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A chondrule having 16O-rich composition with -8%

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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). However details of the reservoirs with two types of oxygen isotopic compositions is still unclear.

16O-rich end-member, 4% enrichment relative to the earth, have observed only in refractory inclusions that are above 5 vol% of constituents of chondrites (MacPherson et al., 1988). Other 95vol% of chondrite is depleted in 16O and close to the earth value. Therefore it has been believed that 16O-rich reservoirs exist at refractory inclusions forming event in the early solar system.

An extreme 16O-rich chondrule of delta 17,18O relative to SMOW = -75 permil was found in a polished thin section of Acfer214 CH chondrite. The major compositions of the extreme 16O-rich chondrule have similar trend of other cryptocrystalline chondrules in CH chondrite (Krot et al., 2002). This chondrule is about 130 micron in apparent diameter, and has spherical core-shell structure. Unusual point from typical cryptocrystalline chondrules is that the core is surrounded by olivine shell (Fo99) of 10 micron thick.

Cryptocrystalline texture with olivine shell indicates that this chondrule crystallized from totally molten liquid droplet depending on bulk composition. The bulk compositions are depleted in moderately volatile elements. On the other hand refractory and normal lithophile elements in this chondrule show close to solar abundance ratios.

Oxygen isotopic composition of this chondrule of delta17, 18O relative to SMOW is plotted on CCAM line or slope-1 line extrapolated towards pure 16O composition. This is the most 16O-rich material ever found in the solar system.

Chondrules were formed by flash melting of precursor dusts (Grossmam et al., 1988). The precursor of this chondrule should have the value of delta17, 18O relative to SMOW = -75 permil. The bulk composition of this chondrule have nearly solar abundance ratios. This suggests that 16O-rich dust have prevailed in the solar dust components. Relatively 16O-poor composition of refractory inclusions and chondrules may have been caused by oxygen isotopic exchanges with 16O-poor gaseous reservoir. In the solar system evolution, 16O-rich dust must have reacted with 16O-poor gas and changed to 16O-poor material, such as refractory inclusions and chondrules.