

Laboratory study of the effects of impurities on the flow and fracture of icy materials on Mars

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PROPOSAL SUMMARY

We propose a laboratory study of the effects of impurities on the flow and fracture of icy materials at cool Martian temperatures. Mars exhibits a wide variety of landforms that are indicative of flow, ranging from the viscous creep of ice-rich permafrost to the glaciation of thick Martian ice sheets to the surface mobility of thin debris flows. Due to the unknown rheological effects of particulates (such as dust and sand) that are widespread on Mars, the amount of subsurface ice implied by these various creep-related landforms has yet to be determined. Using a high-pressure cryogenic creep apparatus and detailed SEM analysis, we will study not only dust-rich water ice (the material most commonly associated with the aforementioned flow phenomena), but also dust-rich clathrate hydrates. These proposed laboratory measurements will provide important constraints on the global Martian volatile inventory, and will also have implications for other fundamental questions such as whether decomposition of subsurface methane clathrate hydrate plays a role in the surprising persistence of atmospheric methane on Mars. Our proposed experimental investigation of the rheological effects of impurities upon water ice and clathrate hydrates is directly relevant to the OSS Strategic Goal II, Solar System Exploration Theme, RFA 4(b): "Investigate the history and behavior of water and other volatiles on Mars.