OVERGROWTHS, OSCILLATORY ZONING, AND FIRST-GENERATION PHENOCRYSTS IN SEMARKONA CHONDRULES: MULTIPLE MELTING EVENTS, HIGH COOLING RATES. John T. Wasson, Tak Kunihiro and Alan E. Rubin, University of California, Los Angeles, CA 90095-1567 USA.

Wasson and Rubin (2003a) investigated high-FeO chondrules in CO3.0 Yamato 81020 and found that low-FeO relicts were ubiquitous and that thicknesses of olivine overgrowths and the radii of "new" olivine crystallites were about 5 μm following the last melting event. They concluded that the large, >50 μm phenocrysts in these type-II chondrules are relicts produced in multiple melting events in the present chondrule or in earlier generations of chondrules. Wasson and Rubin (2003b) studied high-FeO chondrules in LL3.0 Semarkona and LL3.1 Krymka and made similar observations; low-FeO relicts and shards retaining their fragmental shapes were common, and 5-μm overgrowths were observed to be the norm following the last melting events.

We have extended this study to include 15 additional chondrules in Semarkona section USNM 1805-3. In high-FeO porphyritic pyroxene chondrule L4 we find compositional evidence of multiple overgrowth layers, and in others evidence of two overgrowth layers. Compositional and petrographic evidence shows that rhythmic zoning in banded pyroxene in some high-FeO chondrules results from continued growth on structures that were initially skeletal; bands of mesostasis exsolved more evolved pyroxene (i.e., with higher CaO and/or FeO) to produce continuous pyroxene bands.

If, as we infer, most melting events produced only about 5 μm of new olivine or pyroxene, it is important to find chondrules containing first-generation phenocrysts without overgrowths. In Fig. 1 we show one candidate, chondrule G7; it consists mainly of glassy mesostasis with thin (10-30 μm) skeletal bars of Fa0.1 olivine and scattered sparks of Ca pyroxene. Mesostasis occupies regions within the olivine bars. After allowing for oblique sectioning it appears that the thickness of olivine slabs is 5 μm or less. We suggest that additional melting events would have been necessary to make continuous, thicker olivine bars.

Because overgrowth thicknesses are >10× smaller than phenocryst radii used in past studies to estimate cooling rates, it follows that these earlier rates are too low by factors >100.

References: Wasson J. T. and Rubin A. E. (2003a) *GCA* **67**, in press; Wasson J. T. and Rubin A. E. (2003b) . LPS. **34,** abs. 2119.

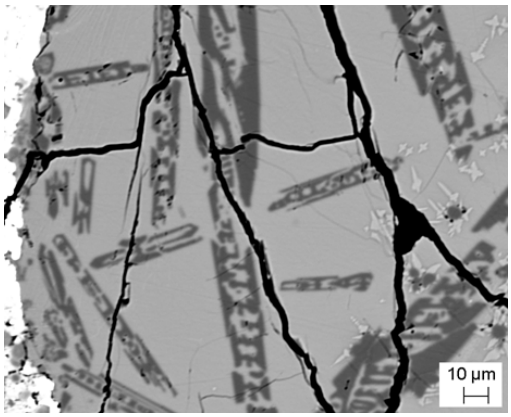

Fig. 1 First-generation skeletal olivine bars in chondrule G7.