

LUNAR IMPACT HISTORIES DEDUCED FROM Ar-Ar.

T. D. Swindle¹, D. A. Kring¹, B. A. Cohen², J. W. Delano³ and N. E. B. Zellner⁴. ¹Lunar and Planetary Laboratory, U. of Arizona, Tucson AZ. E-mail: tswindle@u.arizona.edu. ²Institute of Meteoritics, U. of New Mexico, Albuquerque NM. ³University at Albany (SUNY), Albany NY. ⁴Albion College, Albion MI.

Four data sets have been produced from impact-generated lunar materials in the last 15 years. These four data sets, all based on Ar-Ar dating, do not at first appear to be telling the same story, but may not be inconsistent with one another, because they all sample different material. To understand our current knowledge of the Moon's impact history, one needs to compare these data sets with each other, and with other information available.

These data sets include (A) carefully selected impact melt rocks from different Apollo missions [1-3], (B) crystallized impact melt clasts from lunar meteorites, with chemical compositions suggesting origins far from the Near Side Apollo sites, [4-6], (C) impact glasses of unknown chemistry from Apollo 14 soil [7], and (D) impact glasses from Apollo 14, 16, and 17, selected for unusual (for their location) chemistry [8-10]. Sets (B) and (D) were obtained at Arizona. In addition, several groups continue to obtain ages on various other lunar samples. Many impact samples have "lunar cataclysm" ages of ~3.9 Ga. A few have older ages [11], though not enough to suggest a heavy bombardment earlier.

One question that has appeared is the meaning of younger ages (<3.8 Ga), which are common among crystallized impact melts and among impact glasses culled from the lunar soil. Each of the systematic data sets obtained has selected samples with specific criteria, testing specific ideas. The Apollo samples of (A) were expected to be Near Side basin samples, but the lunar meteorite impact melts (B) were expected to come from large (though not necessarily basin-sized) impacts, perhaps distant from the Near Side, the glasses of (C) were selected randomly, and the glasses of (D) were selected to sample impacts with specific chemistries distinct from the landing sites. Neither set of glasses was selected with the cataclysm in mind. In fact, basin-sized impacts that define the cataclysm may not be effective at producing glass, which requires extremely rapid cooling (cold surroundings).

Although the present sample sets have answered the first-order questions (~3.9 Ga impact ages are common, older ones rare), the second-order questions (how long was the cataclysm, how low was the impact rate before it) remain open, and will require large data sets of well-characterized samples to properly address.

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