ISSN 1028-334X, Doklady Earth Sciences, 2006, Vol. 406, No. 1, pp. 1–3. © Pleiades Publishing, Inc., 2006.
Original Russian Text © V.G. Kazmin, 2006, published in Doklady Akademii Nauk, 2006, Vol. 406, No. 1, pp. 66–68.

GEOLOGY

Tectonic Evolution of the Caucasus and Fore-Caucasus in the Late Paleozoic

V. G. Kazmin

Presented by Academician A.L. Knipper April 26, 2005

Received April 26, 2005

DOI: 10.1134/S1028334X06010016

There are many unresolved problems in the reconstruction of the Late Paleozoic evolution of the Caucasus and Fore-Caucasus, including the following: (1) the position of the suture of the old pre-Visean ocean (Prototethys?); (2) the formation conditions and tectonic setting of the Dizi Series of Svanetia; and (3) causes of the deformation of the sedimentary cover and of granitoid magmatism on the Scythian Platform.

It is known that the Transcaucasus, the Main Caucasus and Frontal ranges, and, to a lesser extent, the Fore-Caucasus and the Karpinsky Ridge were the arena for the Hercynian deformations and magmatism related to the closure of at least two basins located north and south of the Main Caucasus Range (Fig. 1). The northern basin had an ocean floor represented by allochthonous ophiolite slices of the Frontal Range. The basin is traditionally regarded as a backarc structure situated at the northern (in present-day coordinates) margin of the Paleozoic ocean in the rear of the Greater Caucasus island arc [1]. The arc was located on a fragment of the Neoproterozoic–Early Paleozoic basement that has been singled out as the Makera microcontinent [2]. Metamorphosed Lower–Middle Paleozoic rocks and magmatites of the Buul'gen and Labin series of the Greater Caucasus crystalline core are identified with island-arc and/or accretionary complexes of the active margin [3].

Exposures of Paleozoic rocks of the Dizi (or Dessian) Series of Svanetia are known south of the crystalline core. Interpretation of the formation conditions of these rocks is very important for understanding the Paleozoic geodynamics of the Caucasus. Unfortunately, no satisfactory models of the Dizi Series stratigraphy and structure have been compiled so far. The assumption in the past was of a simple folded structure and, accordingly, normal stratigraphic succession of mainly terrigenous sediments making up the series [4, 5]. Later works showed that the series consists of nappes and in fact consists of at least two complexes, which are separated by the epoch of deformation and metamorphism [6]. The lower complex is mainly composed of sandy–silty rocks, including large olistoliths of shallow-water limestone with corals. Some textural features (channels, sediment rewashing, and traces of slumping) point to deposition on the continental slope. Judging from the conodont fauna, the age of rocks is considered to be Eifelian–Early (or Middle) Carboniferous [7]. According to [8], this sequence formed at the passive margin of Gondwana [8]. Evidently, the area in question represents a passive margin of the Pontian–Transcaucasian microcontinent (PTM) situated on the southern side of the Dizi Basin.

The lower complex of the Dizi Series also includes sequences with abundant greenstone-altered basaltic andesite tuff and lava. The amount of volcanic rocks increases in northern areas, probably because of the proximity to the Greater Caucasus volcanic arc.

Rocks of the lower complex were subjected to intense deformation and low-grade metamorphism. The timing of the event is likely to coincide with the main phase of the Hercynian orogeny marked by the appearance of molasse in the Visean [9]. This phase embraced not only the Main and Frontal ranges, but also the PTM. Collision of the PTM with the East European continental margin was responsible for the formation of the Paleozoic foldbelt of the Caucasus.

Deposition of the Permian–Triassic sequences of the upper complex of the Dizi Series, which are composed of almost unmetamorphosed terrigenous sediments in simple folds, most likely proceeded in a small back-arc basin opened in the rear of the PTM or its fragment (the Shatsky Rise) [6].

The structure formed at the end of the Early Carboniferous had a northern vergence both north and south of the Main Caucasus Range (nappes of the Frontal Range and overthrusts in the lower complex of the Dizi Series, respectively) [6]. The structure indicates a general

Shirshov Institute of Oceanology, Russian Academy of Sciences, Nakhimovskii pr. 36, Moscow, 117997 Russia; e-mail: vkazmin@geo.sio.rssi.ru

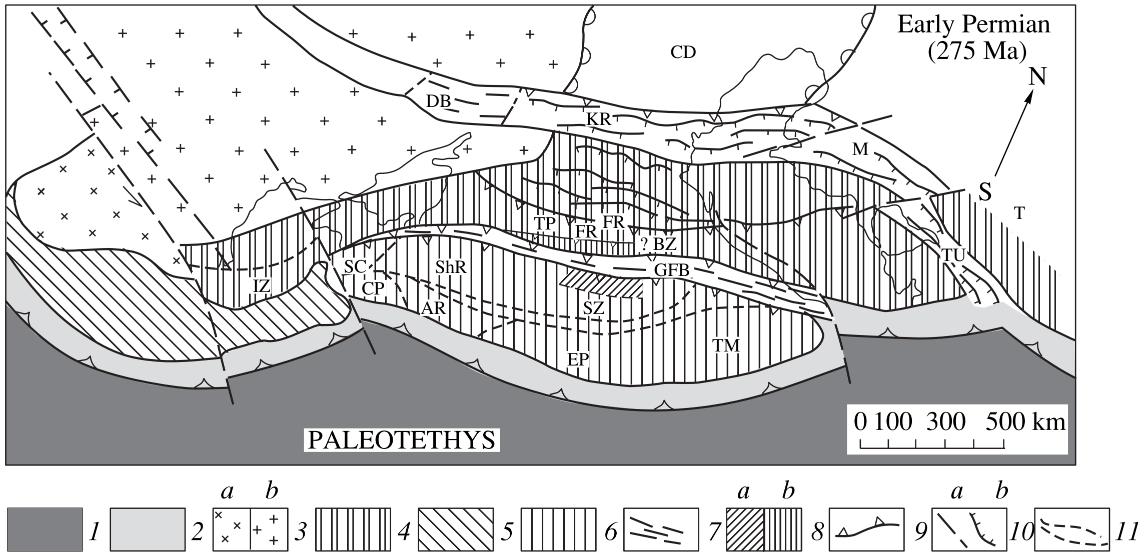

Fig. 1. Tectonic reconstruction of the Caucasian region for the Early Permian. (*1*) Basin with oceanic crust; (*2*) continental slope; (*3*) Platform: (*a*) East European, (*b*) Moesian; (*4*) Scythian–Turanian Platform; (*5*) Rhodope Massif; (*6*) Pontian–Transcaucasian microcontinent; (*7*) foldbelt; (8) tectonic complexes: (*a*) allochthonous (including ophiolites), (*b*) backarc basin (Dizi Series); (*9*) nappe front; (10) fault: (*a*) transverse, (*b*) thrust; (*11*) terrane boundary. Letter symbols in Figs. 1 and 2: (AD) Astrakhan Dome, (BZ) Bechasyn Zone, (KB) Karpinsky Rise Basin, (GFB) Greater Caucasus Foldbelt, (AR) Andrusov Rise, (EP) Eastern Pontides, (ShR) Shatsky Rise, (DB) Donbass, (TM) Transcaucasus Massif, (KR) Karpinsky Rise, (M) Mangyshlak, (MM) Makera Microcontinent, (CD) Caspian Depression, (PTM) Pontian–Transcaucasian Microcontinent, (FR) Frontal Range, (SB) Svanetian Basin, (SZ) Svanetian Zone, (IZ) Istanbul Zone, (SP) Scythian Platform, (T) Turanian Platform, (TP) Tyrnauz–Pshekish Fault Zone, (TU) Tuarkyr, (CP) Central Pontides, (SC) South Crimea.

motion of rock masses from south to north. This contradicts the popular opinion about the active nature of the northern margin of the Paleozoic ocean (Prototethys?) and the northward subduction of its lithosphere [1, 3, 8, and others]. In this case, the collision structure should have a general southern vergence (toward the PTM), and this is not the case.

According to an alternative concept proposed by the author of the present paper, the northern margin of the paleocean was passive in the Paleozoic (Fig. 2). This is confirmed by the platform nature of Paleozoic rocks of the Bechasyn zone at the southern margin of the Scythian Platform. The analog of the Bechasyn zone is the Istanbul zone of western Pontides (a fragment of the Scythian Platform torn away from the latter zone in the course of the Black Sea opening). It is a common opinion that Paleozoic sequences of the Istanbul zone formed on the south-facing passive margin of the East European continent [10].

The formation of allochthons composed of ophiolites and island-arc complexes, as is the case in the Frontal Range and the Bechasyn zone [11, 12], is a phenomenon that is typical for collisions of island arcs with passive continental margins (the Western Urals, Arabia margin, and others). Therefore, one can assume that the suture of the Paleozoic closed ocean coincides with the Tyrnauz–Pshekish fault zone. The Greater Caucasus island arc, a small marginal sea located in its rear part, and the PTM (~1200 × 350 km) collided with the passive margin of the Scythian Platform. Figure 1 shows parts of the PTM (its future fragments). Paleotectonic reconstructions suggest that the Gondwana margin was active in the Early Paleozoic. Microcontinents detached from Gondwana due to backarc spreading migrated northward to become incorporated into the Hercynides of Europe and Asia [13 and others]. The Pontian–Transcaucasian microcontinent was most likely such a terrane.

The model explains, in particular, the relatively weak (as compared to the Greater Caucasus) metamorphism of the Dizi Series rocks. The backarc basin was located in the rear part of the Makera microcontinent away from the collision zone. This model is also in agreement with the concept of Georgian geologists on the position of the Dizi Basin between the Transcaucasus massif and the Greater Caucasus island arc [3].

After the collision, a new (northward-dipping) subduction zone formed at the southern margin of the microcontinent. It extended both eastward along the southern margin of the Turanian Platform and westward along the margin of the Rhodope Massif. The Late Paleozoic–Cenozoic evolution of the Caucasus margin is related to this zone.

The second deformation epoch in the region is referred to the Late Carboniferous–Early Permian. Lateral contraction took place mainly due to the convergence of the Scythian and East European platforms and the compression of the rift basin of the Karpinsky Rise. A system of northvergent nappes formed at its place [14]. The comprehensive analysis of geophysical data

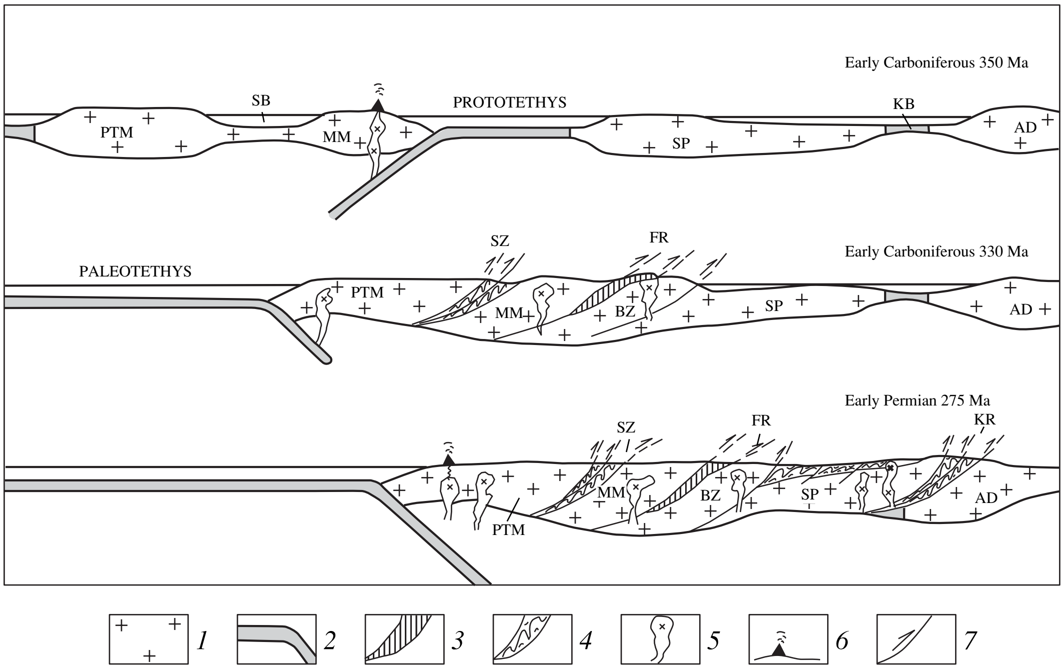

Fig. 2. Scheme of evolution of the Caucasus and Fore-Caucasus in the Late Paleozoic. (*1*) Continental crust; (*2*) oceanic crust; (*3*) island-arc and ophiolite complexes; (*4*) sedimentary and volcanosedimentary complexes; (*5*) granitoid intrusions; (*6*) island-arc volcanism; (*7*) overthrust. Letter symbols are as in Fig. 1.

points to the probable development of the accretion-type crust within the basin [15]. The subduction of this lithosphere under the Scythian Platform provoked an unusual phenomenon—the abundance of Late Paleozoic granitoid magmatism within the platform.

ACKNOWLEDGMENTS

This work was supported by the Russian Foundation for Basic Research, project no. 04-05-64184.

REFERENCES

1. E. B. Khain, Geotektonika, No. 4, 63 (1979).
2. G. I. Baranov and I. I. Grekov, in *Problems of Geodynamics of the Caucasus* (Nauka, Moscow, 1982), pp. 51–59) [in Russian].
3. Sh. A. Adamiya, G. L. Gabuniya, Z. A. Kuteliya, *et al.*, in *Geodynamics of the Caucasus* (Nauka, Moscow, 1989), pp. 3–15 [in Russian].
4. M. L. Somin and A. A. Belov, Byull. Mosk. O-va Ispyt. Prir., Otd. Geol., **42**, 40 (1967).
5. Sh. A. Adamiya, *Pre-Jurassic Rocks of the Caucasus* (Metsniereba, Tbilisi, 1968).
6. V. G. Kazmin and I. M. Sborshchikov, in *Geodynamics of the Caucasus* (Nauka, Moscow, 1989), pp. 46–54 [in Russian].
7. Z. A. Kuteliya and I. S. Barskaya, Dokl. Akad. Nauk SSSR **270**, 394 (1983).
8. A. A. Belov, A. A. Mossakovskii, S. D. Sokolov, and V. A. Shvol'man, in *Problems of Geodynamics of the Caucasus* (Nauka, Moscow, 1982), pp. 21–20 [in Russian].
9. A. A. Belov, *Tectonic Evolution of the Alpine Folded Area in the Paleozoic* (Nauka, Moscow, 1981) [in Russian].
10. A. M. S. Segnor, Geol. Soc. Am. Spec. Pap., No. 195, 1 (1984).
11. G. I. Baranov, in *Geology and Mineral Resources of the Greater Caucasus* (Nauka, Moscow, 1987), pp. 106–116 [in Russian].
12. M. L. Somin, in *Tectonics of the Earth's Crust and Mantle: Tectonic Trends in the Location of Mineral Resources. Materials of the 38th Tectonic Conference* (GEOS, Moscow, 2005), pp. 228–230.
13. G. M. Stampfi, Eclog. Geol. Helv., **89**, 13 (1996).
14. Yu. A. Volozh, M. P. Antipov, Yu. G. Leonov, *et al.*, Geotektonika, No. 1, 28 (1999).
15. T. P. Egorova, R. A. Stephenson, S. L. Kostyuchenko, *et al.*, Tectonophysics, **381**, 81 (2004).