In-situ U-Pb dating of baddeleyite in Shergotty and a chassignite: Implications for Martian chronology

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Introduction

There is a long-standing debate on the crystallization ages of SNC meteorites, which are considered to be of Martian origin. As to shergottites, young ages of 165–475 Ma have been reported using various radiometric methods [1]. However, Bouvier et al. (2005, 2008) [2, 3] reported old Pb-Pb ages (~4.1 Ga) for basaltic shergottites Shergotty and Zagami, as well as young Rb-Sr, Sm-Nd and Lu-Hf ages (150–180 Ma) for the same meteorites. They concluded that the old ages are their crystallization ages, and the young ages correspond to the timing of shock metamorphism or aqueous alteration. Two different ages were reported for the chassignite NWA 2737. Misawa et al. (2005) [4] reported a whole rock Sm-Nd age of NWA 2737 chassignite as ~1.4 Ga, while Bogard et al. (2008) [5] obtained an ^{40}Ar-^{39}Ar age of 160–190 Ma for the same meteorite. We conducted *in-situ* U-Pb dating of baddeleyite (ZrO_2) in these meteorites using SHRIMP-II and -RG in order to clarify the crystallization ages of Shergotty and NWA 2737 chassignite.

Results and Discussions

We found seven baddeleyite in Shergotty and one baddeleyite in NWA 2737, which can be used for SHRIMP analyses. Before SHRIMP analyses, each baddeleyite was carefully characterized by using FE-SEM, micro-Raman spectrometry and EPMA. The size of the baddeleyite grains range from 3×5 μm to 11×24μm. Baddeleyite usually occurs with ilmenite, titanomagnetite and pyrrhotite.

SHRIMP U-Pb measurements of the seven baddeleyite in Shergotty revealed three clusters of data points on the Concordia diagram, corresponding to ages of ~230, ~400 and older than 3000 Ma, respectively. This result could indicate an old crystallization age of this rock (in excess of 3000 Ma) and recent partial age resetting due to shock-induced melting.

Three U-Pb measurements on the one baddeleyite in NWA 2737 chassignite revealed a U-Pb age of 1640 ± 70 Ma. This is consistent with, but slightly older, than the Sm-Nd age of 1420 ± 70 Ma reported by [4]. It suggests that NWA 2737 chassignite crystallized at 1.4–1.6 Ga and experienced a thermal event, probably by impact, at 160–190 Ma.

For a better understanding of the origin and history of these baddeleyite, FIB-TEM studies are in progress.

[1] Nyquist *et al.* (2001) *Chronology and Evolution of Mars* 96, 105-164. [2] Bouvier *et al.* (2005) *EPSL* 240, 221-233. [3] Bouvier *et al.* (2008) *EPSL* 266, 105-124. [4] Misawa *et al. MAPS* 40, A104. [5] Bogard and Garrison (2008) *EPSL* 273, 386-392.