D5-90

34 39, 9

N86-28816

MM504502

9143

MYSTERIOUS IODINE-OVERABUNDANCE IN ANTARCTIC METEORITES.

G. Dreibus, H. Wänke and L. Schultz, Max-Planck-Institut für Chemie, 65 Mainz, F.R. Germany.

Halogen as well as other trace element concentrations in meteorite finds can be influenced by alteration processes on the Earth's surface. The discovery of Antarctic meteorites offers the opportunity to study meteorites which have been kept in one of the most sterile environment of the Earth. However, many of the Antarctic stony meteorites are badly weathered and can be classified with respect to their degree of weathering and fracturing. Of meteorites found in Antarctica we have analysed 9 eucrites, 1 howardite, 1 diogenites, 2 shergottites, 1 carbonaceous chondrite (C2) and 1 H-chondrite (H3). These meteorites were collected in the following areas: Allan Hills (ALH), Elephant Moraine (EET), Pecora Escarpment (PCA), Thiel Mountains (TIL) and the Yamato Mountains (Y).

Table 1 gives the data of our halogen determination in Antarctic meteorites compared with non-Antarctic samples. The important result of this study is the iodine-overabundance in most of the Antarctic meteorites compared to the respective values in non-Antarctic meteorites. We find no correlation between iodine concentration and weathering index, or terrestrial age. However, it might by possible that the overabundance of I is restricted to small meteorites only because stones with masses larger than 1 kg show no excess. The polymict eucrites from Elephant Moraine have the highest iodine excess (11-15 ppm), whereas the Shergottite EET 79001 found in the same area has only in one of its two lithologies an I-overabundance. Also mysterious are the different I-concentrations (6 and 0.23 ppm) in the two eucrites ALH 78132 and ALH 79017 which belong to the same meteorite shower but were collected 1978 and 1979.

Even in eucrites PCA 82503 and TIL 82403 collected about 450 km from the South Pole an I-overabundance is found. Among Cl, Br and I the observed relative excess is largest in the case of iodine but also noticeable for Cl in some cases.

Bromine however, seems not enriched in all meteorites studied. Thus the Cl/Br ratios and the I/Br ratios can be used to estimate the overabundance of Cl and I, respectively (Table 2). Relative to C 1-chondrites the I/Br ratio is up to a factor of 1600 higher, the Cl/Br ratio up to a factor of 9.

Beside the I and Cl-enrichment in the Elephant Moraine eucrites (Table 1), we find for these meteorites a drastical depletion of carbon compared to non-Antarctic eucrites whereas the sulfur content is untouched. If the high C-content in the non-Antarctic eucrites is indigeneous and not changed due to terrestrial contamination the observed carbon depletion in the Antarctic eucrites may be related to the weathering process in a cold environment (1).

Chemical alteration effects on Antarctic meteorites due to weathering have been observed previously for various other trace elements (2). Our halogen measurements on Antarctic meteorites indicate a contaminating phase rich in iodine and partly containing also chlorine. The ice beneath meteorites collected in the Elephant Moranie locality is very low in halogenes (Cl=0.31 ppm, Br=0.015 ppm, I= $<$0.2 ppb). However, iodate-rich nitrate deposits have been found in Victoria Land Mountains (3).

An other source for I-contamination could be expected from aerosols. Several investigators (5, 6) have observed that the I/Cl ratio in marine aerosols as well as in marine atmospheric particulates ranges from 100 to 1000 times the value of seawater (Table 2), whereas the Cl/Br ratio is much closer to the seawater value. A further enrichment of I relative to Cl was observed in Antarctic atmospheric particulates as to be expected on the basis of their size

Table 1:	F	Cl	Br	I	C	S	W*	terr.	
			-ppm-				I	Ages $^{4)}$	Weight
								(10^5yr)	(kg)
Eucrites									
ALH 78132	49	51	0.038	6.3			A	1.2	0.656
ALH 79017	39	7	0.063	0.23			A	1.2	0.310
EET 79004	60	49	0.119	11.2	2	2610	B	2.5	0.39
EET 79005	51	105	0.043	15.5	9	1140	A	1.8	0.45
EET 79006	178	463	0.185	11.0			B	1.9	0.72
EET 79011	153	151	0.081	15.2	39	5173	B		0.086
PCA 82502	40	36	0.018	1.1				3.1	0.89
TIL 82403	69	31	0.029	1.1				<0.3	0.050
Y 74450	-	153	0.047	1.176				<0.5	0.24
Sioux Country	21	12	0.11	0.030	783	1023			4.1
Stannern	25	298	0.70	0.20	687	2789			52
Cachari	-	93	0.96	0.48					23.5
Pasamonte	52	26	0.149	0.056					3.5
Béréba	53	16	0.102	0.134					1.8
Jonzac	12	6	0.093	0.010					2.5
Howardites									
Y 7308	6	7.55	0.074	6.6					0.48
Molteno	11	125	0.24	0.28					0.14
Kapoeta	-	147	0.17	0.30					11
Frankfurt T	-	16	0.10	0.05					0.65
Diogenites									
Y 74013	1.5	2.6	0.017	0.010					2.0
Johnstown	2.0	5.5	0.051	0.020					40
Shergottites									
ALH 77005	22	14	0.085	1.72			A	1.9	0.48
EET 79001-A	39	26	0.189	0.10			A		0.79
EET 79001-B	31	48	0.289	0.96			A		
Shergotty	41	108	0.891	0.036					5
Carbonaceous, 2									
Y 74662	42	340	2.67	4.5					0.15
Murchison	38	180	0.61	0.19					100
H-Chondrite									
ALH 78084 (H3)	8	140	0.39	0.129			B/C	<1.4	14.3
Mt. Baldr (H5-H6) (Heumann, pers. communication)				0.171					17.8
Kesen (H4)	8	90	0.36	0.06					135

*W.I. Weathering Index: A is unweathered, C is highly weathered.

Table 2:	I/Cl	$\frac{I/Cl}{(I/Cl)_{C1}}$	I/Br	$\frac{I/Br}{(I/Br)_{C1}}$	Cl/Br	$\frac{Cl/Br}{(Cl/Br)_{C1}}$
Eucrites						
ALH 78132	0.13	160	160	730	1330	5
ALH 79017	0.033	40	3.7	20	110	0.4
EET 79004	0.23	280	94	430	410	1.5
EET 79005	0.15	180	360	1640	2450	9
EET 79006	0.024	30	60	270	2520	9
EET 79011	0.10	120	188	850	1880	7
PCA 82502	0.031	40	61	280	2000	7
TIL 82403	0.036	40	38	170	1070	4
non-Antarctic	$3.9x10^{-3}$	5	0.50	2	180	0.7
Howardites						
Y 7308	0.91	1100	89	400	100	0.4
non-Antarctic	$2.4x10^{-3}$	3	1.0	5	500	2
Shergottites						
ALH 77005	0.12	150	20	90	165	0.6
EET 79001-A	0.0040	5	0.53	2	140	0.5
EET 79001-B	0.020	20	3.3	15	170	0.6
non-Antarctic	$3.3x10^{-4}$	4	0.040	0.2	120	0.4
H-chondrites						
ALH 78084	$9.1x10^{-4}$	1	0.33	2	360	1
non-Antarctic	$6.7x10^{-4}$	1	0.17	1	255	1
Carbonaceous, 2						
Y 74-662	$1.3x10^{-2}$	20	1.69	8	130	0.5
non-Antarctic	$1.1x10^{-3}$	1	0.31	1	295	1
C 1	$8.3x10^{-4}$	1	0.22	1	270	1
Seawater	$2.6x10^{-6}$	$3x10^{-3}$	$8x10^{-4}$	$4x10^{-3}$	300	1
marine aerosol3)	10^{-4}-10^{-3}	1	0.5	2	300	1
marine atmospheric particulates 4)	$5.6x10^{-4}$	1	0.29	1	520	2
Antarc. atmos. partic.4)						
a) McMurdo	$1.3x10^{-2}$	15	1.0	5	73	0.27
b) South Pole	$4.9x10^{-2}$	59	1.0	5	23	0.09
Ice (Elephant Moraine)	$6x10^{-4}$	1	0.013	0.06	20	0.1

distribution. Contrary to Cl the major portion of I is found in particles with radii from 0.3 µm to 0.6 µm and these small particles have a significantly longer atmospheric residence time than larger particles. Thus, the iodine in the aerosol should not show larger variation with its distance from their source area (6).

So far we have not reached a definite conclusion about the I and Cl enrichment processes in achondrites during their storage in Antarctica. A H_2O-leach experiment of the eucrite EET 79006 has shown that from 463 ppm Cl almost all (428 ppm) is leachable, however, only 3.8 ppm of the 11 ppm total I; Br is not leachable. Our studies have shown that most of the meteorites from Antarctica suffered severe terrestrial contamination for iodine and to a lesser degree also for chlorine. This contamination is independent of the terrestrial age, the degree of weathering and the locality where the meteorites were collected.

Ref.: (1) Gibson E.K. and Yanai K. (1979) LPS-X, Lunar Planet. Inst., Houston, 428. (2) Biswas S., Ngo H.T. and Lipschutz M.E. (1980) Z. Naturforsch. 35a, 191.(3) Johannesson J.K. and Gibson G.W. (1962) Nature 194, 567. (4) Schultz L. (1985) This volume. (5) Duce R.A., Zoller W.H., and Moyers J.L. (1973) J. Geophys. Res. 78, 7803. (6) Duce R.A., Winchester J.W., van Nahl T.W. (1965), J. Geophys. Res. 70, 1775.