IDENTIFICATION OF ARMALCOLITE IN THE ROCKS OF UKRAINE (USSR). V. I. Tatarintsev, S. N. Tsymbal, G. V. Legkova. Institute of Geochemistry and Physics of Minerals Ukr.SSR Academy of Sciences, Kiev, USSR

Armalcolite is a rare mineral of the pseudobroocite series. Most of its findings occur in lunar rocks -- basalts, dolerites, peridotites and other ones (1,5). The only terrestrial armalcolite is known in South African kimberlites (6) and in the impact glasses of the Ries crater (Germany) (4).

Recently the mineral was found in various ages, compositions and origin rocks of the Ukraine.

The most completely studied was the armalcolite from the rocks of explosive structure of late mesozoic age, situated in the western part of the Ukrainian shield (3). The structure is filled by breccias, composed by debris of precambrian granitoids and their minerals various by forms and sizes, as well as by polymineral glasses related by composition to andesites. The breccias have the features of shock metamorphism that gives possibility for some authors to treat the structure as the astrobleme (3). The individual fragments of black glasses with skeletal crystals of armalcolite, highly manganic ilmenite, manganic ulvospinel and globular native iron were found in these breccias (fig. 2). The reactionary rims of ilmenite are frequently observed around armalcolite crystals (fig. 1).

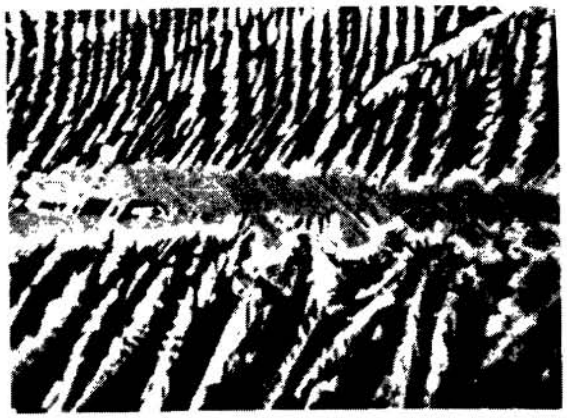

Fig. 1. 20 μ

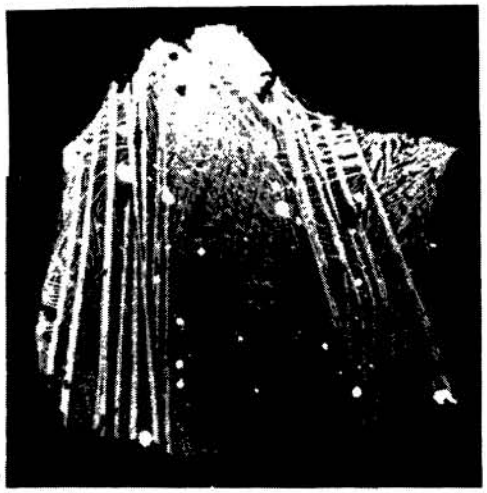

Fig. 2. 0,2 mm

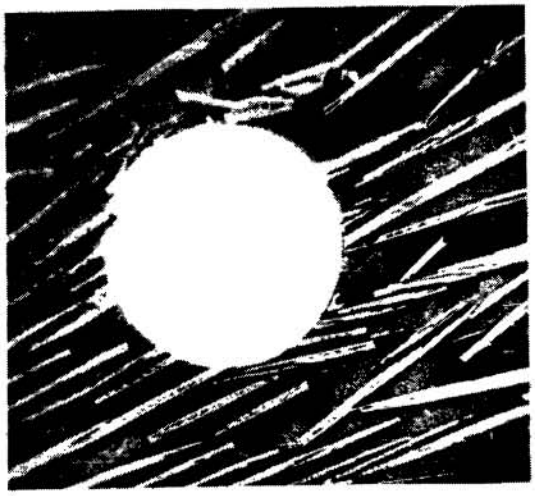

Fig. 3. 0,5 mm

Fig. 4. 0,05 mm

Fig. 1. Lath-shaped crystal of armalcolite (dark gray) surrounded by reactional rim of ilmenite (light gray) in glass (black). Reflected light.

Fig. 2. Skeletal crystals of armalcolite with numerous spherules of native iron in the fragment of glass. Reflected light.

Fig. 3. Skeletal crystals of armalcolite with globule of native iron in glass. Reflected light.

Fig. 4. Ferroarmalcolite (dark gray) surrounded by corroded picroilmenite (white). Reflected light.

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The composition of armalcolite and associated minerals is given in the table. For investigated armalcolite samples the high content of MnO is specific (5.8 - 10.5%), that gives possibility to relate it to manganous variety. There is some relation between chemical composition of armalcolite and associated with it native iron: the more of individualized are iron particles, the less is its content in armalcolite and the richer is armalcolite by titanum content. The preservation of armalcolite in glasses, the skeletal growth of crystals and the absence of decay structures in them indicate that the mineral was formed under fast cooling (quenching) and its paragenesis with native iron is the evidence of its crystallization from silicate high-temperature melts under strongly reducing conditions.

The glasses of irregular form with the skeletal armalcolite crystals and globular particles of native iron (fig. 3) are also found in a dyke of precambrian alkali syenites of the central part of Ukrainian shield. By the features of crystallomorphology and chemical composition this armalcolite shows the similarity with one from explosive breccias, described here, but differs from it by more MnO and less MgO content (table).

The armalcolite in association with picroilmenite, native iron and iozite is found in aphyric trachybasalts of mesozoic age on the western slope of the Ukrainian shield. Usually it forms the inner parts of picroilmenite crystals (fig. 4) and is one of the earliest basalt minerals.

The native iron forms round and irregular, frequently bent and elongated in one direction particles, with sizes from less than millimeter to 0.5 - 1.0 cm. Sometimes it contains minute inclusions of native copper. The iozite and picroilmenite grains do not show regular crystallographic forms, are corroded and surrounded by reactional rims. These minerals as well as armalcolite are intratelluric ones. The armalcolite and ilmenite from the trachybasalts differ from the same minerals from explosive breccias and alkaly syenites of the Ukrainian shield by much more high content of iron and less of manganese (table). By its chemical composition the investigated armalcolite is similar to ferroarmalcolite from lunar basalts (2).

The obtained data on the composition of armalcolite and coexisting opaque minerals are in good agreement with the results of experimental investigations of crystallization of armalcolite in strongly reducing conditions and fast cooling from high temperature melts.

The described findings are the evidence of more wide distribution of armalcolite in terrestrial rocks, that was considered before. They do not make possible to agree with the consideration of A. El Goresy and E. C. T. Chao (4), that proper conditions for armalcolite crystallization can exist only during impact processes in the near surface parts of the Earth. The similar conditions can appear in connection with the processes of platform volcanism. That is why the presence of armalcolite in the rocks of circular explosive structures cannot be considered as the evidence of their impact genesis.

Table. Composition of armalcolite and coexisting minerals (electron microprobe analyses, mas.%).

	1					2	3	
	Armalcolite			Ilmenite	Ulvospinel	Armalcolite		Ilmenite
TiO_2	74.5	77.6	76.1	54.7	35.7	71.2	68.7	53.4
FeO	6.6	2.6	2.0	17.2	57.3	8.5	28.7	35.9
MgO	9.3	10.9	10.1	5.0	0.4	2.1	2.5	7.8
MnO	7.9	5.8	10.5	18.6	7.3	10.7	0.3	0.4
Al_2O_3	2.6	1.1	1.1	3.5	0.7	2.6	0.8	0.5
CaO	0.03	0.04	n.a;	0.6	n.a.	n.a.	n.a.	n.a.
Cr_2O_3	0.1	0.1	n.a.	0.1	0.5	n.a.	trace	trace
Totals	101.03	98.14	99.8	99.7	101.9	95.1	101.0	98.0
Atoms								
O	5	5	5	3	4	5	5	3
Ti	1.96	2.05	2.02	0.98	0.97	2.05	1.95	0.98
Fe	0.19	0.07	0.06	0.34	1.74	0.27	0.90	0.73
Mg	0.49	0.57	0.53	0.18	0.02	0.12	0.14	0.28
Mn	0.23	0.17	0.31	0.37	0.22	0.35	0.01	0.01
Al	0.11	0.04	0.04	0.10	0.03	0.12	0.03	0.01
Cr	0.00	0.00	-	0.00	0.01	-	-	-
Totals	2.98	2.90	2.96	1.97	2.99	2.91	3.03	2.01

1 - the explosive structure of the Ukrainian shield, 2 - syenites, 3 - Trachybasalts; n.a. - not analyzed.

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