ALTERATION HISTORY IN THE CI CHONDRITE PARENT BODY INFERRED FROM MN-CR DATING OF CARBONATES.

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Introduction: CI chondrites are the most compositionally primitive rocks among the solar system materials. However, they experienced pervasive aqueous alteration, during which chemical and isotopic compositions and mineralogy of their constituents were dramatically changed [1]. For a better understanding of the geological history in the CI chondrite parent asteroid, we investigated 53Mn-53Cr ages (half-life: 3.7 Myr) of carbonates to determine the timescale of aqueous alteration. Here we report Mn-Cr ages of dolomite in the Orgueil and Y980115 CI chondrites.

Samples and analytical methods: For Orgueil, many but small (< ~20 μm in diameter) dolomite grains were found in a polished thin section. Four relatively large (~40 μm) grains were chosen for the isotope measurements. For Y980115, most dolomite grains are associated with numerous tiny (submicron-size) magnetite grains, which can result in contamination during the isotope measurements. An exception, for which we obtained Mn-Cr data, is a large (~300 μm) dolomite grain with a clearly distinct morphology, which might have replaced a primordial CAI. Isotope measurements were performed by the NanoSIMS installed at The Univ. of Tokyo. We used a synthetic calcite standard [2] and analytical methods are described elsewhere [3].

Results and discussion: Three out of four dolomite grains in Orgueil have initial 53Mn/55Mn ratios of (3.24-3.54) × 10^-6. Combining these data, we obtain the absolute age of 4563.8 ±0.7/0.7 Ma for crystallization of dolomite in Orgueil. However, one dolomite grain, which cannot be distinguished from the others by their morphologies, shows a significantly younger age of < 4556 Ma. One dolomite grain in Y980115 shows a slightly higher initial 53Mn/55Mn ratio of (4.03 ± 0.46) × 10^-6. This corresponds to the absolute age of 4564.8 ±0.6/0.7 Ma.

The absolute age of three dolomite grains is comparable to those of carbonates in CM chondrites [4]. This indicates that CI and CM chondrite parent bodies accreted around the same time and initial abundances of 26Al are similar as heat sources in these asteroids. Therefore, they experienced heating by the 26Al decay to similar extent, although difference in chemical properties of them (such as water abundances) probably resulted in different thermal histories. The younger dolomite in the present study has a comparable 53Mn abundance to the youngest breunnerites analyzed by Petitat et al. [5], indicating a prolonged duration of aqueous alteration for at least 8 Myr.

The dolomite grain in Y980115 is slightly older than those in Orgueil and Ivuna [3]. The initial 53Mn/55Mn ratio is consistent with those of Kaidun carbonates [6]. Based on the strange morphology, it may have originated from another pre-existing planetesimal and have not precipitated in the CI chondrite parent body.