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APATITE FROM DIABASES PENETRATED BY THE BOREHOLE KUROWO-2 NEAR KOSZALIN (WEST POMERANIA)

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Abstract. The content of apatite in diabases from the borehole Kurowo-2 (NW Poland) ranges from 0.5 to 5.8 vol.%. Apatite was separated from the rock and subjected to X-ray, IR spectroscopic and chemical investigations. It has been found that it is fluorine apatite. It contains no substantial isomorphous admixtures, admitting only little substitution of fluorine by OH^- groups.

The borehole Kurowo-2, situated 30 km SE of Koszalin, penetrated basic igneous rocks, diabases. The main constituents of those rocks are plagioclases (labrador and basic oligoclase) and pyroxenes (diopside augite) whereas magnetite, ilmenite, apatite and biotite are the subordinate components. Moreover, chlorites, talc and calcite have been noted. The diabases appear in two varieties: fine- and medium-crystalline (Heflik, Muszyński 1973; Pendias, Ryka 1974). The apatite content varies from 1.2—5.8 vol.% in the fine-crystalline variety, and from 0.5—1.4 vol.% in the medium-crystalline variety.

Apatite from diabases from Kurowo-2 was subjected to microscopic observations in thin sections. More detailed mineralogical studies were carried out on a monomineral apatite fraction obtained from diabase in the following way: 1) the rock was broken mechanically and 0.09—0.2 mm sieve fraction was taken for further treatment; 2) the heavy fraction containing apatite was separated from it in bromoform; 3) magnetite was separated from that fraction using ferrite; 4) in the remainder, the magnetically susceptible components were separated from non-magnetic apatite using electromagnetic separator (in the Institute of Mineral Processing and Utilization, Academy of Mining and Metallurgy). The apatite fraction

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thus obtained was subjected to microscopic, X-ray and infrared absorption spectroscopic analyses. Moreover, electron microprobe traces for F, Cl, Si, Al, Ba, Mg, Sr were obtained, and the content of rare earth elements was determined by emission spectrography.

Apatite in diabases from Kurowo-2 usually appears in the form of idio- and hipidiomorphic prisms, rods or needles (Phots. 1, 2) 0.03—0.8 mm in length, with the elongation varying from 1 : 2 to 1 : 8 or, in isolated cases, even up to 1 : 22. Irregular grains are rare. Anisometric crystals show transversal parting. In apatite grains, anisotropic inclusions with circular and elliptical outlines are common. The latter are, as a rule, oriented conformably to crystal elongation (Phot. 2). Sometimes lamellar apatite surround partly or completely the other rock components (chlorite, plagioclase, biotite or pyroxene). In consequence, hexahedral forms are visible under the microscope, which, according to ore microscopy nomenclature, may be defined as atol textures (Phot. 3). Apatite is colourless in thin section, but its larger grains observed in powder preparations have a light yellow-grey or grey-greenish colour.

Apatite concentrates evidently near the dark rock components (pyroxenes, biotite, chlorites) and in the proximity of ore minerals (magnetite and ilmenite). In lesser amounts it forms inclusions within plagioclases.

X-ray investigations of the apatite fraction were carried out by powder method, using film technique. A 114.6 mm VEM-60 camera and Co-K_α radiation were used to record the X-ray patterns. The $d_{hk\bar{i}l}$ values obtained are similar to those given by McConnell (1937, 1973) for fluorine apatite (Tab. 1).

Infrared absorption spectrum was obtained in UR-10 (Zeiss) spectrophotometer, using KBr disks and Nujol mulls. The latter were employed to prevent possible coincidence between the bands of adsorbed water molecules and the maxima corresponding to the presence of OH^- groups in the structure of apatite. Absorption spectra in the range of 400—1800 cm^{-1} were recorded using KBr disks, and those in the range of 3000—3800 cm^{-1}, using Nujol mulls. The bands 474, 577, 605, 745, 970, 1050 and 1100 cm^{-1} appearing in the infrared absorption spectrum (Fig. 1) correspond to fluorine-chlorine apatite (Moenke 1962; Ross — vide Farmer 1974). The method used does not permit, however, to differentiate the fluorine from

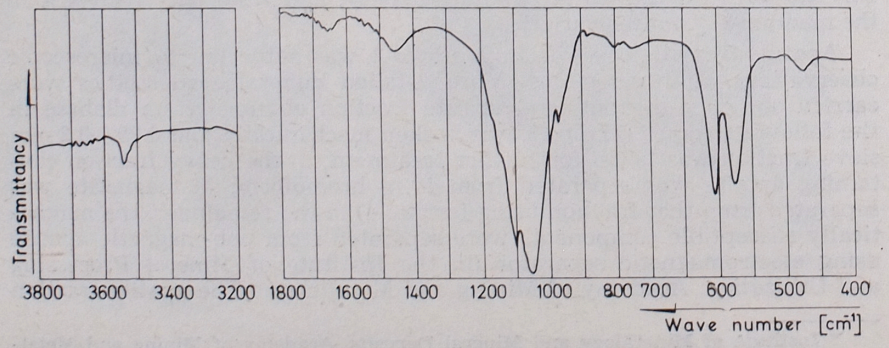

Fig. 1. Infrared absorption spectrum of apatite from diabase from borehole Kurowo-2

chlorine variety. Moreover, a weak band 3543 cm^{-1} indicates that partial substitution, presumably of fluorine, by OH^- groups takes place in apatite (Levitt, Condrate 1970). The absorption spectrum also reveals weak bands due to small admixtures of other minerals: calcite (1450 and 880 cm^{-1}), quartz (515, 780 and 800 cm^{-1}) and presumably plagioclases (1145 cm^{-1}).

Table 1

X-ray powder data for apatites

Apatite from diabase (borehole Kurowo-2)		Fluorapatite from Faraday Township, Hastings, Ontario (McConnell 1937)		Synthetic fluorapatite — prominent diffraction spacings (McConnell 1973)	
d (Å)	*I*	*d* (Å)	*I*	*d* (Å)	*I*
3.42	3	3.432	3		
3.16	1	—	—		
3.06	1	3.060	3	3.06	3–2
2.79	10	2.798	10	2.80	10
2.76	1	2.769	4	2.77	3—2
2.70	8	2.702	6	2.70	7—6
2.62	3	2.616	3		
2,52	0.5	2.517	1		
2.28	1	2.289	1		
2.25	4	2.248	2	2.25	6
2.14	1	2.135	1		
2.05	0.5	2.057	1		
1.996	0.5	2.001	1		
1.933	7	1.937	3	1.935	3—2
1.881	2	1.883	1		
1.834	8	1.838	8	1.835	3—2
1.796	3	1.795	3		
1.769	3	1.769	3		
1.747	3	1.745	3		
1.717	4	1.720	3		
1.636	2	1.637	1		
1.607	1	1.605	1		
1.529	1	1.533	1		
—	—	1.524	1		
1.498	1	1.498	1		
1.468	2	1.468	2		
—	—	1.452	1		
1.447	2	1.445	1		
1.424	2	1.424	1		

A determination of fluorine content in apatite, as well as analyses for Cl, Si, Al, Ba, Mg and Sr were made on the Cameca MS-46 electron microprobe (the analyses were carried out by H. Kucha). The apatite studied has been found to contain 1.8—1.9 wt.% fluorine (CaF_2 standard, beam accelerating voltage 10 kV, probe current 140 μA), $\leqslant$ 0.05—0.06 wt.% silicon (SiO_2 standard, beam accelerating voltage 20 kV, probe current

13.3 μA), and trace amounts of borium (detectability 0.08 wt.%). The analyses failed to detect any other elements.

Semi-quantitative spectrographic analysis of the apatite fraction, carried out in the PGS-2 (Zeiss) spectrograph, has revealed only trace amounts of the rare earth elements: Ho, Tu, Yb, Lu ($\leqslant 0.00X\%$), La, Eu, Gd, Tb ($\geqslant 0.00X\%$), Ce, Sm, Dy, Er ($\leqslant 0.0X\%$), Y ($\geqslant 0.0X\%$). In addition, $\leqslant 0.X\%$ Mn has been noted.

In conclusion, it can be stated that apatite occurring in diabases from the borehole Kurowo-2 is a fluorine variety with little substitution of fluorine by OH^- groups. It contains only trace amounts of the rare earth elements and shows little or no substitution of other elements. Apatites of that kind are fairly typical of basic intrusive igneous rocks (Wasiliewa 1968).

The primary concentration of apatite in diabases from the borehole Kurowo-2 took place in the final stage of formation of those rocks and was parallel to their enrichment in dark components and ore minerals.

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APATYT Z DIABAZÓW NAPOTKANYCH W OTWORZE WIERTNICZYM KUROWO-2 KOŁO KOSZALINA (POMORZE ZACHODNIE)

Streszczenie

Apatyt występuje w diabazach z otworu Kurowo-2 (Pomorze Zachodnie) w ilościach 0,5—5,8% obj. Koncentruje się on w pobliżu ciemnych składników skały (piroksenów, biotytu, chlorytów) oraz minerałów rudnych (magnetytu i ilmenitu). Ma przeważnie formę słupków, pręcików oraz igieł o długości 0,03—0,8 mm i elongacji 1 : 2—1 : 8 (maksymalnie 1 : 22). Składnik ten wyseparowano ze skały i poddano badaniom rentgenograficznym, spektroskopowym absorpcyjnym w podczerwieni oraz chemicznym. Stwierdzono, że jest to apatyt fluorowy nie zawierający znaczniejszych podstawień izomorficznych. Zanotowano jedynie niewielkie zastąpienie fluoru przez grupy OH^-. Zasadnicza koncentracja apatytu w diabazach z otworu Kurowo-2 nastąpiła w końcowym etapie formowania się tych skał, równolegle ze wzbogaceniem ich w składniki ciemne i minerały rudne.

OBJAŚNIENIE FIGURY

Fig. 1. Widmo absorpcyjne w podczerwieni apatytu z diabazu Kurowo-2

OBJAŚNIENIA FOTOGRAFII

Fot. 1. Skupienie hipidiomorficznych słupków apatytu w drobnokrystalicznym diabazie z otworu Kurowo-2. W sąsiedztwie apatytu widoczne są ciemne składniki skały oraz minerały rudne. 1 nikol. Pow. × 70

Fot. 2. Hipidiomorficzne słupki apatytu przerastające się z minerałami rudnymi oraz ciemnymi składnikami skały w drobnokrystalicznym diabazie z Kurowa-2. W najdłuższym osobniku apatytu jest widoczny podłużny wrostek. 1 nikol. Pow. × 70

Fot. 3. Sześcioboczna forma utworzona z lamelek apatytu rozwiniętych wokół plagioklazu i chlorytu w średniokrystalicznym diabazie z otworu Kurowo-2. 1 nikol. Pow. × 135

Веслав ХЕФЛИК, Марек МУШИНЬСКИ

АПАТИТ ИЗ ДИАБАЗОВ НАБУРЕННЫХ В СКВАЖИНЕ КУРОВО-2 БЛИЗ КОШАЛИНА (ЗАПАДНАЯ ПОМЕРАНИЯ)

Резюме

В диабазах буровой скважины Курово-2 (Западная Померания) апатит присутствует в количестве 0,5—5,8 объем.%. Он сосредоточен вблизи темноцветных компонентов породы (пироксенов, биотита, хлорита) и рудных минералов (магнетита и ильменита). Он образует столбчатые, палочковидные и игольчатые формы длиной 0,03—0,8 мм, характеризующиеся удлинением 1 : 2 — 1 : 8 (максимальное 1 : 22). Этот компонент извлечено из породы и подвергнуто рентгенографическим, ИК-спектроскопическим и химическим исследованиям. Обнаружено, что это фтор-апатит не содержащий более значительных изоморфических замещений. Отмечена только небольшая замена фтора группами OH^-. Основная концентрация апатита в диабазах буровой скважины Курово-2 произошла в конечном этапе формирования этих горных пород, параллельно с обогащением их в темноцветные компоненты и рудные минералы.

ОБЪЯСНЕНИЯ К ФИГУРЕ

Фиг. 1. ИК-спектр апатита из буровой скважины Курово-2

ОБЪЯСНЕНИЯ К ФОТОГРАФИЯМ

Фот. 1. Скопления гипидиоморфных призм апатита в мелкозернистом диабазе из буровой скважины Курово-2. Рядом с апатитом видны темноцветные компоненты горной породы и рудные минералы. Один николь. × 70

Фот. 2. Гипидиоморфные призмы апатита в срастании с рудными минералами и темноцветными компонентами породы в мелкокристаллическом диабазе из Курова-2. В самом длинном индивиде апатита виден продолговатый вросток. Один николь. × 70

Фот. 3. Шестиугольная форма, образованная пластинками апатита, развитыми вокруг плагиоклаза и хлорита в среднекристаллическом диабазе из буровой скважины Курово-2. Один николь. × 135

Phot. 1. Concentration of hipidiomorphic apatite prisms in fine-crystalline diabase from borehole Kurowo-2. Adjacent to apatite are dark rock components and ore minerals. One nicol. × 70

Phot. 2. Hipidiomorphic apatite prisms intergrown by ore minerals and dark rock component in fine-crystalline diabase from Kurowo-2. In the longest apatite crystal an elongated inclusion is visible. One nicol. × 70

Wiesław HEFLIK, Marek MUSZYŃSKI — Apatite from diabases penetrated by the borehole Kurowo-2 near Koszalin (West Pomerania)

Phot. 3. A hexahedral body formed from apatite lamellae surrounding plagioclase and chlorite in medium-crystalline diabase from Kurowo-2. One nicol. × 135