Zircon-Baddeleyite Age Relationships in a Polymict Lunar Breccia

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Understanding the behavior of the U-Pb system in zircon (Zr) and baddeleyite (Bd) in lunar rocks becomes increasingly important for unravelling the late bombardment history of the Moon. Here, Pb-Pb ages (typical 2 sd = 24 Ma) and the formation history of < 20 µm Zr and Bd grains in the polymict plagioclase rich impactite 67915 (76, ,84) from the Imbrian Descartes Formation are discussed to provide a better understanding of the response of Zr and Bd in lunar breccias to impact-related heating.

67915 comprises a heterogeneous clast population of different sizes and composition (anorthosites, noritic anorthosites, troctolites, sodic ferrogabbro) in a fine-grained comminuted plagioclase rich matrix. Most U-Pb ages of Zr appear to be concordant while few Bd and Zr are reverse discordant. Different textures of Zr and Bd in this sample can be distinguished: (1) Subhedral Bd intergrown with ilmenite (Ilm) in the matrix yield the oldest ages (4.27-4.24 Ga, n = 3) either reflecting growth of Bd during cooling of magmatic ilmenite or exsolution of Bd from Ilm after impact metamorphism. (2) Similar ages (4.24 Ga, n=3) are shown by Bd and Zr associated with SiO_2-K-feldspar (Kf) bearing clasts, in which Bd is partially replaced by Zr. Local melting of SiO_2 due to shock heating resulted in these replacement textures. (3) Matrix and Kf±SiO_2 bearing clasts also contain subhedral Zr and Bd (without Ilm) showing identical ages (4.24-4.23 Ga. n=7). (4) Somewhat younger, poikilitic Zr (4.23-4.20 Ga, n=9), commonly occurs in the matrix and in SiO_2-Kf bearing impact melt clasts containing Fe-Ni metal. (5) A granular zircon aggregate in the matrix (4.20 Ga, n=1) contains tiny relic Bd (?) inclusions. (6) A rare poikilitic Bd-Ilm intergrowth in the matrix yielded a date with large uncertainty that is difficult to interpret (3.8±0.6 Ga).

Our data on 67915 are consistent with impact-related heating events at ≥4.27 Ga, 4.24 Ga and perhaps 4.20 Ga. The results indicate that the U-Pb systems in Zr and Bd were not disturbed by the 3.9 Ga old Imbrium impact.