DEEP, HEAT-CONDUCTING FAULTS AND THE VICINAL HEAT FIELD OF THE APSHERON PENINSULA[1]

S. T. Ovnatanov and G. P. Tamrazyan

(Presented by Academician A. V. Peyve, March 12, 1969)

Geothermal surveys are increasingly used to determine the geologic structure of oil and gas fields, because they provide valuable information about the possible structure at depth. Thus, for example, thermal data suggested that a gas-mud volcano was present below the surface, and outlined its site. Subsequent drilling confirmed the presence and site of this volcano [1,2]. The application of geothermal surveys to the detection of deep faults would also be interesting. However, we must first consider a latitudinal geothermal profile through the south coast of the Apsheron Peninsula. As can be seen from Fig. 1, geoisotherms rise near anticlines (Karachukhur-Zykh and Kala-Tyurkyan uplifts), but fall near synclines (Baku trough and Bina-Gousanskaya syncline). However, the bends of geoisotherms are not so sharp as those of stratigraphic contacts. Though appearing to smooth out structural differences, geoisotherms do not mask them but are closely associated with them. We shall discuss the temperature variations near deep faults in the downwarped eastern part of the Apsheron Peninsula.

The largest structure in that part of the Peninsula is the Bina-Gousanskaya syncline; it expands southward, grading into one of the northwestern structural embayments of the South Caspian basin [3]. The Surakhany-Karachukhur-Zykh anticlinal zone and the elongated Kala anticline lie, respectively, west and east of the Bina-Gousanskaya syncline.

The Bina-Gousanskaya syncline contacts the more easterly Kala anticline (whose crest is uplifted relative to it) along a deep reverse fault (Fig. 2). This fault intersects the entire multikilometer-thick Productive Formation of the middle Pliocene. The throw increases with depth. It equals 150 to 300 m in the Sabunchi suite, at the top of the productive formation, and reaches 350 to 500 m in the Kala suite, at the bottom of it. Lower in the section, in the Pontian, the throw increases to 1000-1100 m, and more at greater depths.

Analysis of the heat field at the Kala uplift shows that the subsurface temperature increases from northeast to southwest toward the deep fault just mentioned (Fig. 3). Thus, the 55° isotherm lies at the highest elevation (1600 to 1800 m) near the fault, but is at greater depths (1800 to 2000 m and more) on the northeast limb of the Kala uplift. Near the fault, the probable inflow of heat along it has raised the hypsometric level of this isotherm in the adjacent

[1]Translated from: Teploprovodyashchiye glubokiye razlomy i osobennosti termal'nogo polya vblizi nikh (na primere Apsheronskogo poluostrova). Doklady Akademii Nauk SSSR, 1970, Vol. 190, No. 2, pp. 421-423.

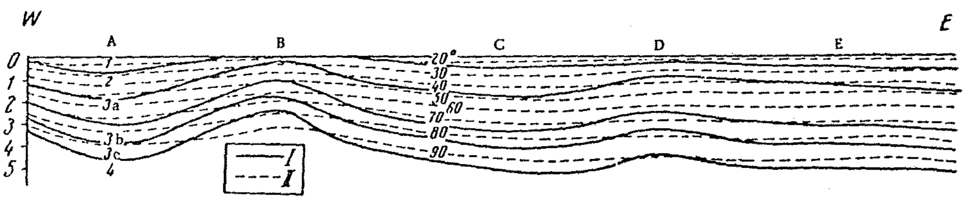

Fig. 1. Geothermal profile through the south coast of the Apsheron Peninsula (western part of the Caspian Sea). I) stratigraphic contacts between suites of the productive formation: 1) Quaternary; 2) upper Pliocene (Apsheronian and Akchagylian); 3) middle Pliocene (productive formation: 3a) Surakhany and Sabunchi suites; 3b) Balakhany and "Pereryv" suites; 3c) Supra-Kirmakinskaya clayey (NKG), Supra-Kirmakinskaya Sandy (NKP), Kirmakinskaya, Sub-Kirmakinskaya (PK) and Kala (KaS) suites); 4) lower Pliocene (Pontian). II) Geoisotherms. Structures: A) Baku trough; B) Karachukhur-Zykh uplift; C) Bina-Gousanskaya syncline; D) Kala-Tyurkyan uplift; E) buried Zyrya uplift.

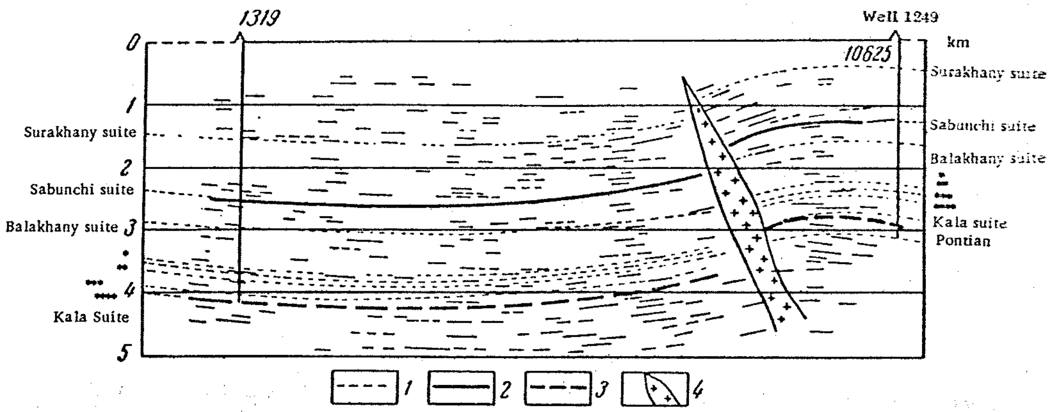

Fig. 2. Seismotectonic profile through the Bina-Gousanskaya syncline and Kala uplift [5]. 1) reflecting areas; 2) provisional seismic horizon at the top of the Sabunchi suite; 3) conventional seismic horizon at the top of the Kala suite; 4) fault zone.

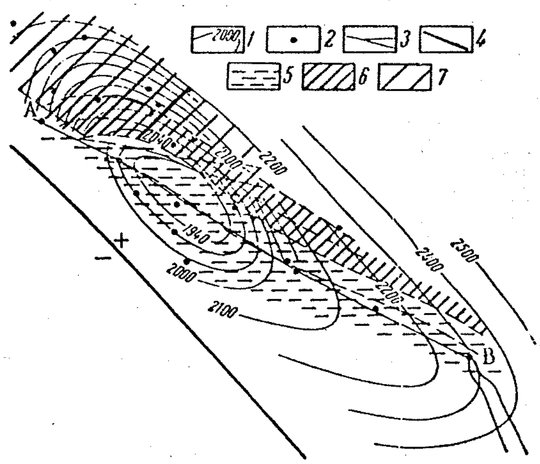

Fig. 3. Map of elevations of the 55° isotherms in the Kala area, Apsheron Peninsula. 1) structure at the top of the Sub-Kirmakinskaya suite of the Productive Formation; 2) wells from which our temperature data came; 3) fractures; 4) deep fracture on the southwest limb of the uplift. Elevations of isotherms: 5) 1600 to 1800 m; 6) 1800 to 2000 m; 7) 2000 to 2100 m.

part of the structure. Thus, an increase in temperature in a specific direction may indicate, regardless of the structural background, the presence of a fault conducting heat from great depth. This fact allows us to consider, in many cases, the thermal method search for deep, heat-conducting faults.

A geothermal profile through the Kala uplift is illustrated in Fig. 4. As can be seen, the structure in the upper Pliocene and at the top of the middle Pliocene does not coincide with that in deeper horizons. And the crest is displaced for several kilometers.

The distribution of isotherms over the profile follows the outlines of upper horizons and not those of the lower. This is probably because most heat is flowing up the fault in the southern part of the area, where the throw is maximum; it is precisely here that the high-temperature zone is farthest from the fault surface along which the heat flow to the uppermost horizons is the most intense.

Geothermal surveys can be employed in some cases to improve the description of subsurface tectonics and establish the position and outlines of deep structures, to locate deeply buried uplifts and determine, against a background of monoclinally plunging strata, whether there are any of the structural complications that are not revealed by classical geophysical methods, or

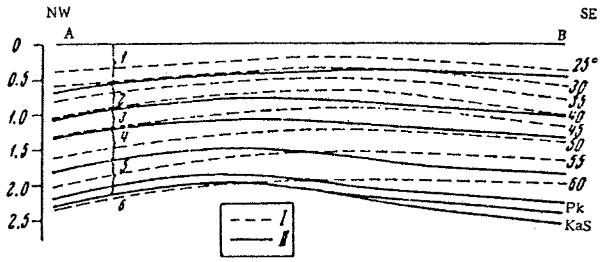

Fig. 4. Geothermal profile through the Kala uplift. I) geoisotherms; II) stratigraphic contacts. 1) upper Pliocene (Apsheronian and Akchagylian); 2 to 5) middle Pliocene (Productive Formation: 2) Surakhany suite; 3) Sabunchi suite; 4) Balakhany and "Pereryv" suites; 5) Supra-Kirmakinskaya clayey, Supra-Kirmakinskaya sandy, Kirmakinskaya, Sub-Kirmakinskaya, and Kala suites); 6) lower Pliocene (Pontian).

even by structural maps based on data for numerous drillholes. The finding of buried gas-mud volcanoes undoubtedly raises oil-and-gas potential of the deeper suites in their vicinity. Geothermal surveys can also be employed to detect deep heat-conducting faults. Their discovery would be of considerable use for firming up the theories on the routes of migration of oil and gas, and the processes of formation and reformation of oil and gas pools.

Received February 26, 1969

REFERENCES

1. Ovnatanov, S. T. and G. P. Tamrazyan. Sov. geol., 10, 99, 1960.
2. Ovnatanov, S. T. and G. P. Tamrazyan. Dokl. Akad. Nauk, 135, No. 2, 403, 1960.
3. Tamrazyan, G. P. Dokl. Akad. Nauk, 155, No. 6, 1337, 1964.
4. Tamrazyan, G. P. Dokl. Akad. Nauk, 157, No. 2, 337, 1964.
5. Tumikyan, G. G. Azerb. neft. khoz., 8, 4-5, 1958.

RESIDUUM AND HYDROTHERMAL DEPOSITS OF THE BATUMI COAST OF THE CAUCASUS[1]

V. N. Razumova

(Presented by Academician A. V. Peyve, March 24, 1969)

Batumi residuum has long attracted the attention of investigators not only as an actively evolving deposit of Quaternary age but also as a thick deposit, formed on a complex, actively evolving terrain of the Alpine fold zone. All other types of residuum known in the Soviet Union are related solely to platform structures, having accumulated on slowly rising peneplaned plateaus [1, 2]. The accumulation of equally thick residuum on the rugged terrain of the Batumi coast is a most unusual event, and was hitherto attributed to the existence here of an epoch of peneplanation and to the protective action of dense subtropical vegetation.

Our data show that this Batumi residuum is not a normal residuum of the Ural type but is a complex polygenetic deposit, formed not only by surface weathering and pedogenesis, but also by postmagmatic hydrothermal processes.

It appears that in the classic Chakva River section the clayey and rubbly products overlying basalt beneath kaolinitic red earth (Fig. 1) are not the lower horizons of the weathering profile, as was formerly thought, but are clayey

[1]Translated from: Kora vyvetrivaniya i gidrotermal'nyye obrazovaniya Batumskogo poberezh'ya Kavkaza. Doklady Akademii Nauk SSSR, 1970, Vol. 190, No. 2, pp. 424-426.