Correlative Microanalysis of a Unique, Chondritic, Precambrian Impactor

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Direct study of impacts older than 1 Ga is limited by the destruction of impactors and impact craters by Earth surface processes. The only material of this age available for study is contained within impact derived material, impact melt, spherules and accretionary lapilli.

The Stac Fada ejecta blanket deposit contains both impact melt and accretionary lapilli, which are enriched in platinum group elements (PGEs) [1]. Here we directly analyse impactor derived material within the lapilli to extract information on a parent body, the breakup age of which must predate 1.177Ga.

Secondary Ion Mass Spectrometry (SIMS) is a powerful tool which is highly surface sensitive and can reach lateral resolutions of 50nm with a traditional beam chemistry. Here we use the Ne beam of the ZEISS ORION Focused Ion Beam (FIB) for microanalysis with an attached magnetic sector mass spectrometer. This yields lateral resolutions limited only by fundamental probe-matter interaction, down to sub 10nm [2].

Using a correlative microscopy approach, we frame these measurements within a larger context taken with transmitted light and scanning electron microscopy and microanalysis.

CI normalised concentrations within the lapilli rims are enriched in the PGEs by over four orders of magnitude relative to the average continental crust. The roughly flat pattern indicates a chondritic impactor, but the interelement PGE ratios do not align with any known chondrite group. This represents the first direct measurements of a chondritic parent body, the breakup of which predates 1.177Ga.

[1] Amor et al., (2008), *Geology* 36, 303-306 [2] Dowsett and Wirtz, (2017), *Anal. Chem.* 119, 8957-8965