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TECTONICS OF THE WESTERN PART OF THE LAPTEV SEA SHELF

Main structural elements and disjunctive dislocation systems are revealed and traced from the results of integrated geophysical investigations (gravimetric, magnetometric) and 2D seismic surveys) conducted from 2005 to 2010 on the Laptev Sea shelf. The breaks of the north-west strike identify the formation of the Laptev Sea Plate and its main structures: the Lena-Taimyr area of border uplifts, West-Laptev rift system and Novosibirsk system of grabens and horsts. The slips of the north-east strike dominate as transversal breaks of Cenozoic activation. Identification of the main disjunctive dislocation systems is the base for tectonic interpretation and understanding of region evolution.

Key words: *rifting, tectonic block, thrust, fault, slip, strike-slip, Laptev Sea Plate.*

The article discusses the tectonics of the western portion of the Laptev Sea shelf, including the coastal lowland and the Lena River delta. Tectonically speaking, the study area lies at the junction of the northern part of the ancient Siberian (epi-Karelian) platform, Taimyr-Severozemelskaya (Early Cimmerian) folded area and the Verkhoyansk-Kolyma (Late Cimmerian) folded area and the (epi-Late Cimmerian) Laptev Sea plate (Figure 1). The region is divided into the western and eastern parts according to geological aspects. The boundary between the west and east runs along the Lazarev fault [Ivanova, Secretov, 1989].

The tectonic position of the Laptev Sea plate is unique in that the plate is confined to the centroclinal closure of the Eurasian sub-basin and is part of frontal margins, which are believed to have developed as the Arctic Ocean was opening.

Most geoscientists, the authors of this article included, consider the rift system within the Laptev Sea shelf [Hinz et al., 1997; Drachev, 2000; Andieva, 2008] to be a link between the mid-oceanic Gakkel ridge and the Momsky continental rift [Grachev et al, 1971]. Kim and co-authors [Geology ..., 2004] also believe that ‘the structure of the Laptev sedimentary basin consists of a system of linear rift grabens filled with Late Cretaceous to Miocene sediments overlain by the blanket Pliocene-Quaternary complex.’ L.I. Krasny refers to this study and cites the ensemble of the Laptev Sea rift structures as an example of how the oceanic rifting affected the Asian passive margin [Krasny, 2009].

However, there is an alternative view that the role of rifting in the formation of the Cenozoic sedimentary cover in the Laptev Sea is over-estimated. This opinion is based on the idea that spreading in the Eurasian sub-basin commenced at a later stage, i.e. during the Oligocene to Early Miocene time [Poselov et al, 1998; Daragan-Suschova et al, 2010].

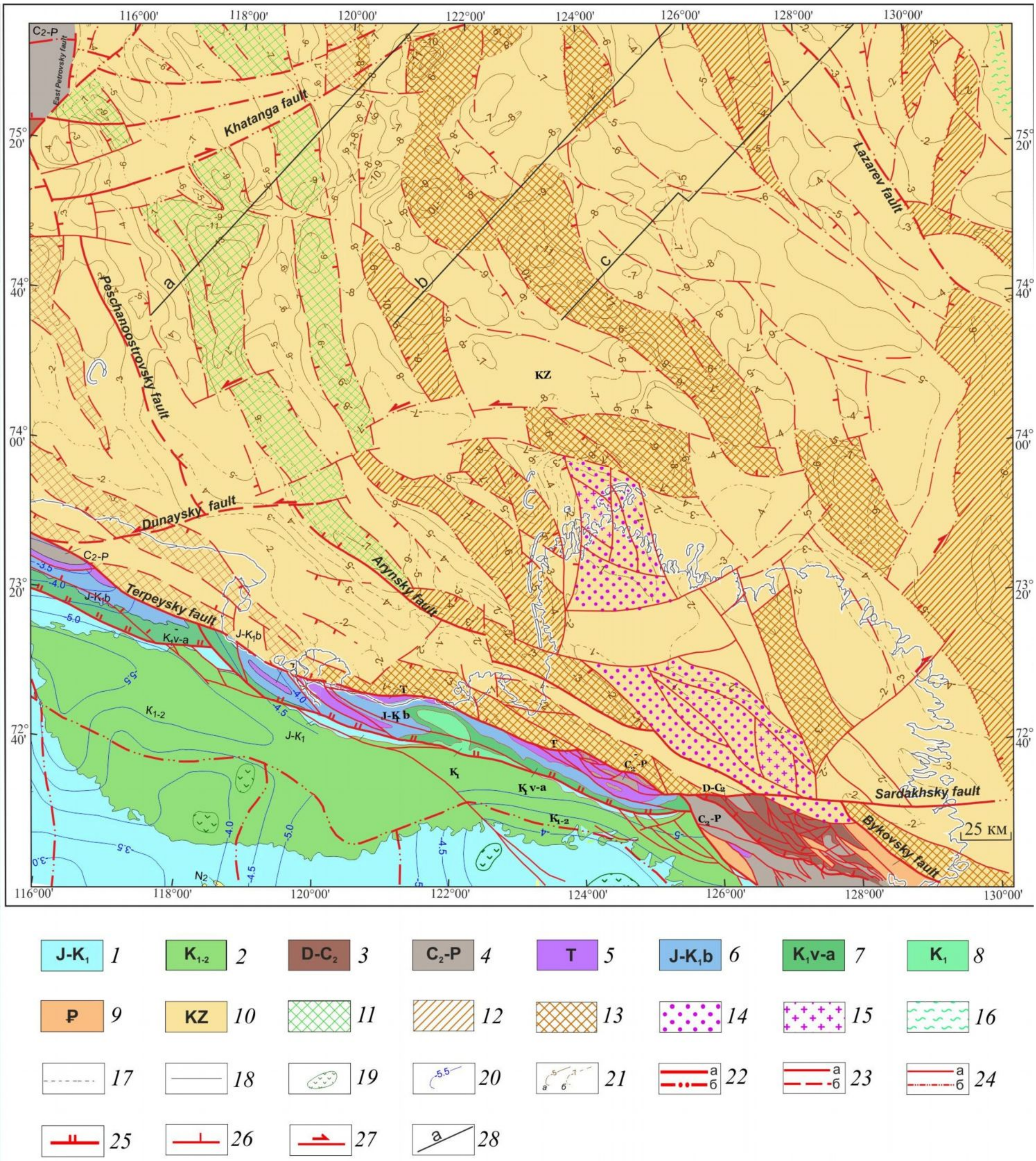

Figure 1. Schematic tectonic map of the western part of the Laptev Sea plate and adjacent areas (S.I. Shkarubo (JSC MAGE), V.F. Proskurnin (VSEGEI))

I. Siberian platform: 1 – Jurassic to Early Cretaceous shelf margin structural/formational complex (SFC), 2 – Early to Late Cretaceous synorogenic continental SFC; II. Verkhoyansk-Kolyma folded area: 3 – Devonian to Middle Carboniferous shelfal SFC, 4 – Middle Carboniferous to Permian terrigenous SFC, 5 – Triassic shelfal/continental SFC, 6 – Jurassic to Early Cretaceous shelf margin SFC, 7, 8 – Early Cretaceous synorogenic continental SFC, 9 – Paleogene continental SFC; III. epi-Late Cimmerian Laptev Sea plate: 10 – Cenozoic continental/marine SFC; IV. Taymir-Severozemelskaya folded area: 4 – Middle Carboniferous to Permian terrigenous SFC; Laptev Sea plate structures: 11 – grabens dominant throughout the Early(?) to Late Cretaceous SFC, grabens overlain onto the folded structures of the Verkhoyansk-Kolyma area: 12 - with minor predominance throughout the Cenozoic SFC, 13 – prevailing throughout the Cenozoic SFC, 14 - block uplift with a reduced thickness of the Cenozoic SFC; 15 – remnants of the ancient massifs, 16 – remnants of the Mesozoids folded complexes, 17 - boundaries of structures that do not match the faults; 18 – limits of the SFC; 19 - sizeable buried intrusions of basic and ultrabasic rocks; strato-contours: 20 – of the Siberian platform basement; 21 – of the Laptev Sea plate folded basement: a) reliable, b) inferred; discontinuous faults: 22 – suture faults (boundaries of platforms, plates and folded areas): a) reliable, b) inferred; 23 - regional: a) reliable, b)inferred, 25 – zonal : a) reliable, b) inferred; fault kinematics: 25 – thrusts, 26 – normal faults, 27 – strike-slips, 28 CDP reflection lines: a- 200712, b- 200520-200918; c-200515 – 200501 – 200918.

The extremely complex fault tectonics has brought about ambiguous and controversial ideas about the Laptev Sea plate geology. Consistent reliable tracing of reflectors is complicated over long distances.

Regional 1986-1990 seismic surveys on the Laptev Sea shelf succeeded in revealing several negative structures (the South Laptev Sea trough, the Ust-Lena and Omoloy grabens) and major positive elements (the Lena-Taimyr zone of boundary highs, Trofimov and Central Laptev highs) [Ivanova, Secretov, 1989]. Further areal integrated studies on a regional 10 by 20 km grid reached the following results: the sedimentary cover was stratified in greater detail; the geological architecture and evolution of the previously revealed tectonic elements were clarified.

According to the geological framework model adopted by the authors, the basement of the western (as well as the eastern) part of the Laptev Sea plate is represented by the Paleozoic-Mesozoic strata faulted to a variable degree and outcropping within the Verkhoyansk-Kolyma folded area (Figure 1). The sedimentary cover is presumably made up by the Aptian/Upper Cretaceous/Paleocene (A - L2), Paleocene (?)/Middle Miocene (L2 - L4) and Middle Miocene/Pleistocene (L4 – sea bottom) seismic sequences (SS). Judging by the seismic patterns, these seismic sequences can be divided into the following sub-sequences (SSS): the Lower(?)/Upper Cretaceous (A-L1), Upper Cretaceous/Paleocene (L1-L2), Paleocene(?)-Eocene (L2-L3), Upper Oligocene/Middle Miocene (L3 -L4), Upper to Middle Miocene (L4-L5) and Pliocene/Quaternary (L5- sea bottom), tentatively divided into two seismic series: Pliocene and Pliocene-Quaternary [Shkarubo, Zavarzina, 2011].

Judging by the topography of the folded basement (at the 'A' reflector), the western part of the Laptev Sea plate contains the Lena-Taimyr area of boundary highs, the West Laptev rift system and the Novosibirsk system of graben and horsts. The principal structures trend in the northwestern direction and are represented by zones of subparallel N/W-trending faults and the associated system of grabens and horsts cut by N/E-trending shear deformations (Figure 1).

The Lena - Taimyr area of boundary highs stretches in a narrow band (up to 100 km) from the northern tip of the Taimyr Peninsula to the Buor-Khai Bay. It is observed as strong and contrasting potential field anomalies. This area hosts a band of earthquakes. Focal mechanisms with vertical and horizontal displacement parameters were estimated in the foci of the earthquakes [G.P. Avetisov, 1991, B.M. Kozmin, 1984].

The Lena-Taimyr area of boundary highs relates on seismic to the uplift of the Late Cimmerian folded basement. Its main geological features testify to the continuation of the fold-and-thrust structures in the East Taimyr - Olenek system buried beneath the Upper Cretaceous to

Cenozoic strata. The East Taimyr - Olenek system is part of the Verkhoyansk-Kolyma folded area (Figure 2).

The horsts buried beneath the Cenozoic cover within the Lena-Taimyr area of boundary highs are made up by the Middle Carboniferous/Permian, Triassic and Jurassic sequences, similar to the onshore outcrops of the East Taimyr – Olenek fold-and-thrust system. The sequences are broken to a variable degree and attain a thickness of up to 3 km. It is likely that thickness of Paleozoic formations is reduced in the cores of the buried horsts and the top of crystalline basement is shallower, indicated by higher gravity values (20-30 mGal or more). As for the grabens, the base of the 'post-Verkhoyansk' sedimentary cover is traced at depths between 3-5 and 2-3 km. The Jurassic to Lower Cretaceous strata are expected on the slopes of horsts and in the bottoms of the grabens, whereas the Upper Cretaceous rocks are expected in the sedimentary cover. The folded basement is overlain solely by Cenozoic sediments in the crests of horsts. In the extreme western and southern parts of the Lena-Taimyr area of boundary highs the Upper Cretaceous to Paleocene sediments (SS L1-L2) pinch out, overlying the folded basement.

The fold-block structures of the Verkhoyansk-Kolyma folded area also extend into the Lena River delta, where the Tumatsky remnant is located. The latter relates to a contrasting positive gravity anomaly of up to 55 mGal (Figure 3). This is the most uplifted block of the pre-Riphean crystalline basement and Early Proterozoic rocks reactivated during the Riphean time, overlain by a thin veneer of Pliocene to Quaternary sediments. The flanks of the remnant are expected to host subcrops of Riphean – Late Vendian volcanic and carbonate/terrigenous complexes as well as Late Vendian to Middle Carboniferous formations. The southern flank is presumably complicated by reverse faults and reverse thrusts with fault planes dipping northeastward. The formation of the Tumatsky remnant was apparently induced by folding/mountain building processes in the East Taimyr - Olenek system during the Cenomanian to Maastrichtian time [MAGE data, 2011].

The Western Laptev rift system extends southeast to northwest. The initiation and formation of this intricate rift system is believed to be linked with the evolution of the Eurasian sub-basin. Speaking in favour of this supposition are 1) general thinning of the Earth's crust to 25-22 km in the axial parts of the basin expressed as deep grabens and 2) the fact that the sedimentary cover is split by abundant faults.

The burial depth of the folded basement is estimated to vary between 2-5 km and 7-13 km within the West Laptev rift system, becoming greater towards the axial part (Figure 1).

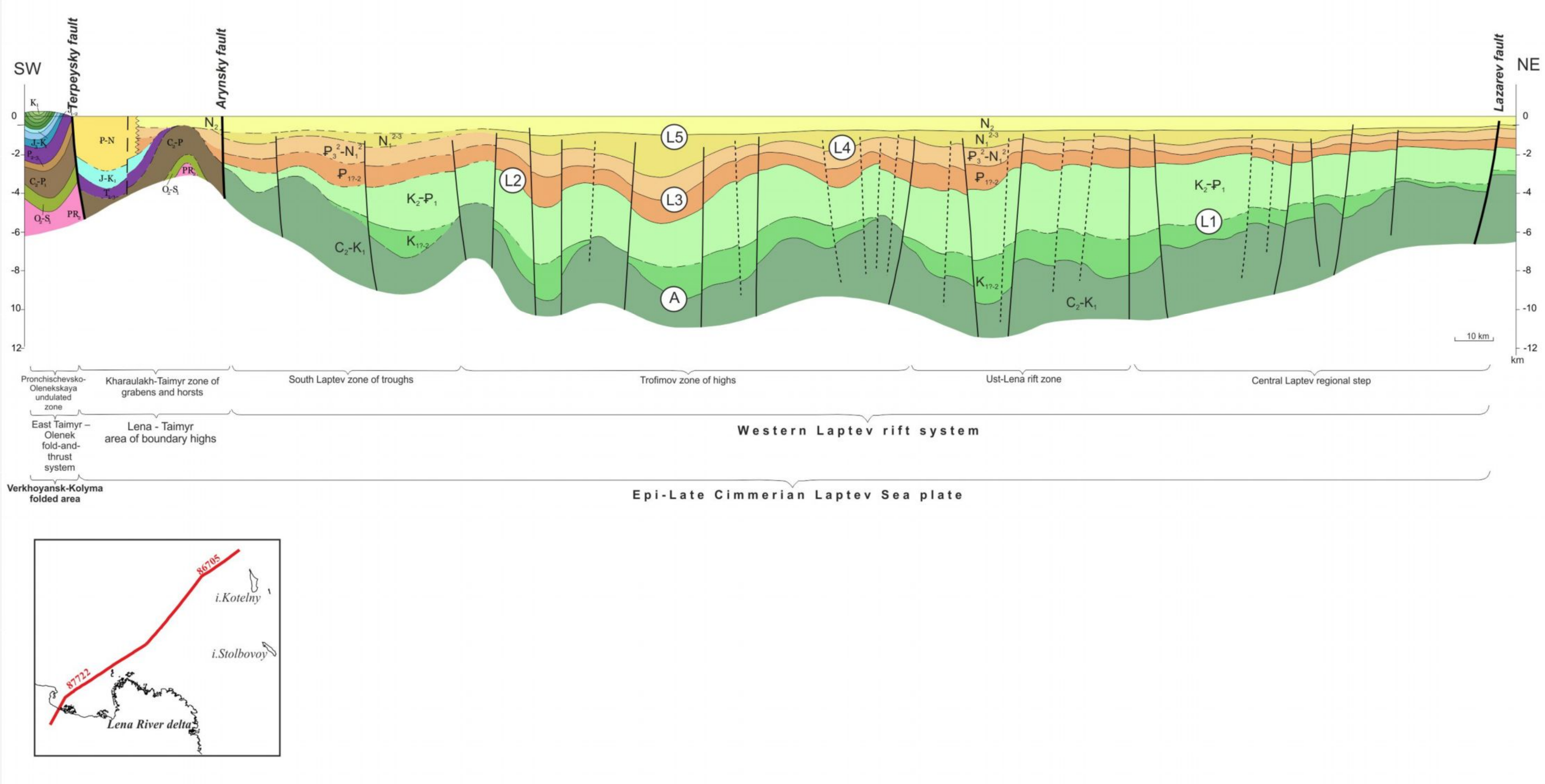

Figure 2. Composite geological cross-section for line 87722-86705 (S.I. Shkarubo, G.A. Zavarzina)

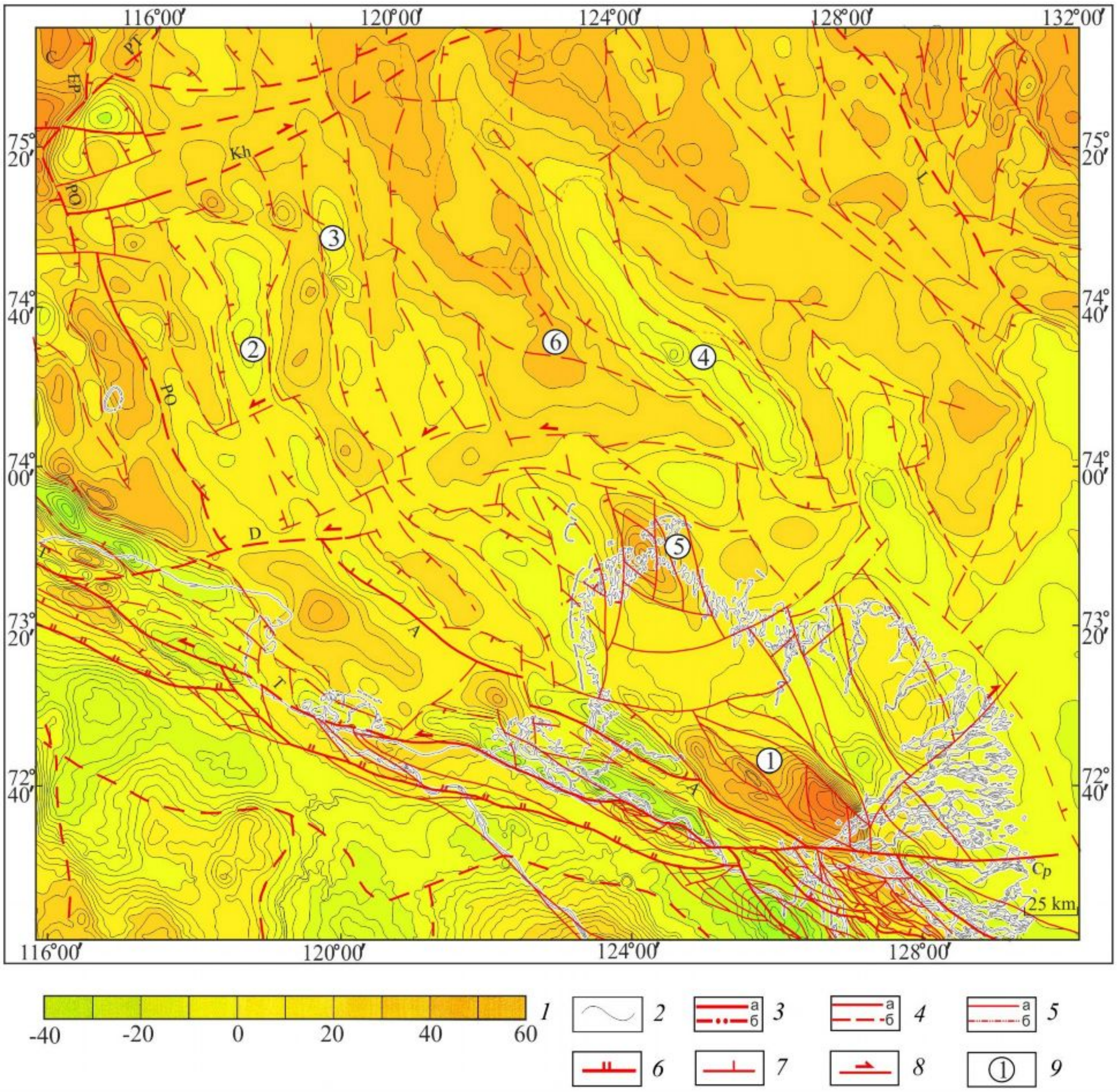

Figure 3. Gravity map (V.V. Vasilev, JSC MAGE)

1 - the scale of gravity anomalies intensity (Bouguer gravity of 2.30 g/cm^3, mGal); 2 – contours; rupture faults: 3 – suture faults (boundaries of platforms, plates, folded areas): a) reliable, b) inferred 4 - regional a) reliable, b) inferred 5 - zonal, a) reliable, b)inferred, fault kinematics: 6 - thrusts, 7 – normal faults, 8 – strike-slips, 9 - structures (1 - Tumatsky remnant, 2 - Aryn-Vityazev graben, 3 - Olenek graben, 4 - Ust-Lena graben, 5 - Muorinsky remnant, 6 - Trofimov zone of highs).

The seismically derived structure of the Laptev Sea plate basement is directly reflected in the gravitational field: most depressions relate to negative gravity anomalies, while highs relate to positive gravity counterparts (Figure 3).

The West Laptev rift system hosts the South Laptev zone of troughs, the Trofimov zone of highs, the Ust-Lena rift zone, the Central Laptev regional step, the Sagystyr step and the Omoloy zone of troughs (Figure 4, 5).

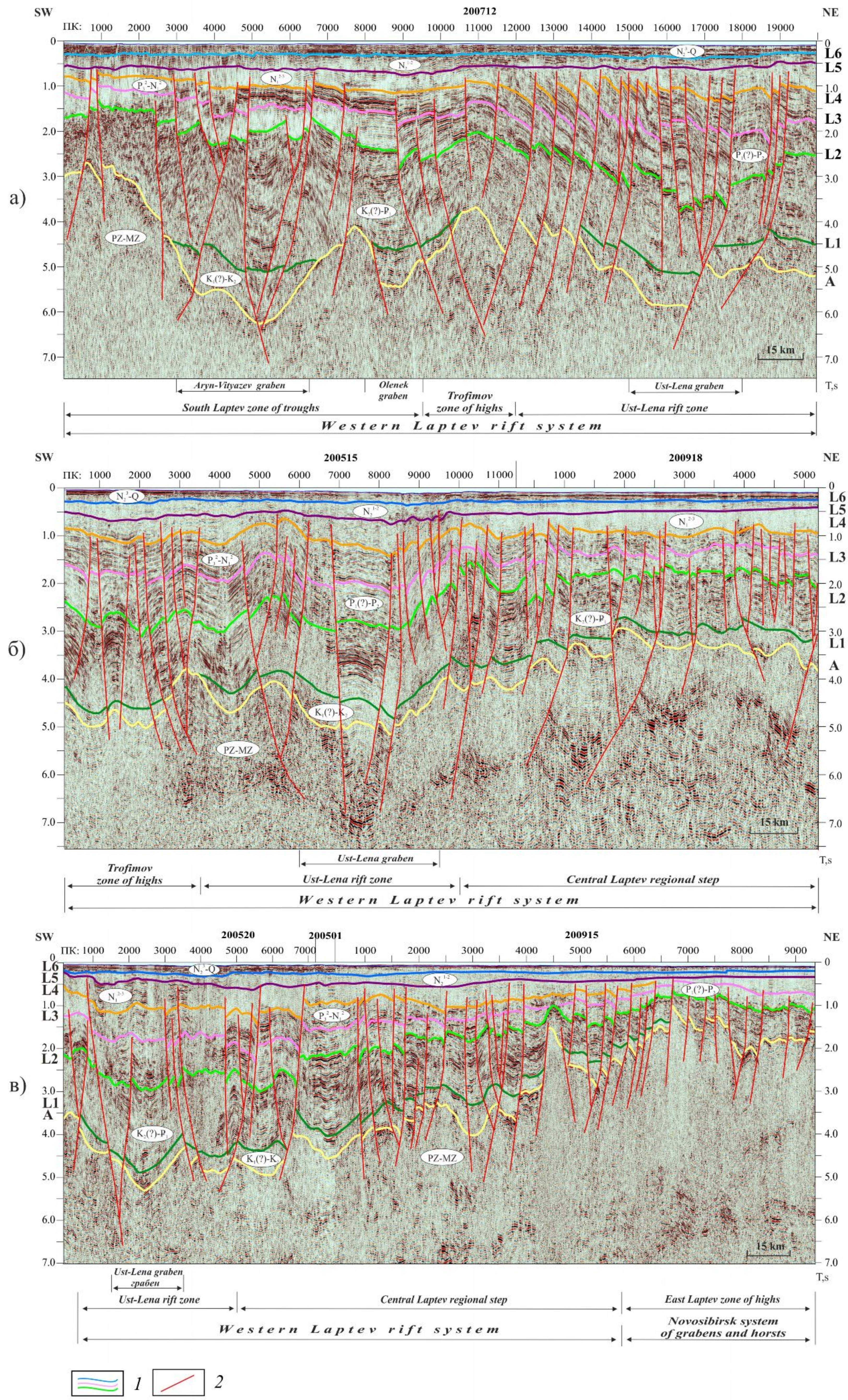

Figure 4. Time sections for lines: a – 200712, b – 200520-200918, c – 200515 – 200501 – 200918

1 - reflectors; 2 – faults.

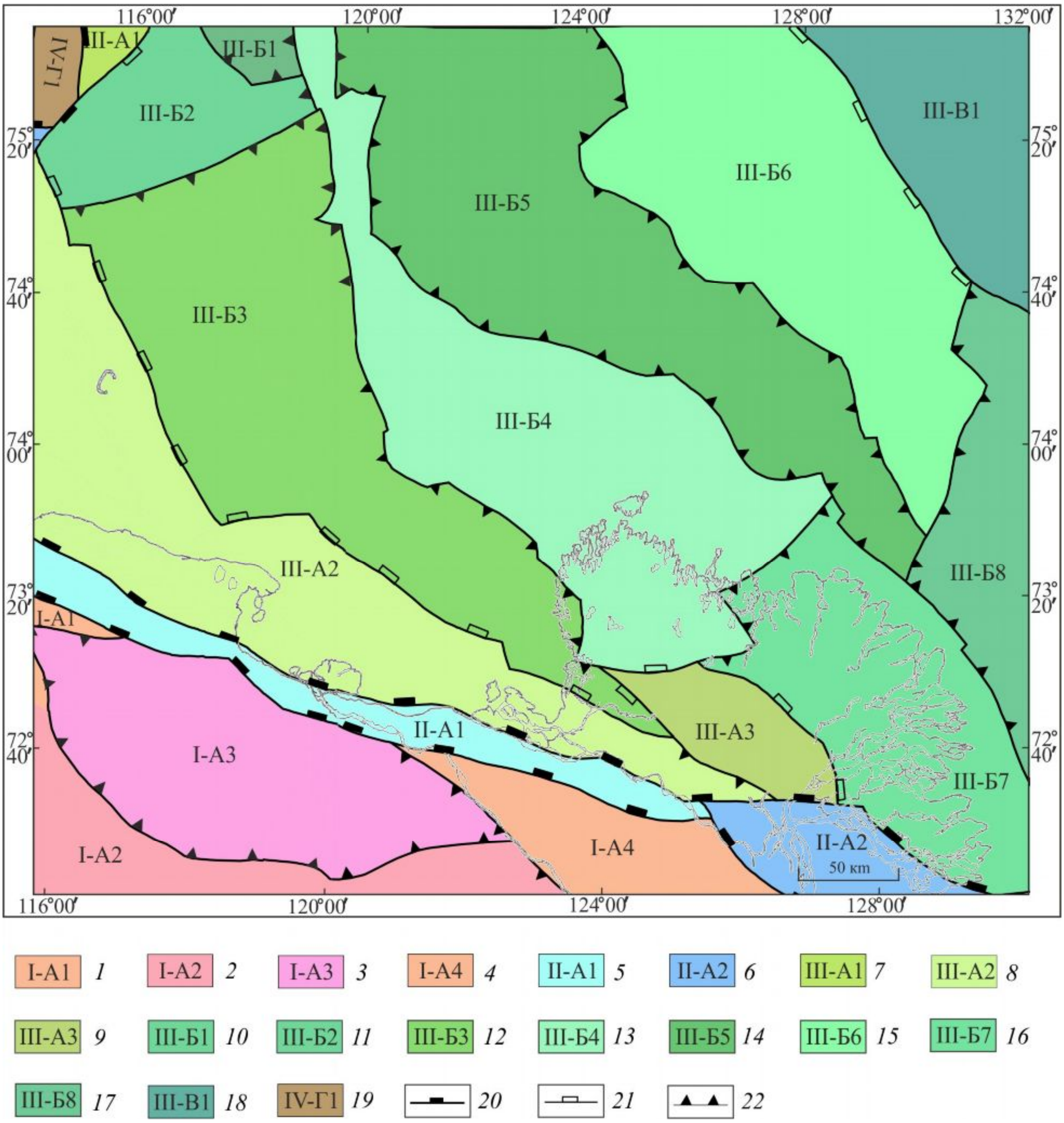

Figure 5. Schematic map of tectonic zonation

(S.I. Shkarubo (JSC MAGE), V.F. Proskurnin (VSEGEI))

I. Siberian Platform: IA – Khatanga-Lena pericratonal mega-trough 1 – I-A1 – Khatanga-Ustanabar mega-saddle, 2 – I-A2 – North Siberian monocline, 3 – I-A3 – Lena-Anabar foredeep, 4 – I-A4 – Chekanov zone of inversional trough; II. Verkoyansk-Kolyma folded area, 5 – II-A1 – Pronchischev-Olenek undulated zone, 6 – II-A2 – Bastakh-Kharaulakh fold-block zone; III. Epi-Late Cimmerian Laptev Sea plate, III-A – Lena-Taimyr area of boundary highs, 7 – III-A1 – Pritaymyrsky remnant, 8 – III-A2 – Kharaulakh-Taimyr zone of grabens and horsts, 9 – III-A3 – Tumatsky remnant; III-Б – West Laptev rift system, 10 – III-Б1 – West Laptev trough, 11 – III-Б2 – East Taimyr step, 12 – III-Б3 – South Laptev zone of troughs, 13 – III-Б4 – Trofimov zone of highs, 14 – III-Б5 – Ust-Lena rift Zone, 15 – III-Б6 – Central Laptev regional step, 16 – III-Б7 – Sagastyr regional step, 17 – III-Б8 – Omoloy zone of troughs, III-B – Novosibirsk system of grabens and horsts, 18 – III-B1 – East Laptev zone of uplift; IV. Taimyr-Severozemelskaya folded area, IV-Г – Taimyr fold-and-thrust system, 19 – IV-Г1 – South Byrangskaya folded zone; boundaries of tectonic structures (20-23): 20 – trans-regional and regional, 21 – subregional; 22 – 1st order.

These structures are seen in the folded basement relief as zones elongated in the northern and northwestern directions. The greatest depth of downwarping is reached in the Aryn-Vityazev and Olenek grabens in the South Laptev zone of troughs, and in the Ust-Lena axial graben in the Ust-Lena rift zone (Figure 4a). In the northwest of the region the grabens are limited by the Khatanga fault and shift eastward along the latter.

The South Laptev zone of troughs and the Ust-Lena rift zone are separated with the Trofimov zone of uplift. The latter consists of large remnants, highs, horsts and steps with the folded basement buried at depths between 1 km and 5.5-6 km. The Muorinsky remnant in the Lena River delta is the most uplifted block of the folded basement. It is seen in the gravity field as a sizeable oval-shaped N/W-trending positive gravity anomaly of up to 38 mGal (Figure 3). The block is separated from Tumatsky remnant with the E/W-trending system of arcuate faults. The Muorinsky remnant is limited from the north and west by zones of normal faults and transtentional faults separating the associated grabens. We may assume by analogy with the Tumatsky remnant that the core of the Muorinsky remnant contains Proterozoic metamorphic rocks beneath the Cenozoic sediments (or near their base). The Proterozoic rocks are bounded by the Upper Vendian - Middle Carboniferous carbonate/terrigenous and volcanic strata, while the Cenozoic is several hundred metres thick in its crest, hardly reaching 1 to 1.5 km on the flanks. The Upper Cretaceous to Paleocene sediments are probably either missing or pinch out within the remnant, overlying the folded basement surface or are limited by faults and tend to occur in adjacent grabens. The Muorinsky remnant comes into clear focus on satellite images and stands out from the rest of the Lena River delta. All delta channels and branches flow around this remnant, indicating its recent uplift [MAGE data, 2011].

The Central Laptev regional step stretches along the northeastern margin of the Ust-Lena rift zone and hosts a series of positive and negative structures. Its folded basement is buried at depths between 7 and 3 km (Figure 2, 4).

The Sagastyr regional step occupies the eastern part of the Lena River delta and adjacent waters, sitting between the highly uplifted blocks of the folded basement, i.e. the Tumatsky and Muorinsky remnants and grabens of the Ust-Lena and Omoloy zones. The Sagastyr regional step is generally marked by a high-gradient gravity field, possibly implying a rugged topography of its folded Late Cimmerian basement.

The Omoloy zone of troughs is an N/S-trending branch of the West Laptev rift system separated from the Ust-Lena rift zone with a transverse horst. The Omoloy zone of troughs extends into the Buor-Khai bay in the south, while in the north it is bounded by the structures of the Central

Laptev step and Novosibirsk system of grabens and horsts. The Omoloy zone of troughs is distinguished from the Ust-Lena rift zone by a shallower burial depth of the base of the post-Cimmerian sedimentary cover and is more compensated with the Upper Cretaceous/Paleocene sediments (SS A-L2).

Over the study area, *the Novosibirsk system of grabens and horsts* presents an area of relative uplift of the folded basement (0.5 to 2 km). It is marked by enhanced background gravity values (between 15 and 40 mGal) and the thinner sedimentary cover. Its boundary with the West Laptev rift system stands out as steep subsidence of the folded basement within the zone of the Lazarev fault (Figure 2). The axial parts of the horsts are overlapped here only by the Pliocene to Quaternary sediments. They are inferred to conceal rocks predominantly of the Upper Cretaceous/Paleocene and Paleocene?/Eocene age on the slopes of the horsts and grabens. The younger Upper Oligocene/Miocene layers were apparently truncated by the pre-Pliocene unconformity.

When analyzing tectonic regularities of the western part of the Laptev Sea plate, we can distinguish two main (northwestern and northeastern) directions of faults, creating a diagonal system, which determine the structure of the sedimentary cover. The N/W-trending system of faults is the predominant one. Identified within the study area are deep-seated faults (suture zones) - the boundaries of the Siberian platform, Laptev Sea plate and folded systems (Verkhoyansk-Kolyma and Taimyr-Severozemelskaya systems); regional faults bounding major tectonic elements and zonal faults bounding grabens and horsts. According to their kinematics, the faults can be divided into normal faults, reverse faults (thrusts) and strike-slips.

In order to trace discontinuous faults seen on CDP reflection lines as typical wave field patterns, we resorted to the interpretation of potential-field data in inter-line space (Figure 3).

The magnetic field of the region is moderately negative in the offshore part and sharply differentiated on the adjoining mainland. As for the gravity field, it is characterized by clear linearity and high gradients on the edges of local anomalies. Predominant both in the onshore and coastal areas are general N/NW-trending contours, whereas in the remaining offshore area the contours maintain a northern trend (Figure 3).

The remnants of the folded basement of the Laptev Sea plate subside along the deep-seated faults which control the areal extent of the Cenozoic sequences and determine evolution of the sedimentary basin. These are: *East Petrovsky* in the west, *Terpeysky*, *Sardakhsky* and *Bykovsky* in the south (Figure 2). They are associated with the onset of the basin formation.

The western boundary of the plate is defined by the N/S-trending *East Petrovsky* fault traced to the north of the Khatanga fault zone according to gravity and magnetic data. It divides the structures of the Taimyr-Severozemelskaya folded area and the Lena-Taimyr area of boundary highs. Its present-day kinematics is defined as a normal fault.

The southern boundary runs along the N/W-trending suture zone, which is a system of transtensional faults. The formation of this system was induced by the Verkhoyansk movements during the Early to Late Cretaceous time. As a result of these movements, thrusts emerged in the frontal part of the East Taimyr - Olenek branch of Verkhoyansk. At a later stage, in the Late Cretaceous-Cenozoic time sediments collapsed along the weakness zones in the rear portion coupled with the formation of predominantly left-lateral transtenstional faults, as evidenced by the location of folds along the faults and distribution of potential fields anomalies.

The Terpeysky fault runs along the northern flank of the Pronchischev-Olenek fold-and-thrust zone. It is along this fault that the Paleozoic-Mesozoic folded formations of the Verkhoyansk-Kolyma area contact with Cenozoic strata (Figure 1, 2). The fault can be seen as gravitational gradient zones. Having collated the available seismic data and the morphological parameters of the magnetic and gravity fields, we may assume that all the horsts within the Lena-Taimyr zone of boundary highs located north of Terpey fault are overlain by the Cenozoic cover [MAGE data, 2011].

Regional structure-forming faults of the northwestern fault system (*Pritaimyrsky, Peschanoostrovsky, Arynsky and Lazarev)* separate the Lena-Taimyr area of boundary highs, the West Laptev rift system and Novosibirsk system of grabens and horsts. Within these systems subordinate faults (zonal) divide individual grabens and horsts. At the stage of the basin initiation, regional and zonal faults were step-like normal faults which determined successive subsidence of the folded basement. They correspond to the stages of basin transtension, indicated by asymmetric and step-like grabens or half-grabens with oblique bottoms. The steps of the grabens and horsts dip towards the inclination of normal faults and represent upturned fault-line blocks. The magnitude of vertical displacement along the faults is estimated at 0.8 to 3 km. The horizontal displacement along the faults is accompanied by the formation of secondary transtensional synthetic and antithetic faults. Vertical displacement is accentuated by the horst-graben elements throughout the geologic column (from the base of the sedimentary cover to the 'L4' horizon), while horizontal displacement is emphasized by the shift of ruptured blocks of structures along the strike-slip. Nearly all structural indications point to the fact that large structures and N/W-trending ruptures (both regional and zonal) were formed as a result of basement blocks movements.

The system of N/E-trending faults is cross-cutting to the N/W-trending faults and represents shear zones. In zones, where these ruptures cross the N/W-trending faults, we observe displacement in plan for large structures and their parts as well as potential field anomalies. Also witnessed is frontal junction of potential field anomalies and structures (grabens and horsts).

The northwestern part of the study area has been found to host the N/E-trending Khatanga zone of faults (based on typical magnetic field anomalies), known as the Khatanga- Lomonosov zone of transform faults, [Shipilov, 2004]. This zone runs beyond the study area along the continental slope of the Laptev Sea. The axis of the oceanic lithosphere spreading of the Eurasian sub-basin is sliding along this fault in the northeastern and eastern directions relative to the shelf [Bogdanov, Khain, 1998]. This fault zone is associated with the change in the strike and frontal junction of structures, changes in the kinematics of the N/W- and N/S-trending ruptures. The N/W-trending structures limited by the Khatanga fault shift eastward along the right-lateral fault (Figure 1).

The Cenozoic evolution of the Laptev Sea region is associated with the opening of the Eurasian sub-basin, which is inferred to have started about 65 mya, at the end of the Paleocene epoch [Drachev, 2000]. Heightened tectonic activity during the Late Paleocene is seen as the fault-block relief of the 'L2' reflector surface. The Ust-Lena rift zone apparently began its formation during this time. At the 'L2' reflector level it is marked by maximum subsidence (over 3 km), implying manifestation of extension processes (Figure 4).

The end of the Eocene – beginning of the Oligocene saw the reactivation of tectonic movements in the region evidenced as the sea regression and transport of coarse clastic material from the relatively uplifted blocks into grabens.

During the Middle Oligocene to Early Miocene and the beginning of the Middle Miocene, the region (with the shelf included) underwent a compression episode with frequent interruption of sedimentation seen on seismic as the 'L4' surface. On the mainland, the Paleocene-Eocene strata rest on the broken Paleozoic to Mesozoic rocks with a sharp angular unconformity (the Soginsky, Kengdeysky grabens). Sometimes the Paleogene rocks are crushed into folds and cut by thrusts and reverse faults, indicating the Middle Miocene compression phase [Imaeva, 2009]. During the Middle Miocene tectonic activity also increased on the Laptev Sea shelf. In all likelihood, this stage is associated with the emergence of the transtension zones that deformed the previously accumulated Cretaceous to Early Miocene formations with serrated faults and 'flower structures' (Figure 4). General geometry of these faults and a structural pattern of tectonic blocks enable us to infer manifestation of shear deformations in the Middle Miocene. On seismic sections the 'flower structures' are observed in the Trofimov zone of uplift, which divides the two main depocentres of downwarping: the South laptev zone of troughs and Ust-Lena rift zone.

Maximum burial depth for the 'L4' horizon (more than 2.5 km) and maximum thickness of the Middle to Upper Miocene sediments (SSS L3-L4) are attained in the Ust-Lena rift zone delineated by faults as well as the near-Lena part of the South Laptev zone of troughs. This may testify that fault-block dislocations of considerable amplitude that have affected nearly the entire Laptev Sea shelf since the second half of the Middle Miocene reach maximum expression (within the West Laptev rift system) within the present-day Lena River delta and adjoining northwestern shelf portion. During the Miocene epoch, highs also reactivated on the continent accompanied with intense erosion of the uplifted areas [MAGE data, 2011].

Starting from the second half of the Middle Miocene, a predominantly blanket sequence formed within the shelf with tectonic faults gradually becoming more subtle. This Middle to Late Miocene sequence almost entirely compensates grabens of the last generation. The end of the Miocene was marked by the stage of the global (Messinian) regression of the World Ocean evidenced on the shelf as a sharp unconformity ('L5' reflector) successively truncating all sedimentary sequences from west to east down to the folded basement remnants (Figure 2). Based on this fact we infer that the Middle to Upper Miocene rocks largely occur in the West Laptev rift system, while they are absent within the East Laptev zone of highs, southeastern part of the Omoloy zone of troughs and over the highs located in the Lena River delta.

Therefore, the patterns established in the trending and kinematics of major discontinuous faults prove that the structures within the West Laptev Sea basin originated during the middle of the Late Cretaceous time and experienced the most intense development in the Cenozoic period. The grabens of earlier initiation that inherit the Late Cimmerian intermountain troughs are more compensated with the Upper Cretaceous to Paleocene deposits in the South Laptev zone. The Cenozoic time saw the most active evolution of the Ust-Lena rift zone, where the Cenozoic sediments reach maximum thickness and grabens and horsts exhibit complex geometry. The Trofimov zone of highs acts as a barrier separating the Ust-Lena rift zone from the South Laptev zone of troughs. Superposition of right-lateral faults along the N/E-trending faults on N/W-trending structural parageneses led to the displacement of structures and their transformation into transtenstional (in grabens) and transpressional (in horsts) structures.

Integrated interpretation of geophysical evidence has enabled us to gain new insights into the architecture of the main tectonic elements within the western portion of the Laptev Sea plate and adjoining mainland areas as well as kinematics behind the structure-forming processes. However, at the present stage of geological knowledge, given the lack of information from deep wells, any model for the stratigraphic tie of reflectors and nature of sedimentary sequences presented by the authors remains debatable.

This study was based on composing sheets of the State Geological Map of the Russian Federation (sheet S-50-52).

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