

METAL GLOBULES IN AGGLUTINATIC GLASS; Abhijit Basu¹, Michael Dorais¹, and D.S. McKay², ¹Department of Geological Sciences, Indiana University, Bloomington, IN 47405; ²NASA-JSC, Houston, TX 77058, U.S.A.

SUMMARY. Our preliminary analyses show that Ni/Co ratios in micrometer sized metal globules in agglutinatic glass of soil 61181 are mostly above 20, which suggests meteoritic derivation. The excess metal in lunar soils relative to lunar rocks, therefore, is likely to be meteoritic in part and possibly resides in agglutinatic glass.

INTRODUCTION. Micrometer sized metal globules occur in the glass of many lunar agglutinates. These may have been produced from indigenous lunar material through a reduction process in which solar wind hydrogen present in lunar soils would react with Fe-silicates in the agglutinatic melt to produce Fe⁰ that may have scavenged Ni, Co, and other elements from the melt or glass. Indeed, Korotev [4] argues that the "excess" metal in Apollo 16 soils is lunar in derivation. It is also possible that the "excess" metal in lunar soils is meteoritic in derivation [9] and that "projectile metal was incorporated in various lunar materials" [2]. Hewins et al. [2] claim that under rapid cooling conditions the concentrations of Ni-Co-P may remain unchanged between a melt and the metal phase that may solidify from the melt. Given the similar geochemical behavior of Ni and Co, we assume that the Ni/Co ratio in progenitors should be the same as in the daughters produced from impact melts that cooled rapidly, but perhaps not exceeding 140°C/s so as to produce globules [6]. In general, Ni/Co ratio in lunar melt rocks average about 16 and in meteoritic melt veins average above 20 [4,5,7]. Therefore, Ni/Co ratios of metal globules in agglutinatic glass may indicate provenance.

METHODS. As a part of our larger project to compare agglutinates from different Apollo sites, we have so far analyzed 54 metal globules in 10 single agglutinate grains from Apollo 16 soil 61181. We used a CAMECA SX50 microprobe at 20kv and 2na beam current to achieve a 0.7µm beam spot. We used pure metal and pyrite as standards, counting for 100 seconds on Mn, Co, Ni, and 20 seconds on S and Fe. We used BSE images at 30000X-50000X magnification to center the beam on a globule and checked EDS spectra on the fix-point mode. Beam penetration through the globules generated some Si and Al x-rays. We did not analyze troilite and did not see any P or Mo peaks at points of analysis.

RESULTS and DISCUSSION. Our data show that there is a large range of Ni/Co ratio (3 to 55) but most are above 20 indicating that the metal globules in agglutinates may be mostly meteoritic (fig. 1). If so, this metal has an origin completely different from nanophase metal believed to be derived from *in situ* reduction. Extreme values up to 55 suggest that (unknown?) fractionation may be involved in some cases. Note, however, that Ni/Co ratio chondritic metal may range from 2 in kamacite to 120 in taenite [8]. Ni/Co ratio of soil 61181 is 13.5 [3] and that of these single agglutinates range from 10.5 to 14 (fig. 2). Clearly, the metal globules are enriched in Ni (or depleted in Co) by a factor of two or so relative to the bulk soils as well as the agglutinate grains in which they reside. Shock experiments show that mixing between projectile and target components to produce Fe-Mo-Si globules is possible [6]. We conclude that parts of micrometeorites, upon impact, were incorporated in agglutinatic melts. Therefore, the excess metal in lunar soils relative to lunar rocks may be, in part, meteoritic in derivation and resides in agglutinatic glass.

METAL GLOBULES: Basu, A. et al.

REFERENCES: [1] Blanchard, D. P., and Morris, R. V., 1984, LPS XV, pp. 66-67. [2] Hewins, R.H. et al. 1976, PLSC 7th, pp. 819-836. [3] Korotev, R. L., 1982, PLPSC 13th, pp. A269-A278. [4] Korotev, R.L., 1987, PLPSC 17th, pp. E447-E461. [5] Ming, C. et al., 1995, Meteoritics, v. 30, pp. 28-32. [6] Rowan, L.R., and Ahrens, T.J., 1994, EPSL, v. 122, pp. 71-88. [7] Sears, D.W., and Axon, H.J., 1975, v. 11, pp. 97-100. [8] Smith, D.G.W. et al., EPSL, v. 120, pp. 487-498. [9] Taylor, L.A. et al., 1976, PLSC 7th, pp. 837-856.

Metal Globules in Agglutinates

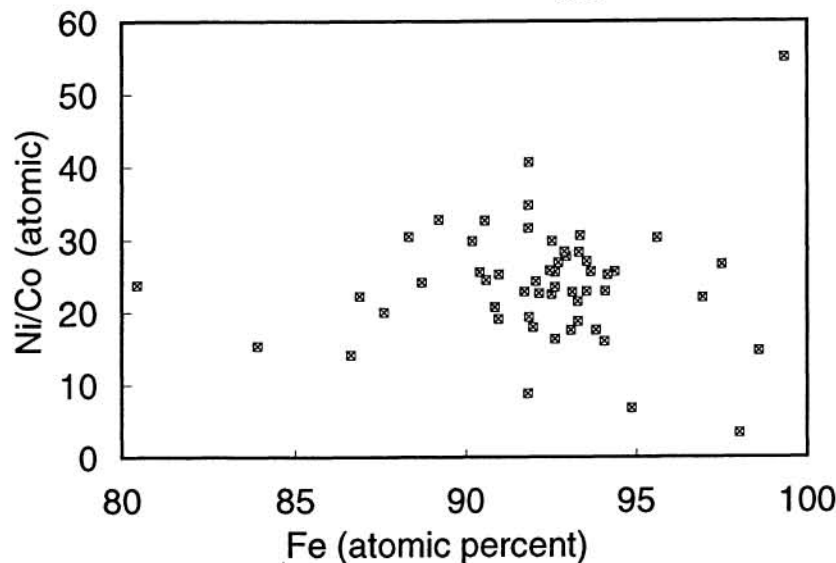
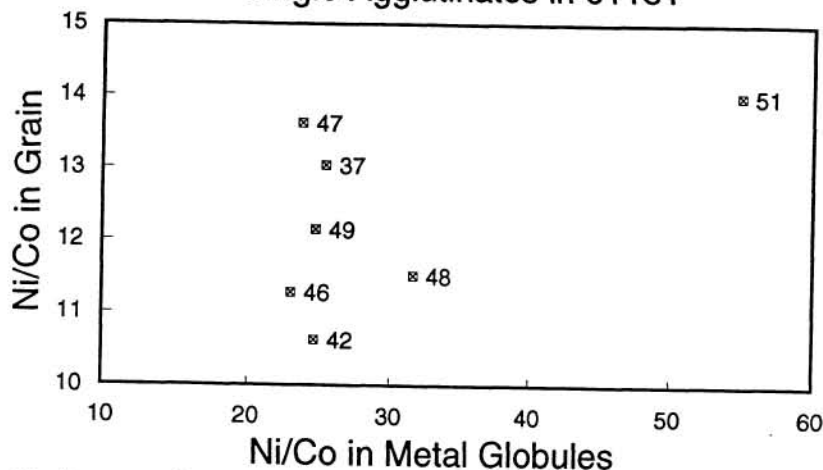


Fig. 1. Distribution of Ni/Co and Fe in metal globules in agglutinatic glass. Atomic concentrations of S, Mn, Fe, Co, and Ni have been normalized to 100 for comparison.

Single Agglutinates in 61181



Numbers on points are grain designations

Fig. 2. Distribution of Ni/Co in metal globules (this work) and host grains (the latter are INAA values of Blanchard and Morris [1]).