COMPOSITION OF MAGNETIC AND NONMAGNETIC FRACTIONS OF NORITIC IMPACT MELT BRECCIAS FROM APOLLO 16. Randy L. Korotev, Dept. of Earth & Planetary Sciences and McDonnell Center for the Space Sciences, Washington University, St. Louis, MO 63130

In a recent paper, Korotev [1] showed that (1) compared to noritic impact melt rocks (18-22% Al_2O_3, i.e., 'LKFM' melt rocks) from other landing sites, those from Apollo 16 are distinct in having high concentrations of meteoritic metal (1-2%) and, consequently, high concentrations of siderophile elements; (2) the composition of the Fe-Ni metal in two types of noritic melt rock, i.e., the 'poikilitic' breccias such as 65015 ('Apollo 16 LKFM/KREEP') and the melt portion of the dimict breccias such as 61015 [2], are similar; (3) the metal is the carrier of the low Ir/Au ratio (~0.3x chondritic) characteristic of 'ancient meteorite group' 1H [3]; (4) the two types of melt rock were formed by impact of two related, metal-rich (probably iron) meteorites and this is the cause of the high metal content.

To examine further the similarities and differences between the Fe-Ni metal in these two types of melt rock, we have analyzed magnetic and nonmagnetic fractions of each by INAA. Samples (~ 0.5 g) of the melt portion of dimict breccia 61015 and poikilitic breccia 65015 were ground in an agate mortar and pestle and a magnetic fraction separated with a hand magnet. INAA results for the two fractions are given in Table 1, along with whole-rock compositions calculated from mass balance. For both rocks the magnetic fraction contained a substantial portion of nonmetallic material. If the sum of the concentrations of Fe, Ni, and Co in the metal phase is assumed to be 100% and the nonmetal portion of the magnetic fraction is assumed to have the same concentrations of Fe, Ni, and Co as the nonmagnetic fraction, then the mass fraction of metal in the magnetic fraction (and whole rock) can be calculated along with the concentrations of Fe, Ni, and Co in the metal. The composition of the metal calculated in this way is listed in Table 1. Also listed are the concentrations of As, W, Ir, and Au in the metal phase, assuming that the entire quantity of these elements in the magnetic fraction resides in the metal phase (the assumption may not be as valid for W as for the other elements). If lithophile elements such as the REE in the magnetic fraction are assumed to occur totally in the nonmetal portion, then the compositions of the nonmetallic portion of the magnetic fractions are easily calculated (Fig. 1).

The metal compositions in Table 1 are similar to those estimated in [1] on the basis of variation in siderophile element concentrations among subsamples of each type of melt rock and with direct analyses of metal in the rocks [2,4,5,6]. The bulk compositions of the metal in both rocks are similar. The data confirm that the Ir/Au ratio of the metal in 65015 is about 30% lower that that in 61015. They also confirm that Fe-Ni metal in Apollo 16 breccias has high concentrations of W which is believed to be extracted from the silicate melt [7,8]. The higher W concentration in the 65015 metal may reflect the higher concentrations of incompatible trace elements (ITEs) in the bulk rock compared to 61015.

A curious difference between the two rocks is that the magnetic fraction of 65015 is largely nonmetallic and contains only 6.6% metal whereas the magnetic fraction of 61015 is 32% metal. Also, the nonmetal portion of the magnetic fraction ('+' in Fig. 1) of 65015 is significantly enriched in ITEs compared to the whole rock ('o'), whereas for 61015 it is slightly depleted. This implies that the metal in 65015 is intimately associated with ITE-rich phases. Melt rock 65015 contains intergranular veins of metal [5]. ITE-rich mesostasis associated with metal grains has been reported for other melt rocks [8]. Fe-Ni metal in poikilitic melt rocks has low P content and rare schreibersite as a result of diffusion of P out of the metal during slow cooling [6,9,10,11]. Such grains often have Ca phosphates at their boundaries which form from oxidation of the exsolved P [6,9,10]. These phosphates are likely hosts for ITEs. By contrast, the 61015 melt has cooled more rapidly and the metal (+ schreibersite) has high P content [2]. As a consequence, there is no association between metal and ITE-rich phases in 61015.

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Table 1. Results of analysis of magnetic and nonmagnetic separates from two types of Apollo 16 noritic impact melt rocks, with calculated whole rock and metal compositions. Values in ug/g, unless noted otherwise.

	65015 (Apollo 16 LKFM)				61015 (Dimict Breccia VHA)				Allende
	Mag.	Nonm.	W.R.	Metal	Mag.	Nonm.	W.R.	Metal	3/23
Na_2O, %	0.64	0.55	0.56	-	0.33	0.49	0.48	-	0.46
CaO, %	14.0	11.8	12.0	-	8.9	13.5	13.3	-	2.5±0.4
Sc	13.0	15.8	15.5	-	6.34	10.47	10.32	-	10.9
Cr	980.	1270.	1240.	-	747.	1060.	1050.	-	3670.
Fe, %	11.64	5.80	6.36	94.2	32.5	4.52	5.53	92.8	23.7
Co	239.	6.58	28.8	3530.	1230.	4.59	48.8	3870.	658.
Ni, %	0.360	0.007	0.041	5.34	2.15	0.003	0.801	6.798	1.40
As	1.22	<0.12	~0.2	~17.	5.4	<0.11	~0.2	~17.	1.65
Zr	1270.	720.	770.	-	230.	360.	360.	-	n.d.
Ba	830.	493.	525.	-	203.	255.	253.	-	n.a.
La	85.4	52.4	55.6	-	16.5	26.6	26.2	-	0.497
Ce	218.	132.	140.	-	41.7	70.3	69.3	-	n.a.
Nd	139.	78.	84.	-	29.	47.	46.	-	n.d.
Sm	38.0	23.2	24.6	-	7.22	12.6	12.4	-	0.326
Eu	2.22	1.98	2.00	-	0.98	1.51	1.49	-	0.095
Tb	6.8	4.5	4.7	-	1.22	2.36	2.31	-	n.d.
Yb	23.0	16.7	17.3	-	4.74	8.33	8.20	-	0.30
Lu	3.04	2.32	2.39	-	0.73	1.12	1.11	-	n.a.
Hf	31.0	18.6	19.8	-	5.58	9.12	8.99	-	0.15±.05
Ta	3.50	1.88	2.04	-	0.80	1.02	1.01	-	0.21±.05
W	5.8	0.9	1.4	75.	7.7	0.3	0.6	24.	<0.4
Ir, ng/g	70.	<2.	7-9	1060.	515.	<2.	18-21	1630.	770.
Au, ng/g	87.	<4.	8-12	1320.	463.	4.	21.	1450.	153.
Th	14.2	8.45	9.0	-	2.8	4.19	4.1	-	n.d.
U	3.3	2.2	2.3	-	0.38	1.06	1.04	-	n.d.
mass %	9.57	90.43	100.	0.63	3.61	96.39	100.	1.14	-

n.a. = not analyzed; spectral interferences.
n.d. = not detected.