

**EXPERIMENTAL STUDIES OF SYNTHETIC LEW 86010 ANALOGS: PETROGENESIS OF A UNIQUE ACHONDRITE.** G. McKay (SN4, NASA-JSC, Houston, TX 77058), D. Lindstrom, L. Le, and S.-R. Yang (Lockheed EMSCO, 2400 NASA Rd. 1, Houston, TX 77058)

**Introduction.** This abstract reports preliminary results of an experimental phase equilibrium study we are undertaking in conjunction with our mineralogic and petrologic study of unique antarctic achondrite LEW 86010, reported in a companion abstract [1]. Two synthetic starting compositions were prepared based on early crude and later more refined estimates of the mode and average mineral compositions of LEW 86010 (Table 1). These synthetic glasses were held on Pt loops at 1300°C for 4 hrs in a 1 atm gas mixing furnace at  $fO_2$  of IW+0.5 log units, then at 1000° for 12 hrs to ensure the presence of all major minerals. Then the charges were heated to the run temperatures, held for ~24 hrs, then quenched in air, and analyzed by electron microprobe. Considerable heterogeneity was observed in the pyroxene compositions, indicating a failure to achieve complete equilibrium (see below). Consequently, these initial experiments should be used primarily as a general guide to the petrogenesis of LEW 86010.

**Results.** Fig. 1 shows compositions of the starting materials and quenched glasses projected onto the wollastonite-olivine-anorthite ternary join using oxygen units [2]. Open symbols are used for glasses containing PL+OL, and closed symbols for glasses also containing CPX. Also shown is the projection of the bulk composition of LEW 86010 (LEW Bulk) estimated from its mode and mineral compositions [1]. Synthetic composition L1 is richer in olivine than LEW Bulk, while L2 is richer in anorthite. Crystallization of L1 yields melt compositions which move along a trajectory which passes to the olivine side of LEW Bulk, while L2 residual melts lie on a trajectory which passes very close to LEW Bulk at ~1210° after crystallization of ~15% AN. The L2 melt is just saturated with olivine at 1200° after crystallization of ~18% AN. Pyroxene appears between 1180° and 1160° after crystallization of 21-25% AN and 2-9% OL. These results indicate that LEW Bulk contains 6-10% excess AN and 2-9% excess OL relative to a triply saturated liquid, and support the inference from textural evidence that AN and OL crystallized before PX in LEW 86010 [1].

**Mineral Compositions.** Fig. 2 shows compositions of pyroxenes from our experiments, LEW 86010, and ADOR [1] projected onto the quadrilateral from all other components, and Figs. 3-4 show variation of Ti and Al. Within each charge from the L2 experiments, a bimodal distribution of pyroxene compositions was observed, with one group having much higher Fe/Mg than the other. Thus two points from each L2 experiment are plotted in Figs 2-4. Compositions of both synthetic and natural pyroxene lie above the quadrilateral (Fig. 2) due to high Ti and Al contents. Most synthetic pyroxenes are somewhat lower in WO than their natural counterparts, but one L2 pyroxene lies exactly at the low-Fe/Mg end of the LEW pyroxene trend in all plots. L2 pyroxenes lie within the LEW trend on the Ti plot, and at the upper limit of the trend in the Al plot, while L1 pyroxenes lie below the LEW trend in both plots. Thus, the experimental pyroxenes, particularly from L2, are very similar in composition to pyroxenes from LEW 86010.

Both synthetic and natural olivines have very high Ca contents (Fig. 5). The most Ca-rich L2 olivine has higher Ca content than ADOR, and falls within the range for LEW. For the experimental olivines, Ca increases with increasing Fe/Mg. It is not known whether this increase is primarily a result of changing temperature, melt composition, or olivine composition. An extrapolation of the trend defined by L1 olivines passes below ADOR, and intersects the low end of the range of LEW olivines, while an extrapolation of the L2 trend passes well above ADOR and LEW.

**Discussion.** Several conclusions may be drawn from the experimental results. First, these experiments strongly support a magmatic origin for LEW 86010. The similarity in composition of synthetic and natural pyroxene and olivine indicates that the unusual mineral compositions in ADOR and LEW 86010 are a natural consequence of the composition of the melts from which they crystallized.

Second, these experiments indicate that LEW 86010 crystallized from a melt similar in composition to the bulk sample. Minor element contents of pyroxene and olivine appear rather sensitive to changes in bulk composition, as reflected in differences between minerals from L1 and L2 experiments. Thus significant departure of the parent melt from our synthetic compositions, particularly melts produced in L2 experiments, would result in mineral compositions which do not match those observed in the meteorite. This apparent similarity of the parent melt to the LEW 86010 bulk composition implies one of two alternatives. Either the sample represents a melt which crystallized by nearly closed system crystallization, or else it represents an accumulation of minerals in nearly cotectic proportions.

One issue requiring further investigation involves the distribution of Fe and Mg between olivine and pyroxene. The synthetic olivines are much richer in Mg than LEW olivines, even though the synthetic pyroxenes span a

comparable range of Fe/Mg ratios. This discrepancy might be a result of the disequilibrium in our experiments. However, it might also reflect equilibration of LEW olivines with the outer Fe-rich portions of the pyroxenes, either continuously as the interstitial melt evolved during slow cooling and crystallization, or through post-crystallization subsolidus exchange. Once we have made better determination of equilibrium olivine-pyroxene Fe-Mg distributions and their variation with temperature, this information might be useful in constraining the thermal history of LEW 86010. Another possible constraint on thermal history might be provided through experimental study of the olivine kirschsteinite solvus at appropriate Fe/Mg values.

Finally, in order to facilitate interpretation of REE data for this sample [e.g., 3], we plan to measure REE partition coefficients for these unusual pyroxene compositions. We anticipate that additional petrologic, geochemical, and experimental investigations will continue to provide clues to the origin of the unusual melt from which LEW 86010 crystallized.

REFERENCES: [1] McKay *et al.* (1988) Lpsc XIX, in press. [2] Longhi and Pan (1988) Journal of Petrology, in press. [3] Crozaz *et al.* (1988) Lpsc XIX, in press.

Table 1. Experimental Starting Compositions (wt.%).

	SiO <sub>2</sub>	TiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	FeO	MgO	CaO	mg
Synth. Comp. L1	41.50	0.83	13.29	20.83	8.28	15.27	0.415
Synth. Comp. L2	41.31	1.06	17.14	15.50	6.59	18.39	0.431
LEW 86010 Bulk [1]	40.32	1.10	14.09	18.24	7.14	18.20	0.411

