6.3.24

^{26}Al ages of ferromagnesian chondrules of CO3.0 Yamato-81020

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^{26}Al ages of chondrules in ordinary chondrites (OC) have been broadly obtained. While, those of ferromagnesian chondrules in least equilibrated carbonaceous chondrites (CC) are very limited, particularly, those for FeO-poor (Type I) chondrules in CC are scarce. In order to clarify the origin and formation processes of chondrules, we have started systematic investigations on Type I chondrules in the most pristine CC (CO3.0 Yamato-81020), by examining textures, bulk chemical compositions, ^{26}Al ages and oxygen isotopic compositions. We find Type I chondrules in CC formed contemporaneously with ferromagnesian chondrules in OC.

The Al-Mg isotopic analysis was performed using a secondary ion mass spectrometer (SIMS) Cameca IMS-1270 at the Geological Survey of Japan (GSJ). Petrographic observations and bulk chemical compositions of individual chondrules were carried out using an optical microscope and an electron microprobe (EPMA).

We examined eleven Type I chondrules and one Al-rich chondrule for Al-Mg isotopic analysis. The initial $^{26}Al/^{27}Al$, $(^{26}Al/^{27}Al)_0$, of the chondrules fall in the range between $(5.1+/-2.2)\times10^{-6}$ and $(1.4+/-0.3)\times10^{-5}$ for Type I chondrules and $(3.1+/-1.4)\times10^{-6}$ for the Al-rich chondrule. Assuming that ^{26}Al was homogeneously distributed in the early solar system, formation ages of the chondrules after CAIs are calculated with the canonical $^{26}Al/^{27}Al$ ratio of 5×10^{-5} [1] to be 1 to 2.5 Myr for Type I chondrules and ~3 Myr for the Al-rich chondrule. It should be noted that the range of ^{26}Al ages is almost the same as those of ferromagnesian chondrules in the least equilibrated OC that is 1-2.5Myr [2-4]. Thus, Type I chondrules in CC formed contemporaneously with ferromagnesian chondrules in OC. We do not observe any correlation among ages of Type I chondrules and their texture or composition, such as mineral assemblages, size distribution, bulk chemical composition, and abundance of metal grains. This suggests that chondrule formation occurred by random sampling of their precursors during 1-2.5Myr after CAIs formation in the Type I CC chondrule forming region.

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6.3.25

I-Xe and Pb-Pb ages of individulal Elenovka (L5) chondrules

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Previous studies [1] of Richardton (H5) chondrules and separated mineral phases demonstrated that, in case of chondrules, both I-Xe and Pb-Pb techniques most probably date the closure of pyroxene, and do provide concordant ages (within experimental uncertainty). The small systematic difference of ~2 Ma older for the Richardton I-Xe ages, relative to the Pb-Pb ages, was atributed to the uncertanty of the Shallowater absolute normalization. The I-Xe system in one of the Richardton chondrules suggested presence of two iodine-bearing mineral phases with age difference of 2.2 ± 0.2 Ma.

New I-Xe and Pb-Pb studies of Elenovka (L5) chondrules are currently under way. Four fragments from different chondrules (from 2.3 to 4.7 mg) were irradiated for I-Xe studies. Other fragments from the same samples were saved for mineralogical and Pb-Pb analyses. Two chondrules yielded Pb-Pb age of 4555.03 ± 0.52 Ma. I-Xe system in one of these chondrules suggested a closure at about the same time 4550 ± 5 Ma, although low abundances of iodine and radiogenic ^{129*}Xe did not allow the usual precision.

Another chondrule seems to contain two iodine-bearing phases. Three low temperature extractions in this sample have both radiogenic and fission xenon. They form a co-linear low temperature isochron, corresponding to 4566.9 ± 0.5 Ma. Higher temperature extraction steps do not have fission xenon and tend to form a line with slightly steeper slope, suggesting the presence of a more refractory phase were the I-Xe system closed somewhat earlier. Since fission Xe in low temperature extractions in this chondrule indicates a presence of uranium, it is possible that this low temperature phase also provided the Pb-Pb age, when fragment of this chondrule was analized in a course of the Pb-Pb studies. Thus, the ~ 12 Ma difference between the two chronometers may be attributed to the difference in closure times of I-Xe and Pb-Pb systems in this phase.

I-Xe analyses with smaller incremental temperature steps of the remaining two chondrules might well provide a better age resolution for the two different mineral phases.

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