MICROSTRUCTURES AND U-PB CHRONOLOGY OF ZIRCONS IN THE REGOLITHIC BRECCIA OF THE LUNAR METEORITE SAYH AL UHAYMIR 169

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Introduction: Lunar zircon U-Pb ages distribute from ~3.9 Ga to ~4.4 Ga, with multiple peaks mainly at ~ 4.34, ~4.20 and ~4.00 Ga, indicative of several intensive magmatic activities at these ages [e.g. 1-4]. However, shock features of zircon grains complicate the interpretation of the U-Pb ages. Based on shock-induced alteration of zircons, several impact events prior to the Late Heavy Bombardment (LHB) have been identified [e.g. 3-4]. Sayh al Uhaymir (SaU) 169 is the most KREEP-rich lunar meteorite, consisting mainly of impact melt breccia and two stages of regolith breccia [5]. Both the impact melt breccia and the regolith breccia contain abundant zircons, which could preserve the magmatic and impacting history of the Moon.

Samples and Experiments: Four polished sections of SaU 169 regolith breccia were analyzed in this study. Detailed textures and petrographic settings of zircon grains were observed with field emission SEM. Crystallographic features of zircon were determined with Raman Spectrometer. Trace element mapping and U-Pb dating were carried out with CAMECA NanoSIMS 50L.

Results and Discussion: More than 40 zircons were identified with various morphologies and petrographic settings. High spatial resolution U-Pb dating was carried out on different areas of large grains of zircon and those with different settings. All zircon U-Pb ages range from ~3.86 Ga to ~4.37 Ga with three peaks at ~3.9 Ga, ~4.2Ga and ~4.3Ga, respectively.

The ages at ~3.9 Ga probably dated both magmatism and impact events, based on the following petrographic features: (1) Zircon assemblages with ~120 ° triple junctions textures and ZrO_2 remnants likely produced by shock-induced thermal metamorphism [e.g. 4, 6-7]. Their U-Pb ages of 3.92 Ga probably dated a severe impact event. (2) A subset of small zircons in a shock-induced highly evolved clast display a core-rim texture with a U, Y-rich core and a U, Y-poor rim. The U, Y-poor rims were probably crystallized from the shock-induced melt and hence their U-Pb ages of 3.95 Ga dated the impact event. The U, Y-rich cores were classified as mineral clasts due to the loss of connection with their source rocks. (3) A few zircons as a congenetic minerals in three alkali suite clasts with U-Pb ages of 3.87 Ga, 3.91 Ga and 3.93 Ga, probably dated the alkali magmatic activities. The shock age of ~3.9 Ga is similar to that of LHB event, which could trigger a contemporary magmatic activity. This is consistent with the previous study of the impact melt breccia of SaU 169 [8].

Zircons with ages of ~4.2 Ga are mineral clasts without obvious shock-induced features. Therefore these ages possibly represent a magmatic activity, which is consistent with previous reports [e.g. 1-4].

The ages around ~4.3 Ga could likely reflect both magmatism and impact events, according to the following petrographic characters: (1) Measurements on some zircon fragments that have sector or oscillatory zoning or are homogeneous yielded ages from 4.29 Ga to 4.37 Ga. Thus the ages are probably corresponding to some magmatic activities in early history of the Moon. (2) A zircon grain occurred in a shocked felsic clast displays a fine-grained granular texture in most areas. Raman spectra collected in this texture area reflected dissociation of zircon which indicates a high-temperature shock-induced process. U-Pb isotopic system has been reset during this process [e.g. 4, 6-7]. Measurements on this area yielded an age of ~4.34 Ga which probably records a pre-Imbrium impact event. This is consistent with the previous study of Apollo samples [e.g. 4, 9].

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