THE ZHURAVKA GEOTHERMAL ANOMALY[1]

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The distribution of temperatures both in profile and in regional plan has been established for the Caucasus and Ciscaucasia as a result of persistent geothermal surveys undertaken in the last ten years in deep reconnaissance holes that penetrated the Mesozoic sedimentary cover at depths down to 3 or 4 km. Analysis of the material available [1, 2] and some fresh information has made it possible to construct a series of section maps of eastern Ciscaucasia at 250 m intervals, between depths of 500 and 4000 m (Fig. 1). The 15 sections constructed were based on the data of 32 key geothermal profiles in which temperatures were measured by one method with maximum mercury thermometers, to within not less than 1 or 2° C.

Analyzing the geothermal section maps, we can draw the following conclusions:

1. In eastern Ciscaucasia there is a conspicuous geothermal anomaly with an epicenter situated in the Zhuravka reconnaissance area (120 km east of the city of Stavropol' and 50 km west of the town of Prikumsk).

New, recently obtained facts show that it is not a local thermal anomaly but an effect with a fairly wide regional character, which is expressed over an extensive area (of about 15 to 20 thou. km^2) and at considerable depths (not less than 5 or 6 km).

2. The geothermal anomaly has a morphologic reflection on almost all geothermal sections, particularly on those plotted every 250 m between depths of 2000 and 4000 m.

Only near the top of the profile (500 to 1000 m) is the Zhuravka anomaly not reflected at all. But at depths of 1000, 1250 and 1500 m, the local Praskovey and North Nagutskoye geothermal anomalies are reflected besides the Zhuravka anomaly, to the east and southwest of it, although with increasing depth they seem to be absorbed by the more powerful Zhuravka anomaly.

3. As can be seen from the configuration of isotherms, the anomalous temperature distribution is distinguished on each section by certain common features including a steady fall in subsurface temperature on all sides of the anomaly epicenter. However, in the best studied district east of the Zhuravka reconnaissance area, the isotherms on all 15 sections outline a rather marked trend indicative of a most considerable fall in temperature.

4. The differences between the maximum and minimum temperatures in plan on each section genrally are about 30°. Admittedly, there is a tendency for this difference to decrease from 34 or 35° on lower sections to 27 or 29° on upper ones. Only in the highest of the sections studied (750 and 500 m) does the temperature drop abruptly to 24° and even 15° (at a depth of 500 m). The $\Delta t = t_{max} - t_{min}$ values are 15° for 500 m, 24° for 750 m, 29° for 1000 m, 27° for 1250 m, 28° for 1500 m, 29° for 1750 m, 31° for 2000 m, 31° for 2250 m, 32° for 2500 m, 34° for 2750 m, 35° for 3250 m, 34° for 3500 m, 35° for 3750 m and 32° for 4000 m.

In conclusion let us consider the possible origin of the Zhuravka geothermal anomaly. The stratigraphic sequence within the sedimentary cover and its tectonic properties indicate, most probably, that they are not the cause of the geothermal anomaly. Indeed, the very weakly differentiated epi-Hercynian platform surface, which is covered by comparatively uniform terrigenous strata of the Jurassic and Lower Cretaceous, by carbonate strata of the Upper Cretaceous and by the thick Maykop clay series, does not exhibit any marked variation in regional plan, especially near the epicenter of the geothermal anomaly. Because of this it is quite logical to show a preference for subsurface causal factors. The most likely are those processes bringing the sources of plutonic heat closer to the surface. The possibilities here include block movements of the basement and even plutonic intrusions, the roots of which, for some reason or other, have not reached the sedimentary cover and lie perhaps at depths of about 5 to 10 km. In referring to plutonic intrusions as a source of heat we should remember not only the actual intrusive bodies of enormous size but also their attendant processes, in particular the inflow of overheated water derived from seepage or sedimentation in contact with intrusive bodies

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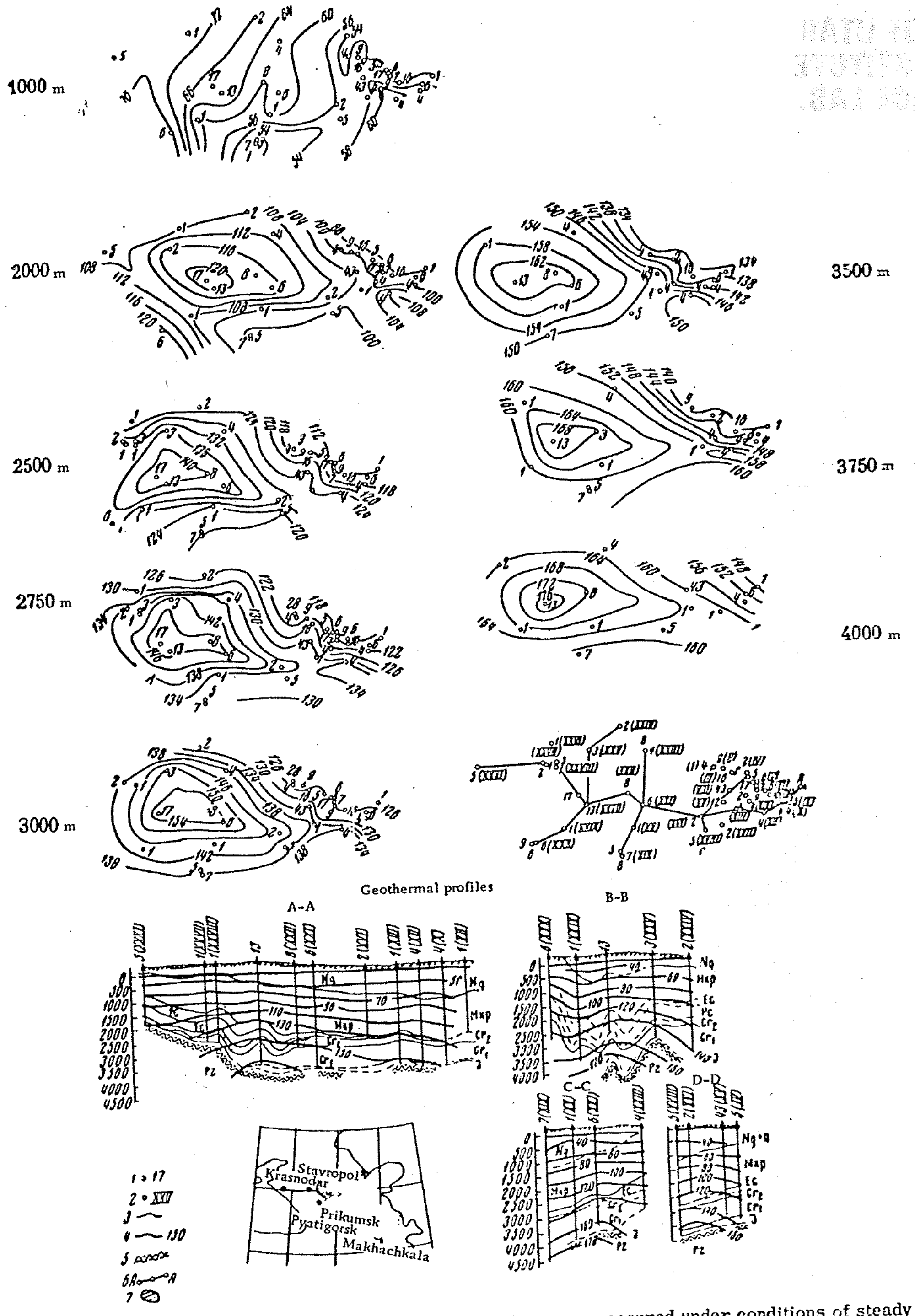

Fig. 1. 1) geothermal test holes in which the temperature was measured under conditions of steady heat flow. Figures show the reconnaissance hole number, 2) names of reconnaissance areas: I) Velelichayevskoye; II) Pravoberezhnoye; III) Zimnyaya Stavka; IV) East; V) Russkiy Khutnor (North); VI) Sukhokumskoye; VII) Stepnoye; VIII) South Sukhokumskoye; IX) Solonchakovskoye; X) Ravnina; XI) Perekrestnoye; XII) Bazhigan; XIII) Kurgan Amurskoye; XIV) Russkiy Khutor (South); XV) Ozek Suat; XVI) South Achikulak; XVII) Mekteb; XVIII) Yamangoy; XIX) Otkaznoye; XX) Arkhangel'skoye; XXI) Praskovey; XXII) Chkalovskoye; XXIII) Gorokhovskoye; XXIV) Arzgir; XXV) Mirnoye; XXVI) Kambulat; XXVII) Buyvolinskoye; XXVIII) Blagodarnoye; XXIX) Aleksandrovskoye; XXX) North Nagutskoye; XXXI) Grachevskoye; XXXII) Zhuravka, 3) boundaries of stratigraphic complexes; 4) isotherms; 5) epi-Hercynian basement; 6) geothermal profile lines; 7) outlines of geothermal anomaly on map.

Deep circulating water thus acts as a conductor of intrusive heat, like a reactor.

Indeed, the district analyzed does have groundwater under hypothermal pressure. Deep drilling would confirm these assumptions or provide fresh, more convincing explanations for this unusual natural phenomenon.

The drilling over the Churavka geothermal anomaly of a special hole to a depth of about 5 or 6 km would be of both scientific and great practical interest in connection with the problem of utilizing subsurface heat.

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PLEISTOCENE PALEOGEOGRAPHY OF SPITSBERGEN[1]

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Recent studies of the Quaternary of Spitsbergen have made it possible to consider the paleogeography of this region in a somewhat different way than has been done before. This concerns, in particular, the history of early glaciation, the role of glacial isostasy in the uplift of Spitsbergen coasts and the relative oscillations in sea level[2].

Until recently all data on the Pleistocene glaciations of Spitsbergen were based mainly on analysis of the macrorelief and the direction of glacial scratches and grooves on glacial exaration forms as well as on the interpretation of information about the history of Quaternary glaciations of adjacent areas of the Arctic and Subarctic regions (Franz Josef Land, Scandinavia, Iceland, Greenland).

No direct information had been cited in the literature about the number and age of the Pleistocene glaciations established by analysis of geologic sections, nor had the actual presence of Pleistocene sediments ever been reported from Spitsbergen.

Surveys disclosed certain sections in which Pleistocene deposits were identified [3]. Their study revealed the deposits of two glaciations and several marine transgressions. In view of all the data available it can be said that in the Würm III the area glaciated in Spitsbergen was similar to and only slightly greater than that of today. In connection with this conclusion it should not be forgotten that the fact that a still larger ice sheet existed in Europe at that time was one of the features characteristic of the evolution of Spitsbergen at the end of the Pleistocene.

Indeed, previous geologic and physiographic studies of the topography of Spitsbergen and its Quaternary formations of diverse age have never disclosed any widespread glacial deposits that could be dated as Würm III.

Material collected by us and other scientists on the relationship between glacial and dated marine deposits showed that on Holocene and Late Pleistocene terrace surfaces they occurred only in the immediate vicinity of present glaciers. One can quote as an example the outer terminal moraine of the Nordenskjöld Glacier, at the side of which there are small areas of abrasion at various heights. The highest of them was noticed at an altitude of some 50 m. This means that the terminal moraine of the Nordenskjöld Glacier is at least older than the 50-m terrace and originated in the time interval between the development of the latter and the highest 84 m in Billet Fjord.

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[1]Translated from: K paleogeografii pleystotsena Shpitsbergena. Doklady Akademii Nauk SSSR, 1968, Vol. 181, No. 1, pp. 178-181.

[2]The geologic and physiographic material, on the basis of which the present article was written, was collected by Yu. A. Lavrushin in the course of field work in Spitsbergen. The absolute C^{14} age was determined by A. L. Devirts and E. I. Dobkina in the Institute of Geochemistry and Analytical Chemistry, USSR Academy of Sciences, and by V. S. Forova and F. S. Zavel'skiy in the Geological Institute, USSR Academy of Sciences.