



## **Evidence of complex rock weathering in the Dry Valleys of Antarctica**

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Pedogenesis starts with the alteration and disaggregation of rocks exposed to the atmosphere, and not in equilibrium with the environmental conditions. In arid and hyperarid lands the processes related to weathering and pedogenesis are particularly slow and sometimes they are apparently lacking. Notwithstanding this, bare rock surfaces in warm and cold deserts present a variety of forms of weathering as, for instance, rock varnish. The latter is a yellowish to dark brown, glossy coating that covers geomorphically stable, aeriially exposed rock surfaces and landforms. In Antarctica, rock varnish develops on a variety of bedrocks and has been described being mostly formed of Si, Al, Fe, and sulphates, suggesting a double process in its formation that includes biomineralization and dust accretion. We investigated rock coatings developed on sandstones outcropping in the Dry Valleys of Antarctica and most of the samples highlighted an extremely complex varnish structure, alternating thin layers of different chemical composition. Optical microscope evidences the occurrence of highly birefringent minerals, occasionally thinly laminated and consisting of Si and Al-rich minerals (clays). Dark, a few microns-thick lenses and/or continuous layers interlayer clays. Thin layers are well evident under the scanning electron microscope, and chemical analysis confirmed that they consist of different kinds of sulphates. Among the others, jarosite is the most represented; gypsum crystals were also found. Fe-rich hypoc coatings and intergranular crusts were also detected, sometimes preserving the shape of the hyphae they have replaced. In a few cases, a dark Mn/Fe-rich rock varnish has been identified on the surface of specific geomorphological features such as weathering pits. Varnish formation required the accretion of airborne dust of variable composition and subsequent recrystallization of some constituents, possibly promoted by microorganisms. The formation of sulphates required the occurrence of S-rich dust, likely produced by volcanic eruptions. On the contrary, the formation of Mn/Fe-rich varnish should be related to the occurrence of higher environmental humidity within weathering pits. Our observations suggest that the formation of rock varnish in the Dry Valleys is a process more complex than previously described, and weathering surfaces may represents a tool to reconstruct changes in water availability and in the aeolian fallout.