IN-SITU (U-TH)/HE DATING OF MARTIAN APATITES: LOW-TEMPERATURE THERMAL PROCESSES IN THE LATE AMAZONIAN MARTIAN REGOLITH AS RECORDED BY NWA 7034

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Apatite is a common accessory mineral in terrestrial rocks and has a low (~75˚C) closure temperature to He loss[1]. As such, the (U-Th)/He thermochronometer has become a widely used dating technique to constrain low temperature cooling histories. Apatite is documented in many meteoritic and lunar samples and is common in many Martian lithologies[2]. Results are commonly interpreted to represent the timing of shock metamorphism related to impacts, which often correlates with CRE ages[2]. NWA 7034 represents the bulk of Martian regolith and documents events on the Martian surface spanning 4 Ga[3]. NWA 7034 contains upwards of 4 wt.% apatite as mineral fragments and as accessory phases in lithic clasts[4]. These apatites have been previously analyzed geochronologically via U-Pb apatite and isotopically via δD and $\delta^{37}Cl$[5,6]. At present, (U-Th)/He dating of NWA 7034 has been restricted to bulk rock analyses[3,7,8,9]. This whole-rock approach relies on assumptions that the He, and its parent isotopes, are evenly distributed throughout the sample and that resetting of the WR-He thermochronometer is universal throughout the sample in response to the thermal pulse associated with an impact. These studies have yielded widely dispersed datasets, putting some of those assumptions into question. Here we utilize the laser ablation double-dating (LADD) technique on individual apatites present within polished slabs of NWA 7034. This targeted approach allows us to acquire (U-Th)/He ages, U-Pb ages, and trace element information within a petrological framework. The (U-Th)/He ages will provide additional constraints on the low temperature history of NWA7034.

References: [1] Zeitler et al. 1987 GCA, [2] Min 2005 Rev. Min. Geochem; [3] Cassata et al. 2018, SciAdv; [4] Agee et al. 2013 Sci; [5] Hu et al. 2019 MAPS; [6] Davidson et al. 2020 EPSL; [7] Cartwright et al. 2014 EPSL; [8] Lindsay et al. 2021 MAPS; [9] Stephenson et al. 2017 MAPS.