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## MINERALS OF BULGARIA

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During the fifteen years of people's government Bulgarian geologists have done a great deal of work in investigating the mineral raw material base of the country. A significant number of different useful mineral deposits were discovered in Bulgaria and the task of providing domestic industry with the useful mineral resources discovered was successfully accomplished within a short time.

In bourgeois Bulgaria deposits of useful minerals were unsatisfactorily studied. Prospecting was carried out primarily to solve geological problems and practically no attention was paid to the study of useful minerals. Up to the establishment of the people's government only coal and polymetallic deposits were exploited in the Rodopskiy mountains, copper deposits in the Burgasskiy, Panagyurskiy and Vrachanskiy regions and iron ore deposits in the Yambol'skiy region. Nevertheless they were all poorly studied.

As a result of the geological prospecting work accomplished with the help of Soviet geologists during the last fifteen years, deposits known in the past were studied and also new deposits of iron, manganese, lead, zinc, copper, coal, petroleum and gas, gypsum, kaolin, magnesite, fluorite and other useful minerals, among them building materials, were discovered and prospected. On the basis of the deposits prospected new enterprises were formed and old ones expanded.

In the Rodopskiy mountains on the basis of new lead-zinc deposits dozens of mines were opened, and large scale concentration plants were built in Rudozem, Madan, Lyuki, Madzharovo and also in the Chiprovtsy and Sedmochislenitsy villages in the northwestern region and in Ustrem in the southeastern region. The resources of lead-zinc ore prospected permitted the building of a lead-zinc plant in the town of Kyrdzhali and the proposed erection of a second plant between the towns of Plovdiv and Asenovgrad.

The copper ore base in the Burgassko-Srandzhanskiy and Pnangyurskiy regions was enlarged. New ore mining

enterprises were undertaken on the basis of the deposits prospected in Meden Rid and Propadnala Voda, Malko Tyrnovo, Gramatikovo, Radka, Chelopek and Sedmochislenitsy. Concentration plants for the processing of copper ore were built in Malko Tyrnovo, Rosen, Sedmochislenitsy and Chelopek. The resources of copper ore prospected provided for the building of the copper smelter combine imeni G. Damyanov near the town of Pirdop.

As a result of the geological prospecting work carried out on the iron ore deposits in Krumovo, Martinovo and others, it was possible to build the metallurgical plant imeni V. I. Lenin in the town of Dimitrov. The Kremikovskiy deposits prospected made possible the projected building of the large scale Kremikoutsa metallurgical combine.

The gypsum deposits discovered in the Radiyevskiy region fully satisfied the needs of the cement industry.

The kaolin deposits prospected in northeastern Bulgaria satisfied the country's need for kaolin raw material, a great amount of which is being exported.

The first petroleum deposit in Bulgaria was discovered with the direct participation of the Soviet geologists.

#### Coal

During the last ten years, thanks to the wide front of geological prospecting work, industrial resources of coal have increased several fold. All largescale fields of brown coal and lignites have been fully studied: the Vostochnomaritskiy, Zapadnomaritskiy, Sofiyskiy, Kyustendil'skiy and Kaninskiy, Dimitrovskiy, Bobovdol'skiy, Pirinskiy, Chernomorskiy and Nikolayevskiy. The Balkanskiy coal fields and the Svogenskiy anthracite fields have been basically prospected.

The assimilation of new industrial capacity has made it possible to attain an output of about 13 million tons of coal per year (in 1944 it was 3.5 million tons). With the assimilation of the Vostochnomaritskiy lignite field, the country's largest, it is intended to bring the coal output to 22 million tons in 1962.

It has been proposed to build a thermo-electric power station-Maritsa-Vostok with a capacity of 2 million kw., a briquet plant with an output of 2 million tons of briquets per year and a new artificial nitrogen fertilizer plant with an output of 500 thousand tons per year.

All the lignite fields date back to the Pliocene period and are situated in the southern and western parts of the country.

The Vostochnomaritskiy field is the largest field in the country and occupies an area of 300 km<sup>2</sup>. Three layers of lignites with a total capacity of 15m-30 m have been discovered here at a depth of 45m-80 m from the surface. The lignites are of the earthy and compact varieties. The average ash content for dry fuel is 25% - 32%, sulfur - about 5%, the yield of volatile matter for combustible material is 56% - 59% and of bitumens for dry material is 10% - 11%. A quarry is being opened here with a capacity of 10 million tons and a second quarry of the same capacity has been proposed.

The Zapadnomaritskiy field occupies an area of about 80 km<sup>2</sup>. The thickness of the Pliocene deposits in the field is about 500 m. The lignites are used as power fuel and as chemical raw material for the chemical combine imeni Stalin.

The Sofiyskiy field occupies an area of about 1000 km<sup>2</sup> and is considered to be the second largest coal field in the country. The resources are estimated at about one billion tons of coal (the field has been partially prospected). The lignites are characterized by a high ash content (35% on the average) and a high moisture content (40% - 50%).

The Lomski field is situated in northwestern Bulgaria. Its geological resources are estimated at 1 billion tons, but due to its difficult hydro-geological conditions the field is not being worked. In southwestern Bulgaria the Kyustendil'skiy and Kaninskiy deposits are being worked the resources of which are estimated at several tens of millions of tons. The lignites are being used for local needs.

In Bulgaria brown coal is the main power fuel for the needs of industry, transport and domestic uses. All brown coal fields are of the Paleogene period and occupy synclines of various sizes in the southern and more often in the southwestern part of the country.

The Dimitrovski field is situated 30 km southwest of the city of Sofiya and holds first place in the country for coal output. It covers a surface of about 200 km<sup>2</sup>. The coal level, represented by coal strata alternating with clay and sandstone, is covered with a thick layer (100m - 200m.) of sandstone-clay marl. The strata have a slanting grade. In the central part of the field four coal strata 5m - 6 m thick are situated. Exploitation is carried out by the underground method. On the northeastern and southern edges of the field the coal strata meet and exploitation is carried out by the open pit method here. The ash content of the coal varies between 15% to 30% in the central part of the basin, and between 30% to 50% in the northeastern part. Of late the output of coal has reached 7 million tons per year.

The Bobovdol'skiy field in southwestern Bulgaria occupies an area of about 40 - 50 km<sup>2</sup>. As to importance and quantity of brown coal resources it is the second most important field in the country. The quality of its coal is analogous to that of the coal found in the Dimitrovskiy field. During the last few years the annual output has been about 1 million tons.

The Pirinskiy field is situated 20 km. south of the city of Blagoyevgrada, at the western foot of the Pirinskiy range. The surface of the field covers several square kilometers. The coal is black, lustrous with an average ash content of 15% - 20%. The annual output is 400 thousand tons.

The Chernomorskiy field is situated 10 km. northwest of the city of Burgas on the coast of the Black Sea. Its total area covers 300 km<sup>2</sup>, and the productive surface covers 10 km<sup>2</sup>. The coal contains 25% - 45% ash and on the average 10% bitumens. The coal is of the Paleogenic period.

The Balkanskiy field is the only coal field of industrial importance. It is composed of deposits of the upper Cretaceous period (Turonio-Senoman stage) and is situated on the highest parts of the Tsentral'nyye Balkanskiye mountains; (it is 70 km. long and 10 km. to 12 km. wide). The coal deposits have been greatly dislocated. The degree of carbonization of the coal is not uniform in different parts of the field. The yield of volatile matter for combustible material is 8% - 42%, which indicates the variety of technological grades of coking coal - from bituminous to gaseous. The ash content is from 15% to 45%, sulfur content 1.5% - 3.5% on the average, and phosphorous content 0.01% - 0.03%. Nearly all the coal with a yield of 14% - 16% of volatile matter is coked in a furnace charge.

On the basis of these coals the building of the first coking plant in Bulgaria with an output of 300 thousand tons per year was proposed.

Coal finds of the Upper Cretaceous period were found in the Sofiyskiy and Trynskiy regions, in the Strandzhanskiye mountains, and coal finds of the Jurassic period were found in the central and western Balkans and in southwestern Bulgaria.

Anthracite is found only in western Bulgaria among deposits of carbon. Zones of industrial importance have been discovered in the Svogenskiy field and on the Praganitsa deposit in the Berkovski region. The Svogenskiy field is situated 30 - 40 km. north of the city of Sofiya. The anthracites are characterized by a yield of 2% - 4% volatile matter, of 20% - 30% ash content and of 1% - 2% sulfur.

The geological conditions of deposits of the Praganitsa and Svogenskiy fields are similar and their coals are analogous in quality.

#### Petroleum and natural fuel gas

Sources of petroleum and gas have been discovered in northeastern and western Bulgaria, and also in the Balkans in Triassic, Jurassic, Upper and Lower Cretaceous and Paleogenic deposits.

The first petroleum and gas deposit was discovered in 1931 by Soviet specialists in the Tolbukhinskiy region on the Black Sea coast between the villages of Tyulenovo and Shabla. The petroleum beds of the Tyulenovskoy deposit are of secondary origin and originated during the formation of cavernous and fissured limestones of "valanzhin" [?] and partly during the formation of limestones of the Upper Cretaceous period, which settled on "valanzhin" deposits at a depth of 300 - 370 m. Above the petroleum level and Upper Cretaceous limestone there is a gas cap.

The deposit is of block structure, characterized by a system of meridional and parallel faults with an amplitude of between 10 and 600 m.

The petroleum has a low sulfur and paraffin content and a high tar content, is of a dark brown color with an oily tint, has a slight smell of hydrogen sulfide, and does not contain benzine or tractor kerosene. Its specific gravity is 0.938, its calorific value is 10,460 cal./kg. Gas reserves have been located in the most elevated parts of the deposit at the base of Oligocene sandstone at a depth of 110 m. - 160m.

A gas reserve has been discovered in deposits of the Upper Eocene epoch in the foothill depression at the lower course of the Kamchin river at a distance of approximately 30 km. south of the city of Varna. The deposit is being worked.

#### Iron ores

At the present time Bulgaria is getting an independent iron ore base. The total iron ore reserves have increased tenfold in comparison to 1944. These are included in deposits of the most varied genetic types.

The Kremikovskiy deposit is situated 16 km. north east of the city of Sofiya on the border between the Balkans and the Sofiyskaya syncline. The deposit is composed of

highly dislocated sedimentary deposits of the Triassic and Jurassic periods.

The iron ores are composed of siderite and hematite, which are primarily of hydrothermal origin, and also of limonite, which formed as a result of the oxidation of siderite under supergenic conditions. The ore deposits are complex: 30.7% iron, 6.7% manganese, 0.55% lead, 0.12% copper and 17.3% barite. The geological mountain conditions permit the use of the open pit method despite the fact that the engineering and hydro-geological conditions of the deposit are complex. The establishment of a mine has been proposed here.

The Krumovo deposit is situated in southeastern Bulgaria in a contact zone of gabbro-dioritic pluton with Paleozoic rock. The main mineral ore is magnetite; hematite; pyrite, pyrrhotite, more rarely chalcopyrite, sphalerite, marcasite and ludwigite are also present. The ore contains 44.1% iron, 0.158% sulfur, 0.01% phosphorus, 0.02% zinc, 0.06% copper. The deposit is being worked by the underground method.

The Martinovo deposit is situated in northwestern Bulgaria, 40 km. west of the city of Mikhaylovgrad in the center of the Berkovskiy anticline, which is the fundamental structural element in the northwestern part of the Balkan mountains. The principal mineral ores are magnetite, pyrrhotite, pyrite, and arsenopyrite. Galenite, molybdenite, scheelite, marcasite are present in smaller quantities. The ore contains 39% iron, 5.14% sulfur and 0.83% arsenic.

Jurassic sedimentary deposits are widely spread and are represented by thick deposits of all formations. Liassic-dogger deposits practically always contain iron. The iron ore reserves and the Liassic-dogger deposits enclosing them in the Sofiyskiy mountains have been studied in detail.

The oolitic iron ores of sedimentary origin are widely spread and form horizontal blanket deposits. All the deposits of this genetic type known in Bulgaria are of the less significant kind. The iron content in the ores varies between 15% and 40%; on the average it is between 20% and 25%.

#### Manganese ores

Manganese deposits are of two genetic types: the sedimentary littoral type, of the Oligocene epoch and the volcanic sedimentary type, originating during Upper Cretaceous andesite volcanism.

Manganese deposits of the Oligocene epoch are found in northeastern Bulgaria in the Varnenskiy region. The ore is carbonaceous and oxidized on the surface. In the middle part of the region, near the Ignat'yev-Pripek deposits a blanket of ore has been traced consisting of cavernous concretions, scattered irregularly among sandstone-clay rocks. In the northern part of the region, where the Oligocene depositions are covered by thick Neogenic depositions, manganese ores have been discovered on the surface of the Tyulenovskiy oil deposit.

The total prospective reserves of manganese ore in the Varnenskiy region are important, but the ores are characterized by a low manganese content from 10% to 15%.

The Upper Cretaceous volcanic-sedimentary manganese ore deposits originated during the formation of the Srednegorskiy volcanic complex and are primary oxides. Its prospects are very limited. Only the Pozharevo deposit 20 km. from Sofiya is being worked.

#### Copper Ores

During the last ten years important reserves of copper ore have been discovered, permitting the foundation of our own copper industry. Copper is the leading element in the metallogenesis of Srednegor'ye and the Strandzhanskiy mountains and plays the part of an associated component in the lead-zinc deposits of the Podopskiy mountains and also in the polymetallic ore region of the west Balkan mountains. In the mountains of Srednegor'ye and Strandzhanskiy copper deposits have been prospected and are being worked in the Panagyurskiy, Burgasskiy and Strandzhanskiy regions.

#### Lead-zinc ores

Up to 1944 only deposits in the Rodopskiy and west Balkan mountains were being worked, where several tens of thousands of tons of ore per year were being extracted. No attention was given to the evaluation of the total reserves.

Starting from 1948 with the direct assistance of Soviet specialists, important reserves of lead-zinc ore were discovered in the Rodopskiy ore mining area and in the northwestern part of the Balkans, in Osogovo and Sakar-planine. Today Bulgaria is considered rich in lead-zinc ores and holds one of the first places in Europe for prospected reserves of lead-zinc ores.

The lead-zinc deposits in the Rodopskiy mountains are of the hydrothermal vein type and are related to the magmatic

processes taking place during the Neogene epoch.

Metamorphic rocks, supposedly of pre-Cambrian period, contain ores, as do depositions of the Tertiary period (breccia), of the Paleogenic epoch (andesite), and of the Upper Paleogenic epoch (rhyolite). The main mineral ores are galenite, sphalerite and pyrite, the secondary ones are chalcopyrite, arsenopyrite, marcasite. The ore contains silver, cadmium, molybdenum, tungsten, bismuth, antimony and others in varied concentrations. The veiny minerals are represented by quartz and more rarely by varied carbonates.

In the ore region of the west Balkans three genetic types of lead-zinc deposits have been discovered: 1) the hypothermal and mesothermal type, related to Hercynian (or pre-Hercynian) magmatism in the Chiprovsko-Martinovskaya ore zone; 2) the mesothermal and epithermal type, related to Al'piyskiy magmatism in the Yetropol'skiy region; 3) the telethermal type among carbonaceous and psammitic rocks of the Triassic and Jurassic periods in the Vrachanskaya group.

#### Nonmetallic minerals

The raw material reserves for the production of cement which have been prospected in southwestern, northwestern, northeastern and southern Bulgaria will supply cement works for many decades. The prospects for the manufacture of cement are unlimited.

Two gypsum regions have been discovered in Bulgaria: the Radnevskiy region in southern Bulgaria and the Vidinskiy region in northwestern Bulgaria. The gypsum found in the Radnevskiy region originated during the formation of sandy clay. The saturation of clay with gypsum concretions varies between  $100 \text{ kg/m}^3$  and  $600 \text{ kg/m}^3$  (on the average  $150 \text{ kg/m}^3 - 200 \text{ kg/m}^3$ ). The gypsum in the Vidinskiy region is of sedimentary formation, of the Miocene epoch (Tortonian).

Hydrothermal barite veins exist practically throughout the country. An important barite deposit is the Starozagorskoye, associated with the rod-like body found in andesite tuffs. The satisfaction of industrial needs has been fully assured with the discovery of the Kremikovskiy iron ore deposit, where important reserves of barite have been found. Two industrial fluorite deposits are known in the region of the Palat Blagoyevgradskiy okrug and near the Mikhailkovo-Smolyanskiy district. The quantity of fluorite being extracted satisfies the needs of the country.

The industrial kaolin deposits discovered in northeastern Bulgaria are of secondary origin and originated during the formation of quartz sand with kaolin, filling in the

caverns in the Aptian limestones.

Refractory clay has been discovered in Bulgaria in the Sarmatian stage depositions in the region of the city of Pleven and in the Liassic-dogger depositions between the villages of Zhablino and Yelov Dol in Dimitrovskiy okrug.

Feldspar and mica are extracted in the Ril'skiy and Zapadno-Rodopskiy mountains, in the Ikhtimanskiy region and in the Tsentral'naya Staraya Gora; they originated during the formation of pegmatite bodies among the so called south Bulgarian granites and the highly crystalline metamorphites. The yield of feldspar and mica satisfy the needs of one peoples' economy.

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