Tracing meteoritic components in Cretaceous-Paleogene microkrystites using XRF nano-analysis

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Impact ejecta found more than ~10 crater diameters away from large impact structure consist primarily of glassy spherules, droplets solidified from melt or condensed from vapour. Most impact spherules are smaller than 1 mm in diameter and are either microtektites, consisting of pure glass, or microkrystites, also containing primary crystallites. Microkrystites are generally more mafic in composition, can be highly contaminated by the impactor as indicated by elevated siderophile element contents [1], including the platinum group elements (PGEs, Re, Os, Ir, Ru, Pt, Rh, Pd), and may contain Ni-rich spinels.

Prior LA-ICP-MS experiments indicate that roughly 100 ppb Ir and 250-400 ppb Pt is present in the selected bulk microkrystites [2]. These low concentrations in combination with their microscopic size (~200-500 μm) require the application of a nanometric X-ray beam (< 100 nm), excitation energies of at least 14 keV, and a fast scanning approach with sensitive multi-element SDD detectors. These requirements were attained at the ID16B beam line of the ESRF, as detection limits of ~0.2 ppm for Pt with 1000 s RT allow to resolve any PGE-enriched microphases present. Multiple areas of Pt enrichment were detected, while only one scan measured Ir at the same position as an equally dilute Pt signal. Importantly, the regions of increased Pt and Ir are distinct from any textural or mineralogical features, including Ni-rich spinels. Complementary measurements using LA-ICP-MS confirm that spherule zones rich or poor in spinels do not show distinct Ir and Pt contents. Except for an association with refractory Ca, Ti, Cr, and Y, no clear host phase for the Pt is apparent. Additional information regarding the alteration of primary condensation and melt phases, the distribution of (moderately siderophile) trace elements (Cr and Ni), and the dispersed occurrence of volatile Zn may help to unravel the complex formation history of these and other impact spherules.

References: [1] Goderis S. et al. (2013) *Geochim. Cosmochim. Acta* 120, 417–446. [2] Belza J. et al. (2013) *Geochim. Cosmochim. Acta* 202, 231–263.