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NanoSIMS Pb/Pb dating of tranquillityite in high-Ti lunar basalts: Implications for the chronology of high-Ti volcanism on the Moon

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Abstract

In this study, we carried out Pb/Pb dating of tranquillityite in high-Ti mare basalts 10044, 75055, and 74255, using a Cameca NanoSIMS 50 at a spatial resolution of ~3 µm. The analyses yielded $^{207}Pb/^{206}Pb$ dates of 3722 ± 11 Ma for sample 10044, 3772 ± 9 Ma for sample 75055, and 3739 ± 10 Ma for sample 74255, at 95% confidence level. These dates are consistent with previously determined crystallization and emplacement ages of these samples using different radiogenic systems. These high-precision ages allow refinement of the timing of some of the high-Ti basaltic volcanism on the Moon. Crystallization ages of three different high-Ti basalt units, integrating these new Pb/Pb ages with previous Rb-Sr and Sm-Nd age determinations, are consistent with previous estimates but associated with uncertainties 3 to 5 times lower. In addition, the data obtained in this study confirm that tranquillityite contains very low amounts of initial common Pb and has a high-Pb ionization efficiency, making it an excellent candidate for Pb/Pb dating by ion microprobe. The higher spatial resolution afforded by NanoSIMS 50 and the recent discovery of tranquillityite in several terrestrial mafic rocks opens up a new area of research allowing an independent and rapid age dating of basaltic rocks in polished sections.

Keywords: Ion probe, high-Ti mare basalts, NanoSIMS 50, Pb/Pb dating, tranquillityite