EVIDENCE FOR CHEMICAL VARIATIONS WITH SHOCK LOADING IN L CHONDRITE FALLS. J. M. Friedrich[1], J. C. Bridges[2], and M. E. Lipschutz[1], [1] Department of Chemistry, Purdue University, 1393 Brown Building, West Lafayette, IN, 47907-1393 USA, [2] Department of Mineralogy, Natural History Museum, Cromwell Road, London SW7 5BD, U.K.

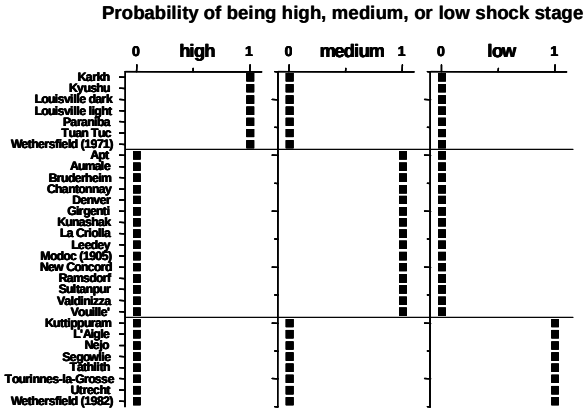
Introduction: We have analyzed 62 equilibrated L chondrite falls for 51 elements by ICPMS and RNAA. We use our data to identify post-accretionary geochemical fractionations in the L chondrite parent body or bodies. Herein, we describe statistically significant chemical effects arising from tertiary processes, or geochemical fractionations resulting from shock related heating episodes.

Method: We analyzed 62 L 4-6 chondrite falls for 51 elements by ICPMS and RNAA. [1-3]. Elements analyzed by our ICPMS method include (by increasing Z): Li, Sc, Ti, V, Mn, Co, Cu, Zn, Ga, As, Se, Rb, Sr, Y, Zr, Nb, Mo, Ru, Pd, Sn, Sb, Te, Cs, Ba, REE, Hf, W, Re, Ir, Pt, Th, U [3]. The 14 elements analyzed by our well-documented RNAA technique [4] include (by increasing lability): Co, Ag, Sb, Ga, Rb, Cs, Se, Au, Te, Zn, In, Bi, Tl, Cd. From our analyzed group of chondrites, we have excluded samples that exhibit unique REE patterns and meteorites that are breccias or regolith breccias, since these meteorites' chemical signatures could affect our data analysis [5], [6]. When these samples are excluded, our suite consists of 47 L chondrite falls representing all stages of shock loading.

Our goals when examining the L chondrite results are to deconvolve secondary (parent body) and tertiary (shock-related) effects on elemental concentrations of L chondrite falls. Here, we focus on tertiary effects evident in the chemical composition of L chondrites. Since shock stage or facies classifications are accurate to about ±1 units, during this study we focus on simply low (S3), medium (S4), and high (S5-6) suites of shock-loaded L6 chondrites. Our previous examination hinted that petrographic type may also exhibit elemental concentration differences so we focus on only L6 chondrites here [7].

Discussion: In a limited suite of L chondrites, tertiary processes, or shock heating, have been shown to cause statistically different concentrations in highly labile elements where the greater the shock loading, the greater the loss of highly labile elements [8]. We have previously compared geometric means of 51 analyzed elements between high and low shock-loaded suites of 62 L chondrite falls [9]. No individual element exhibited a highly significant statistical difference; however, obvious trends suggested that lithophile element contents, on a CI1 (Orgueil) weight-normalized basis, are *enriched* in samples exhibiting higher shock-loading and, as expected, highly labile elements are generally depleted in our highly shock-loaded suite. Likewise, siderophile contents in the high shock suite seem to be lower than that of the low shock group.

Figure 1: Discriminant analysis results based on 30 lithophile and thermally labile elements.



No Misclassifications

We are continuing our expanded study by using multivariate statistics to interpret compositional data for our suite of L chondrites. Discriminant analysis results for the 30 L6 chondrites in our suite show highly significant statistical differences between the low, medium, and highly shock loaded L6 samples. Our current statistical programs (JMP version 3.1) only allow for 30 input elements so we show data based on 30 lithophile and thermally labile elements: Hf, Lu, Zr, Y Ti, Sc, Er, Th, Ho, Tm, Dy, Tb, Gd, U, Nd, Pr, Sm, La, Ce, Nb, V, Yb, Eu, Sr, Ba, Te, Zn, In, Bi, Tl, Cd. Figure 1 shows P values for discriminant analysis of the three suites of L6 chondrites: our analysis indicates a perfect relationship between trace element content and shock stage. P values can range continuously from 0 to 1: in our case meteorites clearly show either membership in a suite (P=1) or are not associated (P=0) with a category. It is highly significant that no misclassifications or values other than 0 or 1 are present after statistical treatment and analysis. According to the computer-model-dependent results, the chances of this occurring randomly are zero.

Conclusion: Preliminary examination by discriminant analysis demonstrates statistical differences in chemical fractionations due to shock loading when comparing three groups of L6 chondrite fall suites characterized by shock loading. Continued statistical analysis and

the addition of the remainder of L chondrite falls to the study will give additional insight into recognizable chemical signatures due to varying amounts of shock loading present in L chondrite samples. Addition of L4 and L5 samples to the statistical study should allow us to deconvolve secondary and tertiary effects resulting in observed chemical and elemental composition of the L chondrite parent body or bodies.

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