THE LUNAR METEORITE ELEPHANT MORAINE 87521: A MIXTURE OF LOW TI MARE BASALT AND HIGHLAND MATERIAL?; G. Dreibus, H. Palme, B. Spettel and H. Wänke, Max-Planck-Institut für Chemie, Saarstrasse 23, D-6500 Mainz, F.R.Germany.

Originally, the meteorite EET 87521, recently found in Antarctica, was identified as basaltic achondrite (1). However, based on detailed petrological investigations and trace element chemistry, Delaney (2) and Warren and Kallemeyn (3) demonstrated that this meteorite is a lunar mare basalt.

From a total of 30.7 g, we obtained the matrix chip EET 87521.46 (0.364 g). From this, two bulk samples of 39 mg and 73 mg, respectively, were prepared for INAA.

Preliminary results of the bulk chemical composition are given in the Table, and are compared to the earlier analysis of Warren and Kallemeyn (3). Our two bulk samples are chemically very similar but show large differences in major and trace elements to the sample analysed by Warren and Kallemeyn.

Table 1: Preliminary data on composition of EET 87521.46

		1 38.9 [mg]	2 73.4 [mg]	3*) 278 [mg]
Mg	%	5.58		3.8
Al		7.80		6.6
Ca		7.8	7.9	8.3
Ti		0.39		0.68
Fe		12.52	13.3	14.9
Na	ppm	2360	2500	3060
K		330	300	570
Sc		31.4	34	44
Cr		1980	2150	1470
Mn		1535	1610	1890
Co		47.2	50	46
Ni		<50		29
Ga		4.33	4.0	5.27
Sr		120	60	104
Ba		62	56	88
La		5.04	4.7	8.3
Ce		14.1	10	20.9
Nd		8.1	-	13.0
Sm		2.43	2.40	3.86
Eu		0.66	0.70	0.98
Tb		0.55	0.52	0.80
Dy		3.42	3.3	4.8
Ho		0.66	0.66	-
Yb		1.99	2.0	3.19
Lu		0.29	0.30	0.48
Hf		1.83	1.92	2.88
Ta		0.19	<0.2	0.37
Ir		<0.003	<0.005	<0.001
Th		0.67	0.61	0.95
U		0.18	0.18	0.23
Mg*		0.51		0.37

) EET 87521.6 = Warren and Kallemeyn (1989); Mg = atomic Mg/(Mg+Fe)

As pointed out by (3), the Fe/Mn ratio of 80 in EET 87521 is in agreement with the ratio in lunar samples, but a factor of two higher than in eucrites. Also, its Co concentration of 46 ppm exceeds the Co content in eucrites by a factor of 10, but fits very well into the lunar correlation diagram of Co vs. MgO + FeO (4), (Fig. 1).

In Fig. 1, the EET 87521 plots in the field of low Ti-mare basalts, reflecting the mare basalt character of this meteorite. All other lunar meteorites plot among the data points of highland breccias slightly below the correlation line for pristine highland rocks.

The major differencies in chemistry between our sample EET 87521.46 and that of Warren and Kallemeyn, EET 87521.6, are: (a) Mg and Cr is a factor of 1.4 higher in our sample, but Fe is lower, leading to a large difference in the Mg*-number (Table). (b) In our sample the incompatible elements including K are lower by a factor of 1.7. (c) Our sample has higher Al, but similar Ca, resulting in a lower Ca/Al-ratio of 1.04 more representative of highland samples than the ratio of 1.3 found by (3). Warren and Kallemeyn reported the presence of highland material in their sample. The high Al-content of our sample probably indicates an even higher fraction of plagioclase of highland origin. This is clearly evident from the Fe-Sc and Ga-Al plots (Figs. 2 and 3), where our sample (EET 87521.46) plots in the direction of highland basalts. A similar shift towards highland samples is also seen in Fig. 4. The lower content of incompatible elements in our sample is probably the result of dilution by a higher plagioclase content.

Both, the Warren and Kallemeyn (3) sample and our sample have similar Mg/Cr-ratios, typical of mare basalts, but different from highland breccias (Fig. 5). The reason for the high Mg- and Cr-contents of our sample is unclear. It may reflect a higher modal content of olivine and chromite. The much higher Mg*-number of our sample could indicate a more primitive, i.e. less evolved magma composition. However, the essentially parallel patterns of incompatible elements in the Warren and Kallemeyn sample and in our sample make a relationship by differentiation unlikely.

Figures modified from: Fig. 1 ref. (4); Fig. 2 ref (5); Fig. 3 ref. (6); Fig. 4 ref. (7) and Fig. 5 ref. (6).

Ref.: (1) Schwarz, C. and Mason, B., 1988, Antarct. Meteorite Newsl. **11**, 21. (2) Delaney, J.S., 1989, Nature **342**, 889. (3) Warren, P. H. and Kallemeyn, G.W, 1989, Geochim. Cosmochim. Acta **53**, 3323. (4) Wänke H. et al., 1990, LPSC XXI, 1289. (5) Wänke H. et al., 1976, PLSC 7th, 3479. (6) Palme H. et al., 1991, submitted to GCA. (7) Wänke H. et al., 1975, PLSC 6th, 1313.

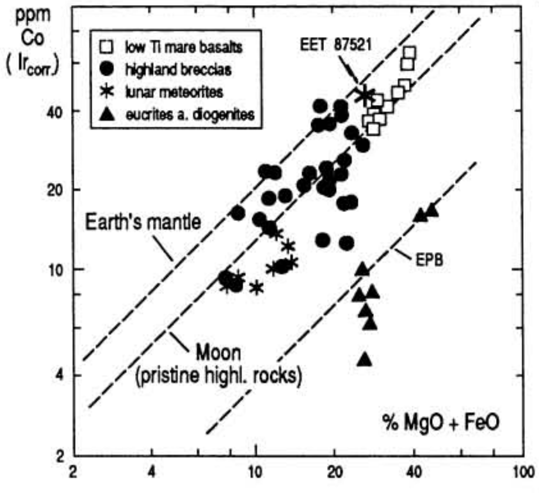


Fig. 1

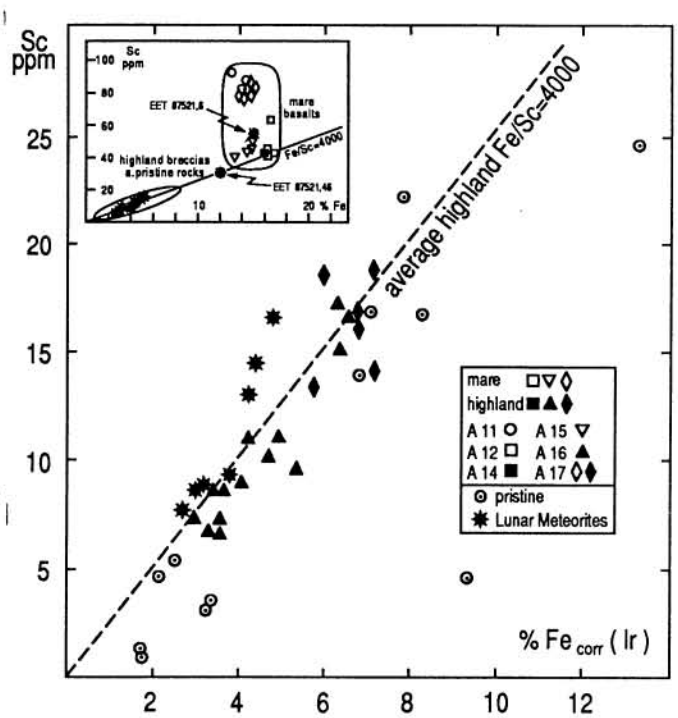


Fig. 2 →

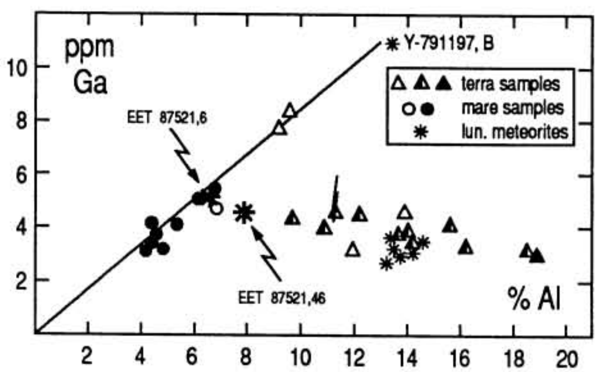


Fig. 3

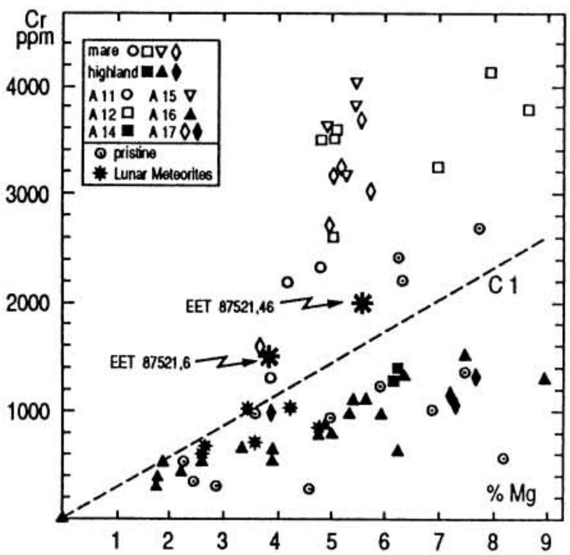
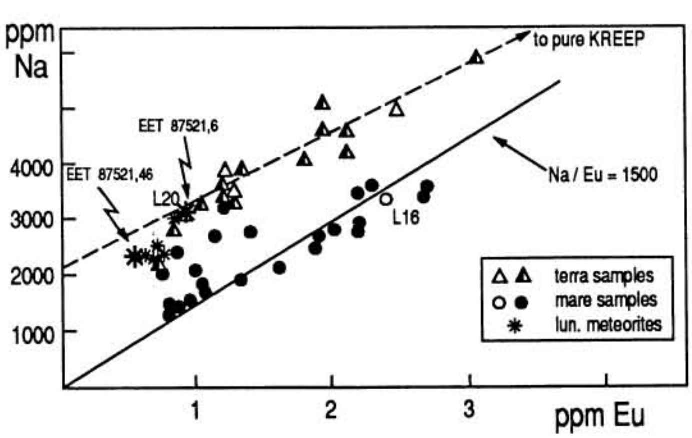


Fig. 5



← Fig. 4