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Why is Mars Red? The Battle Between Iron and Manganese Oxidants on Mars

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Mars has captivated mankind's attention for thousands of years. What probably started as fear for the Roman God of War owing to the ominous red color turned to fascination with the invention of the telescope. Today, after several decades of dedicated Mars exploration, we can still agree with early mankind on one key aspect, its characteristic red color. But Why is Mars red? As the nearest planetary neighbor with potential earlier habitable conditions, Mars is replete with minerals that hold clues to its past chemistry and evolution of the aqueous systems. Oxidized iron (Fe) and manganese (Mn) minerals on Mars are geochemical markers of such environments in which they formed and record past pH, redox conditions, and intensity of water-rock interaction. Fe and Mn oxides can therefore be used to reconstruct past Martian environmental conditions from settings where aqueous fluids were active. Various processes that form Fe and Mn oxide minerals on Mars have been previously proposed, including chemical oxidation using molecular oxygen (O2) and photo-oxidation by ultraviolet (UV) rays. However, the effectiveness of O2 and UV as oxidants on Mars might be adversely affected due to the acidic fluid chemistry generally expected under Mars-relevant conditions. Oxyhalogens have a high thermodynamic oxidation potential, wide distribution, high preservation potential, and the ability to form dense brines that may percolate deeply into the Martian subsurface. However, their role as potential Fe and Mn oxidants on Mars has been largely unexplored. During Geology Open Night, I will discuss the formation of Fe and Mn oxide minerals by oxyhalogens [(per)chlorate & bromate] under Mars-relevant conditions.

Kaushik Mitra is a planetary geochemist working as a postdoc in the Department of Geosciences at Stony Brook University. He is an experimental geochemist and uses lab experiments to determine geochemical parameters of various geochemical processes occurring in the solar system and to test hypotheses related to planetary sciences in general. Prior to moving to Stony Brook in late 2021, he worked at Washington University in St. Louis from where he received his Ph.D. for his work on the effectiveness of oxyhalogen species as potent iron and manganese oxidants on the Martian surface.