Weathering & heterogeneous phase distribution in brachinite NWA 4872

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Brachinites are thought to be the residuum of a partially melted asteroid [e.g. 1-3] and offer insights into the initial stages of asteroid differentiation. Multiple splits from single brachinites show differences in highly siderophile element (HSE) abundances, likely reflecting the effects of heterogeneous phase distribution and uneven weathering [3]. Weathering is an important issue as it can obscure primary information on parent-body processes. We report a detailed Raman spectroscopy, micro-computed tomography (micro-CT) and laser-ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) study of weathering and phase distribution for brachinite Northwest Africa (NWA) 4872.

Raman analyses employed for investigating weathering products used a Horiba LabRAM Aramis micro-Raman spectrometer with a 532 nm, 50 mW laser (filtered to 10% power). *In situ* mineral REE and HSE abundance analyses used a New Wave Research UP213 (213 nm) laser-ablation system coupled to a Thermo-Finnigan Element 2 ICP-MS. Micro-CT scans employed for investigating phase distribution were run with a GE eXplore speCZT using a X-ray voltage of 110 kV and a beam current of 32 mA.

Raman analyses showed a redistribution of S from the initial troilite resulting in S-rich areas (mostly marcasite) and S-poor areas (mostly Fe-oxide). Studies of weathering in martian meteorites have found marcasite [e.g. 4] and sulphur removal from troilite has been linked to hot desert weathering [5]. Absolute abundances of HSE were hard to determine by LA-ICP-MS due to variable degrees of alteration, but relative abundances reveal that positive Ru-anomalies that are characteristic of brachinites [3] are common to weathered sulphide grains as well as to fresh troilite. Variability in elements were observed relative to the Ru-anomaly and grain-to-grain variations in Re and Os were seen. This accounts for differences in HSE abundances and Re/Os seen in separate splits of NWA 4872.

The light REE, Ba, Sr, U and Pb did not show elevation related to weathering in whole rock analyses [3]. This is consistent with the observed weathering. Weathered sulphide and metal were widespread; however, silicates showed no obvious weathering, no carbonate was found and sulfate was minimal. The measured splits of NWA 4872 appear to be influenced mostly by uneven weathering. However, micro-CT analysis showed a heterogeneous distribution of high density grains. This is likely true of other brachinites and could affect measured bulk trace element abundances.

[1] Day et al. (2009) *Nature* **457**, 179-182. [2] Goodrich (1998) *MAPS* **33**, A60. [3] Day et al. (2012) *GCA* **81**, 94-128. [4] Floran et al. (1978) *GCA* **42**, 1213-1229. [5] Lee & Bland (2004) *GCA* **68(4)**, 893-916.