

OLIVINES IN ANGRITE LEW87051: PHENOS OR XENOS? G. McKay (SN2, NASA-JSC, Houston, TX, 77058) L. Le, and J. Wagstaff (Lockheed ESCO, 2400 NASA Rd. 1, Houston, TX 77058)

Nyquist et al. [1] recently reported the presence of live ^{53}Mn in angrite LEW 86010 when it crystallized. Hence, melting must have occurred within $\sim 10\text{Ma}$ of accretion of the angrite parent body, and LEW 86010 is the oldest known differentiated meteorite. This discovery has made it even more desirable to understand the petrogenesis of angrites, which presumably were all formed at a similar time. As part of our continuing work on angrite petrogenesis, we have conducted crystallization experiments on LEW 87051, the other antarctic angrite, to clarify its petrogenesis. This abstract reports several aspects of our experimental results.

LEW 87051 consists of coarse subhedral to euhedral zoned olivine crystals ($\sim \text{Fo}_{60-90}$, typical grainsize $\sim 0.5\text{mm}$) set in a fine-grained intergranular matrix composed primarily of elongate anorthite and interstitial olivine, kirschsteinite, and fassaitic pyroxene [2,3]. The groundmass clearly represents a crystallized melt. Groundmass ferromagnesian minerals are zoned to nearly Mg-free compositions, indicating fairly rapid cooling with nearly perfect fractional crystallization.

The large olivine crystals in LEW 87051 consist of volumetrically minor Cr-enriched cores, in which Cr decreases with decreasing Fo, and volumetrically dominant rims, in which Cr increases with decreasing Fo (Fig. 1). A major question concerning the petrogenesis of this sample is the relationship of these large olivine crystals to their host melt. At LPSC XXI, Prinz and co-workers [2] suggested that the large olivines are xenocrysts, grossly out of equilibrium with the melt, while we [3] interpreted at least the rims as phenocrysts whose fractional crystallization from a more primitive, olivine-rich melt produced the groundmass. To clarify this relationship, we have conducted experiments to determine the phase relations and major, minor, and trace element partitioning behavior for LEW 87051.

At $f_{\text{O}_2} = \text{IW} \times 10$ (the value we prefer for angrite crystallization [4]) a synthetic LEW 87051 analog (L7) crystallizes olivine alone from 1420-1320°C, where Al,Cr-rich spinel appears. At 1220°C, after crystallization of $\sim 25\%$ olivine and a trace of spinel, plagioclase appears. Olivine/Liquid values for D_{Ca} and D_{Cr} are shown in Fig 2. D_{Ca} is constant, while D_{Cr} increases slightly over the crystallization interval (1420-1220°C). Note that the behavior of Cr changes from incompatible to compatible over this interval.

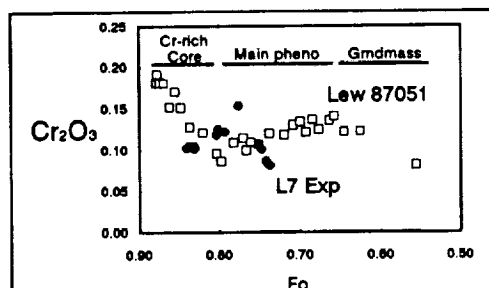


Figure 1. Variation of Cr content with Fo for LEW 87051 natural olivines and olivines from our L7 experiments.

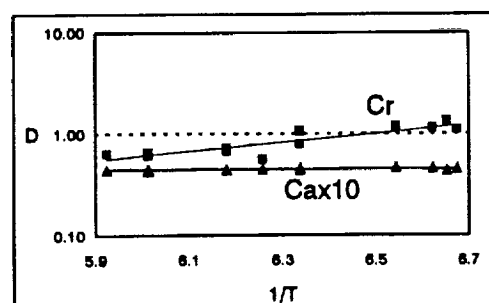


Figure 2. Variation of olivine $D(\text{Cr})$ and $D(\text{Ca})$ with $1/T$ along crystallization path of LEW 87051 ($\text{IW} \times 10$). $D(\text{Ca})$ is essentially constant, while $D(\text{Cr})$ increases with falling T . Note that Cr changes from slightly incompatible to slightly compatible over this crystallization interval.

Comparison of compositional trends in the synthetic olivine crystals with those in LEW 87051 olivine phenocrysts (Fig. 1) reveals some interesting contrasts. Except for the Cr-rich cores ($\sim \text{Fo}_{90} - \text{Fo}_{80}$), Cr in the natural olivine phenocrysts increases continuously from core to rim ($\sim \text{Fo}_{65}$), and then falls again in the groundmass olivines (Fig 1). We had earlier modeled this continuous increase as resulting from normal fractional crystallization, with D_{Cr} increasing from about 0.6 at the outer edge of the Cr-rich cores to about 0.8 at the phenocryst rims. However, our experimental values for D_{Cr} are closer to unity (Fig. 2), and are too high to explain the gradual increase in Cr in the olivine. Nevertheless, despite these high D values, our more Fo-rich synthetic olivines also show an increase in Cr with decreasing Fo, followed by a decrease at about Fo_{75} . Although we do not yet understand the details, it is clear that the Cr abundance in our experimental olivines must be controlled by spinel crystallization. We plan future experiments to work out the details of the spinel stability field and the Cr mass balance over a range of oxygen fugacities. For now, the relationship of the large olivines to the groundmass remains ambiguous.

References: [1] Nyquist *et al.* (1991) LPS XXII 989. [2] Prinz *et al.* (1990) LPS XXI 979. [3] McKay *et al.* (1990). LPS XXI, 771. [4] McKay *et al.* (1989) LPS XX 677.