EXPERIMENTAL PARTIAL MELTING OF THE LAPEZ ICE FIELD 03639 R4 CHONDRITE.
K. G. Gardner-Vandy and D. S. Lauretta. Lunar and Planetary Laboratory, University of Arizona. kgardner@lpl.arizona.edu.

Introduction: As part of an ongoing study of the petrology, geochemistry and formation conditions of the FeO-rich primitive achondrites [1-3], we perform partial melting experiments of FeO-rich chondritic meteorites. We recently reported that melting experiments of a CK5 chondrite yield compositions similar to those in several ungrouped primitive achondrites, but we also concluded that a more FeO-rich chondritic precursor is needed to yield brachinite compositions [3]. From this, we have begun similar experiments on R4 chondrite LaPaz Ice Field (LAP) 03639.

Methods: We obtained a thin section and chip (2.7 g) of LAP 03639 from the Meteorite Working Group. We used an ~250 mg chip in each experiment to capture textural changes across the experimental conditions. Experiments were run in a Deltech gas-mixing furnace with an oxygen sensor and type R thermocouple. Thus far, we have completed and analyzed two experiments, R1 and R2. Temperature for both was 1250 °C; and each ran for 4 days. The oxygen fugacity for R1 was IW-1 and R2 was IW+1, controlled with a 1-bar CO+CO2 gas mixture. We choose $fO_2$ values based on our previous analyses of the thermodynamic environment of FeO-rich primitive achondrite meteorites [2]. No attempt was made to retain volatiles.

Starting Material: LAP 03639 is an R4 chondrite [4-5]. It has chondrules and chondrule fragments ≤1.1 mm across. The matrix is made of olivine, pyroxene and plagioclase with sulfides containing 0-30 wt% Ni. Olivine is Fa 38.8±0.2, low-Ca pyroxene is Fs6-26, high-Ca pyroxene is Fs10-12, and plagioclase is An5-13.

Experimental Results: Both the R1 and R2 experiments resulted in significant silicate melting to the extent that homogeneous (Fa33.5±0.8 and Fa39.8±0.9, respectively) anhedral to subhedral olivine is the only silicate mineral remaining. These grains are surrounded by silicate melt with Mg# 28.0±1.1 and 20.8±0.8, respectively. Significant S loss occurred, but there are several rounded Ni-rich sulfides in each charge; R1 sulfides have 8.5-40 wt% Ni, and R2 sulfides have 63-70 wt% Ni. R1 contains taenite with up to 39 wt% Ni. R2 has a few grains of Fe,Ni-metal with 60-79 wt% Ni. The original chondritic texture remains only in small regions with relict barred olivine grains.

Discussion: Olivine compositions generated in the R1 experiment resulted in olivine with compositions matching those of brachinites (Fa32-35) [1]. Those for the R2 experiment, however, resulted in compositions more oxidized than the starting material. This is likely due to the wide range of intrinsic oxygen fugacities ($fO_2$) calculated for the R chondrites (FMQ-1 to FMQ-3.5) [5], and proves that LAP 03639 formed at more reducing conditions than IW+1. These initial results indicate that brachinites could form from the partial melting of an R-chondrite at IW-1.


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