A COMPARISON OF ARGON AGES OF MANICOUAGAN IMPACT MELT AND SOLID-STATE MASKELYNITE

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Introduction: Determining the evolution of planetary surfaces relies heavily on radiometric age constraints. For heavily cratered bodies, such as the Moon, Mars, Mercury, and asteroids, one potential complication is the effect of shock metamorphism on measured ages. In most cases impact melt rocks yield the most precise impact ages [1]. Unfortunately, pristine impact melt rocks are often unpreserved or lacking and many terrestrial and extraterrestrial samples only contain shocked, unmelted minerals. Because of the susceptibility of Ar loss during heating events, the K-Ar system has been used for determining the timing of impact in lunar impactites. However, some details of how argon behaves during natural shock conditions remain unclear [2-3]. This is particularly important for martian shergottites where there has been considerable debate over how to interpret argon ages obtained from maskelynite [4].

To test this, we conducted $^{40}Ar/^{39}Ar$ 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 [5]. Manicouagan is an impact into mixed Grenville age gneisses, including anorthositic rocks, exposed within the central uplift. Mani-couagan is a well-established planetary analog, particularly useful for comparisons with anorthorsites of the lunar highlands. Additionally maskelynite of labradorite composition is an analog for martian shergottite maskelynite.

Results: Single step $^{40}Ar/^{39}Ar$ ages of impact melt yield an isochron age of 215.6 ± 0.4 Ma, with a slightly elevated initial $^{40}Ar/^{36}Ar$ of 305 ±2. Single step $^{40}Ar/^{39}Ar$ 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 consisted with the U-Pb zircon age [6] and the (U-Th)/He zircon age [7] 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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