ARGON AGES OF SOLID-STATE MASKELYNITE: WHAT DO THE AGES MEAN?
S. J. Jaret1,2, Y. Cai2, S. R. Hemming2, E. T. Rasbury1, F. D. Winslow1, L. M. Thompson3, and T. D. Glotch1
1Department of Geosciences, Stony Brook University 2Division of Geochemistry, Lamont-Doherty Earth Observatory 3Planetary and Space Science Centre, University of New Brunswick.
Steven.jaret@stonybrook.edu.

Introduction: Impact cratering is an important planetary process, particularly during the earliest history of the Solar System. The timing of impact events can best be constrained by ages of impact melt rocks [1]. Unfortunately, pristine impact melt rocks are often unpreserved or lacking and many extraterrestrial samples only contain shocked, unmelted minerals. These shocked samples have had a violent and energetic formation history, and therefore it has been suggested that shocked samples can be used to date impact events, specifically using easily reset isotopic systems, such as K-Ar. However, some details of how argon behaves during natural shock conditions remain unclear [2-3].

To test this, we conducted 40Ar/39Ar heating experiments on impact melt and shocked, unmelted maskelynite from the Manicouagan impact structure, Canada. This was compared to previous K-Ar analysis of the target Grenvillian rocks [4]. Manicouagan is an impact into mixed Grenvillian gneisses, including anorthositic rocks, exposed within the central uplift. Manicouagan is a well-established planetary analog, particularly useful for comparisons with shocked anorthorsites of the lunar highlands.

Results: Single step 40Ar/39Ar ages of impact melt yield an isochron age of 215.6 ± 0.4 Ma, with a slightly elevated initial 40Ar/36Ar of 305 ±2. Single step 40Ar/39Ar of single grain maskelynite, show significant scatter, and yield ages between 450 and 600 Ma. Step-heating experiments on maskelynite did not yield a plateau age, with individual steps ranging from 330 to 590 Ma.

Discussion and Conclusions: Impact melt samples yield a well-behaved isochron age that is consistent with the U-Pb zircon age [5] and the (U-Th)/He zircon age [6] of the impact melt. This supports previous claims that impact melt is the most reliable sample for determining impact ages.

The maskelynite samples are much more difficult to interpret. Interestingly, no steps yield ages consistent with the impact age or the target age. The samples do show evidence of partial resetting, however, without independent knowledge of the impact age, determining the timing of partial resetting from the maskelynite data alone is difficult.


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