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ICE-EXPOSING IMPACT CRATERS AND PROPERTIES OF THE SUBSURFACE ICE ON MARS

Abstract

Fresh (nascent) craters have been discovered on Mars in the past two decades using orbital imaging, of which many have exposed ice, confirmed to be water in composition. The ice-exposing craters are detected in mid to high-latitude regions and across all longitudes, indicating the presence of a global subsurface ice table buried under the surface of Mars at varying depths. The shallow nature of the buried water ice can be helpful for In Situ Resource Utilization (ISRU). Several studies have provided a general picture of the present ice table conditions; however, local heterogeneities have often been ignored.

Remote sensing observations of fresh ice-exposing craters are conducted using data from instruments such as Context Camera (CTX), High-Resolution Imaging Science Experiment (HiRISE), and Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) onboard the Mars Reconnaissance Orbiter (MRO). These observations were complemented by numerical impact modelling to estimate the nature, thickness and depth of the subsurface ice table within the region of crater formation. We chose craters within Arcadia Planitia due to spectral, radar and geomorphological evidence of large quantities of buried ice in the area. Initial results suggest that the simple bowl-shaped morphology of these fresh impacts is due to a thick, homogenous layer consisting primarily of pore (or dirty) ice, which has higher rocky (lithic) content and mechanical strength than the pure ice modelled in the simulations. Variations in ejecta and surrounding geomorphology of the craters suggest that both types of ice (pore and pure) coexist where the latter is present in the form of ice lenses, wedges or discrete blocks underneath the surface – similar to the types of landforms observed in Earth's near-polar freeze-thaw terrain (periglacial).

Understanding the present ice table properties will contribute to developing effective ISRU systems, guide studies exploring current and past habitability, and initial exploration for achieving sustained human presence on Mars.