

FACIES-GENETIC ANALYSIS OF TATARIAN DEPOSITS AND CONDITIONS OF FORMATION OF THE "KOTEL'NICH" LOCALITY

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Abstract. In the section on the Vyatka River, below the town of Kotel'nich, we identified four stages in the formation of the deposits represented here. The first and second are associated with sedimentation in the Kotel'nich drainage basin. The first stage is represented by the accumulation in semiarid conditions of the plain proluvium associated with the mass burial of terrestrial vertebrates. In the second step in a more severe aridity in the central part of the depression aeolian "blown" sands were deposited, substitutions for the trend of the plain proluvium. In the third stage we see the complete levelling of the drainage basin, the inception of an alluvial-deltaic system. The fourth stage already belongs to the Early Triassic and represents plain proluvium of more arid appearance.

On the right bank of the River Vyatka, below the town of Kotel'nich, is a unique location of terrestrial vertebrates called 'Kotel'nich'. Its special feature is the huge accumulation of remains of animals buried *in vivo*.

In the Kotel'nich section, four phases of formation are clearly distinguished. The first can be attributed to the accumulation of the lower clay-silt packets over an apparent thickness of more than 10 m. It is composed of reddish-brown shales and siltstones, often forming mixtites containing in addition to the clay-silt mixture well- and fine-grained sandy material. In the rocks, there are bleached areas, grouped at certain levels, which have undergone a process of palaeohypergenesis and represent soil formation. S. V. Naugolnykh [2] has identified within this packet four soil profiles, which are attributable to calcium-rich soil formation in semi-arid conditions with rainfall rare, but abundant seasonal rainfall.

In general, rocks of lower packets have all the features of the plain proluvia [7] - deposits formed by the removal of temporary streams in drainage basins, takyrs, sori and other temporary bodies of water created by these same streams. In the Kotel'nich drainage basin, in all probability a regime of arid wetlands dominated, seasonally disturbed by something wetter, then significant drainage in the formation of soil horizons.

Burial of tetrapod remains, apparently totally at random, reached the highest concentration at two levels 3 and 4 m below the base of the overlying sandstones [4] directly under the two lower horizons of paleosols. It seems to us that in the wet seasons the terrestrial tetrapod fauna was evenly distributed in the vast spaces of the watershed. With the onset of the dry season, the fauna was concentrated near the remaining water drainage basins, where during the driest season the bulk of small and weak animals perished in the muddy dirt, followed by complete drying which led to the formation of soil horizons. In the Kotel'nich drainage basins from the bottom up along the section, the lower packets witnessed an increase in the duration of

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drying, which is expressed in the formation of more mature soil profiles, the elimination of water that did not contribute to a high concentration of animals, and their burial is rare.

The beginning of the second phase of sedimentation in the Kotel'nich section is associated with a significant increase in aridity. As a result, in the central part of the drainage basins a lenticular sand body up to 15 m thick and 10 km long formed. Its aeolian genesis and belonging to a group of 'airborne' sands was established by V. P. Tverdokhlebov [5]. This position of aeolian sand bodies, confined to the central parts of the drainage basin, is typical of many modern arid regions of the world.

The wind accumulation is interrupted by periodic wetting and accompanied by full or partial leveling of palaeodunes and argillization of the cleared surface. In terms of the sand body in the second packet, at least four periods of wetting can be traced. Between the villages of Boroviki and Volki in the section of the sand lens, there is a large, up to 8 m high, fragment of preserved dunes up to 150 m wide. According to the marginal parts of the Korel'nich depression (Figure 1), the sand lens wedges out and is replaced by clay and silty sediments of the plain proluvium, similar to the lower formations of the packet, but differs from them in the build-up of greater aridity and the almost complete absence of faunal remains.

In general, the deposits of the first and second phases (Fig. 1, 1, P) constitute a single cycle of sedimentation, by the deposition of which the Kotel'nich drainage basin was completely levelled. The third stage is a new kind of transgressive cycle. The entire section of this stage is represented by exclusively deltaic formations – sediments of the deltaic floodplain and crashed into their beds of deltaic branches, has all the features characteristic of arid and semiarid zones [6]. Drainage basins as such ceased to exist and became part of a large alluvial-deltaic system.

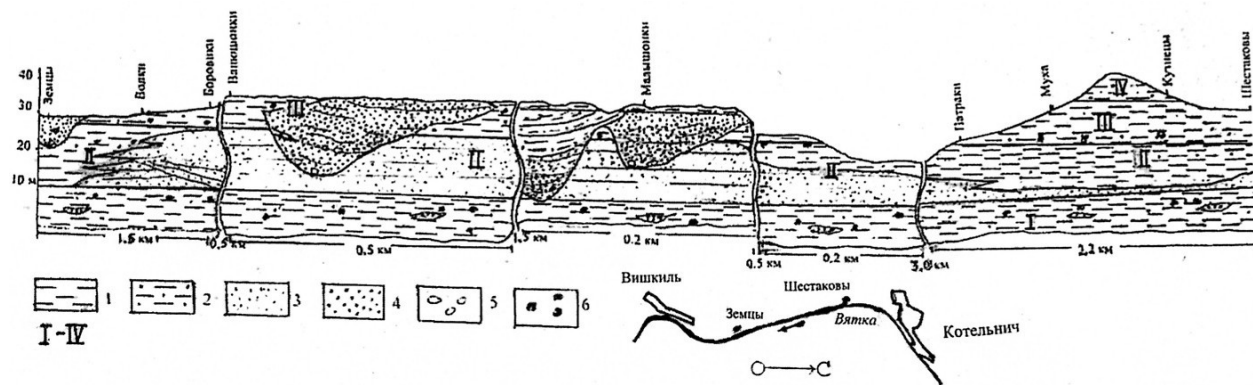


Figure 1. Section of Upper Tatarian sediments. Right bank of the Vyatka River, below Kotel'nich town: 1 - mudstone, 2 - siltstone; 3 - fine-grained sands, aeolian, 4 - Sands inequigranular, fluvial, 5 - pebbles and conglomerates; and 6 - soil nodules, I-IV - stages in the formation of the deposits of the Kotel'nich section.

In those parts of the section where sediments of the deltaic floodplain were deposited on aeolian sands of the second phase, their boundary is clear (village Vanyushonki). In the case of their occurrence on sediments of the lowland proluvium (villages Volki, Patraki, Mukha, Kuznetzy, Shestakovy) the interpretation is complicated by their greater lithological similarity. In the deltaic sediments of the floodplain, aquatic organisms were introduced - fishes. Quite often there are remains of ostracods, characteristic of the lower half of the Vyatkian Stage according to

the conclusion of I. I. Molostovskaya; less common are finds of the remains of tetrapods. Deltaic sediments of the channel branches are fine- and medium-grained sands and sandstones, containing various weathered fragments of red shale and siltstone, and thin lenses of conglomerates. Channel delta arms, eroding deltaic sediments of the floodplain, cut deeply into the body of the aeolian sand lens, sometimes reaching down to its base. In it were found the remains of tetrapod animals, often in the form of scattered bones and fragments of skeletons.

The highest part of the section, attributable by us to the fourth stage, is located between the villages of Kuznetsy and Mukha, on the slope at a height of 145.9 m. Here, a packet of red-brown clays and silts is exposed. Genetically, these rocks are most similar to the plain proluvium. I. I. Molostovskaya identified Early Triassic ostracods in this packet: numerous *Gerdalia* ex. gr. *vetlugensis* Bel., *Gerdalia* sp.

Based on the tetrapods, attributable to the Kotel'nich and Il'inskoye faunal subkomplekses, the entire thickness of the Kotel'nich section was dated as Severodvinsian in age [3]. We believe that the deposition of the first and second phases, which represent a single sedimentary cycle, may still include Severodvinian deposits. Some researchers [1] dispute the age, and these parts of the section are called into doubt. Fluvial-deltaic sediments of the third stage, according to the fauna of ostracods, undoubtedly belong to the Vyatkian Stage in its lower half. This part of the section is covered by the Lower Triassic, and suggests that the upper Vyatkian stage is lacking.

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