CHRONOLOGY OF THE UNIQUE ANGRITE NORTHWEST AFRICA 10463

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Introduction: Angrites are a group of basaltic achondrite meteorites which play an important role in establishing the chronology of planetesimal formation and differentiation in the early Solar System. Not only do they record some of the earliest evidence of volcanic activity in the Solar System [e.g. 1,2], members of the angrite group have been used as reference points for anchoring short-lived chronometers like ^{26}Al-^{26}Mg (half-life ~0.717 Myr) to absolute ^{207}Pb-^{206}Pb dates. They can thus be used to evaluate the degree of homogeneity of ^{26}Al within the protoplanetary disk and the validity of using the ^{26}Al-^{26}Mg system as a chronometer [3].

Angrites are subdivided according to their petrology into the (quenched) volcanic angrites (~ 4564 Ma) and the (coarse-grained) plutonic angrites (~4557 Ma) [1,4]. Northwest Africa (NWA) 10463 represents a new type of cumulative angrite. Its texture is similar to those of plutonic angrites, however, the presence of ~30% olivine as well as chemical zoning and exsolution lamellae in some olivines suggest a different petrogenesis [5]. In order to constrain its formation age and the evolution of the angrite parent body, we selected the ^{207}Pb-^{206}Pb and ^{26}Al-^{26}Mg radiogenic systems in NWA 10463.

Sample and Methods: Pyroxene, olivine and plagioclase mineral separates were dissolved and underwent ion-exchange chromatography at Western before their Mg isotope composition were determined by multi-collector -ICP-MS at FAU. For Pb isotopes, both a hand-picked pyroxene fraction and a whole-rock fraction were leached in progressively stronger acids, before Pb was separated from the dissolved leachates and residues by ion-exchange chromatography at Western [6]. The Pb isotope compositions were determined using a Tl-doping method and standard-sample bracketing by MC-ICP-MS at UCA. Trace element abundances were determined by qICP-MS at Western.

Results: Blank-corrected ^{206}Pb/^{204}Pb ratios of the pyroxene leachates range from 37.9 to 2658, while the leachates of the bulk fraction range from 39.6 to 216.7. A York regression (Model 1: Isoplot 4.15 [7]) of the most-radiogenic leachates (W7 and W8) from both fractions, as well as the Px residue, results in an absolute age of 4560.25 ± 0.18 Ma (MSWD = 0.36), calculated using the average ^{238}U/^{235}U of plutonic angrites (^{238}U/^{235}U = 137.771), as reported by [8]. Magnesium isotope data of olivine, pyroxene and plagioclase fractions of NWA 10463 do not exhibit any resolvable ^{26}Mg excesses as a product of the decay of ^{26}Al. Normalised rare-earth element abundances show less enrichment in LREE compared to HREE with $(La/Yb)_n$ = 0.5 and $(La)_n$ = 2.5.

Discussion: The calculated Pb-Pb age of 4560.25 ± 0.18 Ma is consistent with formation of NWA 10463 as an intermediate sample between the younger plutonic angrites and the older volcanic angrites. It matches within errors reported U-corrected Pb-Pb and model Hf-W ages for the NWA 6291 and NWA 2999 [8,9], which are two paired plutonic angrites with unusually high abundances of metal, likely influenced by an impact event. Furthermore, their REE abundances also closely resemble those of NWA 10463 [10], suggesting that these meteorites originated from a common source reservoir on the angrite parent body, but no evidence of metal nor shock were found in NWA 10463. The Al-Mg results are also consistent with its relatively late Pb-Pb formation age and point toward an intermediate group of plutonic angrites formed at ~4560 Ma. Crystallization and cooling of the angrite parent body was therefore recorded sporadically, potentially disrupted by impact events, over the course of 7-10 Myr.

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