AN ABSTRACT OF THE THESIS OF

Matthew J. Steinkamp for the degree of Master of Science in Geology presented March 20. 2006.

Title: Lacustrine Micro-Fossil Assemblage in Core NP04-KH3, a Kullenberg Piston core from the Moba-Kalya Horst Region of Lake Tanganyika, East Africa, as a Biogeochemical Proxy for Late Pleistocene and Early Holocene Climate and Lake Level Changes.

Abstract Approved: _____

Julia A. Jones

Abstract: The objective of this research is to determine the correlation of lacustrine micro-fossils in Lake Tanganyika to changes in climate and lake levels during the Late Pleistocene and Early Holocene.

Lake Tanganyika is the second deepest and one of the oldest lakes in the world. The horst and graben geometry of the lake has created subaqueous structural platforms that accumulate pelagic sediments that contain and archive changes in micro-fossil assemblages controlled by changes in climate and lake levels. One such structural platform is the Moba-Kalya Horst.

Micro-fossil analysis of lacustrine sediments from a single Kullenberg piston core from the Moba-Kalya Horst indicate dramatic Late Pleistocene and Early Holocene climate and lake level changes that appear to be synchronized with regional, as well as hemispherical climate shifts.

During the Late Pleistocene at the Last Glacial Maximum which ended approximately 15 ky B.P., Lake Tanganyika experienced low-lake stands of 250-350 meters or more below the present lake level. From 17,537 to 15,000 calendar years BP, periphytic diatoms such as *Rhopalodia gibberula* and *Surirella fuellebornii* were abundant, as were grass phytoliths and sponge spicules, indicative of a dry climate regime. The dominant planktonic diatom was *Stephanodiscus astraea*, which thrived in low Si:P supply ratio, stratified lake environments in Na-HCO_3 rich waters, indicative of a cool, arid climate regime. Periphytic diatoms were also abundant in Lake Malawi to the south and significantly negative $\delta^{18}0$ values were recorded in Greenland ice cores for this period.

Following the low-lake stands of the Late Glacial Maximum, lake levels generally rose as East Africa experienced the AHP (African Humid Period) (14.4-5.5 cal ky BP). An increase in planktonic diatoms and decrease in periphytic diatoms were recorded in the lacustrine sediments at this time which indicate a positive water balance and rising lake levels. The accumulation of dark-bundled, laminated sediments indicate that the climate was wet and the coring site was below the annual thermocline. A decrease in *S. astraea* and increase in *Cyclostephanos damasii* signal conditions of increased moisture to the lake, and decreased evaporation.

Around 13 ky B.P. conditions at Lake Tanganyika reverted to Late Glacial Maximum conditions which lasted until approximately 11.5 ky B.P.. Periphytic diatoms once again became abundant, and sponge spicule and grass phytolith

counts rose. *S.astraea* dominance again rose as lake conditions were calm and stratified and the climate was cool and arid. Periphytic diatoms became abundant in Lake Malawi during this period, and increased negative $\delta^{18}0$ values were recorded in the Greenland ice cores correlating with increased periphytic diatoms in both Lake Tanganyika and Lake Malawi.

Following the Late Pleistocene cold period, lake levels once again began rising as the climate became wetter and windier. Fluctuations from wet and windy to wet and calm occurred at the terminus of the Late Pleistocene as diatom dominance alternated from *Aulacoseira granulata*, which indicates wet and windy with increase upwelling, to *C.damasii*, which indicate wet and stratified. Around 9800 B.P. lake conditions stabilized and remained wet and windy with increase turbulence and upwelling which optimized conditions for the dominance of *A.granulata*. These conditions prevailed through the Early Holocene to at least 6500 B.P. From the Middle Holocene to the present, the general climate of East Africa was and is more arid than the early Holocene, with dry windy conditions and continued upwelling.

Lacustrine Micro-Fossil Assemblage in Core NP04-KH3, a Kullenberg Piston core from the Moba-Kalya Horst Region of Lake Tanganyika, East Africa, as a Biogeochemical Proxy for Late Pleistocene and Early Holocene Climate and Lake Level Changes.

By
Matthew J. Steinkamp

A THESIS

submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Master of Science

Presented March 20, 2006
Commencement June 2006

Master of Science thesis of Matthew J. Steinkamp presented on March 20, 2006

APPROVED:

_____

Major Professor, representing Geology

_____

Chair of the Department of Geosciences

_____

Dean of the Graduate School

I understand that my thesis will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my thesis to any reader upon request.

_____

Matthew J. Steinkamp, Author

ACKNOWLEDGMENTS

First and foremost I would like to thank my father. His endless support and drive for me to follow my dreams is the foundation for my work and this document. I would also like to thank my mother for putting up with him and myself through all these years. Next I would love to thank my wife and best friend Michele. Her love, support, guidance, sense of humor and all-around good nature has so positively impacted my life. My daughter Margaret, undoubtedly the finest child to ever grace the planet, gave me endless support and kept me on my toes throughout my studies. I thank Michele's parents, Paul and Lee, who never stop giving and never end the laughter. I would like to thank Julia A. Jones, who believed in my goal to obtain a Masters degree, accepted me under her wing, and gave endless guidance throughout my Master's experience. I thank members of the 2004 Nyanza Project, especially Jim Russell, whom I believe knows something about everything. His training on coring methods, diatom analysis and thesis work was pivotal to success of my thesis work. I wish to thank the National Science Foundation for covering the expenses for my fieldwork in Tanzania (Funded by the NSF Grant ATM # 0223920, Dr. Andrew Cohen P.I.). A special thanks to my crazy animals that surely add 20 years to my life with their constant antics. The show never ends with them. Thanks to Mike Leblanc for his generous guidance on statistical analysis and Ann-Morey Ross for making statistics interesting and understandable. Finally, thanks to my committee members who helped me through the process and tortured me when it was necessary.

TABLE OF CONTENTS

Page

LIST OF FIGURES

LIST OF FIGURES (Continued)

LIST OF TABLES