Pb-Pb DATING OF A CAI FROM THE REDUCED CV3 CHONDRITE VIGARANO.

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Introduction: The age of the Solar System is best estimated by dating calcium-aluminum-rich inclusions (CAIs), which are recognized as the earliest-formed solids in the solar nebula. There is a range of ^{207}Pb-^{206}Pb internal isochron ages (4567.1 ± 0.1 Ma to 4568.7 ± 0.3 Ma) reported for CAIs from 3 CV3 chondrites, Allende and NWA 2364 (oxidized), and the Efremovka (reduced) [1-4], which is inconsistent with ^{26}Al-^{26}Mg systematics that indicate a short duration of formation (<300 ky) [1]. This range of Pb-Pb ages of CAIs could potentially be due to U isotopic variations [5] or secondary processes that may have affected, in particular, the U-Pb systematics in some CAIs. Therefore, we investigated a CAI from Vigarano (CV3 reduced), to assess the cause of this apparent spread in the Pb-Pb ages. This CAI has well-defined initial ^{27}Al/^{26}Al = 5.17 (± 0.31) × 10^{-5} [6], consistent with the "refined" canonical value of 5.2 (± 0.2) × 10^{-5} [6].

Sample and Methods: We have analyzed the trace element and Pb isotopic composition of a compact type A CAI (hereafter referred to as F9) from Vigarano. The F9 CAI was extracted from the slab using a wire-saw and W needles. A fragment of F9 (~50 mg) was ultrasonicated in distilled acetone and water before crushing. An aliquot of the crushed F9 CAI (~3mg) was reserved, unleached, for trace-element analysis, which were carried out using a quadrupole ICPMS at ASU. The remaining was processed for Pb-Pb isotope systematics. Details about the sample preparation, including the 7-step leaching protocol, Pb extraction, isotopic analysis using the Neptune MC-ICPMS at ASU, and blank corrections are described in [3,7].

Results and Implications: The REE pattern for F9 is flat (~13 × CI) with a slight positive Eu anomaly (Eu_N/Sm_N = 1.2). The ^{232}Th/^{238}U and ^{144}Nd/^{238}U ratios are 3.4 and 10.8 (±10%; 2SD) respectively. The Pb-Pb isotopic compositions were measured on the final residue (R) which was dissolved after the 7-step leaching protocol, and on the last 2 leachates, L_6 (cold 1M HF), and L_7 (hot 1M HF). The blank-corrected ^{206}Pb/^{204}Pb ratios for L6, L7 and R are ~4906, 7636 and 7690, respectively, and the Pb-Pb systematics yield corresponding CDT model ages (assuming ^{238}U/^{235}U = 137.88) of 4569.0 ±0.5 Ma (L_6), 4569.3 ±0.3 Ma (L_7) and 4568.7 ±0.3 Ma (R). Using the correlation of the Th/U (or Nd/U) ratio with ^{235}U/^{238}U in Allende CAIs [5], we can estimate a ^{235}U/^{238}U ratio for F9 based on its measured trace element composition, which in turn can be used to obtain corrected CDT model ages of 4568.7 ±0.6 Ma, 4569.0 ±0.3 Ma, and 4568.4 ±0.4 Ma, respectively, for these same samples. These model ages are consistent with the internal Pb-Pb age of 4568.7 ±0.3 Ma for a type-B CAI from the NWA 2364 CV3 chondrite, which is currently our best estimate for the age of the Solar System [3].

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