A robust in-situ phosphate U-Pb age for Martian meteorite Los Angeles

C.R.M. MCFARLANE[1], J. G. SPRAY[1], B. WILSON[1]

[1]University of New Brunswick, Department of Earth Sciences, 2 Bailey Drive, Fredericton NB (crmm@unb.ca; jgs@unb.ca; bennett.wilson@unb.ca)

Martian meteorite Los Angeles (LA-1) is a shocked (>35GPa) differentiated basalt containing ubiquitous chlorapatite and merrillite. Previous studies have used conventional Rb/Sr and Sm/Nd dating using major mineral phases (Nyquist et al. 2001) and U-Th/He dating of phosphates (Min et al. 2004) to obtain a crystallization age of 170 ± 8 Ma and an ejection age of 3.28 ± 0.15 Ma. Partial to complete diffusive loss of He from merrillite during impact and ejection also constrains initial shock-induced temperatures to 400-500˚C. Based on experimental constraints and empirical observations in terrestrial systems, this shock temperature estimate is expected to be well below the closure temparture for Pb-diffusion in rapidly cooled, large-radii Ca-phosphate grains.

A dataset of 118 in-situ measurements of U-Pb isotopic data on large (locally >200 µm wide) merrilite (n=100) and chlorapatite (n=18) were collected on 5 polished slabs of LA-1 during a single 2-hr LA ICP-MS session at the University of New Brunswick, Canada. The phosphates were ablated with an 82µm crater and externally standardized using the 474 Ma MAD apatite. An in-house apatite from Phalaborwa, SA, produced an age of 2051 ± 10 Ma confirming the accuracy of calibration and data reduction.

The raw dataset yielded a lower-intercept age of 172 ± 34 Ma (MSWD of 10.8). This array was refined to a robust (MSWD = 1.2) lower intercept age of 167 ± 13 Ma and a common-Pb intercept of 0.9859 ± 0.0035. Merrillite and chlorapatite host similar levels of U (1-5 ppm) whereas merrillite host significantly higher Th (up to 35 ppm).

This in-situ merrillite-chlorapatite U-Pb age indicates that Pb-diffusion was insignificant over the temperatures, timescales, and shock pressures experienced during lofting from Mars. Although a better understanding of conditions for Pb retention during shock metamorphism is still required, this study demonstrates the potential for robust extraterrestrial phosphate U-Pb dating using LA ICP-MS.

Nyquist L. E., et al. (2000) Rubidium-strontium age of Los Angeles shergottite. *Meteor. Planet. Sci.* **35,** A121–A122

Min, K., et al. (2004) Age and temperature of shock metamorphism of Martian meteorite Los Angeles from (U-Th)/He thermochronometry. *Geology*, 32, 8, 677-680.