THE CHEMICAL COMPOSITION OF ACAPULCO AND ACAPULCOITES; J. Zipfel and H. Palme, MPI für Chemie, Postfach 3060, 55020 Mainz, Germany.

We report here the results of new INA analyses of Acapulco bulk samples and of several other Acapulcoites. Variations in the bulk chemical composition of Acapulco samples are primarily the result of large differences in modal phosphate and chromite contents and, to a lesser degree, in variable sulfide and metal fractions. Elements contained in plagioclase are uniformly distributed. The constant and approximately chondritic K content in all samples analysed excludes loss or gain of partial melts. Variations in the bulk chemistry of Acapulcoites mimic those in individual Acapulco samples. An average Acapulcoite composition derived from these data shows that Acapulcoites form a separate group of chondritic meteorites unrelated to other chondrite groups. Acapulcoites have slightly lower Fe and K and higher Mn, Se and Zn contents than H-chondrites. It appears in the light of several new groups of chondritic meteorites (Acapulcoites, Rumurutiites etc.) that the large fraction of ordinary chondrites among recovered meteorites does not reflect a high ordinary chondrite abundance in the asteroidal belt, but indicates recent break-ups of ordinary chondrite parent bodies.

On the basis of 6 new analyses of Acapulco bulk samples we define a new average Acapulco composition (table 1). The results of the analyses of individual Acapulco samples are graphically shown in Fig. 1, where all data are normalized to average H-chondrites [1]. Samples are arranged according to size. Analyses of [2] are shown for comparison, older analyses from this lab are marked by AP-A and AP-B [3]. Full bars represent an average of all analyses except [2]. Fig. 1 shows higher Mn and Se and lower Fe and K contents in Acapulco compared to H-chondrites. Refractory elements, represented by Sc, and Na, primarily contained in plagioclase, are on the H-chondrite abundance level, while K, almost exclusively sited in plagioclase, is distinctly lower than in H-chondrites. The uniform K-content in all Acapulco samples excludes major mobilisation of partial melts so prominent in Lodranites [4]. The large variability of La reflects large variations in modal phosphate contents. This is supported by similar variations in U and the absence of corresponding enrichments in Th which is, unlike U, not enriched in apatite. The surprisingly large variations in Cr do not allow to define a precise Cr-content for Acapulco. Sulfides, represented by Se, are also rather inhomogeneously distributed (Fig. 1). The elemental pattern in Acapulco is consistent with a large degree of melting and local crystal accumulation of chromite and phosphate. The absence of incompatible element variations (K and Th) and the constant, uniform and chondritic plagioclase content indicate a closed system behaviour except for gains of phosphate which is so obvious in most Acapulco samples.

Similar variations as those of individual Acapulco samples are found in Acapulcoites (see table 1). ALHA 81261 which is probably paired with ALHA 77081 [5,6] is compositionally very similar to average Acapulco. Monument Draw is somewhat different and may have lost a small fraction of a partial melt judging from the low K-content and abundant metal-sulfide veins. ALHA 81187 has obviously suffered a large degree of partial melting which caused a major loss of K and a slight depletion in LREE. This meteorite differs from all other Acapulcoites. In addition, ALHA 81187 is more reduced (Fa 3-4) and has a slightly different oxygen isotope composition than other Acapulcoites. For these reasons ALHA 81187 is not considered in the calculation of the average Acapulcoite composition. The bulk composition of Acapulcoites (AC) is compared to other types of chondritic meteorites in Figs. 2-4 (Chondrite data [1] except CI-data [7], CR-data [8] and solar data compilation in [7]). Chemically, Acapulcoites show some similarity to Rumurutiites (R) [9], although the latter meteorite group is significantly more oxidized. Refractory elements are at a similar abundance level as in ordinary chondrites. Moderately volatile elements of Acapulcoites are distinctly different from ordinary chondrites (Fig. 3). The Se and Zn contents are much higher than in ordinary chondrites while Mn and Na contents are similar. Siderophile elements are basically chondritic in Acapulcoites, although the bulk iron content is slightly below the chondritic value.

Acapulcoites represent a group of chondritic meteorites with basically chondritic abundances but with unique characteristics that distinguish them from other groups of chondritic meteorites. The absence of chondrules and the equilibrated texture of Acapulcoites indicates a thermal history different from other chondrite groups. Acapulcoites were heated to temperatures above the solidus, and have slowly cooled to lower temperatures, although no apparent loss of a low temperature melt fraction is observed implying a closed system during melting. These data demonstrate the importance of classifications based on chemical composition. The increasing number of new meteorite groups with chondritic composition undermines the priviledged position of the ordinary chondrites. Their abundances may reflect the effects of recent collisions of a few Earth crossing asteroids but may not tell us anything about frequency of meteorite types in the asteroidal belt.

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Table 1. Average bulk composition of Acapulcoites (INAA)

	ALHA 81261 (1)	Monum Draw (2)	ALHA 77081 (3)	Acapulco (4)		Acapulcoites average (5)	(6)	ALHA 81187 (7)
%					s.d. in %			
Mg	15.48	14.23	15.70	15.32	3	15.18	3.7	16.31
Al	1.12	1.16	1.20	1.22	3	1.18	3.3	0.99
Ca	1.25	1.04	0.59	1.14	7	1.14	7.5	1.25
Fe	21.81	25.54	24.80	20.69	3	23.21	8.7	18.48
ppm								
Na	6880	6710	7520	6947	3	7014	4.3	5300
K	603	354	690	567	8	553	22.3	192
Sc	8.65	7.43	10.3	8.33	3	8.68	12.0	8.20
V	91.7	70.3	88.7	75.5	3	81.5	10.9	65.8
Cr	5970	2150	7190	3962	3	4818	39.9	3493
Mn	2700	2460	3030	3076	3	2817	8.9	2755
Co	673	900	795	650	3	755	13.3	759
Ni	13600	23400	15600	14333	4	16733	23.4	11600
Zn	243	90.0	306	168	7	202	40.1	119
Ga	9.3	8.6	10.4	6.9	10	8.8	14.4	7.0
As	1.96	3.57	2.14	1.72	10	2.35	30.7	1.96
Se	8.66	10.6	10.3	11.0	5	10.1	8.7	2.0
Br	0.36	1.7	0.35	2.3	5	1.2	72.5	0.8
Sb	0.067	0.10	0.065	0.11	20	0.085	23.0	0.11
La	0.330	0.290	0.290	0.576	15	0.372	32.1	0.225
Sm	0.190	0.119	0.200	0.211	8	0.180	19.9	0.166
Eu	0.094	0.079	0.094	0.097	6	0.091	7.7	0.066
Yb	0.24	0.16	0.30	0.23	25	0.23	22.3	0.21
Lu	0.039	0.030	0.057	0.042	13	0.042	23.1	0.032
Hf	0.15	0.19	0.21		12	0.18	13.6	0.17
Re	0.07	0.10	0.06		35	0.08	24.1	0.077
Os	0.93	1.20	0.95	0.67	15	0.94	20.1	0.928
Ir	0.756	1.07	0.840	0.513	7	0.794	24.9	0.766
Au	0.186	0.344	0.200	0.161	30	0.223	32.0	0.189
U	0.019	<0.06		0.09	15	0.06	65.7	<0.02

(1) Zipfel and Palme, 1993; (2) average Monument Draw, (3) Schultz et al., 1982; (4) average Acapulco, Zipfel et al. in prep.; (5) average of all analyses except (7); (6) variance of (5) in %; (7) this work; < detection limit

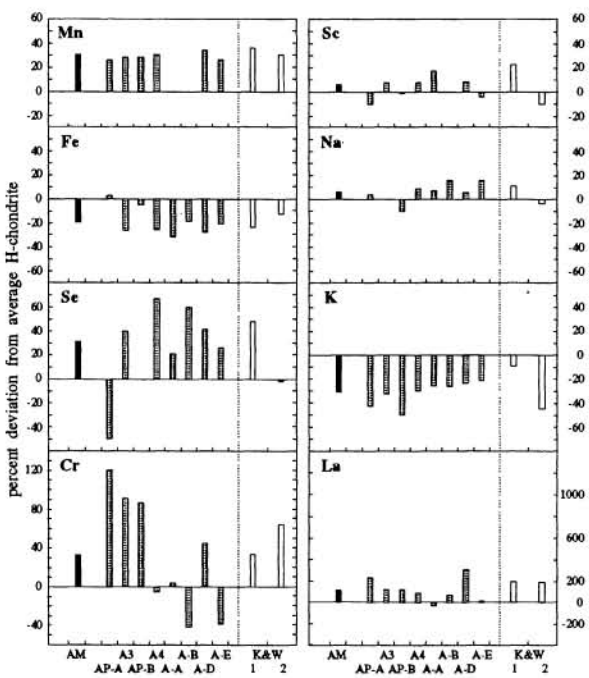

Fig. 2 Refractory Lithophile Elements

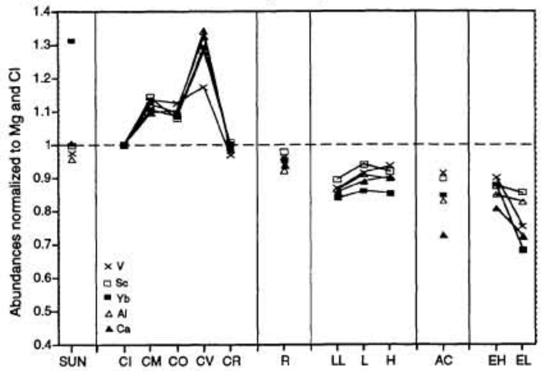

Fig. 3 Moderately Volatile Elements

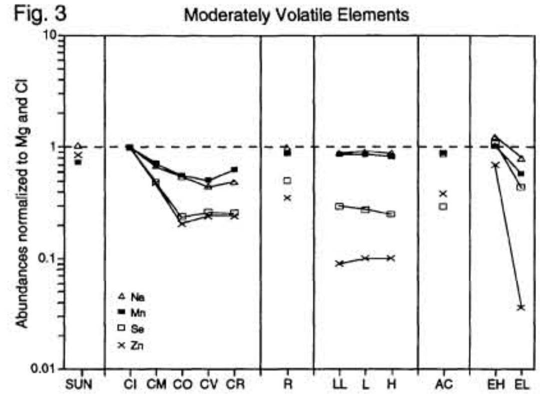

Fig. 4 Siderophile Elements

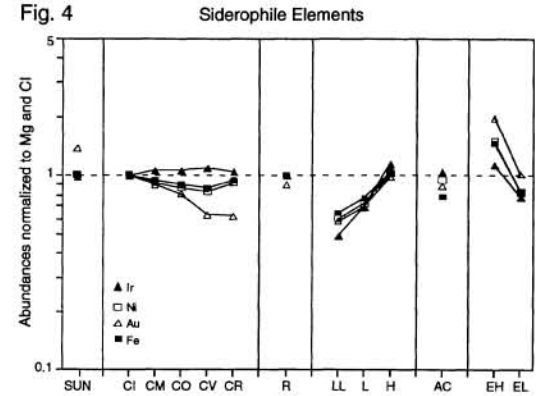

Fig. 1

Ref. [1] Wasson J.T. and Kallemeyn G.W. (1988) Phil. Trans. R. Soc. Lond. A 325, 535-544. [2] Kallemeyn G.W. and Wasson J.T. (1985) Geochim. Cosmochim. Acata 49, 261-270. [3] Palme H. et al. (1981) Geochim. Cosmochim Acta 45, 727-752. [4] Zipfel J. and Palme H. (1993) Meteoritics 28, 469. [5] Mason B. et al. (1998) Smithson. Contrib. Earth Sci. No. 28, 29-59. [6] Schultz L. et al. (1982) Earth Planet Sci. Lett. 61, 23-31. [7] Palme H. and Beer H. (1993) In: Landolt-Börnstein. New Series Vol. VI/3a, 196-221. [8] Bischoff A. et al. (1993) Geochim. Cosmochim. Acta 57, 1587-1603. [9] Schulze et al. (1994) Meteoritics, in print.