Ar-Ar Age Correlation of the Elkhorn Mountain Volcanics and Base Metal Mineralization in the Ratio Mountain Quadrangle, Montana

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Introduction

The Ratio Mountain Quadrangle is located in Southwest Montana, East of the city of Butte. This quadrangle features two major geologic units; the Elkhorn Mountain Volcanics, a series of several ignimbrites of varying composition, and the Boulder Batholith, a large granite pluton that rose through the EMV. Previous studies in the region have focused on the Boulder Batholith, while comparatively little work has been done on the Elkhorn Mountain Volcanics. The most detailed work on the EMV was produced by Prostka in the 1960's, in which he described a series of five ignimbrite layers, underlain by a basal porphyry unit. An EDMAP grant was funded for Dr. John Dilles (OSU) during the summer of 2015 to map the EMV exposed in the Ratio Mountain Quadrangle in more detail and build on Prostka's work from the 1960's. The geochronology of the area is not fully understood; Dilles (OSU) and Dr. Kaleb Scarberry (Montana Bureau of Mines and Geology) have gotten two Ar-Ar ages on hornblende from mafic intrusions in the EMV, and have two mica samples from hydrothermal veins in the Boulder Batholith, but no geochronology had been conducted on the EMV prior to this year.

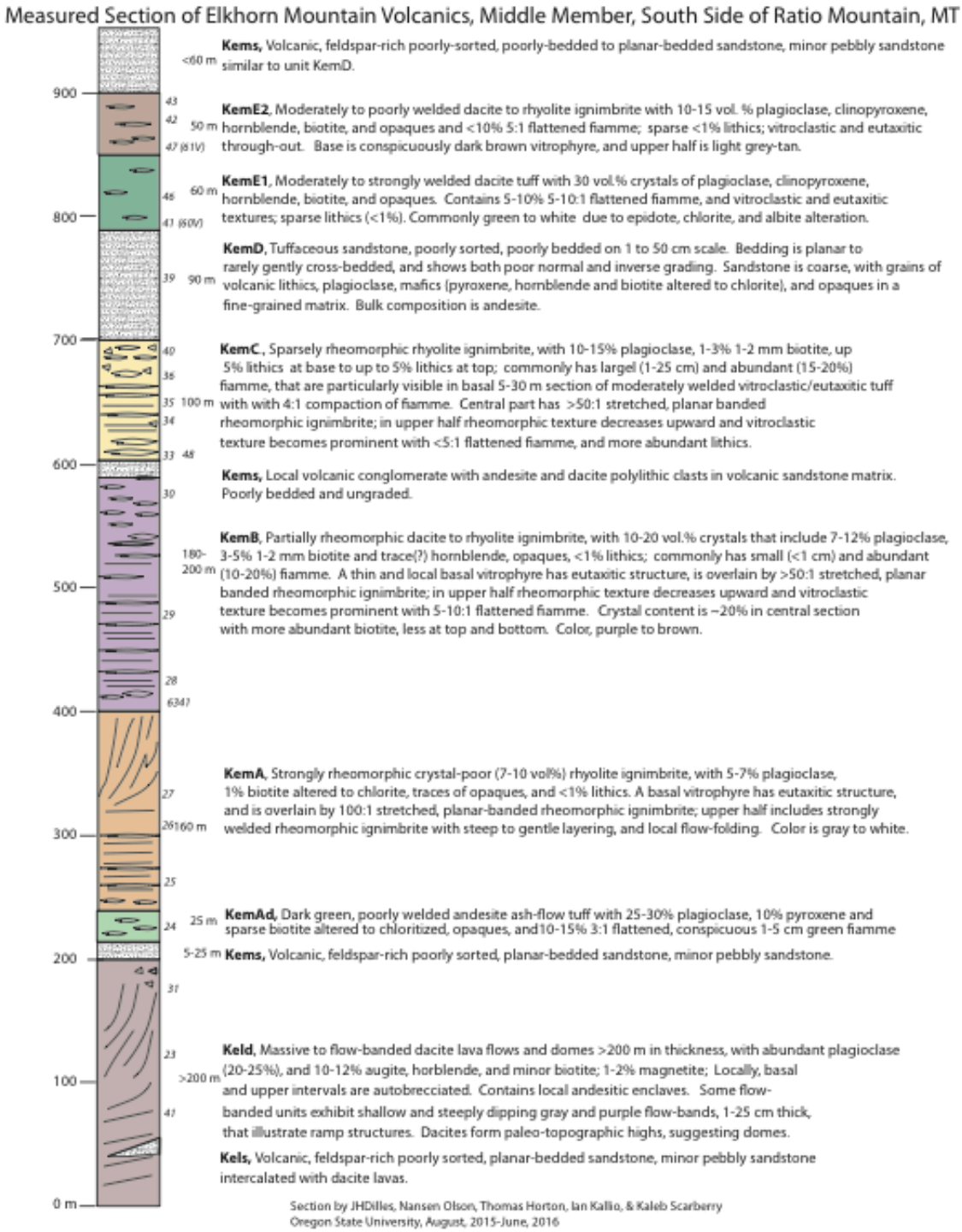

Fig. 1: Measured Section of EMV in Ratio Mtn. Quad

Methods

Two samples, NHO-15-31 and NHO-15-47, were selected from the measured section in the quadrangle and prepared for Ar-Ar geochronology at the Oregon State University Argon Geochronology Laboratory. Samples NHO-15-31 and NHO-15-47 were selected because they 1. Encompass the entire measured section in the southeast section of the quadrangle and 2. Have sufficient hornblende (1-3%) to separate for argon dating. Hornblende was the preferred mineral phase for dating, as it has a higher closure temperature and is fairly robust, meaning it is less likely to experience argon loss due to reheating after the emplacement of the Butte granite.

Samples were prepared by crushing to a small size fraction, 180-355 micrometers. After washing to remove dust, samples were separated by density using LST heavy liquid. After cleaning and drying, 4-5 mg of clean hornblende was handpicked from each sample and packaged for irradiation. Samples were irradiated at the Radiation Center at Oregon State University, and analyzed on the ARGUS VI multi collector mass spectrometer in the OSU Argon Laboratory.

Ar-Ar dating is based on the radioactive decay of

Results and Discussion

Both samples formed stable age plateaus. As expected, NHO-15-31 has a higher age than NHO-15-47, as it forms the bottom of the section. NHO-15-31 from the base of the section gave an age of 84.65±0.35 Ma, and NHO-15-47 from the top of the section gave an age of 83.72±0.31 Ma. These age dates help to paint a more complete picture of the Cretaceous arc magmatism that covered this area around 80

million years ago. Around 84 Ma, the Elkhorn Mountain Volcanics erupted as a series of ignimbrite flows over a time period of around one million years. After this eruption, the remaining magma source cooled more slowly beneath the surface, during this time mafic intrusions were emplaced throughout the area, one in the Ratio Mountain Quad was dated to 80.02±0.40 Ma. The Boulder Batholith is believed to have erupted around 76 Ma, and was giving off hydrothermal fluids until around 74 Ma, which results in the many metal deposits found in the region.

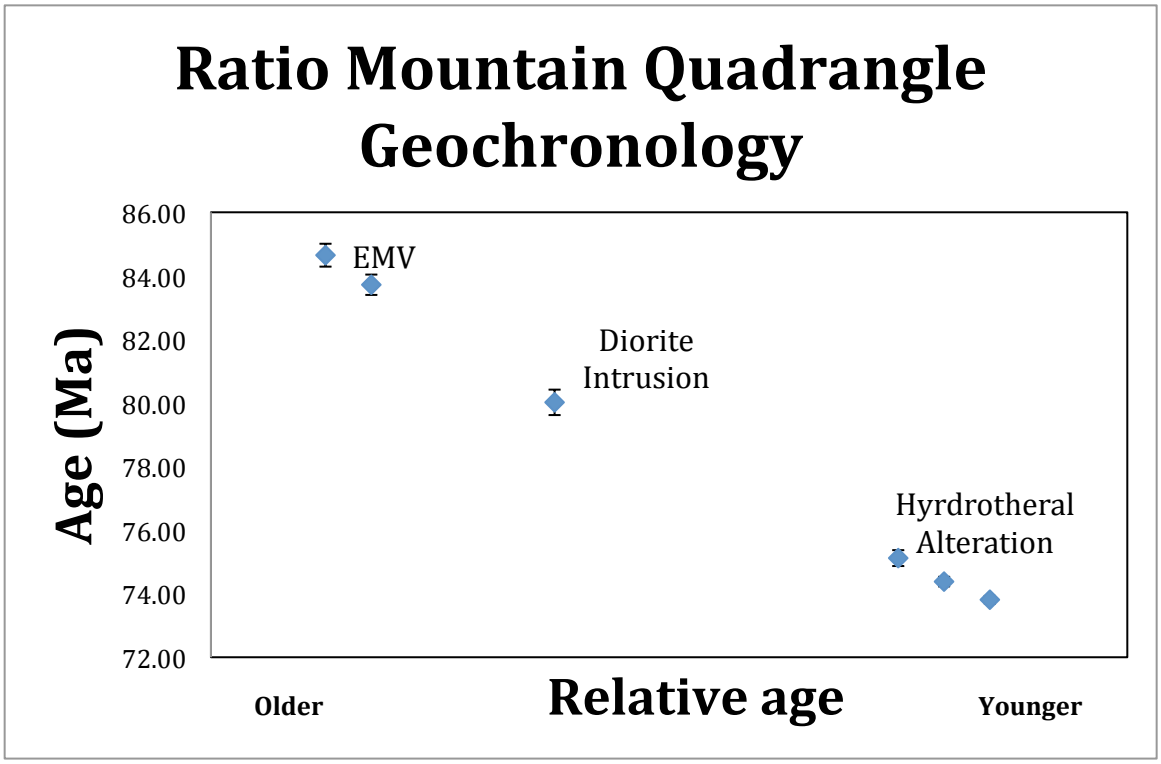

Fig.2: Ar-Ar Ages from various sources in Ratio Mtn. Quad

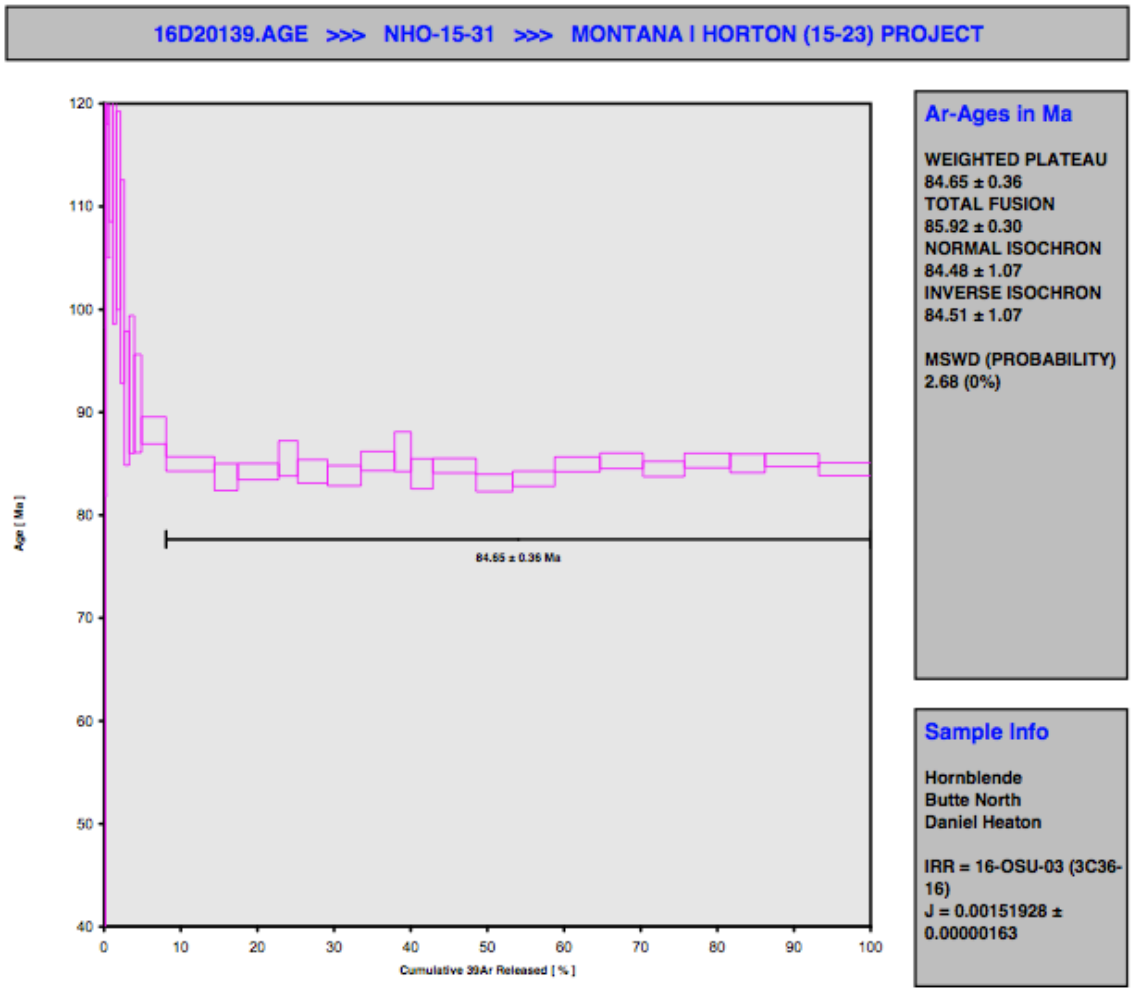

Fig. 3: Age Plateau for NHO-15-31 (Basal Dacite)

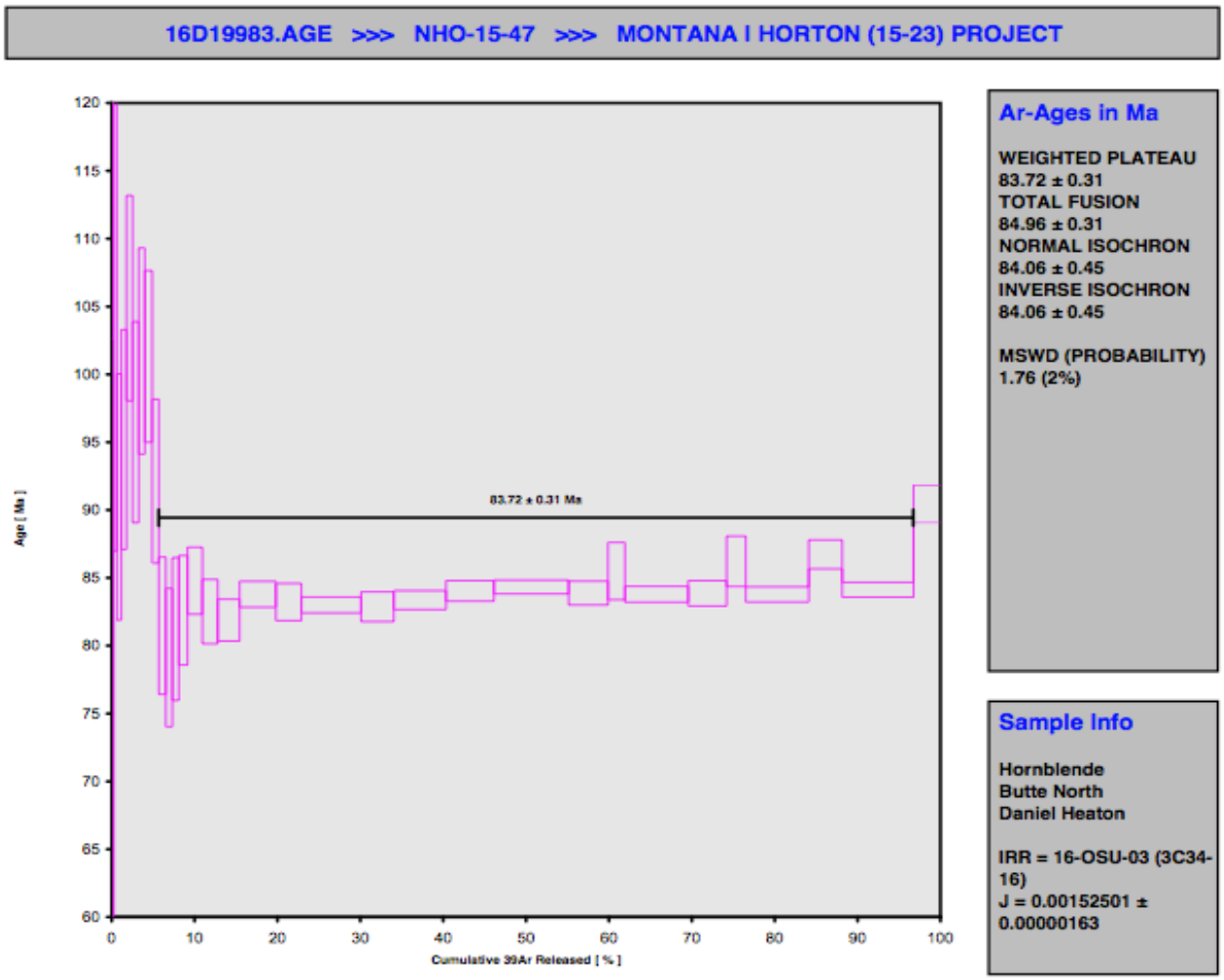

Fig. 4: Age Plateau for NHO-15-47 (Unit E)

Works Cited

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Lageson, D., Schmitt, J., Horton, B., Kalakay, T., and Burton, B., 2001, Influence of Late Cretaceous magmatism on the Sevier orogenic wedge, western Montana: Geology, v. 29, p. 723-726.

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