Stratigraphic Structure of Cenozoic Deposits of Prekerch Shelf and East Black Sea Basin*

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Abstract

The model of stratigraphic structure has been developed and the regional stratigraphic chart of Cenozoic sediments of the Prekerch shelf and East Black Sea Basin has been proposed. (Figure 1) It is based on the analysis of the biostratigraphic, lithologic, geomorphologic, structural-tectonic, formation, facial, sediment-paleographical, seismographic factors and the tectonic-geodynamic peculiarities of the region. Characteristics were subjected to biolithofacial space-time zonality, cycles of the Cenozoic complexes, in particular to Paleogene (Eocene, Maikop), Neogene and Quaternary complexes. The detailed stratification of the Cenozoic sediments of the Subotin structure and Miocene-Quaternary structure of the East Black Sea Basin based on the complex of methods is presented. Geodynamics and sedimentological stages of the Cenozoic evolution have been described. The existence of the biolithofacial and sedimentological analogy was proved together with similarities in the development of the Carpathian, Karkinit, Sorokin, Indolo-Cuban boundary deeps. The similarity and cycles of the terrigenous complexes of the schists, carbonate-terrigenous facies of the Cenozoic different stratigraphic levels (Menilite geosyncline deposits of the Precarpathian deep, Planorbel, Kerleut and Tarchan thin-layered black-colored facies of the external shelf and continental slope of the Western and Eastern Black Sea basin) are essential features of the hydrocarbon perspectives on the Prekerch shelf and continental slope of the Western and Eastern Black Sea basin.

Discussion

The detailed stratification of the Cenozoic deposits has been made applying the results of drilling on the Subbotina Uplift in the central part of the Kerch-Taman Trough. The Miocene-Quaternary section is characterized using the results of deep-water drilling (“Glomar Challenger”) seismostratigraphic derivatives and data from numerous stations of marine geological-geophysical expeditions carried out by the Institute of Geological Sciences and Branch of Marine Sedimentation and Ore-Formation (both — in NAS of Ukraine) and leaded by E.F. Shniukov, Academician of NAS of Ukraine.

By seismostratigraphic data, the sedimentary cover of the near-Kerch shelf and Eastern Black Sea Depression is composed by a thick sequence (over 6-8 km) of the Mesozoic and Cenozoic deposits, which erosionally cover the crystalline rocks. (Figure 2) The sedimentary cover is conventionally divided into a number of seismic complexes. The Mesozoic rocks at both shelf and depression are represented by the terrigenous-carbonate formations. Their occurrence depth exceeds 6,000 m. The Cenozoic deposits have a relatively complex structure that is often caused by the fold-dislocated structure of the Kerch-Taman Trough. Almost one third of the Cenozoic deposits on the shelf and continental slope of the depression consists of the thick Maikopian sequence (Oligocene-Lower Miocene). The Maikopian sequence reaches the thickness of kilometers in the depressions and troughs, but it is almost absent on the vaults of the Andrusov and Shatsky Ramparts. The over-Maikopian deposits (Middle Miocene and Anthropogene) cover the ramparts, their thicknesses is almost constant. It means that in the post-Maikopian time the ramparts passed through significant subsidence.

The continental slope of the Eastern Black Sea Depression, in part the vault part of the Shatsky Rampart has the structural position that is significantly similar to the NW shelf. The Cenozoic sediments have varying thicknesses and lay almost horizontally. However, in difference from the Andrusov Rampart where the Middle Miocene subsidence cover the whole region and was almost instant, the Eastern Black Sea Depression and the western part of the Shatsky Rampart were in involved in the subsidence gradually, therefore the sharp differences between thicknesses of the Miocene, Pliocene and Anthropogene are absent there. (Figure 3) The thicknesses of the Miocene-Quaternary are practically identical.

The Sorokina Trough that forms since the beginning of the Oligocene is composed mainly by the Maikopian formations over 5 km total thick, with which significant petroleum promises. It is covered by a thick sequence of the Middle Miocene — Quaternary deposits. The Cenozoic deposits form the system of folds of various genesis: typical diapirs (including formations of mud volcanoes), linear groups, which are benches of lying wings of large listric chops. The folds of the Sorokina Trough are a result of powerful lateral compression to the north-northwest from the side of the Andrusov Rampart, Tetiayev Uplift and Shatsky Rampart.

This compression caused anomalous high reservoir pressures, therefore, extruded the fluid-saturated deposits on the surface of bottom. Such the folding mechanism that was generated by intense fold and fracture deformation formed a complex fault-block pattern. This pattern is visible on the temporal sections and displays in the complexly built stratigraphic model. (Figure 4)

The use of direct geological methods and the examination results of core samples from the boreholes drilled at the Subbotina structure enabled to specify and detail the section, index the ages of rocks and determine the chronostratigraphic structure.

The characteristic feature of the drilled section is a significantly higher thickness (over 1,200 m) of the Eocene sediments, in part the Bakhchisaray, Novopavlovka and Kuma regiostages in comparison with coeval deposits of the Kerch Peninsula.

The drilled Paleogene-Neogene section enables us to determine additional stratigraphic, lithological-facial and sedimentological criteria for an assessment of the hydrocarbon potential from both the Subbotina structure and the near-Kerch shelf. As boreholes were stopped in the

Eocene deposits, one of the main productive horizon, Paleocene, remained untapped. (Figure 5).

We have the notion that promising deposits by lithobiostratigraphic criteria are the Almian and discordantly covering them Lower Maikopian (Planorbelia regiostage). The latter deposits are the main promising horizon of the Subbotina field. They are represented by rather complete sections of the Diurmen and Indol suites with cyclic structures.

On the near-Kerch shelf, the rocks prevail, which testify to the development accumulation bodies in the planorbelian sedimentational basin, fans in the inner shelf zone and continental slope. Based on biolithostratigraphic features, the Subbotina uplift deposits of the Planorbelia regiostage and of Bakhchisaray, Kuma, Molotchna, Kerleut and Bathysiphon are similar to the coeval productive sequences of the Kerch Peninsula and northwest shelf of the Black Sea, Carpathians (Vygoda, Popelska, Bystritska suites of the Eocene, Menilite suite of the Oligocene-Miocene) and corresponding Paleogene strata of the Caucasus. Besides the sedimentological and biolithofacial features, the analogies are observed between the structural-morphological model of the Subbotina structure and overthrust structures of the Borislav-Pokuttia zone (Fore-Carpathian Trough), in part the Dolina and Spasle fields. Therefore, they are significant criteria, stratigraphic, sedimentological, formational features, which testify to the petroleum promises of the near-Kerch shelf and the continental slope of the Eastern Black Sea Depression, in part the Sorokina Trough.

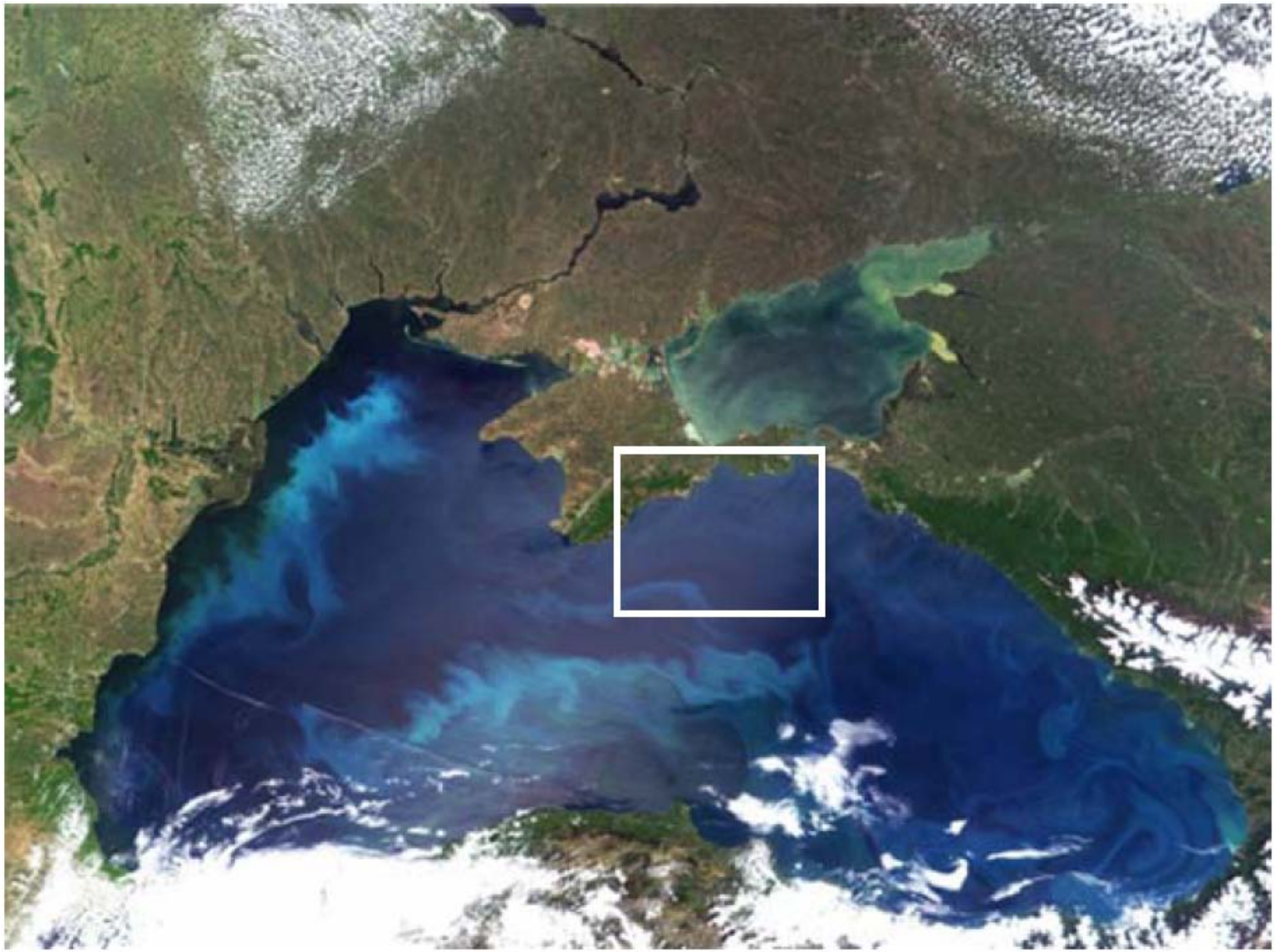

Figure 1. Landsat image of Prekerch Shelf and East Black Sea Basin.

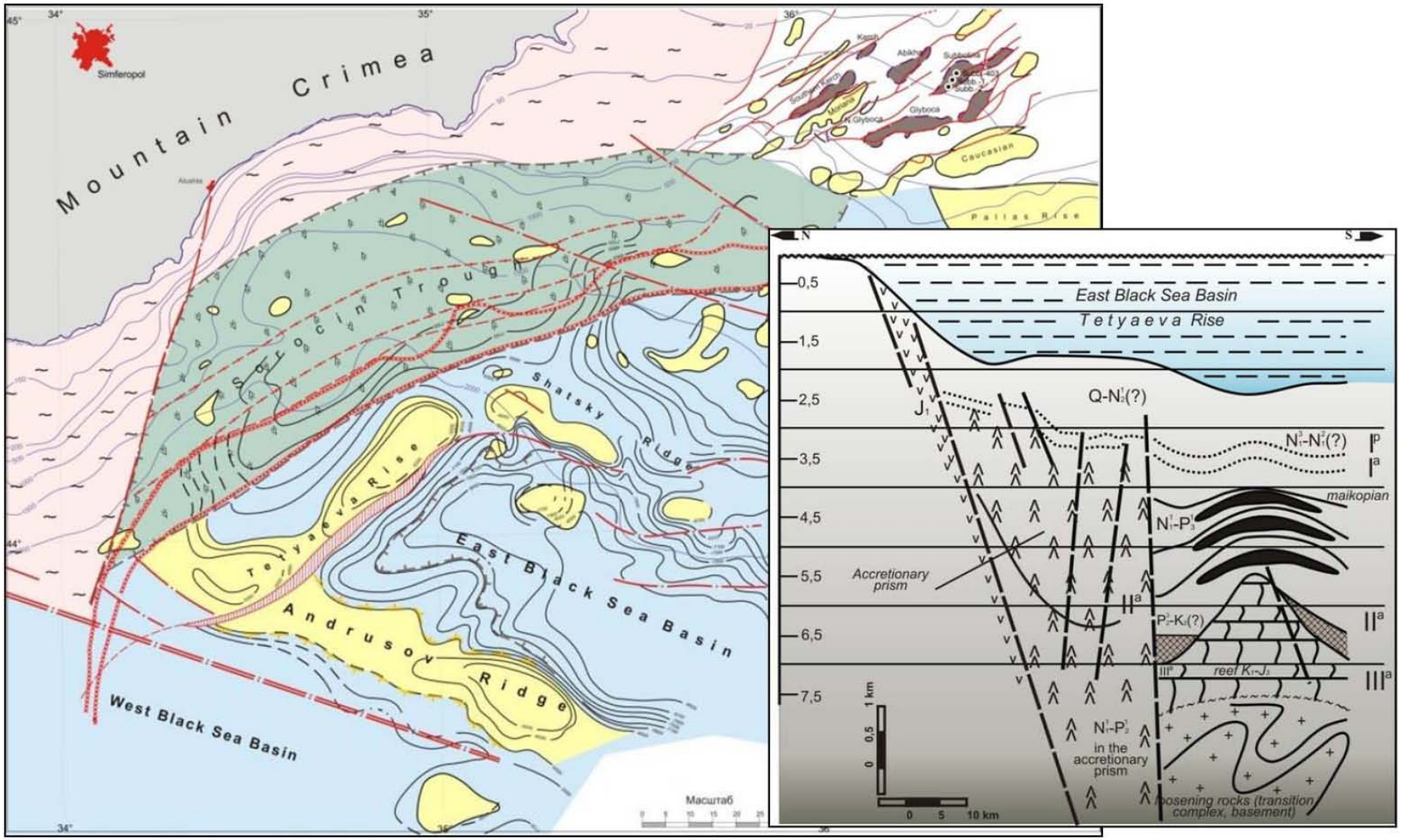

Figure 2. Structural and tectonic scheme of the Near-Crimean and Kerch parts of the Black Sea aquatory.

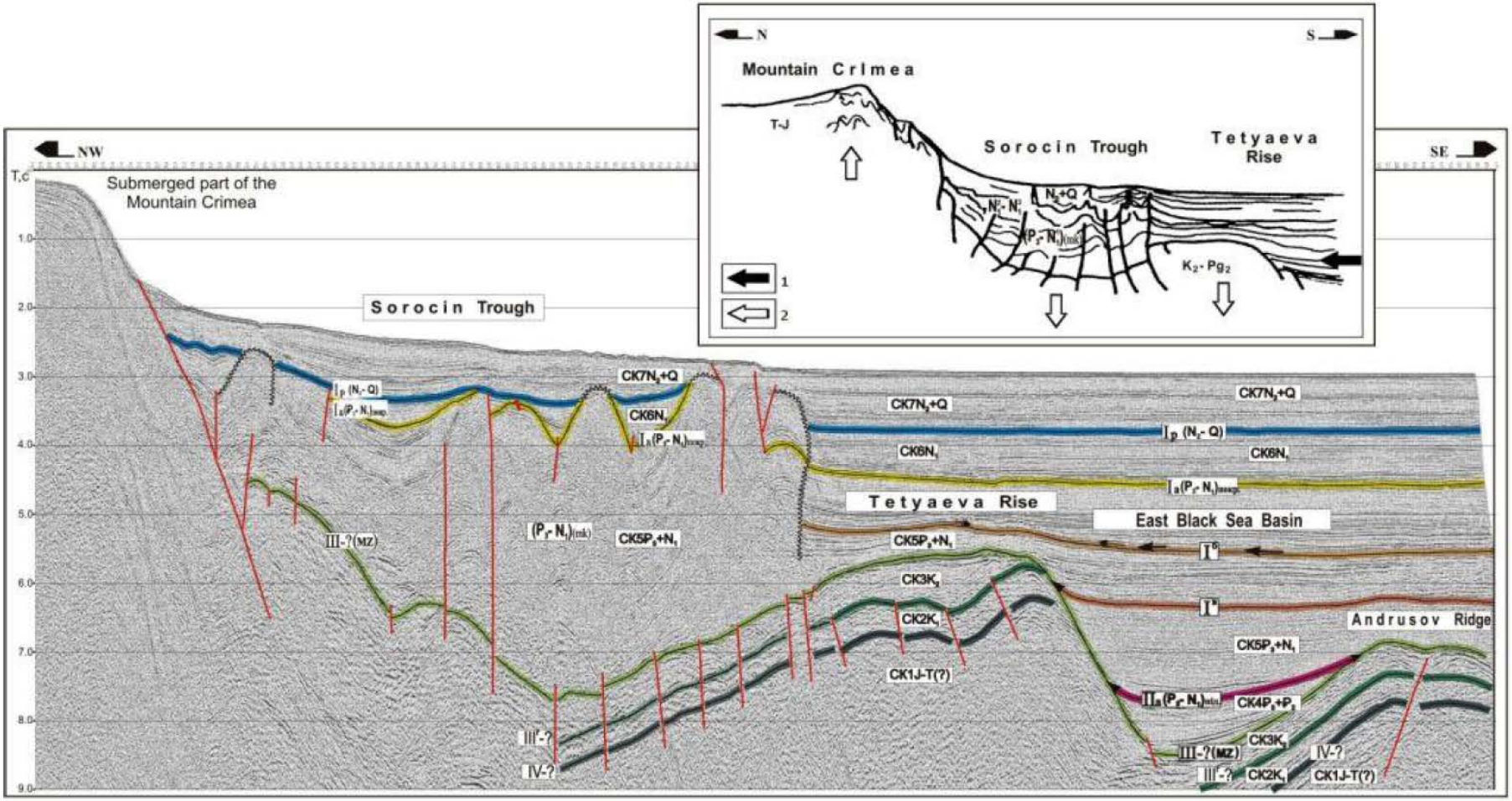

Figure 3. Model of the seismostratigraphic section along I-I profile (Eastern Black Sea Depression). It is a formation model of the Sorokin Trough.

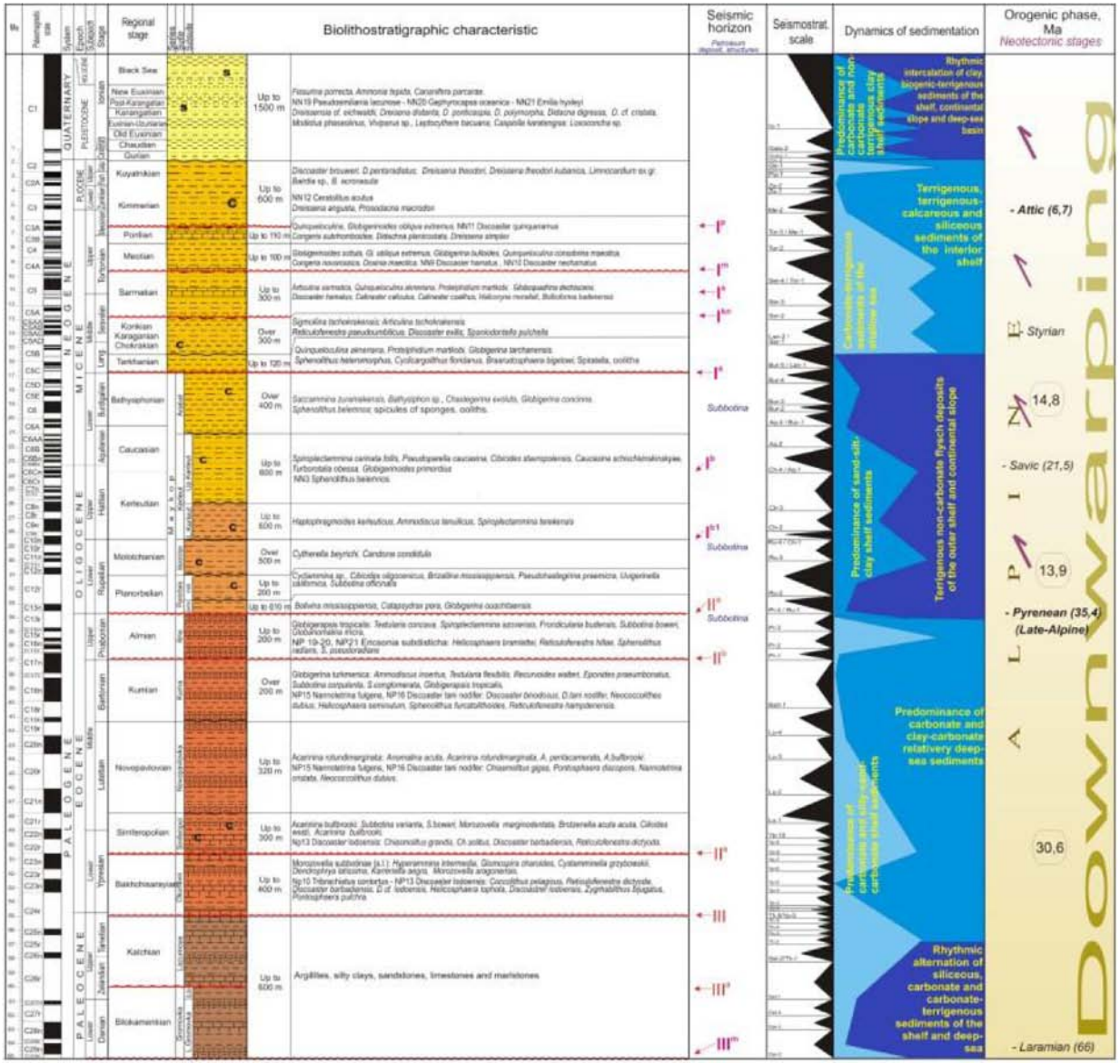

Figure 4. Stratigraphic chart of the Cenozoic deposits of the near-Kerch Shelf and Eastern Black Sea Depression.

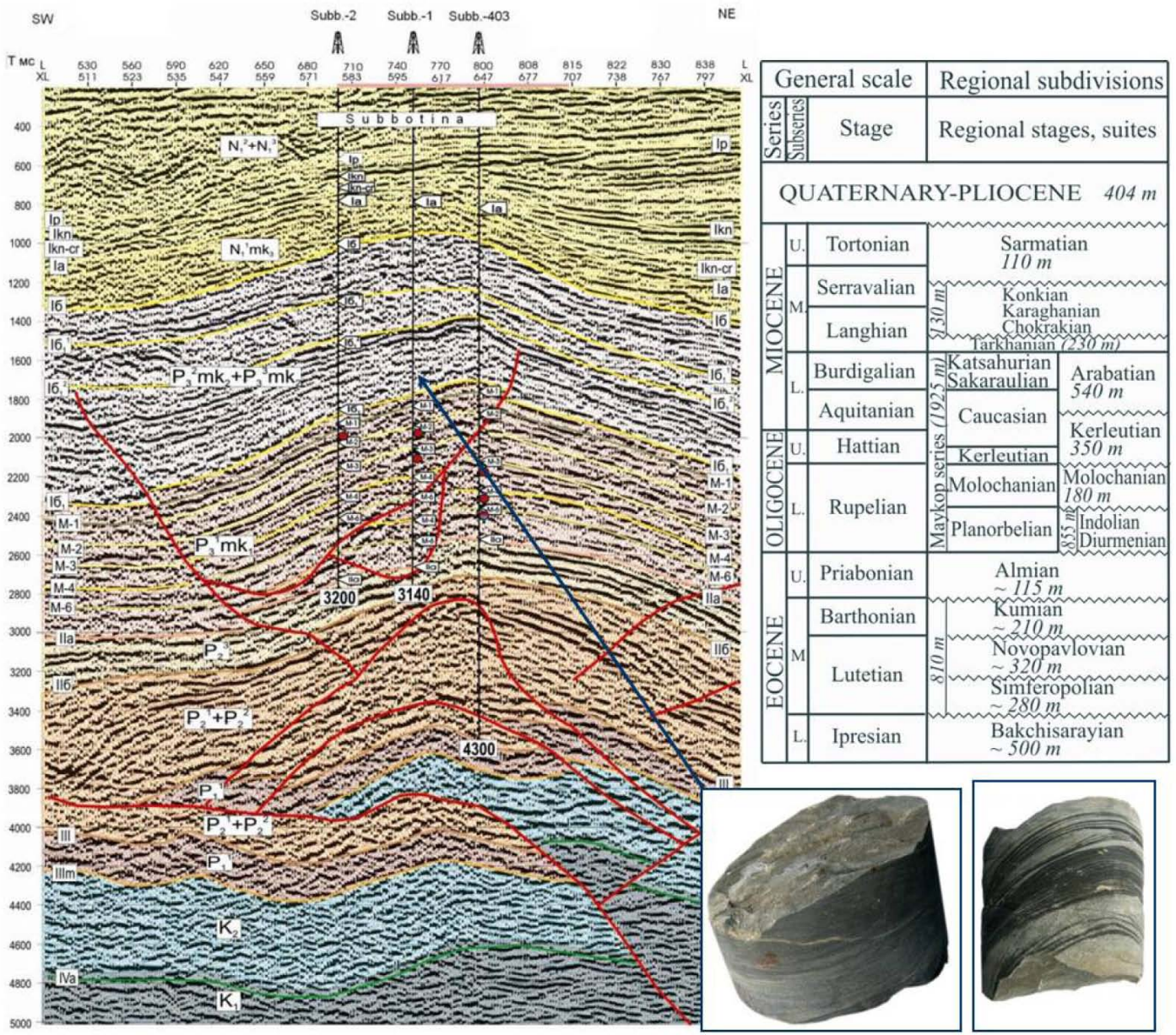

Figure 5. Fragment of vertical section of the migrated cube 3-D through b/h Subbotina-2, -1, 403.