NON-SPHERICAL LOBATE LOW-FeO PORPHYRITIC CHONDRULES IN THE Y-81020 CO3.0 CHONDRITE: EVIDENCE FOR SMALL DEGREES OF MELTING. Alan E. Rubin and John T. Wasson, Inst. of Geophysics and Planetary Physics, University of California, Los Angeles, CA 90095-1567, USA.

Most type-I (low-FeO) porphyritic chondrules in CO3 chondrites show large deviations from sphericity (Fig. 1). We surveyed 200 type-I PO and POP chondrules with apparent diameters ≥100 µm in CO3.0 Y-81020. There is a continuum of shapes ranging from irregular, non-spherical multi-lobed objects (~70%) to those that appear "round" in thin section (~30%); however, some of these "round" chondrules are probably cross-sections of lobes. We chose eight non-spherical and ten "round" type-I chondrules for detailed study. The chosen non-spherical chondrules have larger apparent diameters (420±140 vs. 230±80 µm) and a higher content of opaque phases (12±5 vs. 5±4 vol.%) than the "round" chondrules. The two groups have similar olivine grain sizes (20±5 vs. 26±11 µm) and similar olivine, low-Ca pyroxene and Ca-pyroxene compositions (Fa1.0 vs. Fa1.4; Fs1.1Wo2.2 vs. Fs1.7Wo1.9; Fs1.0Wo38 vs. Fs1.7Wo40).

The non-spherical chondrules are not chondrule fragments: they have rounded protuberant and embayed outlines inconsistent with fracturing.

Some researchers have modeled type-I chondrules as having formed from near-total melts during a single heating/cooling episode. However, nearly totally molten droplets the size of the non-spherical chondrules (with viscosities of 1-5 poise and a surface tension of 360 dynes/cm, appropriate for a basaltic melt) would collapse into spheres very quickly, i.e., in <<1 sec. It does not seem possible that the chondrules could have nucleated and grown their 20-µm-size olivine phenocrysts within this short period of time. This indicates that the non-spherical chondrules did not form from near-total melts. Instead, they probably experienced only small degrees of melting during their final heating episode and solidified from highly viscous (10^2-10^3 poise) crystal-laden melts.

There are two end-member scenarios for forming the non-spherical chondrules: (1) collisions of crystal-laden spatter of similar composition in a small, hot opaque formation region and (2) deformation of individual objects due to heterogeneities in internal motions. In either case, the non-spherical chondrules achieved their present convoluted shapes before quenching. The "round" chondrules may have experienced higher degrees of melting than the non-spherical chondrules and lost a higher proportion of their opaque spherules by centrifugal action.

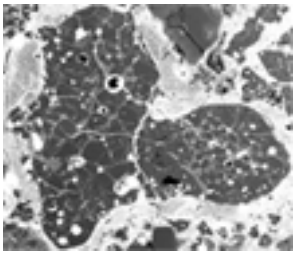

Fig. 1. Lobate type-I chondrule in Y-81020. Image is 715 µm across.