ISSN 1028-334X, Doklady Earth Sciences, 2006, Vol. 411, No. 8, pp. 1222–1224. © Pleiades Publishing, Inc., 2006.
Original Russian Text © V.I. Popkov, 2006, published in Doklady Akademii Nauk, 2006, Vol. 411, No. 2, pp. 223–225.

GEOLOGY

Imbricate Thrust Structure of the Northwestern Caucasus

V. I. Popkov

Presented by Academician V.A. Babeshko, January 17, 2006

Received February 7, 2006

DOI: 10.1134/S1028334X06080137

Many geologists suggest a determinative role of folding in the formation of the Northwestern Caucasus structure. Mapped or drilled thrusts are considered minor structures complicating steep fold limbs. Moreover, they are often described as reverse or even normal faults. In accordance with the generally accepted concept of overthrusts as subordinate structures relative to faulting, they are shown as short unlinked segments, which do not extend beyond anticlinal folds [1, 4, and others]. However, as will be shown below, this concept is erroneous and inconsistent with factual data. Actually, the genesis, morphology, and position of folds in plan view are completely controlled by overthrusts, which define the general tectonic style of the Northwestern Caucasus.

The considered region adjacent to the Western Kuban marginal trough is divided into the Psebeps–Goitkh anticlinorium in the axial part, the Novorossiisk–Lazarevsk synclinorium in the south, and Soberbash–Gunai synclinorium in the north. The tectonic zones mentioned above are bordered by large regional overthrusts. The most important of them is the Akhtyr overthrust, which separates the Caucasus fold belt from the adjacent Western Kuban marginal trough in the north. The overthrust initiated at the orogenic stage separated terranes of different geodynamic settings during the subsequent evolution of the region. The Western Kuban marginal trough was significantly buried beneath allochthonous structures of the Soberbash–Gunai synclinorium as a result of the northward displacement and overthrusting of rock masses on its southern flank. Therefore, the trough has a distinct asymmetrical structure with the axis inclined to the thrust front.

The complex imbricate Akhtyr thrust consists of smaller thrusts. Therefore, its main surface, which is marked by major tectonic displacements, can be taken as the northern boundary of the Soberbash–Gunai synclinorium. Its front passes through the Dzhiginka–Ust-Chekup–Adagum–Kesler–Kudak–Kievsk areas. Smaller thrusts that splay off from the main thrust to the north control the North Varenikov, North Adagum, and North Krymsk anticlines among others.

The Soberbash–Gunai synclinorium and Psebeps–Goitkh anticlinorium are in tectonic contact along the thrust fault, the front of which marks high-amplitude local uplifts (South Krymsk, Damansk, Gladkov, Verkhnii Chekup, and others). The anticlines have a linear shape, with short northern (near-thrust) limbs but gentler and wider southern limbs. Tectonic doubling of sections, brecciation zones, and slickensides are recorded in boreholes. To the south-southwest, the thrust fault surface becomes gentler with depth. In plan view, its front represents a slightly curved rather than straight line, which consists of smaller arc-shaped thrusts concave to the north-northeast.

The Psebeps–Goitkh anticlinorium and the Soberbash–Gunai synclinorium are crosscut by small overthrusts extending for tens of kilometers (Figs. 1, 2). Thus, these first-order structures are divided into tectonic slices extending as sublatitudinal bands and sequentially overthrusted upon each other from the south. The rear parts of the slices are overthrusted to a variable extent by the southern allochthons, so that synclines between them are occasionally absent.

Thrust faults have a distinct listric form; i.e., they have steep near-vertical fault surfaces in the frontal part, which rapidly become gentler to the south-southeast grading into near-horizontal decollement fractures. Correspondingly, the archs of semianticlines are also displaced in accordance with the dip of thrust surfaces. Occasionally, they are transformed into monoclinal blocks jammed between adjacent thrusts. Thus, horizontal tectonic movements are transformed into vertical ones in the frontal parts of slices under the influence of lateral stresses to form characteristic fold–thrust structures [2]. Such areas are marked by the formation of high-amplitude linear anticlines with steep asymmetri-

Kuban State University, ul. Stavropol'skaya 149, Krasnodar, 350640 Russia; e-mail: geoskubsu@mail.ru

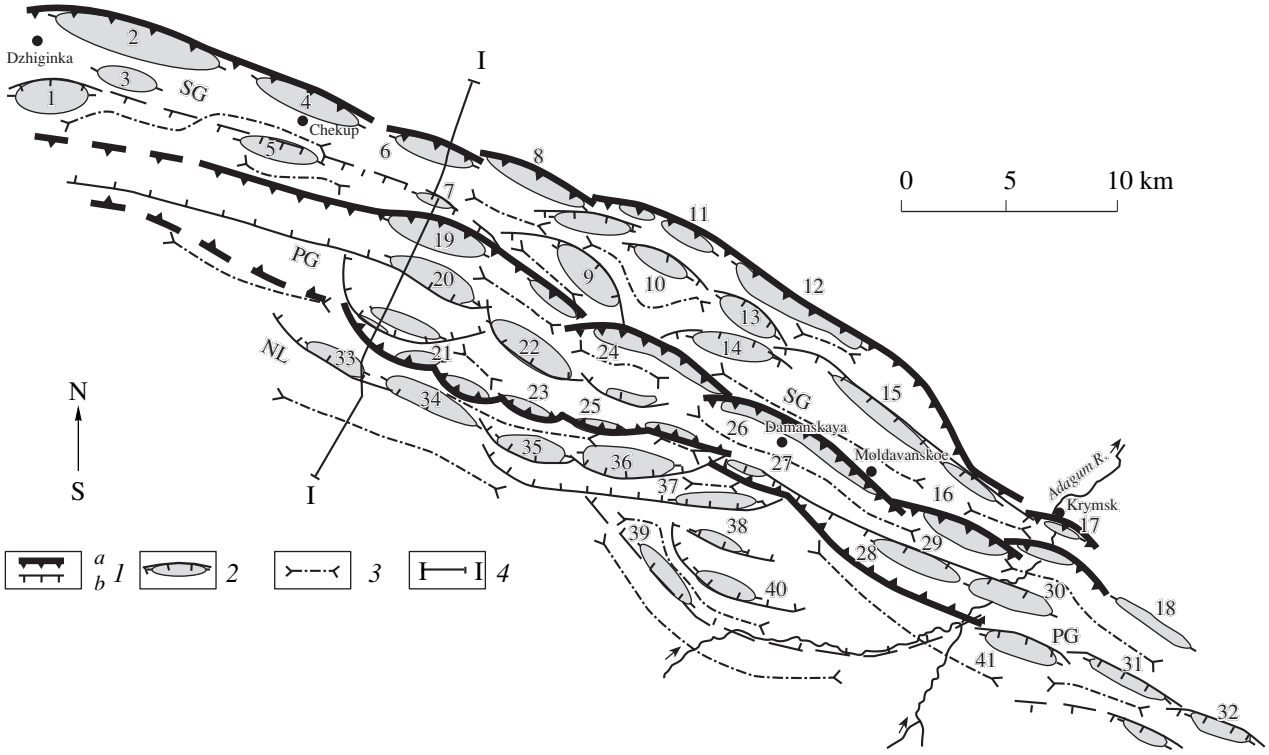

Fig. 1. Tectonic scheme of the Psebeps–Goitkh anticlinorium and Soberbash–Gunai synclinorium. (*1*) Thrusts: (*a*) main, (*b*) subsidiary (ticks are directed toward the thrust surface dip); (*2*) anticlinal folds; (*3*) axis of synclines; (*4*) position of geological profile. (SG) Soberbash–Gunai synclinorium, (PG) Psebeps–Goitkh anticlinorium, (NL) Novorossisk–Lazarevsk synclinorium. Local uplifts: (1) Utash, (2) Dzhiginka, (3) Yurovsk, (4) Ust-Chekup, (5) Brigadanoe, (6) Varenikov, (7) Shugo, (8) Adagum, (9) Sumarokov, (10) Medov, (11) Keslerov, (12) Kudakov, (13) Verkhnii Medov, (14) Psif; (15) Arnaut, (16) Krymsk, (17) Verkhnii Krymsk, (18) Ukrainian, (19)Verkhnii Chekup, (20) North Shumai, (21) Shumai, (22) Kukolov, (23) Pervomaisk, (24) Gladkov, (25) Psebeps, (26) Damansk, (27) Bednyatsk, (28) Verkhnii Adagum, (29) South Krymsk, (3) Nizhnii Bakan, (31) Sheptal, (32) South Abinsk, (33) West Gostagaev, (34) Gostagaev, (35) Sibzir, (36) Nikolaev, (37) Novyi Krymsk, (38) Verkhnii Amanat, (39) Gornoe; (40) Amanat, (41) Taranov.

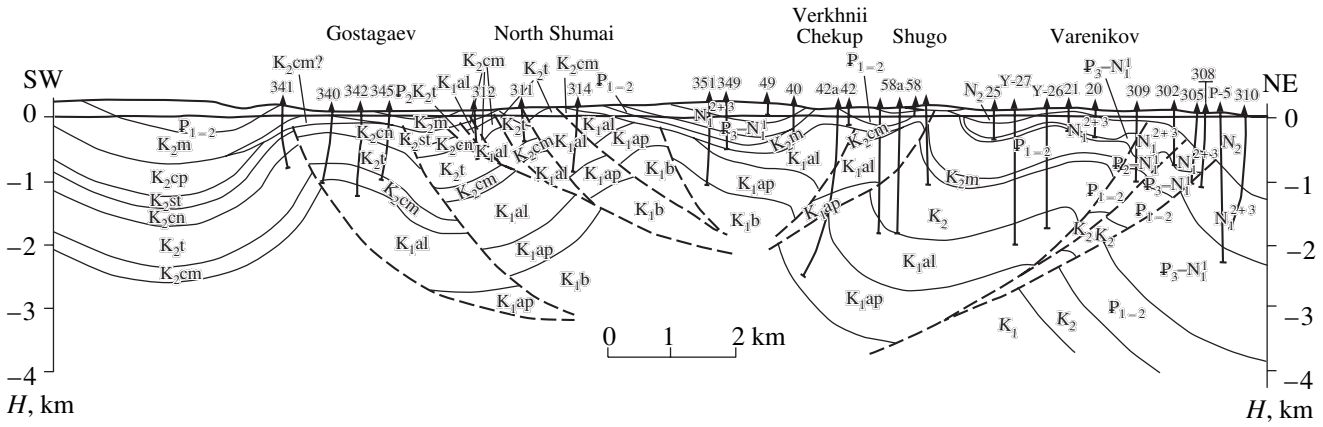

Fig. 2. Geological section across profile I–I (see Fig. 1).

cal (occasionally overturned) limbs, the maximum amplitude of vertical displacement along ruptures, and the highest stratigraphic range of their penetration. From the front to both sides of the imbricate thrust, the amplitude of vertical displacement along the rupture significantly decreases with the appearance of strike-slip component.

This situation can be exemplified by the Kudaks–Kiev fold, where the thrust surface in the near-arch part is located at a depth less than 500 m, subsiding in peri-

clines to 1000–2000 m. A similar situation can be observed in other areas, e.g., the decrease in amplitude and upper range of rupture penetration from the Gladkov slice front to its rear parts and then again uplift and increase in vertical amplitude toward the frontal parts of both the Damansk and Verkhnii Chekup slices. As a result, the front of large thrusts have an arc-type shape in plan view due to specific features of their morphology that reflect the imbricate structure of the smaller thrusts.

Thrust deformations in the Soberbash–Gunai synclinorium and northern Psebeps–Goitkh anticlinorium are oriented in such a way that their dip is directed to the source of tectonic transport of rock masses. The dip of thrusts is oriented to the south-southwest. Correspondingly, according to available geological data, rock masses are transported from south-southwest to the north-northeast. At the same time, NNE-dipping thrusts have been recorded in the southern part of the anticlinorium (Shumai, North Shumai, Kukolov, Pervomaisk, Psebeps, and other areas) and adjacent areas of the Novorossisk–Lazarevsk synclinorium (West Gostagaev, Gostagaev, Sibzir, Nikolaev, Amanat, and other areas). Hence, the block located above the Bezeps thrust surface must be considered as an active element, while its NNE movement should be considered as underthrusting. Correspondingly, the Bezeps thrust is considered the counter thrust.

Thus, the Psebeps–Goitkh anticlinorium is bordered on the SSW and NNE sides by thrusts with opposite vergence, resulting in the formation of a divergent fold–thrust fan. This is typical of central parts of fold systems related to tangential compression.

Thus, the regional tectonics of the Northwestern Caucasus unambiguously testifies to its imbricate thrust structure. The folding of the Soberbash–Gunai synclinorium (like dislocations of the Western Kuban trough) and central and northern parts of the Psebeps–Goitkh anticlinorium are characterized by distinctly expressed northern vergence. The change from northern to the opposite southern vergence in the southern Psebeps–Goitkh anticlinorium is caused by underthrusting of the northern limb of the Novorossisk–Lazarevsk synclinorium beneath the aforementioned anticlinorium. The southern vergence of folding is preserved not only within this synclinorium but also in the Tuapse trough [2].

The obtained data indicate that the Northwestern Caucasus has a distinctly expressed asymmetrical bilateral tectonic zoning. The structure of the region and the formation of fold–thrust dislocations can be explained only by NNE-trending tangential stress caused by underthrusting (pseudosubduction [5]) of the Transcaucasian–Eastern Black Sea plate beneath the Caucasus fold system [2, 3]. The Scythian plate in this case plays the role of a passive block on the pathway of allochthonous structures of the Caucasus.

ACKNOWLEDGMENTS

This work was supported by the Russian Foundation for Basic Research (r 2006 south division), project no. 06-05-96621.

REFERENCES

1. A. I. Letavin and V. M. Pererva, in *Fault Tectonics and Petroleum Potential of the Marginal Zone of Northwestern Caucasus* (Nauka, Moscow, 1987) [in Russian].
2. V. I. Popkov, *Fold–Thrust Dislocations* (Nauchnyi Mir, Moscow, 2001) [in Russian].
3. V. I. Popkov, in *Tectonics of the Earth's Crust and Mantle: Tectonic Control on the Distribution of Mineral Resources* (GEOS, Moscow, 2005), pp. 107–109 [in Russian].
4. A. N. Shardanov and V. P. Peklo, Tr. Krasnodar. Fil. Vseross. Nauch.-Issled. Inst. Neft. **6**, 204 (1961).
5. V. E. Khain and L. E. Levin, Izv. Earth Sci. Sect. Russ. Acad. Nat. Sci., No. 11, 9 (2004).