We have performed preliminary mapping of the manganese and iron present in a cross-section of a rock varnish from the Cima volcanic flows in the Mojave Desert, California. Rock varnish is a nanostratigraphic deposit found on typically fine-grained rocks in hyper-arid to semi-arid deserts (Figure 1a) [1]. Rock varnish is defined as consisting of about 70% clay particles held together by about 30% iron and manganese oxides [2]. The mechanism(s) by which rock varnish nucleates and grows remains unknown despite more than 30 years of study using electron microscopy. The dating of rock varnish layers and a possible microbiological contribution to the growth of varnish have both been exceedingly controversial during recent years. Microbiology is often invoked as the mechanism of varnish growth due to the significant enhancement of manganese in varnish compared to the concentration in the host rock, but its involvement remains a mystery.

As part of a project to indirectly date the layers in a rock varnish from the Cima volcanic flows using a nearby dated lake sediment core, we have mapped the concentration of manganese in a cross-section of a varnish from Cima using the Spectromicroscope for PHotoelectron Imaging of Nanostructures with X-rays (SPHINX) (Figure 1b). With its very high spatial resolution, SPHINX is particularly well suited to the study of the complex nanostructures with rock varnish. SPHINX shows a wide range of oxidation states for Mn, suggesting that further understanding of the oxidation states of the various layers may be possible. The iron spectra indicate that all of the iron is present as hematite.

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References: