Oxygen isotopic compositions of refractory inclusions in CH chondrite

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Oxygen isotope systematics between 16O-rich and -poor reservoirs is well known in the solar system (Clayton, 1993). Oxygen isotopic composition of component of chondrite of delta17, 18O relative to SMOW is plotted on CCAM line or slope-1 line (Young and Russell, 1998).

Refractory inclusions (Ca, Al-rich inclusions (CAIs) and amoeboid olivine aggregates (AOAs)) in a polished thin section of Acfer214 CH chondrite were studied by BSE imaging, X-ray elemental mapping and EPMA equipped with Oxford LINK ISIS EDS. Oxygen isotopes were measured in-situ by ion microprobe spot analysis (16O, 17O and 18O) and ion microscope (16O and 18O) by TiTech Cameca ims1270 SIMS instrument equipped with SCAPS (2-D ion detector).

CAIs in Acfer214 are mineralogically classified into (1) grossite-melilite [Al-diopside rim] inclusions, (2) grossite (hibonite)-spinel-melilite [Al-diopside + olivine rim] inclusions, (3) spinel-melilite [Al-diopside rim] inclusions, (4) pyroxene spherule and (5) pyroxene-spinel [Al-diopside rim] spherule and otherwise CaAl2O4 were found in only one inclusion and the inclusion seems to be corroded. AOAs are composed of olivine, pyroxene, spinel and anorthite.

Oxygen isotopic compositions of (1), (2), (3) and (5) were measured by ion microprobe spot analysis, which are distributed continuously on slope-1 line (delta17, 18OSMOW = - 60 - 0 permil) on a 3 isotope diagram. (1) and (3) are relatively 16O-rich and (2) and (5) are relatively 16O-poor. Results of delta18O mapping of some CAIs and AOAs show that they have nearly homogeneous oxygen isotopic compositions. (4) and AOAs are 16O-rich (delta18O = -30 permil and -50 - -30 permil, respectively) and CaAl2O4 is 16O-poor (nearly terrestrial value).

Matrix of Acfer214 seems to be altered by terrestrial weathering, but refractory inclusions are primitive because they have no alteration products and no oxygen isotopic alteration. Oxygen isotopic compositions of refractory inclusions reflect formation condition, place and time. Wide distribution of oxygen isotopic compositions shows that refractory inclusions in Acfer214 were formed in different places, time, conditions and accreted into Acfer214 parent body.