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OVERVIEW OF MARS: SNC METEORITE RESULTS, H. Wänke, Max-Planck-Institut für Chemie, Saarstrasse 23, D-6500 Mainz, F.R.Germany.

The SNC meteorites according to their oxygen isotope ratios (1) and various trace element ratios (2-3) form a distinct group of 8 achondrites. Their young crystallization ages and fractionated REE pattern which exclude an asteroidal origin, were the first observations to point towards Mars as their parent body (4-6). Further evidences came from the discovery of a trapped rare gas and nitrogen component with element and isotope ratios closely matching the highly characteristic ratios of the Mars' atmosphere (e.g. $^{40}Ar/^{36}Ar$; $^{14}N/^{15}N$; $^{14}N/^{40}Ar$ and $^{129}Xe/^{132}Xe$) in shock glasses of shergottite EETA 79001 (7-9). Jagoutz and Wänke (10) obtained for Shergotty a Sm/Nd age of 360±16 myr. The 180±20 myr Rb-Sr age found in shergottites had been interpreted as shock age (11-12), as true crystallization age (13) and as thermal spike due to by endogenic process (10). Recent work on ALHA 77005 (14) yielded a crystallization age of 154±6 myr and a shock age of 15±15 myr, which agrees with the cosmic ray exposure age of 2.7 x 10^6yrs (15) and, hence, obviously dates the ejection of this meteorite from its parent body. Jochum and Palme (16) observed that the range of variation of the Zr/Nb respectively Hf/Ta ratios for the SNC's is intermediate between that of the Earth and the Moon (Fig. 1). In spite of the numerous arguments for Mars as the parent body of the SNC meteorites there does not exist a generally accepted model for the ejecting process and other dynamical problems involved (17). In the following discussion it is, however, assumed that Mars is indeed the SNC parent body.

Compared to the terrestrial mantle the higher FeO content of the shergottites reflects the higher FeO content of the Martian mantle, while the high MnO and Cr_2O_3 concentrations in shergottites indicates that it is not depleted in MnO and Cr_2O_3. Similarly, phosphorus is much more abundant. Aside pressure effects and the H_2O poverty, the high P content of the Martian mantle could be of influence to magmatic processes. A low degree of fractionation and a large proportion of Mg-rich provinces seem to be further important characteristics of the Martian crust.

On the Earth, the Moon and the eucrite parent body the refractory lithophile elements and Si and Mg are present in these objects within ± 30% in C 1 abundances. The same holds for Fe if we neglect the Moon. The major differences in the compositions of planets lie in the Fe_{metal}/FeO-ratio in the concentrations of the moderately volatile and volatile elements and in the distribution of chalcophile and siderophile elements between mantle and core. With these assumptions and the use of a number of element correlations Dreibus and Wänke (18) calculated the composition of the Martian mantle (Table 1 and Fig. 2). Similar to the case of the Earth almost identical depletions for a number of geochemically very different elements are found for the Martian mantle. The mean abundance value for the elements Ga, Fe, Na, P, K, F and Rb in the Martian mantle is 0.35 and, hence, exceeds the terrestrial values by about a factor of two. The composition can successfully be explained in term of the two component model (19,20). According to this model the terrestrial planets are formed from a highly reduced component A almost free of all elements more volatile than Na and an oxidized component B containing all elements in C 1 abundances but with different mixing ratios. In the Martian mantle there are, however, a number of elements which relative to Fe, Na, Ga, K, F and Rb have either a higher abundance as in the case of W, or considerably lower abundances as in the case of Zn, Co, Ni, Cu and In. The latter elements all have rather strong chalcophile character. These depletions point towards homogeneous accretion. The high portion of component B which supplied large amounts of sulphur was obviously responsible that FeS became a major phase and at its segregation extracted all chalcophile elements according to their sulfide-silicate partition coefficients. These partition coefficients are low for W, Cr and Mn. The bulk composition of Mars (mantle+core, Table 1) is in excellent agreement with the geophysical data of the planet.

The SNC meteorites are extremely dry rocks. Shergotty contains 180 ppm H_2O which would indicate about 36 ppm H_2O for the Martian mantle. This is exactly the value obtained by comparing the solubilities of H_2O and HCl in basalts (21). The amount of ^{132}Xe in Shergotty (22) compared with the ^{132}Xe in the Martian atmosphere (23), yields an upper limit for the degassing efficiency of the Martian mantle of about 40%, while a lower limit of 2.6% can be obtained from the amount of ^{40}Ar released to the atmosphere. Assuming the degassing efficiency of H_2O to be within these limits, we obtain for the amounts of H_2O released to the surface values which would correspond to surface layers (ocean) of about 3.5 to 50m depth.

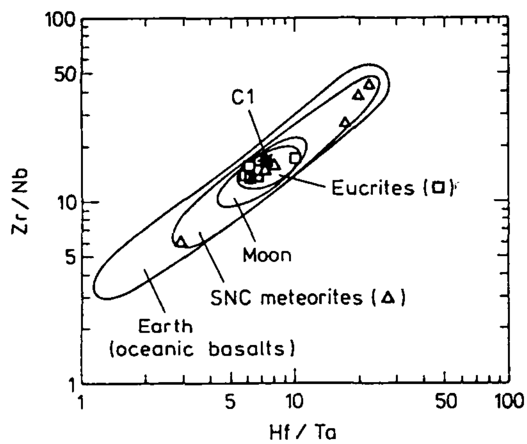

Fig.1

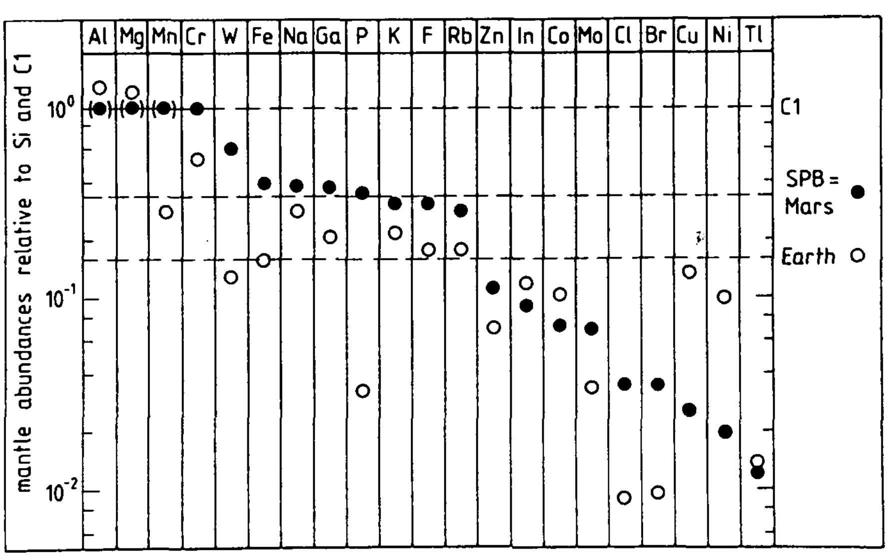

Fig.2

Table 1: MARS

Mantle + crust		
MgO	%	30.2
Al_2O_3		3.02
SiO_2		44.4
CaO		2.45
TiO_2		0.14
FeO		17.9
Na_2O		0.50
P_2O_5		0.16
Cr_2O_3		0.76
MnO		0.46
K	ppm	305
Rb		1.06
Cu		5.5
Zn		74
Ga		6.6
Mo	ppb	118
In		14
Tl		3.6
Cl	ppm	38
Br	ppb	145
I		32
La	ppm	0.48
Th	ppb	56
U		16
Core		
Fe	%	77.8
Ni		7.6
Co		0.36
S		14.24
Core mass	%	21.7

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