STUDY OF CHONDRULES IN CH CHONDrites - III: OXYGEN ISOTOPE RATIOS OF SILICA-BEARING, METAL-BEARING, AND 16O-RICH CHONDRULES.
D. Nakashima1, M. Kimura2, K. Yamada2, T. Noguchi2, T. Ushikubo1, and N. T. Kita1. 1University of Wisconsin-Madison, USA. (nakai@geology.wisc.edu) 2Ibaraki University, Japan.

Introduction: From a systematic survey of chondrule oxygen isotope ratios in Asuka-881020 (CH), we reported that magnesian and ferroan cryptocrystalline (CC) chondrules were derived from two distinct isotope reservoirs with δ17O values of –2‰ and +1.5‰, respectively [1]. CH chondrites also contain ferroan non-porphyritic chondrules such as silica-bearing (SB) and FeNi metal-bearing (MB) chondrules [2], which may be related to ferroan CC chondrules according to their similar sizes (<100µm) and FeO-rich chemistry. Exceptionally 16O-rich oxygen isotope ratios were reported from a glassy chondrule with olivine rim by [3] in Acfer 214 (CH). Here we report additional oxygen three-isotope analyses of several minor types of chondrules in Asuka-881020.

Results: IMS-1280 at UW-Madison was used to obtain oxygen isotope ratios using 2×4µm spots, which yield analytical precisions of 1-2‰ (2SD). All data plot along a slope 1 line on a three-isotope oxygen diagram (δ17O vs. δ18O). Isotope ratios of ferrous pyroxene and silica in SB chondrules are consistent within the analytical uncertainties. Nine SB chondrules with spherical shapes have nearly identical δ17O values with the average +1.2±1.4‰ (2SD), while five SB chondrules with irregular shapes and fine-grained textures have variable δ17O values from –6 to +5‰. Three ferroan MB chondrules have δ17O values from 0 to +2‰. Two olivine-rimmed Al-rich chondrules show δ17O values of –12‰ and –6‰, respectively. We analyzed one magnesian MB chondrule that shows the δ17O value (–21‰) as low as CAIs, though it has no olivine rim.

Discussion: Nearly identical oxygen isotope ratios of ferrous pyroxene and silica in SB chondrules suggest formation from common isotope reservoirs. Spherical SB and ferroan MB chondrules have similar δ17O values to ferroan CC chondrules, and are depleted in refractory and volatile elements like ferroan CC chondrules. Thus, these three types of ferroan chondrules might have formed via fractional condensation from an isotopically uniform gaseous reservoir. δ17O range of irregular-shaped SB chondrules overlaps with that of type I porphyritic chondrules in Asuka-881020 [1], implying that the irregular-shaped SB chondrules formed in the solar nebula like the porphyritic chondrules [4].

Al-rich chondrules with olivine rim show intermediate δ17O values between 16O-rich CAIs [5] and ferromagnesian chondrules [1] in CH chondrites, indicating mixing of CAI-like materials and ferromagnesian chondrules as their precursors. The lowest δ17O value from this work was obtained from the magnesian MB chondrule, which is not enriched in refractory elements unlike CAIs. The origin of the magnesian MB chondrule would be related to that of olivine-rimmed glassy chondrule in [3]. They may have formed from a 16O-rich gaseous reservoir or preserved the 16O-rich composition after melting [3].