^{40}AR-^{39}AR STUDIES OF THE SHOCKED L6 CHONDRITES ALLAN HILLS 78003, YAMATO 74445, AND YAMATO 791384. T. D. Swindle[1,2,3], C. E. Isachsen[3], J. R. Weirich[1,2], and M. Kimura[4]. [1]Lunar and Planetary Laboratory, University of Arizona, Tucson AZ 85721-0092 USA, Department of Planetary Sciences, University of Arizona, Tucson AZ 85721-0092 USA, [3]Department of Geosciences, University of Arizona, Tucson AZ 85721-0047 USA, [4]Faculty of Science, Ibaraki University, Mito 310-8512 Japan.

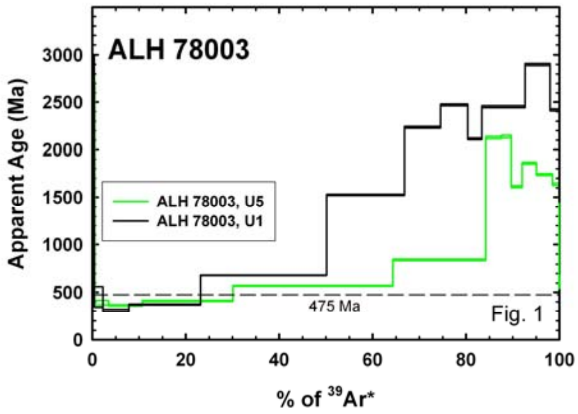
Introduction: Impact cratering has been the dominant geological process on chondritic asteroids for more than 4 Ga. However, heavily shocked chondrites are relatively rare, and hence are uniquely valuable for trying to decipher the impact history of their parent bodies. In this abstract, we report ^{40}Ar-^{39}Ar (a variant of K-Ar) analyses of three heavily shocked L6 chondrites. These data will then be combined with petrological studies to set constraints on the time-temperature history of the L chondrite asteroid.

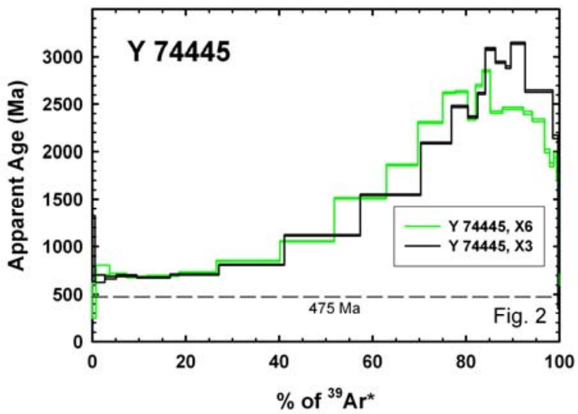
Methods: Multiple samples of each meteorite (~5-10 mg per sample), with varying amounts of vein material compared to host material, were irradiated at the Cd-lined in-core irradiation tube (CLICIT) at the Oregon State University reactor, then analyzed in the VG5400 mass spectrometer at the University of Arizona Noble Gas Laboratory using stepwise heating extraction with a resistance-heated furnace. Because an extended down-time caused by instrumental problems, the time elapsed after the irradiation was long enough that radioactive Ca-produced ^{37}Ar would have decayed to unacceptable levels, so the samples were irradiated a second time, with the samples and the (same) irradiation standards in as close to the same geometric configuration as possible. While this could lead to slightly larger uncertainties in reactor production rates, it should not lead to any systematic effects. Two samples from each meteorite are presented here. More will be analyzed.

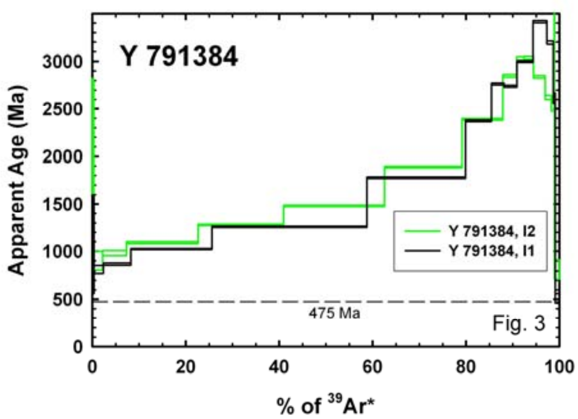
Results: Data were corrected for decay and reactor interferences. Corrections for spallation production and trapped (atmospheric, primordial and/or redistributed) were attempted in several ways, as will be discussed below. The details of the apparent ages, and the partial plateaus) obtained are sensitive to the details of the data reduction, but the basic chronological results are not. Plateau plots of apparent age vs. percentage of ^{39}Ar (i.e., potassium) are shown for each meteorite in Figs. 1-3 and summarized in Table 1. Normally, we conclude that we have evidence for an event at a specific time only if we see the same apparent age as a minimum or a multi-step plateau in multiple samples.

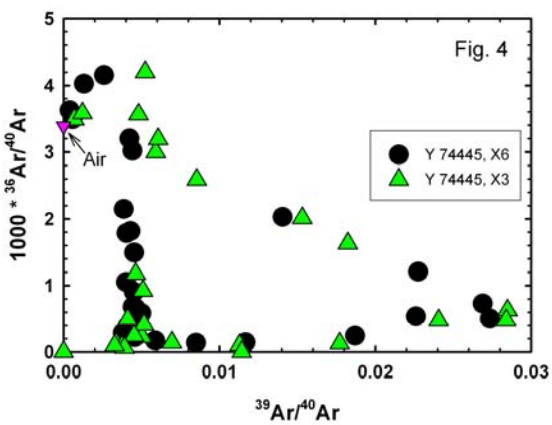
Interpretation of chronology: Since these are L chondrites, and most L chondrites' K-Ar systems were apparently at least partially reset in an event that disrupted the L chondrite parent body at ~475 Ma [1,2], we expected to see the signature of that event, but evidence for it is slim. In all cases, it is apparent that there has been partial resetting in some event in the last 1200 Ma. One split of Allan Hills (ALH) 78003 gives a partial plateau at ~470 Ma if we assume that the trapped component is terrestrial atmosphere, but this is not consistent with an isochron plot (Fig. 4). For both splits of Yamato (Y) 791384, we can find a trapped ^{40}Ar/^{36}Ar ratio that will yield a two-step "plateau", but the values for the trapped ratio and the apparent age differ for the two samples, so the data only gives a maximum age of ~850 Ma. The most intriguing sample is Yamato (Y) 74445. Both samples give partial plateaus of at least three steps, making up ~20% of the ^{39}Ar and giving ages of 700-775 Ma (depending on the details of the data reduction). Neither has any steps with younger apparent ages. Normally, we would interpret this as a resetting event at 700-775 Ma. In fact, similar data for the shocked L4 Cat Mountain was interpreted as an event at ~800 Ma [3] and an apparent high-temperature isochron for Northwest Africa 091 [4] also gives ~800Ma. Whether there was an earlier L chondrite event [3] or whether several samples were partially reset in the 475 Ma event in a way that mimics an 700-800 Ma event remains to be seen. Although for some L chondrites it is possible to find one or two trapped ^{40}Ar/^{36}Ar ratios that lead to uniform apparent ages for virtually all extractions [2.4], that is not possible for any of these samples (Fig. 4).

Implications for data reduction: Irradiation at CLICIT is used by several laboratories for ^{40}Ar-^{39}Ar experiments because the Cd-shielding reduces the flux of thermal neutrons, which can produce ^{38}Ar from ^{37}Cl. For extraterrestrial samples, ^{38}Ar is the most sensitive indicator of cosmic ray irradiation, but production from Cl makes such a correction impossible. One alternative is to use the maximum ^{37}Ar/^{36}Ar ratio, since ^{37}Ar is produced in the reactor by Ca, and most spallation Ar in chondrites is produced from Ca. If there is an extraction with no trapped ^{36}Ar, then the ^{37}Ar/^{36}Ar ratio in that extraction should be the highest seen in the experiment, and that value can then be used to correct the ^{36}Ar for spallation production [5-7]. If the Cd-shielding has eliminated Cl activation, and if the maximum-^{37}Ar/^{36}Ar technique works, the three-isotope plot shown in Fig. 5 should yield a straight line, a mixture between a pure trapped component with ^{37}Ar/^{36}Ar = 0 and ^{38}Ar/^{36}Ar ≈0.188 (pink point), and a pure spallation component with ^{38}Ar/^{36}Ar ≈1.5 (dashed line) and the maximum ^{37}Ar/^{36}Ar value. Clearly this is not the









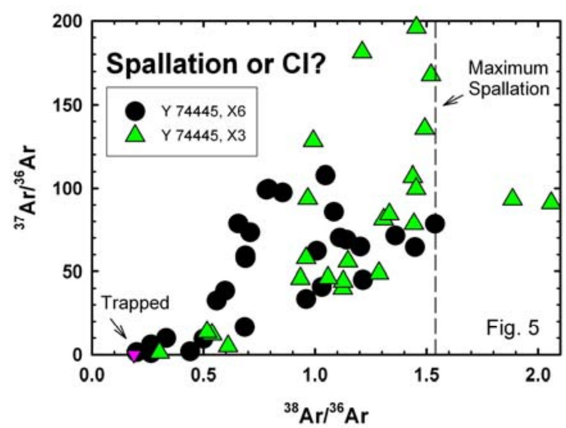
case. The existence of $^{38}Ar/^{36}Ar$ values >1.5 suggests that we do have some Cl activation. In part, this could be a result of Cl contamination of Antarctic meteorites (suggested by [8,9], but see [5]). In addition, reverse isochron plots (e.g., Fig. 4) show a few low-temperature points that may be collinear, but many higher temperature extractions form a roughly vertical array, though the fit of any line through them is poor.

Further work: Next steps include analysis of more splits, but also integration with petrographic and other results [10-12].

Table 1: Summary of partial plateaus

Sample	Plateau			Summed Age (Ma)
	#	% ^{39}Ar	Age (Ma)	
ALH 78003				
U1 (H)	3	22.7	361±32	1341±40
U5 (H+M)	3	29.6	396±10	786±22
Y 74445				
X3 (M)	5	26.5	693±13	1443±29
X6 (M+H)	5	25.8	715±9	1448±33
Y 791384				
I1 (H)	2	7.9	850±22	1586±33
I2 (H)	2	7.0	961±55	1642±57

M, H = Melt or Host (first one listed dominates split); # = Number of points; % ^{39}Ar = Percentage of total ^{39}Ar involved in plateau; Summed Age = Age calculated from total ^{39}Ar and radiogenic ^{40}Ar in sample.



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