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EIGHTH INTERNATIONAL CARTOGRAPHIC CONFERENCE

MOSCOW, USSR August 1976

V.K. Eremin, V.N. Brukhanov, R. J. Sokelev

GEOLOGICAL MAPPING IN THE USSR AT PRESENT AND  
ITS FURTHER TRENDS

USSR National Committee of Cartographers

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The geological mapping in the Soviet Union plays an important role in geological investigations as a graphical presentation of our knowledge of the geological pattern of the territory, its history and of distribution of minerals. Geological maps are of scientific and practical values as these are the result of geological studies and present the basis for forecasting, exploration and prospecting minerals.

The amount of field data used, variety of the applied methods of geological investigations and of graphic presentation of geological features on maps define how much information geological maps contain and the extent to which they are true.

If the information which geographical maps contain exceeds 22 times that of the corresponding texts, then this figure increases by 2 or 3 times in the case of geological maps.

The compilation of geological maps for the territory of our country began as early as at the end of the past century but the fact that the territory was inadequately studied from the geological point of view, the Asian part in particular, made it impossible to make a map covering the whole of the country or some major regions.

After the Great October Revolution, there came a necessity of providing the developing national economy with minerals. It greatly stimulated the geological investigation

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of the country and further development of the geological mapping. From year to year, the geological surveys kept on increasing their volumes and rates and so did the total geological knowledge of the country. It permitted to compile general geological maps on scales of from 1:420 000 to 1:2 250 000 of the European part of the USSR, of the Turkmen Republic, of Kuznetsk coal basin and of the Crimea as early as in the twenties.

1954 was a turning point in the Soviet geological mapping, when the Soviet government issued a special decree announcing the national significance of the planned geological mapping aimed at studying the geological patterns of the USSR territory and finding its minerals. In this connection, the said decree strictly regulated the scales of geological surveys and those of maps to be published as well as the rate of map publications. Special manuals published stated the typical requirements to map scales and basic contents as well as to map appearance. To control the quality of the maps prepared to publishing, the Scientific Editorial Council was set up which was authorized to sanction the publishing of geological maps.

By present, the whole lot of the territory of the Soviet Union had been mapped on a scale of 1:1 000 000. 78 percent of the country territory has been mapped on a scale of 1:200 000. The most important mining regions in the European part of the USSR, in Siberia, southern portions of the Far East, in the Urals, Kazakhstan and Central Asia has been nearly completely mapped on large scales.

Since publishing the Governmental decree in 1954, the compilation and publication of general and summary geological

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maps became more systematic and better planned. The data collected by Soviet geologists made it possible to construct quite a number of general, summary geological maps and sheets for the whole of the Soviet Union. At present, about 1 000 general and summary maps on various scales have been published.

For the past 20 years, geological maps of the USSR on a scale of 1:7 500 000 were published three times and those on scales of 1:5 000 000 and 1:2 500 000 were published twice. The tectonic and hydrogeological maps on the above mentioned scales, geomorphological and Quaternary Sediments maps on scales of 1:7 500 000 and 1:5 000 000 were also published. At present, the geological map of the USSR on a scale of 1:10 000 000 is under publication. A series of other thematic geological maps mainly on a scale of 1:2 500 000 covering the whole of the country were published in addition to the above mentioned maps.

Summary geological maps on a scale of 1:1 500 000 were published for major regions of the USSR, covering, on the whole, all the country territory. On the same scale are published the maps of the Quaternary Sediments in the West Siberian Lowland and those in the European Part of the USSR.

The maps of various scales illustrating geological patterns of the territories described in the volumes, are published as appendixes to volumes "The Geology of the USSR". The maps are on a scale of 1:2 500 000 for the North Caucasus, Kamchatka Peninsula, Krasnoyarsky Kray, Povolzhie and Primorje, Tadzhik SSR, Turkmen SSR, Khabarovskiy Kray and Amur Oblast; on a scale of 1:1 500 000 for the Central European part, Highlands of the West Siberia, South Kazakh SSR, Novaya

Zemlya Islands, Vaygach and Kolguyev Islands, New Siberian Islands, Severnaya Zemlya, Chita Oblast and Yakut ASSR; on a scale of 1:1 000 000 for the Byelorussian SSR, East Carpathians, Crimea, Leningrad Oblast, Pskov Oblast, Novgorod Oblast, Murmansk Oblast, Primorsky Kray, Rostov Oblast, Volgograd Oblast, Astrakhan Oblast and Kalmyk ASSR, Sakhalin, North Urals, Central and North-Eastern part of the South Urals; on scales of 1:500 000 for the Moldavian SSR.

Apart from the maps of the USSR territory, a series of summary geological maps showing geological structures of some continents and the whole Earth were compiled. The Geological Map and the Map of Mineral Resources of Africa on a scale of 1:10 000 000, Geological Map of the Eurasia on a scale of 1:5 000 000, Geological Map and the Map of Mineral Resources of the World on a scale of 1:15 000 000, Tectonic Map of the Earth's Polar Regions on a scale of 1:10 000 000, Geological and Tectonic Maps of the South Pacific Mobile Belt and of the Pacific Ocean on a scale of 1:10 000 000 etc.

The Soviet Union was the first country in the world to make the Geological Globe on a scale of 1:15 000 000 showing the geological structure not only of the land but the ocean floor too.

Soviet geologists are taking an active part in compiling International geological maps, namely, in preparing the Geological and Hydrogeological maps of the Europe on a scale of 1:1 500 000, the Map of the Quaternary Sediments of Europe, Metallogenic Map of Europe and Geomorphological Map of Europe on a scale of 1:2 500 000.

The ever growing need of the national economy in mi-

neral raw materials calls for urgent discovery of new major deposits and mineral-bearing regions. Taking into account the fact that the number of deposits that may be easily discovered keep on reducing, the necessity arises to look for mineral deposits lying at greater depths or those of new types. It calls for a further development of scientific forecast methods which are, in turn, based on complex studies of the geological structure of the territory.

In this connexion, one may mark out three main trends of not traditional mapping that developed recently.

The first trend of the geological mapping lies in the increase of mapping depths. The second trend is the compilation of various thematic maps which, when put together, allow us to study the history of geological development, formation and distribution of mineral resources. The third one is construction of maps of paleogeographical and paleogeological reconstructions.

The increase of mapping depth is possible due to wide application of geophysical methods, great amount of drilling and the use of aerial and satellite data. It permits to construct maps showing sections at various depths, maps of surfaces with removed sedimentary cover, maps of the Precambrian basement topography etc.

The maps of tectosphere illustrating the structure of the lithosphere on the whole, i.e. the ratio of its sedimentary, granitic and basaltic planes sometimes assumed by the asthenosphere data and the Golitzin bed, are a special kind of maps. It is quite natural that the said maps based largely on geophysical data are somewhat schematic, illustrating only depths to some tectosphere planes, bed thick-

nesses, their physical parameters, probable rock composition as well as superdeep faults going down to the mantle. Among this type of the cartographic material charts and cross-sections are predominant.

The geological mapping on various scales is very often accompanied by compilation of a set of thematic maps supplementing one another.

A series comprising six maps, i.e. the geological map, the map of Quaternary sediments, geomorphological, hydrogeological maps and the map of mineral resources of the Soviet Union were first published in 1968.

Later on, the construction of special-purpose maps was continued on a scale of 1:2 500 000. So, to thorough disclose the geological pattern of the USSR, a series of maps revealing peculiar aspects of geological phenomena, were prepared on the basis of the Geological Map of the USSR on a scale of 1:2 500 000 with no Quaternary sediments.

At present, the following maps of the Soviet Union on a scale of 1:2 500 000 have been or being published: the map of Quaternary sediments, tectonic map, the map of peneplanes and weathering crust, maps of magmatic formations, sedimentary and igneous formations, anomalous magnetic field and metallogenic maps.

Fundamentally new is a series of paleotectonic maps of the USSR on a scale of 1:5 000 000, which display, in the historical aspect, the origin and dynamics of faults, production of troughs and elevations, development of folded regions, platforms and mountain masses rather than only formation, by epochs and ages, of sedimentary rocks and magmatic bodies different in their compositions. The above maps

are important for studying the accumulation and redistribution of various minerals in time.

It is for the first time that the whole of the USSR territory was plotted on the map of a scale of 1:10 000 000 showing morphostructures of a central type with ring and adjacent to them linear structures of various orders, based on geomorphological evidence.

In addition to the above mentioned, we compile and publish maps of the Precambrian formations for some major regions, structure-formation maps, maps of recent tectonics, of the subsurface drainage, fault maps, maps of oil content, of coal layers, of metamorphic facies, geothermal maps etc. All the aforesaid maps are, to a certain extent, experimental for the time being but they, when taken together, help reveal the laws of the Earth evolution, the formation and distribution of mineral resources.

The regional geological investigations as well as geological mapping are based on the achievements in stratigraphy studies, new trends in geotectonics (mobility theory), in metallogeny, on formation, lithological, structural-geological, structural-geomorphological, paleogeomorphological, paleotectonic and other geological methods.

Considerably greater objectiveness of geological data as far as the relationship of mapped geological features and regional long-term forecasts for various minerals is concerned was achieved due to application of new efficient regional geological survey methods, i.e. to a special geological survey which is known in the USSR as a 'group' geological survey as well as aerial photogeological mapping.

Basic features of the 'group' geological survey and the

aerial photogeological mapping are the following:

- a) the survey is undertaken by one team over a vast territory of a similar geological structure within a group of sheets bearing the same name;
- b) remote sensing data are applied on a broad scale with simultaneous reduction of the ground work;
- c) geological investigations are performed from the general to the particular, i.e. by means of gradual extension of control, drawing the attention to most complex and important sites.

Thematic geological maps constructed as a result of the above operations are characterized by a great amount of details and objective information and lay a ground for search of minerals, help solving engineering-geology, hydrogeological and other tasks aimed at exploring the territory. These are the geological map, maps of the Quaternary sediments, of mineral resources, geomorphological, tectonic, geophysical, lithologic-facies, metallogenic, hydrogeological and other maps. Some maps are drawn on transparent paper for superimposing on a geological base.

In connexion with the development of remote sensing methods for studying the Earth such as high altitude airborne, radar, thermal and satellite surveys, it became possible to increase not only the objectiveness in mapping geological features and phenomena but also to obtain qualitatively new information what helps the geological mapping present new, previously unknown information. The recognition, on photographs, of ring and buried structures, major lineations presenting deep faults and planetary jointing raises new problems of their cartographic representation. Natural

generalization of geological features on satellite pictures makes it possible to carry out the mapping on a fundamentally new basis of geological legends.

So, one may speak of a new kind of thematic geological mapping output, namely, of satellite photogeological maps displaying true representation of geological bodies occurring on the surface and conspicuous details of the deep geological structure of the territory under survey. The maps in question would, apart from the traditional information, show deep tectonics, geological structure of water-covered areas, geological formations, genetic types of structures and their relationships.

As was already mentioned, the complex investigations are essential for comprehensive understanding of the geological pattern. The cartographic representation of results of the said studies calls for compilation of series of thematic geological maps which disclose most completely the geological build-up of the territory, its history, laws of distribution of geological features and of phenomena. The maps should be constructed on the same scales and in the same projection, i.e. they should be comparable. Hence, it is quite essential to compile regional atlases illustrating all the geological aspects of a certain territory and/or the whole of the country.

Such a system of geological mapping would permit to use the computer processing of the information available on maps. Legends and symbols based, probably, on screening would be worked out for the purpose, which are good for automatic convolution of the information in the Tenth and Eleventh Five-Year Plans.

The development of geological science, technical aids and investigation methods requires the periodical renewal of geological maps. In this connexion, a great attention has been recently paid in the USSR to additional surveying of the areas mapped before. The additional studies are performed by means of new, more efficient methods and are based on the predominant application of geophysical data and interpretation of aerial and satellite information.

The Soviet geological mapping has a century-long tradition, i.e. the maps made in the USSR are, as a rule, characterized by a logically compiled legend, their comprehensiveness, a great amount of field information they are based upon, uniform representation of geological data and by high quality of published maps.

The thematic geological mapping in the USSR is successfully developing basically aimed at further expansion of mineral resources in the Soviet Union.