^{50}Ti ISOTOPE EXCESSES IN CAIS FROM ORDINARY AND RUMURUTI CHONDRITES

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Introduction: Ca,Al-rich inclusions (CAIs) are regarded to be the first solids condensed from a hot solar nebula. They are frequently observed (up to ~4 vol%) components of carbonaceous chondrites (e.g., [1]), but are very rare (<0.1 vol%) constituents of ordinary (OC), Rumuruti (RC), and enstatite chondrites (EC) [2-4]. Most CAIs found within OC, RC, and EC are fine-grained inclusions that are typically spinel-rich with Ca-pyroxene, Na-rich alteration products, and accessory ilmenite. Only a small number of CAIs within these chondrite groups contain melilite, hibonite, and perovskite (e.g., [2-6]), and previous isotopic studies have been performed on some of these inclusions [5-10]. The relationship between CAIs from different chondritic groups are still a matter of debate. Nevertheless, the inferred initial $^{26}Al/^{27}Al$ ratios and oxygen isotopic compositions of CAIs from the most primitive OCs and ECs are indistinguishable from those in most CAIs from carbonaceous chondrites [5-9]. This has lead to the hypothesis that CAIs in non-carbonaceous (NC) and carbonaceous chondrites (CC) formed within the same region of the solar nebula. This hypothesis can be tested using the Ti isotopic composition of CAIs from non-carbonaceous chondrites. As CAIs from carbonaceous chondrites typically have ε^{50}Ti excesses of between ~2-16 [11,12], CAIs from non-carbonaceous chondrites should show similar ^{50}Ti excesses if they formed from the same isotopic reservoir.

Samples and Methods: Nine different CAIs from five chondrites (3 OCs, 1 RC, and 1 CO3) were selected for this study, including two CAIs from Hammadah al Hamra 335 (H3), two CAIs from Moorabie (L3.8), two CAIs from Sahara 98175 (L3.5), two CAIs from Dar al Gani 083 (CO3), and one CAI from NWA 753 (R3.9). Like samples used in previous studies on Al-Mg and O isotope systematics [6-7], these non-carbonaceous CAIs are fine-grained spinel rich inclusions with Ca-pyroxene, Na-rich alteration products, and accessory ilmenite. The CAIs were detected, measured and classified with the Jeol 6610-LV SEM and then drilled out with a MicroMill at the University of Münster. Titanium separation was performed using a two-stage ion-exchange chromatography after [13]. The Ti isotope measurements were performed on a Thermo Scientific Neptune *Plus* MC-ICPMS in Münster.

Results: Both CO3 CAIs have ε^{50}Ti excesses of ~9, similar to CV CAIs (Fig. 1). Most of the investigated NC CAIs exhibit resolvable ε^{50}Ti excesses with OC CAIs ranging between 1.6 ± 1.3 and 8.0 ± 1.1, and the RC CAI has an ε^{50}Ti excess of 1.3 ± 0.8 (Fig. 1). Due to the small sizes of the OCs und RC CAIs, the analyzed samples were likely contaminated by surrounding bulk material from the meteorite during the removal process. However, because bulk OC materials and OC chondrules do not show excesses in ^{50}Ti [11,14,15], any contamination from the bulk meteorite can only lead to a slight decrease in the ε^{50}Ti excess. SEM measurements of the CAIs and the surrounding host material revealed that the TiO_2 concentration of the CAIs is at least seven times higher than that of the bulk meteorite material. Even if a significant percentage of bulk OC was mixed with CAI material during the sample removal process, the contaminant would only contribute a small amount to the total Ti budget of each CAI sample.

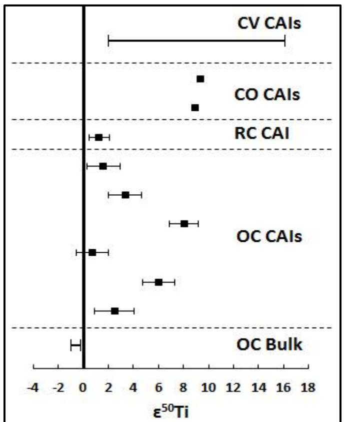

Fig. 1: ε^{50}Ti data for seven NC CAIs and two CO3 CAIs. Errors are 2σ. Data for OC bulk from [11,14,16] and for CV CAIs from [11,12].

Discussion: This initial study of Ti isotopes in CAIs from OC, RC, and CO3 reveals an excess of ^{50}Ti within the range of values for CV CAIs [11,12]. The dataset for OC and RC CAIs is limited, but their mean ε^{50}Ti of ~4ε is lower than that of CV CAIs, which show a peak at around 9ε [11,12,14]. Additional Ti isotopic data for more OC/RC CAIs are needed to assess whether this is a real compositional difference or rather a sampling effect. Nevertheless, one OC CAI shows a ^{50}Ti excess of about 8ε, suggesting there is a link between the reservoir from which OC and CV/CO CAI ultimately formed. This is consistent with the assumption that CAIs from NC and CC chondrites formed from the same isotopic reservoir [6-9] and were than distributed unevenly throughout the solar nebula.

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