CONTRASTING TRACE ELEMENT (ESPECIALLY TUNGSTEN) CONTENTS AND THE ORIGINS OF TWO MASSES OF MOON METAL: 14286 AND 63344,1

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I have used instrumental neutron activation analysis (INAA) to determine 15 trace elements in two of the largest pieces of metal acquired from the Moon. The "grape cluster", Apollo 16 coarse fines sample 63344,1, is a 0.22 g particle of almost pure Fe-metal discovered by Marvin [1] and studied petrographically by Goldstein et al. [2]. Apollo 14 sample 14286 is a 4.4 g rock that consists mostly of kamacite, with only minor selvages of attached silicates [3,4]. Albrecht et al. [4] reported INAA data for trace elements in 14286. I have re-analyzed the identical sample, using a technique [cf. 5] more tailored for iron meteorite-like materials. Results are generally similar to those of [4]; e.g. (in µg/g) Co 5400, Ni 56000, Ga 13.6, W 89, Ir 1.88. The new analysis significantly revises Ru, to 4.4 µg/g (± 13%) and adds detection of Ge, at 178 µg/g (± 12%). The only data previously reported for 63344,1 were for major elements including Co and P; although W, Ir and Au were qualitatively detected [2]. The new 63344,1 analysis shows (in µg/g): Cr 103, Co 3900, Ni 67000, Cu 183, Ga 82, Ge <100, As 10.0, Ru 5.1 (± 16%), Sb 0.17 (± 9%), W 6.2, Re 0.39, Os 5.46, Ir 4.16, Pt 5.3, Au 1.01.

The trace element data help to constrain the origin of these materials. As discussed previously [4], the 14286 composition features very high W in comparison to other elements of similar general siderophility and volatility; and this ~ 100× W anomaly is readily explained as a result of equilibration of the metal as a settled component within a very large mass of impact melt that had the KREEP enrichment characteristic of Apollo 14 regional materials [4]. Noritic-KREEPy silicates are attached in igneous contact to the metal [3].

The "grape cluster" 63344,1 has the unique structure of several hundred tiny globules, welded into one cohesive mass. From the textural evidence, it was apparent [2] that this particle formed from a fluid, either as droplets of impact melt or a droplets formed by an impact-driven cycle of vaporization and condensation, or perhaps, [2] suggested, as splash droplets from a fall-back impact into a pool of impact-melted metal. The new trace element data show a mildly atypical-high W/Ir ratio, by iron meteorite standards, but W/Ir is not nearly as enhanced as in the case of 14286. To a surprising degree, 63344,1 has a composition typical of a IAB or perhaps IIICD iron meteorite, albeit belonging to the extreme low-Ni, low-Au, etc. end of the IAB compositional trends [5]. The fall-back impact splash model can be eliminated, but it is still not clear whether vaporization or simple liquid splashing was involved (although considering the purity of this material, on physical grounds the former seems more likely).

Other than having endured a neutron irradiation of ~1.1×10^{16} cm^{-2}, the studied (0.17 g) main mass of the "grape cluster" is intact and available for future investigations. The main mass of 14286 is still at NASA-JSC.

References: [1] Marvin U. B. (1972) *Apollo 16 Coarse Fines (4-10 mm): Sample Classification, Description and Inventory*, NASA-JSC. [2] Goldstein J. I. et al. (1975) *EPSL* 28, 217-224. [3] Warren P. H. et al. (1991) *LPS* 22, 1469-1470. [4] Albrecht A. et al. (1995) *LPS* 26, 13-14. [5] Wasson J. T. & Kallemeyn G. W. (2002) *GCA* 66, 2445-2473. [6] .