Allan Hills 76005 polymict eucrite pairing group: curatorial and scientific update on a jointly curated meteorite. **K. Righter**[1], [1]Mailcode KT, NASA–JSC, Houston, TX 77062 USA.

Introduction:
Allan Hills 76005 (or 765) was collected by the joint US-Japan field search for meteorites in 1976-77 (**Figure 1**). It was described in detail by Olsen, et al. (1978) as *"pale gray in color and consists of finely divided macrocrystalline pyroxene-rich matrix that contains abundant clastic fragments: (1) Clasts of white, plagioclase-rich rocks. (2) Medium-gray, partly devitrified, cryptocrystalline. (3) Monomineralic fragments and grains of pyroxene, plagioclases, oxide minerals, sulfides, and metal. In overall appearance it is very similar to some lunar breccias*." Subsequent studies found a great diversity of basaltic clast textures and compositions, and therefore it is best classified as a polymict eucrite. Samples from the 1976-77, 77-78, and 78-79 field seasons (76, 77, and 78 prefixes) were split between US and Japan (NIPR). The US specimens are currently at NASA-JSC, Smithsonian Institution, or the Field Museum in Chicago. After this initial finding of ALH 76005, the next year's team recovered one additional mass ALH 77302, and then four additional masses were found during the third season – ALH 78040 and ALH 78132, 78158 and 78165. The joint US-Japan collection effort ended after three years and the US began collecting in the Trans-Antarctic Mountains with the 1979-80 and subsequent field seasons. ALH 79017 and ALH 80102 were recovered in these first two years, and then in 1981-82 field season, 6 additional masses were recovered from the Allan Hills. Of course it took some time to establish pairing of all of these specimens (see [2] for a nice summary), but altogether the samples comprise 4292.4 g of material. Here will be summarized the scientific findings as well as some curatorial details of how specimens have been subdivided and allocated for study. A detailed summary is also presented on the NASA-JSC curation webpage for the HED meteorite compendium.

Figure 1: ALH 76005 photographed in blue ice when it was found in January 1977.

Figure 2a: Mass of ALH 76005 curated at NASA-JSC.

Figure 2b: Mass of ALH 76005 curated at NIPR.

Table 1: 14 samples in pairing group

Sample	Mass	Studies
ALH 76005	1425	[1,2,3,4,5,11]
ALH 77302	235.5	[4,7]
ALH 78040	211.7	
ALH 78132	656.0	[8]
ALH 78158	15.1	
ALH 78165	20.9	
ALH 79017	310.0	[9]
ALH 80102	471.2	[8,10]
ALH 81006	254.9	
ALH 81007	163.5	
ALH 81008	43.8	
ALH 81009	229.0	
ALH 81010	219.1	
ALH 81012	36.7	

Petrography and mineral chemistry:
The ALH polymict eucrites contain a wide range of basaltic clast types (spherulitic, variolitic,

coarse- and fine-grained, and subophitic basalts), as well as dark fine-grained material, and some mineral fragments such as metal, oxides, feldspar, and pyroxene. The matrix contains many mineral fragments as well, and careful petrographic studies of the bulk meteorite and clasts were carried out by the studies indicated in Table 1. The unique modal mineralogy of the ALH pairing group, compared to other polymict eucrites groups such as the Yamato and Elephant Moraine groups is demonstrated by [2]; the ALH group forms a distinct field with respect to plagioclase, and low and high Ca pyroxenes.

Pyroxene compositions and textures are variable, and have been summarized into four distinct groups by [11]. Group A (Pasamonte type) are characterized by large homogeneous cores with a thin rim of more FeO-rich pyroxene; group B pyroxenes have Fe-Mg zoning from core to rim, but also have exsolution lamellae; group C has pyroxene grains that have two portions that are comprised of group A (zoning and no exsolution) and group B (zoning and exsolution); and group D (Juvinas type) have fine exsolution lamellae with uniform chemical composition.

The bulk rock composition of samples from the ALH-pairing group falls in the middle of the region defined by polymict eucrites, in terms of major (MgO and Al_2O_3) and trace (Sc, Sm) elements ([11] Figure 3).

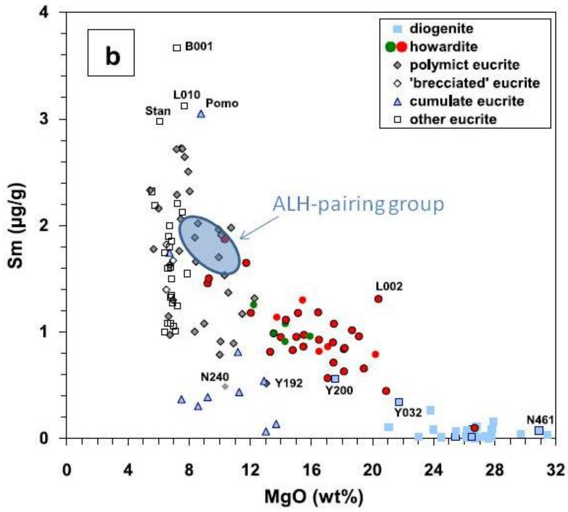

Figure 3: Bulk rock analyses of ALH pairing group samples (in blue ellipse) compared to H-E-D meteorite analyses from [12].

Exposure ages:

Cosmic ray exposure ages were determined by several groups and using different isotopes. [13] measured ALH 76005, 78132, 79017, 80102, 81008, 81009, and 81010, and found ages of 7.3 to 8.3 Ma based on $^{53}Mn/^{21}Ne$, and ages of 7.7 to 8.8 Ma based on ^{21}Ne. Later, [14] report ages of 10.3(2.1) Ma and 13.1(1.3) Ma based on ^{21}Ne and ^{38}Ar, respectively, for ALH 78132 (see also [15]).

Chronology:

Age dating of the ALH polymict eucrites has consisted of Ar-Ar, Rb-Sr, Sm-Nd, and Lu-Hf studies. Ar-Ar dating of ALH 76005 by [16], ALH 77302 by [17] and ALH 76005, ALH 78132, and ALH 80102 by [18] have all yielded ages between 3.0 and 4.0 Ga, indicating some disturbances to the Ar system. Dating with the Rb-Sr system was done by [19] and yields an age of 4.63 (+/- 0.19) Ga by using a number of paired ALH and Yamato polymict eucrites. Application of the Sm-Nd system yields similar ages by [20] for ALH 76005 and for several polymict eucrites by [19] - 4.52 and 4.56 Ga, respectively. And finally, the Lu-Hf system was used to help define the decay constant for this system, yielding a value of 1.962 x 10^{-11} yr^{-1} [21].

Summary:

Studies of the clasts within the separate masses of the pairing group indicate the possibility that many could have originated during the fractional crystallization of the same parent liquid(s) [2,4]. The textural diversity of the clasts, of course, suggests a range of thermal conditions and cooling histories for the intrusive and extrusive rock types found in the clasts within the pairing group. Age dating has yielded ages that are consistent with the very early differentiation event that is proposed for the HED parent body (likely 4 Vesta), with some younger resetting due to impacts or metamorphism.

References: [1] Olsen, E.J. et al. (1978) Meteoritics 13, 209-225.; [2] Delaney, J.S. et al. (1983) Mem. NIPR Special Issue 30, 206-223; [3] Fuhrman, M. and Papike, J.J. (1982) Lunar Planet. Sci. Conf. 12th Proceedings Pt. 2., 1257-1279; [4] Simon, S.B. and Papike, J.J. (1983) Meteoritics 18, 35-50; [5] Grossman, L. et al. (1981) GCA 45, 1267-1279; [6] Olsen, E.J. et al. (1980) 43rd Meteoritical Society, La Jolla, CA, p.105; [7] Labotka, T. and Papike, J.J. (1980) Lunar Planet. Sci. Conf. 11th, Proceedings Pt. 2, 1103-1130; [8] Metzler, K. et al. (1995) Planetary and Space Science 43, 499-525.; [9] Reid, A. and Score, R. (1981) Mem. NIPR Special Issue 20, 33-52; [10] Treiman, A.H. and Drake, M.J. (1985) JGR 90, Suppl., C619-C628; [11] Miyamoto, M. et al. (1979) Mem. NIPR Special Issue 12, 59-71; [12] Warren, P.H. et al. (2009) GCA 73, 5918-5943; [13] Herpers, U. et al. (1995) Planetary and Space Science 43, p. 545-556; [14] Welten, K. et al. (1997) MaPS 32, 891-902.; [15] Eugster, O. and Michel, Th. (1995) GCA 59, 177-199; [16] Kaneoka, I. et al. (1981) Mem. NIPR Special Issue 20, 250; [17] Spangler, R.R. et al. (1985) Lunar Planet. Sci. XVI, 805-806; [18] Kunz, J. et al. (1995) Planetary and Space Science 43, 527-543; [19] Wooden, J. et al. (1983) Mem. NIPR Special Issue 30, 315-322; [20] Nakamura, N. et al. (1983) Mem. NIPR Special Issue 30, 323-331; [21] Patchett, P.J. and Tatsumoto, M. (1980) Nature 288, 571-574.