Desert varnish and dust: Nano- and femtosecond LA-ICP-MS studies of major and trace elements

L. M. OTTER[13]*, D. S. MACHOLDT[1], K. P. JOCHUM[1], B. STOLL[1], U. WEIS[1], B. WEBER[2], D. SCHOLZ[3], A. AL-AMRI[4] AND M. O. ANDREAE[14]

[1]Biogeochemistry Department, Max Planck Institute for Chemistry, P.O.Box 3060, 55128 Mainz, Germany (*correspondence: laura.otter@mpic.de)

[2]Multiphase Chemistry Department, Max Planck Institute for Chemistry, P.O.Box 3060, 55128 Mainz, Germany

[3]Institute for Geosciences, Johannes Gutenberg-University Mainz, Johann-Joachim-Becher-Weg 25, D-55099 Mainz, Germany

[4]Geology and Geophysics Department, King Saud University, Riyadh, Saudi Arabia

Desert varnish describes thin, lustrous, brown to black coatings on rock surfaces of physically stable lithologies. Bulk material consists of clay minerals, cemented together by manganese and iron oxyhydroxides. Aeolian dust is considered a potential source of Mn, due to leaching processes after wetting by dew or soft rain [1]. In addition, bioenhancement might be responsible for further enrichment.

We investigated major and trace element compositions of varnish from one semi-arid (Knersvlakte, South Africa) and three arid environments (Mojave Desert, CA, USA, Negev Desert, Israel, and An Nafud Desert, Saudi Arabia). Some of these samples were described previously by Macholdt et al. [2]. Corresponding samples of dust were collected adjacent to varnish sites. Varnish and dust samples were studied using single collector sector field LA-ICP-MS with nanosecond and femtosecond lasers, respectively. Varnish coatings were ablated as thin layers of about 1 μm each, using a fast scan speed of 80 μm/s. This provides a high spatial resolution and allows stepwise insight into elemental distributions from the uppermost coating to the underlying rock.

The varnish samples are enriched in Mn, Pb, Co, and Ba, independent of their origin. Dust samples are not significantly enriched in these elements, but have high concentrations of Al, Ca, and Mg, which are typical for clay minerals. Yet, the possibility of Mn enrichment in varnishes resulting from leaching of dust over periods of several ka must still be considered, despite the long-term formation process of varnish and will be discussed among other hypotheses.

[1] Goldsmith, Stein & Enzel (2014) *Geochim. et Cosmochim. Acta* **126**, 97-111, [2] Macholdt et al. 2015 *Chem. Geol.* (subm.),