

Mn-Cr dating of carbonates in CM chondrites.

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Aqueously altered carbonaceous chondrites have secondary phases such as carbonates and phyllosilicates. Carbonates often contain relatively abundant Mn contents so that they are suitable for ⁵³Mn-⁵³Cr dating (half life: 3.7 Myr). Previous studies reported Mn-Cr systematics of carbonates in CI and CM chondrites obtained by Secondary Ion Mass Spectrometry (SIMS), indicating in-situ decay of ⁵³Mn. However, using the angrite LEW 86010 as a time anchor, these data suggest that the onset of carbonate formation in CM chondrites predates that of CAIs, which is inconsistent with a commonly accepted view of carbonate formation.

Here, we report Mn-Cr ages of carbonates in four CM chondrites; Murchison, Y791198, ALH 83100 and Sayama. These data were obtained using a NanoSIMS 50 installed at Ocean Research Institute, the Univ. of Tokyo. We used a newly determined Mn⁺/Cr⁺ relative sensitivity factor for a synthetic calcite standard [1].

The absolute ages of four CM chondrites were similar, approximately 4563 Ma. These results imply that age difference between the two CM chondrites with different degree of aqueous alteration is smaller than proposed earlier (at least 4 Myr) [2]. If the ages correlate with degree of aqueous alteration, results in this study indicate duration of alteration is relatively short.

A model calculation dealing with the flow of liquid water, conductive heat flow, oxygen isotope exchange between rock and liquid water, and progress of a model mineralogical reaction was performed earlier [3]. According to the model, a small icy planetesimal with a radius of 9 km which accretes 1.6 Myr after the formation of CAIs experiences aqueous alteration within the first several hundred thousand years of heating. Such a rapid evolution of a planetesimal is inconsistent with our age data of the carbonate formation. Therefore, if aqueous alteration in CM chondrites took place about 5 Myr after the formation of CAIs, we favor a relatively large body as the setting where aqueous alteration in CM chondrites occurred.

[1]Sugiura N. et al. (2010) LPS XXXXI, #1617. [2]de Leuw S. et al. (2009) GCA 73, 7433-7442.

[3]Young E. D. (2001) Phil. Trans. R. Soc. Lond. 359, 2095-2110.

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