Ni-, Cr- and PGE rich vitric products found in distal ejecta: New data from the Stac Fada Member, Scotland.

P. C. Guyett[1], J. A. Petrus[2] and B. S. Kamber[1], [1]Dept. Geology, Trinity College Dublin, Dublin 2, Ireland (*correspondence: guyettp@tcd.ie), [2]Earth Sciences, Laurentian University, Sudbury, Canada.

Introduction: Meteoritic material has been invoked to explain elevated siderophile element and Cr- and Os-isotope ratios in a variety of impact ejecta layers and spherule beds. The physical carriers of the extraterrestrial cargo, however, have remained elusive in the majority of studies.

Here we present new geochemical data from the 1.18 Ga Stac Fada Member ejecta layer, exposed on the northwestern coast of Scotland [1]. Previous studies of this ejecta layer have noted the presence of a variety of matrix-supported devitrified melt products (called 'shards') [1][2] throughout the Stac Fada Member and interpreted these shards to be melted target rock [1]. Existing studies have noted elevated siderophile element concentrations compared to the surrounding country rock. However these studies were based on whole rock analysis rather than *in situ* analysis on individual melt clasts

In this study we completed thorough petrographic and *in situ* geochemical analysis on the devitrified melt shards (SEM EDS and LA-ICP-MS). Our results suggest that there were two distinct melt sources. Analysis of the beige-grey shards concurs with the previous study's [1] claim that these shards are simply melted target rock (either Lewisian gneiss, Torridonian sandstone, or, more likely, a mixture thereof). However, a second class of distinctively green shards must have come from a different source. The green shards display far higher siderophile element concentrations than the grey-beige shards and underlying Torridonian sandstone and Lewisian gneiss with Ni/Cr and Pt/Ir ratios falling close to the range (2-7 and 1.6-2.3) of normal chondrite. On binary plots of siderophile element ratios, the green shards plot towards the chondrite meteorite array, whereas beige-grey shards plot closer to the terrestrial targets. The whole rock data of [1] plot between the target compositions and the green shards. The REE patterns of the green shards are indistinguishable from chondrite, with relatively low light REE concentrations. By contrast, the beige-grey shards have REE pattern similar to typical upper continental crust.

Our results suggest that the green shards are the main carriers of siderophile elements. Because the Cr-isotope composition of the hosting suevite is different from the canonical terrestrial value, the siderophile elements must, at least in part, be derived from the impactor. However, even the most siderophile element enriched green shards have much lower Ir concentrations than all classes of chondrite, rendering the possibility of green shards representing melted impactor very unlikely. It is more probable that a fraction of the extraterrestrial siderophile element cargo was transferred to a relatively magnesian melt in the impact structure before being emplaced in the ejecta deposit.

It is interesting that petrologically and geochemically different impact melts have been noted in large impact structures such as Chicxulub, Mexico [3] and Sudbury, Canada [4][5] yet their origin has been interpreted to be that of melted target rock. Recent studies on the Sudbury impact structure [6] have highlighted notable geochemical differences between the crystallised melt sheet and vitric products in the basin fill. The basin fill contains melt products that are more magnesian than the melt sheet, suggesting that they could have come from an unrelated deeper source. The Ir content in the Sudbury basin fill is highest where the abundance of magnesian green shard is also highest, pointing to a similar association as at Stac Fada.

Our new evidence suggests that the green and beige-grey shards in Stac Fada ejecta originated from different sources. We propose that the green shards contain siderophile elements from the impactor and that green shards at all major terrestrial impact sites deserve closer study.

References: [1] Amor K. et al. 2008. *Geology*. 36:303–306. [2] Simms M.J. 2015. *Proceedings of the Geologists' Association*. 126:742–761. [3] Claeys P. et al. 2003. *Meteoritics & Planetary Science* 38:1299–1317. [4] Dressler B.O. et al. 1996. *Geochimica et Cosmochimica Acta*, 60:2019-2036. [5] Ames D.E. et al. 2002. *Economic Geology*. 97:1541–1562. [6] Petrus J.A. et al. 2015, *Terra Nova*, 27:9–20.