

⁵³Mn-⁵³Cr DATING OF SECONDARY DOLOMITE IN A RENAZZO (CR CHONDRITE) DARK INCLUSION

C. E. Jilly-Rehak^{1,2}, G. R. Huss², and K. Nagashima².
¹Department of Geology and Geophysics, University of Hawai'i at Mānoa, Honolulu, HI, USA. ²Hawaii Institute of Geophysics and Planetology, University of Hawai'i at Mānoa, Honolulu, HI, USA. E-mail: cjilly@hawaii.edu.

Introduction: The ⁵³Mn-⁵³Cr system is a robust radiochronometer for dating early Solar System materials [e.g., 1]. ⁵³Mn decays into stable ⁵³Cr with a half-life of 3.7 Myr, useful for dating minerals formed by aqueous alteration processes within the first ~15 Myr of Solar System history. Though aqueous alteration in CR chondrites is well documented, questions remain regarding the timescales of alteration for the different CR-chondrite lithologies. We measured Mn-Cr isotopes in dolomite grains from a dark inclusion in Renazzo (CR2), to understand the temporal relationship between dark inclusions and the host lithology.

Methods: Dolomite was measured for ⁵³Mn-⁵³Cr using the University of Hawai'i Cameca IMS 1280 SIMS with the procedure described by [2]. Isotope ratios were calculated using the sum of the counts to reduce bias due to low count rates [3]. Synthetic Mn- and Cr-doped calcites [4] were used to correct isotopic and elemental fractionation. Recent studies [5,6] have suggested that the dolomite relative sensitivity factor (RSF) may be ~20% greater than that of calcite, but the values are poorly constrained. Due to this ambiguity, we investigated the dolomite ages for both the calcite RSF, and a 20% RSF increase.

Results and Discussion: Though rare in CR chondrites, anhedral 5-20 μm-sized dolomite grains were found in a dark inclusion from Renazzo. The ⁵⁵Mn/⁵²Cr ratios among dolomites vary from ~800 to 9400. The δ⁵³Cr* values correlate with ⁵⁵Mn/⁵²Cr, and the resolved trend is interpreted as an isochron. The isochron slope corresponds to an initial (⁵³Mn/⁵⁵Mn)₀ ratio of (3.1±1.5) × 10⁻⁶ for the calcite RSF, or (3.8±1.8) × 10⁻⁶ for the dolomite RSF. Measurements were anchored to the U-isotope-corrected Pb-Pb age of the D'Orbigny angrite [7-9], yielding ages of ~4.6 Myr (calcite RSF) or ~3.6 Myr (dolomite RSF) after the formation of CV CAIs [10]. Due to the large uncertainties from low count rates, these values are indistinguishable from the Renazzo calcite age (3.9 Myr after CAI formation [11]). Alteration in the dark inclusion and the CR host lithology of Renazzo both occurred early in the parent body history, likely from ²⁶Al decay, rather than in late-stage alteration events such as observed for calcite in a heavily altered CR GRO 95577 [11]. The absolute age of the Renazzo dolomite is in excellent agreement with carbonates (both calcite and dolomite) measured in CM and CI chondrites [2,12].

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