Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

PPS009-11 会場: 301A 時間: 5月27日14:24-14:37

CMコンドライト中の炭酸塩のMn-Cr年代測定

Mn-Cr dating of carbonates in CM chondrites.

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Aqueously altered carbonaceous chondrites have secondary phases such as carbonates and phillosilicates. Carbonates often contain relatively abundant Mn contents so that they are suitable for ^{53}Mn-^{53}Cr 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 ^{53}Mn. 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 8310 0 and Sayama. These data were obtained using a NanoSIMS 50 installed at Ocean Reseach 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.

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Keywords: aqueous alteration, carbonates, Mn-Cr dating, CM chondrites