

Subsurface Water in Mars' Shallow Diluvium Deposits: Evidence from Tianwen-1 Radar Observations

Authors : Changzhi Jiang, Chunyu Ding, Yan Su, Jiawei Li, Ravi Sharma, Yuanzhou Liu, Jiangwan Xu

Abstract : Early Mars is believed to have had extensive liquid water activity, which has now predominantly transitioned to a frozen state, with the majority of water stored in polar ice caps. It has long been deemed that the shallow subsurface of Mars' mid-to-low latitudes is devoid of liquid water. However, geological features observed at the Tianwen-1 landing site hint potential subsurface water. Our research indicates that the shallow subsurface at the Tianwen-1 landing site consists primarily of diluvium deposits containing liquid brine and brine ice, which exhibits diurnal thermal convection processes. Here we report the relationship between the loss tangent and temperature of materials within 5 meters depth of the subsurface at the Tianwen-1 landing site, as in-situ detected by high-frequency radar and climate station onboard the Zhurong rover. When the strata temperature exceeds ~ 240 K, the mixed brine ice transitions to liquid brine, significantly increasing the loss tangent from an average of ~ 0.0167 to a maximum of ~ 0.0448 . This finding indicates the presence of substantial subsurface water in Mars' mid-to-low latitudes, influencing the shallow subsurface heat distribution and contributing to the current Martian hydrological cycle.

Keywords : water on mars, mars exploration, in-situ radar detection, tianwen-1 mission

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