CHEMISTRY OF THE SHERGOTTITES ELEPHANT MORAINE A79001 AND ZAGAMI.

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In continuation of our studies regarding the geochemistry and the petrogenesis of shergottites (1), we have analyzed two lithologies A and B from A79001 and Zagami by INAA (Table 1). The unique Antarctic meteorite A79001, studied by a consortium headed by H.Y. McSween, represents two contiguous layered lithologies that have occurred on at least one parent body, that of shergottites. Chemical analyses of lithology C and mineral separates from A79001 are currently in progress and the results will be presented at the Conference.

A79001: Major and minor element abundances in lithologies A and B (Table 1) are similar to those obtained by (2). The normative mineralogy indicates that A and B contain ∿16 and 2% ol, 44 and 34% low-Ca pyx, 19 and 26% high-Ca cpx, 19 and 35% plag, 1 and 0.3% chr, and 1 and 2% ilm, respectively. Lith-A is characterized by its lower TiO_2, Al_2O_3, CaO, Na_2O, K_2O and REE and higher FeO, MgO, Cr_2O_3, Co and Ni abundances relative to those in lith-B. Both Mg' (≡(Mg/(Mg+Fe) molar) and (CaO/Al_2O_3) wt ratios of lith-A (0.60 and 1.23, resp.) are higher than those of lith-B (0.43 and 0.99, resp.). The REE patterns for both A and B are nearly identical and are similar to those of shergottites (1, 3, 4). All above mentioned chemical characteristics of A and B indicate that lith-B is more fractionated than lith-A.

Zagami: To obtain both major and trace element data from the same aliquant of shergottites (Shergotty or Zagami), that are lacking and important for petrogenetic discussions of coarser-grained rocks, and to resolve the discrepancy between REE patterns obtained by INAA (5) and isotope dilution (ID) technique (3, 4), we have analyzed a 40 mg aliquant of Zagami provided by C.-Y. Shih and L.E. Nyquist. Major and minor element abundances are comparable to those obtained by (5, 6) except the aliquant analyzed has ∿12% higher Al_2O_3 abundance. The REE abundances are ∿0.6X those obtained in another aliquant by I.D. (4) and a positive Eu anomaly appears to be present. These data confirm the unique fractionated Zagami pattern (4) and the REE patterns in Shergottites in general (1, 3) and do not support the flat REE pattern reported by (5).

Petrogenesis: It has been suggested (7) that the major and minor element abundances in lith-B of A79001 can be derived by fractional crystallization of ∿28% opx, 16% ol, and 0.6% chr from a composition like that of lith-A. Difficulties with this suggestion are evident because 1) fractional crystallization of ∿44% mafic phases (ol+opx) would result in a Mg' for B of less than 0.30 even if the magma temperatures were as high as ∿1500°C; 2) the groundmass grain sizes of A are significantly smaller relative to those of B (7) which suggests that the groundmass in A is more likely to be a residual liquid than B; and 3) the phenocrysts in A are strongly zoned to Fe-rich indicating that the phenocrysts are not in equilibrium with the surrounding liquid (a case which can be explained if Fe-rich residual liquid were injected into cumulate ol and opx). More likely, lith-A is a product of mixing.

Another interpretation of the data invokes an impact induced partial melting from a cumulate ol and pyx source which would produce liquids with the observed relative REE and other incompatible element abundances.

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Migration of such liquids into cooler surrounding unmelted cumulus phases would result in the lith-A. Since the liquid formed by partial melting is primarily composed of ol and opx these phases will only be on the liquidus. Fractional crystallization of these phases would proceed until plag saturation is reached. Once plag begins to crystallize, the entire magma solidifies resulting in a hypidiomorphic granular texture observed in lith-B. This senario can be expanded to include all of the shergottites. Fig. 2 illustrates the mixing lines predicted using averaged data (1, 5, 6, 7, 9, 10, 11 and this work). Since there is little reason to believe that all of these shergottites came from the same impact triggered melting event the degree of partial melting may vary the relative abundances of the highly incompatible trace elements. Also, their very similar REE+Sc and other trace element profiles suggest that the shergottites were all derived from similar cumulate sources, a point which is also supported by the major and trace element data fits in Fig. 2.

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Table 1
Element abundances in Elephant Moraine ALHA 79001 and Zagami shergottites*

	Lithology A 310 mg	Lithology B 301 mg	Zagami 40 mg
TiO_2(%)	0.6	1.1	0.8
Al_2O_3	5.6	10.5	6.4
FeO	19.2	17.9	19.0
MgO	16.3	7.5	11.1
CaO	6.9	10.4	10.6
Na_2O	0.87	1.62	1.21
K_2O	0.04	0.07	0.14
MnO	0.469	0.413	0.502
Cr_2O_3	0.612	0.175	0.291
Sc(ppm)	37	50	53
V	210	206	312
Co	48	30	36
La	0.42	0.82	0.90
Nd	-	3	-
Sm	0.78	1.50	0.76
Eu	0.38	0.72	0.44
Tb	0.24	0.55	0.22
Dy	1.7	3.7	1.7
Yb	1.11	2.04	0.98
Lu	0.19	0.30	0.13
Hf	0.97	1.81	1.7
Ta	(0.02)	(0.08)	0.2
Ni	150	20	-

*Estimated errors due to counting statistics are: Al_2O_3, FeO, Na_2O, MnO, Cr_2O_3, Sc, Co, Sm and Eu, ±1-5%; MgO, CaO, V, La, Yb, Lu and Hf, ±5-10%; TiO_2, K_2O, Tb and Dy, ±10-20%; Nd, Ta and Ni ≳ 30%.