IDENTIFYING THE FORM AND CARRIER PHASE OF THE EXTRATERRESTRIAL SIGNATURE IN DISTAL K-PG BOUNDARY IMPACT MATERIALS.

L.V. Forman[1], L. Daly[1,2], P.A. Bland[1], G.K. Benedix[1], N.J. Evans[1,3], K. Merigot[3], C.G. Ryan[4], M. Saunders[5], N.E. Timms[1] & J. Smit[6]. [1]Department of Applied Geology, Curtin University, GPO Box U1987, Perth, WA 6845, Australia, lucy.forman@curtin.edu.au, [2]School of Geographical and Earth Sciences, University of Glasgow, Glasgow, G12 8QQ, UK, [3]John de Laeter Centre, Curtin University, GPO Box U1987, Perth, WA 6845, Australia, [4]CSIRO Mineral Resources, Clayton, VIC 3168, Australia, [5]Centre for Microscopy, Characterisation and Analysis, University of Western Australia, WA 6009, Australia, [6]Geology and Geochemistry, VU University, Amsterdam, 1081HV.

Introduction: The global stratigraphic K-Pg layer that formed at ~65 Ma contains an enrichment of platinum group elements (PGEs), specifically Ir, which is primarily acknowledged to be extraterrestrial in origin [e.g. 1, 2]. Distal sites, greater than 4000 km in paleodistance from the surmised impact site at the Chicxulub crater, Mexico, contain up to ~39 ng/g Ir as determined from bulk geochemical analyses [e.g. 3, 4]. The distribution of Ir is relatively uniform across all sites [4]. Greater understanding of impact ejecta processing can be obtained through identification of the PGE-enriched carrier phase, as has recently been achieved for Archaean impact spherule layers [e.g. 5]. Here we present *in situ* identification and analyses of the Ir-enriched phases within the Woodside Creek K-Pg boundary sample from South Island, New Zealand. This sample was originally located ~14,000km from the impact site at 65 Ma and has a relatively high bulk Ir concentration of 29.74 ng/g [4]. The distal location of the sample relative to the impact site allows for our results to be considered in the context of ejecta cloud material processing and transport to distal K-Pg boundary sites, which in turn may be used to inform impact modelling parameters [e.g. 6].

Methods & Materials: The Woodside Creek K-Pg boundary sample was embedded in a 1-inch epoxy resin round and polished flat for analysis. X-ray fluorescence (XRF) synchrotron maps were obtained at the Australian synchrotron facility, which produced 25 elemental distribution maps, including Ir, at 2 μm spatial resolution. Feature mapping was also employed using the INCA feature mapping module, to identify any micro-nugget PGE alloys of high density, such as those observed in the Archaean impact spherule layers [e.g. 6]. High-resolution Tescan integrated mineral analyser (TIMA) imaging then generated comprehensive phase maps using a combination of backscattered electron (BSE) images with energy dispersive x-ray spectrometer (EDS) measurements allows a distinction of grain boundaries and mineral phases. A small region (1.5 mm x 2 mm) containing most of the phases present in the sample was then selected for laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) analysis. Data were collected on a total of 39 isotopes (including ^{193}Ir) and areas with a large number of Ir counts were correlated with the TIMA maps to acquire a reasonable estimation of the host composition, so that accurate concentration maps could be generated. Further investigation into the high-Ir phases within the region were done using transmission electron microscopy (TEM) and prepared using focused ion beam (FIB) techniques [see 7].

Preliminary Results: XRF images did not clearly identify the location of Ir within the sample, likely due to the low concentration of the Ir relative to the sensitivity of the XRF instrumentation, and no high-density micro-nuggets >100 nm in diameter were identified via feature mapping. The combination of TIMA imaging and LA-ICP-MS data revealed higher relative Ir concentrations in amphibole and FeO-rich phases within this sample, at concentrations of ~6 ppm and ~4 ppm respectively. The surrounding clays do not appear to be enriched in Ir above terrestrial values. Initial TEM analysis of the FeO-rich phase did not identify any Ir bearing nano-nuggets (>1 nm) of high density that may be indicative of a PGE-enriched composition, tentatively indicating the PGEs are not in nugget form at any scale within this sample. TEM examination of other PGE-enriched phases is ongoing.

Preliminary Discussion & Conclusions: The apparent lack of nuggets at the micro- and nano-scales imply further ejecta plume processing has occurred than was evident in the Archaean spherule layer samples, or that excessive reworking in the Woodside Creek region followed deposition of the material. PGEs are typically concentrated into refractory metal nuggets within meteorites [e.g. 8]. However, these are not observed in this sample, and when combined with the large paleodistance from the impact site and uniform deposition of material across distal sites, pure ballistic transport of the material is unlikely. Recent impact models [e.g. 6] have suggested distal impact material may have been ejected from the Earth's atmosphere and dispersed upon re-entry; vapourisation of Ir would likely have occurred within the oxidizing ejecta plume due to high predicted temperatures [6], which is corroborated by our initial results, and the presence of Ir within the amphibole and FeO-rich phases is indicative that condensation of the bulk material probably occurred rapidly if this is a primary feature. Further TEM analyses will clarify the Ir form and aid in developing our understanding of how this material was processed and potentially redistributed.

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