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Medanitos and Putinga, two South American meteorites

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SUMMARY. Petrographic descriptions, bulk chemistry, and partial analyses of several mineral phases in each stone are presented. Medanitos, previously classed as a eucrite, is now shown to be a howardite: Putinga is an equilibrated olivine–hypersthene chondrite.

THESE stony meteorites are described together because specimens of both were acquired by the British Museum from the same donor, the Vatican Collection of Meteorites, through the auspices of Fr. E. W. Salpeter, S.J.

MEDANITOS

The specimen described is a 6-g slice, B.M. 1968, 3, in excellent condition, from the larger of the two stones found (Hey, 1966), and represents some 20 % of the material collected. Beneath a dark fusion crust, the central portion is leucocratic, being composed of clear or milky-white feldspar, pale brown pyroxene, and occasional spots of sulphide. Rounded intergrowths of coarser-grained crystals, up to 1 mm long, are set in a finer-grained groundmass. The intergrowths range from 2 to 4 mm in diameter. Although the groundmass is generally fine-grained (0·2 mm), some large, subophitic patches of pyroxene have lengths up to 2 mm. Groundmass textures are due to granulation; the subophitic pyroxenes do not exhibit complete optical continuity and are probably relicts of even larger grains; some thin exsolution lamellae, probably parallel to (001), are occasionally present. Feldspars are unzoned. Sulphide is unevenly distributed, but is mostly in grains less than 0·2 mm in length; it was absent from the fragment taken for analysis. A translucent red-brown phase occurs as inclusions in feldspar and pyroxene, and a microprobe study has shown it to be chromite. Calcite has been identified by an X-ray diffraction technique, and a subsequent test for CO_2 proved positive.

The chemical analysis is presented in table I, together with the Wahl (weight) norm and partial analyses of the feldspar and pyroxene. Compositions of feldspar derived from the bulk chemical and the microprobe analyses agree closely at about An_{96}. The normative pyroxene is richer in Ca than that measured directly; this is partly due to the concentration of this element in exsolution lamellae and partly to the presence of calcite. The presence of calcite also helps to explain the appearance of normative olivine when none was found in the section; calcium actually present as carbonate appears as wollastonite in the norm and reduces the amount of SiO_2 available for normative hypersthene.

TABLE I. *Bulk analyses, norms, and partial microprobe analyses of minerals*

	1	2	Medanitos Feld.	Medanitos Pyr.	Putinga Feld.	Putinga Pyr.	Putinga Oliv.
Fe	0·22	6·6	—	—	—	—	—
Ni	n.d.	1·2	—	—	—	—	—
Co	n.d.	0·06	—	—	—	—	—
FeS	n.d.	5·4	—	—	—	—	—
SiO_2	47·74	40·4	44·2	51·5	n.d.	54·4	38·5
TiO_2	0·03	0·1	—	—	—	—	—
Al_2O_3	15·09	2·1	35·1	n.d.	23·5	n.d.	n.d.
Cr_2O_3	0·14	0·5	—	—	—	—	—
FeO	13·72	16·3	n.d.	26·1	—	14·0	22·6
MnO	0·51	0·3	—	n.d.	—	n.d.	n.d.
MgO	12·16	24·4	n.d.	20·2	—	28·5	39·1
CaO	10·38	1·8	19·4	0·81	2·3	0·67	n.d.
Na_2O	0·20	1·0	0·8	n.d.	10·3	n.d.	—
K_2O	0·09	0·1	n.d.	n.d.	1·4	n.d.	—
P_2O_5	$<$0·03	0·2	—	—	—	—	—
CO_2	tr.	n.d.	—	—	—	—	—
Sum	100·28	100·5	99·5	98·6	—	97·6	100·2
Total Fe	10·88	23·3					

Wahl norms	1	2	Mineral compositions	Medanitos Norm	Medanitos Probe	Putinga Norm	Putinga Probe
Metal	0·22	7·9*	*Feldspar:*				
Troilite	nil	5·4	Ab	3·6	3·6	87·0	82·4
Olivine	9·7	47·7	Or	1·2	n.d.	4·3	7·4
Pyroxene	47·8	27·8	*Pyroxene:*				
Feldspar	42·3	10·0	Fs	37·6	41·1	24·1	21·2
Ilmenite	0·1	0·2	Wo	4·8	1·6	11·1	1·3
Chromite	0·2	0·7	*Olivine:*				
Apatite	tr.	0·5	Fa	39·5	—	27	24·3

1. Medanitos, B.M. 1968, 3. Anal. A. J. Easton. Microprobe analyses by R. F. Symes.
2. Putinga, B.M. 1964, 34. Anal. A. A. Moss. Microprobe analyses by R. F. Symes.

* Fe:Ni:Co = 84:15:1.

The high content of Ca-poor pyroxene together with anorthite indicates that Medanitos is a howardite.

PUTINGA

The British Museum specimen of Putinga, B.M. 1964, 34, was cut from the 284-g Vatican specimen, and weighs 29 g; several hundred kilogrammes of this fall were collected (Hey, 1966). It is a fragment of grey interior, with crust on one edge only. Metal has slightly oxidized, so that the light grey surface has diffuse red-brown spots up to about 1 cm in diameter. Few chondrules are identifiable on a fresh surface. In thin section, rare chondrules can be seen, set in a fine-grained groundmass composed dominantly of anhedral olivine crystals of variable grain-size, the mean being perhaps 0·1 mm. Occasional pyroxene crystals occur; their grain-size is generally smaller than the biggest olivines, about 1 mm. Metal grains are unevenly distributed.

Various types of chondrule are present, the largest encountered being about 7 mm in diameter and consisting of a reticulate mass of minute olivine grains showing hour-glass type extinction. This feature might be due to shock, but no groundmass olivine grains exhibit it, although they proved to be of the same composition as the chondrule olivines. A second, unidentified phase is also present in this chondrule.

Feldspar occurs interstitially to olivine in barred chondrules, and although it is present as anhedral grains in the groundmass, it tends to be more abundant in or near chondrules. No trace of glass has been found, chondrule margins are usually poorly defined, olivine grains are uniform in composition and it is evident that this stone is equilibrated, type 6 of Van Schmus and Wood.

Chemically (table I), Putinga is a typical olivine–hypersthene chondrite. The norm shows that it is composed dominantly of olivine, Fa_{27} in composition, which agrees closely with the figure obtained by microprobe analysis. Kamacite (Ni 7·1 %) and taenite are present as individual grains, except for one example where a kamacite grain is in contact with a rim of taenite, which in turn abuts against olivine. The taenite is variable in composition; the average Ni content at the centre of three analysed grains was 29 %. Troilite was also found to be present.

The mineralogy, texture, and chemical composition indicate that Putinga should be assigned to the L6 group of Van Schmus and Wood's classification.

REFERENCE

HEY (M. H.), 1966. *Catalogue of Meteorites*, pp. 298 and 396. London, British Museum (Natura History).

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