VOLATILE/MOBILE TRACE ELEMENTS IN LL4-6 CHONDRITES; Patrick W. Kaczaral and Michael E. Lipschutz, Purdue University, W. Lafayette, IN 47907 U.S.A.

For about 2 decades, it was known that L chondrites generally experienced significant, late collisional shock-heating that H chondrites escaped. The effect of this upon volatile trace elements was not considered and it was assumed that contents in all ordinary chondrites (the unitarian philosophy) reflected but one genetic process, primary condensation and accretion. Relatively recently, our group demonstrated that shock heating was sufficient to mobilize (vaporize and deplete) certain trace elements: in fact, mobile trace element contents of non-Antarctic L4-6 chondrites predominantly reflect such fractionation [1-3]. Contents of these elements in non-Antarctic H4-6 chondrites do not reflect late processes but, rather, an early high temperature episode that L chondrites escaped [4]. Since unitarianism fails to hold, it seemed worthwhile to determine systematically mobile element contents of the little-studied LL chondrites, known, however, as shock-brecciated. Moreover, since Antarctic H and L chondrites differ compositionally, hence genetically, from non-Antarctic brethren [5,6], we wanted to similarly compare LL chondrites. Here, we report results.

We used RNAA to determine Co, Au, Se, Ga, Rb, Cs, Te, Bi, In, Ag, Zn, Tl and Cd in 11 non-Antarctic LL4-6 non-Antarctic falls and 13 Antarctic LL5, 6 samples of weathering types A or B (7 from Victoria Land and 4 LL6 samples from the Yamato Mts., Queen Maud Land). We made our usual special efforts to exclude paired Antarctic samples.

Using for LL6 chondrites, the same statistical tests used earlier for comparing Antarctic and non-Antarctic H5 and L6 chondrites, differences beyond those attributable to chance are evident (Table 1). For 5 Victoria Land samples, 3 elements differ: when augmented with 4 Yamato Mts. samples, 7 elements differ, compared with 8 each for H5 and L6 chondrites. Hence, there is additional strong reason to doubt that Antarctic and non-Antarctic meteorite sample populations derive from the same parent population.

We do not yet have petrographic data to characterize shock histories of LL chondrites. For H and L chondrites, Antarctic and non-Antarctic congeners differ e.g. in shock history distribution [5]. The few existing non-Antarctic LL4,5 chondrite falls have lesser trace element contents than do LL6 chondrites: 5 elements differ at statistically significant levels (Table 2). Whether these differences reflect disproportionately high degree of shock in LL4,5 chondrites or some other cause must be established.

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Table 1. Statistically significant (>90% confidence level) differences between specific chemical-petrologic types of ordinary chondrites from Antarctica and non-Antarctic falls.

		H5†			L6†			LL6				
		V.L. (22)	Non. (20)	Sig.	V.L. (13)	Non. (25)	Sig.	V.L. (5)	Non. (11)	Sig.	V.L.+Y. (9)	Sig.
Co	(ppm)*				480	600	97					
Au	(ppb)*				140	160	90	90.8	141	95	106	94
Sb	(ppb)	83	69	97								
Se	(ppm)*	9.0	8.2	99					7.3		8.7	91
Rb	(ppm)	2.0	2.5	97	2.6	2.2	95					
Cs	(ppb)				4.02	12.4	99					
Te	(ppb)*				340	380	90		410		310	95
Bi	(ppb)	2.8	1.14	98	0.58	2.7	99		6.4		2.5	91
Ag	(ppb)				45	71	97					
In	(ppb)	0.21	0.49	97				1.22	0.37	98	0.83	96
Tl	(ppb)	0.81	0.24	96								
Zn	(ppm)*	42.8	53.1	96					59		48	93
Cd	(ppb)	0.72	3.7	99	1.6	14.2	99	1.00	3.2	94	1.06	97

*Arithmetic means: all others are geometric means.

†References: H5- Lingner et al. (1985); L6 - Kaczaral et al. (1985).

Column Headings: V.L. - Victoria Land (Antarctica); V.L.+Y. - Victoria Land and Yamato Mts. (Antarctica); Non.-Non-Antarctic falls; Sig. - Significance level at which it may be concluded that the respective sample populations do not derive from the same parent population. Numbers in parentheses are number of samples analyzed in that population.

Table 2. Significant compositional differences with petrologic type of non-Antarctic LL chondrites. (See notes to Table 1)

Element	LL4,5 (3)	LL6 (11)	Sig.
Ga(ppm)*	4.22	5.3	93
Cs(ppb)	17	79	96
Te(ppb)*	240	410	97
Bi(ppb)	1.23	6.4	95
Ag(ppb)	24	50	96