

**PARTITIONING OF NI BETWEEN OLIVINE AND HIGH-MGO BASALTIC LIQUIDS; D. Elthon, Lunar and Planetary Inst., 3303 NASA Rd. 1, Houston, TX 77058 and Dept. of Geosciences, Univ. of Houston, Houston, TX 77004.**

Olivine is the most abundant mineral in the Earth's upper mantle and the liquidus mineral phase for many basalts. As a consequence, the understanding of magma production and fractionation processes requires that olivine-liquid equilibrium must be well understood and quantitatively applied. Recent syntheses of Fe-Mg equilibria between olivine and basaltic liquids [1,2] provide coefficients for the calculation of liquidus olivine compositions for a range of pressure, temperature and liquid compositions.

The partitioning of Ni between olivine and liquid has been previously studied by many investigators [e.g., 3-8]. Although earlier studies indicated that this distribution coefficient was strongly dependant on temperature, Hart and Davis [7] demonstrated that the bulk composition of the liquid (particularly the MgO content) most strongly influenced the distribution coefficient, with temperature being only a second-order effect.

Amongst these earlier studies, a discrepancy exists between the data of Hart and Davis [7] and Arndt [6] for basaltic liquids with high MgO contents (>10 wt.% MgO), with the data of Hart and Davis being systematically lower at a specified MgO content. This discrepancy potentially has important petrological implications because the Hart and Davis data suggest that most basalts are not derived from primary high-MgO basalts [7], whereas the data of Arndt [6] do not preclude this possibility [9,10]. This study of the partitioning of Ni between olivine and liquid for high-MgO basalt compositions was undertaken in an attempt to resolve this discrepancy.

The following series of experiments were undertaken at 1 atm under QFM oxygen fugacity conditions. Natural basalt or komatiite compositions were chosen for starting compositions, with the natural samples doped with small amounts of Ni and (sometimes) olivine. The experiments were conducted on 0.003-inch diameter Pt wire loops that were pre-saturated with Ni and Fe by immersion for ~24 hours in a molten sample of the basalt being studied. The wires were cleaned with HF and then presaturated two additional times before the experiments reported here were conducted. This triple saturation eliminated Fe and Ni losses to the Pt-wire loop. Experimental run durations were generally 22-26 hours. Analyses of experimental charges were conducted with the ARL SEMQ electron microprobe at the Smithsonian Institution. Glass compositions, determined by routine analytical methods, are listed in Table 1. The Ni contents of olivines and glasses were measured using high precision electron microprobe techniques. Operating conditions were 15 KV at 40 nA, with background measured on both sides of the peak. Counting times were 200 sec/spot, with 20-40 spots per sample. The beam was slightly defocused for glass analyses to reduce damage to the glass.

The partitioning of Ni between olivine and natural high-MgO basaltic liquids shows a strong compositional dependency similar to that demonstrated in the Fo-Ab-An system [7]. The  $D_{Ni}$  decreases from ~10 in basalts with 10% MgO to ~3.5 in samples with 20% MgO (Table 1). The data in Table 1, along with the data of Nabelek [8] and Arndt [6] are fit with the following equation ( $r=0.97$ ):

$$D_{Ni} = \frac{\text{wt.\% NiO in Olivine}}{\text{wt.\% NiO in Liquid}} = \frac{122.16}{\text{MgO in Liq.}} - 2.27$$

These 1 atm data can be used for quantitative modeling of olivine crystallization at low pressures. High-pressure data on basalts and komatiites [11,12] suggest that the pressure effect of this distribution coefficient is very small, indicating that these data can also be used in the evaluation of melting processes (10-30 kbars) within the mantle.

GLASS COMPOSITIONS:

Table 1 -- Experimental Data

Expt. Run	3A	3C	4A	4C	4D	4E	5B	5C	7G	7K	16J
SiO <sub>2</sub>	49.34	48.88	49.85	49.97	49.91	49.82	52.92	52.30	50.19	49.29	49.45
TiO <sub>2</sub>	0.30	0.23	0.51	0.62	0.60	0.48	0.31	0.27	1.03	1.02	0.34
Al <sub>2</sub> O <sub>3</sub>	10.03	9.21	11.87	12.23	12.01	11.29	6.36	5.83	15.86	15.66	11.64
FeO*	7.41	7.30	6.84	6.85	6.73	7.15	10.76	10.71	9.59	9.26	13.03
MnO	0.15	0.14	0.14	0.13	0.14	0.16	0.27	0.21	0.18	0.17	0.25
MgO	18.42	20.88	14.38	12.79	13.43	15.14	14.76	16.87	10.59	12.38	15.86
CaO	13.83	13.43	17.20	17.63	17.54	16.40	13.91	12.61	12.47	11.47	8.86
Na <sub>2</sub> O	0.73	0.59	0.31	0.44	0.45	0.38	0.40	0.35	0.96	0.76	0.27
K <sub>2</sub> O	0.01	0.01	0.03	0.04	0.02	0.03	0.04	0.00	0.07	0.08	0.07
Total	100.22	100.67	101.13	100.70	100.83	100.85	99.73	99.15	100.94	100.09	99.77
NiO in OL	0.325	0.342	0.483	0.769	0.454	0.627	0.369	0.362	0.170	0.220	0.367
1 S.D.	±0.029	±0.047	±0.024	±0.052	±0.024	±0.018	±0.024	±0.011	±0.018	±0.007	±0.029
NiO in GL	0.099	0.092	0.074	0.101	0.063	0.107	0.059	0.075	0.023	0.041	0.097
1 S.D.	±0.004	±0.005	±0.008	±0.012	±0.006	±0.007	±0.006	±0.011	±0.008	±0.006	±0.018
D	3.28	3.72	6.53	7.61	7.21	5.86	6.25	4.83	7.39	5.37	3.78
Temp C	1375	1412	1301	1266	1277	1321	1296	1339	1258	1300	1335

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