MINING THE LITERATURE FOR "NEW" DATA: EXPANDING THE APOLLO 14 HIGH-ALUMINA BASALT ISOTOPE DATABASE. C.R. Neal[1], [1]Dept. of Civil Eng. & Geo. Sci., University of Notre Dame, Notre Dame, IN 46556, USA (neal.1@nd.edu).

Introduction: The Apollo 14 high-alumina basalts are known primarily from clasts in breccias (e.g., [1]). They are distinct from most other mare basalts in that they contain >11 wt% Al_2O_3 and were called "high-alumina" by [2]. They are also distinct because they older (3.95-4.33 Ga; [3,4]) than the bulk of the returned mare basalts (3.15-3.89 Ga; e.g., [5]).

It has been demonstrated that the Apollo 14 high-alumina basalts can be divided into three groups on the basis of trace element ratios, with a possible fourth group comprised only of sample 14072 [6]. These groups appear to be also defined on the sparse age data that are available in the literature: Group A >4.2 Ga; Group B = 4-4.15 Ga; Group C <4 Ga. However, the number of samples that have been dated using isochron methods is small. A total of 10 samples that have been analyzed for whole-rock data have also been dated using Rb-Sr isochrons, with two of these being the "large" samples 14053 (Group C) and 14072 [3,4,7,8].

The purpose of this presentation is to present the results of detective work in combing the literature for other Rb-Sr age data for Apollo 14 high-alumina basalts and to demonstrate that there are four groups of basalts at Apollo 14. One major problem is trying to discover if whole-rock chemical data are available in the literature for those samples that have isochron ages

Isotope Data: Rb-Sr isochrons data are available for a further eight Apollo 14 high-alumina basalt samples, but isochron data are only available for 4 of these (Table 1). Placing these within the group classification of [6] is difficult because details regarding whole-rock sample numbers are lacking in the isotope publications and vce versa. In looking at the 14321 genealogy, all but two of the basalt clasts can be related back to 14321,184, which was a large piece subdivided for consortium studies. What is unclear is whether or not the samples analyzed for Rb-Sr have whole-rock data available for them. In fact, only two samples [14321,88(6A) and 14321,478] can be traced to whole-rock analyses on the same sample (refs. [14] and [15], respectively). The question is can the remaining samples for which there are Rb-Sr data be classified into the classification proposed by [6]?

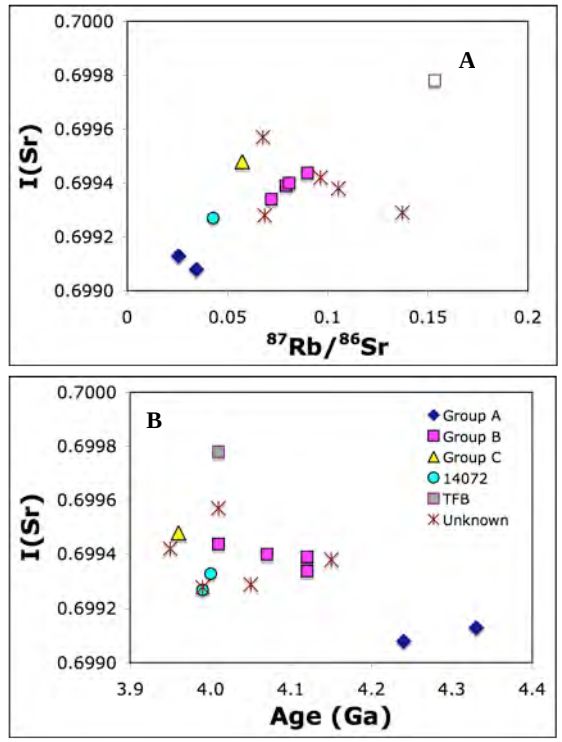

Figure 1: Age and Rb-Sr isotope data for basalts in Table 1.

Classification: The lack of whole-rock data for most of the clasts in Table 1 means that use of trace element ratios for classifying the clasts canniot be used. Figure 1a shows the isotope data for those Apollo 14 high-alumina basalts that have Rb-Sr isochron ages. The "unknown" samples are from Table 1 and the plot suggests that one sample is similar to 14072 [14321,88(6A)], one is similar to the Group C basalt 14053 (14321,184-55), while the remainder ap-

Table 1: Literature Isotope Data for the Apollo 14 high-alumina basalts.

Sample	Rb (ppm)	Sr (ppm)	$^{87}Rb/^{86}Sr$	$(^{87}Sr/^{86}Sr)_P$	2σ	Age (Ga)	2σ	I(Sr)	2σ	Ref.
14321,191-X	3.628	87.76	0.0964	0.70484	6	3.95	0.04	0.69942	4	[3]
14321,184-55	2.33	95.7	0.0678	0.70339	6	4.01	0.12	0.69957	13	[9]
14321,371*	2.571	108.3	0.0686	(0.70322)		3.99	0.14	0.69928	12	[10]
14321,88(4A)	6.25	171.5	0.1054	0.70568	6	4.15	0.10	0.69938	18	[11]
14321,88 (6A)	5.7	120	0.1373	0.70392	5	4.05	0.08	0.69929	13	[12]

*Whole rock composition calculated proportionally from mineral and density fractions.

pear to belong to Group B. If I(Sr) is plotted against isochron age (Fig. 1b), both 14321,88(6A) and 14321,371 appear similar to 14072. On this plot, 14321,184-55 now falls close to the Group B basalts, while 14321,191-X appears to be a Group C basalt.

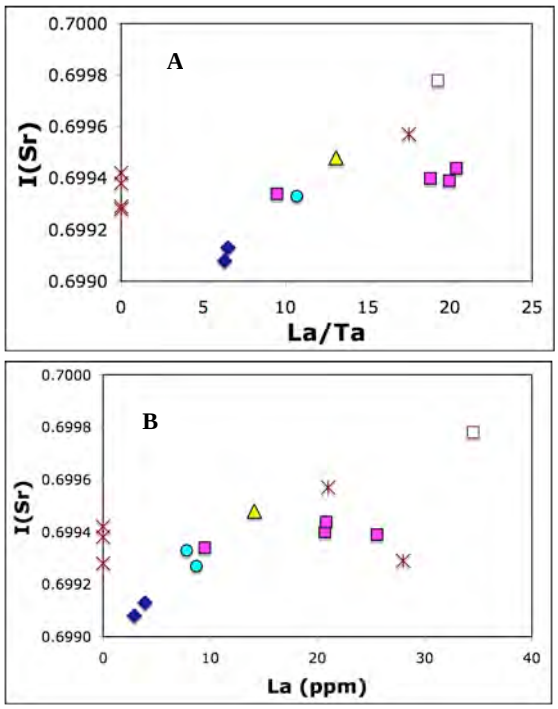

Figure 2: I(Sr)-trace element systematics.

Incorporating trace element data starts to clarify the situation. In Figure 2a, La/Ta is plotted against I(Sr). The "unknown" basalts without La/Ta data are plotted on the y-axis. 14321,184-55 is a Group B basalt on this plot. When I(Sr) is plotted against La (Fig. 2b), 14321,88(6A) also plots close to the Group B basalts. Interestingly in Figure 2, 14321,1394 plots with 14072. Trace element ratios available for this sample (which was not included in the study of [6]) indicate that it is similar to 14072, as are age and Sr isotope data. Using age and I(Sr), it is tentatively concluded that 14321,371 is also similar to 14072 (Fig. 1b). Similarly, 14321,191-X is tentatively classified as a Group C basalt. 14321,88(4A) and 14321,184-55 are both classified as a Group B basalts.

Conclusions: The recognition of other Apollo 14 high-alumina basalts with the geochemical and isotopic signatures similar to 14072 indicates that a fourth group of these basalts is probably represented in the Apollo 14 collection. In keeping with the classification of [6], this would be Group D.

References: [1] Duncan A.R. et al. (1975) *Geochim. Cosmochim. Acta* **39**, 247-260; [2] Ridley W.I. (1975) *Proc. Lunar Sci. Conf.* **6th**, 131-145; [3] Papanastassiou D. & Wasserburg G. (1971) *Earth Planet. Sci. Lett.* **12**, 36-48; [4] Dasch E.J. et al. (1987) *Geochim. Cosmochim. Acta* **51**, 3241-3254; [5] Nyquist L.E. & Shih C-Y. (1992) *Geochim. Cosmomchim. Acta* **56**, 2213-2234; [6] Neal C.R. & Kramer G.Y. (2006) *Amer. Min.* **91**, 1521-1535. [7] Dasch E.J. et al. (1991) *LPS* **XXII**, 275-276; [8] Neal C.R. et al. (2006) *LPS* **XXXVII** #2003; [9] Mark R.K. et al. (1973) *Proc. Lunar Sci. Conf.* **4th**, 1785-1795; [10] Mark R.K. et al. (1975) *Proc. Lunar Sci. Conf.* **6th**, 1501-1507; [11] Compston W. et al. (1971) *Earth Planet. Sci. Lett.* **12**, 55-58; [12] Compston W. et al. (1972) *Proc. Lunar Sci. Conf.* **3rd**, 1487-1501; [13] Mark R.K. et al. (1974) *Proc. Lunar Sci. Conf.* **5th**, 1475-1485; [14] Taylor S.R. et al. (1972) *Proc. Lunar Sci. Conf.* **3rd**, 1231-1249; [15] Lindstrom M.M. et al. (1972) *Proc. Lunar Sci. Conf.* **3rd**, 1201-1214.