PB-PB AGE OF HIGH-AL BASALT NORTHWEST AFRICA 4898

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Introduction: High-Al basalt is among the oldest lunar basalts found to date. The oldest sample, collected during the Apollo 14 mission, has an age of approximately 4.3 Ga, while the youngest sample from the Apollo 12 collection has an age of 3.2 Ga [1]. Therefore, high-Al volcanism has extended from the pre-mare to mare regime on the Moon, providing insights into the transformation of the lunar igneous environment. Northwest Africa (NWA) 4898 is currently the only high-Al basaltic meteorite discovered. In our previous work, we utilized the crystal size distribution method to demonstrate that NWA 4898 originated from an endogenous igneous process rather than formed by an exogenous impact event [2]. Mineralogical and mineral trace element composition analyses showed that it has a similar composition to Apollo 14 Group A basalt but did not derive from the same mantle source [3]. The preliminary chronological investigation of this meteorite yielded an Rb-Sr age of 3578 ± 40 Ma [4] and an Ar-Ar age of 3536 ± 20 Ma [5]. However, the credibility of these ages has been compromised by terrestrial contamination and shock alteration [3,4]. In this study, we report the Pb-Pb age of NWA 4898, analyzed using the SIMS technique.

Result and Discussion: The Pb-Pb data set falls within the triangular space defined by three Pb components, including initial, radiogenic, and terrestrial Pb. However, the majority of these data (17/22) align along the tie line between the latter two components, indicating significant terrestrial contamination. If only these data are considered, an age of 3790 ± 8 Ma (MSWD = 1.02, 95% confidence) would be obtained. This age represents the maximum estimation of the crystallization age of NWA 4898, as the potential minor initial lunar Pb is not involved in the age calculation. We also calculated the weighted average Pb-Pb age using the three data points with the least common Pb. By considering terrestrial Pb and the most radioactive lunar initial Pb as end members of the common Pb, the calculated ages are 3787 ± 42 Ma and 3796 ± 35 Ma, respectively. The ages should closely approximate the true crystallization age since the contribution from common Pb, including both initial and terrestrial Pb, is less than 1%. Therefore, we suggest that NWA 4898 likely crystallized around 3790 Ma, significantly older than previous estimations. We propose that the younger Ar-Ar age of NWA 4898 is biased due to terrestrial alteration and the presence of impact melt [3]. Similarly, the Rb-Sr isochron age, which is constrained by only two data points, has also been influenced by terrestrial alteration.

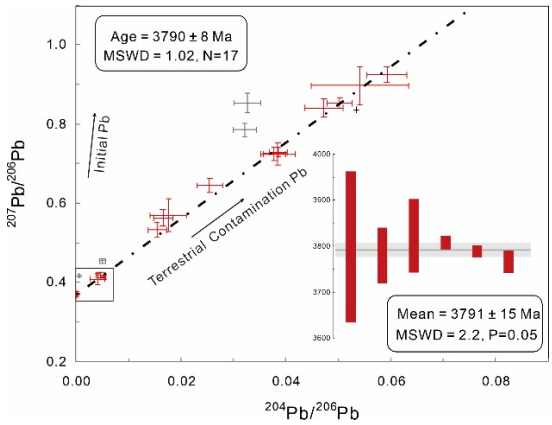

Figure 1. The Pb-Pb age of NWA 4898.

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