PRIMARY AND SECONDARY MINERALS IN METEORITES SHED LIGHT ON THE HABITABILITY OF MARS

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Introduction: Martian meteorites contain essential information about martian environments. In particular, the identity of both primary minerals, such as merrillite and chlorapatite, and secondary minerals, such as clay minerals, records valuable information about past aqueous, environmental, and nutrient conditions on Mars. Here we present experiments to interpret minerals found in martian meteorites, focusing on the implications for potential habitability.

Methods and Results: Secondary minerals such as clay minerals record interaction with liquid water, as well as the environment in which they formed. Fe-Mg-rich clay minerals such as nontronite are found in martian meteorites [1], and are widely distributed on the martian surface [2]. The information they preserve about formation conditions is therefore critical in interpreting the history of the martian surface. Here we present results of synthesis experiments of Fe-Mg clay minerals under varying conditions of composition and environment that indicate important characteristics regarding formation.

In addition to the record secondary minerals preserve of their formation environments, primary minerals in martian meteorites such as merrillite and chlorapatite shed light on possible nutrient availability on Mars. Here we present results of our synthesis [3] and dissolution experiments [4] of phosphate minerals. Results indicate significantly enhanced dissolution of the phosphate minerals merrillite and chlorapatite over the terrestrial mineral fluorapatite [4]. In addition, meteorites and interplanetary dust particles have delivered large amounts of organic carbon to the surface of Mars [5]. Dissolution experiments of Mars-relevant phosphate minerals in the presence of prebiotically important organic compounds indicate enhanced dissolution over inorganic conditions, suggesting abundant phosphate in potentially habitable early martian environments.

Conclusions: Secondary minerals in martian meteorites record important information about formation environments, and primary minerals can help shed light on past nutrient availability on Mars. Interpretation of these mineral assemblages in martian meteorites provides important information about the potential habitability of that planet.

References:

1. Gooding, J.L., S.J. Wentworth, and M.E. Zolensky, (1991) *Meteoritics*, *26* 135-143.
2. Ehlmann, B.L., et al., (2011) *Nature*, *479* 53-60.
3. Adcock, C.T., et al., (2014) *American Mineralogist*, *9* 1221-1232.
4. Adcock, C., E. Hausrath, and P. Forster, (2013) *Nature Geoscience*, *6* 824-827.
5. Flynn, G.J., (1996) *Earth, Moon and Planets*, *72* 469-474.