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Geomorphology of the Tunka rift (South-west Pribaikalye)

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Abstract: The Tunka rift consists of a system of baikal type basins and low-mountain interbasin ridges separating them. In the north it is surrounded by the alpine Tunka ridge and the low Olkha upland, and in the south by the Siberian mountains Western Khamar-Daban with volcanic plateau. This rift may be as a morphotype of dry rift basin of the Baikal type (rift valley) because it has a full set of their typical structural elements and their unified forms. Relief of the rift and its mountain surroundings are composed of five belts: the belt of plains and the belt of tilted piedmonts, the apical belt, the belt of slopes, and the belt of valley bottoms in its mountain frame. Instead of them there is a large group of interzonal land forms.

Key words: structure of relief, Tunka rift valley

Introduction

The Tunka rift stretches over 200 km in a sub-latitudinal direction from the Baikal's south-western termination to lake Khubsugul (fig. 1). It consists of a system of dry valley basins of the baikal type (Florensov, 1960) consisting of a thick (up to 2,5 km) series of Cenozoic deposits alternating with Neogen-Quaternary basal sheets (Logachev & Florensov, 1978) and low-mountain interbasin spurs.

In the east the Tunka rift is begins with a complex combination of low-mountain tectonic steps, horsts, and the small Bystrinskaya basin, constituting of intrarift commissure. Further to the west there is a wide Tora basin. The latter, the largest Tunka and small Tura and Khoitogol basins form the central part of rift valley, and are divided by the low-mountain Elovsky and Nilovsky block spurs. Westward of the Khoitogol basin the rift valley narrows by transforming a commissure between the Tunka and Khubsugul rifts formed by high tectonic steps and the small Mondy basin.

In the north mountain rift frame is represented by a horst of the Tunka ridge of alpine relief type tilted to the north and broken to the rift valley by a high (up to 2000 m), steep tectonic scarp and a tilted uplifted

step of the Olkha highland of the Siberian platform margin. In the south the rift is framed by the Western Khamar-Daban dome of the Siberian relief type.

It is reasonable to treat the relief of these geomorphologic regions as belts. Five belts of relief in the Tunka rift and its mountain frame emerge. The belt of plains and the belt of tilted peidmonts are distinguished in a relief of basins, but in their mountain frame the summit belt, the belt of slopes and the belt of valley bottoms are distinguished. Besides, there is a large group of land forms spread among the belts.

Rift valley Bottoms of basins

The bottoms of the Tora, Tunka, Khoitogol and Tura basins consist of low accumulative plains. The alluvial plain formed by the Irkut river and its largest affluents is the main one. It is formed by low and high flood plains (the widest levels in morphological structure of the alluvial plain), and by two cyclic terraces. The alluvium of the Tunka rift terraces are characterized by a constrictive structure.

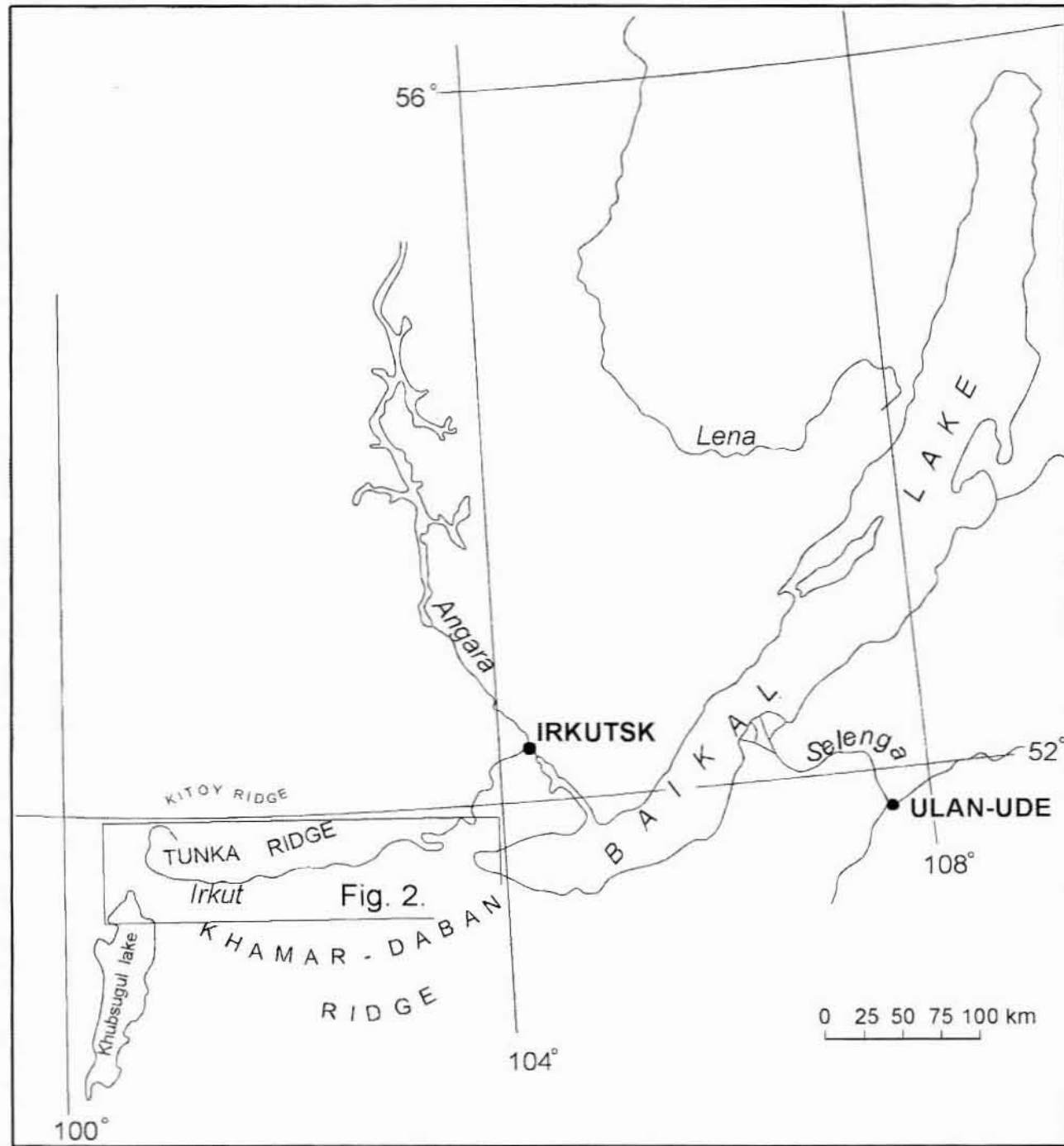


Fig. 1. Location map of region investigations.

The height of the first cyclic terrace varies from 3 m to 9 m. Minimum heights occur in the central parts of the basin bottoms. The absolute age of their deposits in the Tora basin near the Tibelti village in the upper part of the section is 5180 ± 40 ^{14}C years, and in the middle 10300 ± 80 ^{14}C years (Logachev (ed.) 1981).

The second cyclic terrace 14 m in height occurs only near interbasin spurs cut through by the Irkut and its largest affluents. The deposits of the middle

part of this terrace near vill. Tibelti have 40060 ± 820 and 31860 ± 37 ^{14}C years (Logachev (ed.) 1981), and in the upper parts of the section on the eastern margin of the Khoitogol basin 29300 ± 1000 years (Radio-Thermo-Luminescence dating, Geological Institute SB RAS).

The bottoms of the Tora, Tura and Khoitogol basins are occupied by alluvial plains. In the Tunka basin such a kind of plain is located on its margins,

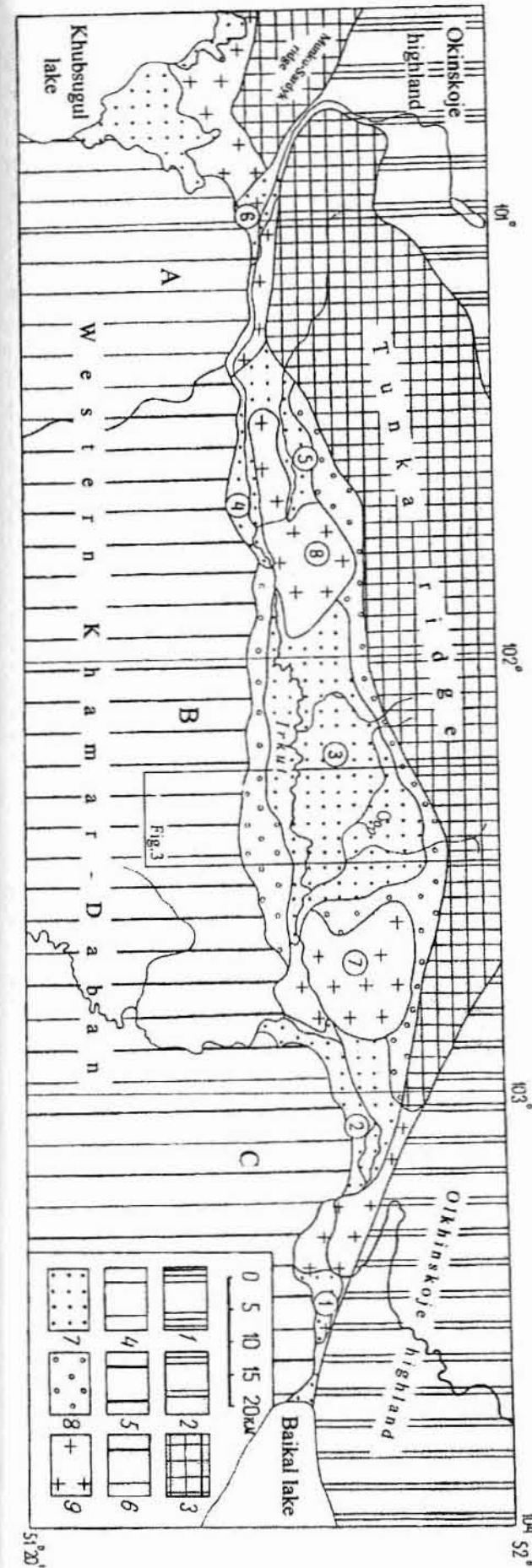


Fig. 2. Map-scheme of main morphologic elements of the Tunka rift and its surrounding.

1-6 - mountain surrounding of the rift including middle heights (2000-2400 m) (1) and low (middle heights 800-1000 m) (2) highlands strongly dissected (up to 1200 m) mountains with absolute marks up to 3491 m (3), middle heights (up to 2534 m) slightly dissected (200-300 m) volcanic plateaus (4), mountains of Siberian type with absolute marks up to 2994 m - middle dissected (300-800 m) with prevalence of sub-horizontal gently-wavy fragments of peneplanation plane in their summit belt (6); 7-9 - rift valley including accumulative planes of basins' bottoms (7), tilted piedmonts (8) and low-mountain relief of interbasin commissures (9).

Number in circles mean: basins (1 - Bystrinian, 2 - Torian, 3 - Tunka, 4 - Tora, 5 - Khoitogol, 6 - Mondy) and interbasin commissures - troughs (7 - Elovsky, 8 - Nilovsky).

Letters mean: geomorphologic regions of Western Khamar-Daban - Kheven-Dzalu-Urijn-Sardigian (A), Kharagulian (B), Khangarulian (C).

but accumulative formations of another type prevail in the center.

The Irkut terraces lie in the southern part of the basin, and the low subhorizontal surfaces, systems of the first merged cyclic terraces of the rivers flowing down spurs, stretch along the feet of the Elovsky and Nilovsky spurs. The absolute age of the deposits of the upper parts of the section is 39000 ± 6000 RTL years (GI SB RAS), and is related to the second cyclic terrace of the Irkut. This terrace level transforms into a waterlogged flood plain, and then latter transforms into a lacustrine-boggy area of an intense recent subsiding (fig. 3).

At the center of the lacustrine-boggy area is the isometric arch-shaped Badar uplift. Its height is 150 m, and its diameter is 15 km. According to geophysical data (Bulmasov 1963), the basin's foundation has no protrusion. Badar consists of cross bedding sands whose absolute age in the low part of section of the uplift on the Irkut left-bank is 65200 ± 4000 RTL years (GI SB RAS). The near-surface part of the sands has underwent eolian processes.

There are some hypotheses the origin of this uplift. The cryogenic origin of Badar was supposed by A.P. Bulmasov (Bulmasov 1963). On his hypothesis, the uplift is an original gigantic pingo according to gravimetric data pointing to the existence of a thick (up to 600 m) lens of frozen rocks. S.M. Zamarajev (Zamarajev 1975) considers that the Badar uplift is an inverted uplift as a result of gravitational sliding of Cenozoic strata along the foundation surface on the basin's sides, and dome-shaped swelling of layers in its middle parts.

The Bystrinskaya and Mondy small basins currently take part in inverted uplifting, and form part of intrarift commissures. In their bottoms, hilly flat summit, low dissected (up to 100 m) relief on the neogene

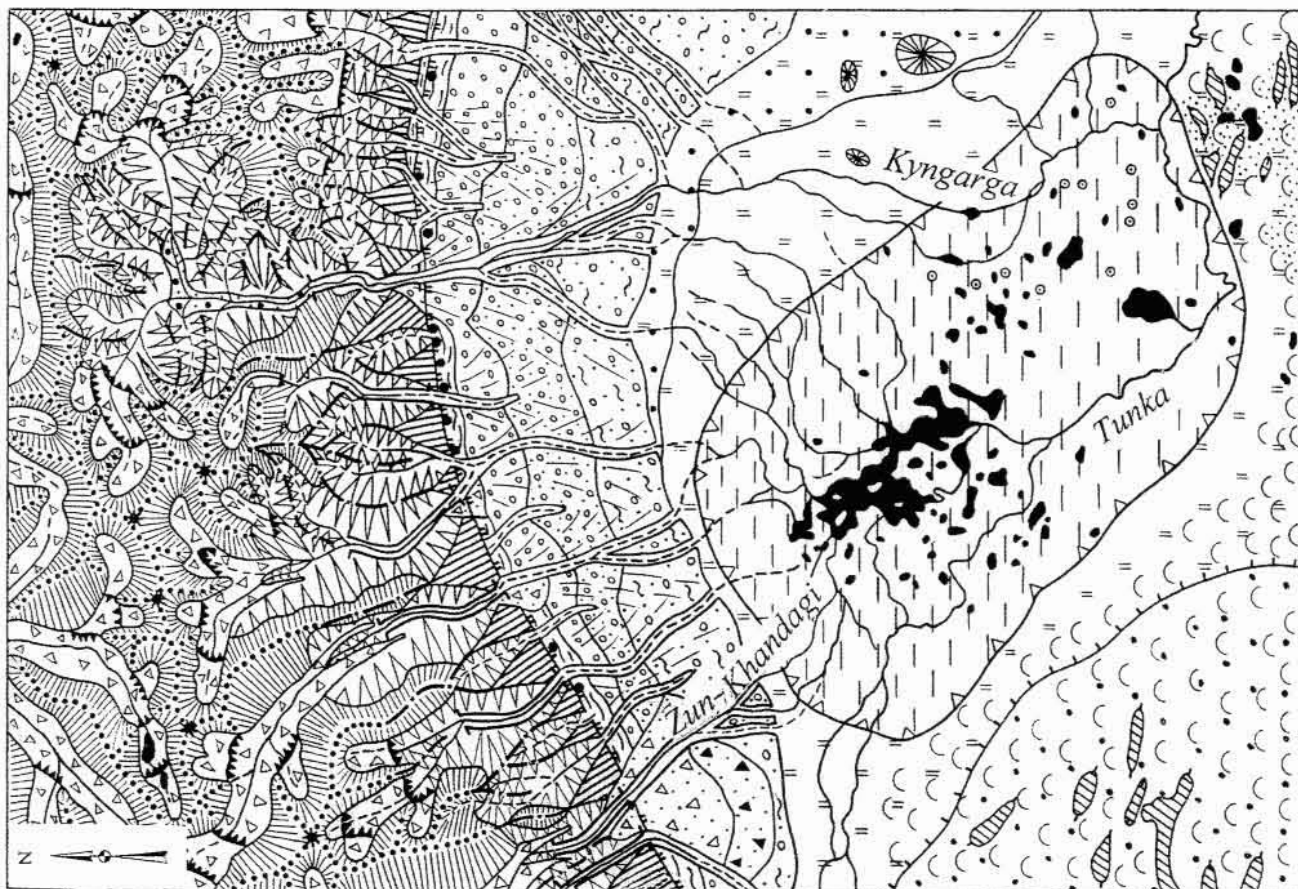


Fig. 3 a. Fragment of geomorphic map of the Tunka rift and its mountain surrounding (conventional signs see fig. 3 b).

deposits prevails, but in the south-western part of the Bystrinskaya basin it is small dissected (up to 50 m) on Pleistocene sands. These uplifted surfaces are superposed by the Irkut terraces of down-cutting. There are more than 5 such terraces which extend eastward the Mondy basin.

Interbelt relief forms in basin bottoms are represented by modern and relict eolian forms (Ufimtsev et al. 1999a). The Tunka rift valley elongating in the latitudinal direction and surrounded by high mountain massifs is a typical „wind corridor” where wind speeds reach 46 m/s, and eolian processes predominate. Modern wind morphogenesis in the Tunka basin is taking place on 28% of its area, but relict eolian landscapes occur on 35-40 % of its area. The main phase of formation of the latter occupies the second half of the sarten period and the boreal period of Early Holocene (Ufimtsev et al. 1999a).

The Upper Pleistocene accumulative forms in bottoms of the Tunka rift basin are further important formations. They occur in the western part of the Mondy basin on the Irkut right-bank at an altitude of 1400-1485 m a.s.l., and in the western part of the Khoitogol basin near the mouth of the Ikhe-Ukhgun

river through the valley at heights of 950-1050 m. In the first case these are ridge-sink moranic landscapes with lakes and ridges up to 15 m in height. They are composed of unsorted rubbly-pebbly deposits cemented by aleurite-pelite carbonaceous material (glacier meal).

The western part of the Khoitogol basin includes a moraine amphitheater of width 2 km and about 9 km in extent with two parallel arcuate rows of frontal stadal moraines up to 80 m in height (the outer row is higher than the inner one by 20 m). A wide fluvial-glacial debris cone cut down by the Ikhe-Ukhgun river conjugates the amphitheater.

The bottoms of basins show a wide occurrence of cryogenic forms (modern and relict thermokarst, pingos, etc.). They occur in subsided and moistened parts of the basins, in, for example, the lacustrine-boggy depressions of the Tunka basin where small forms of bulging had developed – thufurs are 1 m in diameter and 0,5 m in height, and on high parts, in, for example, the southern part of the Bystraya basin with developed modern thermokarst.

Young single-action volcanoes in the north-eastern part of the Tunka basin are special relief forms

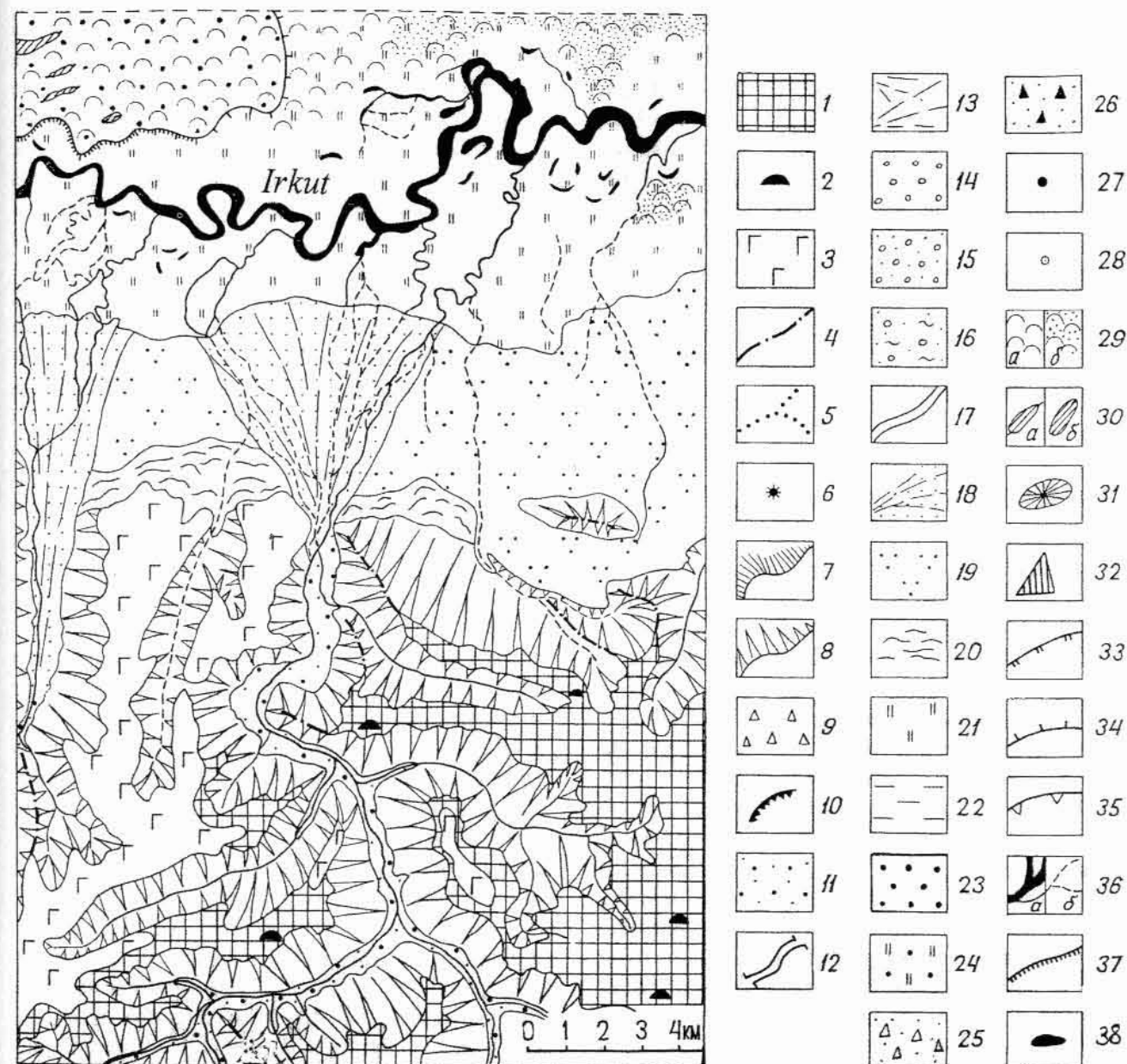


Fig. 3 b. Fragment of geomorphic map of the Tunka rift and its mountain surrounding (continuation).

1-6 – summit belt including peneplanation plane(1) and rounded relicts on it(2), surfaces of basaltic covers(3), erosional (4) and intercorridor ridges (crests) and ridges of glacial valleys(5), horns(6); in slope belt – slopes with developed gravitative processes (rockfalls, landslides, hillside wates, avalanche denudation and slope mudflows) (7), and slopes with developed cryogenic processes (solution, stone-river forming) and linear erosion (8); 9-12 – belt of basins' bottoms including bottoms of corries, cirrus and glacial valleys(9) with riegels and mouth steps(10), bottoms of river valleys with terrace complexes(11) and thalwegs of their antecedent areas(12); 13-20 – tilted piedmonts' belt including in debris cones(13) facieses of unsorted cobble round-stones and rubby bench gravels with angles of surface inclination more than 10°(14), facieses of slightly sorted rubby bench gravels with angle of surface inclination 5-10°(15), facieses of slightly sorted bench gravels with areas of stratified sands and angle of surface inclination less 5°(16), fluvial hollows(17), interior deltas(18), gently tilted piedmont surfaces – glades(19), submontane trains of proluvial-slope deposits(20); in a plains' belt – flood plain(21), low lacustrine-boggy plains(22), hilly (up to 50 m dissected) surfaces of uplifted level of Pleistocene accumulation(23) and gently tilted alluvial plains(24); 24-35 – interbelt forms of relief and their elements including areas of glacial and water-glacial accumulation(25) including frontal moraine lines(26), areas of development of landslides and mud avalanches(27), bulges(28), areas of relict(29 a) and modern(29 b) eolian microrelief, and large eolian forms(30) (30 a – dunes, 30 b – deflation basins), volcanic slaggy cones(31), 32-35 – tectonic forms including basal facets(32), fault trenches and escarp-micrograben systems(33), arch-shaped uplifts in basins' bottoms(34), regions of intensive recent subsidence(35); 36 – channels (36 a – constant, 36 b – temporary); 37 – erosional scarps; 38 – lacustrine basin (kettle).

of the bottom basins (Florensov & Loscutova 1953). These volcanoes take part in basin subsiding, and are overlapped by young deposits. The exposed height of the volcanoes decreases towards the center of the basin where the rates of subsiding are the highest. The height of the Khurai-Khobok volcano located on the basin margin is 116 m in height, but the Kunten volcano lying on lacustrine-boggy lowlands is only 6 m in height. The average height of such volcanoes in the south of East Siberia is 80-100 m, and the approximate amplitude of their subsiding for the second half of the Upper Pleistocene in the Tunka basin is at most 70-80 m (Ufimtsev et al. 1999b).

Tilted piedmonts

A different structure of the Tunka rift flanks determines the composition of tilted piedmonts. Merged imposed debris cones formed by channels of different orders are piedmonts at the foot of a high and steep tectonic scarp of the Tunka ridge.

Loose deposits of piedmont slope, the thickness of which reaches 300 m, overlap submerged intermediate steps (concealed prolongation of marginal fault zone) (Shchetnikov 1999). Near the village Arshan, the intermediate step is buried under 200-300 m of proluvial deposits (Florensov (ed.) 1973). In the Khoitogol basin such a step is covered by thinner veneer of deposits, and it is well visible in relief. In the Mondy basin the piedmont is a complex system of narrow tectonic steps of different heights covered by strata of rubby round-stones and rubby-block deposits of water-glacial origin (Ufimtsev 1995).

The base of the accumulative part of piedmont slope is formed by large debris cones in junctions of extended valleys. For example, the Kyngarga debris cone in the Tunka basin is 5 km in extent and 300 m in thickness of deposits. Its conehead surface is composed of unsorted rubby bench gravel and cobble round-stones. In the middle part of the cone the deposits consist of subsorted bench gravel with sand lenses. The width of this zone is about 3 km. At least, the periphery of the debris cone with a narrow horizontal surface has subsorted bench gravel and bending sands' areas. Sheets of loess-shaped sandy loam more than 3 m in thickness occur in the last two zones.

The debris cone surface is dissected by numerous radially divergent washout rills 2 m in depth and up to 200 m in width. In the upper cone part the washout rills are accompanied by mudflow banks 2 m in height and more than 100 m in extent.

The conehead part of the Kyngarga debris cone is included in the mountains in a triangular block form, and is cut off from the main part of the cone by a large paleoseismodislocation (McCalpin & Khromovskih 1995). Here the debris cone is a socle formation more than 30 m in height (socle) and 10 m in thickness (rubby bench gravel). There are many terraces of cutting down (Lukina 1989), but the Kyngarga valley acquires a canyon-shaped appearance.

The debris cones, merging and imposing on each other, form a wave-shaped gently tilted accumulative belt composed of three conjugated zones of a different hypsographic position. The low and middle zones conform to the merged areas of large cones, but debris cones of small channels, shorter and steeper with a similar composition of deposits (unsorted rubby bench gravel and cobble round-stones with fragments 5 m in diameter) with summit areas of large cones form the upper under-mountain zone of this accumulative belt.

Subsidence's between tops of debris cones fill proluvial-slope (including landslide) deposits, forming an interrupted train at the foundation of a tectonic scarp of the Tunka ridge. Ancient and modern landslides are manifested within the train limits. The latter include mud avalanches because of the yield of water by rocks forming the foundation of the tectonic scarp. The relict block landslides occur in the zone of paleoseismic dislocations. There are seismogravitative rocky mudslides. Other kinds of landslides occur in places of outcroppings of strata of proluvial-sloped deposits.

Tilted piedmonts in the Khamar-Daban dome have a different structure. Two morphological elements form piedmonts. They alternate along the strike: accumulative rilling gently-tilted surfaces with smooth and concave profile conjugated with slopes of lateral ridges of Khamar-Daban so called „glades" and interior wide and extent (up to 6 km) deltas of large channels.

The Khamar-Daban glades are margins of basins involved in slow arched uplifting. Piedmonts become hilly when inversional uplifts in the Khamar-Daban basement attain differentiated block type. 40 % of the Tora basin were involved in such a kind of uplifting. Because of the intensity of uplifting, this part of the basin is in Khamar-Daban contact.

Trains of slope deposits or debris cones in the mouths of small valleys are imposed on the upper parts of glades. They are triangular gentle tilted facets if they are cut by deep conjugated mountain valleys

Interbelt land forms in the tilted piedmonts' limits are represented by glacial, eolian and cryogenic formations.

During the last Pleistocene fall of temperature many glaciers of the southern slope of the Tunka ridge

came down to piedmonts, forming terminal moraine complexes.

During the post-glacial period moraines were exposed to strong erosion. The moraines well preserved only in two places. Firstly, it is the north-eastern angle of the Khoitogol basin. Here an interbasin commissure of the Nilovsky spur forms an angle combination with the frontal part of the Tunka ridge. The latter is directed to the north, the piedmont slope uplifts to 1800 m, and the angle combination looks as a large amphitheater and six glacial valleys lying centripetally are open in it. A complex of merged, superimposed Upper Pleistocene terminal moraines are located at the center of the amphitheater at absolute heights from 1800 m to 1200 m.

The second area is located in the Tunka basin in the yield place of Zun- and Burun-Khandagai rivers' conjugated valleys from the mountains. The merged terminal moraines of two glaciers coming down along the valleys of these rivers are located at absolute heights of 780-1100 m.

In the Khamar-Daban tilted piedmonts glacial accumulations are absent.

Eolian formations are represented on tilted piedmonts mainly by covers of loess-shaped sandy loams 5 m in thickness. They occur both on the Khamar-Daban glades and on debris cones at the Tunka ridge's foot.

Interbasin spurs

The Elovsky and Nilovsky spurs are structurally and morphologically isolated low-mountain enrift massifs. They are separated from the front scarps of the Tunka ridge by tectonic subsidences partly filled with proluvial and slope deposits, and from the Khamar-Daban dome by antecedent areas of the Irkut valley downcutting spurs in zones of their conjugation with the ridge.

The horst tilted to the south-west and uplifted above the basin bottoms by 650 m at an absolute height of up to 1427 m, is the main part of the Elovsky spur. This horst is bounded by steep tectonic scarps from the north-east; in the west its slope surface transforms into a belt of gentle tilted glades. From the south and south-east it is accompanied by two tectonic steps whose absolute heights are not more than 1000 m.

The main area of the Elovsky spur is armored by flood basalts, but only on its eastern margin gentle-wavy areas of Cretaceous Paleogene leveling plane from under volcanic formations occur.

The Nilovsky spur is the analogue of the Elovsky spur. It is the same horst tilted to the south-west, but its relative height reaches 950 m, and the absolute height reaches 1694 m. From the south it is accompanied by a longitudinal system of horsts of different heights dissecting the Tunka and Khoitogol basins bounded on all sides by a steep fault scarp. The basalt cover armours only the longitudinal system of spurs, but in the summit belt a gentle-wavy relief of the Cretaceous-Paleogene leveling plane prevails.

Mountain frame of rift The Tunka ridge

The Tunka ridge represents typical glacial-erosive mountains with vertical ruggedness of relief from 600 m to 1200 m. Morphologic landscapes of their summit belt are composed of elements of ancient glacial morphosculpture (fig. 3): corries, cirques, horns, and acute ridges, etc. Here modern glaciation is also taking place. It is represented by 10 small glaciers located at heights of 2600-3000 m in the upper part of the Ar-Oshei river, the area of each of them is no more than 0,25 km².

On the north-western margin of the Tunka ridge alpine landscape of the summit belt is substituted for by gently-wavy forms of the Cretaceous Paleogene peneplanation plane actively modeled by processes of antiplanation.

In the Tunka ridge there are 534 corries, 50% of which have northern (23,3%) and north-eastern (27%) exposure with a minimum number of corries facing westwards (4,8%) and eastwards (5,6%). This situation is typical of the mountains of the Siberia south, and is the result of snow redistribution and snow accumulation on leeward, shady slopes of north and north-eastern exposure.

The corries are 500-700 m in diameter, and the rocky walls are from 300 m to 600 m in height. The high-attitude level of occurrence of the corries' bottoms along the Tunka ridge's strike and on its opposite macroslopes is very different. It rises from east to west: for the south-eastern slope from 1800-1900 m to 2400-2550 m; for the north-western slope - from 1600-1700 to 2200-2300 m. It is connected with the orographical peculiarities of territory determining the character of distribution of deposits: the Tunka ridge is oriented perpendicularly to the main (north-western) transportation of the air mass, and its western flange finds itself in the wind shadow of the Kitoy ridge, and other East Sayan ridges.

The corries often form original step-like valleys, so-called corrie steps with three and less steps and with a height range of interval up to 180 m. There the largest corries occupy, as a rule, the middle or low position.

The river valleys of the Tunka ridge have come through a stage of glacial processing. U-shaped, box-shaped and trapezium-shaped transverse and step-like, gentle concave longitudinal profiles of the river valleys and dressed rocks, ice-dressed rocks and moraines in the valley bottoms testify to it. The Kyngarga river valley, one of the largest valleys of the Tunka ridge, is the only exception because of glaciations of the upper valley due to its arrangement in a wide and deep graben-shaped subsidence.

The troughs themselves in the Tunka ridge occur in a minimum amount; they are mainly box-shaped and trapezium-shaped glacial valleys. On the northern macroslope of the Tunka ridge glacial valleys are as long as 30 km or more with the flanges up to 1300-1400 m in height. There they have mostly a dendrite character, but on the faulted short steep south slope of the ridge as short as 6-7 km, rectilinear glacial valleys 900 m in depth prevail. In the near-mouth areas of the latter, in the zone of marginal fault there are deep (up to 100 m or more) young erosive downcuttings with steep thalweg and numerous waterfalls. In many areas the Post-Pleistocene downcutting had been so intense that it annihilated all evidence of glacial modeling of the valley, and its initial extent may only be established on terminal moraines occurring on the ridge piedmonts.

The slopes of the Tunka ridge are subdivided into two types. Steep (50-70° or more) and rocky, walls of corries, cirques and slopes of glacial valleys jagged by lobes and avalanches chutes refer to the first type. An intense preparation of products of weathering on these slopes is accompanied by strong rock falls and landslides, hillside wastes, avalanches, and mud flows. Slopes of that type occur in the bald peak belt (it occupies an area of the mountains at a height of 2000-2200 m or more), and they are predominant. Gentle (25-40°) slopes with evolving cryogenic processes (mainly solifluction and rock-stream forming), and also linear erosion and landslides correspond to the second type. These slopes occur at sub bald peak and mountain-taiga belts which spread all over the ridge periphery lower than the 2000-2200 m elevation mark.

The bottoms of corries, cirques and glacial valleys are filled with morainic deposit trains of downfalls and hillside waste material, and proluvial debris cones. Numerous moraines are reworked by cryogenic processes (mainly solifluction), sometimes they are transformed into tongues of stone mountain glacier.

Olkha highland

In the south-western part the Olkha highland reaches maximum absolute heights (1500 m). There it breaks off into rift basins by steep tectonic scarps. North-eastwards it becomes lower down to elevation marks 700-800 m or less. Vertical ruggedness of relief is 200-300 m, it only rarely reaches 500-600 m.

Most of the highland there has preserved a gentle relief of the ancient level of plantation with typical rocky and conic outliers.

Within the geological situation of the region it may be supposed that the peneplanation plane may contain fragments of exhumated peneplain (protopenplain) (Klimaszewski, 1961). The Olkha highland is a tilted uplifted margin of the Siberian platform without sedimentary cover. The latter is wedged out in the north of an uplift exhuming the Pre-Cambrian denudative surface of a crystalline foundation, paleopenplain. It is included in the younger Cretaceous paleogenic level of planation, whose morphology of relief does not change in the zone of conventional protopenplain location.

The slopes of the Olkha highland are gentle, and cryogenic processes (solifluction and stone river forming) and linear erosion are taking place.

Western Khamar-Daban

Western Khamar-Daban (absolute heights up to 2994 m) is a latitudinally orientated mountain ridge with wide bun-shaped interfluvies and deep (up to 1000 m) valleys with steep slopes. Flattened surfaces of Neogen-Quaternary basaltic covers prevail in its summit belt. Fragments of Cretaceous-paleogenic peneplanation plane (fig. 3) outcrop from beneath them.

Modern glaciation in Western Khamar-Daban is absent. Ancient glaciation had taken place in the axial, highest area of uplift with a visible rise scale of its occurrence eastwards, although absolute heights of the ridge become low. The height level of the position of the corrie bottoms become low in the same direction. It is 2150-2300 m at the middle of the ridge, and 1700-1950 m in the eastern part. This is the result of a barrier effect which takes place in the Tunka ridge, but Khamar-Daban finds it self in the wind shadow from the Tunka ridge itself.

The corries in Western Khamar-Daban have a sporadic distribution. Their diameters are about 300-500 m with the walls 100-400 m in height. There are 176 corries in Khamar-Daban, their maximum number is orientated to the south-east (28%) and east (16%),

but their minimum number is orientated to the south (6,3%) and west (5%). This testifies that the snow redistribution here is more important for the formation of corries than that in the Tunka ridge.

No one glacier in Western Khamar-Daban reaches its feet. Most of the valleys have no traces of glacial processing, and have V-shaped transverse profiles and unworked out gently concave longitudinal profiles. Only the river heads of the largest rivers beginning in the axial ridge area have expanded trough parts with garlands of lakes in their bottoms and hanging valleys.

The Western Khamar-Daban slopes have developed mainly under cryogenic processes (solifluction and stone river forming) and creep influence with linear erosion and landslides participation. Slopes with developed gravitational processes are important for the uplifted area in the bald mountain zone (it occupies a mountain region from 1700-2000 m in height) which underwent a glacial modeling.

In Western Khamar-Daban three geomorphologic regions are distinguished: the Khaven-Dzalu region, and the Kharagulian and Khangarulian regions (fig. 1). A volcanic plateau with absolute heights of 200-300 m lying in the bald mountain belt is the first region. The main element of its morphologic landscapes are low table uplands modeled by altiplanation processes. Evidence of glacial morphogenesis is lacking.

The Kharagulian region (absolute heights up to 2994 m, relative heights 400-800 m) is the massive and most uplifted area of Western Khamar-Daban almost devoid of basaltic covers. The latter occur only within a narrow strip in the dome basement where they armour crests of separate flank ridges. Fragments of a gently-wavy Cretaceous paleogenic peneplanation plane form the base of morphologic landscapes of the summit belt of this region. Depressions (up to 25 sq. km) filled with Neogene-Quaternary alluvial and lacustrine-boggy deposits a few tens of meters in thickness are elements peculiar to the peneplanation plane.

The Khangarulian region (absolute heights up to 2623 m) is a strongly dissected (up to 1000 m) mountain plexus with water partings armoured by basalts which form summit plateaus, table mountains, and small „caps” – remains of overall cover prepared by denudation. Processes of altiplanation are actively evolving in this region, hence the relief of the summit belt is a combination of flat terraced surfaces dissected by short small river valleys (creek valleys), wide water-logged saddles, and tors. Fragments of the peneplanation plane outcrop in some places from beneath basaltic covers.

Conclusion

Thus, the Tunka rift is a complex, high organized formation with a full set of morphologic elements typical of dry-valley rifts of the East Siberian south, and their unified forms.

Noteworthy is an important peculiarity of the Tunka rift. It makes a contribution to the beauty and uniqueness of scenery of southern Siberia compared with Baikal, but this rift is less well understood. Nevertheless, the main part of the rift forms part of the national natural park forming the basis for its unique landscapes. Therefore, a special approach to studying it is needed in order to resolve applied problems of protection and use of the relief monuments of the Tunka rift valley.

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Lakes of the Amut depression (Northern Pribaikalye)

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Abstract: The article considers lacustrine morpholithosystems of the Amut depression in the south of the Stanovoy upland, one of the interesting and poorly known elements of the Baikal rift zone. Lake basins vary in way of formation at the leading part of a glacial factor. Their complex characteristic (geomorphology, bottom sediments) is presented.

Introduction: a brief physical-geographical characteristic of the area

The Amut depression is situated in zone of conjugation between the Ikatsky and Barguzinsky ridges (Fig. 1). The absolute heights of the alpine-type mountains framing the depression reach 2500-2600 m, and elevation marks of its bottom vary from 1230 to 1460 m. The Upper Cenozoic filling of the depression is 300-400 m, the glacial and aqueo-glacial deposits compose about 150 m of the upper unit (Explanatory..., 1981). The graben is located within the distribution of the Late Proterozoic granitoids. It has an oval shape in plan, of lateral axes measuring 9 by 16 km, and an asymmetric morphology of the boards. The large Balantamursky fault that is marked in relief as a steep (up to 400) and high (up to 1000 m) tectonic scarp controls the southeastern board of the depression. The northwestern board is more gentle, 25-300. In the basement of Balantamursky fault is the Malanzurkhensky fault that does not have so distinct topography. These faults converge in the southwestern corner of the depression. The Yurgon River draining this part of the depression develops the zone of their convergence. It is the left tributary of the Kovyli River, in turn falling into the Barguzin River. The Barguzin River is a magistral watercourse of the Amut depression; it crosses the depression from SE to NW along its smaller diameter, dividing it into two approximately equal parts. It is of interest that the

Kovyli River falls into the Barguzin River far beyond the depression, nearly where the latter comes into the Barguzin rift valley. That is, there are two streams that flow out of the Amut depression: one running north-westward, it is the Barguzin River, and another one running southwestward through the water gap in the board of depression into the Yurgon River, and then into Kovyli River and into the Barguzin River.

The graben bottom is located within mountain-woody and subalpine natural complexes (Molozhnikov, 1986). The wood cover makes 34% of the territory at a leading part of ledum larch-trees. The soil cover consists of mountain cryogenic-taiga ferruginous, surface podzolic, and mountain-tundra gley soils, and by peat bog soils in the fluvial plain of the Barguzin River. The average annual amount of precipitation varies from 600 to 1000 mm, 90% of that falls on the warm season, from April to October (Atlas..., 1967). About 5% of the bottom area of the depression are bogged up, especially near the Barguzin River channel.

The valley of this transit river between the mountains framing the depression is a typical trough. The ancient gletcher intensively melting within the Amut depression produced a typical ridge-and-hummock-and-sink morainic topography on the most part of its bottom, with a system of 100-m high lateral moraine lines curved towards the boards of depression. The gletcher also incised within the graben bottom itself (Fig. 2). Moraine deposits are composed of unsorted, mostly rubbly-pebbly-clumpy material with aleurite-pelitic cement. From our data, the content of clayey fraction in these deposits makes some-