LACK OF UBIQUITOUS IMPACTOR COMPONENT IN THE CHICXULUB PEAK RING IMPACT MELT ROCKS: IMPLICATIONS FOR THE FATE OF THE PROJECTILE.

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Introduction: Constraining the amount of a meteoritic signature within rocks of an impact structure provides important information on the fate of the projectile, as well as on the processes that occur during and after an impact cratering event. In 2016, the IODP-ICDP Expedition 364 drilling recovered a ~829 m continuous core (M0077A) of impactites and basement rocks within the peak ring of the ~200-km-diameter Chicxulub impact structure [1]. An iridium anomaly and a near-chondritic highly siderophile element (HSE) signature were identified within the transitional unit of core M0077A, at the top of the peak ring, corresponding to the settling of atmospheric fallout of fine-grained extraterrestrial material [2]. Previous works on other drill cores recovered from the Chicxulub structure have shown that most Chicxulub impactites contain a rather minor, heterogeneously distributed, chondritic component, up to 0.1% in a few samples [3, and references therein]. This study focuses on the search for a meteoritic component within impact melt rock samples recovered from the peak ring.

Methods: To identify a possible meteoritic contribution within the impact melt rock units from the peak ring, detailed geochemical investigations, including selected moderately (Cr, Co, Ni; 25 samples), and HSE (Ir, Pt, Re, Os; 12 samples) contents, as well as Re–Os isotopic analyses (12 samples), were completed. In addition, two suevite samples, as well as pre-impact lithologies (one amphibolite, one dolerite, one dacite, and two granite samples) of the Chicxulub peak ring, were also analyzed. Details on the methods used for this study are provided in [3].

Results and Discussion: Impact melt rock samples are generally of andesitic composition. The moderately siderophile element contents (Cr, Co, Ni) of impact melt rocks reflect primarily a mixture of a felsic (granite) and a mafic (dolerite) components, with the incorporation of carbonate material in the upper impact melt rock unit (from 715.60 to 747.02 meters below seafloor). Concentrations of the HSEs in impact melt rock and suevite samples are generally low (<39 ppt Ir, <96 ppt Os, <149 ppt Pt), similar to upper continental crust [4]. Only three impact melt rock samples exhibit an enrichment in Os (125, 344, and 410 ppt) and/or Ir (250 and 324 ppt) by one order of magnitude relative to the other samples investigated. However, the dolerite sample shows a similar enrichment in the HSEs (245 ppt Os, 156 ppt Ir, and 346 ppt Pt) by roughly one order of magnitude relative to the other pre-impact lithologies. In contrast, granite, dacite, and suevite samples are depleted in Ir, with contents ranging from 1 to 10 ppt.

The $^{187}Os/^{188}Os$ ratios of the impact melt rocks range from 0.18 to 2.09, probably reflecting heterogenous target rock contributions. The presence of a significant (~20–60%, and up to 80–90%) mafic, unradiogenic dolerite ($^{187}Os/^{188}Os$ of 0.17) component within the impact melt rocks may be the most likely explanation of the lowest $^{187}Os/^{188}Os$ ratios measured in impact melt rocks. Granite samples have unusually unradiogenic $^{187}Os/^{188}Os$ ratios (~0.16). Only one of the investigated samples of the upper impact melt rock unit could be interpreted in terms of a highly diluted (~0.01–0.05%) meteoritic component. Importantly, the impact melt rocks and pre-impact lithologies were affected by a long-lived (>1 Myr) post-impact hydrothermal system [5], locally remobilizing Re and Os.

This study shows that the amount of meteoritic material incorporated within the Chicxulub impact structure seems to be rather low and heterogeneously distributed. In contrast, significant meteoritic contribution (up to ~5%) is found in distal K–Pg impact ejecta [6,7]. The low amount of meteoritic material preserved within the Chicxulub impact structure may result from a steeply inclined trajectory of the impactor (~45–60°), as suggested by numerical modeling [8], with most of the projectile material likely ejected and deposited outside the crater. Our study (see details in [3]) shows the challenges associated with the unambiguous identification of a meteoritic component at terrestrial impact structures.

Acknowledgements: Thanks to ECORD, IODP-ICDP, the Yucatán Government, and Universidad Nacional Autónoma de México for drilling funding. University of Vienna doctoral school, FWO-Flanders, BELSPO, and VUB Strategic Research Program supported this research.

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