

LETTER

Evidence in favor of small amounts of ephemeral and transient water during alteration at Meridiani Planum, Mars

**GILLES BERGER,^{1,*} MICHAEL J. TOPLIS,² ERWAN TREGUIER,^{3,†} CLAUDE D'USTON,³
AND PATRICK PINET²**

¹LMTG, CNRS-Université Toulouse, 14 av. E. Belin, 31400 Toulouse, France

²DTP, CNRS-Université Toulouse, 14 av. E. Belin, 31400 Toulouse, France

³CESR, CNRS-Université Toulouse, 14 av. E. Belin, 31400 Toulouse, France

ABSTRACT

In light of the controversy surrounding the origin of sulfate-rich rocks analyzed by the Mars Exploration Rover Opportunity, thermodynamic and kinetic models explored the consequences of in situ alteration of basaltic sand by pristine sulfuric acid. Simulations at 273 K and current martian atmosphere show that it is possible to simultaneously account for both chemical and mineralogical observations at the Meridiani landing site, but only when the amounts of water are small (water/rock mass ratio ≤ 1), the aqueous solutions are highly acidic ($\text{pH} < 3$), and the lifetimes of liquid water are extremely short (on the order of tens of years). Furthermore, the best agreement between observations and models is obtained if evolved fluids are removed after alteration. If this simple self-consistent scenario is relevant to bedrock formation at Meridiani, it provides stringent constraints on the issues of where and when liquid water was present at the surface of Mars.

Keywords: Mars, alteration, Meridiani, thermodynamic modeling, sulfuric acid, SO_3