SHORT COMMUNICATIONS

Minor elements present in the silicate phase of enstatite chondrites

MOST published analyses of enstatite chondrite meteorites report the concentration of the minor elements Mn, P, Cr, and Ti on the entire meteorite without reference to their partition between the various phases present. The geochemical behaviour and possible partition of these elements in this class of meteorites has been discussed by Mason (1966), but the lack of adequate analytical data has so far restricted conclusions as to their detailed geochemical behaviour.

TABLE I. Percentage minor elements in the oxidized phases

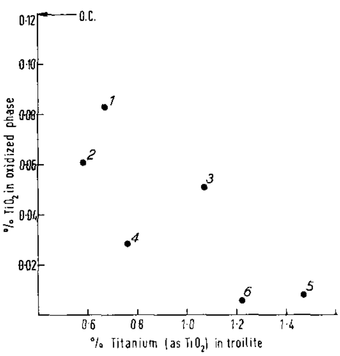
No.	FeO	P_2O_5	TiO_2			
	oxidized	*oxidized*	*total*	*oxidized*	*sulphide*	*troilite*†
o.c.	15·0	0·22	0·10	0·12	<0·005	<0·005
1	2·1	0·37	0·09	0·083	0·46	0·67
2	1·3	0·26	0·08	0·061	0·43	0·60
3	1·8	0·14	0·11	0·051	0·94	1·07
4	1·5	0·06	0·07	0·029	0·66	0·76
B	0·55	0·07	0·01	0·019	n.d.*	n.d
5	0·45	0·03	0·15	0·008	1·20	1·47
6	0·42	<0·02	0·16	<0·006	1·06	1·22

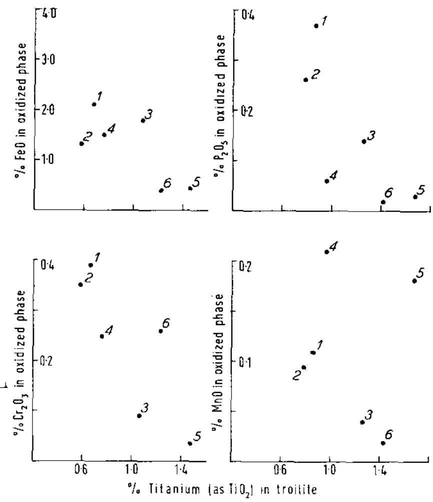
No.	Cr_2O_3			MnO		
	total	*oxidized*	*sulphide*	*total*	*oxidized*	*sulphide*
o.c.	0·33	0·41	<0·0002	0·33	0·42	<0·002
1	0·46	0·39	2·4	0·33	0·11	3·0
2	0·52	0·35	3·6	0·30	0·10	2·6
3	0·29	0·09	3·2	0·22	0·04	2·8
4	0·37	0·25	1·8	0·38	0·21	2·1
B	0·02	0·040	n.d.*	0·01	0·02	n.d.*
5	0·35	0·035	3·2	0·34	0·18	2·2
6	0·17	0·26	4·4	0·11	<0·02	0·9

o.c. Ordinary chondrites, mean of Oakley, Barwell, Ohuma, and Wold Cottage from Moss *et al.* (1967).
1. Kota-Kota, B.M. 1905, 355.
2. Indarch, B.M. 86948.
3. Jajh deh Kot Lalu, B.M. 1928, 479.
4. South Oman, B.M. 1966, 1.
B. Blithfield, B.M. 1924, 185.
5. Hvittis, B.M. 86754.
6. Khairpur, B.M. 51366.

* Not determined because of shortage of material.
† Assuming no Ti is present in other sulphides.

It had been found from recent work that a clean separation of the silicate phase (more accurately total oxidized phases) from sulphide and metal phases was possible by using the chlorination technique (Moss *et al.*, 1967). Small quantities (50 to 100 mg) of the clean silicate phase from seven enstatite chondrites were used and the minor elements and FeO determined by colorimetric methods;[1] the results are shown in table I. For the sulphide figures 2 to 4 g. of meteorite were used.





FIGS. 1 and 2: FIG. 1 (left). Concentration of titanium in oxidized and troilite phases: 1, Kota-Kota; 2, Indarch; 3, Jajh deh Kot Lalu; 4, South Oman; 5, Hvittis; 6, Khairpur; o.c., mean of ordinary chondrites. FIG. 2 (right). Comparison of elements in the oxidized phase with percentage of titanium, as TiO_2, in troilite. Key as in fig. 1.

These values show a depletion in all the minor elements relative to their concentration in the silicate phase of ordinary chondrites. An interesting correlation was found between the titanium in the silicate and troilite phases and is shown in fig. 1. Titanium, which is almost entirely lithophilic in ordinary chondrites and present in the pyroxene, is seen to change its behaviour to chalcophilic, confirming the findings of Keil and Andersen (1965), obtained with the microprobe. Our results, however, show that the increase in the titanium content of the troilite at the expense of the silicate phase is gradual and therefore allows the enstatite chondrites to be placed in a series. Of the specimens examined Kota-Kota would appear to be one end member (Ti still being litho-

[1] Colorimetric methods on a solution obtained by HF and H_2SO_4: MnO as permanganate; P_2O_5 as reduced phosphomolybdate; Cr_2O_3 by diphenylcarbazide; TiO_2 as tiron complex; Fe_2O_3 as sulphosalicylic complex.

philic) and Khairpur the other end member, in which the silicate phase is almost entirely depleted in titanium.

Iron and phosphorus closely follow the behaviour of titanium while chromium and manganese do not. There appears to be no correlation between the Mn, P, and Cr in the silicate phase and the amount of ferroalabandine, schreibersite, or daubréelite in the meteorite. Since these phases only amount to 1 % or less, any inhomogeneity or deviation from a completely closed chemical system would obscure correlation.

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References

KEIL (K.) and ANDERSEN (C. A.), 1965. Geochimica Acta, vol. 29, p. 621.
MASON (B.), 1966. *Ibid.*, vol. 30, p. 365.
MOSS (A. A.), HEY (M. H.), ELLIOTT (C. J.), and EASTON (A. J.), 1967. Min. Mag., vol. 36, p. 101.

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Cutting of stony-iron meteorites

STONY-IRON meteorites can be difficult to cut using normal rock-cutting diamond wheels and impossible using hacksaws. On the suggestion and with the help of Mr. G. J. Burton, who is responsible for rock sectioning and polishing in the Department of Mineralogy, British Museum (Natural History), experiments were tried using a diamond-coated hacksaw blade in a power hacksaw. It was found that it provided an effective way of cutting stony-iron meteorites as well as other meteorites and rocks.

A new Eclipse high-speed steel blade ($14 \times 1 \times 0{\cdot}050$ in., 14 teeth/in.) had the teeth ground down to half their original depth and then coated with a 0·006 in. thickness of P.S. 60–72 # diamond grit by the Diaface electroplating process. It was used in an unadapted workshop power-hacksaw with water as coolant.

The method was tried first on the Bencubbin mesosiderite, which has been reported as being particularly hard to cut by any means. A smooth cut about 2 mm wide leaving a face with an area of 33 cm^2 and depth of 6 cm was made without difficulty in 40 min. The cut face showed about 35 % stony material and 65 % iron. L. M. Van Mappes and Sons (Diamond Tools) Limited, Basingstoke, Hampshire, kindly examined