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Crystal Water on Mars: Insights from the Mars Exploration Rovers

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The purpose of this paper is to constrain the total water contents from crystal H_2O and OH in several materials analyzed by the Mars Exploration Rovers (MER). Crystal H_2O is part of the unit cell and cannot be removed without changing the structure. Minerals that contain only OH in their structures are anhydrous minerals containing hydroxyls, although they are formed as a product of aqueous activity and will decompose with evolution of H_2O when heated.

The crystal water and OH contents of a bulk material at the MER landing sites can be estimated from mineralogical composition, which is determined by a combination of Fe-mineralogy obtained by the Mossbauer Spectrometer and mineral abundances based upon the chemical composition determined by the Alpha Particle X-ray Spectrometer.

Jarosite, along with Ca- and Mg-sulfates, have been suggested as the sulfur-bearing phases in Meridiani Planum outcrop. Models of various hydration states of Fe-, Ca-, and Mg-sulfates and other possible secondary phases suggest that 6 to 22 wt.% of the outcrop may occur as crystal H_2O and/or OH (Clark *et al.*, 2005). This estimate of water is consistent with measurements from the Odyssey orbiter, where 7 % H_2O-equivalent H was measured down to a depth of approximately 1 m for the region (Feldman *et al.*, 2004).

The Peace outcrop material, which is composed of basaltic sands cemented by Mg- and Ca-sulfates, exhibited the highest water content (1.2 to 6.9 wt.% H_2O) of rocks and outcrops encountered on the northwestern flank of Husband Hill in Gusev crater (Ming et al., 2006, 2007). Paso Robles soil on Husband Hill contains Fe^{3+}-, Mg-, Ca-bearing and other sulfates, Ca-phosphates, and other secondary phases (Ming *et al.*, 2006). The water content derived from these materials ranges from 2.4 to 16.9 wt.% (Ming et al., 2007).

Unfortunately, the MER Athena instrument payload has not identified the secondary aluminosilicates in outcrops, rocks, and soils at the two landing sites. Therefore, it is likely that the total water constraints listed above are higher than suggested if hydrated secondary aluminosilicates are present.

References

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