

SPECIAL COLLECTION: MARTIAN ROCKS AND MINERALS: PERSPECTIVES FROM ROVERS, ORBITERS, AND METEORITES

## Esperance: Multiple episodes of aqueous alteration involving fracture fills and coatings at Matijevic Hill, Mars

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### ABSTRACT

In the search for evidence of past aqueous activity by the Mars Exploration Rover Opportunity, fracture-filling veins and rock coatings are prime candidates for exploration. At one location within a segment of remaining rim material surrounding Endeavour Crater, a set of “boxwork” fractures in an outcrop called Esperance are filled by a bright, hydrated, and highly siliceous ( $\text{SiO}_2 \sim 66$  wt%) material, which has overall a montmorillonite-like chemical composition. This material is partially covered by patches of a thin, dark coating that is sulfate-rich ( $\text{SO}_3 \sim 21$  wt%) but also contains significant levels of Si, Fe, Ca, and Mg. The simultaneous presence of abundant S, Si, and Fe indicates significant mineralogical complexity within the coating. This combination of vein and coating compositions is unlike previous analyses on Mars. Both materials are heterogeneously eroded, presumably by eolian abrasion. The evidence indicates at least two separate episodes of solute precipitation from aqueous fluids at this location, possibly widely separated in time. In addition to the implications for multiple episodes of alteration at the surface of the planet, aqueous chemical environments such as these would have been habitable at the time of their formation and are also favorable for preservation of organic material.

**Keywords:** Mars, aqueous, water, geochemistry, vein, coating, montmorillonite, smectite, phyllosilicate, sulfate, habitability, organics