ELEMENTAL FRACTIONATION AND MOBILIZATION IN EQUILIBRATED L FALLS DUE TO SHOCK-RELATED HEATING.

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Introduction: Of all major chondrite groups, L chondrites experienced the most extreme episode(s) of post-metamorphic shock-related alteration, culminating in the massive impact(s) disrupting the L parent(s) ~500 Ma ago. Our previous work indicated that shock-related (re)heating is the primary source of equilibrated L fall trace element compositional patterns; we found no relation between petrographic type and composition [1,2]. Our studies suggest differences arise from open-system loss of thermally labile elements along with subtle metal/silicate partitioning during the extended cooling of shock-heated bodies [1].

Methods: To further examine the role of open-system (re)heating on the compositional patterns of L chondrite falls, we compare the thermally labile element content of our large (n=48), chemically representative [3], L chondrite suite with those of artificially heated Krymka (LL3.1) [4].

Additionally, using the multivariate statistical metrics discriminant analysis (DA) and logistic regression (LR), we compare major element content of mildly- (n=12) and strongly- (n=25) shocked L chondrite suites. We chose this sub-suite because our trace element determinations were done on homogenized aliquots used for major elements quantification [cf. 1,5], making direct comparison with previous results unambiguous.

Results and Implications:

Trace elements and mobilization. When comparing volatile element content of our L suite with heated Krymka, several points become evident. First, mobile elements In, Bi, Tl are more markedly depleted in many strongly-shocked L chondrites than in 1000°-heated Krymka. Although Zn, Se, Te also show systematic depletions in highly-shocked L samples, only one sample shows depletion of these elements greater than Krymka heated to 650°. Zn, Se, and Te were likely partially retained in a S-rich partial melt that was incompletely segregated from bulk L material unlike In, Bi, and Tl, which were more readily vaporized during the same heating episodes.

Statistical comparison of major element content. Comparisons of our two L suites based on major lithophiles (SiO_2, MgO, Al_2O_3, CaO, Cr_2O_5) and permutations of them yield DA and LR model-dependent [1 and references therein] p-values of <0.05 (highly statistically significant). DA and LR comparisons based on major siderophile (and S) content (FeO, FeS, Fe_m, Ni) yielded poor separations with p-values >0.3. Excellent separation is possible when diverse geochemical species (e.g. MgO, Cr_2O_5, MnO, FeS; model-dependent p-values DA: 0.010 and LR: 0.008) are considered. Further investigation shows that, like trace elements, the strongly-shocked suite is enriched in lithophiles compared to mildly-shocked L falls with a corresponding mean depletion of siderophile content.

References: [1] Friedrich J. M. et al. 2004 *Geochim. Cosmochim. Acta*, in press. [2] Friedrich J. M. and Lipschutz M. E. 2002 Abstract #1086, 33rd LPSC. [3] Friedrich J. M. et al. 2003 *Geochim. Cosmochim. Acta* 67: 2467-2479. [4] Ikramuddin M. et al. 1977 *Geochim. Cosmochim. Acta* 41: 393-401. [5] Jarosewich E. 1990 *Meteoritics* 25: 323-337.