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Laterites developed on a peridotitic bedrock and magnetic similitudes with Martian regoliths

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The development of the Martian regolith under a thin atmosphere is fundamentally different from soil formation on Earth. However, the regolith properties might be inherited from a soil if Mars earlier had a wet atmosphere. The early magmatic evolution of Mars and the recent discovery of olivine in several localities leads to the speculation that the Martian surface might be underlain by significant expanses of peridotitic or komatiitic bedrock. On Earth, peridotites undergo serpentinization from interaction with seawater at the ridge to interaction with meteoric water (weathering rinds). We propose that laterites developed from alteration of a peridotitic bedrock on Earth may display mineral similarities with some of the Martian bedrock underlying the regolith.

The peridotitic laterites of the New Caledonia ophiolite provide excellent opportunities for geoscience investigations because numerous boreholes have been drilled through the alteration profiles as part of an exploration program for nickel. The peridotite nappe, emplaced in the late Eocene, has an estimated thickness up to 3 km and is exposed over an area of 8000 km^2. Common lithologies include harzbugite, dunite, wherlite and cumulate gabbro. Regardless of the bedrock lithology, the lateritic profiles display an increase in concentration of Fe oxides and hydroxides to-

wards the top. The alteration paths of distinct bedrock types tend to converge toward the same mineralogy. Alteration profiles commonly display 6 superimposed horizons: mangano-ferricrete; red pisolitic laterite; red laterite; yellow laterite; saprolite and unaltered bedrock. Common minerals in these profiles include ferric oxides (hematite, maghemite, lepidocrosite, goethite, magnetite), clays (kaolinite and smectite, Mg-trioctahedral silicates) and quartz. The variable crystallinity and fine granulometry of these materials makes mineral identification difficult.

A combination of XRD analyses and TIR spectroscopy measurements indicates the abundance of iron oxides and of a smectite phyllosilicate having 2:1 layering (saponite?). Mössbauer analyses, performed at 19 K on two large grains of specular hematites reveal that these grains actually consist of a mixture of hematite, goethite and a phase not yet identified. Low-field and high-field magnetic techniques as well as frequency dependence of susceptibility have been combined to refine the vertical zonation of the lateritic profiles into distinct horizons. Magnetite is the main component in the magnetic susceptibility budget while hematite controls the coercivity.

Several distinguishing features are observed in peridotitic laterites: 1) bulbous hematite concretions, 2) reddish fine-grained hematite, 3) gray flaky specular hematite (up to 10 mm in length), 4) ferricretes and manganocretes, and 5) preservation of olivine grains in spite of intense alteration in zones of high relief. Similar characteristics have been deduced from the MGS TES data or observed directly by the Mars Rovers. These results highlight the possibility that some of Martian surface features might have been inherited from a wet past and that some of the regolith may have developed from altered peridotites.