Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.20563

Martian Organic Geochemistry – A Review.

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Over the last decade there has been a paradigm shift in our understanding of organic molecules, their synthesis, provenance and processing on Mars. This has been heralded by two major events, the fall and recovery of the Tissint meteorite and landing and subsequent mission activity of the Curiosity rover. These two events have allowed analyses of other meteorites and other mission data in relation to a mutually confirming dataset generated by analyses of Tissint in context with SAM data sets from Curiosity. I will place literature published observations from missions into context with published and unpublished Martian meteorites data to show that Mars has an active organic geochemical cycle comprising: 1) water rock synthesized organic material from three different synthesis mechanisms; electrochemical reduction of CO_2, serpentinization and carbonation, 2) impact altered organic material, 3) heterogeneity of organic material between differing lithologies that suggests other synthesis / alteration mechanisms may also play a role. Martian organic carbon is extremely diverse in nature and contains N, O, S, Cl and Mg functionalities that hint both at its formation mechanism and possible processing after synthesis. The diversity of organics discovered reveals abiotic / prebiotic reactions that are complex in nature and are not only important for understanding Mars they are also relevant for the processes producing organic material for the formation of life on any planet. I will further hypothesize on processes involved in cycling of Martian organic material and its importance for understanding the habitability of Mars and the baseline for Martian life detection with minimal assumptions on the nature of Mars life. Indeed, it is becoming increasingly apparent that Martian Organic Geochemical cycling will allow the study of abiotic / prebiotic synthesis on a planetary body that has direct relevance to how life could have formed on Earth, the record of which has been destroyed. In essence the search for life on Mars, is also an important step in the search for our own origins.