01	0.03	5.9	5.3	0.7
JD97-4.B.J.1	0.39	0.03	5.01	57	40	3
JD97-4.B.J.2	0.46	0.04	5.01	48	48	4
average Stage 5 plag after bio	0.42	0.04	5.01	53	44	4
standard deviation	0.05	0.01	0.00	6.5	5.7	0.9
JD97-4.A.A.4	0.44	0.02	4.91	48	49	2
JD97-4.A.H.1	0.47	0.02	5.00	49	48	2
JD97-4.A.H.2[1]	0.43	0.02	4.99	53	45	2
JD97-4.A.H.3	0.41	0.02	4.99	56	42	2
JD97-4.A.H.4	0.39	0.01	4.99	59	40	1
JD97-4.A.J.3	0.41	0.01	5.00	57	42	2
JD97-4.B.B.4	0.45	0.02	4.99	51	47	2
JD97-4.B.C.1	0.41	0.02	4.99	57	42	2
JD97-4.B.C.2	0.48	0.03	5.00	49	48	3
JD97-4.B.I.1	0.39	0.02	5.00	59	40	2
JD97-4.B.I.2	0.40	0.02	5.00	57	41	2
JD97-4.B.I.3	0.40	0.02	5.00	57	41	2
JD97-4.B.L.1	0.42	0.02	5.00	55	43	2
JD97-4.B.M.4	0.40	0.01	5.00	58	41	2
JD97-4.B.N.1	0.47	0.02	4.99	49	48	3
JD97-4.B.N.2	0.44	0.02	4.99	52	45	2
average Stage 5 quench plag	0.43	0.02	4.99	54	44	2
standard deviation	0.03	0.00	0.02	3.8	3.5	0.4

Appendix F. Pyroxene Compositional Data.

Label	Code	Wt% oxides						
		SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO*	MnO	MgO
STAGE 3 pyroxene								
JD97-1.MLT.1	CN	51.57	0.30	1.34	0.02	15.13	0.47	19.51
JD97-1.MLT.E.1	CE	51.94	0.32	1.76	0.04	10.74	0.40	15.25
JD97-1.MLT.E.2	CE	52.98	0.30	1.14	0.04	9.30	0.33	15.44
JD97-1.MLT.E.3	C	52.57	0.48	1.62	0.01	9.88	0.39	16.17
JD97-1.MLT.E.4	C	52.35	0.61	1.97	0.02	10.29	0.35	15.88
JD97-1.MLT.E.6	CE	52.97	0.31	1.44	0.04	9.11	0.27	14.89
JD97-1.MLT.E.7	CE	52.98	0.18	1.07	0.07	9.45	0.32	15.82
JD97-1.MLT.E.8	CE	53.03	0.20	1.24	0.05	9.28	0.38	15.74
JD97-1.MLT.E.10	CN	52.58	0.69	1.98	0.02	12.12	0.38	15.71
JD97-1.MLT.G.1	CE	54.97	0.19	1.85	0.00	8.83	0.21	14.36
JD97-1.MLT.G.3[1]	C	52.53	0.41	2.49	0.03	10.23	0.41	15.64
JD97-1.MLT.G.4	C	52.99	0.09	1.63	0.03	11.25	0.39	15.84
JD97-1.MLT.G.5	C	54.75	0.19	3.00	0.02	9.96	0.36	14.44
JD97-1.MLT.G.6	C	52.32	0.74	1.99	0.02	9.79	0.45	16.17
JD97-1.MLT.G.7	C	52.72	0.29	4.10	0.00	9.60	0.43	14.56
JD97-1.MLT.J.1	CN	51.34	1.59	4.26	0.00	12.93	0.36	15.06
JD97-1.MLT.J.3	C	53.31	0.35	1.02	0.00	10.43	0.35	15.69
JD97-1.MLT.J.4	CE	53.47	0.27	0.67	0.01	11.03	0.39	15.20
JD97-1.MLT.J.5	CE	52.09	0.62	1.80	0.02	10.25	0.40	15.91
JD97-1.MLT.J.6	CE	52.35	0.55	1.70	0.00	9.77	0.30	14.94
JD97-1.MLT.J.7	CE	52.85	0.29	1.60	0.01	8.72	0.32	15.16
JD97-1.MLT.J.8	C	52.61	0.78	2.70	0.00	11.48	0.39	16.73
JD97-1.A.C.3	C	51.76	0.53	1.56	0.00	10.55	0.43	15.39
JD97-1.A.I.2	C	52.41	0.59	6.62	0.04	10.48	0.35	13.56
JD97-1.A.J.1	CN	52.77	0.56	2.43	0.00	12.01	0.35	13.74
JD97-1.A.J.2	C	51.77	0.58	7.21	0.00	12.45	0.31	13.37
JD97-1.A.J.3	C	51.25	0.38	1.67	0.02	12.18	0.34	14.86
JD97-1.A.J.4	CE	51.55	0.45	8.18	0.03	9.33	0.28	11.44
JD97-1.A.R.2	C	51.78	0.33	1.30	0.03	10.35	0.39	15.31
JD97-1.A.R.3	C	51.90	0.28	1.10	0.02	10.30	0.42	15.36
JD97-1.A.R.4	CN	51.02	0.66	2.74	0.02	11.67	0.41	14.94
JD97-1.B.B.1	CE	51.99	0.27	1.11	0.01	9.28	0.34	15.74
JD97-1.B.B.2	CE	52.83	0.24	1.33	0.00	8.75	0.42	15.88
JD97-1.B.B.3	CN	51.01	0.69	1.98	0.02	11.90	0.48	16.60
av. Stage 3 cpx after hbl		52.45	0.45	2.34	0.02	10.55	0.37	15.30
standard deviation		0.89	0.27	1.77	0.02	1.40	0.06	1.26
JD97-1.MLT.2	P	54.22	0.36	9.30	0.00	12.07	0.39	17.84
JD97-1.MLT.G.8	P	54.91	0.18	1.95	0.02	16.54	0.62	24.57
JD97-1.A.I.3[1]	PE	53.86	0.30	2.86	0.00	15.82	0.46	23.23
JD97-1.A.R.1	PE	52.71	0.17	0.97	0.01	17.94	0.45	23.31
JD97-1.B.F.2	P	53.47	0.31	2.17	0.02	16.22	0.46	24.18

Label				Cations				
	CaO	Na_2O	Total	Si	Ti	Al	Cr	Fe^{2+}
STAGE 3 pyroxene								
JD97-1.MLT.1	13.10	0.23	101.66	1.91	0.01	0.06	0.00	0.47
JD97-1.MLT.E.1	18.94	0.29	99.69	1.95	0.01	0.08	0.00	0.34
JD97-1.MLT.E.2	20.40	0.28	100.21	1.97	0.01	0.05	0.00	0.29
JD97-1.MLT.E.3	18.89	0.27	100.30	1.95	0.01	0.07	0.00	0.31
JD97-1.MLT.E.4	18.49	0.32	100.28	1.94	0.02	0.09	0.00	0.32
JD97-1.MLT.E.6	21.40	0.26	100.69	1.96	0.01	0.06	0.00	0.28
JD97-1.MLT.E.7	19.16	0.26	99.31	1.98	0.01	0.05	0.00	0.29
JD97-1.MLT.E.8	19.63	0.27	99.82	1.97	0.01	0.05	0.00	0.29
JD97-1.MLT.E.10	15.92	0.27	99.68	1.96	0.02	0.09	0.00	0.38
JD97-1.MLT.G.1	20.08	0.40	100.89	2.01	0.01	0.08	0.00	0.27
JD97-1.MLT.G.3[1]	18.03	0.46	100.22	1.94	0.01	0.11	0.00	0.32
JD97-1.MLT.G.4	18.18	0.29	100.70	1.96	0.00	0.07	0.00	0.35
JD97-1.MLT.G.5	16.61	0.61	99.94	2.01	0.01	0.13	0.00	0.31
JD97-1.MLT.G.6	18.63	0.32	100.41	1.94	0.02	0.09	0.00	0.30
JD97-1.MLT.G.7	17.72	0.60	100.03	1.94	0.01	0.18	0.00	0.30
JD97-1.MLT.J.1	14.27	0.69	100.49	1.90	0.04	0.19	0.00	0.40
JD97-1.MLT.J.3	19.07	0.25	100.47	1.97	0.01	0.04	0.00	0.32
JD97-1.MLT.J.4	19.28	0.23	100.55	1.98	0.01	0.03	0.00	0.34
JD97-1.MLT.J.5	18.57	0.26	99.93	1.94	0.02	0.08	0.00	0.32
JD97-1.MLT.J.6	20.51	0.27	100.39	1.95	0.02	0.07	0.00	0.30
JD97-1.MLT.J.7	21.11	0.28	100.34	1.96	0.01	0.07	0.00	0.27
JD97-1.MLT.J.8	14.77	0.34	99.81	1.95	0.02	0.12	0.00	0.36
JD97-1.A.C.3	18.37	0.19	98.79	1.95	0.02	0.07	0.00	0.33
JD97-1.A.I.2	15.14	1.11	100.30	1.92	0.02	0.29	0.00	0.32
JD97-1.A.J.1	15.96	0.35	98.17	1.99	0.02	0.11	0.00	0.38
JD97-1.A.J.2	13.33	1.14	100.15	1.90	0.02	0.31	0.00	0.38
JD97-1.A.J.3	18.12	0.22	99.04	1.94	0.01	0.07	0.00	0.39
JD97-1.A.J.4	16.33	1.27	98.85	1.91	0.01	0.36	0.00	0.29
JD97-1.A.R.2	19.00	0.25	98.74	1.96	0.01	0.06	0.00	0.33
JD97-1.A.R.3	19.06	0.21	98.65	1.96	0.01	0.05	0.00	0.33
JD97-1.A.R.4	17.30	0.36	99.12	1.92	0.02	0.12	0.00	0.37
JD97-1.B.B.1	19.32	0.20	98.28	1.96	0.01	0.05	0.00	0.29
JD97-1.B.B.2	18.97	0.30	98.72	1.98	0.01	0.06	0.00	0.27
JD97-1.B.B.3	15.98	0.28	98.95	1.92	0.02	0.09	0.00	0.38
av. Stage 3 cpx after hbl	17.93	0.39	99.81	1.95	0.01	0.10	0.00	0.33
standard deviation	2.12	0.27	0.83	0.03	0.01	0.08	0.00	0.04
JD97-1.MLT.2	4.37	1.70	100.25	1.93	0.01	0.39	0.00	0.36
JD97-1.MLT.G.8	2.25	0.25	101.29	1.97	0.00	0.08	0.00	0.50
JD97-1.A.I.3[1]	2.54	0.40	99.47	1.96	0.01	0.12	0.00	0.48
JD97-1.A.R.1	3.15	0.02	98.74	1.97	0.00	0.04	0.00	0.56
JD97-1.B.F.2	2.19	0.19	99.20	1.96	0.01	0.09	0.00	0.50

Label	Mn	Mg	Ca	Na	Total	En	Fs	Wo
STAGE 3 pyroxene								
JD97-1.MLT.1	0.01	1.07	0.52	0.02	4.06	52	23	25
JD97-1.MLT.E.1	0.01	0.85	0.76	0.02	4.02	44	17	39
JD97-1.MLT.E.2	0.01	0.85	0.81	0.02	4.01	44	15	42
JD97-1.MLT.E.3	0.01	0.89	0.75	0.02	4.01	46	16	38
JD97-1.MLT.E.4	0.01	0.88	0.73	0.02	4.01	45	17	38
JD97-1.MLT.E.6	0.01	0.82	0.85	0.02	4.01	42	14	43
JD97-1.MLT.E.7	0.01	0.88	0.77	0.02	4.00	45	15	39
JD97-1.MLT.E.8	0.01	0.87	0.78	0.02	4.01	45	15	40
JD97-1.MLT.E.10	0.01	0.87	0.64	0.02	3.99	46	20	34
JD97-1.MLT.G.1	0.01	0.78	0.79	0.03	3.96	43	15	43
JD97-1.MLT.G.3[1]	0.01	0.86	0.71	0.03	4.01	46	17	38
JD97-1.MLT.G.4	0.01	0.87	0.72	0.02	4.01	45	18	37
JD97-1.MLT.G.5	0.01	0.79	0.65	0.04	3.94	45	17	37
JD97-1.MLT.G.6	0.01	0.89	0.74	0.02	4.01	46	16	38
JD97-1.MLT.G.7	0.01	0.80	0.70	0.04	3.98	45	16	39
JD97-1.MLT.J.1	0.01	0.83	0.57	0.05	3.99	46	22	31
JD97-1.MLT.J.3	0.01	0.87	0.76	0.02	4.00	45	17	39
JD97-1.MLT.J.4	0.01	0.84	0.77	0.02	4.00	43	18	39
JD97-1.MLT.J.5	0.01	0.88	0.74	0.02	4.01	45	16	38
JD97-1.MLT.J.6	0.01	0.83	0.82	0.02	4.01	42	16	42
JD97-1.MLT.J.7	0.01	0.84	0.84	0.02	4.01	43	14	43
JD97-1.MLT.J.8	0.01	0.92	0.59	0.02	3.99	50	19	31
JD97-1.A.C.3	0.01	0.87	0.74	0.01	4.00	45	17	38
JD97-1.A.I.2	0.01	0.74	0.59	0.08	3.96	45	19	36
JD97-1.A.J.1	0.01	0.77	0.65	0.03	3.95	43	21	36
JD97-1.A.J.2	0.01	0.73	0.53	0.08	3.96	45	23	32
JD97-1.A.J.3	0.01	0.84	0.74	0.02	4.02	43	20	38
JD97-1.A.J.4	0.01	0.63	0.65	0.09	3.95	40	18	41
JD97-1.A.R.2	0.01	0.86	0.77	0.02	4.01	44	17	39
JD97-1.A.R.3	0.01	0.87	0.77	0.02	4.01	44	17	39
JD97-1.A.R.4	0.01	0.84	0.70	0.03	4.01	44	19	37
JD97-1.B.B.1	0.01	0.89	0.78	0.02	4.01	45	15	40
JD97-1.B.B.2	0.01	0.89	0.76	0.02	4.00	46	14	40
JD97-1.B.B.3	0.02	0.93	0.65	0.02	4.02	48	19	33
av. Stage 3 cpx after hbl	0.01	0.85	0.71	0.03	4.00	45	17	38
standard deviation	0.00	0.07	0.09	0.02	0.02	2.1	2.5	3.8
JD97-1.MLT.2	0.01	0.95	0.17	0.12	3.93	64	24	11
JD97-1.MLT.G.8	0.02	1.31	0.09	0.02	3.99	69	26	5
JD97-1.A.I.3[1]	0.01	1.26	0.10	0.03	3.98	68	26	5
JD97-1.A.R.1	0.01	1.30	0.13	0.00	4.01	65	28	6
JD97-1.B.F.2	0.01	1.32	0.09	0.01	3.99	69	26	5

Label	Code	Wt% oxides						
		SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO*	MnO	MgO
av. Stage 3 pigeon after hbl		53.83	0.27	3.45	0.01	15.72	0.48	22.63
standard deviation		0.82	0.08	3.34	0.01	2.19	0.09	2.73
JD97-1.MLT.3	OE	53.75	0.21	1.40	0.00	16.74	0.49	25.19
JD97-1.MLT.4	O	54.82	0.19	0.68	0.00	17.07	0.55	25.94
JD97-1.MLT.5	OE	54.73	0.18	0.82	0.02	16.39	0.60	26.32
JD97-1.MLT.6	O	54.44	0.27	2.21	0.02	17.75	0.47	23.64
JD97-1.MLT.7	OE	54.60	0.17	0.76	0.03	18.35	0.54	25.29
JD97-1.MLT.8	O	54.76	0.25	0.70	0.00	16.86	0.59	25.92
JD97-1.MLT.9	O	56.25	0.12	1.23	0.02	14.78	0.53	26.44
JD97-1.MLT.10	O	55.12	0.32	0.76	0.04	15.77	0.52	27.31
JD97-1.MLT.E.9	O	54.44	0.20	0.87	0.02	16.70	0.55	25.80
JD97-1.MLT.G.2[1]	OE	54.57	0.19	1.11	0.01	17.30	0.62	25.15
JD97-1.A.C.1	OE	53.29	0.48	0.90	0.02	17.44	0.66	24.36
JD97-1.A.C.2	O	53.18	0.32	0.92	0.03	18.36	0.56	24.09
JD97-1.A.C.4	ON	53.27	0.27	0.95	0.00	18.23	0.58	24.05
JD97-1.A.I.1	ON	52.91	0.51	1.17	0.02	18.69	0.61	23.89
JD97-1.A.L.2	O	53.00	0.44	1.14	0.03	18.57	0.47	23.90
JD97-1.A.L.3	OE	53.23	0.21	0.71	0.02	18.24	0.43	24.10
JD97-1.B.F.1	OE	53.74	0.16	0.68	0.03	15.90	0.54	25.83
av. Stage 3 opx after hbl		54.02	0.26	0.98	0.02	17.38	0.55	25.00
standard deviation		0.93	0.11	0.37	0.01	1.16	0.06	1.11
JD97-1.A.N.1	OQ	52.78	0.22	0.58	0.00	19.33	0.54	23.45
JD97-1.A.N.2	OQ	53.55	0.30	1.08	0.04	17.81	0.53	24.40
av. Stage 3 quench opx		53.17	0.26	0.83	0.02	18.57	0.54	23.92
standard deviation		0.54	0.06	0.35	0.03	1.07	0.00	0.67
STAGE 4 pyroxene								
GAL94-3A.F.4	C	50.31	0.86	4.78	0.00	10.21	0.27	14.85
GAL94-3A.G.1	CN	51.73	0.74	4.80	0.07	9.32	0.31	14.07
av. Stage 4 cpx after hbl		51.02	0.80	4.79	0.04	9.76	0.29	14.46
standard deviation		1.00	0.08	0.01	0.05	0.63	0.03	0.55
GAL94-3A.9	P	52.24	0.44	7.57	0.02	16.13	0.28	20.19
GAL94-3A.F.2	P	54.34	0.42	2.76	0.02	16.56	0.43	24.30
GAL94-3A.G.2	P	54.15	0.49	1.37	0.03	17.25	0.56	25.62
GAL94-3A.G.3	P	54.35	0.38	8.16	0.03	13.93	0.36	19.26
GAL94-3A.A.C.1	PN	52.66	0.31	1.72	0.01	16.53	0.46	24.04
GAL94-3A.A.D.3	P	53.61	0.38	1.18	0.02	16.51	0.44	25.35
GAL94-3A.A.F.3	P	53.23	0.24	2.84	0.05	16.72	0.41	23.57
GAL94-3A.A.H.2	P	52.15	0.34	2.95	0.01	17.09	0.38	22.98
GAL94-3A.B.G.1	PN	52.46	0.48	5.48	0.00	14.00	0.46	21.60
GAL94-3A.B.G.4	PE	51.91	1.27	4.30	0.00	15.45	0.46	22.70
GAL94-3A.B.J.1	PE	52.29	0.33	2.46	0.05	17.63	0.55	23.33
GAL94-3A.B.J.2[1]	P	51.94	0.37	2.42	0.02	17.31	0.47	22.67
GAL94-3A.B.J.3	P	51.80	0.38	3.69	0.06	17.57	0.55	21.91
GAL94-3A.B.J.4	PN	50.72	0.24	11.94	0.01	13.19	0.35	15.86
av. Stage 4 pigeon after hbl		52.70	0.43	4.20	0.02	16.13	0.44	22.38
standard deviation		1.08	0.25	3.09	0.02	1.45	0.08	2.58
GAL94-3A.1	OE	53.61	0.39	2.54	0.01	19.16	0.31	24.00

Label				Cations				
	CaO	Na_2O	Total	Si	Ti	Al	Cr	Fe^{2+}
av. Stage 3 pigeon after hbl	2.90	0.51	99.79	1.96	0.01	0.15	0.00	0.48
standard deviation	0.90	0.68	1.00	0.02	0.00	0.14	0.00	0.07
JD97-1.MLT.3	2.03	0.06	99.87	1.96	0.01	0.06	0.00	0.51
JD97-1.MLT.4	1.85	0.02	101.12	1.98	0.01	0.03	0.00	0.51
JD97-1.MLT.5	1.86	0.03	100.95	1.97	0.00	0.03	0.00	0.49
JD97-1.MLT.6	2.20	0.26	101.25	1.96	0.01	0.09	0.00	0.54
JD97-1.MLT.7	1.96	0.03	101.73	1.97	0.00	0.03	0.00	0.55
JD97-1.MLT.8	1.81	0.01	100.91	1.98	0.01	0.03	0.00	0.51
JD97-1.MLT.9	1.34	0.17	100.88	2.00	0.00	0.05	0.00	0.44
JD97-1.MLT.10	1.41	0.03	101.28	1.97	0.01	0.03	0.00	0.47
JD97-1.MLT.E.9	1.91	0.02	100.51	1.97	0.01	0.04	0.00	0.51
JD97-1.MLT.G.2[1]	2.00	0.04	101.00	1.97	0.01	0.05	0.00	0.52
JD97-1.A.C.1	1.80	0.03	98.98	1.97	0.01	0.04	0.00	0.54
JD97-1.A.C.2	1.93	0.03	99.42	1.97	0.01	0.04	0.00	0.57
JD97-1.A.C.4	1.95	0.02	99.30	1.97	0.01	0.04	0.00	0.56
JD97-1.A.I.1	2.16	0.01	99.97	1.95	0.01	0.05	0.00	0.58
JD97-1.A.L.2	1.98	0.04	99.58	1.96	0.01	0.05	0.00	0.57
JD97-1.A.L.3	1.91	0.03	98.88	1.98	0.01	0.03	0.00	0.57
JD97-1.B.F.1	1.79	0.03	98.69	1.98	0.00	0.03	0.00	0.49
av. Stage 3 opx after hbl	1.82	0.05	100.25	1.97	0.01	0.04	0.00	0.53
standard deviation	0.27	0.06	0.97	0.01	0.00	0.02	0.00	0.04
JD97-1.A.N.1	1.43	0.02	98.34	1.98	0.01	0.03	0.00	0.61
JD97-1.A.N.2	1.25	0.11	99.06	1.98	0.01	0.05	0.00	0.55
av. Stage 3 quench opx	1.34	0.06	98.70	1.98	0.01	0.04	0.00	0.58
standard deviation	0.13	0.06	0.51	0.00	0.00	0.01	0.00	0.04
STAGE 4 pyroxene								
GAL94-3A.F.4	18.34	0.17	99.78	1.87	0.02	0.21	0.00	0.32
GAL94-3A.G.1	18.68	0.41	100.13	1.91	0.02	0.21	0.00	0.29
av. Stage 4 cpx after hbl	18.51	0.29	99.96	1.89	0.02	0.21	0.00	0.30
standard deviation	0.24	0.18	0.25	0.02	0.00	0.00	0.00	0.02
GAL94-3A.9	3.53	0.57	100.97	1.88	0.01	0.32	0.00	0.49
GAL94-3A.F.2	2.73	0.13	101.70	1.94	0.01	0.12	0.00	0.50
GAL94-3A.G.2	2.37	0.04	101.88	1.94	0.01	0.06	0.00	0.52
GAL94-3A.G.3	4.34	0.43	101.24	1.92	0.01	0.34	0.00	0.41
GAL94-3A.A.C.1	3.35	0.10	99.19	1.94	0.01	0.07	0.00	0.51
GAL94-3A.A.D.3	3.02	0.05	100.56	1.95	0.01	0.05	0.00	0.50
GAL94-3A.A.F.3	2.70	0.18	99.95	1.94	0.01	0.12	0.00	0.51
GAL94-3A.A.H.2	2.22	0.23	98.34	1.94	0.01	0.13	0.00	0.53
GAL94-3A.B.G.1	3.61	0.46	98.56	1.92	0.01	0.24	0.00	0.43
GAL94-3A.B.G.4	3.10	0.35	99.54	1.90	0.03	0.19	0.00	0.47
GAL94-3A.B.J.1	2.53	0.12	99.30	1.93	0.01	0.11	0.00	0.55
GAL94-3A.B.J.2[1]	2.74	0.19	98.12	1.94	0.01	0.11	0.00	0.54
GAL94-3A.B.J.3	3.19	0.18	99.33	1.92	0.01	0.16	0.00	0.54
GAL94-3A.B.J.4	6.38	0.70	99.40	1.84	0.01	0.51	0.00	0.40
av. Stage 4 pigeon after hbl	3.27	0.27	99.86	1.92	0.01	0.18	0.00	0.49
standard deviation	1.06	0.20	1.22	0.03	0.01	0.13	0.00	0.05
GAL94-3A.1	1.29	0.08	101.40	1.94	0.01	0.11	0.00	0.58

Label	Mn	Mg	Ca	Na	Total	En	Fs	Wo
av. Stage 3 pigeon after hbl	0.01	1.23	0.11	0.04	3.98	67	26	6
standard deviation	0.00	0.16	0.03	0.05	0.03	2.4	1.4	2.8
JD97-1.MLT.3	0.02	1.37	0.08	0.00	4.01	70	26	4
JD97-1.MLT.4	0.02	1.39	0.07	0.00	4.01	70	26	4
JD97-1.MLT.5	0.02	1.41	0.07	0.00	4.01	71	25	4
JD97-1.MLT.6	0.01	1.27	0.09	0.02	3.99	67	28	4
JD97-1.MLT.7	0.02	1.36	0.08	0.00	4.01	68	28	4
JD97-1.MLT.8	0.02	1.39	0.07	0.00	4.00	71	26	4
JD97-1.MLT.9	0.02	1.40	0.05	0.01	3.98	74	23	3
JD97-1.MLT.10	0.02	1.45	0.05	0.00	4.01	73	24	3
JD97-1.MLT.E.9	0.02	1.39	0.07	0.00	4.00	71	26	4
JD97-1.MLT.G.2[1]	0.02	1.35	0.08	0.00	4.00	69	27	4
JD97-1.A.C.1	0.02	1.34	0.07	0.00	4.00	69	28	4
JD97-1.A.C.2	0.02	1.33	0.08	0.00	4.01	67	29	4
JD97-1.A.C.4	0.02	1.33	0.08	0.00	4.00	67	29	4
JD97-1.A.I.1	0.02	1.31	0.09	0.00	4.01	66	29	4
JD97-1.A.L.2	0.01	1.32	0.08	0.00	4.01	67	29	4
JD97-1.A.L.3	0.01	1.33	0.08	0.00	4.00	68	29	4
JD97-1.B.F.1	0.02	1.42	0.07	0.00	4.01	72	25	4
av. Stage 3 opx after hbl	0.02	1.36	0.07	0.00	4.00	69	27	4
standard deviation	0.00	0.05	0.01	0.00	0.01	2.3	2.0	0.5
JD97-1.A.N.1	0.02	1.31	0.06	0.00	4.00	66	31	3
JD97-1.A.N.2	0.02	1.34	0.05	0.01	4.00	69	28	3
av. Stage 3 quench opx	0.02	1.33	0.05	0.00	4.00	68	30	3
standard deviation	0.00	0.02	0.01	0.00	0.00	1.9	1.7	0.3
STAGE 4 pyroxene								
GAL94-3A.F.4	0.01	0.82	0.73	0.01	4.00	44	17	39
GAL94-3A.G.1	0.01	0.77	0.74	0.03	3.98	43	16	41
av. Stage 4 cpx after hbl	0.01	0.80	0.74	0.02	3.99	43	16	40
standard deviation	0.00	0.04	0.00	0.01	0.02	0.7	0.7	1.4
GAL94-3A.9	0.01	1.08	0.14	0.04	3.97	64	28	8
GAL94-3A.F.2	0.01	1.30	0.10	0.01	3.99	68	26	6
GAL94-3A.G.2	0.02	1.37	0.09	0.00	4.02	69	26	5
GAL94-3A.G.3	0.01	1.02	0.16	0.03	3.91	64	26	10
GAL94-3A.A.C.1	0.01	1.32	0.13	0.01	4.01	67	26	7
GAL94-3A.A.D.3	0.01	1.37	0.12	0.00	4.02	69	25	6
GAL94-3A.A.F.3	0.01	1.28	0.11	0.01	4.00	68	27	6
GAL94-3A.A.H.2	0.01	1.27	0.09	0.02	4.00	67	28	5
GAL94-3A.B.G.1	0.01	1.18	0.14	0.03	3.97	67	25	8
GAL94-3A.B.G.4	0.01	1.24	0.12	0.02	3.99	68	26	7
GAL94-3A.B.J.1	0.02	1.29	0.10	0.01	4.01	67	28	5
GAL94-3A.B.J.2[1]	0.01	1.26	0.11	0.01	4.00	66	28	6
GAL94-3A.B.J.3	0.02	1.21	0.13	0.01	4.00	64	29	7
GAL94-3A.B.J.4	0.01	0.86	0.25	0.05	3.92	57	27	16
av. Stage 4 pigeon after hbl	0.01	1.22	0.13	0.02	3.98	66	27	7
standard deviation	0.00	0.14	0.04	0.01	0.03	3.2	1.4	3.1
GAL94-3A.1	0.01	1.29	0.05	0.01	4.00	67	30	3

Label	Code	Wt% oxides						
		SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO*	MnO	MgO
GAL94-3A.2	O	53.56	0.40	1.92	0.00	19.31	0.40	24.98
GAL94-3A.3	O	53.63	0.43	1.40	0.00	19.31	0.31	25.09
GAL94-3A.4	O	53.81	0.42	1.87	0.03	19.00	0.34	24.92
GAL94-3A.5	O	53.68	0.44	2.51	0.00	19.12	0.32	24.11
GAL94-3A.7	OE	53.15	0.47	2.29	0.02	20.03	0.34	24.40
GAL94-3A.8	OE	53.56	0.46	1.96	0.02	20.00	0.38	24.80
GAL94-3A.10	O	52.93	0.45	2.35	0.00	19.27	0.31	25.22
GAL94-3A.11	O	56.20	0.51	3.32	0.02	18.08	0.32	21.89
GAL94-3A.12	OE	53.64	0.41	1.73	0.00	20.04	0.35	24.54
GAL94-3A.F.1	ON	54.39	0.34	0.90	0.04	19.11	0.46	24.63
GAL94-3A.F.3	OE	54.12	0.29	0.90	0.02	19.11	0.43	24.13
GAL94-3A.F.5	OE	53.90	0.38	1.79	0.04	19.29	0.53	23.42
GAL94-3A.F.6	O	53.45	0.45	1.62	0.05	19.56	0.57	23.13
GAL94-3A.G.4	OE	54.31	0.40	1.53	0.00	17.32	0.44	24.64
GAL94-3A.A.C.2	O	53.04	0.16	0.98	0.00	17.47	0.45	25.01
GAL94-3A.A.C.3	O	52.64	0.28	1.53	0.05	17.34	0.39	24.74
GAL94-3A.A.C.4	OE	52.53	0.31	1.32	0.02	18.57	0.40	24.65
GAL94-3A.A.D.1	ON	53.39	0.35	1.04	0.03	16.96	0.49	25.36
GAL94-3A.A.D.2	O	53.58	0.38	1.35	0.00	17.06	0.48	25.68
GAL94-3A.A.D.4[1]	OE	53.44	0.47	1.52	0.00	17.70	0.46	25.03
GAL94-3A.A.F.1	O	53.13	0.33	1.28	0.00	17.86	0.54	25.00
GAL94-3A.A.F.2	O	53.23	0.29	1.03	0.01	17.68	0.49	24.75
GAL94-3A.A.H.1	ON	51.92	0.34	3.49	0.03	17.66	0.37	22.79
GAL94-3A.A.H.3	O	52.51	0.30	1.55	0.00	17.92	0.37	24.98
GAL94-3A.A.H.4	OE	52.76	0.32	1.28	0.01	18.05	0.43	24.69
GAL94-3A.B.E.1	ON	53.00	0.22	0.90	0.01	16.30	0.49	25.13
GAL94-3A.B.E.2	O	53.55	0.26	1.27	0.00	15.63	0.53	25.42
GAL94-3A.B.E.3	O	53.62	0.23	1.16	0.00	16.62	0.57	25.05
GAL94-3A.B.E.4	OE	53.87	0.26	0.78	0.01	15.79	0.50	25.82
GAL94-3A.B.G.2	OE	53.60	0.23	0.92	0.01	15.87	0.47	25.67
GAL94-3A.B.G.3	OE	53.75	0.23	0.83	0.03	15.97	0.52	25.89
av. Stage 4 opx after hbl		53.48	0.35	1.59	0.01	18.07	0.43	24.67
standard deviation		0.73	0.09	0.69	0.02	1.33	0.08	0.87
GAL94-3A.A.I.2[1]	OB	50.77	0.49	3.67	0.00	18.43	0.44	22.49
GAL94-3A.A.I.1	OQ	51.04	0.39	2.44	0.02	18.26	0.40	24.34
GAL94-3A.B.I.1	OQ	52.77	0.28	1.06	0.03	18.18	0.33	24.23
av. Stage 4 quench opx		51.91	0.34	1.75	0.02	18.22	0.37	24.29
standard deviation		1.22	0.07	0.98	0.01	0.05	0.05	0.07
STAGE 5 pyroxene								
JD97-4.MLT.C1.6[1]	P	52.78	0.41	1.43	0.00	14.51	0.37	22.22
JD97-4.MLT.1	O	54.80	0.22	0.55	0.03	15.93	0.44	26.78
JD97-4.MLT.2	OE	53.39	0.37	1.14	0.03	17.03	0.47	25.27
JD97-4.MLT.4	O	53.32	0.35	1.59	0.00	15.22	0.33	27.13
JD97-4.MLT.5	OE	53.21	0.28	1.07	0.01	14.56	0.39	27.57
JD97-4.MLT.6	O	53.37	0.33	1.33	0.03	14.85	0.43	27.30
JD97-4.MLT.7	O	54.17	0.33	1.23	0.04	15.35	0.44	26.85
JD97-4.MLT.8	OE	52.94	0.37	1.27	0.00	17.30	0.53	24.89

Label				Cations				
	CaO	Na_2O	Total	Si	Ti	Al	Cr	Fe^{2+}
GAL94-3A.2	0.84	0.00	101.41	1.94	0.01	0.08	0.00	0.58
GAL94-3A.3	0.90	0.01	101.09	1.95	0.01	0.06	0.00	0.59
GAL94-3A.4	1.00	0.04	101.44	1.94	0.01	0.08	0.00	0.57
GAL94-3A.5	1.47	0.09	101.73	1.94	0.01	0.11	0.00	0.58
GAL94-3A.7	0.71	0.02	101.44	1.93	0.01	0.10	0.00	0.61
GAL94-3A.8	0.81	0.00	101.98	1.93	0.01	0.08	0.00	0.60
GAL94-3A.10	0.77	0.02	101.34	1.92	0.01	0.10	0.00	0.58
GAL94-3A.11	0.98	0.20	101.52	2.00	0.01	0.14	0.00	0.54
GAL94-3A.12	0.85	0.02	101.58	1.94	0.01	0.07	0.00	0.61
GAL94-3A.F.1	1.94	0.04	101.84	1.96	0.01	0.04	0.00	0.58
GAL94-3A.F.3	2.04	0.02	101.06	1.97	0.01	0.04	0.00	0.58
GAL94-3A.F.5	2.09	0.05	101.48	1.96	0.01	0.08	0.00	0.59
GAL94-3A.F.6	2.05	0.04	100.93	1.95	0.01	0.07	0.00	0.60
GAL94-3A.G.4	2.08	0.05	100.77	1.97	0.01	0.07	0.00	0.52
GAL94-3A.A.C.2	2.00	0.03	99.13	1.96	0.00	0.04	0.00	0.54
GAL94-3A.A.C.3	1.77	0.05	98.79	1.95	0.01	0.07	0.00	0.54
GAL94-3A.A.C.4	1.11	0.05	98.95	1.95	0.01	0.06	0.00	0.58
GAL94-3A.A.D.1	1.89	0.03	99.55	1.96	0.01	0.05	0.00	0.52
GAL94-3A.A.D.2	1.56	0.02	100.10	1.95	0.01	0.06	0.00	0.52
GAL94-3A.A.D.4[1]	1.97	0.05	100.66	1.94	0.01	0.07	0.00	0.54
GAL94-3A.A.F.1	2.17	0.04	100.35	1.94	0.01	0.06	0.00	0.55
GAL94-3A.A.F.2	1.85	0.03	99.36	1.96	0.01	0.04	0.00	0.55
GAL94-3A.A.H.1	2.01	0.23	98.83	1.92	0.01	0.15	0.00	0.55
GAL94-3A.A.H.3	1.33	0.01	98.96	1.94	0.01	0.07	0.00	0.55
GAL94-3A.A.H.4	1.22	0.02	98.78	1.96	0.01	0.06	0.00	0.56
GAL94-3A.B.E.1	1.88	0.04	97.96	1.97	0.01	0.04	0.00	0.51
GAL94-3A.B.E.2	2.07	0.01	98.74	1.97	0.01	0.06	0.00	0.48
GAL94-3A.B.E.3	1.61	0.02	98.89	1.97	0.01	0.05	0.00	0.51
GAL94-3A.B.E.4	1.76	0.04	98.83	1.98	0.01	0.03	0.00	0.48
GAL94-3A.B.G.2	2.00	0.03	98.82	1.97	0.01	0.04	0.00	0.49
GAL94-3A.B.G.3	1.93	0.07	99.21	1.97	0.01	0.04	0.00	0.49
av. Stage 4 opx after hbl	1.56	0.05	100.22	1.95	0.01	0.07	0.00	0.55
standard deviation	0.49	0.05	1.25	0.02	0.00	0.03	0.00	0.04
GAL94-3A.A.I.2[1]	1.43	0.18	97.90	1.91	0.01	0.16	0.00	0.58
GAL94-3A.A.I.1	0.82	0.02	97.73	1.92	0.01	0.11	0.00	0.57
GAL94-3A.B.I.1	1.45	0.04	98.39	1.97	0.01	0.05	0.00	0.57
av. Stage 4 quench opx	1.13	0.03	98.06	1.94	0.01	0.08	0.00	0.57
standard deviation	0.45	0.01	0.47	0.03	0.00	0.04	0.00	0.00
STAGE 5 pyroxene								
JD97-4.MLT.C1.6[1]	7.53	0.12	99.38	1.95	0.01	0.06	0.00	0.45
JD97-4.MLT.1	1.67	0.06	100.47	1.98	0.01	0.02	0.00	0.48
JD97-4.MLT.2	1.52	0.04	99.27	1.96	0.01	0.05	0.00	0.52
JD97-4.MLT.4	1.19	0.02	99.15	1.94	0.01	0.07	0.00	0.46
JD97-4.MLT.5	1.39	0.05	98.53	1.95	0.01	0.05	0.00	0.45
JD97-4.MLT.6	1.38	0.02	99.03	1.95	0.01	0.06	0.00	0.45
JD97-4.MLT.7	1.59	0.06	100.06	1.96	0.01	0.05	0.00	0.46
JD97-4.MLT.8	1.59	0.04	98.93	1.96	0.01	0.06	0.00	0.53

Label	Mn	Mg	Ca	Na	Total	En	Fs	Wo
GAL94-3A.2	0.01	1.35	0.03	0.00	4.01	69	30	2
GAL94-3A.3	0.01	1.36	0.04	0.00	4.01	69	30	2
GAL94-3A.4	0.01	1.34	0.04	0.00	4.01	69	29	2
GAL94-3A.5	0.01	1.30	0.06	0.01	4.00	67	30	3
GAL94-3A.7	0.01	1.32	0.03	0.00	4.01	68	31	1
GAL94-3A.8	0.01	1.33	0.03	0.00	4.01	68	31	2
GAL94-3A.10	0.01	1.36	0.03	0.00	4.02	69	30	2
GAL94-3A.11	0.01	1.16	0.04	0.01	3.92	67	31	2
GAL94-3A.12	0.01	1.33	0.03	0.00	4.01	67	31	2
GAL94-3A.F.1	0.01	1.33	0.08	0.00	4.01	67	29	4
GAL94-3A.F.3	0.01	1.31	0.08	0.00	4.00	66	30	4
GAL94-3A.F.5	0.02	1.27	0.08	0.00	4.00	66	30	4
GAL94-3A.F.6	0.02	1.26	0.08	0.00	4.00	65	31	4
GAL94-3A.G.4	0.01	1.33	0.08	0.00	3.99	69	27	4
GAL94-3A.A.C.2	0.01	1.38	0.08	0.00	4.02	69	27	4
GAL94-3A.A.C.3	0.01	1.36	0.07	0.00	4.01	69	27	4
GAL94-3A.A.C.4	0.01	1.36	0.04	0.00	4.01	69	29	2
GAL94-3A.A.D.1	0.02	1.39	0.07	0.00	4.01	70	26	4
GAL94-3A.A.D.2	0.02	1.39	0.06	0.00	4.01	71	26	3
GAL94-3A.A.D.4[1]	0.01	1.36	0.08	0.00	4.01	69	27	4
GAL94-3A.A.F.1	0.02	1.36	0.09	0.00	4.02	68	27	4
GAL94-3A.A.F.2	0.02	1.36	0.07	0.00	4.01	69	28	4
GAL94-3A.A.H.1	0.01	1.26	0.08	0.02	4.00	67	29	4
GAL94-3A.A.H.3	0.01	1.38	0.05	0.00	4.02	69	28	3
GAL94-3A.A.H.4	0.01	1.36	0.05	0.00	4.01	69	28	2
GAL94-3A.B.E.1	0.02	1.39	0.07	0.00	4.01	71	26	4
GAL94-3A.B.E.2	0.02	1.39	0.08	0.00	4.00	71	25	4
GAL94-3A.B.E.3	0.02	1.37	0.06	0.00	4.00	71	26	3
GAL94-3A.B.E.4	0.02	1.41	0.07	0.00	4.00	72	25	4
GAL94-3A.B.G.2	0.01	1.41	0.08	0.00	4.01	71	25	4
GAL94-3A.B.G.3	0.02	1.41	0.08	0.00	4.01	71	25	4
av. Stage 4 opx after hbl	0.01	1.34	0.06	0.00	4.00	69	28	3
standard deviation	0.00	0.05	0.02	0.00	0.02	1.7	2.1	1.0
GAL94-3A.A.I.2[1]	0.01	1.26	0.06	0.01	4.01	66	31	3
GAL94-3A.A.I.1	0.01	1.36	0.03	0.00	4.02	69	29	2
GAL94-3A.B.I.1	0.01	1.35	0.06	0.00	4.00	68	29	3
av. Stage 4 quench opx	0.01	1.35	0.05	0.00	4.01	69	29	2
standard deviation	0.00	0.01	0.02	0.00	0.01	0.6	0.3	0.9
STAGE 5 pyroxene								
JD97-4.MLT.C1.6[1]	0.01	1.22	0.30	0.01	4.01	62	23	15
JD97-4.MLT.1	0.01	1.44	0.06	0.00	4.01	73	24	3
JD97-4.MLT.2	0.01	1.38	0.06	0.00	4.01	70	27	3
JD97-4.MLT.4	0.01	1.47	0.05	0.00	4.01	74	23	2
JD97-4.MLT.5	0.01	1.50	0.05	0.00	4.02	75	22	3
JD97-4.MLT.6	0.01	1.48	0.05	0.00	4.02	75	23	3
JD97-4.MLT.7	0.01	1.45	0.06	0.00	4.01	73	24	3
JD97-4.MLT.8	0.02	1.37	0.06	0.00	4.01	70	27	3

Label	Code	Wt% oxides						
		SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO*	MnO	MgO
JD97-4.MLT.9	O	54.34	0.36	1.45	0.00	15.12	0.37	26.06
JD97-4.MLT.10	OE	54.27	0.30	0.63	0.00	14.66	0.47	26.80
JD97-4.MLT.C1.1	OE	53.02	0.26	1.48	0.05	15.69	0.44	26.22
JD97-4.MLT.C1.2	OE	51.86	0.38	0.75	0.01	20.38	0.70	22.20
JD97-4.MLT.C1.3	O	54.30	0.30	0.98	0.00	14.43	0.42	27.11
JD97-4.MLT.C1.4	ON	53.95	0.34	1.22	0.02	14.38	0.45	26.70
JD97-4.MLT.C1.5[1]	O	53.71	0.26	1.20	0.02	15.48	0.40	26.20
JD97-4.MLT.C1.7	OE	53.49	0.27	1.00	0.04	15.67	0.59	25.92
JD97-4.MLT.C1.8	OE	53.73	0.28	0.89	0.04	14.08	0.43	27.11
JD97-4.MLT.E1.1	ON	53.20	0.44	0.95	0.00	15.13	0.49	26.35
JD97-4.MLT.E1.2	O	53.05	0.34	1.18	0.03	15.21	0.48	26.60
JD97-4.MLT.E1.3	O	53.22	0.24	1.10	0.03	14.97	0.51	26.73
JD97-4.MLT.E1.4	OE	53.76	0.23	1.05	0.06	14.68	0.46	26.73
JD97-4.MLT.E2.1	ON	54.07	0.28	1.37	0.00	14.63	0.43	26.61
JD97-4.MLT.E2.2	O	53.83	0.45	1.20	0.01	14.85	0.44	26.50
JD97-4.MLT.E2.3	O	53.98	0.27	0.99	0.04	14.56	0.44	27.01
JD97-4.MLT.E2.4	OE	54.32	0.16	0.86	0.04	14.35	0.45	27.00
JD97-4.A.E.1	OE	54.25	0.32	1.01	0.05	16.06	0.55	26.39
JD97-4.A.E.2	O	53.89	0.48	1.29	0.04	16.01	0.45	27.12
JD97-4.A.E.3	ON	53.93	0.31	1.01	0.02	17.21	0.53	25.66
JD97-4.A.F.1	OE	53.98	0.37	1.52	0.01	16.06	0.36	27.01
JD97-4.A.F.2	O	54.45	0.41	1.17	0.00	15.31	0.42	27.33
JD97-4.A.F.3	O	54.04	0.47	1.57	0.00	15.39	0.39	27.78
JD97-4.A.F.4	ON	53.72	0.52	1.59	0.01	15.15	0.41	27.68
JD97-4.A.G.1	O	53.70	0.31	1.39	0.02	15.77	0.39	27.18
JD97-4.A.G.2	O	53.33	0.30	1.36	0.00	16.14	0.40	26.56
JD97-4.A.G.3	O	53.68	0.38	1.34	0.02	14.93	0.35	27.62
JD97-4.A.K.1	OE	53.99	0.39	1.12	0.01	15.20	0.43	26.79
JD97-4.A.K.2	O	53.04	0.49	0.96	0.02	16.58	0.45	25.70
JD97-4.A.K.3	O	53.37	0.37	1.27	0.04	16.62	0.47	26.01
JD97-4.A.K.4	O	53.51	0.41	1.29	0.03	16.24	0.45	26.40
JD97-4.A.K.5	O	54.61	0.44	0.95	0.00	15.47	0.44	27.15
JD97-4.A.K.6	ON	54.01	0.31	1.40	0.03	15.55	0.47	26.94
JD97-4.B.D.1	OE	54.81	0.24	0.71	0.03	15.13	0.48	27.03
JD97-4.B.D.2	O	54.20	0.27	1.37	0.00	15.70	0.43	26.04
JD97-4.B.D.3	O	54.43	0.24	1.02	0.01	15.89	0.43	26.05
JD97-4.B.D.4	ON	54.80	0.26	1.25	0.02	15.49	0.46	26.29
JD97-4.B.I.1	ON	54.44	0.31	1.20	0.01	15.90	0.48	26.49
JD97-4.B.I.2	O	54.34	0.28	1.17	0.04	15.61	0.51	26.77
JD97-4.B.I.3	O	54.51	0.23	2.32	0.04	14.62	0.49	25.75
JD97-4.B.I.4	OE	54.58	0.14	0.88	0.03	16.68	0.50	25.96
JD97-4.B.M.1	ON	53.69	0.32	1.92	0.03	15.67	0.32	26.55
JD97-4.B.M.2	O	54.40	0.27	1.36	0.03	14.78	0.40	27.93
JD97-4.B.M.3	OE	52.85	0.31	1.62	0.03	18.02	0.42	24.43
av. Stage 5 opx after hbl		53.84	0.32	1.21	0.02	15.60	0.45	26.51
standard deviation		0.60	0.08	0.31	0.02	1.08	0.06	0.93
JD97-4.B.A.1	OB	54.32	0.40	1.97	0.00	14.10	0.35	28.72

Label				Cations				
	CaO	Na_2O	Total	Si	Ti	Al	Cr	Fe^{2+}
JD97-4.MLT.9	1.80	0.14	99.64	1.97	0.01	0.06	0.00	0.46
JD97-4.MLT.10	2.00	0.03	99.16	1.97	0.01	0.03	0.00	0.45
JD97-4.MLT.C1.1	1.66	0.05	98.87	1.95	0.01	0.06	0.00	0.48
JD97-4.MLT.C1.2	1.78	0.03	98.11	1.97	0.01	0.03	0.00	0.65
JD97-4.MLT.C1.3	1.76	0.05	99.35	1.97	0.01	0.04	0.00	0.44
JD97-4.MLT.C1.4	1.93	0.01	99.00	1.96	0.01	0.05	0.00	0.44
JD97-4.MLT.C1.5[1]	1.74	0.02	99.03	1.96	0.01	0.05	0.00	0.47
JD97-4.MLT.C1.7	1.77	0.03	98.79	1.96	0.01	0.04	0.00	0.48
JD97-4.MLT.C1.8	1.88	0.01	98.46	1.96	0.01	0.04	0.00	0.43
JD97-4.MLT.E1.1	1.93	0.05	98.56	1.96	0.01	0.04	0.00	0.47
JD97-4.MLT.E1.2	1.85	0.02	98.74	1.95	0.01	0.05	0.00	0.47
JD97-4.MLT.E1.3	1.93	0.00	98.73	1.95	0.01	0.05	0.00	0.46
JD97-4.MLT.E1.4	2.03	0.04	99.04	1.96	0.01	0.05	0.00	0.45
JD97-4.MLT.E2.1	2.03	0.04	99.46	1.96	0.01	0.06	0.00	0.44
JD97-4.MLT.E2.2	1.99	0.04	99.31	1.96	0.01	0.05	0.00	0.45
JD97-4.MLT.E2.3	1.94	0.02	99.25	1.96	0.01	0.04	0.00	0.44
JD97-4.MLT.E2.4	1.95	0.03	99.15	1.97	0.00	0.04	0.00	0.44
JD97-4.A.E.1	1.60	0.02	100.25	1.96	0.01	0.04	0.00	0.49
JD97-4.A.E.2	1.95	0.06	101.30	1.93	0.01	0.05	0.00	0.48
JD97-4.A.E.3	1.70	0.05	100.43	1.96	0.01	0.04	0.00	0.52
JD97-4.A.F.1	0.70	0.02	100.02	1.95	0.01	0.06	0.00	0.49
JD97-4.A.F.2	1.33	0.02	100.44	1.96	0.01	0.05	0.00	0.46
JD97-4.A.F.3	1.04	0.02	100.70	1.94	0.01	0.07	0.00	0.46
JD97-4.A.F.4	0.99	0.00	100.08	1.94	0.01	0.07	0.00	0.46
JD97-4.A.G.1	0.98	0.05	99.79	1.95	0.01	0.06	0.00	0.48
JD97-4.A.G.2	1.20	0.02	99.32	1.95	0.01	0.06	0.00	0.49
JD97-4.A.G.3	1.26	0.03	99.61	1.94	0.01	0.06	0.00	0.45
JD97-4.A.K.1	2.03	0.05	100.00	1.95	0.01	0.05	0.00	0.46
JD97-4.A.K.2	1.95	0.01	99.21	1.95	0.01	0.04	0.00	0.51
JD97-4.A.K.3	1.62	0.03	99.80	1.95	0.01	0.05	0.00	0.51
JD97-4.A.K.4	1.69	0.02	100.03	1.94	0.01	0.06	0.00	0.49
JD97-4.A.K.5	1.81	0.02	100.90	1.96	0.01	0.04	0.00	0.46
JD97-4.A.K.6	1.52	0.00	100.24	1.95	0.01	0.06	0.00	0.47
JD97-4.B.D.1	1.68	0.07	100.17	1.98	0.01	0.03	0.00	0.46
JD97-4.B.D.2	2.12	0.07	100.19	1.96	0.01	0.06	0.00	0.47
JD97-4.B.D.3	1.95	0.04	100.06	1.97	0.01	0.04	0.00	0.48
JD97-4.B.D.4	2.03	0.05	100.65	1.97	0.01	0.05	0.00	0.47
JD97-4.B.I.1	1.73	0.03	100.58	1.96	0.01	0.05	0.00	0.48
JD97-4.B.I.2	1.87	0.05	100.63	1.96	0.01	0.05	0.00	0.47
JD97-4.B.I.3	2.20	0.16	100.31	1.96	0.01	0.10	0.00	0.44
JD97-4.B.I.4	1.85	0.04	100.65	1.97	0.00	0.04	0.00	0.50
JD97-4.B.M.1	1.31	0.00	99.81	1.94	0.01	0.08	0.00	0.47
JD97-4.B.M.2	1.17	0.01	100.34	1.95	0.01	0.06	0.00	0.44
JD97-4.B.M.3	1.54	0.03	99.23	1.95	0.01	0.07	0.00	0.56
av. Stage 5 opx after hbl	1.67	0.04	99.66	1.96	0.01	0.05	0.00	0.47
standard deviation	0.34	0.03	0.74	0.01	0.00	0.01	0.00	0.04
JD97-4.B.A.1	0.45	0.02	100.35	1.94	0.01	0.08	0.00	0.42

Label	Mn	Mg	Ca	Na	Total	En	Fs	Wo
JD97-4.MLT.9	0.01	1.41	0.07	0.01	4.00	73	24	4
JD97-4.MLT.10	0.01	1.45	0.08	0.00	4.00	73	23	4
JD97-4.MLT.C1.1	0.01	1.43	0.07	0.00	4.02	72	24	3
JD97-4.MLT.C1.2	0.02	1.25	0.07	0.00	4.01	64	33	4
JD97-4.MLT.C1.3	0.01	1.46	0.07	0.00	4.00	74	22	3
JD97-4.MLT.C1.4	0.01	1.45	0.08	0.00	4.00	74	22	4
JD97-4.MLT.C1.5[1]	0.01	1.43	0.07	0.00	4.00	72	24	3
JD97-4.MLT.C1.7	0.02	1.42	0.07	0.00	4.01	72	24	4
JD97-4.MLT.C1.8	0.01	1.48	0.07	0.00	4.01	75	22	4
JD97-4.MLT.E1.1	0.02	1.44	0.08	0.00	4.01	73	23	4
JD97-4.MLT.E1.2	0.01	1.45	0.07	0.00	4.02	73	23	4
JD97-4.MLT.E1.3	0.02	1.46	0.08	0.00	4.02	73	23	4
JD97-4.MLT.E1.4	0.01	1.45	0.08	0.00	4.01	73	23	4
JD97-4.MLT.E2.1	0.01	1.44	0.08	0.00	4.00	73	23	4
JD97-4.MLT.E2.2	0.01	1.44	0.08	0.00	4.00	73	23	4
JD97-4.MLT.E2.3	0.01	1.46	0.08	0.00	4.01	74	22	4
JD97-4.MLT.E2.4	0.01	1.46	0.08	0.00	4.00	74	22	4
JD97-4.A.E.1	0.02	1.42	0.06	0.00	4.01	72	25	3
JD97-4.A.E.2	0.01	1.45	0.08	0.00	4.03	72	24	4
JD97-4.A.E.3	0.02	1.39	0.07	0.00	4.01	70	26	3
JD97-4.A.F.1	0.01	1.46	0.03	0.00	4.01	74	25	1
JD97-4.A.F.2	0.01	1.46	0.05	0.00	4.01	74	23	3
JD97-4.A.F.3	0.01	1.49	0.04	0.00	4.02	75	23	2
JD97-4.A.F.4	0.01	1.49	0.04	0.00	4.01	75	23	2
JD97-4.A.G.1	0.01	1.47	0.04	0.00	4.02	74	24	2
JD97-4.A.G.2	0.01	1.45	0.05	0.00	4.02	73	25	2
JD97-4.A.G.3	0.01	1.49	0.05	0.00	4.02	75	23	2
JD97-4.A.K.1	0.01	1.45	0.08	0.00	4.01	73	23	4
JD97-4.A.K.2	0.01	1.41	0.08	0.00	4.02	71	26	4
JD97-4.A.K.3	0.01	1.41	0.06	0.00	4.02	71	26	3
JD97-4.A.K.4	0.01	1.43	0.07	0.00	4.02	72	25	3
JD97-4.A.K.5	0.01	1.45	0.07	0.00	4.01	73	23	4
JD97-4.A.K.6	0.01	1.45	0.06	0.00	4.01	73	24	3
JD97-4.B.D.1	0.01	1.45	0.06	0.00	4.01	74	23	3
JD97-4.B.D.2	0.01	1.40	0.08	0.00	4.01	72	24	4
JD97-4.B.D.3	0.01	1.41	0.08	0.00	4.00	72	25	4
JD97-4.B.D.4	0.01	1.41	0.08	0.00	4.00	72	24	4
JD97-4.B.I.1	0.01	1.42	0.07	0.00	4.01	72	24	3
JD97-4.B.I.2	0.02	1.44	0.07	0.00	4.01	73	24	4
JD97-4.B.I.3	0.01	1.38	0.08	0.01	3.99	72	23	4
JD97-4.B.I.4	0.02	1.40	0.07	0.00	4.01	71	26	4
JD97-4.B.M.1	0.01	1.43	0.05	0.00	4.00	73	24	3
JD97-4.B.M.2	0.01	1.49	0.04	0.00	4.01	75	22	2
JD97-4.B.M.3	0.01	1.34	0.06	0.00	4.01	69	28	3
av. Stage 5 opx after hbl	0.01	1.44	0.07	0.00	4.01	73	24	3
standard deviation	0.00	0.04	0.01	0.00	0.01	1.9	1.8	0.7
JD97-4.B.A.1	0.01	1.53	0.02	0.00	4.01	78	21	1

Label	Code	Wt% oxides						
		SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO*	MnO	MgO
JD97-4.B.A.2	OB	51.60	0.71	4.63	0.00	14.73	0.44	27.33
av. Stage 5 opx after bio		52.96	0.56	3.30	0.00	14.42	0.39	28.03
standard deviation		1.93	0.22	1.88	0.00	0.44	0.06	0.98
JD97-4.A.J.1	CQ	52.53	0.41	1.18	0.00	10.96	0.34	16.21
JD97-4.A.J.2[1]	CQ	52.37	0.46	1.47	0.00	10.18	0.37	15.67
JD97-4.B.B.1	CQ	51.10	0.82	2.05	0.01	11.26	0.34	14.20
av. Stage 5 quench cpx		52.00	0.56	1.56	0.00	10.80	0.35	15.36
standard deviation		0.78	0.23	0.44	0.01	0.56	0.02	1.04
JD97-4.A.O.1[1]	OQ	53.27	0.45	1.72	0.01	16.10	0.46	25.92
JD97-4.A.O.2	OQ	54.54	0.18	1.10	0.06	14.75	0.46	26.93
JD97-4.A.O.3	OQ	53.90	0.26	1.23	0.03	14.97	0.49	26.84
JD97-4.B.K.1	OQ	53.97	0.38	1.67	0.03	14.92	0.40	27.13
JD97-4.B.K.2	OQ	52.74	0.43	0.94	0.01	19.89	0.62	22.93
JD97-4.B.K.3	OQ	54.08	0.33	1.76	0.02	14.64	0.42	28.14
av. Stage 5 quench opx		53.75	0.34	1.40	0.03	15.88	0.47	26.31
standard deviation		0.64	0.10	0.35	0.02	2.03	0.08	1.80

[1] indicates points selected as representative compositions and presented in the main text.

* indicates all Fe as FeO.

Code abbreviations as follows: C, clinopyroxene replacing hornblende; P, pigeonite replacing hornblende; O, orthopyroxene replacing hornblende; OB, orthopyroxene replacing biotite; N, point analyzed at the center of a cluster of replacement pyroxene; E, point analyzed at the edge of a cluster; CQ, clinopyroxene quench crystal; OQ, orthopyroxene quench crystal.

Pyroxene stoichiometry calculated on the basis of 6 oxygen.

Label				Cations				
	CaO	Na_2O	Total	Si	Ti	Al	Cr	Fe^{2+}
JD97-4.B.A.2	0.49	0.02	99.95	1.86	0.02	0.20	0.00	0.44
av. Stage 5 opx after bio	0.47	0.02	100.15	1.90	0.02	0.14	0.00	0.43
standard deviation	0.03	0.00	0.28	0.06	0.01	0.08	0.00	0.02
JD97-4.A.J.1	17.40	0.25	99.28	1.97	0.01	0.05	0.00	0.34
JD97-4.A.J.2[1]	18.68	0.26	99.46	1.96	0.01	0.06	0.00	0.32
JD97-4.B.B.1	18.97	0.30	99.05	1.93	0.02	0.09	0.00	0.36
av. Stage 5 quench cpx	18.35	0.27	99.26	1.95	0.02	0.07	0.00	0.34
standard deviation	0.84	0.03	0.21	0.02	0.01	0.02	0.00	0.02
JD97-4.A.O.1[1]	1.67	0.03	99.63	1.94	0.01	0.07	0.00	0.49
JD97-4.A.O.2	1.97	0.02	100.02	1.97	0.00	0.05	0.00	0.44
JD97-4.A.O.3	2.06	0.05	99.82	1.95	0.01	0.05	0.00	0.45
JD97-4.B.K.1	1.38	0.01	99.88	1.95	0.01	0.07	0.00	0.45
JD97-4.B.K.2	1.87	0.04	99.46	1.96	0.01	0.04	0.00	0.62
JD97-4.B.K.3	0.68	0.04	100.11	1.94	0.01	0.07	0.00	0.44
av. Stage 5 quench opx	1.61	0.03	99.82	1.95	0.01	0.06	0.00	0.48
standard deviation	0.52	0.01	0.24	0.01	0.00	0.01	0.00	0.07

Label	Mn	Mg	Ca	Na	Total	En	Fs	Wo
JD97-4.B.A.2	0.01	1.47	0.02	0.00	4.02	76	23	1
av. Stage 5 opx after bio	0.01	1.50	0.02	0.00	4.02	77	22	1
standard deviation	0.00	0.04	0.00	0.00	0.01	1.2	1.1	0.1
JD97-4.A.J.1	0.01	0.90	0.70	0.02	4.00	46	18	36
JD97-4.A.J.2[1]	0.01	0.87	0.75	0.02	4.01	45	16	39
JD97-4.B.B.1	0.01	0.80	0.77	0.02	4.01	42	19	40
av. Stage 5 quench cpx	0.01	0.86	0.74	0.02	4.01	44	18	38
standard deviation	0.00	0.05	0.04	0.00	0.00	2.5	1.1	2.1
JD97-4.A.O.1[1]	0.01	1.41	0.07	0.00	4.01	72	25	3
JD97-4.A.O.2	0.01	1.45	0.08	0.00	4.00	74	23	4
JD97-4.A.O.3	0.01	1.45	0.08	0.00	4.02	73	23	4
JD97-4.B.K.1	0.01	1.46	0.05	0.00	4.01	74	23	3
JD97-4.B.K.2	0.02	1.27	0.07	0.00	4.01	65	31	4
JD97-4.B.K.3	0.01	1.51	0.03	0.00	4.01	76	22	1
av. Stage 5 quench opx	0.01	1.42	0.06	0.00	4.01	72	25	3
standard deviation	0.00	0.08	0.02	0.00	0.00	4.0	3.5	1.0

Appendix G. Fe-Ti Oxide Compositional Data.

Label	Code	Wt% oxides							
		SiO_2	TiO_2	Al_2O_3	Cr_2O_3	V_2O_3	FeO*	Fe_2O_3 (c)	FeO (c)
STAGE 1 Fe-Ti oxides									
GAL94-1A.1	MR	0.01	0.00	0.06	0.27	0.49	94.43	70.08	31.37
GAL94-1A.2	M	0.04	0.00	0.10	0.28	0.47	93.55	69.27	31.22
GAL94-1A.3	MC	0.00	0.00	0.10	0.28	0.43	92.65	68.95	30.61
GAL94-1A.4	MR	0.00	0.00	0.06	0.27	0.36	93.91	69.66	31.24
GAL94-1A.5	MC	0.03	0.00	0.06	0.29	0.34	92.24	68.29	30.79
GAL94-1A.6[1]	M	0.00	0.00	0.04	0.39	0.34	91.57	67.83	30.54
GAL94-1A.7	M	0.02	0.01	0.02	0.32	0.33	91.27	67.36	30.66
GAL94-1A.8	M	0.00	0.00	0.04	0.26	0.31	91.50	67.78	30.51
GAL94-1A.9	M	0.01	0.00	0.06	0.30	0.33	91.31	67.67	30.42
GAL94-1A.10	M	0.00	0.00	0.00	0.31	0.31	93.82	69.31	31.45
GAL94-1A.11	MR	0.03	0.00	0.03	0.34	0.34	93.99	69.38	31.56
GAL94-1A.12	MC	0.01	0.00	0.09	0.30	0.37	94.56	70.17	31.42
GAL94-1A.13	M	0.05	0.00	0.08	0.30	0.35	93.92	69.43	31.44
GAL94-1A.B.1	M	0.00	0.00	0.05	0.28	0.42	92.79	68.73	30.95
GAL94-1A.G.1	MR	0.02	0.00	0.05	0.31	0.34	93.51	69.25	31.20
GAL94-1A.G.2	MC	0.00	0.00	0.08	0.26	0.41	93.70	69.63	31.05
GAL94-1A.A.E.1	M	0.00	0.00	0.04	0.28	0.35	90.60	67.07	30.24
GAL94-1A.A.G.1	MC	0.00	0.74	0.00	0.25	0.45	89.55	65.12	30.96
GAL94-1A.A.G.2	MR	0.06	0.17	0.00	0.24	0.45	89.92	65.82	30.70
GAL94-1A.A.G.3	M	0.00	0.05	0.04	0.26	0.32	89.88	66.47	30.07
GAL94-1A.A.H.1	MC	0.02	0.08	0.01	0.22	0.27	89.93	66.35	30.23
GAL94-1A.A.K.2	MR	0.03	0.04	0.01	0.05	0.13	90.13	66.57	30.23
GAL94-1A.A.K.3	M	0.01	0.05	0.06	0.27	0.34	90.05	66.76	29.98
JD97-3.A.E.3	MR	0.00	0.02	0.11	0.33	0.34	90.29	67.12	29.90
JD97-3.A.F.1	MC	0.00	0.07	0.08	0.29	0.43	91.60	67.84	30.55
JD97-3.A.F.2	MR	0.01	0.23	0.03	0.29	0.33	91.75	67.53	30.99
JD97-3.A.G.1	M	0.00	0.02	0.07	0.37	0.47	91.74	67.96	30.59
JD97-3.A.M.1	M	0.00	0.01	0.05	0.49	0.32	89.52	66.24	29.92
JD97-3.A.M.2	M	0.04	0.06	0.10	0.46	0.36	89.47	66.19	29.91
JD97-3.A.M.5	M	0.04	0.08	0.06	0.54	0.44	89.76	66.09	30.30
average Stage 1 mag		0.01	0.05	0.05	0.30	0.36	91.76	67.86	30.70
standard deviation		0.02	0.14	0.03	0.09	0.07	1.71	1.42	0.52
GAL94-1A.C.5[1]	IR	0.00	49.03	0.00	0.04	0.00	43.62	6.27	37.99
GAL94-1A.C.6	Ru	0.01	92.39	0.02	0.00	0.23	6.07	0.00	6.07
GAL94-1A.C.7	Ru	0.00	84.23	0.00	0.04	0.21	13.04	0.00	13.04
average Stage 1 rutile		0.01	88.31	0.01	0.02	0.22	9.56	0.00	9.56
standard deviation		0.01	5.77	0.02	0.03	0.01	4.93	0.00	4.93
STAGE 2 Fe-Ti oxides									
HP99-9.A.1	TC	0.07	4.17	1.82	0.14	0.50	84.06	57.33	32.48
HP99-9.A.2[1]	TR	0.08	4.40	1.87	0.13	0.48	83.39	56.57	32.49
HP99-9.E.2	T	0.05	9.40	1.94	0.06	0.75	77.82	46.40	36.07
HP99-9.E.3	T	0.10	9.44	1.92	0.19	0.76	77.79	46.23	36.20
HP99-9.F.1	TC	0.05	3.83	2.21	0.19	0.56	83.04	57.05	31.70
HP99-9.F.2	TR	0.07	3.78	2.29	0.12	0.58	81.95	56.19	31.39
HP99-9.L.1	TR	0.07	7.55	2.02	0.24	0.89	78.41	48.77	34.52

Label					Cations				
	MnO	MgO	ZnO	Total	Si	Ti	Al	Cr	V
STAGE 1 Fe-Ti oxides									
GAL94-1A.1	0.05	0.02	0.23	102.72	0.00	0.00	0.00	0.01	0.02
GAL94-1A.2	0.04	0.00	0.09	101.64	0.00	0.00	0.00	0.01	0.02
GAL94-1A.3	0.04	0.07	0.05	100.67	0.00	0.00	0.00	0.01	0.02
GAL94-1A.4	0.04	0.00	0.10	101.80	0.00	0.00	0.00	0.01	0.01
GAL94-1A.5	0.04	0.02	0.13	100.08	0.00	0.00	0.00	0.01	0.01
GAL94-1A.6[1]	0.04	0.01	0.05	99.32	0.00	0.00	0.00	0.01	0.01
GAL94-1A.7	0.03	0.02	0.00	98.85	0.00	0.00	0.00	0.01	0.01
GAL94-1A.8	0.04	0.00	0.00	99.02	0.00	0.00	0.00	0.01	0.01
GAL94-1A.9	0.04	0.00	0.00	98.92	0.00	0.00	0.00	0.01	0.01
GAL94-1A.10	0.03	0.01	0.00	101.50	0.00	0.00	0.00	0.01	0.01
GAL94-1A.11	0.03	0.00	0.00	101.79	0.00	0.00	0.00	0.01	0.01
GAL94-1A.12	0.03	0.01	0.00	102.48	0.00	0.00	0.00	0.01	0.01
GAL94-1A.13	0.05	0.00	0.00	101.78	0.00	0.00	0.00	0.01	0.01
GAL94-1A.B.1	0.04	0.02	0.00	100.58	0.00	0.00	0.00	0.01	0.02
GAL94-1A.G.1	0.05	0.00	0.08	101.42	0.00	0.00	0.00	0.01	0.01
GAL94-1A.G.2	0.06	0.00	0.08	101.74	0.00	0.00	0.00	0.01	0.02
GAL94-1A.A.E.1	0.04	0.00	0.00	98.10	0.00	0.00	0.00	0.01	0.01
GAL94-1A.A.G.1	0.04	0.00	0.00	97.65	0.00	0.02	0.00	0.01	0.02
GAL94-1A.A.G.2	0.05	0.00	0.00	97.59	0.00	0.01	0.00	0.01	0.02
GAL94-1A.A.G.3	0.00	0.02	0.00	97.31	0.00	0.00	0.00	0.01	0.01
GAL94-1A.A.H.1	0.03	0.00	0.09	97.36	0.00	0.00	0.00	0.01	0.01
GAL94-1A.A.K.2	0.00	0.01	0.00	97.11	0.00	0.00	0.00	0.00	0.01
GAL94-1A.A.K.3	0.03	0.03	0.11	97.70	0.00	0.00	0.00	0.01	0.01
JD97-3.A.E.3	0.06	0.01	0.00	97.97	0.00	0.00	0.00	0.01	0.01
JD97-3.A.F.1	0.03	0.00	0.00	99.40	0.00	0.00	0.00	0.01	0.02
JD97-3.A.F.2	0.02	0.01	0.00	99.51	0.00	0.01	0.00	0.01	0.01
JD97-3.A.G.1	0.06	0.01	0.00	99.64	0.00	0.00	0.00	0.01	0.02
JD97-3.A.M.1	0.03	0.00	0.00	97.14	0.00	0.00	0.00	0.02	0.01
JD97-3.A.M.2	0.06	0.00	0.00	97.29	0.00	0.00	0.00	0.01	0.01
JD97-3.A.M.5	0.03	0.02	0.00	97.69	0.00	0.00	0.00	0.02	0.02
average Stage 1 mag	0.04	0.01	0.04	99.53	0.001	0.002	0.002	0.009	0.014
standard deviation	0.01	0.01	0.06	1.85	0.00	0.00	0.00	0.00	0.00
GAL94-1A.C.5[1]	5.50	0.27	0.03	99.17	0.00	0.94	0.00	0.00	0.00
GAL94-1A.C.6	0.00	0.00	0.00	98.76	0.00	0.93	0.00	0.00	0.00
GAL94-1A.C.7	0.00	0.00	0.00	97.59	0.00	0.85	0.00	0.00	0.00
average Stage 1 rutile	0.00	0.00	0.00	98.18	0.00	0.89	0.00	0.00	0.00
standard deviation	0.00	0.00	0.00	0.83	0.00	0.06	0.00	0.00	0.00
STAGE 2 Fe-Ti oxides									
HP99-9.A.1	0.23	1.34	0.01	98.20	0.00	0.12	0.08	0.00	0.02
HP99-9.A.2[1]	0.26	1.35	0.06	97.79	0.00	0.13	0.08	0.00	0.02
HP99-9.E.2	0.27	1.75	0.32	97.16	0.00	0.27	0.09	0.00	0.03
HP99-9.E.3	0.31	1.75	0.30	97.36	0.00	0.27	0.09	0.01	0.03
HP99-9.F.1	0.15	1.39	0.35	97.61	0.00	0.11	0.10	0.01	0.02
HP99-9.F.2	0.17	1.36	0.31	96.37	0.00	0.11	0.10	0.00	0.02
HP99-9.L.1	0.28	1.60	0.10	96.24	0.00	0.22	0.09	0.01	0.03

Label	Fe^{3+}	Fe^{2+}	Mn	Mg	Zn	Total	Xusp	Xmag	Xilm	Xhem
STAGE 1 Fe-Ti oxides										
GAL94-1A.1	1.98	0.98	0.00	0.00	0.01	3.00	0.00	1.00		
GAL94-1A.2	1.97	0.99	0.00	0.00	0.00	3.00	0.00	1.00		
GAL94-1A.3	1.98	0.98	0.00	0.00	0.00	3.00	0.00	1.00		
GAL94-1A.4	1.98	0.99	0.00	0.00	0.00	3.00	0.00	1.00		
GAL94-1A.5	1.98	0.99	0.00	0.00	0.00	3.00	0.00	1.00		
GAL94-1A.6[1]	1.98	0.99	0.00	0.00	0.00	3.00	0.00	1.00		
GAL94-1A.7	1.97	1.00	0.00	0.00	0.00	3.00	0.00	1.00		
GAL94-1A.8	1.98	0.99	0.00	0.00	0.00	3.00	0.00	1.00		
GAL94-1A.9	1.98	0.99	0.00	0.00	0.00	3.00	0.00	1.00		
GAL94-1A.10	1.98	1.00	0.00	0.00	0.00	3.00	0.00	1.00		
GAL94-1A.11	1.98	1.00	0.00	0.00	0.00	3.00	0.00	1.00		
GAL94-1A.12	1.98	0.99	0.00	0.00	0.00	3.00	0.00	1.00		
GAL94-1A.13	1.98	0.99	0.00	0.00	0.00	3.00	0.00	1.00		
GAL94-1A.B.1	1.98	0.99	0.00	0.00	0.00	3.00	0.00	1.00		
GAL94-1A.G.1	1.98	0.99	0.00	0.00	0.00	3.00	0.00	1.00		
GAL94-1A.G.2	1.98	0.98	0.00	0.00	0.00	3.00	0.00	1.00		
GAL94-1A.A.E.1	1.98	0.99	0.00	0.00	0.00	3.00	0.00	1.00		
GAL94-1A.A.G.1	1.93	1.02	0.00	0.00	0.00	3.00	0.02	0.98		
GAL94-1A.A.G.2	1.95	1.01	0.00	0.00	0.00	3.00	0.01	0.99		
GAL94-1A.A.G.3	1.98	1.00	0.00	0.00	0.00	3.00	0.00	1.00		
GAL94-1A.A.H.1	1.98	1.00	0.00	0.00	0.00	3.00	0.00	1.00		
GAL94-1A.A.K.2	1.99	1.00	0.00	0.00	0.00	3.00	0.00	1.00		
GAL94-1A.A.K.3	1.98	0.99	0.00	0.00	0.00	3.00	0.00	1.00		
JD97-3.A.E.3	1.99	0.98	0.00	0.00	0.00	3.00	0.00	1.00		
JD97-3.A.F.1	1.98	0.99	0.00	0.00	0.00	3.00	0.00	1.00		
JD97-3.A.F.2	1.97	1.00	0.00	0.00	0.00	3.00	0.01	0.99		
JD97-3.A.G.1	1.98	0.99	0.00	0.00	0.00	3.00	0.00	1.00		
JD97-3.A.M.1	1.98	0.99	0.00	0.00	0.00	3.00	0.00	1.00		
JD97-3.A.M.2	1.97	0.99	0.00	0.00	0.00	3.00	0.00	1.00		
JD97-3.A.M.5	1.96	1.00	0.00	0.00	0.00	3.00	0.00	1.00		
average Stage 1 mag	1.976	0.993	0.001	0.001	0.00	3.00	0.00	1.00		
standard deviation	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00		
GAL94-1A.C.5[1]	0.12	0.81	0.12	0.01	0.00	2.00			0.94	0.06
GAL94-1A.C.6	0.00	0.07	0.00	0.00	0.00	1.00				
GAL94-1A.C.7	0.00	0.15	0.00	0.00	0.00	1.00				
average Stage 1 rutile	0.00	0.11	0.00	0.00	0.00	1.00				
standard deviation	0.00	0.06	0.00	0.00	0.00	0.00				
STAGE 2 Fe-Ti oxides										
HP99-9.A.1	1.65	1.04	0.01	0.08	0.00	3.00	0.13	0.87		
HP99-9.A.2[1]	1.63	1.04	0.01	0.08	0.00	3.00	0.13	0.87		
HP99-9.E.2	1.34	1.16	0.01	0.10	0.01	3.00	0.29	0.71		
HP99-9.E.3	1.33	1.16	0.01	0.10	0.01	3.00	0.29	0.71		
HP99-9.F.1	1.65	1.02	0.00	0.08	0.01	3.00	0.12	0.88		
HP99-9.F.2	1.64	1.02	0.01	0.08	0.01	3.00	0.12	0.88		
HP99-9.L.1	1.42	1.12	0.01	0.09	0.00	3.00	0.24	0.76		

Label	Code	Wt% oxides							
		SiO_2	TiO_2	Al_2O_3	Cr_2O_3	V_2O_3	FeO*	Fe_2O_3 (c)	FeO (c)
HP99-9.Q.1	TC	0.09	2.49	1.83	0.13	0.67	84.92	59.48	31.40
HP99-9.Q.2	T	0.12	2.16	1.96	0.14	0.66	84.94	59.78	31.15
average Stage 2 Ti-mag		0.08	5.25	1.98	0.15	0.65	81.81	54.20	33.04
standard deviation		0.02	2.81	0.17	0.05	0.13	3.00	5.48	2.02
HP99-9.A.4	TB	0.20	3.96	7.37	0.00	0.09	75.51	51.93	28.79
HP99-9.A.5[1]	TB	0.10	4.30	7.93	0.00	0.10	75.72	51.45	29.43
HP99-9.A.7	TB	0.15	5.28	9.98	0.00	0.08	73.19	46.94	30.95
average Stage 2 mag after bio		0.15	4.51	8.43	0.00	0.09	74.81	50.11	29.72
standard deviation		0.05	0.69	1.37	0.00	0.01	1.41	2.76	1.11
STAGE 3 Fe-Ti oxides									
JD97-1.1	TC	0.02	9.62	2.04	1.15	0.40	76.00	44.43	36.02
JD97-1.4	TC	0.12	0.58	1.72	0.30	0.39	84.87	62.99	28.19
JD97-1.5	TR	0.08	0.56	1.67	0.41	0.42	85.82	63.15	28.99
JD97-1.6	TC	0.09	0.10	1.10	0.28	0.28	87.09	65.57	28.09
JD97-1.7	TR	0.14	0.11	0.96	0.40	0.28	87.08	65.23	28.38
JD97-1.8	T	0.04	2.01	3.45	0.30	0.34	82.32	59.55	28.74
JD97-1.G.1[1]	TC	0.09	1.90	2.88	0.30	0.30	82.56	59.60	28.93
JD97-1.G.2	TR	0.07	1.87	2.94	0.31	0.31	82.46	59.66	28.77
JD97-1.G.3	T	0.03	5.96	2.45	0.40	0.43	79.43	52.47	32.22
JD97-1.G.4	T	0.04	7.40	1.58	0.05	0.24	79.81	50.34	34.51
JD97-1.A.D.1	TC	0.10	5.09	4.37	0.26	0.40	79.53	52.91	31.92
JD97-1.A.D.2	TR	0.06	4.81	3.92	0.27	0.42	79.53	53.57	31.32
JD97-1.A.D.3	TC	0.07	5.67	3.24	0.19	0.36	79.09	52.02	32.28
JD97-1.A.D.4	TR	0.10	5.59	3.07	0.19	0.40	80.02	52.73	32.58
JD97-1.A.D.5	T	0.08	7.17	2.45	0.24	0.53	81.33	51.21	35.25
JD97-1.A.K.1	TC	0.06	7.08	2.66	0.41	0.63	78.91	49.37	34.49
JD97-1.A.K.2	TR	0.06	6.94	2.62	0.69	0.66	79.24	49.76	34.47
JD97-1.A.Q.1	T	0.18	0.90	2.37	0.32	0.45	85.09	61.83	29.45
JD97-1.B.J.1	T	0.11	2.48	2.99	0.24	0.66	84.25	59.30	30.90
JD97-1.B.J.2	TC	0.06	1.94	3.08	0.32	0.47	85.55	60.99	30.68
JD97-1.B.J.3	TR	0.06	1.69	3.19	0.28	0.43	85.22	60.84	30.47
average Stage 3 Ti-mag		0.08	3.60	2.66	0.36	0.43	82.27	56.86	31.11
standard deviation		0.04	2.91	0.87	0.22	0.12	3.18	6.04	2.54
JD97-1.A.A.2	IR	0.16	54.99	2.63	0.00	0.07	30.61	0.00	30.61
JD97-1.A.C.1[1]	IR	0.03	54.98	1.46	0.00	0.02	34.45	0.00	34.45
JD97-1.A.C.2	IC	0.00	45.62	0.32	0.01	0.00	45.09	13.64	32.82
average Stage 3 ilm		0.06	51.87	1.47	0.00	0.03	36.72	4.55	32.63
standard deviation		0.08	5.41	1.16	0.01	0.03	7.50	7.87	1.93
JD97-1.3	TB	0.10	9.33	1.37	0.11	0.23	77.84	46.12	36.34
JD97-1.F.4	TB	0.12	10.24	7.14	0.06	0.17	69.18	39.74	33.41
JD97-1.A.A.3[1]	TB	0.05	6.65	9.38	0.16	0.33	72.89	44.10	33.20
JD97-1.A.A.5	TB	0.04	10.05	7.76	0.07	0.23	69.53	40.48	33.10
JD97-1.A.C.3	TB	0.18	10.49	5.62	0.07	0.18	71.27	40.87	34.49
JD97-1.A.C.4	TB	0.13	5.85	1.12	0.14	0.41	82.67	53.67	34.38
JD97-1.A.K.3	TB	0.05	7.56	1.53	0.14	0.58	77.43	47.87	34.36
JD97-1.B.C.2	TB	0.07	12.41	5.95	0.06	0.25	66.46	35.50	34.52
JD97-1.B.C.3	TB	0.32	9.37	7.01	0.10	0.24	71.60	41.86	33.93
JD97-1.B.C.4	TB	0.18	5.02	1.63	0.19	0.49	82.75	54.61	33.62
JD97-1.B.D.3	TB	0.23	6.33	7.69	0.11	0.42	72.36	46.11	30.87
average Stage 3 mag after bio		0.13	8.48	5.11	0.11	0.32	74.00	44.63	33.84
standard deviation		0.09	2.33	3.09	0.04	0.14	5.44	5.85	1.33

Label					Cations				
	MnO	MgO	ZnO	Total	Si	Ti	Al	Cr	V
HP99-9.Q.1	0.17	0.92	0.00	97.32	0.00	0.07	0.08	0.00	0.03
HP99-9.Q.2	0.14	0.89	0.00	97.15	0.00	0.06	0.09	0.00	0.02
average Stage 2 Ti-mag	0.22	1.37	0.16	97.24	0.00	0.15	0.09	0.00	0.02
standard deviation	0.06	0.31	0.15	0.63	0.00	0.08	0.01	0.00	0.01
HP99-9.A.4	0.83	3.66	0.05	96.90	0.01	0.11	0.32	0.00	0.00
HP99-9.A.5[1]	0.87	3.56	0.12	97.88	0.00	0.12	0.34	0.00	0.00
HP99-9.A.7	0.60	3.60	0.08	97.66	0.01	0.14	0.42	0.00	0.00
average Stage 2 mag after bio	0.77	3.61	0.08	97.48	0.01	0.12	0.36	0.00	0.00
standard deviation	0.15	0.05	0.03	0.51	0.00	0.02	0.06	0.00	0.00
STAGE 3 Fe-Ti oxides									
JD97-1.1	0.42	1.62	0.15	96.04	0.00	0.28	0.09	0.04	0.02
JD97-1.4	0.16	1.56	0.11	96.24	0.00	0.02	0.08	0.01	0.01
JD97-1.5	0.16	1.09	0.09	96.77	0.00	0.02	0.08	0.01	0.02
JD97-1.6	0.14	1.47	0.04	97.28	0.00	0.00	0.05	0.01	0.01
JD97-1.7	0.11	1.30	0.03	97.07	0.01	0.00	0.04	0.01	0.01
JD97-1.8	0.21	2.37	0.07	97.23	0.00	0.06	0.15	0.01	0.01
JD97-1.G.1[1]	0.25	1.96	0.09	96.43	0.00	0.06	0.13	0.01	0.01
JD97-1.G.2	0.25	2.04	0.13	96.44	0.00	0.05	0.13	0.01	0.01
JD97-1.G.3	0.37	2.17	0.07	96.72	0.00	0.17	0.11	0.01	0.02
JD97-1.G.4	0.43	1.24	0.15	96.09	0.00	0.22	0.07	0.00	0.01
JD97-1.A.D.1	0.29	2.42	0.12	97.98	0.00	0.14	0.19	0.01	0.01
JD97-1.A.D.2	0.30	2.44	0.06	97.26	0.00	0.14	0.17	0.01	0.02
JD97-1.A.D.3	0.31	2.11	0.00	96.33	0.00	0.16	0.15	0.01	0.01
JD97-1.A.D.4	0.34	1.99	0.04	97.12	0.00	0.16	0.14	0.01	0.01
JD97-1.A.D.5	0.32	1.46	0.08	98.90	0.00	0.20	0.11	0.01	0.02
JD97-1.A.K.1	0.22	1.55	0.07	96.69	0.00	0.20	0.12	0.01	0.02
JD97-1.A.K.2	0.25	1.57	0.07	97.23	0.00	0.20	0.12	0.02	0.02
JD97-1.A.Q.1	0.19	1.28	0.03	97.10	0.01	0.03	0.11	0.01	0.02
JD97-1.B.J.1	0.29	1.55	0.06	98.71	0.00	0.07	0.13	0.01	0.02
JD97-1.B.J.2	0.26	1.50	0.04	99.43	0.00	0.05	0.14	0.01	0.02
JD97-1.B.J.3	0.26	1.36	0.00	98.68	0.00	0.05	0.14	0.01	0.02
average Stage 3 Ti-mag	0.26	1.72	0.07	97.29	0.00	0.10	0.12	0.01	0.02
standard deviation	0.09	0.41	0.04	0.98	0.00	0.08	0.04	0.01	0.00
JD97-1.A.A.2	0.07	5.00	0.00	93.53	0.00	1.06	0.08	0.00	0.00
JD97-1.A.C.1[1]	0.10	4.26	0.00	95.30	0.00	1.06	0.04	0.00	0.00
JD97-1.A.C.2	0.39	4.36	0.04	97.21	0.00	0.87	0.01	0.00	0.00
average Stage 3 ilm	0.19	4.54	0.01	95.35	0.00	0.99	0.04	0.00	0.00
standard deviation	0.18	0.40	0.03	1.84	0.00	0.11	0.04	0.00	0.00
JD97-1.3	0.43	1.09	0.20	95.39	0.00	0.28	0.06	0.00	0.01
JD97-1.F.4	0.43	4.29	0.10	95.89	0.00	0.28	0.31	0.00	0.01
JD97-1.A.A.3[1]	0.36	2.90	0.07	97.26	0.00	0.18	0.40	0.00	0.01
JD97-1.A.A.5	0.44	4.66	0.18	97.06	0.00	0.27	0.33	0.00	0.01
JD97-1.A.C.3	0.47	3.76	0.14	96.31	0.01	0.29	0.25	0.00	0.01
JD97-1.A.C.4	0.37	0.70	0.09	96.95	0.01	0.17	0.05	0.00	0.02
JD97-1.A.K.3	0.32	1.13	0.06	93.71	0.00	0.23	0.07	0.00	0.02
JD97-1.B.C.2	0.40	4.42	0.02	93.66	0.00	0.35	0.27	0.00	0.01
JD97-1.B.C.3	0.34	4.02	0.15	97.39	0.01	0.26	0.30	0.00	0.01
JD97-1.B.C.4	0.32	0.82	0.16	97.12	0.01	0.15	0.07	0.01	0.02
JD97-1.B.D.3	0.34	3.96	0.15	96.29	0.01	0.18	0.33	0.00	0.01
average Stage 3 mag after bio	0.38	2.89	0.12	96.09	0.01	0.24	0.22	0.00	0.01
standard deviation	0.05	1.61	0.06	1.34	0.00	0.06	0.13	0.00	0.01

Label	Fe^{3+}	Fe^{2+}	Mn	Mg	Zn	Total	Xusp	Xmag	Xilm	Xhem
HP99-9.Q.1	1.73	1.02	0.01	0.05	0.00	3.00	0.08	0.92		
HP99-9.Q.2	1.75	1.01	0.00	0.05	0.00	3.00	0.07	0.93		
average Stage 2 Ti-mag	1.57	1.06	0.01	0.08	0.00	3.00	0.16	0.84		
standard deviation	0.16	0.06	0.00	0.02	0.00	0.00	0.09	0.09		
HP99-9.A.4	1.44	0.89	0.03	0.20	0.00	3.00	0.13	0.87		
HP99-9.A.5[1]	1.41	0.90	0.03	0.19	0.00	3.00	0.14	0.86		
HP99-9.A.7	1.28	0.93	0.02	0.19	0.00	3.00	0.20	0.80		
average Stage 2 mag after bio	1.38	0.91	0.02	0.20	0.00	3.00	0.16	0.84		
standard deviation	0.09	0.02	0.00	0.00	0.00	0.00	0.04	0.04		
STAGE 3 Fe-Ti oxides										
JD97-1.1	1.29	1.17	0.01	0.09	0.00	3.00	0.30	0.70		
JD97-1.4	1.85	0.92	0.01	0.09	0.00	3.00	0.02	0.98		
JD97-1.5	1.86	0.95	0.01	0.06	0.00	3.00	0.02	0.98		
JD97-1.6	1.92	0.91	0.00	0.09	0.00	3.00	0.00	1.00		
JD97-1.7	1.92	0.93	0.00	0.08	0.00	3.00	0.00	1.00		
JD97-1.8	1.70	0.91	0.01	0.13	0.00	3.00	0.06	0.94		
JD97-1.G.1[1]	1.73	0.93	0.01	0.11	0.00	3.00	0.06	0.94		
JD97-1.G.2	1.73	0.93	0.01	0.12	0.00	3.00	0.06	0.94		
JD97-1.G.3	1.51	1.03	0.01	0.12	0.00	3.00	0.18	0.82		
JD97-1.G.4	1.48	1.13	0.01	0.07	0.00	3.00	0.22	0.78		
JD97-1.A.D.1	1.49	1.00	0.01	0.14	0.00	3.00	0.16	0.84		
JD97-1.A.D.2	1.52	0.99	0.01	0.14	0.00	3.00	0.15	0.85		
JD97-1.A.D.3	1.50	1.04	0.01	0.12	0.00	3.00	0.18	0.82		
JD97-1.A.D.4	1.51	1.04	0.01	0.11	0.00	3.00	0.17	0.83		
JD97-1.A.D.5	1.45	1.11	0.01	0.08	0.00	3.00	0.22	0.78		
JD97-1.A.K.1	1.43	1.11	0.01	0.09	0.00	3.00	0.23	0.77		
JD97-1.A.K.2	1.43	1.10	0.01	0.09	0.00	3.00	0.22	0.78		
JD97-1.A.Q.1	1.80	0.95	0.01	0.07	0.00	3.00	0.03	0.97		
JD97-1.B.J.1	1.69	0.98	0.01	0.09	0.00	3.00	0.08	0.92		
JD97-1.B.J.2	1.72	0.96	0.01	0.08	0.00	3.00	0.06	0.94		
JD97-1.B.J.3	1.73	0.96	0.01	0.08	0.00	3.00	0.05	0.95		
average Stage 3 Ti-mag	1.64	1.00	0.01	0.10	0.00	3.00	0.11	0.89		
standard deviation	0.18	0.08	0.00	0.02	0.00	0.00	0.09	0.09		
JD97-1.A.A.2	0.00	0.66	0.00	0.19	0.00	2.00			1.00	0.00
JD97-1.A.C.1[1]	0.00	0.74	0.00	0.16	0.00	2.00			1.00	0.00
JD97-1.A.C.2	0.26	0.69	0.01	0.16	0.00	2.00			0.86	0.14
average Stage 3 ilm	0.26	0.70	0.00	0.17	0.00	2.00			0.95	0.05
standard deviation	0.00	0.04	0.00	0.02	0.00	0.00			0.08	0.08
JD97-1.3	1.36	1.20	0.01	0.06	0.01	3.00	0.28	0.72		
JD97-1.F.4	1.10	1.03	0.01	0.24	0.00	3.00	0.35	0.65		
JD97-1.A.A.3[1]	1.21	1.01	0.01	0.16	0.00	3.00	0.26	0.74		
JD97-1.A.A.5	1.11	1.01	0.01	0.25	0.00	3.00	0.34	0.66		
JD97-1.A.C.3	1.14	1.07	0.01	0.21	0.00	3.00	0.34	0.66		
JD97-1.A.C.4	1.57	1.12	0.01	0.04	0.00	3.00	0.18	0.82		
JD97-1.A.K.3	1.44	1.15	0.01	0.07	0.00	3.00	0.24	0.76		
JD97-1.B.C.2	1.01	1.09	0.01	0.25	0.00	3.00	0.42	0.58		
JD97-1.B.C.3	1.15	1.04	0.01	0.22	0.00	3.00	0.32	0.68		
JD97-1.B.C.4	1.59	1.09	0.01	0.05	0.00	3.00	0.16	0.84		
JD97-1.B.D.3	1.28	0.95	0.01	0.22	0.00	3.00	0.22	0.78		
average Stage 3 mag after bio	1.27	1.07	0.01	0.16	0.00	3.00	0.28	0.72		
standard deviation	0.20	0.07	0.00	0.09	0.00	0.00	0.08	0.08		

Label	Code	Wt% oxides							
		SiO_2	TiO_2	Al_2O_3	Cr_2O_3	V_2O_3	FeO*	Fe_2O_3 (c)	FeO (c)
JD97-1.F.1	IB	0.07	54.06	2.15	0.00	0.05	33.68	0.00	33.68
JD97-1.A.A.4	IB	0.03	46.68	0.27	0.00	0.00	43.45	10.55	33.95
JD97-1.A.K.4[1]	IB	0.11	47.53	0.26	0.00	0.00	41.30	9.28	32.95
JD97-1.B.C.1	IB	0.11	41.35	0.15	0.16	0.28	48.94	18.22	32.55
average Stage 3 ilm after bio		0.08	47.41	0.71	0.04	0.08	41.84	9.51	33.28
standard deviation		0.04	5.21	0.97	0.08	0.13	6.32	7.47	0.65
JD97-1.9	TH	0.07	4.94	1.24	0.03	0.25	82.57	55.31	32.81
JD97-1.10	TH	0.13	3.74	1.11	0.12	0.19	84.20	57.83	32.16
JD97-1.E.1	TH	0.10	6.61	1.17	0.09	0.35	80.95	51.64	34.48
JD97-1.E.2	TH	0.11	6.09	1.13	0.18	0.39	80.56	52.00	33.77
JD97-1.E.4	TH	0.27	2.99	1.14	0.01	0.12	82.73	57.16	31.30
JD97-1.E.5	TH	0.12	3.44	0.97	0.01	0.10	84.01	58.50	31.37
JD97-1.G.3	TH	0.03	5.96	2.45	0.40	0.43	79.43	52.47	32.22
JD97-1.G.4	TH	0.04	7.40	1.58	0.05	0.24	79.81	50.34	34.51
JD97-1.J.2	TH	0.11	11.08	0.93	0.21	0.37	75.61	42.12	37.71
average Stage 3 mag after hbl		0.11	5.81	1.30	0.12	0.27	81.10	53.04	33.37
standard deviation		0.07	2.49	0.47	0.13	0.12	2.69	5.06	2.03
JD97-1.A.H.1	QT	0.12	3.50	1.63	0.02	0.24	85.03	58.31	32.56
JD97-1.A.H.2	QT	0.11	5.76	1.37	0.02	0.25	79.52	51.68	33.02
average Stage 3 quench mag		0.12	4.63	1.50	0.02	0.25	82.27	55.00	32.79
standard deviation		0.01	1.59	0.18	0.00	0.01	3.89	4.69	0.33
STAGE 4 Fe-Ti oxides									
GAL94-3A.1	TC	0.10	15.07	1.83	0.16	0.61	74.18	35.85	41.92
GAL94-3A.2	T	0.07	14.69	2.31	0.10	0.54	74.81	36.99	41.53
GAL94-3A.10	T	0.08	12.81	2.91	0.41	0.57	74.55	39.49	39.02
GAL94-3A.A.C.1	T	0.06	8.26	3.23	0.46	0.78	77.64	47.54	34.86
GAL94-3A.A.C.2	T	0.06	8.70	3.34	0.32	0.68	77.64	47.51	35.49
GAL94-3A.A.F.1	T	0.08	9.11	2.35	0.27	0.63	77.64	48.59	35.98
GAL94-3A.A.F.2[1]	T	0.06	9.46	1.88	0.42	0.64	77.64	46.20	35.80
GAL94-3A.A.H.1	T	0.06	9.16	2.06	0.74	1.00	77.64	45.15	35.38
GAL94-3A.A.K.1	T	0.06	9.48	3.21	0.32	0.42	77.64	44.65	34.81
GAL94-3A.A.K.4	TC	0.06	9.06	3.22	0.26	0.52	77.64	45.98	35.05
GAL94-3A.A.K.5	TR	0.40	8.76	3.02	0.21	0.48	77.64	44.78	34.67
GAL94-3A.B.A.1	TC	0.08	4.13	2.83	0.22	0.54	77.64	56.04	30.47
GAL94-3A.B.A.2	TR	0.02	3.84	2.67	0.47	0.53	77.64	57.18	30.80
GAL94-3A.B.A.3	T	0.06	4.30	2.65	0.23	0.54	77.64	56.16	30.99
GAL94-3A.B.F.1	T	0.04	7.83	2.58	0.05	0.36	77.64	48.97	33.51
GAL94-3A.B.J.2	T	0.04	10.25	2.10	0.70	0.59	77.64	45.57	36.55
average Stage 4 Ti-mag		0.08	9.06	2.64	0.34	0.59	77.05	46.67	35.43
standard deviation		0.09	3.27	0.50	0.19	0.15	1.26	6.18	3.31
GAL94-3A.7[1]	TB	0.09	11.81	2.38	0.16	0.67	76.12	41.45	38.82
GAL94-3A.8	TB	0.20	13.82	2.41	0.12	0.53	74.10	37.49	40.36
GAL94-3A.A.H.3	TB	0.06	10.32	2.50	0.09	0.50	72.49	41.83	34.85
GAL94-3A.A.I.3	TB	0.43	9.70	3.69	0.06	0.40	74.16	43.45	35.06
GAL94-3A.A.K.2	TB	0.07	10.79	1.40	0.25	0.44	73.83	41.64	36.37
GAL94-3A.A.K.6	TB	0.06	10.58	1.50	0.15	0.52	75.00	42.68	36.60
GAL94-3A.A.K.7	TB	0.38	10.79	1.83	0.14	0.42	72.49	40.68	35.89
GAL94-3A.B.F.4	TB	0.07	7.45	1.88	0.07	0.36	76.73	48.42	33.16
GAL94-3A.B.F.5	TB	0.08	7.45	1.91	0.05	0.33	76.41	48.41	32.85
average Stage 4 mag after bio		0.16	10.30	2.17	0.12	0.46	74.59	42.89	36.00
standard deviation		0.15	1.99	0.69	0.06	0.11	1.59	3.54	2.44

Label					Cations				
	MnO	MgO	ZnO	Total	Si	Ti	Al	Cr	V
JD97-1.F.1	0.04	3.73	0.00	93.85	0.00	1.05	0.07	0.00	0.00
JD97-1.A.A.4	0.57	4.17	0.06	96.30	0.00	0.89	0.01	0.00	0.00
JD97-1.A.K.4[1]	0.58	5.22	0.05	95.98	0.00	0.90	0.01	0.00	0.00
JD97-1.B.C.1	0.29	2.50	0.00	95.67	0.00	0.81	0.00	0.00	0.01
average Stage 3 ilm after bio	0.37	3.91	0.03	95.45	0.00	0.92	0.02	0.00	0.00
standard deviation	0.26	1.12	0.03	1.09	0.00	0.10	0.03	0.00	0.00
JD97-1.9	0.18	1.03	0.05	96.07	0.00	0.15	0.06	0.00	0.01
JD97-1.10	0.33	0.76	0.18	96.60	0.01	0.11	0.05	0.00	0.01
JD97-1.E.1	0.35	0.85	0.05	95.83	0.00	0.20	0.05	0.00	0.01
JD97-1.E.2	0.27	0.90	0.00	95.00	0.00	0.18	0.05	0.01	0.02
JD97-1.E.4	0.57	0.40	0.04	94.04	0.01	0.09	0.05	0.00	0.00
JD97-1.E.5	0.81	0.70	0.07	96.13	0.00	0.10	0.05	0.00	0.00
JD97-1.G.3	0.37	2.17	0.07	96.72	0.00	0.17	0.11	0.01	0.02
JD97-1.G.4	0.43	1.24	0.15	96.09	0.00	0.22	0.07	0.00	0.01
JD97-1.J.2	0.43	0.97	0.19	94.25	0.00	0.33	0.04	0.01	0.01
average Stage 3 mag after hbl	0.42	1.00	0.09	95.64	0.00	0.17	0.06	0.00	0.01
standard deviation	0.18	0.50	0.07	0.98	0.00	0.07	0.02	0.00	0.00
JD97-1.A.H.1	0.33	0.61	0.16	97.54	0.00	0.10	0.07	0.00	0.01
JD97-1.A.H.2	0.76	0.62	0.11	93.76	0.00	0.17	0.07	0.00	0.01
average Stage 3 quench mag	0.54	0.62	0.14	95.65	0.00	0.14	0.07	0.00	0.01
standard deviation	0.31	0.00	0.04	2.67	0.00	0.05	0.01	0.00	0.00
STAGE 4 Fe-Ti oxides									
GAL94-3A.1	0.16	1.65	0.07	97.66	0.00	0.43	0.08	0.00	0.02
GAL94-3A.2	0.22	1.90	0.03	98.56	0.00	0.41	0.10	0.00	0.02
GAL94-3A.10	0.20	2.38	0.00	98.11	0.00	0.36	0.13	0.01	0.02
GAL94-3A.A.C.1	0.29	2.35	0.00	98.00	0.00	0.23	0.14	0.01	0.03
GAL94-3A.A.C.2	0.32	2.39	0.00	98.97	0.00	0.24	0.15	0.01	0.02
GAL94-3A.A.F.1	0.30	2.41	0.00	99.83	0.00	0.25	0.10	0.01	0.02
GAL94-3A.A.F.2[1]	0.30	2.09	0.00	96.98	0.00	0.27	0.08	0.01	0.02
GAL94-3A.A.H.1	0.30	2.01	0.05	96.11	0.00	0.27	0.09	0.02	0.04
GAL94-3A.A.K.1	0.29	2.70	0.04	96.09	0.00	0.27	0.14	0.01	0.02
GAL94-3A.A.K.4	0.29	2.47	0.09	97.11	0.00	0.26	0.14	0.01	0.02
GAL94-3A.A.K.5	0.32	2.44	0.04	95.22	0.02	0.25	0.14	0.01	0.02
GAL94-3A.B.A.1	0.27	2.46	0.12	97.28	0.00	0.12	0.13	0.01	0.02
GAL94-3A.B.A.2	0.29	2.19	0.10	98.20	0.00	0.11	0.12	0.01	0.02
GAL94-3A.B.A.3	0.32	2.32	0.00	97.70	0.00	0.12	0.12	0.01	0.02
GAL94-3A.B.F.1	0.33	2.47	0.00	96.23	0.00	0.23	0.12	0.00	0.01
GAL94-3A.B.J.2	0.39	2.38	0.00	98.70	0.00	0.29	0.09	0.02	0.02
average Stage 4 Ti-mag	0.29	2.29	0.03	97.55	0.00	0.26	0.12	0.01	0.02
standard deviation	0.05	0.26	0.04	1.22	0.00	0.09	0.02	0.01	0.01
GAL94-3A.7[1]	0.19	1.71	0.07	97.62	0.00	0.34	0.11	0.00	0.02
GAL94-3A.8	0.19	1.99	0.05	97.39	0.01	0.39	0.11	0.00	0.02
GAL94-3A.A.H.3	0.29	2.46	0.09	93.10	0.00	0.31	0.12	0.00	0.02
GAL94-3A.A.I.3	0.27	3.09	0.04	96.28	0.02	0.28	0.16	0.00	0.01
GAL94-3A.A.K.2	0.30	1.69	0.00	93.03	0.00	0.32	0.07	0.01	0.02
GAL94-3A.A.K.6	0.29	1.61	0.06	94.16	0.00	0.31	0.07	0.00	0.02
GAL94-3A.A.K.7	0.31	2.25	0.00	92.77	0.02	0.32	0.09	0.00	0.02
GAL94-3A.B.F.4	0.35	1.90	0.03	93.77	0.00	0.22	0.09	0.00	0.01
GAL94-3A.B.F.5	0.32	2.04	0.14	93.65	0.00	0.22	0.09	0.00	0.01
average Stage 4 mag after bio	0.28	2.08	0.05	94.64	0.01	0.30	0.10	0.00	0.02
standard deviation	0.05	0.47	0.04	1.92	0.01	0.05	0.03	0.00	0.00

Label	Fe^{3+}	Fe^{2+}	Mn	Mg	Zn	Total	Xusp	Xmag	Xilm	Xhem
JD97-1.F.1	0.00	0.73	0.00	0.14	0.00	2.00			1.00	0.00
JD97-1.A.A.4	0.20	0.72	0.01	0.16	0.00	1.84			0.89	0.11
JD97-1.A.K.4[1]	0.18	0.70	0.01	0.20	0.00	2.00			0.90	0.10
JD97-1.B.C.1	0.36	0.71	0.01	0.10	0.00	2.00			0.81	0.19
average Stage 3 ilm after bio	0.25	0.72	0.01	0.15	0.00	1.96			0.90	0.10
standard deviation	0.10	0.01	0.01	0.04	0.00	0.08			0.08	0.08
JD97-1.9	1.63	1.08	0.01	0.06	0.00	3.00	0.15	0.85		
JD97-1.10	1.71	1.05	0.01	0.04	0.01	3.00	0.11	0.89		
JD97-1.E.1	1.53	1.14	0.01	0.05	0.00	3.00	0.20	0.80		
JD97-1.E.2	1.55	1.12	0.01	0.05	0.00	3.00	0.19	0.81		
JD97-1.E.4	1.74	1.06	0.02	0.02	0.00	3.00	0.09	0.91		
JD97-1.E.5	1.74	1.04	0.03	0.04	0.00	3.00	0.10	0.90		
JD97-1.G.3	1.51	1.03	0.01	0.12	0.00	3.00	0.18	0.82		
JD97-1.G.4	1.48	1.13	0.01	0.07	0.00	3.00	0.22	0.78		
JD97-1.J.2	1.26	1.26	0.01	0.06	0.01	3.00	0.34	0.66		
average Stage 3 mag after hbl	1.57	1.10	0.01	0.06	0.00	3.00	0.18	0.82		
standard deviation	0.15	0.07	0.01	0.03	0.00	0.00	0.08	0.08		
JD97-1.A.H.1	1.70	1.06	0.01	0.04	0.00	3.00	0.11	0.89		
JD97-1.A.H.2	1.57	1.11	0.03	0.04	0.00	3.00	0.18	0.82		
average Stage 3 quench mag	1.63	1.08	0.02	0.04	0.00	3.00	0.14	0.86		
standard deviation	0.10	0.04	0.01	0.00	0.00	0.00	0.05	0.05		
STAGE 4 Fe-Ti oxides										
GAL94-3A.1	1.02	1.33	0.01	0.09	0.00	3.00	0.46	0.54		
GAL94-3A.2	1.04	1.30	0.01	0.11	0.00	3.00	0.45	0.55		
GAL94-3A.10	1.11	1.22	0.01	0.13	0.00	3.00	0.40	0.60		
GAL94-3A.A.C.1	1.34	1.09	0.01	0.13	0.00	3.00	0.26	0.74		
GAL94-3A.A.C.2	1.33	1.10	0.01	0.13	0.00	3.00	0.27	0.73		
GAL94-3A.A.F.1	1.35	1.11	0.01	0.13	0.00	3.00	0.27	0.73		
GAL94-3A.A.F.2[1]	1.33	1.15	0.01	0.12	0.00	3.00	0.29	0.71		
GAL94-3A.A.H.1	1.31	1.14	0.01	0.12	0.00	3.00	0.29	0.71		
GAL94-3A.A.K.1	1.28	1.11	0.01	0.15	0.00	3.00	0.30	0.70		
GAL94-3A.A.K.4	1.31	1.11	0.01	0.14	0.00	3.00	0.28	0.72		
GAL94-3A.A.K.5	1.30	1.12	0.01	0.14	0.00	3.00	0.28	0.72		
GAL94-3A.B.A.1	1.60	0.97	0.01	0.14	0.00	3.00	0.12	0.88		
GAL94-3A.B.A.2	1.63	0.97	0.01	0.12	0.00	3.00	0.11	0.89		
GAL94-3A.B.A.3	1.60	0.98	0.01	0.13	0.00	3.00	0.13	0.87		
GAL94-3A.B.F.1	1.41	1.07	0.01	0.14	0.00	3.00	0.23	0.77		
GAL94-3A.B.J.2	1.28	1.14	0.01	0.13	0.00	3.00	0.31	0.69		
average Stage 4 Ti-mag	1.33	1.12	0.01	0.13	0.00	3.00	0.28	0.72		
standard deviation	0.18	0.10	0.00	0.01	0.00	0.00	0.10	0.10		
GAL94-3A.7[1]	1.18	1.23	0.01	0.10	0.00	3.00	0.37	0.63		
GAL94-3A.8	1.07	1.28	0.01	0.11	0.00	3.00	0.43	0.57		
GAL94-3A.A.H.3	1.24	1.15	0.01	0.15	0.00	3.00	0.33	0.67		
GAL94-3A.A.I.3	1.24	1.11	0.01	0.17	0.00	3.00	0.30	0.70		
GAL94-3A.A.K.2	1.25	1.22	0.01	0.10	0.00	3.00	0.34	0.66		
GAL94-3A.A.K.6	1.27	1.21	0.01	0.09	0.00	3.00	0.33	0.67		
GAL94-3A.A.K.7	1.22	1.19	0.01	0.13	0.00	3.00	0.34	0.66		
GAL94-3A.B.F.4	1.45	1.10	0.01	0.11	0.00	3.00	0.23	0.77		
GAL94-3A.B.F.5	1.45	1.09	0.01	0.12	0.00	3.00	0.23	0.77		
average Stage 4 mag after bio	1.26	1.18	0.01	0.12	0.00	3.00	0.32	0.68		
standard deviation	0.12	0.07	0.00	0.03	0.00	0.00	0.06	0.06		

Label	Code	Wt% oxides							
		SiO_2	TiO_2	Al_2O_3	Cr_2O_3	V_2O_3	FeO*	Fe_2O_3 (c)	FeO (c)
GAL94-3A.11	IB	0.25	52.37	1.25	0.00	0.38	34.69	0.00	34.69
GAL94-3A.B.G.3	IB	0.23	52.50	2.34	0.00	0.19	32.99	0.00	32.99
average Stage 4 ilm after bio		0.24	52.44	1.79	0.00	0.29	33.84	0.00	33.84
standard deviation		0.01	0.09	0.77	0.00	0.13	1.20	0.00	1.20
GAL94-3A.3	TH	0.06	15.48	2.09	0.13	0.55	73.60	35.30	41.83
GAL94-3A.4	TH	0.11	14.87	1.90	0.16	0.61	74.03	35.83	41.78
GAL94-3A.6	TH	0.08	10.68	2.43	0.15	0.66	77.15	43.97	37.59
GAL94-3A.13	TH	0.07	13.90	2.25	0.22	0.80	73.87	37.61	40.03
GAL94-3A.14	TH	0.29	12.67	2.47	0.52	1.13	74.35	38.71	39.52
GAL94-3A.16	TH	0.05	14.93	2.19	0.43	0.91	73.18	35.96	40.83
GAL94-3A.F.1	TH	0.12	12.45	1.48	0.06	0.95	74.71	39.99	38.73
GAL94-3A.F.2	TH	0.07	9.96	1.54	0.01	0.80	77.73	45.57	36.72
GAL94-3A.F.3	TH	0.10	36.47	0.17	0.06	0.88	53.62	0.00	53.62
GAL94-3A.A.F.3	TH	0.09	11.37	1.36	0.27	0.61	76.15	42.55	37.86
GAL94-3A.B.J.1	TH	0.09	9.94	1.87	0.03	0.52	74.41	43.08	35.64
average Stage 4 mag after hbl		0.10	12.63	1.96	0.20	0.75	74.92	39.86	39.05
standard deviation		0.07	2.10	0.40	0.17	0.20	1.55	3.74	2.12
GAL94-3A.15	IH	0.08	54.36	1.23	0.01	0.54	34.60	0.00	34.60
GAL94-3A.G.1	IH	0.49	53.22	2.35	0.07	1.17	31.99	0.00	31.99
average Stage 4 ilm after hbl		0.29	53.79	1.79	0.04	0.86	33.29	0.00	33.29
standard deviation		0.29	0.81	0.79	0.04	0.44	1.84	0.00	1.84
GAL94-3A.A.I.1	QT	0.05	10.71	2.48	0.55	0.60	77.64	42.04	36.67
GAL94-3A.B.A.4	QT	0.08	5.32	2.03	0.08	0.46	77.64	54.37	32.41
average Stage 4 quench mag		0.06	8.02	2.25	0.32	0.53	77.64	48.20	34.54
standard deviation		0.03	3.81	0.32	0.33	0.09	0.00	8.72	3.01
STAGE 5 Fe-Ti oxides									
JD97-4.A.E.1	T	0.04	8.18	1.64	0.49	0.45	81.87	50.20	36.70
JD97-4.A.G.2	T	0.08	8.82	2.29	0.24	0.48	77.95	47.33	35.36
JD97-4.A.G.3[1]	T	0.05	9.12	2.07	0.28	0.49	78.66	47.11	36.27
average Stage 5 Ti-mag		0.05	8.71	2.00	0.34	0.47	79.49	48.21	36.11
standard deviation		0.02	0.48	0.33	0.13	0.02	2.09	1.72	0.69
JD97-4.B.K.1[1]	I	0.04	55.45	2.66	0.00	0.17	31.97	0.00	31.97
JD97-4.D.3	TB	0.04	8.90	3.24	0.07	0.32	71.98	44.35	32.08
JD97-4.D.4	TB	0.03	10.58	1.87	0.14	0.30	72.91	41.52	35.55
JD97-4.D.5	TB	0.08	11.00	1.76	0.27	0.34	72.77	40.74	36.11
JD97-4.B.A.1	TB	0.03	11.51	2.61	0.06	0.42	75.67	42.73	37.22
JD97-4.B.A.2	TB	0.14	11.30	3.02	0.08	0.41	73.12	41.25	36.00
JD97-4.B.A.4	TB	0.04	10.54	4.83	0.04	0.23	69.79	41.32	32.61
JD97-4.B.F.3	TB	0.07	10.60	3.57	0.07	0.32	71.61	42.16	33.67
JD97-4.B.J.1	TB	0.20	11.37	5.04	0.03	0.31	69.22	39.26	33.89
JD97-4.B.J.3	TB	0.11	11.08	9.07	0.03	0.25	64.44	36.06	32.00
JD97-4.B.K.2[1]	TB	0.09	11.51	4.37	0.04	0.28	71.77	41.28	34.62
JD97-4.B.K.3	TB	0.06	11.63	4.90	0.03	0.24	70.95	41.18	33.90
average Stage 5 mag after bio		0.08	10.91	4.03	0.08	0.31	71.29	41.08	34.33
standard deviation		0.05	0.78	2.04	0.07	0.06	2.86	2.09	1.74
JD97-4.B.A.3[1]	IB	0.08	52.97	1.83	0.00	0.18	34.39	0.00	34.39
JD97-4.B.A.5	IB	0.10	53.81	1.90	0.00	0.11	31.55	0.00	31.55
JD97-4.B.J.4	IB	0.13	55.06	3.15	0.00	0.17	29.74	0.00	29.74
average Stage 5 ilm after bio		0.10	53.95	2.29	0.00	0.15	31.90	0.00	31.90
standard deviation		0.02	1.05	0.74	0.00	0.04	2.34	0.00	2.34
JD97-4.2	TH	0.07	10.66	1.01	0.10	0.50	75.71	42.66	37.32

Label					Cations				
	MnO	MgO	ZnO	Total	Si	Ti	Al	Cr	V
GAL94-3A.11	0.00	3.47	0.10	93.60	0.01	1.03	0.04	0.00	0.01
GAL94-3A.B.G.3	0.06	5.08	0.00	93.43	0.01	1.01	0.07	0.00	0.00
average Stage 4 ilm after bio	0.03	4.27	0.05	93.52	0.01	1.02	0.05	0.00	0.01
standard deviation	0.04	1.14	0.07	0.12	0.00	0.01	0.02	0.00	0.00
GAL94-3A.3	0.20	1.97	0.09	97.91	0.00	0.44	0.09	0.00	0.02
GAL94-3A.4	0.24	1.51	0.09	97.32	0.00	0.43	0.09	0.00	0.02
GAL94-3A.6	0.19	1.95	0.01	97.95	0.00	0.30	0.11	0.00	0.02
GAL94-3A.13	0.21	2.04	0.31	97.71	0.00	0.39	0.10	0.01	0.03
GAL94-3A.14	0.23	1.91	0.29	98.14	0.01	0.36	0.11	0.02	0.04
GAL94-3A.16	0.22	2.32	0.13	98.31	0.00	0.42	0.10	0.01	0.03
GAL94-3A.F.1	0.34	1.69	0.13	96.23	0.00	0.36	0.07	0.00	0.04
GAL94-3A.F.2	0.43	1.59	0.18	97.05	0.00	0.29	0.07	0.00	0.03
GAL94-3A.F.3	0.23	1.65	0.00	93.42	0.00	1.08	0.01	0.00	0.03
GAL94-3A.A.F.3	0.37	1.63	0.11	96.35	0.00	0.33	0.06	0.01	0.02
GAL94-3A.B.J.1	0.39	1.73	0.00	93.42	0.00	0.30	0.09	0.00	0.02
average Stage 4 mag after hbl	0.28	1.83	0.14	97.04	0.00	0.36	0.09	0.01	0.03
standard deviation	0.09	0.25	0.10	1.46	0.00	0.06	0.02	0.01	0.01
GAL94-3A.15	0.00	3.37	0.04	95.07	0.00	1.06	0.04	0.00	0.01
GAL94-3A.G.1	0.08	3.68	0.00	94.49	0.01	1.03	0.07	0.00	0.03
average Stage 4 ilm after hbl	0.04	3.52	0.02	94.78	0.01	1.05	0.05	0.00	0.02
standard deviation	0.05	0.22	0.03	0.42	0.01	0.02	0.02	0.00	0.01
GAL94-3A.A.I.1	0.31	2.03	0.05	95.61	0.00	0.31	0.11	0.02	0.02
GAL94-3A.B.A.4	0.30	1.79	0.07	97.02	0.00	0.15	0.09	0.00	0.02
average Stage 4 quench mag	0.31	1.91	0.06	96.31	0.00	0.23	0.10	0.01	0.02
standard deviation	0.01	0.16	0.01	1.00	0.00	0.11	0.01	0.01	0.00
STAGE 5 Fe-Ti oxides									
JD97-4.A.E.1	0.45	0.94	0.24	99.42	0.00	0.23	0.07	0.01	0.02
JD97-4.A.G.2	0.30	2.04	0.06	97.10	0.00	0.25	0.10	0.01	0.02
JD97-4.A.G.3[1]	0.29	1.66	0.06	97.50	0.00	0.26	0.09	0.01	0.02
average Stage 5 Ti-mag	0.35	1.55	0.12	98.01	0.00	0.25	0.09	0.01	0.02
standard deviation	0.09	0.56	0.10	1.24	0.00	0.02	0.02	0.00	0.00
JD97-4.B.K.1[1]	0.03	4.97	0.00	95.33	0.00	1.05	0.08	0.00	0.00
JD97-4.D.3	0.35	3.40	0.01	92.87	0.00	0.26	0.15	0.00	0.01
JD97-4.D.4	0.32	1.89	0.05	92.34	0.00	0.32	0.09	0.00	0.01
JD97-4.D.5	0.29	1.85	0.10	92.68	0.00	0.33	0.08	0.01	0.01
JD97-4.B.A.1	0.29	2.52	0.10	97.58	0.00	0.33	0.12	0.00	0.02
JD97-4.B.A.2	0.31	2.92	0.11	95.63	0.01	0.32	0.14	0.00	0.02
JD97-4.B.A.4	0.36	4.56	0.11	94.69	0.00	0.30	0.21	0.00	0.01
JD97-4.B.F.3	0.27	3.84	0.17	94.80	0.00	0.30	0.16	0.00	0.01
JD97-4.B.J.1	0.36	4.46	0.16	95.16	0.01	0.32	0.22	0.00	0.01
JD97-4.B.J.3	0.31	5.86	0.23	95.04	0.00	0.30	0.39	0.00	0.01
JD97-4.B.K.2[1]	0.33	4.38	0.00	96.96	0.00	0.32	0.19	0.00	0.01
JD97-4.B.K.3	0.32	5.03	0.02	97.38	0.00	0.32	0.21	0.00	0.01
average Stage 5 mag after bio	0.32	3.70	0.10	95.01	0.00	0.31	0.18	0.00	0.01
standard deviation	0.03	1.31	0.07	1.84	0.00	0.02	0.09	0.00	0.00
JD97-4.B.A.3[1]	0.03	4.67	0.00	94.18	0.00	1.02	0.06	0.00	0.00
JD97-4.B.A.5	0.03	4.99	0.00	92.52	0.00	1.05	0.06	0.00	0.00
JD97-4.B.J.4	0.03	5.69	0.00	94.01	0.00	1.05	0.09	0.00	0.00
average Stage 5 ilm after bio	0.03	5.12	0.00	93.57	0.00	1.04	0.07	0.00	0.00
standard deviation	0.00	0.52	0.00	0.91	0.00	0.02	0.02	0.00	0.00
JD97-4.2	0.28	0.98	0.21	93.95	0.00	0.32	0.05	0.00	0.02

Label	Fe^{3+}	Fe^{2+}	Mn	Mg	Zn	Total	Xusp	Xmag	Xilm	Xhem
GAL94-3A.11	0.00	0.76	0.00	0.14	0.00	2.00			1.00	0.00
GAL94-3A.B.G.3	0.00	0.71	0.00	0.19	0.00	2.00			1.00	0.00
average Stage 4 ilm after bio	0.00	0.73	0.00	0.17	0.00	2.00			1.00	0.00
standard deviation	0.00	0.04	0.00	0.04	0.00	0.00			0.00	0.00
GAL94-3A.3	1.00	1.32	0.01	0.11	0.00	3.00	0.47	0.53		
GAL94-3A.4	1.03	1.33	0.01	0.09	0.00	3.00	0.46	0.54		
GAL94-3A.6	1.25	1.19	0.01	0.11	0.00	3.00	0.33	0.67		
GAL94-3A.13	1.07	1.26	0.01	0.11	0.01	3.00	0.43	0.57		
GAL94-3A.14	1.10	1.24	0.01	0.11	0.01	3.00	0.41	0.59		
GAL94-3A.16	1.01	1.28	0.01	0.13	0.00	3.00	0.46	0.54		
GAL94-3A.F.1	1.16	1.25	0.01	0.10	0.00	3.00	0.38	0.62		
GAL94-3A.F.2	1.32	1.18	0.01	0.09	0.01	3.00	0.30	0.70		
GAL94-3A.F.3		1.77	0.01	0.10	0.00	3.00	1.00	0.00		
GAL94-3A.A.F.3	1.24	1.22	0.01	0.09	0.00	3.00	0.35	0.65		
GAL94-3A.B.J.1	1.29	1.19	0.01	0.10	0.00	3.00	0.31	0.69		
average Stage 4 mag after hbl	1.15	1.25	0.01	0.10	0.00	3.00	0.39	0.61		
standard deviation	0.12	0.05	0.00	0.01	0.00	0.00	0.07	0.07		
GAL94-3A.15	0.00	0.75	0.00	0.13	0.00	2.00			1.00	0.00
GAL94-3A.G.1	0.00	0.69	0.00	0.14	0.00	2.00			1.00	0.00
average Stage 4 ilm after hbl	0.00	0.72	0.00	0.14	0.00	2.00			1.00	0.00
standard deviation	0.00	0.04	0.00	0.01	0.00	0.00			0.00	0.00
GAL94-3A.A.I.1	1.22	1.18	0.01	0.12	0.00	3.00	0.34	0.66		
GAL94-3A.B.A.4	1.57	1.04	0.01	0.10	0.00	3.00	0.16	0.84		
average Stage 4 quench mag	1.40	1.11	0.01	0.11	0.00	3.00	0.25	0.75		
standard deviation	0.25	0.10	0.00	0.01	0.00	0.00	0.13	0.13		
STAGE 5 Fe-Ti oxides										
JD97-4.A.E.1	1.43	1.16	0.01	0.05	0.01	3.00	0.25	0.75		
JD97-4.A.G.2	1.36	1.13	0.01	0.12	0.00	3.00	0.27	0.73		
JD97-4.A.G.3[1]	1.35	1.16	0.01	0.09	0.00	3.00	0.28	0.72		
average Stage 5 Ti-mag	1.38	1.15	0.01	0.09	0.00	3.00	0.26	0.74		
standard deviation	0.04	0.02	0.00	0.03	0.00	0.00	0.02	0.02		
JD97-4.B.K.1[1]	0.00	0.68	0.00	0.19	0.00	2.00			1.00	0.00
JD97-4.D.3	1.31	1.05	0.01	0.20	0.00	3.00	0.27	0.73		
JD97-4.D.4	1.25	1.19	0.01	0.11	0.00	3.00	0.33	0.67		
JD97-4.D.5	1.23	1.21	0.01	0.11	0.00	3.00	0.35	0.65		
JD97-4.B.A.1	1.21	1.17	0.01	0.14	0.00	2.86	0.35	0.65		
JD97-4.B.A.2	1.19	1.15	0.01	0.17	0.00	2.83	0.35	0.65		
JD97-4.B.A.4	1.17	1.03	0.01	0.26	0.00	2.74	0.32	0.68		
JD97-4.B.F.3	1.21	1.08	0.01	0.22	0.00	3.00	0.32	0.68		
JD97-4.B.J.1	1.11	1.06	0.01	0.25	0.00	3.00	0.36	0.64		
JD97-4.B.J.3	0.99	0.97	0.01	0.32	0.01	3.00	0.39	0.61		
JD97-4.B.K.2[1]	1.15	1.07	0.01	0.24	0.00	3.00	0.35	0.65		
JD97-4.B.K.3	1.13	1.04	0.01	0.27	0.00	3.00	0.35	0.65		
average Stage 5 mag after bio	1.18	1.09	0.01	0.21	0.00	2.95	0.34	0.66		
standard deviation	0.08	0.08	0.00	0.07	0.00	0.09	0.03	0.03		
JD97-4.B.A.3[1]	0.00	0.74	0.00	0.18	0.00	2.00			1.00	0.00
JD97-4.B.A.5	0.00	0.69	0.00	0.19	0.00	2.00			1.00	0.00
JD97-4.B.J.4	0.00	0.63	0.00	0.22	0.00	2.00			1.00	0.00
average Stage 5 ilm after bio	0.00	0.69	0.00	0.20	0.00	2.00			1.00	0.00
standard deviation	0.00	0.05	0.00	0.02	0.00	0.00			0.00	0.00
JD97-4.2	1.28	1.25	0.01	0.06	0.01	3.00	0.33	0.67		

Label	Code	Wt% oxides							
		SiO_2	TiO_2	Al_2O_3	Cr_2O_3	V_2O_3	FeO*	Fe_2O_3 (c)	FeO (c)
JD97-4.3	TH	0.15	11.01	0.95	0.10	0.50	74.31	41.08	37.35
JD97-4.4	TH	0.40	9.13	7.65	0.10	0.65	69.59	36.03	37.17
JD97-4.5	TH	0.07	10.04	1.44	0.13	0.49	75.17	43.03	36.45
JD97-4.6	TH	0.10	10.55	0.88	0.30	0.49	74.70	42.07	36.85
JD97-4.7	TH	0.06	11.84	0.88	0.72	0.49	73.79	39.66	38.10
JD97-4.8	TH	0.12	6.03	0.93	0.21	1.19	78.15	50.07	33.09
JD97-4.C1.2	TH	0.07	7.13	1.63	0.45	0.89	75.24	46.75	33.17
JD97-4.C1.3	TH	0.06	11.73	1.45	0.16	0.63	72.61	39.12	37.40
JD97-4.A.G.4	TH	0.06	9.75	1.27	0.19	0.46	79.79	46.81	37.67
JD97-4.A.G.5	TH	0.05	10.05	1.85	0.23	0.54	78.35	45.90	37.05
JD97-4.A.G.6	TH	0.05	9.38	1.86	0.19	0.52	79.05	46.85	36.89
average Stage 5 mag after hbl		0.10	9.77	1.82	0.24	0.61	75.54	43.34	36.54
standard deviation		0.10	1.72	1.87	0.18	0.22	2.93	4.05	1.65
JD97-4.A.I.1	QT	0.08	9.31	1.83	0.06	0.57	78.71	46.73	36.66
JD97-4.A.J.1	QT	0.05	9.88	1.47	0.02	0.54	80.04	46.68	38.04
JD97-4.B.G.1[1]	QT	0.07	9.46	1.44	0.03	0.54	80.14	47.32	37.56
JD97-4.B.L.1	QT	0.07	9.43	1.59	0.03	0.49	79.77	47.30	37.21
JD97-4.B.L.2	QT	0.09	9.80	1.29	0.02	0.66	79.56	46.44	37.76
average Stage 5 quench mag		0.07	9.58	1.52	0.03	0.56	79.64	46.90	37.45
standard deviation		0.01	0.25	0.20	0.02	0.06	0.57	0.39	0.53

[1] indicates points selected as representative compositions and presented in the main text.

* indicates all Fe as FeO.

Code abbreviations as follows: M, primary magnetite; Ru, primary rutile; T, residual titaniferous magnetite; I, primary/residual ilmenite; R, point analyzed at the rim of a crystal; C, point analyzed at the core of a crystal; TB, titaniferous magnetite replacing biotite; IB, ilmenite replacing biotite; TH, titaniferous magnetite replacing hornblende; IH; ilmenite replacing hornblende; QT, titaniferous magnetite quench crystal.

Oxide recalculations by the method of Stormer (1983). Low totals in oxides are due to small size.

Label					Cations				
	MnO	MgO	ZnO	Total	Si	Ti	Al	Cr	V
JD97-4.3	0.27	1.06	0.12	92.75	0.01	0.33	0.05	0.00	0.02
JD97-4.4	0.36	0.90	0.23	92.81	0.02	0.27	0.35	0.00	0.02
JD97-4.5	0.29	1.09	0.18	93.41	0.00	0.30	0.07	0.00	0.02
JD97-4.6	0.34	1.03	0.07	92.88	0.00	0.32	0.04	0.01	0.02
JD97-4.7	0.34	1.10	0.06	93.42	0.00	0.36	0.04	0.02	0.02
JD97-4.8	0.42	0.75	0.21	93.38	0.00	0.18	0.04	0.01	0.05
JD97-4.C1.2	0.34	1.27	0.04	92.04	0.00	0.22	0.08	0.01	0.04
JD97-4.C1.3	0.38	1.35	0.05	92.53	0.00	0.36	0.07	0.01	0.02
JD97-4.A.G.4	0.36	1.07	0.05	97.79	0.00	0.28	0.06	0.01	0.02
JD97-4.A.G.5	0.40	1.71	0.08	97.97	0.00	0.29	0.08	0.01	0.02
JD97-4.A.G.6	0.34	1.42	0.00	97.61	0.00	0.27	0.08	0.01	0.02
average Stage 5 mag after hbl	0.34	1.14	0.11	94.21	0.00	0.29	0.08	0.01	0.02
standard deviation	0.05	0.26	0.08	2.22	0.00	0.05	0.09	0.01	0.01
JD97-4.A.I.1	0.41	1.38	0.10	97.25	0.00	0.27	0.08	0.00	0.02
JD97-4.A.J.1	0.72	0.78	0.12	98.42	0.00	0.28	0.07	0.00	0.02
JD97-4.B.G.1[1]	0.52	0.97	0.00	98.04	0.00	0.27	0.07	0.00	0.02
JD97-4.B.L.1	0.55	1.10	0.10	97.97	0.00	0.27	0.07	0.00	0.02
JD97-4.B.L.2	0.55	0.88	0.16	97.79	0.00	0.28	0.06	0.00	0.02
average Stage 5 quench mag	0.55	1.02	0.10	97.89	0.00	0.28	0.07	0.00	0.02
standard deviation	0.11	0.23	0.06	0.43	0.00	0.01	0.01	0.00	0.00

Label	Fe^{3+}	Fe^{2+}	Mn	Mg	Zn	Total	Xusp	Xmag	Xilm	Xhem
JD97-4.3	1.25	1.26	0.01	0.06	0.00	3.00	0.35	0.65		
JD97-4.4	1.06	1.21	0.01	0.05	0.01	3.00	0.39	0.61		
JD97-4.5	1.30	1.22	0.01	0.07	0.01	3.00	0.32	0.68		
JD97-4.6	1.28	1.25	0.01	0.06	0.00	3.00	0.33	0.67		
JD97-4.7	1.20	1.28	0.01	0.07	0.00	3.00	0.38	0.62		
JD97-4.8	1.52	1.12	0.01	0.05	0.01	3.00	0.19	0.81		
JD97-4.C1.2	1.43	1.13	0.01	0.08	0.00	3.00	0.23	0.77		
JD97-4.C1.3	1.19	1.26	0.01	0.08	0.00	3.00	0.38	0.62		
JD97-4.A.G.4	1.35	1.21	0.01	0.06	0.00	3.00	0.29	0.71		
JD97-4.A.G.5	1.31	1.18	0.01	0.10	0.00	3.00	0.30	0.70		
JD97-4.A.G.6	1.35	1.18	0.01	0.08	0.00	3.00	0.29	0.71		
average Stage 5 mag after hbl	1.29	1.21	0.01	0.07	0.00	3.00	0.32	0.68		
standard deviation	0.12	0.05	0.00	0.01	0.00	0.00	0.06	0.06		
JD97-4.A.I.1	1.35	1.18	0.01	0.08	0.00	3.00	0.28	0.72		
JD97-4.A.J.1	1.34	1.21	0.02	0.04	0.00	3.00	0.30	0.70		
JD97-4.B.G.1[1]	1.36	1.20	0.02	0.06	0.00	3.00	0.29	0.71		
JD97-4.B.L.1	1.36	1.19	0.02	0.06	0.00	3.00	0.28	0.72		
JD97-4.B.L.2	1.34	1.21	0.02	0.05	0.00	3.00	0.30	0.70		
average Stage 5 quench mag	1.35	1.20	0.02	0.06	0.00	3.00	0.29	0.71		
standard deviation	0.01	0.02	0.00	0.01	0.00	0.00	0.01	0.01		

Appendix H. Fluorapatite Compositional Data.

Label	Code	Wt% oxides						
		MgO	CaO	SrO	CeO	Na2O	P2O5	S
STAGE 1 fluorapatite								
GAL94-1A.1	C	0.01	56.36	0.06	0.14	0.05	42.40	0.04
GAL94-1A.2	C	0.00	56.14	0.05	0.15	0.07	42.00	0.10
GAL94-1A.3	C	0.01	55.65	0.06	0.19	0.07	41.79	0.06
GAL94-1A.4	C	0.02	55.55	0.05	0.14	0.04	42.29	0.03
GAL94-1A.5	C	0.03	55.52	0.03	0.15	0.04	42.01	0.07
GAL94-1A.6	R	0.00	55.56	0.06	0.00	0.00	42.72	0.02
GAL94-1A.7	R	0.01	55.84	0.05	0.18	0.05	42.43	0.03
GAL94-1A.8	R	0.02	55.94	0.05	0.11	0.05	41.59	0.06
GAL94-1A.9		0.02	56.14	0.05	0.10	0.01	41.49	0.04
GAL94-1A.11	R	0.02	56.19	0.07	0.17	0.04	41.68	0.07
GAL94-1A.12	R	0.00	56.28	0.03	0.16	0.05	41.98	0.09
GAL94-1A.A.A.1	C	0.01	55.10	0.04	0.21	0.06	41.67	0.05
GAL94-1A.A.A.2	R	0.01	54.11	0.07	0.15	0.04	40.88	0.03
GAL94-1A.A.B.1	C	0.00	53.47	0.06	0.00	0.00	41.64	0.02
GAL94-1A.B.1		0.01	55.45	0.03	0.16	0.06	42.22	0.10
GAL94-1A.B.2	C	0.01	54.89	0.04	0.20	0.11	41.30	0.11
GAL94-1A.B.3		0.00	55.91	0.06	0.12	0.06	42.09	0.06
GAL94-1A.B.4	R	0.00	56.00	0.05	0.15	0.07	42.07	0.10
GAL94-1A.G.1	C	0.00	54.92	0.05	0.14	0.06	41.85	0.10
GAL94-1A.G.2[1]	R	0.02	55.31	0.05	0.15	0.05	41.38	0.07
GAL94-1A.G.3	C	0.01	56.18	0.07	0.16	0.06	41.76	0.09
GAL94-1A.G.4	R	0.01	56.49	0.05	0.15	0.06	41.75	0.07
JD97-3.A.A.1		0.01	53.37	0.05	0.13	0.08	41.86	0.10
JD97-3.A.E.3		0.00	54.04	0.08	0.16	0.10	40.64	0.14
JD97-3.A.H.1		0.00	54.47	0.06	0.29	0.07	41.42	0.09
av. Stage 1 fluorap		0.01	55.39	0.05	0.15	0.05	41.80	0.07
standard deviation		0.01	0.90	0.01	0.06	0.03	0.47	0.03
STAGE 2 fluorapatite								
HP99-9.A.1	C	0.22	54.77	0.04	0.29	0.08	41.98	0.07
HP99-9.A.2	C	0.76	54.38	0.04	0.19	0.10	42.12	0.10
HP99-9.A.4	C	0.92	53.50	0.03	0.18	0.12	41.86	0.13
HP99-9.A.6	C	0.98	53.14	0.02	0.20	0.12	41.34	0.14
HP99-9.B.1	C	0.83	54.10	0.07	0.11	0.07	42.40	0.10
HP99-9.D.1	C	0.20	54.69	0.09	0.22	0.13	41.40	0.10
HP99-9.D.2	R	0.58	53.34	0.05	0.29	0.16	40.50	0.06
HP99-9.E.1	C	0.14	54.70	0.07	0.27	0.09	41.55	0.10
HP99-9.F.1	C	0.13	54.60	0.02	0.11	0.06	41.82	0.07
HP99-9.F.3	C	0.09	54.15	0.04	0.17	0.04	41.17	0.01
HP99-9.F.5	R	0.19	52.90	0.04	0.11	0.05	42.01	0.02
HP99-9.K.1	C	0.22	53.44	0.07	0.28	0.09	41.13	0.07
HP99-9.K.2[1]	C	0.24	54.20	0.06	0.25	0.08	41.25	0.10

Label	F	Cl	Total	O=F	O=Cl	cations Mg	Ca	Na
STAGE 1 fluorapatite								
GAL94-1A.1	2.21	0.27	100.61	0.93	0.06	0.00	9.63	0.02
GAL94-1A.2	2.30	0.21	100.15	0.97	0.05	0.00	9.64	0.02
GAL94-1A.3	2.00	0.35	99.33	0.84	0.08	0.00	9.63	0.02
GAL94-1A.4	2.26	0.20	99.61	0.95	0.05	0.00	9.57	0.01
GAL94-1A.5	2.15	0.31	99.41	0.90	0.07	0.01	9.59	0.01
GAL94-1A.6	2.19	0.21	99.83	0.92	0.05	0.00	9.52	0.00
GAL94-1A.7	2.16	0.26	100.07	0.91	0.06	0.00	9.58	0.01
GAL94-1A.8	2.30	0.20	99.39	0.97	0.05	0.00	9.69	0.01
GAL94-1A.9	2.58	0.10	99.48	1.09	0.02	0.00	9.74	0.00
GAL94-1A.11	2.00	0.26	99.69	0.84	0.06	0.00	9.70	0.01
GAL94-1A.12	2.32	0.24	100.22	0.98	0.05	0.00	9.67	0.01
GAL94-1A.A.A.1	2.42	0.38	98.88	1.02	0.09	0.00	9.88	0.02
GAL94-1A.A.A.2	2.46	0.29	96.97	1.03	0.07	0.00	9.89	0.01
GAL94-1A.A.B.1	3.04	0.10	97.06	1.28	0.02	0.00	9.77	0.00
GAL94-1A.B.1	2.28	0.23	99.68	0.96	0.05	0.00	9.54	0.02
GAL94-1A.B.2	2.14	0.38	98.33	0.90	0.09	0.00	9.60	0.03
GAL94-1A.B.3	2.26	0.22	99.87	0.95	0.05	0.00	9.62	0.02
GAL94-1A.B.4	2.17	0.36	100.12	0.91	0.08	0.00	9.62	0.02
GAL94-1A.G.1	2.11	0.28	98.68	0.89	0.06	0.00	9.54	0.02
GAL94-1A.G.2[1]	2.29	0.22	98.62	0.97	0.05	0.00	9.65	0.02
GAL94-1A.G.3	2.30	0.25	99.94	0.97	0.06	0.00	9.68	0.02
GAL94-1A.G.4	2.32	0.26	100.21	0.98	0.06	0.00	9.72	0.02
JD97-3.A.A.1	1.98	0.58	97.32	0.83	0.13	0.00	9.61	0.03
JD97-3.A.E.3	2.16	0.59	97.07	0.91	0.13	0.00	9.86	0.03
JD97-3.A.H.1	2.08	0.75	98.29	0.88	0.17	0.00	9.81	0.02
av. Stage 1 fluorap	2.26	0.30	99.15	0.95	0.07	0.00	9.67	0.02
standard deviation	0.22	0.15	1.09	0.09	0.03	0.00	0.11	0.01
STAGE 2 fluorapatite								
HP99-9.A.1	2.88	0.33	99.45	1.21	0.08	0.06	9.81	0.03
HP99-9.A.2	1.81	0.32	99.12	0.76	0.07	0.19	9.57	0.03
HP99-9.A.4	1.24	0.29	97.87	0.52	0.07	0.23	9.43	0.04
HP99-9.A.6	1.93	0.50	97.63	0.81	0.11	0.24	9.53	0.04
HP99-9.B.1	1.58	0.31	98.98	0.66	0.07	0.20	9.47	0.02
HP99-9.D.1	2.19	1.02	98.98	0.92	0.23	0.05	9.84	0.04
HP99-9.D.2	2.04	1.22	97.15	0.86	0.28	0.15	9.80	0.05
HP99-9.E.1	2.67	0.29	98.80	1.12	0.07	0.04	9.84	0.03
HP99-9.F.1	2.58	0.30	98.63	1.09	0.07	0.03	9.80	0.02
HP99-9.F.3	2.91	0.31	97.60	1.23	0.07	0.02	9.91	0.01
HP99-9.F.5	2.62	0.33	97.12	1.10	0.07	0.05	9.60	0.02
HP99-9.K.1	2.66	0.27	97.13	1.12	0.06	0.06	9.76	0.03
HP99-9.K.2[1]	2.58	0.27	98.00	1.08	0.06	0.06	9.81	0.03

Label	P	S	Sr	Ce	Total cations	F	Cl
STAGE 1 fluorapatite							
GAL94-1A.1	5.73	0.01	0.01	0.01	15.40	1.45	0.07
GAL94-1A.2	5.70	0.03	0.00	0.01	15.41	1.51	0.06
GAL94-1A.3	5.72	0.02	0.01	0.01	15.41	1.32	0.10
GAL94-1A.4	5.76	0.01	0.01	0.01	15.36	1.49	0.05
GAL94-1A.5	5.73	0.02	0.00	0.01	15.37	1.42	0.08
GAL94-1A.6	5.78	0.01	0.01	0.00	15.31	1.43	0.06
GAL94-1A.7	5.75	0.01	0.00	0.01	15.37	1.42	0.07
GAL94-1A.8	5.69	0.02	0.00	0.01	15.43	1.52	0.05
GAL94-1A.9	5.69	0.01	0.00	0.01	15.45	1.71	0.03
GAL94-1A.11	5.69	0.02	0.01	0.01	15.44	1.32	0.07
GAL94-1A.12	5.70	0.03	0.00	0.01	15.42	1.52	0.06
GAL94-1A.A.A.1	5.90	0.01	0.00	0.01	15.84	1.28	0.11
GAL94-1A.A.A.2	5.91	0.01	0.01	0.01	15.84	1.33	0.08
GAL94-1A.A.B.1	6.01	0.01	0.01	0.00	15.80	1.64	0.03
GAL94-1A.B.1	5.74	0.03	0.00	0.01	15.35	1.50	0.06
GAL94-1A.B.2	5.71	0.03	0.00	0.01	15.40	1.43	0.10
GAL94-1A.B.3	5.72	0.02	0.01	0.01	15.39	1.48	0.06
GAL94-1A.B.4	5.71	0.03	0.00	0.01	15.39	1.42	0.10
GAL94-1A.G.1	5.74	0.03	0.00	0.01	15.34	1.40	0.08
GAL94-1A.G.2[1]	5.71	0.02	0.01	0.01	15.41	1.53	0.06
GAL94-1A.G.3	5.69	0.03	0.01	0.01	15.44	1.51	0.07
GAL94-1A.G.4	5.68	0.02	0.00	0.01	15.46	1.53	0.07
JD97-3.A.A.1	5.96	0.03	0.00	0.01	15.64	1.05	0.16
JD97-3.A.E.3	5.86	0.05	0.01	0.01	15.81	1.16	0.17
JD97-3.A.H.1	5.90	0.03	0.01	0.02	15.79	1.11	0.21
av. Stage 1 fluorap	5.77	0.02	0.01	0.01	15.49	1.42	0.08
standard deviation	0.10	0.01	0.00	0.00	0.18	0.15	0.04
STAGE 2 fluorapatite							
HP99-9.A.1	5.94	0.02	0.00	0.02	15.88	1.52	0.09
HP99-9.A.2	5.86	0.03	0.00	0.01	15.69	0.94	0.09
HP99-9.A.4	5.83	0.04	0.00	0.01	15.57	0.64	0.08
HP99-9.A.6	5.86	0.04	0.00	0.01	15.74	1.02	0.14
HP99-9.B.1	5.87	0.03	0.01	0.01	15.61	0.82	0.08
HP99-9.D.1	5.89	0.03	0.01	0.01	15.87	1.17	0.29
HP99-9.D.2	5.88	0.02	0.01	0.02	15.92	1.10	0.35
HP99-9.E.1	5.91	0.03	0.01	0.02	15.86	1.42	0.08
HP99-9.F.1	5.93	0.02	0.00	0.01	15.81	1.37	0.08
HP99-9.F.3	5.95	0.00	0.00	0.01	15.91	1.57	0.09
HP99-9.F.5	6.03	0.01	0.00	0.01	15.71	1.40	0.09
HP99-9.K.1	5.94	0.02	0.01	0.02	15.84	1.44	0.08
HP99-9.K.2[1]	5.90	0.03	0.01	0.02	15.85	1.38	0.08

Label	Code	Wt% oxides						
		MgO	CaO	SrO	CeO	Na2O	P2O5	S
HP99-9.L.1	C	0.25	54.13	0.05	0.25	0.16	41.24	0.24
av. Stage 2 fluorap		0.41	54.00	0.05	0.21	0.10	41.56	0.09
standard deviation		0.33	0.63	0.02	0.07	0.04	0.50	0.05
STAGE 3 fluorapatite								
JD97-1.A.C.2	C	0.41	52.45	0.05	0.29	0.10	41.51	0.09
JD97-1.A.C.4		0.40	53.18	0.05	0.23	0.07	41.51	0.09
JD97-1.A.D.1		0.40	53.35	0.06	0.32	0.09	40.51	0.08
JD97-1.A.D.2		0.35	53.14	0.04	0.30	0.10	41.15	0.12
JD97-1.A.D.4	R	0.35	52.48	0.10	0.28	0.09	41.33	0.09
JD97-1.A.F.1		0.39	53.51	0.04	0.17	0.05	41.01	0.07
JD97-1.A.K.1[1]		0.44	52.93	0.07	0.16	0.08	41.84	0.10
JD97-1.A.K.2	C	0.51	52.54	0.03	0.22	0.07	41.26	0.06
JD97-1.A.K.3	R	0.37	52.84	0.08	0.13	0.05	40.96	0.03
JD97-1.A.Q.2	C	0.45	51.60	0.07	0.34	0.12	41.68	0.10
JD97-1.B.C.1	C	0.58	52.51	0.06	0.15	0.05	41.87	0.04
JD97-1.B.C.2	R	0.54	52.75	0.09	0.15	0.04	41.87	0.01
JD97-1.B.J.1		0.29	53.65	0.05	0.17	0.05	41.33	0.05
JD97-1.B.J.2	C	0.05	54.59	0.05	0.08	0.06	42.03	0.07
JD97-1.B.J.3	R	0.34	54.46	0.07	0.05	0.05	41.87	0.01
av. Stage 3 fluorap		0.39	53.07	0.06	0.20	0.07	41.45	0.07
standard deviation		0.12	0.78	0.02	0.09	0.02	0.43	0.03
STAGE 4 fluorapatite								
GAL94-3A.A.C.1	C	0.51	53.47	0.08	0.10	0.06	41.44	0.10
GAL94-3A.A.C.2	R	0.34	53.52	0.09	0.16	0.04	42.08	0.02
GAL94-3A.A.C.3[1]		0.45	53.15	0.10	0.08	0.05	42.30	0.04
av. Stage 4 fluorap		0.44	53.38	0.09	0.11	0.05	41.94	0.05
standard deviation		0.08	0.20	0.01	0.04	0.01	0.44	0.04
STAGE 5 fluorapatite								
JD97-4.A.S.1	C	0.65	55.06	0.10	0.13	0.04	42.76	0.01
JD97-4.A.S.2	R	0.40	54.37	0.08	0.13	0.03	42.34	0.01
JD97-4.B.D.1		0.38	52.97	0.12	0.08	0.05	41.54	0.08
JD97-4.B.D.2		0.58	53.41	0.11	0.12	0.09	42.09	0.10
JD97-4.B.D.3	C	0.67	52.50	0.09	0.16	0.10	41.97	0.07
JD97-4.B.D.4[1]	R	0.49	52.84	0.10	0.08	0.06	41.92	0.08
av. Stage 5 fluorap		0.53	53.53	0.10	0.12	0.06	42.10	0.06
standard deviation		0.12	0.99	0.01	0.03	0.03	0.41	0.04

[1] indicates points selected as representative compositions and presented in the main text.

Code as follows: C, point analyzed in core of a crystal; R, point analyzed at the rim of a crystal.

Fluorapatite stoichiometry calculated on the basis of 25 oxygen equivalents.

Label				O=F	O=Cl	cations		
	F	Cl	Total			Mg	Ca	Na
HP99-9.L.1	2.51	0.55	98.53	1.06	0.13	0.06	9.75	0.05
av. Stage 2 fluorap	2.30	0.45	98.21	0.97	0.10	0.10	9.71	0.03
standard deviation	0.51	0.30	0.81	0.21	0.07	0.08	0.16	0.01
STAGE 3 fluorapatite								
JD97-1.A.C.2	3.14	0.43	97.15	1.32	0.10	0.11	9.64	0.03
JD97-1.A.C.4	2.91	0.54	97.75	1.22	0.12	0.10	9.70	0.02
JD97-1.A.D.1	3.64	0.41	97.30	1.53	0.09	0.10	9.95	0.03
JD97-1.A.D.2	3.36	0.50	97.67	1.41	0.11	0.09	9.79	0.03
JD97-1.A.D.4	2.77	0.55	96.85	1.17	0.13	0.09	9.64	0.03
JD97-1.A.F.1	4.30	0.21	97.99	1.81	0.05	0.10	9.96	0.02
JD97-1.A.K.1[1]	3.09	0.33	97.80	1.30	0.08	0.11	9.63	0.03
JD97-1.A.K.2	3.83	0.37	97.24	1.61	0.08	0.13	9.76	0.02
JD97-1.A.K.3	4.08	0.32	97.08	1.72	0.07	0.10	9.89	0.02
JD97-1.A.Q.2	3.55	0.36	96.80	1.50	0.08	0.12	9.55	0.04
JD97-1.B.C.1	3.75	0.29	97.71	1.58	0.07	0.15	9.65	0.02
JD97-1.B.C.2	3.89	0.30	97.94	1.64	0.07	0.14	9.71	0.01
JD97-1.B.J.1	3.70	0.31	98.01	1.56	0.07	0.08	9.88	0.02
JD97-1.B.J.2	3.77	0.16	99.35	1.59	0.04	0.01	9.89	0.02
JD97-1.B.J.3	3.82	0.21	99.23	1.61	0.05	0.09	9.90	0.02
av. Stage 3 fluorap	3.57	0.35	97.72	1.50	0.08	0.10	9.77	0.02
standard deviation	0.44	0.12	0.75	0.18	0.03	0.03	0.13	0.01
STAGE 4 fluorapatite								
GAL94-3A.A.C.1	3.48	0.22	98.09	1.46	0.05	0.13	9.77	0.02
GAL94-3A.A.C.2	3.41	0.15	98.36	1.44	0.03	0.09	9.72	0.01
GAL94-3A.A.C.3[1]	3.49	0.23	98.40	1.47	0.05	0.11	9.64	0.01
av. Stage 4 fluorap	3.46	0.20	98.29	1.46	0.05	0.11	9.71	0.02
standard deviation	0.04	0.04	0.17	0.02	0.01	0.02	0.06	0.00
STAGE 5 fluorapatite								
JD97-4.A.S.1	3.56	0.22	100.97	1.50	0.05	0.16	9.78	0.01
JD97-4.A.S.2	3.53	0.34	99.68	1.48	0.08	0.10	9.79	0.01
JD97-4.B.D.1	3.40	0.34	97.55	1.43	0.08	0.10	9.72	0.02
JD97-4.B.D.2	4.11	0.36	99.28	1.73	0.08	0.15	9.74	0.03
JD97-4.B.D.3	3.35	0.40	97.89	1.41	0.09	0.17	9.58	0.03
JD97-4.B.D.4[1]	3.57	0.37	98.03	1.50	0.08	0.12	9.66	0.02
av. Stage 5 fluorap	3.58	0.34	98.90	1.51	0.08	0.13	9.71	0.02
standard deviation	0.27	0.06	1.31	0.11	0.01	0.03	0.08	0.01

Label	P	S	Sr	Ce	Total cations	F	Cl
HP99-9.L.1	5.87	0.08	0.01	0.02	15.83	1.33	0.16
av. Stage 2 fluorap	5.90	0.03	0.00	0.01	15.79	1.22	0.13
standard deviation	0.05	0.02	0.00	0.00	0.11	0.28	0.09
STAGE 3 fluorapatite							
JD97-1.A.C.2	6.03	0.03	0.01	0.02	15.85	1.70	0.12
JD97-1.A.C.4	5.98	0.03	0.00	0.02	15.86	1.57	0.16
JD97-1.A.D.1	5.97	0.02	0.01	0.02	16.10	2.00	0.12
JD97-1.A.D.2	5.99	0.04	0.00	0.02	15.96	1.83	0.14
JD97-1.A.D.4	6.00	0.03	0.01	0.02	15.81	1.50	0.16
JD97-1.A.F.1	6.03	0.02	0.00	0.01	16.14	2.36	0.06
JD97-1.A.K.1[1]	6.01	0.03	0.01	0.01	15.82	1.66	0.10
JD97-1.A.K.2	6.06	0.02	0.00	0.01	16.01	2.10	0.11
JD97-1.A.K.3	6.06	0.01	0.01	0.01	16.09	2.25	0.10
JD97-1.A.Q.2	6.09	0.03	0.01	0.02	15.86	1.94	0.10
JD97-1.B.C.1	6.08	0.01	0.01	0.01	15.93	2.03	0.08
JD97-1.B.C.2	6.09	0.00	0.01	0.01	15.97	2.11	0.09
JD97-1.B.J.1	6.02	0.02	0.00	0.01	16.02	2.01	0.09
JD97-1.B.J.2	6.02	0.02	0.01	0.01	15.97	2.01	0.05
JD97-1.B.J.3	6.02	0.00	0.01	0.00	16.04	2.05	0.06
av. Stage 3 fluorap	6.03	0.02	0.01	0.01	15.96	1.94	0.10
standard deviation	0.04	0.01	0.00	0.01	0.11	0.25	0.03
STAGE 4 fluorapatite							
GAL94-3A.A.C.1	5.98	0.03	0.01	0.01	15.95	1.87	0.06
GAL94-3A.A.C.2	6.04	0.01	0.01	0.01	15.88	1.83	0.04
GAL94-3A.A.C.3[1]	6.06	0.01	0.01	0.01	15.86	1.87	0.06
av. Stage 4 fluorap	6.03	0.02	0.01	0.01	15.90	1.86	0.06
standard deviation	0.04	0.01	0.00	0.00	0.05	0.03	0.01
STAGE 5 fluorapatite							
JD97-4.A.S.1	6.00	0.00	0.01	0.01	15.97	1.87	0.06
JD97-4.A.S.2	6.03	0.00	0.01	0.01	15.95	1.88	0.10
JD97-4.B.D.1	6.02	0.02	0.01	0.01	15.90	1.84	0.10
JD97-4.B.D.2	6.06	0.03	0.01	0.01	16.02	2.21	0.10
JD97-4.B.D.3	6.05	0.02	0.01	0.01	15.87	1.80	0.11
JD97-4.B.D.4[1]	6.05	0.03	0.01	0.01	15.90	1.92	0.11
av. Stage 5 fluorap	6.04	0.02	0.01	0.01	15.94	1.92	0.10
standard deviation	0.02	0.01	0.00	0.00	0.06	0.15	0.02

Appendix I. Glass Compositional Data.

Label	Code	Color[2]	Wt% oxides SiO_2	TiO_2	Al_2O_3	FeO*	MnO	MgO	CaO
STAGE 2 glass									
HP99-9.J.1[1]			69.31	0.15	13.79	1.15	0.03	0.86	2.53
HP99-9.J.2[1]			74.84	0.07	10.60	0.85	0.02	0.74	4.49
HP99-9.J.3[1]			65.72	0.61	12.19	4.41	0.08	3.84	2.58
average Stage 2 glass			70.28	0.34	11.39	2.63	0.05	2.29	3.53
standard deviation			4.60	0.29	1.60	1.98	0.03	1.76	1.11
STAGE 3 glass									
JD97-1.A.E.1	T		74.11	11.12	0.11	0.60	0.00	0.24	3.57
JD97-1.A.E.3	T		72.40	11.21	0.45	0.84	0.00	0.16	3.76
JD97-1.A.F.1	T		78.57	10.81	0.46	0.58	0.00	0.09	3.33
JD97-1.A.F.3	T		79.72	10.10	0.37	0.52	0.03	0.07	3.49
JD97-1.A.H.2	T		71.55	11.22	0.24	0.66	0.02	0.19	3.47
JD97-1.A.L.1	T		74.23	11.89	0.21	0.45	0.01	0.09	3.39
JD97-1.A.L.2	T		74.97	11.16	0.35	0.52	0.00	0.05	3.89
JD97-1.A.L.4	T		72.59	11.94	0.29	0.70	0.00	0.08	3.84
JD97-1.A.N.1	T		74.24	10.49	0.25	0.80	0.05	0.22	3.45
JD97-1.A.N.3	T		73.93	11.32	0.19	0.97	0.00	0.08	3.55
JD97-1.A.O.2[1]	T		74.18	11.49	0.21	0.49	0.00	0.04	3.51
JD97-1.A.Q.2	T		75.27	11.38	0.11	0.51	0.04	0.03	3.84
JD97-1.A.R.2	T		71.07	12.31	0.18	0.65	0.00	0.30	3.38
JD97-1.A.R.4	T		77.32	10.77	0.32	0.42	0.02	0.05	2.99
JD97-1.A.F.2	T		79.19	10.38	0.57	0.56	0.00	0.05	2.72
av. Stage 3 tonal glass			74.89	11.17	0.29	0.62	0.01	0.12	3.48
standard deviation			2.69	0.60	0.13	0.15	0.01	0.08	0.31
JD97-1.A.E.2	G		75.32	11.46	0.42	0.50	0.02	0.02	0.33
JD97-1.A.G.1	G		75.18	11.21	0.56	1.61	0.02	0.04	0.37
JD97-1.A.G.2	G		76.88	11.24	0.37	0.42	0.00	0.02	0.36
JD97-1.A.G.3[1]	G		75.99	11.62	0.49	0.44	0.00	0.02	0.53
JD97-1.A.G.4	G		74.49	12.26	0.64	0.77	0.01	0.03	1.44
JD97-1.A.G.5	G		75.61	11.98	0.48	0.50	0.00	0.09	1.23
JD97-1.A.H.1	G		75.89	11.40	0.26	0.32	0.00	0.02	1.46
JD97-1.A.L.3	G		74.78	11.49	0.29	0.45	0.00	0.04	0.30
JD97-1.A.N.2	G		74.13	11.56	0.26	0.48	0.04	0.21	0.39
JD97-1.A.O.1	G		76.35	11.28	0.21	0.27	0.01	0.00	0.29
JD97-1.A.O.3	G		76.35	11.36	0.24	0.30	0.03	0.01	0.32
JD97-1.A.O.4	G		75.68	11.42	0.26	0.34	0.00	0.07	0.31
JD97-1.A.Q.1	G		73.99	12.17	0.16	0.49	0.02	0.31	0.55
JD97-1.A.Q.3	G		75.53	11.64	0.24	0.27	0.03	0.00	0.32
JD97-1.A.R.1	G		75.73	11.37	0.38	0.45	0.00	0.03	0.35
JD97-1.A.R.3	G		78.90	9.96	0.33	0.64	0.03	0.06	1.47
JD97-1.B.A.1	G		74.75	11.98	0.30	0.28	0.00	0.00	0.35
JD97-1.B.A.2	G		73.25	11.70	0.21	0.60	0.00	0.31	0.91
JD97-1.B.A.3	G		71.52	12.47	0.37	0.47	0.03	0.07	0.42
JD97-1.B.B.1	G		74.44	11.76	0.18	0.48	0.00	0.02	0.44
JD97-1.B.B.2	G		73.53	12.17	0.20	0.33	0.00	0.01	0.78
JD97-1.B.B.3	G		74.58	11.50	0.15	0.30	0.00	0.01	0.44

Label	Na_2O	K_2O	P_2O_5	S	F	Cl	Total	O=F	O=Cl
STAGE 2 glass									
HP99-9.J.1[1]	1.24	6.70	0.01	0.00	0.14	0.01	95.85	0.06	0.00
HP99-9.J.2[1]	0.83	1.45	0.02	0.01	0.09	0.08	94.03	0.04	0.02
HP99-9.J.3[1]	1.40	4.47	0.00	0.00	0.11	0.01	95.38	0.05	0.00
average Stage 2 glass	1.11	2.96	0.01	0.00	0.10	0.05	95.09	0.05	0.01
standard deviation	0.30	2.63	0.01	0.00	0.02	0.04	0.95	0.01	0.01
STAGE 3 glass									
JD97-1.A.E.1	2.76	0.28	0.04	0.00	0.21	0.03	92.97	0.09	0.01
JD97-1.A.E.3	2.90	0.28	0.08	0.00	0.19	0.02	92.21	0.08	0.00
JD97-1.A.F.1	2.86	0.28	0.13	0.04	0.14	0.01	97.23	0.06	0.00
JD97-1.A.F.3	2.53	0.21	0.10	0.01	0.18	0.01	97.26	0.07	0.00
JD97-1.A.H.2	2.97	0.26	0.02	0.03	0.19	0.03	90.76	0.08	0.01
JD97-1.A.L.1	3.32	0.33	0.11	0.00	0.13	0.02	94.11	0.05	0.00
JD97-1.A.L.2	2.83	0.21	0.13	0.00	0.12	0.01	94.19	0.05	0.00
JD97-1.A.L.4	3.13	0.26	0.11	0.00	0.11	0.03	93.03	0.05	0.01
JD97-1.A.N.1	2.71	0.25	0.09	0.01	0.15	0.02	92.67	0.06	0.01
JD97-1.A.N.3	3.10	0.30	0.10	0.00	0.13	0.02	93.64	0.06	0.00
JD97-1.A.O.2[1]	3.15	0.31	0.07	0.01	0.14	0.02	93.57	0.06	0.00
JD97-1.A.Q.2	2.79	0.25	0.00	0.00	0.09	0.04	94.30	0.04	0.01
JD97-1.A.R.2	3.31	0.41	0.06	0.01	0.19	0.03	91.82	0.08	0.01
JD97-1.A.R.4	3.19	0.38	0.08	0.00	0.19	0.01	95.66	0.08	0.00
JD97-1.A.F.2	2.90	0.96	0.08	0.01	0.12	0.01	97.50	0.05	0.00
av. Stage 3 tonal glass	2.96	0.33	0.08	0.01	0.15	0.02	94.06	0.06	0.00
standard deviation	0.23	0.18	0.04	0.01	0.04	0.01	2.05	0.02	0.00
JD97-1.A.E.2	2.00	7.07	0.07	0.01	0.14	0.01	97.32	0.06	0.00
JD97-1.A.G.1	1.97	6.39	0.10	0.01	0.16	0.01	97.57	0.07	0.00
JD97-1.A.G.2	1.93	6.42	0.08	0.01	0.13	0.01	97.82	0.06	0.00
JD97-1.A.G.3[1]	2.17	6.21	0.08	0.00	0.14	0.01	97.65	0.06	0.00
JD97-1.A.G.4	2.89	4.11	0.05	0.00	0.14	0.01	96.78	0.06	0.00
JD97-1.A.G.5	2.47	4.96	0.07	0.01	0.12	0.01	97.48	0.05	0.00
JD97-1.A.H.1	2.62	3.93	0.13	0.01	0.13	0.02	96.13	0.05	0.00
JD97-1.A.L.3	2.03	6.98	0.05	0.01	0.10	0.01	96.50	0.04	0.00
JD97-1.A.N.2	1.84	6.85	0.08	0.00	0.16	0.01	95.95	0.07	0.00
JD97-1.A.O.1	1.92	7.13	0.06	0.01	0.11	0.01	97.59	0.05	0.00
JD97-1.A.O.3	1.91	6.97	0.09	0.01	0.12	0.01	97.64	0.05	0.00
JD97-1.A.O.4	1.86	6.93	0.09	0.00	0.13	0.00	97.05	0.05	0.00
JD97-1.A.Q.1	1.87	7.24	0.11	0.01	0.09	0.01	96.97	0.04	0.00
JD97-1.A.Q.3	1.92	7.37	0.06	0.01	0.10	0.01	97.48	0.04	0.00
JD97-1.A.R.1	1.85	6.93	0.22	0.01	0.17	0.01	97.42	0.07	0.00
JD97-1.A.R.3	2.33	3.27	0.07	0.00	0.18	0.01	97.18	0.07	0.00
JD97-1.B.A.1	2.16	7.21	0.15	0.00	0.12	0.00	97.25	0.05	0.00
JD97-1.B.A.2	2.24	6.86	0.07	0.00	0.12	0.01	96.24	0.05	0.00
JD97-1.B.A.3	2.37	7.21	0.14	0.00	0.14	0.02	95.17	0.06	0.01
JD97-1.B.B.1	2.20	6.62	0.05	0.00	0.13	0.01	96.28	0.05	0.00
JD97-1.B.B.2	2.75	5.76	0.01	0.00	0.15	0.01	95.64	0.06	0.00
JD97-1.B.B.3	2.27	6.38	0.08	0.01	0.17	0.00	95.82	0.07	0.00

Label	CIPW Norm									
	Q	C	Or	Ab	An	Di	Wo	Hy	Il	Ap
STAGE 2 glass										
HP99-9.J.1[1]	28.96	0.00	39.59	10.48	12.28	0.19	0.00	3.96	0.29	0.02
HP99-9.J.2[1]	53.43	0.00	8.57	6.98	20.92	0.97	0.00	2.83	0.14	0.06
HP99-9.J.3[1]	25.90	0.35	26.44	11.83	12.81	0.00	0.00	16.82	1.15	0.00
average Stage 2 glass	39.66	0.18	17.51	9.41	16.86	0.48	0.00	9.83	0.65	0.03
standard deviation	15.09	0.20	15.57	2.50	4.84	0.51	0.00	7.77	0.54	0.03
STAGE 3 glass										
JD97-1.A.E.1	48.76	0.00	1.65	23.32	17.14	0.23	0.00	1.42	0.21	0.09
JD97-1.A.E.3	46.29	0.00	1.68	24.58	16.70	1.21	0.00	0.58	0.85	0.18
JD97-1.A.F.1	53.83	0.07	1.64	24.23	15.64	0.00	0.00	0.52	0.87	0.31
JD97-1.A.F.3	56.95	0.00	1.21	21.43	15.59	0.90	0.00	0.12	0.70	0.24
JD97-1.A.H.2	45.35	0.00	1.55	25.10	16.52	0.49	0.00	1.07	0.46	0.04
JD97-1.A.L.1	46.36	0.17	1.94	28.09	16.11	0.00	0.00	0.71	0.40	0.26
JD97-1.A.L.2	49.76	0.00	1.25	23.94	17.14	0.98	0.09	0.00	0.67	0.29
JD97-1.A.L.4	45.10	0.00	1.56	26.46	17.77	0.53	0.00	0.74	0.55	0.25
JD97-1.A.N.1	49.72	0.00	1.49	22.91	15.73	0.66	0.00	1.35	0.48	0.22
JD97-1.A.N.3	46.81	0.00	1.75	26.26	16.08	0.81	0.00	1.25	0.36	0.22
JD97-1.A.O.2[1]	47.15	0.00	1.85	26.67	16.28	0.62	0.00	0.34	0.40	0.16
JD97-1.A.Q.2	49.74	0.00	1.47	23.57	17.82	1.05	0.00	0.35	0.21	0.01
JD97-1.A.R.2	42.35	0.43	2.41	27.98	16.36	0.00	0.00	1.65	0.34	0.15
JD97-1.A.R.4	50.99	0.00	2.25	27.00	13.95	0.30	0.00	0.26	0.61	0.19
JD97-1.A.F.2	53.00	0.00	5.69	24.56	12.45	0.46	0.00	0.01	1.08	0.17
av. Stage 3 tonal glass	48.81	0.05	1.96	25.07	16.08	0.55	0.01	0.69	0.55	0.19
standard deviation	3.81	0.12	1.08	1.94	1.39	0.39	0.02	0.54	0.25	0.09
JD97-1.A.E.2	35.94	0.09	41.80	16.96	1.14	0.00	0.00	0.32	0.80	0.17
JD97-1.A.G.1	37.72	0.60	37.78	16.68	1.22	0.00	0.00	2.17	1.07	0.22
JD97-1.A.G.2	40.45	0.65	37.93	16.32	1.27	0.00	0.00	0.20	0.71	0.19
JD97-1.A.G.3[1]	38.67	0.56	36.67	18.37	2.11	0.00	0.00	0.06	0.93	0.19
JD97-1.A.G.4	38.77	0.56	24.30	24.46	6.80	0.00	0.00	0.47	1.21	0.12
JD97-1.A.G.5	39.64	0.48	29.29	20.90	5.65	0.00	0.00	0.35	0.92	0.15
JD97-1.A.H.1	42.75	0.50	23.24	22.16	6.36	0.00	0.00	0.21	0.50	0.31
JD97-1.A.L.3	35.56	0.18	41.22	17.21	1.13	0.00	0.00	0.43	0.56	0.13
JD97-1.A.N.2	36.04	0.60	40.50	15.56	1.42	0.00	0.00	1.04	0.50	0.19
JD97-1.A.O.1	37.42	0.05	42.11	16.24	1.00	0.00	0.00	0.16	0.39	0.15
JD97-1.A.O.3	38.03	0.30	41.18	16.13	1.03	0.00	0.00	0.24	0.45	0.20
JD97-1.A.O.4	37.73	0.51	40.98	15.73	0.94	0.00	0.00	0.37	0.50	0.21
JD97-1.A.Q.1	33.79	0.52	42.78	15.78	2.02	0.00	0.00	1.46	0.30	0.25
JD97-1.A.Q.3	35.55	0.07	43.57	16.25	1.19	0.00	0.00	0.16	0.46	0.15
JD97-1.A.R.1	38.22	0.73	40.93	15.63	0.28	0.00	0.00	0.27	0.73	0.52
JD97-1.A.R.3	49.50	0.08	19.30	19.70	6.84	0.00	0.00	0.83	0.64	0.17
JD97-1.B.A.1	34.24	0.34	42.61	18.31	0.73	0.00	0.00	0.03	0.56	0.35
JD97-1.B.A.2	31.93	0.00	40.56	18.95	1.59	2.04	0.00	0.52	0.40	0.17
JD97-1.B.A.3	29.38	0.34	42.60	20.07	1.16	0.00	0.00	0.50	0.70	0.32
JD97-1.B.B.1	35.22	0.30	39.15	18.59	1.84	0.00	0.00	0.64	0.35	0.12
JD97-1.B.B.2	33.74	0.03	34.04	23.23	3.79	0.00	0.00	0.28	0.39	0.03
JD97-1.B.B.3	36.11	0.26	37.71	19.19	1.65	0.00	0.00	0.32	0.28	0.19

Label	Code	Color[2]	Wt% oxides						
			SiO_2	TiO_2	Al_2O_3	FeO*	MnO	MgO	CaO
JD97-1.B.B.4	G		72.91	12.56	0.24	0.38	0.00	0.04	0.32
JD97-1.B.C.1	G		68.01	12.64	0.94	1.03	0.00	0.07	1.14
JD97-1.B.C.2	G		70.99	13.21	0.37	0.72	0.00	0.15	0.89
JD97-1.B.C.3	G		71.37	12.66	0.83	0.94	0.01	0.06	1.00
JD97-1.B.C.4	G		72.47	12.66	0.85	0.83	0.00	0.18	0.53
JD97-1.B.D.1	G		73.83	12.20	0.75	0.71	0.04	0.17	0.40
JD97-1.B.D.2	G		73.65	12.75	0.51	0.66	0.06	0.09	1.45
JD97-1.B.E.1	G		65.86	15.61	0.03	0.98	0.01	0.94	0.56
JD97-1.B.E.2	G		79.58	10.00	0.07	0.25	0.00	0.10	0.32
JD97-1.B.F.1	G		72.60	12.01	0.36	0.90	0.00	0.06	0.35
JD97-1.B.F.2	G		74.00	11.61	0.32	0.52	0.00	0.00	0.53
JD97-1.B.F.3	G		73.98	11.21	0.17	0.39	0.00	0.03	1.73
JD97-1.B.H.1	G		75.20	12.06	0.18	0.47	0.02	0.06	0.36
JD97-1.B.H.2	G		75.47	11.86	0.11	0.39	0.00	0.10	0.31
JD97-1.B.H.3	G		75.24	11.57	0.17	1.17	0.00	0.27	0.70
JD97-1.B.H.4	G		75.68	12.11	0.19	0.41	0.00	0.00	0.32
av. Stage 3 gran glass			74.31	11.89	0.35	0.56	0.01	0.10	0.64
standard deviation			2.51	0.91	0.22	0.29	0.02	0.16	0.42
STAGE 4 glass									
GAL94-3A.B.A.3	T	brown	77.10	0.60	11.83	0.71	0.00	0.09	3.34
GAL94-3A.B.E.2	T	brown	77.52	0.49	11.54	1.07	0.01	0.10	3.54
GAL94-3A.B.F.2[1]	T	brown	76.19	0.78	11.40	0.89	0.04	0.14	3.08
av. Stage 4 tonal glass			76.94	0.62	11.59	0.89	0.02	0.11	3.32
standard deviation			0.68	0.15	0.22	0.18	0.02	0.03	0.23
GAL94-3A.B.A.5	Gr	brown	77.97	0.45	11.38	0.67	0.01	0.04	2.60
GAL94-3A.B.G.4	Gr	brown	70.27	0.50	15.53	0.84	0.01	0.12	4.51
av. Stage 4 granod glass			74.12	0.47	13.45	0.76	0.01	0.08	3.56
standard deviation			5.44	0.04	2.93	0.12	0.00	0.05	1.35
GAL94-3A.A.C.1	G		71.91	0.85	10.71	0.89	0.00	0.09	1.37
GAL94-3A.A.C.2	G		72.83	0.89	10.29	1.49	0.03	0.18	0.64
GAL94-3A.A.F.1	G	brown	72.17	1.03	10.63	0.97	0.01	0.06	1.41
GAL94-3A.A.H.1	G		71.97	0.82	10.59	0.77	0.01	0.06	0.63
GAL94-3A.A.I.1	G	brown	72.95	0.91	10.50	0.89	0.07	0.11	0.58
GAL94-3A.A.I.2	G	clear	72.22	0.64	10.99	0.69	0.05	0.08	0.42
GAL94-3A.A.I.3	G	clear	70.99	0.71	10.78	0.74	0.01	0.07	1.28
GAL94-3A.A.I.4	G	brown	71.34	0.80	11.08	0.72	0.01	0.09	0.55
GAL94-3A.A.I.5	G	brown	72.09	0.93	10.43	0.95	0.00	0.11	0.56
GAL94-3A.A.J.1	G	brown	73.50	0.90	10.06	0.72	0.01	0.11	0.36
GAL94-3A.A.J.2	G	brown	69.91	0.80	11.14	0.63	0.01	0.08	2.24
GAL94-3A.A.J.3	G	gray	72.79	0.90	11.03	0.61	0.00	0.08	0.57
GAL94-3A.A.J.4	G	gray	71.61	0.67	11.47	0.91	0.00	0.14	1.28
GAL94-3A.A.J.5	G	clear	73.59	0.78	10.44	0.54	0.02	0.06	0.30
GAL94-3A.A.L.1	G	gray	72.50	0.78	10.56	1.04	0.05	0.14	0.53
GAL94-3A.A.L.2[1]	G	brown	72.73	0.74	10.46	0.97	0.01	0.14	0.68
GAL94-3A.A.L.3	G	gray	73.77	0.72	10.54	0.67	0.02	0.09	0.45
GAL94-3A.A.L.4	G	clear	71.42	0.82	11.14	0.99	0.02	0.06	1.09
GAL94-3A.A.M.1	G	brown	71.88	0.73	10.82	1.25	0.05	0.43	1.03
GAL94-3A.A.M.2	G	gray	72.39	0.72	11.04	0.72	0.04	0.06	0.49
GAL94-3A.A.M.4	G	clear	72.62	0.70	11.06	1.14	0.03	0.09	0.44
GAL94-3A.B.A.1	G	clear	73.79	0.53	10.59	0.71	0.00	0.08	0.55
GAL94-3A.B.A.2	G	gray	72.42	0.50	10.64	0.95	0.00	0.21	1.28

Label	Na_2O	K_2O	P_2O_5	S	F	Cl	Total	O=F	O=Cl
JD97-1.B.B.4	2.19	7.62	0.04	0.00	0.17	0.01	96.41	0.07	0.00
JD97-1.B.C.1	2.53	6.44	0.54	0.01	0.23	0.02	93.50	0.10	0.00
JD97-1.B.C.2	2.78	6.71	0.14	0.01	0.14	0.01	96.07	0.06	0.00
JD97-1.B.C.3	2.63	6.15	0.25	0.00	0.14	0.00	95.98	0.06	0.00
JD97-1.B.C.4	2.33	7.05	0.14	0.00	0.12	0.01	97.12	0.05	0.00
JD97-1.B.D.1	2.03	7.25	0.11	0.01	0.12	0.00	97.57	0.05	0.00
JD97-1.B.D.2	2.81	5.05	0.17	0.00	0.12	0.01	97.27	0.05	0.00
JD97-1.B.E.1	2.08	9.80	0.01	0.01	0.14	0.01	95.99	0.06	0.00
JD97-1.B.E.2	1.86	5.96	0.02	0.02	0.08	0.00	98.21	0.04	0.00
JD97-1.B.F.1	2.18	6.90	0.05	0.00	0.08	0.01	95.45	0.03	0.00
JD97-1.B.F.2	2.17	6.17	0.03	0.00	0.11	0.01	95.41	0.05	0.00
JD97-1.B.F.3	3.27	2.45	0.04	0.00	0.12	0.02	93.36	0.05	0.01
JD97-1.B.H.1	2.30	6.96	0.04	0.00	0.17	0.00	97.74	0.07	0.00
JD97-1.B.H.2	2.20	6.82	0.03	0.01	0.12	0.00	97.36	0.05	0.00
JD97-1.B.H.3	2.18	6.47	0.00	0.00	0.14	0.01	97.87	0.06	0.00
JD97-1.B.H.4	2.27	6.92	0.05	0.00	0.13	0.00	98.04	0.05	0.00
av. Stage 3 gran glass	2.25	6.41	0.09	0.01	0.13	0.01	96.69	0.06	0.00
standard deviation	0.34	1.30	0.09	0.00	0.03	0.01	1.13	0.01	0.00
STAGE 4 glass									
GAL94-3A.B.A.3	2.79	1.29	0.15	0.00	0.10	0.00	97.96	0.04	0.00
GAL94-3A.B.E.2	2.84	0.84	0.18	0.00	0.12	0.01	98.21	0.05	0.00
GAL94-3A.B.F.2[1]	2.88	1.50	0.16	0.01	0.16	0.00	97.15	0.07	0.00
av. Stage 4 tonal glass	2.84	1.21	0.16	0.00	0.13	0.00	97.77	0.05	0.00
standard deviation	0.04	0.33	0.02	0.00	0.03	0.00	0.55	0.01	0.00
GAL94-3A.B.A.5	2.48	2.28	0.14	0.00	0.15	0.00	98.12	0.06	0.00
GAL94-3A.B.G.4	2.64	3.05	0.24	0.00	0.15	0.01	97.80	0.06	0.00
av. Stage 4 granod glass	2.56	2.67	0.19	0.00	0.15	0.01	97.96	0.06	0.00
standard deviation	0.11	0.54	0.08	0.00	0.00	0.01	0.16	0.00	0.00
GAL94-3A.A.C.1	2.73	4.24	1.09	0.01	0.19	0.03	94.01	0.08	0.01
GAL94-3A.A.C.2	2.16	4.90	0.35	0.00	0.16	0.05	93.89	0.07	0.01
GAL94-3A.A.F.1	2.55	4.30	0.63	0.00	0.22	0.03	93.91	0.09	0.01
GAL94-3A.A.H.1	1.64	5.53	0.20	0.01	0.13	0.03	92.33	0.05	0.01
GAL94-3A.A.I.1	2.79	4.53	0.35	0.00	0.16	0.04	93.82	0.07	0.01
GAL94-3A.A.I.2	2.91	4.46	0.24	0.01	0.13	0.04	92.80	0.05	0.01
GAL94-3A.A.I.3	2.73	4.65	0.84	0.01	0.22	0.04	92.98	0.09	0.01
GAL94-3A.A.I.4	2.91	4.55	0.28	0.01	0.15	0.03	92.45	0.06	0.01
GAL94-3A.A.I.5	2.68	4.26	0.27	0.00	0.18	0.03	92.41	0.07	0.01
GAL94-3A.A.J.1	2.59	4.33	0.08	0.00	0.21	0.02	92.79	0.09	0.01
GAL94-3A.A.J.2	2.64	4.11	1.13	0.00	0.24	0.04	92.86	0.10	0.01
GAL94-3A.A.J.3	2.80	4.19	0.16	0.00	0.24	0.02	93.30	0.10	0.01
GAL94-3A.A.J.4	2.64	4.35	0.22	0.00	0.17	0.03	93.41	0.07	0.01
GAL94-3A.A.J.5	2.77	4.23	0.12	0.01	0.15	0.02	92.97	0.06	0.00
GAL94-3A.A.L.1	2.72	4.30	0.30	0.01	0.20	0.03	93.05	0.09	0.01
GAL94-3A.A.L.2[1]	2.64	4.40	0.35	0.00	0.18	0.04	93.25	0.07	0.01
GAL94-3A.A.L.3	2.69	4.44	0.31	0.00	0.16	0.04	93.83	0.07	0.01
GAL94-3A.A.L.4	2.83	4.46	0.68	0.01	0.20	0.03	93.65	0.08	0.01
GAL94-3A.A.M.1	2.76	4.29	0.21	0.00	0.15	0.03	93.55	0.06	0.01
GAL94-3A.A.M.2	2.82	4.47	0.23	0.00	0.20	0.03	93.11	0.08	0.01
GAL94-3A.A.M.4	2.83	4.36	0.16	0.00	0.19	0.04	93.57	0.08	0.01
GAL94-3A.B.A.1	2.58	4.21	0.25	0.00	0.21	0.02	93.42	0.09	0.00
GAL94-3A.B.A.2	2.54	4.34	0.80	0.00	0.25	0.03	93.85	0.11	0.01

Label	CIPW Norm									
	Q	C	Or	Ab	An	Di	Wo	Hy	Il	Ap
JD97-1.B.B.4	30.24	0.23	45.01	18.55	1.32	0.00	0.00	0.42	0.45	0.08
JD97-1.B.C.1	27.46	0.72	38.06	21.42	2.13	0.00	0.00	0.51	1.79	1.25
JD97-1.B.C.2	27.09	0.10	39.65	23.53	3.49	0.00	0.00	1.08	0.71	0.33
JD97-1.B.C.3	30.87	0.47	36.36	22.21	3.31	0.00	0.00	0.51	1.58	0.58
JD97-1.B.C.4	30.85	0.56	41.69	19.71	1.73	0.00	0.00	0.57	1.61	0.33
JD97-1.B.D.1	33.43	0.56	42.83	17.18	1.23	0.00	0.00	0.57	1.42	0.26
JD97-1.B.D.2	35.00	0.42	29.84	23.75	6.12	0.00	0.00	0.70	0.97	0.39
JD97-1.B.E.1	12.88	0.59	57.90	17.59	2.73	0.00	0.00	4.12	0.06	0.02
JD97-1.B.E.2	45.04	0.00	35.24	15.70	1.35	0.13	0.00	0.52	0.12	0.04
JD97-1.B.F.1	32.37	0.45	40.78	18.41	1.37	0.00	0.00	1.21	0.68	0.13
JD97-1.B.F.2	36.52	0.48	36.46	18.35	2.42	0.00	0.00	0.44	0.60	0.07
JD97-1.B.F.3	41.77	0.13	14.50	27.63	8.31	0.00	0.00	0.50	0.33	0.10
JD97-1.B.H.1	34.18	0.18	41.12	19.45	1.55	0.00	0.00	0.74	0.34	0.09
JD97-1.B.H.2	35.61	0.36	40.29	18.59	1.37	0.00	0.00	0.78	0.21	0.06
JD97-1.B.H.3	35.22	0.00	38.26	18.43	2.68	0.65	0.00	2.21	0.33	0.00
JD97-1.B.H.4	35.20	0.41	40.91	19.24	1.28	0.00	0.00	0.44	0.36	0.12
av. Stage 3 gran glass	35.27	0.35	37.87	19.00	2.46	0.07	0.00	0.69	0.66	0.22
standard deviation	5.84	0.22	7.67	2.87	2.02	0.34	0.00	0.75	0.42	0.21
STAGE 4 glass										
GAL94-3A.B.A.3	48.89	0.12	7.64	23.64	15.61	0.00	0.00	0.53	1.14	0.34
GAL94-3A.B.E.2	50.06	0.00	4.98	24.00	16.27	0.09	0.00	1.37	0.93	0.42
GAL94-3A.B.F.2[1]	47.28	0.00	8.84	24.37	13.76	0.39	0.00	0.56	1.49	0.36
av. Stage 4 tonal glass	48.74	0.04	7.15	24.00	15.22	0.16	0.00	0.82	1.19	0.37
standard deviation	1.40	0.07	1.98	0.36	1.30	0.21	0.00	0.48	0.28	0.04
GAL94-3A.B.A.5	49.30	0.42	13.49	21.01	12.03	0.00	0.00	0.63	0.85	0.32
GAL94-3A.B.G.4	33.77	0.27	18.01	22.32	20.80	0.00	0.00	1.02	0.96	0.56
av. Stage 4 granod glass	41.54	0.34	15.75	21.66	16.42	0.00	0.00	0.82	0.90	0.44
standard deviation	10.98	0.11	3.20	0.92	6.20	0.00	0.00	0.28	0.08	0.17
GAL94-3A.A.C.1	39.57	1.63	25.07	23.06	0.00	0.00	0.00	0.47	1.61	2.41
GAL94-3A.A.C.2	40.27	1.12	28.94	18.28	0.88	0.00	0.00	1.76	1.70	0.81
GAL94-3A.A.F.1	39.50	0.72	25.39	21.57	2.91	0.00	0.00	0.26	1.95	1.46
GAL94-3A.A.H.1	40.35	1.24	32.69	13.85	1.82	0.00	0.00	0.25	1.55	0.46
GAL94-3A.A.I.1	38.83	0.80	26.77	23.64	0.55	0.00	0.00	0.56	1.72	0.82
GAL94-3A.A.I.2	37.78	1.19	26.33	24.61	0.52	0.00	0.00	0.49	1.22	0.56
GAL94-3A.A.I.3	36.80	0.96	27.46	23.06	0.84	0.00	0.00	0.38	1.35	1.95
GAL94-3A.A.I.4	36.44	1.03	26.90	24.66	0.90	0.00	0.00	0.24	1.52	0.64
GAL94-3A.A.I.5	39.50	1.05	25.17	22.68	0.98	0.00	0.00	0.50	1.76	0.64
GAL94-3A.A.J.1	41.19	0.67	25.57	21.89	1.24	0.00	0.00	0.27	1.53	0.19
GAL94-3A.A.J.2	37.06	0.97	24.30	22.37	3.73	0.00	0.00	0.20	1.34	2.62
GAL94-3A.A.J.3	39.57	1.24	24.79	23.67	1.78	0.00	0.00	0.21	1.29	0.37
GAL94-3A.A.J.4	37.02	0.62	25.70	22.33	4.91	0.00	0.00	0.92	1.28	0.51
GAL94-3A.A.J.5	40.87	1.03	25.00	23.45	0.74	0.00	0.00	0.15	1.19	0.27
GAL94-3A.A.L.1	39.42	1.19	25.39	23.00	0.65	0.00	0.00	1.07	1.48	0.69
GAL94-3A.A.L.2[1]	39.60	0.96	25.98	22.37	1.08	0.00	0.00	0.91	1.41	0.81
GAL94-3A.A.L.3	40.84	1.22	26.26	22.77	0.22	0.00	0.00	0.31	1.37	0.71
GAL94-3A.A.L.4	37.15	1.30	26.35	23.93	1.00	0.00	0.00	0.66	1.55	1.57
GAL94-3A.A.M.1	36.59	0.26	25.38	23.38	3.72	0.00	0.00	2.24	1.38	0.49
GAL94-3A.A.M.2	38.29	1.22	26.44	23.82	0.95	0.00	0.00	0.37	1.36	0.53
GAL94-3A.A.M.4	38.38	1.27	25.77	23.99	1.11	0.00	0.00	1.21	1.33	0.38
GAL94-3A.B.A.1	41.90	1.40	24.85	21.86	1.06	0.00	0.00	0.62	1.01	0.58
GAL94-3A.B.A.2	39.81	1.35	25.65	21.51	1.12	0.00	0.00	1.45	0.95	1.85

Label	Code	Color[2]	Wt% oxides						
			SiO_2	TiO_2	Al_2O_3	FeO*	MnO	MgO	CaO
GAL94-3A.B.A.4	G	gray	73.46	0.43	10.56	0.84	0.01	0.08	0.38
GAL94-3A.B.E.1	G	clear	70.01	0.55	10.92	0.68	0.02	0.09	0.56
GAL94-3A.B.E.3	G	clear	72.60	0.53	11.14	0.86	0.06	0.11	0.49
GAL94-3A.B.F.1	G	clear	72.84	0.75	10.29	0.64	0.04	0.08	0.42
GAL94-3A.B.F.3	G		73.07	0.66	10.57	0.74	0.00	0.09	0.41
GAL94-3A.B.G.1	G	clear	73.39	0.66	10.79	0.71	0.01	0.09	0.39
GAL94-3A.B.G.2	G	clear	72.87	0.49	11.29	0.65	0.00	0.08	0.51
GAL94-3A.B.G.3	G	brown	73.48	0.65	13.29	0.61	0.00	0.04	2.75
GAL94-3A.B.I.1	G	clear	72.44	0.82	10.70	0.89	0.05	0.23	1.05
GAL94-3A.B.I.2	G	brown	73.04	0.92	10.55	0.61	0.00	0.07	0.63
GAL94-3A.B.I.3	G	brown	72.57	0.84	11.25	0.82	0.05	0.08	1.07
GAL94-3A.B.I.4	G	clear	73.43	0.78	10.18	0.93	0.05	0.26	0.48
GAL94-3A.B.J.1	G	brown	72.28	1.19	10.47	0.92	0.00	0.08	0.84
GAL94-3A.B.J.2	G	brown	70.97	1.07	10.21	0.85	0.05	0.08	1.68
GAL94-3A.B.J.3	G	clear	73.69	1.12	10.31	0.68	0.00	0.10	0.50
av. Stage 4 gran glass			72.46	0.77	10.78	0.83	0.02	0.11	0.81
standard deviaton			0.96	0.17	0.54	0.19	0.02	0.07	0.54
STAGE 5 glass									
JD97-4.A.A.3[1]	T		78.90	0.58	11.46	0.56	0.00	0.04	3.36
JD97-4.A.A.4	T		78.65	0.67	10.98	1.15	0.04	0.15	3.23
JD97-4.A.S.4	T		77.96	0.36	12.18	0.55	0.03	0.02	3.69
JD97-4.A.S.5	T		78.31	0.51	11.54	0.43	0.01	0.06	2.52
JD97-4.A.T.1	T		79.11	0.78	10.84	0.67	0.02	0.09	2.84
JD97-4.A.U.2	T		80.18	0.45	11.06	0.48	0.02	0.06	3.26
JD97-4.B.G.2	T		75.78	0.65	12.09	0.84	0.01	0.11	4.08
JD97-4.B.L.2	T		78.50	0.53	10.93	0.57	0.05	0.05	3.15
av. Stage 5 ton glass			78.42	0.57	11.39	0.66	0.02	0.07	3.27
standard deviation			1.26	0.13	0.52	0.23	0.02	0.04	0.48
JD97-4.A.A.1	G		76.59	0.58	11.43	0.52	0.01	0.02	0.62
JD97-4.A.A.2	G		76.23	0.95	11.80	0.89	0.00	0.06	1.21
JD97-4.A.C.1	G		75.11	0.36	12.25	0.79	0.01	0.24	0.62
JD97-4.A.C.2	G		75.86	0.44	11.44	0.66	0.00	0.05	0.65
JD97-4.A.C.3	G		74.34	0.73	11.34	1.68	0.05	0.21	0.51
JD97-4.A.E.1	G		76.00	0.61	11.37	1.56	0.03	0.15	0.57
JD97-4.A.E.2	G		75.30	0.58	12.42	0.84	0.02	0.12	1.26
JD97-4.A.E.3	G		75.71	0.92	10.88	1.04	0.06	0.15	0.79
JD97-4.A.F.1	G		76.17	1.01	11.31	0.97	0.05	0.07	0.85
JD97-4.A.H.1	G		73.39	1.44	11.29	1.60	0.07	0.17	0.68
JD97-4.A.H.2	G		73.81	0.54	12.33	0.78	0.02	0.17	1.13
JD97-4.A.H.3	G		74.23	0.86	11.72	1.18	0.03	0.10	0.77
JD97-4.A.I.1	G		74.25	0.83	11.98	0.74	0.02	0.05	0.40
JD97-4.A.I.2	G		73.14	0.57	13.29	0.93	0.01	0.07	1.25
JD97-4.A.I.3	G		74.10	1.17	11.40	1.42	0.06	0.17	0.63
JD97-4.A.I.4	G		76.32	0.53	11.37	0.40	0.00	0.02	0.77
JD97-4.A.J.1	G		75.00	0.56	12.04	0.59	0.03	0.02	0.39
JD97-4.A.J.2	G		75.85	0.59	11.81	0.49	0.02	0.01	0.24
JD97-4.A.J.3	G		75.91	0.46	12.02	0.42	0.01	0.01	0.40
JD97-4.A.J.4	G		76.18	0.65	11.44	0.87	0.00	0.01	0.48
JD97-4.A.K.1	G		76.98	0.52	10.61	0.75	0.00	0.36	0.56
JD97-4.A.O.1	G		75.86	0.75	11.44	0.80	0.03	0.06	1.10
JD97-4.A.O.2	G		73.94	1.01	11.06	2.66	0.03	0.11	0.49

Label	Na_2O	K_2O	P_2O_5	S	F	Cl	Total	O=F	O=Cl
GAL94-3A.B.A.4	2.04	5.09	0.16	0.00	0.17	0.05	93.19	0.07	0.01
GAL94-3A.B.E.1	2.78	4.23	0.22	0.00	0.22	0.02	90.20	0.09	0.00
GAL94-3A.B.E.3	2.84	4.64	0.17	0.00	0.20	0.02	93.57	0.08	0.01
GAL94-3A.B.F.1	2.59	4.29	0.17	0.00	0.16	0.02	92.21	0.07	0.00
GAL94-3A.B.F.3	2.72	4.35	0.22	0.01	0.18	0.02	92.97	0.07	0.01
GAL94-3A.B.G.1	2.76	4.28	0.22	0.00	0.21	0.02	93.44	0.09	0.00
GAL94-3A.B.G.2	2.82	4.37	0.24	0.00	0.18	0.02	93.45	0.08	0.01
GAL94-3A.B.G.3	2.14	4.75	0.23	0.00	0.17	0.00	98.04	0.07	0.00
GAL94-3A.B.I.1	2.79	4.15	0.33	0.00	0.19	0.03	93.60	0.08	0.01
GAL94-3A.B.I.2	2.76	4.16	0.26	0.00	0.21	0.01	93.13	0.09	0.00
GAL94-3A.B.I.3	2.49	4.16	0.04	0.00	0.19	0.02	93.50	0.08	0.00
GAL94-3A.B.I.4	2.60	4.14	0.14	0.00	0.15	0.02	93.10	0.06	0.01
GAL94-3A.B.J.1	1.29	6.55	0.31	0.01	0.19	0.01	94.04	0.08	0.00
GAL94-3A.B.J.2	2.25	4.73	1.18	0.00	0.27	0.02	93.25	0.11	0.00
GAL94-3A.B.J.3	2.63	4.33	0.07	0.00	0.18	0.02	93.56	0.08	0.01
av. Stage 4 gran glass	2.59	4.48	0.35	0.00	0.19	0.03	93.33	0.08	0.01
standard deviaton	0.34	0.45	0.29	0.00	0.03	0.01	1.04	0.01	0.00
STAGE 5 glass									
JD97-4.A.A.3[1]	3.51	0.33	0.19	0.00	0.15	0.02	99.03	0.07	0.00
JD97-4.A.A.4	3.35	0.32	0.07	0.00	0.12	0.01	98.68	0.05	0.00
JD97-4.A.S.4	3.50	0.32	0.10	0.01	0.13	0.01	98.79	0.05	0.00
JD97-4.A.S.5	3.89	0.79	0.06	0.00	0.12	0.01	98.19	0.05	0.00
JD97-4.A.T.1	3.71	0.58	0.24	0.00	0.12	0.04	98.97	0.05	0.01
JD97-4.A.U.2	3.30	0.29	0.10	0.01	0.17	0.01	99.31	0.07	0.00
JD97-4.B.G.2	3.51	0.35	0.41	0.01	0.12	0.04	97.94	0.05	0.01
JD97-4.B.L.2	3.24	0.31	0.12	0.00	0.16	0.01	97.56	0.07	0.00
av. Stage 5 ton glass	3.50	0.41	0.16	0.00	0.14	0.02	98.56	0.06	0.00
standard deviation	0.21	0.18	0.12	0.00	0.02	0.01	0.60	0.01	0.00
JD97-4.A.A.1	2.53	6.06	0.37	0.00	0.11	0.01	98.80	0.05	0.00
JD97-4.A.A.2	3.17	4.23	0.24	0.00	0.12	0.01	98.85	0.05	0.00
JD97-4.A.C.1	2.80	6.17	0.22	0.01	0.24	0.01	98.72	0.10	0.00
JD97-4.A.C.2	2.68	6.04	0.28	0.01	0.12	0.06	98.22	0.05	0.01
JD97-4.A.C.3	2.54	6.01	0.19	0.00	0.13	0.01	97.69	0.05	0.00
JD97-4.A.E.1	2.54	6.00	0.29	0.00	0.08	0.01	99.17	0.03	0.00
JD97-4.A.E.2	3.29	4.84	0.25	0.00	0.12	0.01	99.01	0.05	0.00
JD97-4.A.E.3	2.70	5.61	0.50	0.00	0.11	0.02	98.45	0.05	0.01
JD97-4.A.F.1	3.14	4.46	0.16	0.00	0.09	0.02	98.28	0.04	0.00
JD97-4.A.H.1	2.81	5.55	0.39	0.00	0.15	0.19	97.61	0.06	0.04
JD97-4.A.H.2	3.02	5.62	0.35	0.00	0.11	0.01	97.84	0.05	0.00
JD97-4.A.H.3	2.92	5.57	0.35	0.01	0.15	0.00	97.83	0.06	0.00
JD97-4.A.I.1	2.58	6.32	0.15	0.00	0.12	0.00	97.40	0.05	0.00
JD97-4.A.I.2	3.55	5.02	0.19	0.00	0.10	0.01	98.09	0.04	0.00
JD97-4.A.I.3	2.65	5.83	0.28	0.01	0.16	0.00	97.82	0.07	0.00
JD97-4.A.I.4	3.03	4.60	0.17	0.00	0.14	0.00	97.30	0.06	0.00
JD97-4.A.J.1	2.78	6.08	0.12	0.00	0.16	0.00	97.71	0.07	0.00
JD97-4.A.J.2	2.66	6.14	0.00	0.01	0.16	0.01	97.92	0.07	0.00
JD97-4.A.J.3	2.88	5.98	0.08	0.00	0.11	0.00	98.24	0.05	0.00
JD97-4.A.J.4	2.48	5.77	0.22	0.00	0.15	0.00	98.20	0.06	0.00
JD97-4.A.K.1	2.37	5.84	0.30	0.01	0.13	0.01	98.38	0.05	0.00
JD97-4.A.O.1	3.24	4.32	0.34	0.01	0.16	0.01	98.04	0.07	0.00
JD97-4.A.O.2	2.59	5.94	0.19	0.01	0.13	0.00	98.13	0.06	0.00

Label	CIPW Norm									
	Q	C	Or	Ab	An	Di	Wo	Hy	Il	Ap
GAL94-3A.B.A.4	41.25	1.39	30.08	17.26	0.85	0.00	0.00	1.04	0.82	0.38
GAL94-3A.B.E.1	36.79	1.28	24.97	23.49	1.36	0.00	0.00	0.61	1.05	0.50
GAL94-3A.B.E.3	37.22	0.96	27.41	24.03	1.32	0.00	0.00	1.10	1.00	0.39
GAL94-3A.B.F.1	40.82	1.03	25.34	21.92	0.97	0.00	0.00	0.21	1.42	0.39
GAL94-3A.B.F.3	40.04	1.14	25.71	23.05	0.63	0.00	0.00	0.50	1.25	0.50
GAL94-3A.B.G.1	40.48	1.42	25.32	23.32	0.53	0.00	0.00	0.49	1.25	0.50
GAL94-3A.B.G.2	39.05	1.57	25.82	23.84	0.96	0.00	0.00	0.59	0.93	0.56
GAL94-3A.B.G.3	37.53	0.19	28.09	18.11	12.10	0.00	0.00	0.14	1.23	0.54
GAL94-3A.B.I.1	38.48	0.51	24.54	23.65	3.01	0.00	0.00	0.94	1.57	0.77
GAL94-3A.B.I.2	40.31	0.96	24.57	23.39	1.48	0.00	0.00	0.17	1.29	0.59
GAL94-3A.B.I.3	39.74	0.78	24.59	21.10	5.06	0.00	0.00	0.41	1.60	0.09
GAL94-3A.B.I.4	41.21	0.89	24.46	22.01	1.45	0.00	0.00	1.16	1.48	0.32
GAL94-3A.B.J.1	38.72	0.50	38.69	10.88	2.10	0.00	0.00	0.19	1.95	0.73
GAL94-3A.B.J.2	39.37	1.14	27.96	19.04	0.66	0.00	0.00	0.21	1.91	2.73
GAL94-3A.B.J.3	40.79	0.56	25.58	22.28	2.01	0.00	0.00	0.25	1.43	0.17
av. Stage 4 gran glass	39.17	1.02	26.45	21.92	1.77	0.00	0.00	0.62	1.40	0.80
standard deviaton	1.54	0.34	2.64	2.88	2.09	0.00	0.00	0.48	0.27	0.67
STAGE 5 glass										
JD97-4.A.A.3[1]	50.70	0.00	1.92	29.66	14.57	0.33	0.18	0.00	1.11	0.45
JD97-4.A.A.4	50.87	0.00	1.87	28.32	14.01	1.32	0.00	0.78	1.26	0.17
JD97-4.A.S.4	48.75	0.00	1.89	29.59	16.59	0.93	0.00	0.04	0.68	0.23
JD97-4.A.S.5	47.45	0.00	4.65	32.89	11.71	0.31	0.02	0.00	0.94	0.13
JD97-4.A.T.1	50.06	0.00	3.45	31.36	11.23	0.46	0.29	0.00	1.46	0.55
JD97-4.A.U.2	53.21	0.00	1.72	27.96	14.47	0.65	0.09	0.00	0.85	0.24
JD97-4.B.G.2	46.33	0.00	2.07	29.71	16.21	1.18	0.00	0.16	1.23	0.94
JD97-4.B.L.2	51.98	0.00	1.82	27.39	14.39	0.38	0.00	0.20	1.01	0.28
av. Stage 5 ton glass	49.92	0.00	2.42	29.61	14.15	0.70	0.07	0.15	1.07	0.37
standard deviation	2.30	0.00	1.06	1.82	1.89	0.40	0.11	0.27	0.25	0.27
JD97-4.A.A.1	38.35	0.47	35.83	21.41	0.64	0.00	0.00	0.08	1.10	0.87
JD97-4.A.A.2	39.57	0.38	25.01	26.81	4.44	0.00	0.00	0.22	1.80	0.55
JD97-4.A.C.1	33.71	0.35	36.49	23.71	1.65	0.00	0.00	1.47	0.69	0.50
JD97-4.A.C.2	36.27	0.00	35.68	22.70	1.33	0.04	0.00	0.59	0.84	0.65
JD97-4.A.C.3	34.80	0.18	35.51	21.45	1.34	0.00	0.00	2.51	1.39	0.43
JD97-4.A.E.1	36.75	0.34	35.45	21.53	0.94	0.00	0.00	2.27	1.16	0.67
JD97-4.A.E.2	35.15	0.06	28.63	27.86	4.62	0.00	0.00	0.93	1.11	0.58
JD97-4.A.E.3	37.81	0.12	33.13	22.84	0.69	0.00	0.00	0.86	1.75	1.15
JD97-4.A.F.1	39.24	0.15	26.38	26.59	3.18	0.00	0.00	0.38	1.91	0.38
JD97-4.A.H.1	34.94	0.39	32.79	23.73	0.78	0.00	0.00	1.10	2.74	0.91
JD97-4.A.H.2	32.75	0.05	33.24	25.58	3.32	0.00	0.00	1.00	1.02	0.81
JD97-4.A.H.3	34.77	0.35	32.94	24.68	1.49	0.00	0.00	1.06	1.63	0.82
JD97-4.A.I.1	34.54	0.53	37.38	21.81	0.99	0.00	0.00	0.14	1.58	0.35
JD97-4.A.I.2	30.65	0.20	29.69	30.07	4.93	0.00	0.00	0.95	1.09	0.45
JD97-4.A.I.3	35.22	0.26	34.44	22.42	1.30	0.00	0.00	1.20	2.23	0.65
JD97-4.A.I.4	39.88	0.41	27.21	25.63	2.71	0.00	0.00	0.06	0.84	0.40
JD97-4.A.J.1	34.91	0.45	35.94	23.56	1.16	0.00	0.00	0.26	1.07	0.28
JD97-4.A.J.2	36.37	0.36	36.27	22.50	1.19	0.00	0.00	0.03	1.08	0.00
JD97-4.A.J.3	35.60	0.27	35.35	24.35	1.48	0.00	0.00	0.07	0.87	0.19
JD97-4.A.J.4	38.99	0.77	34.09	21.02	0.95	0.00	0.00	0.56	1.23	0.51
JD97-4.A.K.1	39.73	0.09	34.51	20.06	0.82	0.00	0.00	1.40	0.99	0.70
JD97-4.A.O.1	38.84	0.24	25.54	27.43	3.25	0.00	0.00	0.44	1.43	0.78
JD97-4.A.O.2	34.00	0.00	35.12	21.90	1.02	0.17	0.00	3.48	1.91	0.44

Label	Code	Color[2]	Wt% oxides						
			SiO_2	TiO_2	Al_2O_3	FeO*	MnO	MgO	CaO
JD97-4.A.O.3	G		73.87	0.97	11.38	1.06	0.02	0.15	0.66
JD97-4.A.O.4	G		76.84	0.64	10.25	0.72	0.00	0.11	1.77
JD97-4.A.S.1	G		73.75	0.73	13.22	0.73	0.04	0.06	1.92
JD97-4.A.S.2	G		76.50	0.48	11.47	0.46	0.00	0.04	1.11
JD97-4.A.S.3	G		75.39	0.64	11.30	1.45	0.01	0.04	0.59
JD97-4.A.T.2	G		74.24	0.55	12.51	1.15	0.00	0.05	1.65
JD97-4.A.T.3	G		76.56	0.48	11.60	0.43	0.00	0.06	0.65
JD97-4.A.T.4[1]	G		76.26	0.87	11.02	0.95	0.05	0.05	0.73
JD97-4.A.U.1	G		74.45	1.22	11.47	1.62	0.03	0.08	0.72
JD97-4.A.U.3	G		76.34	0.21	11.94	0.27	0.00	0.05	0.49
JD97-4.B.B.1	G		72.45	0.94	12.46	1.54	0.04	0.15	1.54
JD97-4.B.B.2	G		72.27	0.95	12.14	1.39	0.06	0.17	1.62
JD97-4.B.B.3	G		73.74	0.74	11.89	0.65	0.00	0.03	1.17
JD97-4.B.C.1	G		75.07	0.33	11.76	0.39	0.00	0.04	0.49
JD97-4.B.D.1	G		76.09	0.65	11.78	0.59	0.00	0.03	0.92
JD97-4.B.G.1	G		76.79	0.53	11.19	0.40	0.00	0.03	0.52
JD97-4.B.G.3	G		77.11	0.42	11.38	0.57	0.03	0.08	1.14
JD97-4.B.H.1	G		77.50	0.38	11.25	0.44	0.00	0.04	0.77
JD97-4.B.K.1	G		74.49	1.11	11.11	1.17	0.05	0.12	0.66
JD97-4.B.K.2	G		75.66	0.77	11.02	0.90	0.01	0.14	0.56
JD97-4.B.L.1	G		75.98	0.79	10.90	1.09	0.02	0.10	0.46
JD97-4.B.L.3	G		74.89	0.71	11.10	1.01	0.00	0.29	0.53
JD97-4.B.M.1	G		75.40	0.96	10.92	1.10	0.05	0.25	0.59
JD97-4.B.M.2	G		75.58	0.83	11.14	0.90	0.03	0.11	0.77
JD97-4.B.N.1	G		76.65	0.40	11.60	0.52	0.02	0.02	0.58
JD97-4.B.N.2	G		75.42	0.45	11.56	0.98	0.01	0.23	0.52
JD97-4.B.N.3	G		74.94	0.64	11.83	0.59	0.03	0.04	0.55
av. Stage 5 gran glass			75.29	0.70	11.58	0.91	0.02	0.10	0.80
standard deviation			1.24	0.25	0.59	0.45	0.02	0.08	0.39

[1] indicates points selected as representative compositions and presented in the main text.

[2]Glass is brown except where indicated in Stage 4. See description of Stage 4 in text for additional info

* indicates all Fe as FeO.

Code as follows: T, tonalitic glass; G, granitic glass; Gr, granodioritic glass.

CIPW Norm abbreviations as follows: Q, quartz; C, corundum; Or, orthoclase; Ab, albite; An, anorthite; Hy, hypersthene; Il, ilmenite; Ap, apatite.

Label	Na_2O	K_2O	P_2O_5	S	F	Cl	Total	O=F	O=Cl
JD97-4.A.O.3	3.12	5.62	0.28	0.01	0.11	0.27	97.41	0.05	0.06
JD97-4.A.O.4	3.50	2.45	0.29	0.01	0.12	0.24	96.84	0.05	0.06
JD97-4.A.S.1	4.22	3.07	0.11	0.00	0.13	0.16	98.07	0.05	0.04
JD97-4.A.S.2	3.47	3.95	0.16	0.01	0.16	0.22	97.91	0.07	0.05
JD97-4.A.S.3	2.84	5.64	0.27	0.00	0.15	0.01	98.27	0.06	0.00
JD97-4.A.T.2	3.61	3.93	0.31	0.00	0.11	0.00	98.09	0.05	0.00
JD97-4.A.T.3	2.96	5.45	0.25	0.00	0.15	0.01	98.53	0.06	0.00
JD97-4.A.T.4[1]	2.81	5.35	0.27	0.00	0.14	0.01	98.45	0.06	0.00
JD97-4.A.U.1	2.89	6.04	0.32	0.01	0.10	0.27	99.11	0.04	0.06
JD97-4.A.U.3	2.85	6.25	0.11	0.00	0.12	0.22	98.74	0.05	0.05
JD97-4.B.B.1	3.22	4.65	0.44	0.00	0.14	0.01	97.52	0.06	0.00
JD97-4.B.B.2	2.80	4.88	0.24	0.00	0.13	0.01	96.60	0.05	0.00
JD97-4.B.B.3	2.72	5.84	0.54	0.01	0.13	0.01	97.42	0.05	0.00
JD97-4.B.C.1	2.76	5.97	0.13	0.01	0.12	0.02	97.03	0.05	0.00
JD97-4.B.D.1	3.14	4.51	0.17	0.00	0.11	0.01	97.95	0.05	0.00
JD97-4.B.G.1	2.36	6.44	0.33	0.00	0.06	0.02	98.64	0.02	0.01
JD97-4.B.G.3	3.30	4.19	0.23	0.00	0.12	0.02	98.54	0.05	0.01
JD97-4.B.H.1	2.72	5.17	0.11	0.01	0.11	0.01	98.46	0.05	0.00
JD97-4.B.K.1	2.61	5.82	0.43	0.00	0.15	0.05	97.68	0.06	0.01
JD97-4.B.K.2	2.39	6.06	0.30	0.01	0.15	0.02	97.91	0.06	0.00
JD97-4.B.L.1	2.35	6.14	0.30	0.01	0.11	0.02	98.21	0.05	0.00
JD97-4.B.L.3	2.62	5.98	0.15	0.01	0.17	0.03	97.40	0.07	0.01
JD97-4.B.M.1	2.57	5.58	0.17	0.00	0.08	0.02	97.64	0.03	0.00
JD97-4.B.M.2	2.66	5.25	0.23	0.01	0.11	0.01	97.58	0.05	0.00
JD97-4.B.N.1	2.87	5.62	0.24	0.01	0.15	0.00	98.61	0.06	0.00
JD97-4.B.N.2	2.62	5.86	0.17	0.00	0.14	0.00	97.89	0.06	0.00
JD97-4.B.N.3	2.41	6.40	0.24	0.00	0.14	0.01	97.74	0.06	0.00
av. Stage 5 gran glass	2.87	5.40	0.25	0.00	0.13	0.04	98.04	0.05	0.01
standard deviation	0.38	0.87	0.11	0.00	0.03	0.08	0.57	0.01	0.02

Label	CIPW Norm									
	Q	C	Or	Ab	An	Di	Wo	Hy	Il	Ap
JD97-4.A.O.3	33.42	0.00	33.20	26.38	0.47	0.83	0.00	0.33	1.84	0.64
JD97-4.A.O.4	44.26	0.00	14.47	29.58	5.05	1.10	0.22	0.00	1.22	0.67
JD97-4.A.S.1	33.61	0.00	18.12	35.75	8.06	0.63	0.00	0.04	1.39	0.26
JD97-4.A.S.2	39.26	0.00	23.35	29.39	4.03	0.31	0.02	0.00	0.92	0.37
JD97-4.A.S.3	35.99	0.11	33.34	24.03	1.14	0.00	0.00	1.71	1.22	0.64
JD97-4.A.T.2	34.90	0.07	23.23	30.58	6.13	0.00	0.00	1.34	1.04	0.73
JD97-4.A.T.3	37.70	0.24	32.21	25.06	1.61	0.00	0.00	0.14	0.91	0.57
JD97-4.A.T.4[1]	38.43	0.00	31.63	23.75	1.66	0.18	0.00	0.43	1.66	0.62
JD97-4.A.U.1	33.54	0.00	35.71	24.42	0.50	0.86	0.00	0.75	2.32	0.74
JD97-4.A.U.3	35.03	0.00	36.96	24.11	1.31	0.33	0.00	0.10	0.40	0.26
JD97-4.B.B.1	33.00	0.37	27.47	27.29	4.78	0.00	0.00	1.72	1.78	1.02
JD97-4.B.B.2	33.82	0.00	28.85	23.68	6.15	0.30	0.00	1.36	1.80	0.55
JD97-4.B.B.3	34.50	0.26	34.53	23.04	2.27	0.00	0.00	0.08	1.37	1.25
JD97-4.B.C.1	35.33	0.17	35.28	23.38	1.59	0.00	0.00	0.26	0.63	0.30
JD97-4.B.D.1	38.99	0.44	26.68	26.58	3.50	0.00	0.00	0.08	1.23	0.38
JD97-4.B.G.1	38.18	0.17	38.04	20.00	0.43	0.00	0.00	0.06	0.84	0.77
JD97-4.B.G.3	39.82	0.00	24.76	27.96	3.83	0.30	0.00	0.45	0.80	0.53
JD97-4.B.H.1	40.44	0.05	30.53	22.98	3.13	0.00	0.00	0.28	0.73	0.25
JD97-4.B.K.1	36.47	0.34	34.41	22.05	0.49	0.00	0.00	0.70	2.10	0.98
JD97-4.B.K.2	37.84	0.23	35.80	20.22	0.82	0.00	0.00	0.74	1.46	0.69
JD97-4.B.L.1	38.20	0.28	36.28	19.90	0.29	0.00	0.00	0.96	1.51	0.70
JD97-4.B.L.3	35.48	0.00	35.36	22.14	0.87	0.63	0.00	1.10	1.34	0.35
JD97-4.B.M.1	37.67	0.00	32.99	21.77	1.76	0.06	0.00	1.13	1.82	0.39
JD97-4.B.M.2	38.71	0.25	31.02	22.49	2.29	0.00	0.00	0.62	1.58	0.54
JD97-4.B.N.1	37.73	0.32	33.20	24.26	1.32	0.00	0.00	0.38	0.76	0.56
JD97-4.B.N.2	36.34	0.39	34.63	22.13	1.45	0.00	0.00	1.62	0.86	0.40
JD97-4.B.N.3	35.84	0.50	37.82	20.36	1.21	0.00	0.00	0.16	1.22	0.55
av. Stage 5 gran glass	36.55	0.21	31.93	24.26	2.21	0.11	0.00	0.75	1.32	0.58
standard deviation	2.54	0.18	5.14	3.21	1.78	0.26	0.03	0.73	0.49	0.25