SEARCHING FOR AN IMPACTOR SIGNATURE IN AUSTRALASIAN MICROTEKTITES

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Introduction: Projectile identification is a critical aspect in large-scale impact cratering studies due to the dilution of meteoritic material in impact melt rocks. [1] have recently shown that Australasian microtektites from the Transantarctic Mountains (AUS/TAM), i.e. those thrown furthest away (~11,000 km) from the hypothetical impact location in Indochina, are depleted in Ni, Co relative to Australasian microtektites found in deep-sea sediments (DSS) at lower latitudes (AUS/DSS) and, in particular, that AUS/TAM do not contain the high-Ni compositional type. Earlier, [2] proposed that the enrichment in Ni, Co and Cr in seven high-Ni AUS/DSS microtektites relative to the average upper continental crust may be due to projectile (chondritic?) contamination. In this work we have determined the major and trace element composition of a new selection of high-Ni AUS/DSS microtektites. Based on the compositional comparison with Australasian microtektites in the literature, we reassess here the possible presence of impactor contamination in AUS microtektites and discuss its geographical distribution in the strewnfield.

Samples and methods: We selected 49 glassy particles from the Australasian microtektite layer with the brown to dark-brown characteristic color of high-Ni microtektites described in the literature. Selected microtektites range in size from 170 to 670 µm. They are from 8 deep-sea sediment cores within ~3000 km form Indochina (ODP 758B, 767B, 769A, 1144A, RC14-46, SO95-17957-2 and V19-153). Whole microtektites were first studied using a FE-SEM (EDS) to gain information on their morphology and surface features, and then analysed for their magnetic properties. They were subsequently embedded in resin, sectioned and polished for petrographic and bulk major and trace element compositional analyses using FE-SEM-EDS, µRaman spectroscopy, EPM and LA-ICP-MS.

Results: The 49 brown to dark-brown particles selected for this work include 23 normal-type, 1 intermediate type, 23 high-Ni-type, one anomalous high-Fe,Ni-type (FeO = 11 wt%) microtektites, and 1 microcrystite dominated by Fe-Ti oxides. Most notably, on considering the complete compositional database of the Australasian microtektites so far available (48 AUS/DSS from this work, 54 from [2, 3], and 44 AUS/TAM from [1, 4], we observe that Ni and Co contents (and to some extent Fe) decrease with distance from the hypothetical source crater location in Indochina [5], with concentrations of up to Ni = 678 and Co = 50 µg/g in the AUS/DSS, and Ni <26 and Co <13 µg/g in the AUS/TAM. The highest concentrations of Ni and Co are observed in high-Ni microtektites which were found within 3000 km form Indochina, i.e. close to the hypothetical impact location area. In high-Ni microtektites, Ni and Co are positively correlated with each other (Ni/Co = 10±2) and roughly positively correlated with Fe, Mg and Cr. Nickel and Co are positively correlated also in normal, intermediate and high-Mg type microtektites, yet with a distinctly lower Ni/Co ratios of ~3. Chromium contents increase on average from normal-type microtektites (98±75 µg/g), to high-Ni (210±90 µg/g), high-Al (392 µg/g), intermediate-type (396±177) to high-Mg type (627±330 µg/g), and do not correlate with distance regardless of the compositional type.

Discussion and conclusions: The concentrations of Ni and Co in AUS/DSS, and in particular in the high-Ni type, are significantly higher than in the Upper Continental Crust or Bulk Continental Crust (Ni = 20, 105 µg/g, Co = 10, 29 µg/g [6]), and could be meteoritic projectile contamination, as suggested previously [2]. In this view, we speculate that projectile contamination decreases with distance from the source crater and eventually becomes negligible in those microtektites that were thrown at greater distances, as far south as the Antarctic. The latter are also those microtektites which experienced the highest thermal regimes [7]. We therefore suggest that those microtektites that were heated most and launched furthest away were also those that did not physically interact with the projectile, whereas those microtektites that were heated less and launched closer to the crater were contaminated by the impactor. Although no correlation with distance is observed, the Cr contents are also higher than the Bulk Continental Crust value in intermediate, high-Mg and high-Ni microtektites and could be due to projectile contamination, but this requires further study.

References

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