

Appendix 2

Electron microprobe (EPMA)

Samples were initially analyzed using the Cameca SX100 at Johnson Space Center. Later analyses were collected on the JEOL JXA 8200 electron microprobe at the Institute of Meteoritics (IOM) and Department of Earth and Planetary Sciences (E&PS), at the University of New Mexico (UNM). Electron microprobe analyses initially examined the major/minor element chemistry of the experiments and phases of interest (olivine, spinel, and glass). Samples were analyzed under a 15 kV accelerating voltage, 20 nA beam current, and a 2 μm spot for olivine, 10 μm for glass and $<1\mu\text{m}$ for spinel. Elements were calibrated using C.M. Taylor Co. EPMA standards, as well as additional standards developed in-house. Subsequent olivine measurements were focused on the trace element abundance of V in olivine. These measurements consisted of extended peak and background counting times for V in olivine, along with the concurrent measurement of Ti concentration. By increasing the counting statistics for both V and Ti (with the Ti K β peak representing a known interference for V K α), the 3σ detection limit for each was reduced drastically (33 and 42 ppm for V and Ti, respectively). The data is presented in Table 1 in an abbreviated fashion for space considerations. Complete data sets for spinel, olivine, and glass are given in the electronic appendices.

Ion microprobe (SIMS)

Vanadium measurements for olivine in the Y98 meteorite sample were collected on the Cameca 4f Ion Microprobe in the Institute of Meteoritics at the University of New Mexico. Analytical conditions included an accelerating voltage of 10 kV, a beam current of 20 nA, and an offset voltage of -105 V. Standardization was carried out using 3 olivines and 1 orthopyroxene standard. See Shearer et al. (2006) for details.

Propagation of Uncertainty in Partition Coefficients

Uncertainties associated with the calculated partition coefficient values (e.g., for $D_{\text{V}^{\text{spinel/olivine}}}$) were propagated using the 1σ standard deviations and the mean of the EPMA determined vanadium analyses:

$$\pm 1\sigma \text{ (as a \% of } D) = \sqrt{\left[\frac{1\sigma \text{ stdev } (V)}{\text{mean } (V)}\right]_{\text{olivine}}^2 + \left[\frac{1\sigma \text{ stdev } (V)}{\text{mean } (V)}\right]_{\text{spinel}}^2}$$

The means and 1σ standard deviations were typically calculated with a population of > 10 spot analyses. The sparse and small ($< 10\mu\text{m}$) spinel crystals present in some of the more reduced experiments prevented us from obtaining large populations of analytical spots. For the spinels, the number of analytical points ranges from five to eight analyses. Typically, the 1σ standard deviation for a given population of vanadium analyses was greater than the 2σ analytical uncertainty derived from x-ray counting statistics; therefore we feel the use of the 1σ standard

deviation is a more accurate portrayal of the actual uncertainties that arise from subtle compositional inhomogeneity (in the olivine and spinel).