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Variability in Composition of 2.0-Ga Lunar Basalts at Chang'e-5 Landing Site

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The China mission Chang'e-5 (CE-5) successfully returned 1.731Kg of lunar soil from the north-eastern Oceanus Procellarum region. The samples were reported to have an age of approximately 2.0 Ga, however, there is ongoing debate as to whether they should be classified as low-Ti or high-Ti mare basalt types (Che et al., 2021; Li et al., 2021; Tian et al., 2021). In this study, we developed a low sample consumption method to determine the mineralogical, elemental composition, and age of lunar rock samples, and applied it to the CE-5 mare basalt clast (#CE5C0000YJYX048). Our results showed that the poikilitic clast has a bulk TiO_2 content of 3.78±1.01 wt%, which is representative of a low-Ti basalt end member in the lunar samples (Figure 1). Additionally, the dominant pyroxene mineral in the clast is pigeonite, which differs from other reported CE-5 samples where augite is the dominant mineral. Despite these differences, in situ SIMS dating showed a Pb-Pb age of 2040±22 Ma for the fragment, aligning with the ages reported in other CE-5 samples studied by Che et al. (2021) at 1,963 ±57 Ma and Li et al. (2021) at 2,030±4 Ma (Figure 2). This overlap rules out the possibility of a fundamentally different magmatic origin for this clast compared to other CE-5 lunar basalts. Assuming that the Pb-Pb ages correspond to a single lunar basaltic magma eruption, the estimated age of that event can be obtained by computing the error-weighted average of the three ages, yields 2030±15 Ma. The chemical and age data suggest that the lunar soil samples returned by the CE-5 mission are a heterogeneous representation of the basalts, characterized by low-intermediate TiO_2 levels and possible contributions from small volcanic and/or impact sources at the landing site.

References

Che et al. (2021). Age and composition of young basalts on the moon, measured from samples returned by Chang'E-5. Science (374), 887–90.

Li et al (2021). Two billion-year-old volcanisms on the Moon from Chang'E-5 basalts. Nature (600), 54–58.

Tian et al. (2021). Non-KREEP origin for Chang'E-5 basalts in the Procellarum KREEP Terrane. Nature (600), 59–63.

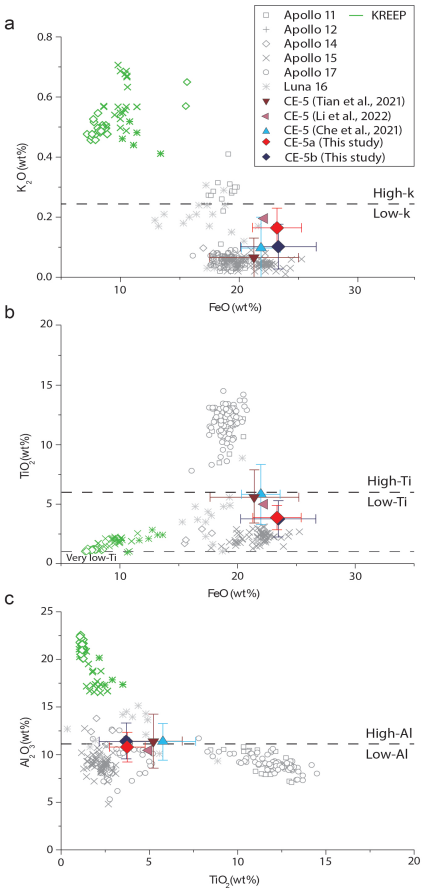

Figure 1. Chang'e-5 mare basalts diagrams of the estimated bulk composition. CE-5a contains the results from the bulk composition calculated by using the vol% of minerals from ImagJ software and CE-5b following Tian et al. (2021) approach. The Apollo and Luna basalts data are from Clive Neal's Mare Basalts Database (https://www3.nd.edu/~cneal/Lunar-L/).

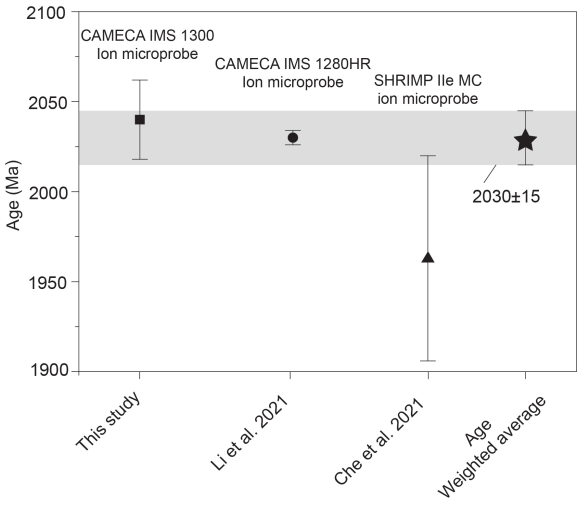

Figure 2. Comparison of Chang'e-5 basalts clast Pb-Pb ages from different studies.