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NON-EQUILIBRIA IN THE ACUNA IIIAB IRON; G.Kurat, F.Brandstätter, Naturhistorisches Museum, Postfach 417, A-1014 Vienna, Austria, H.Palme, B.Spettel, Max-Planck-Institut für Chemie, Saarstraße 23, D-65 Mainz, Germany.

The Acuna iron (217,7 kg) was found 1981 near Sonora, Coahuila, Mexico (1). Originally classified as IVA it was reclassified by (2) as IIIAB. Acuna is rich in large schreibersite crystals and troilite nodules containing variable amounts of other phases. A detailed chemical and mineralogical study of this meteorite appeared to be rewarding in several respects since surprisingly few analyses of minerals in iron meteorites exist, although detailed modelling of the origin of iron meteorites requires such data. This is a preliminary report on the results of our incomplete study.

Results and discussion: Selected samples taken from the main mass (inventory no.M1599, Natural History Museum Vienna) were studied by optical microscopy and SEM and phases were analyzed by EMPA. Metal, phosphide, troilite, and oxide phases were separated mechanically and analyzed for trace element by INAA (3,4). The results are summarized in the Table.

The bulk composition agrees well with that previously published by (2) and places Acuna at the high-Ni end of the IIIAB trends. However, our bulk Ir value is substantially below that of (2) and and is lower than in separate analyses of kamacite, clearly indicating inhomogeneous distribution of Ir. This is surprising since Ir distribution reported from other irons (5-6) appears to be fairly homogeneous. Metal forming embayments in troilite (sample AQKB4) has the composition of the bulk metal but is slightly poorer in Cu and richer in As and noble metals (Ir, Pt, Au). This metal is very similar in composition to the bulk Acuna reported by (2). Swathing kamacite (about 2 mm wide) covers all troilite nodules and large schreibersite crystals. Its major element composition is similar to that of kamacite bands. However, its trace element content (sample AQKA2) appears to be high compared to the bulk metal. According to kamacite-taenite distribution coefficients found for other irons (7) trace element abundances in kamacite should be considerably lower. Swathing kamacite apparently is not in equilibrium with the bulk metal (except for Cu). Especially the As content is very high implying a kamacite-bulk distribution coefficient above unity, similar to Buenaventura, the only other case known, which also has a bulk composition very similar to Acuna (7). Taenite compositions as determined by EMPA vary and reach up to 32 wt.-% Ni, indicating a fairly high equilibration temperature - in accordance with the average kamacite Ni content of 7.2 wt.-%.

Troilite nodules are usually up to several cm wide and granular, always contain a metal embayment and some grains of phosphates of variable size and distribution. They are partially covered by schreibersite (± chromite, ± phosphate) and enveloped by swathing kamacite. Major element composition of troilite corresponds to stoichiometric FeS. Trace element contents including Se (110 ppm) are within the usual range found for other irons (8-10). The correlation between kamacite bandwidth and the troilite-bulk distribution coefficient for Cu found by (10) also holds for Acuna, for Ni the correlation is not as good. However, all sulfide-metal distribution coefficients are smaller than those derived from metal-sulfide nodules in basalts (11), except for Cu. The large difference in As, Co and Ni distribution coefficients may be a result of the different composition of metal in the two systems.

Schreibersite is abundantly present in Acuna mainly as very large (up to 5 cm long, up to 1 cm wide) feathery crystals with approximately concordant and discordant orientations with respect to kamacite lamellae. The composition of schreibersite is dependent on its grain-size and ranges from 16 wt.-% Ni (large crystals) to 43 % (very small crystals in metal) - a relationship very well established by previous studies (e.g., 12). Most trace element abundances in large Acuna schreibersites are close to or below the lowest abundances reported by (12) except for Ga which is overabundant. Consequently some of the apparent schreibersite- bulk metal distribution coefficients are much smaller than those reported from other meteorites and extend the already surprisingly large ranges. These ranges extend from far below to far above unity for Cu, W, Pt, and Ir with range factors up to >300 (Ir). Such ranges are difficult to reconcile with formation of schreibersites by exsolution from the metal (e.g., 13).

Phosphates are abundantly present within or at the surface of troilite nodules. Sofar we have studied two nodules and one rim occurrence. All phosphates are of the graftonite-sarcopside family (14). One nodule contained large (1 mm) single crystals and aggregates with equilibrated composition (MnO=5 wt.-%.). The second nodule contained mostly small crystals of unequilibrated composition (MnO=2-13 wt.%). Phosphates associated with schreibersite and chromite at a nodule rim were also unequilibrated. A single large chromite crystal associated with schreibersite and phosphate is very pure and does not contain any detectable Mg, Al, and Ti. It therefore very likely formed by oxidation of Cr dissolved in metal.

Conclusion: Preliminary data on bulk and mineral separates of the Acuna(IIIAB) iron meteorite indicate a large range of trace element ratios among phases in iron meteorites that are not completely understood. Iridium appears to be inhomogeneously distributed within the Acuna meteorite. Further analyses will be performed to better understand the behaviour of Ir and related elements.

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Table: INAA of a bulk sample and separated phases from Acuna (Om-IIIAB) (in ppm).

Sample	Bulk	Metal in Tr	Kamac	Troil	Schreib	Phosph	Typical error (%)
S.no.	AQIB	AQKB4	AQKA2	AQ TR	AQ S1	AQCR3	
Mass. (mg)	161.4	152.81	57.13	109.61	30.521	6.48	
Co	5220	5310	6590	74.6	4930	84.4	3
Ni	105900	106000	66900	1250	108000	5800	3
Cu	130	117	86.2	84.4	75.0	390	3
Ga	18.6	18.8	18.8	0.12	10.5	0.0048	3
Ge	29	30	33	<40	<25	<80	20
As	20.0	20.8	25.8	0.10	15.9	0.16	3
Mo	8.46	7.75	7.17	5.72	24.3	<0.8	6
Pd	4.5	n.d.	4.7	<0.5	5.0	<20	15
W	0.14	0.17	0.17	<0.02	0.16	<0.1	15
Ir	<0.006	0.020	0.022	<0.0015	<0.02	<0.01	13
Pt	2.0	2.6	2.7	<0.1	2.5	<3	15
Au	2.20	2.71	2.03	0.0506	1.14	0.165	3