PRESERVATIONAL VARIATIONS OF 2.5-BILLION-YEAR-OLD FILAMENTOUS MICROFOSSILS FROM THE GAMOHAAN FORMATION OF SOUTH AFRICA. K. N. Lorber[1], A. D. Czaja[1], and N. J. Beukes[2] [1]Department of Geology, University of Cincinnati, Cincinnati, OH, 45221-0013, USA, lorberkn@mail.uc.edu, [2]Paleoproterozoic Mineralization Research Group, Department of Geology, University of Johannesburg, Auckland Park, South Africa.

Introduction: Fundamental knowledge of the origin and evolution of life during the Precambrian is poorly understood and currently still under great debate (e.g., Apex chert investigations)[1,2]. Fossils of microorganisms (microfossils) can provide keys to addressing gaps in the knowledge of early life on Earth[2,3]. The morphological and geochemical analyses of microfossils, can both provide evidence of ancient life in the geological record, as well as important information on the origin and evolution of life[4,5]. Any new findings of Precambrian microfossils are important and necessary so that major gaps in the record of life on Earth may be filled.

Detecting physical or chemical evidence of Archean-age life is challenging due to often poor preservation of microorganisms, and the relative paucity of well-preserved sedimentary units from that period. Advances in microscopy and spectroscopy have allowed for a better understanding and characterization of the organic chemistry and morphology of the Earth's earliest fossil record.

Methods and Results: Here is reported a set of 2.5-billion-year-old filamentous microfossils from black cherts within the Gamohaan Formation of the Kaapvaal Craton of South Africa. The cherts were collected from correlative strata in outcrop and drill core within ~1 km of each other. Preliminary microscopic and Raman spectroscopic analyses have revealed variability in the morphological and geochemical preservation of the microfossils from each location and the organic matter (kerogen) of which they are composed. Biologic morphology of the potential microfossils is confirmed through the use of optical microscopy and confocal laser scanning microscopy. Differences in the physical preservation of the microfossils are stark, with the outcrop samples being much more morphologically degraded than the drill core samples. In addition, the variation of the geochemical signatures of the microfossil kerogen is pronounced. Kerogen preservation is principally thought to be a function of thermal alteration, but the regional geology indicates all of the specimens experienced the same thermal history. It is hypothesized that the outcrop fossils were altered by surface weathering, whereas the drill core fossils, buried to a depth of ~250 m, were not. Such differential weathering is unusual for cherts, which have extremely low porosities. Additional investigations of the 2.5-billion-year-old microfossils are conducted here in order to understand these preservational differences. Further study of geochemical signatures of the microfossils, and the rock matrix are explored here. These investigations include the use of x-ray diffraction, porosity and permeability studies, and bulk and *in situ* analyses of kerogen molecular structure and carbon isotopic composition.

Conclusions: In addition to determining the degree of preservation through analyzing microfossil morphology, these investigations provide a unique opportunity to characterize the geochemical variations of fossilized kerogen. Any increase of precision when interpreting kerogen signals would assist scientists of many disciplines to better quantify the level of preserved organic matter: thus deepening our understanding of complex systems on Earth, such as climate and the carbon-cycle, either in the past or during present times.

Recent studies suggest that Mars contains more life-supporting habitats (either present or past) than once thought. The key to finding life on Mars (whether extinct or extant) is though comparative planetary geology studies combined with geochemical investigations that will help characterize potential Martian habitats and also Mars mission science sites of interest. In particular, these investigations suggest a significant reduction in the degree of preservation of both the morphological and geochemical characteristics of microfossil sets, comparing those found at the outcrop level versus those microfossil sets found within deep drill core samples. These observations confirm that even though samples taken from localities at the surface (or a shallow sub-surface) can provide useful data, the potential for mission success would be much greater with the inclusion of a drill able to penetrate much deeper into the Martian surface.

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