COMPARISON OF THE CHEMISTRY OF Y-000593 AND Y-000749 WITH OTHER NAKHLITES.
G. Dreibus, W. Huisl, B. Spettel, and R. Haubold, Max-Planck-Institut f. Chemie, P.O. BOX 3060, D-55020 Mainz, Germany, (dreibus@mpch-mainz.mpg.de).

Introduction: Nakhlites are a small group among the Martian meteorites (SNC) with until today altogether 5 meteorites: Nakhla, Lafayette, Governador Valadares, NWA 817, and the paired samples Y-000593 and Y-000749. Nakhlites are augite and olivine cumulates of similar chemical composition and ages (1.3 Ga). We have studied with different methods the two paired nakhlites recently discovered in Antarctica by one of the Japanese Antarctic expeditions. The chemical composition of the two paired samples is much more uniform compared to Nakhla.

Results: Our results obtained by INAA, RNAA, C-S analyzer and ion selective electrode (ISE) are reported in Table 1. This table also contains our results for Lafayette and two aliquots of Nakhla, which we received from A. El Goresy (Nakhla El G.) and from M. Grady, British Museum (Nakhla Grady). The analytical results of one Nakhla sample from the National Museum in Vienna have been published earlier [1]. The chemical similarity of the Yamato nakhlites clearly shows that the two samples are indeed paired. The REE patterns in Fig. 1 show no great variations among Nakhla, Yamato nakhlites, and Lafayette.

REE-U-Th in Nakhlites

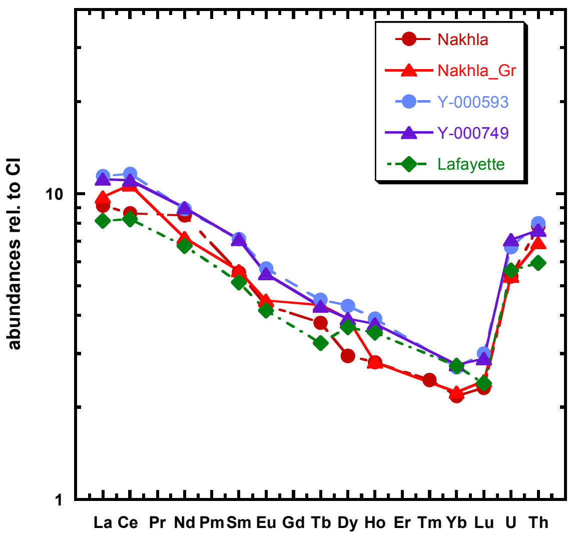

Fig. 1: Similarity of the REE patterns of 3 nakhlites.

Table 1: Analytical results of nakhlites.

	Nakhla (El G.)	Nakhla (Grady)	Y-000593	Y-000749	Lafayette
CaO %	14.7	14.4	13.7	13.7	13.2
FeO	16.08	19.54	21.01	22.41	20.13
Na_2O	0.729	0.574	0.643	0.593	0.427
S	0.067	0.032			0.034
K	0.107	0.122	0.127	0.134	0.095
Cr_2O_3	0.281	0.267	0.248	0.243	0.275
MnO	0.421	0.476	0.513	0.520	0.515
Li ppm			4.6		3.9
C	500	270			673
F	52	69	264		74
Cl	1890	876	101		101
Sc	56.1	55.5	58.2	57.8	51.1
Co	36.9	44.8	43.9	49.1	45.4
Ni	58	60	56	72	90
Zn	<70	70	89	105	79
Ga	3.7	3.4	3.8	3.9	3.5
Br	3.46	8.45	0.078	0.26	0.59
Rb	<4	<7.0	4	4	3.3
Sr	65	90	90	100	80
I	0.017	0.026	0.378		0.054
Cs	0.26	0.60	0.36	0.34	0.32
Ba	40	31	32	40	23
La	2.18	2.39	2.79	2.73	2.00
Ce	5.35	6.80	7.41	7.05	5.27
Nd	2.93	3.4	4.19	4.26	3.2
Sm	0.867	0.862	1.095	1.09	0.794
Eu	0.236	0.260	0.325	0.317	0.238
Tb	0.14	0.16	0.16	0.16	0.12
Dy	0.90	0.99	1.1	0.99	0.93
Ho	0.18	0.16	0.22	0.21	0.20
Yb	0.35	0.37	0.46	0.455	0.445
Lu	0.052	0.061	0.076	0.072	0.059
Hf	0.31	0.28	0.40	0.38	0.27
Ta	0.096	0.10	0.115	0.105	0.098
W ppb	170	320	300	200	200
Au	7.5	0.5	2.6	1.9	3.4
Th	170	200	230	220	190
U	<60	44*	55	58	43

* measured by isotope dilution

However, the three Nakhla specimens reveal great differences in the concentrations of Fe, S, Cs and halogens [2, 3]. Halogens in Nakhla are discussed controversially by various authors [4, 5, 6]. All nakhlites display evidence for aqueous alterations in form of iddingsite. A pre-terrestrial origin of the high Br and also unusually high Cl contents in Nakhla is debated since many years. We proposed the overabundances of Cl and Br in Nakhla as a terrestrial contamination [3]. The high variability of Cl and Br in the different Nakhla samples and the high solubility (90 %) of these elements during water leaching experiments within 10 minutes indicate terrestrial contaminations. The overabundance of Br in Nakhla samples is demonstrated in the plot of La versus Br in Fig. 2. In principle, a perfect correlation of La with Br is found for Martian meteorites. The exceptions are Nakhla and the basaltic shergottites with a high portion of olivine, DaG 476, Dhofar 019, and SaU 005, collected in hot deserts. All olivine-rich shergottites from hot deserts contain terrestrial alteration products explaining the unusually high Br concentrations. Surprisingly, the hot desert nakhlite NWA 817 [7] plots on the correlation line with the other SNCs. With the Yamato nakhlites we have two nakhlites found in a cold desert. In Antarctica, however, we face the problem of iodine contamination caused by aerosols [8]. Iodine can penetrate into the meteorite during its storage in Antarctica, whereas such a contamination was not observed for Br. Also the iodine content of Y-000593 of about 0.4 ppm seems to be at least a factor of 10 too high.

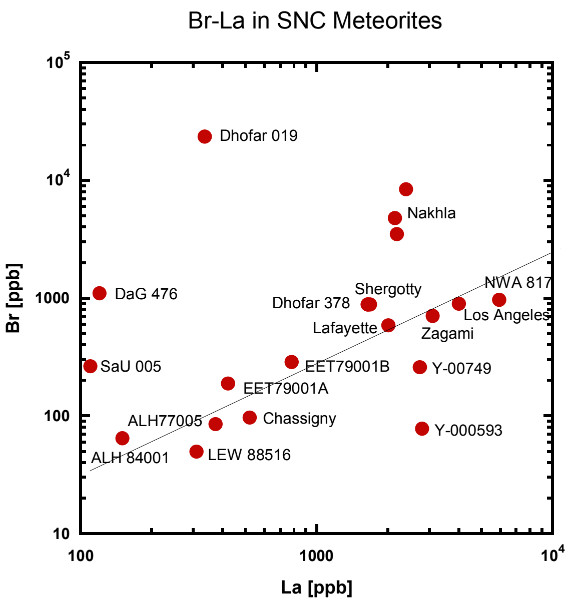

Fig. 2: La-Br correlation for SNC meteorites.

The Cl content of 100 ppm is similar to that measured in Lafayette, but the Br content of only 78 ppb is a factor of 8 too low. An explanation might be a possible interaction of Antarctic ice, respectively water, with this meteorite by extracting a salt component. Y-000749 has a Br content of 260 ppb which correlates with La as illustrated in Fig. 2. The low Br content in the new nakhlites from hot and cold deserts might be a further evidence for our arguments of a terrestrial contamination in Nakhla, even if Nakhla is the only fall among the nakhlites.

The major elemental abundances with respect to Mg, Al, and Si are also similar among Lafayette, Nakhla, and the Yamato nakhlites as shown in the Mg/Si versus Al/Si plot (Fig. 3). In this diagram the shergottites and the olivine cumulate Chassigny plot along the Mars mantle-crust fractionation line. However, the pyroxene cumulates ALH 84001 and the nakhlites with their low Al contents are away from this line. Y-000593 has similar Mg/Si and Al/Si ratios [9] as determined for Lafayette and Nakhla, whereas the Al content of NWA 817 [7] is about twice as high.

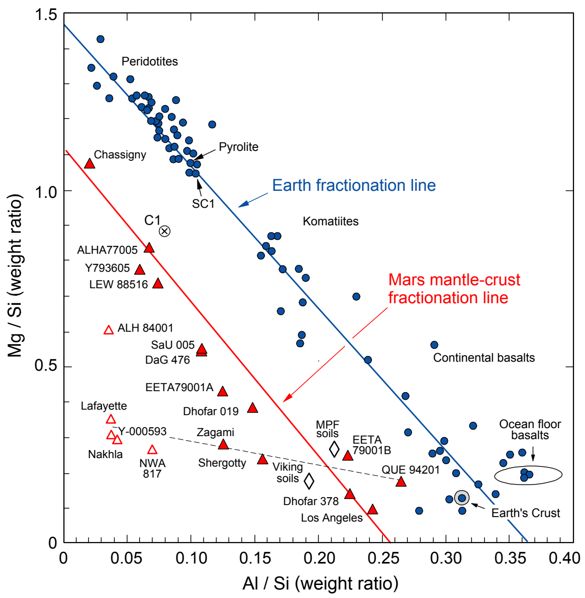

Fig. 3: Nakhlites in the Mg/Si vs. Al/Si diagram.

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