Ancient Depositional Environments of the Eastern Black Sea*

Alexey Meisner[1], Cameron Sheya[2], and Michal Nemcok[2]

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[1]Schlumberger Pererva str. 33, Moscow, Russia (almeis@mail.ru)
[2]Energy and Geoscience Institute, Bratislava, Slovak Republic (csheya@egi.utah.edu)

Abstract

This study aims to detail the main features of the ancient depositional environments as they evolved from the Late Jurassic to the present time. A 2D seismic survey offshore and geological data onshore are contributing to understanding the depositional paleo-environments of the Eastern Black Sea**.**

In the Late Jurassic the relatively deep water Western Caucasus basin was connected with the Eastern Crimea basin and was surrounded by shelfal zone. The limestones deposited on the Late Jurassic shelf consist of reefs with associated deposits. The areas of these Upper Jurassic carbonate deposits have been considered as favorable for oil and gas pools, as illustrated by the Shatsky Ridge in the Eastern Black Sea.

The relatively deep water depositional area of the Western Caucasus had been developing until the middle Eocene; however during this time the size of the basin diminished. Presumably, beginning from the middle Eocene, the Tuapse trough, a new deep-water basin, began to form at the same time as the post-rift subsidence of the Eastern Black Sea basin. The Tuapse trough and Eastern Black Sea basin are separated by the Shatsky ridge, and both basins consist of onlap fill successions. The middle Eocene – lower Oligocene sediments in both of these basins provide possible oil and gas source rocks.

The Late Mesozoic and the Early Paleogene shallow-water carbonate sedimentation was changed by predominant terrigenous deposits in the relatively deep-water basins. The late Sarmatian time (beginning of the late Miocene) was characterized by a strong regression. Subaerial exposure on the eastern periphery of the sea at that time is confirmed by a buried paleo-river valley stretching 230 km from Gudauta uplift along north slope of the Shatsky ridge. This fluvial incision has a depth of 200-300 meters. Late Miocene rivers were sediment transport pathways into the Eastern Black Sea basin. After the Sarmatian, the Shatsky ridge began to subside due to thermal relaxation, as well as the

increasing sediment load into the basin. The average rate of subsidence is estimated to be 0.4 km/my. for the last 10 million years. Non–anticlinal hydrocarbon traps can be located within the buried valley.

Late Pliocene-Quaternary subsidence of the Black Sea Basin is thought to be the most rapid due to the rate and amount of sediment deposited within that time period. Both the Shatsky ridge and Tuapse trough were involved in this basin subsidence and seem to have acted as a unit rather than independent features; it appears that these two features are now reacting to the basin subsidence as dependent units rather than separate ones.

Ancient depositional environments of the Eastern Black Sea

Alexey Meisner, Schlumberger

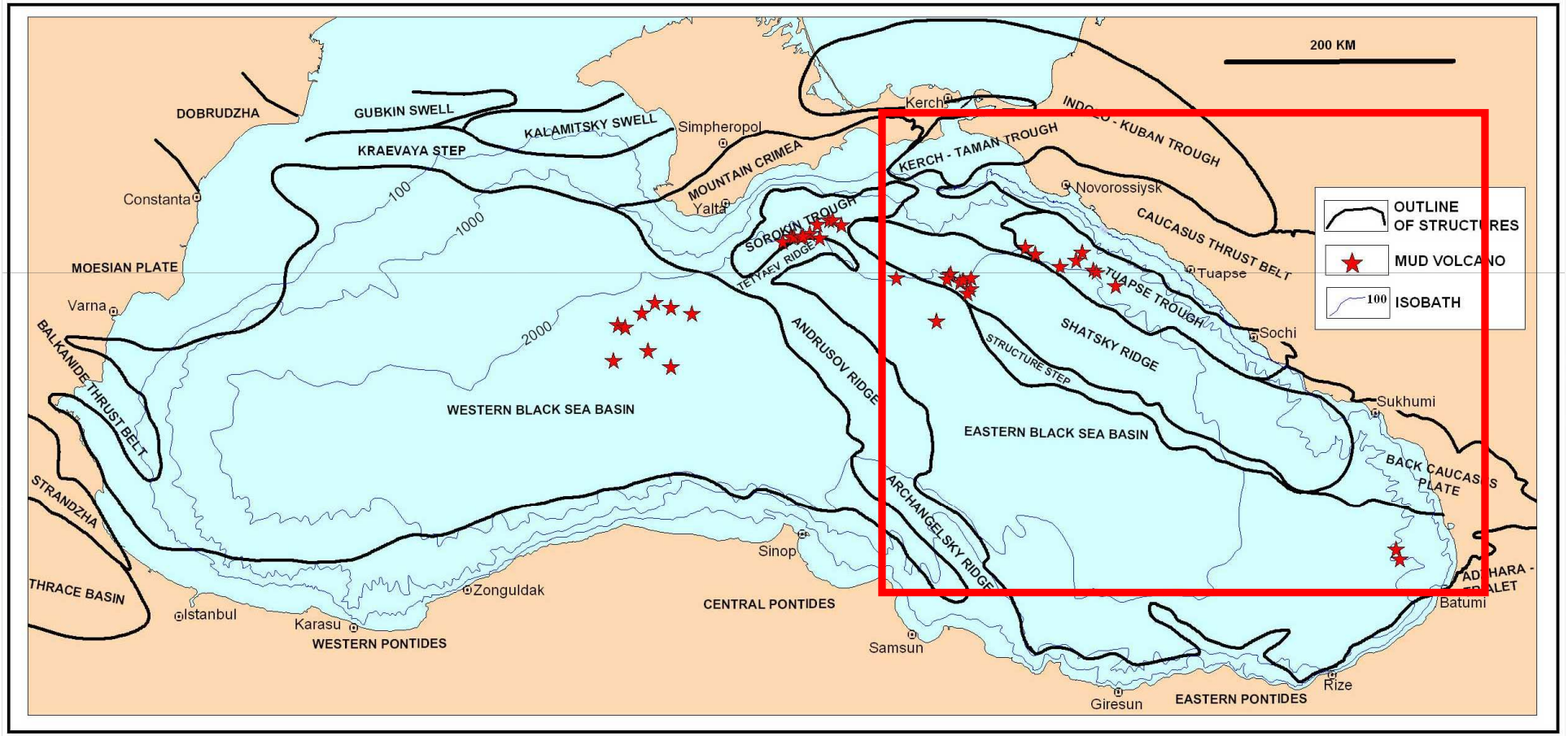
Cameron Sheya, Energy and Geoscience Institute

Michal Nemčok, Energy and Geoscience Institute

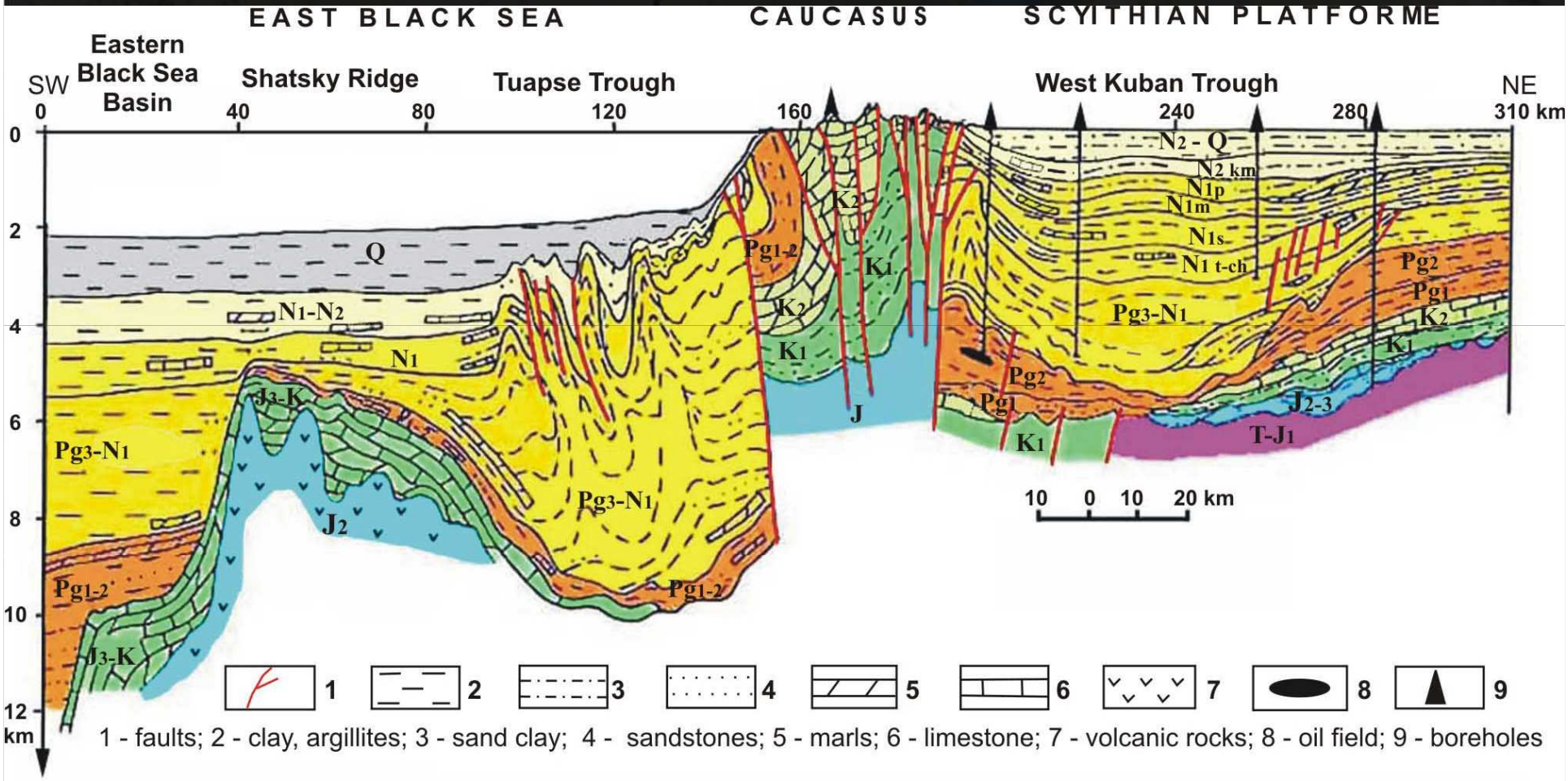
Objectives

To describe the main features of depositional environments during the period from Late Jurassic to Quaternary using seismic data from offshore and geological data from adjacent onshore

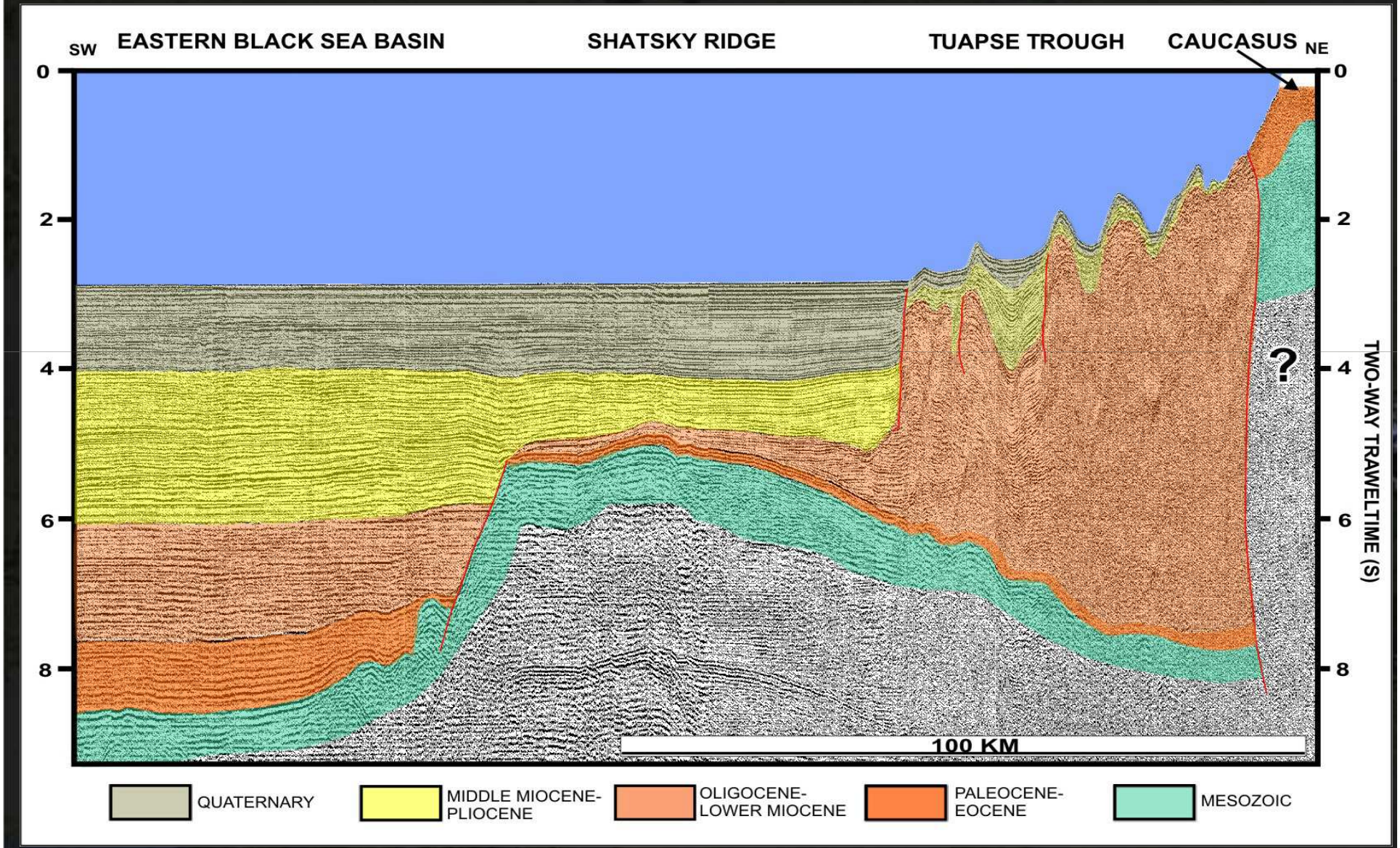
Schematic map of the main structures of the Black Sea Basin

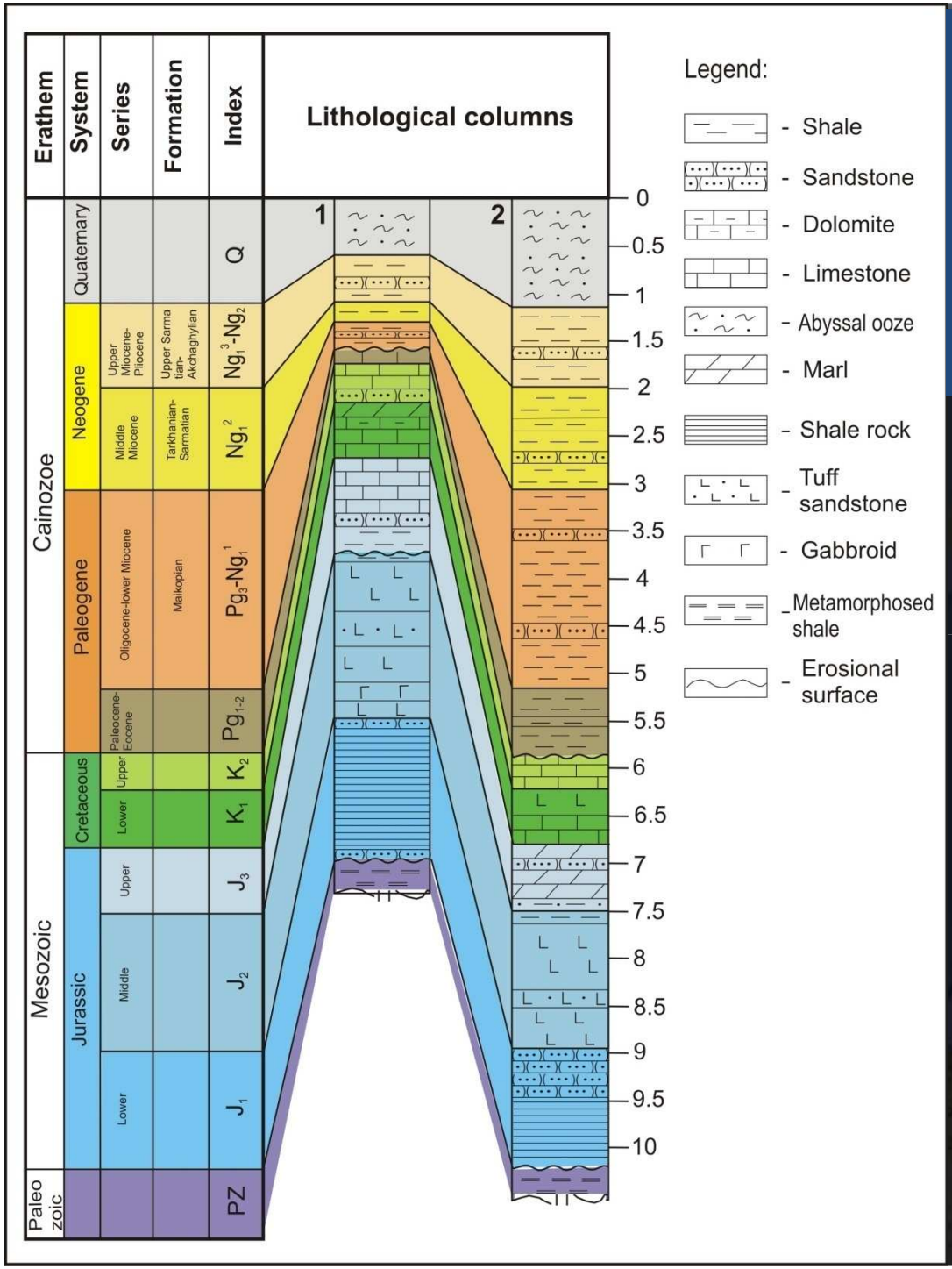


Geological section through Eastern Black Sea basin, Shatsky ridge, Tuapse trough, Caucasus and West Kuban trough



Seismic section through Eastern Black Sea basin, Shatsky ridge, Tuapse trough

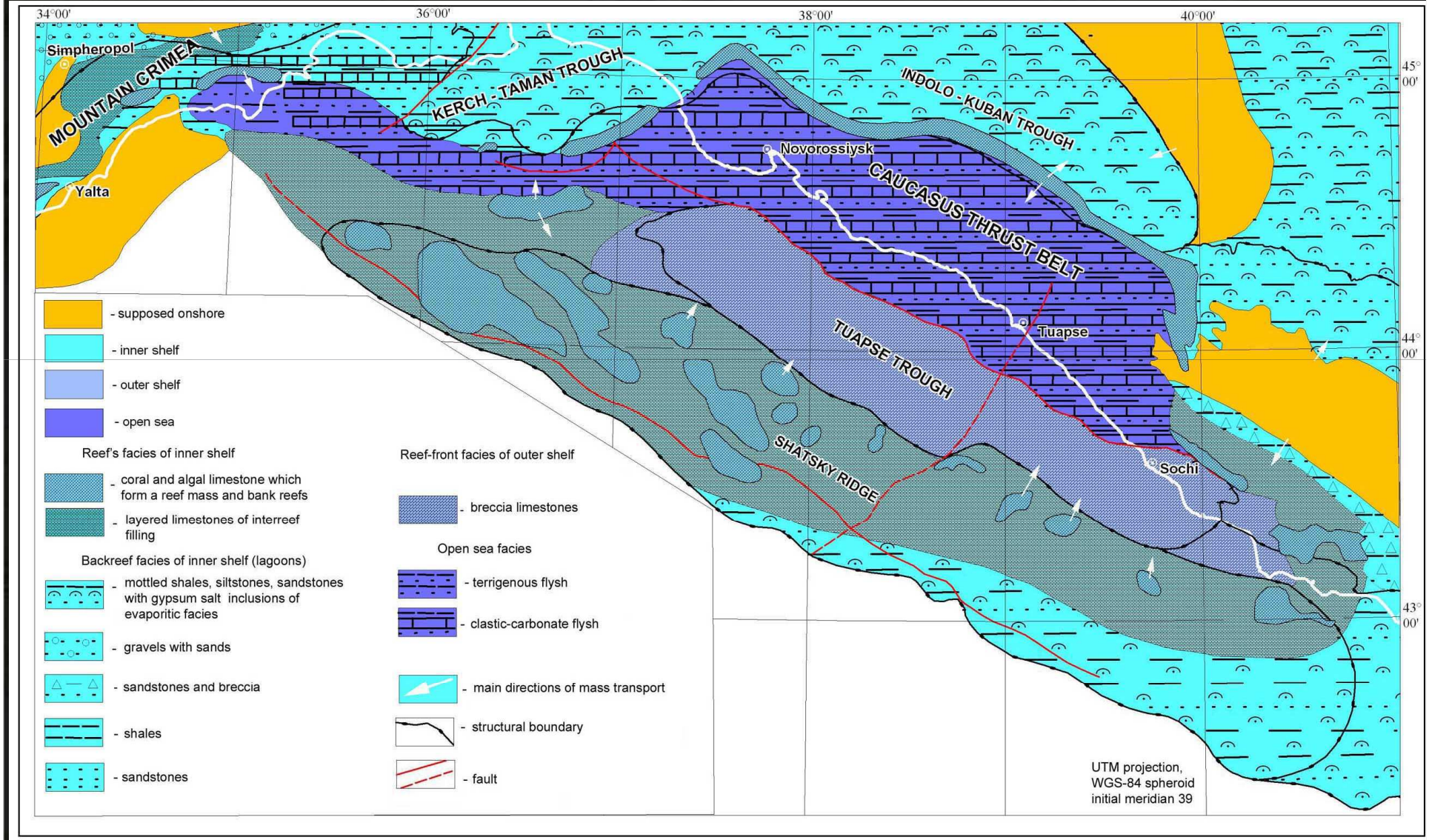




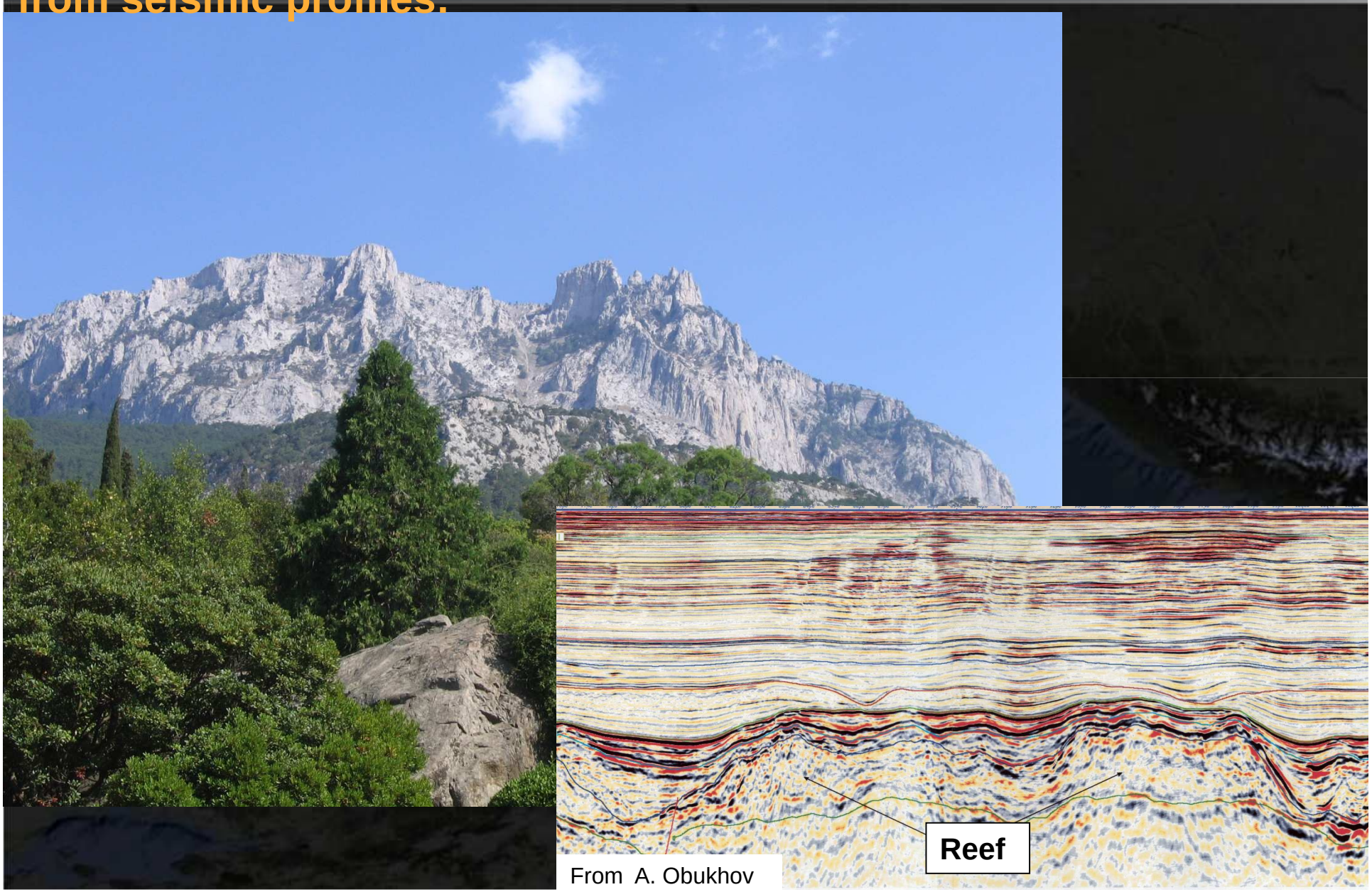
Lithostratigraphic model: 1. For the crest of Shatsky ridge 2. For the structural step on Shatsky ridge

- Shatsky ridge is a structural high composed of Mesozoic rocks
- Sedimentary cover of Shatsky ridge is composed of rocks from Paleocene to Quaternary
- The most significant unconformity in the sedimentary cover can be observed between the Eocene and Oligocene

The Eastern Black Sea Region. Scheme of the Late Jurassic sedimentary environments and sediments



Outcrops on Mountain Crimea showing examples of Upper Jurassic reefs which can also be seen occurring on Shatsky ridge from seismic profiles:



From A. Obukhov

The Eastern Black Sea Region. Scheme of the late Eocene sedimentary environments and sediments

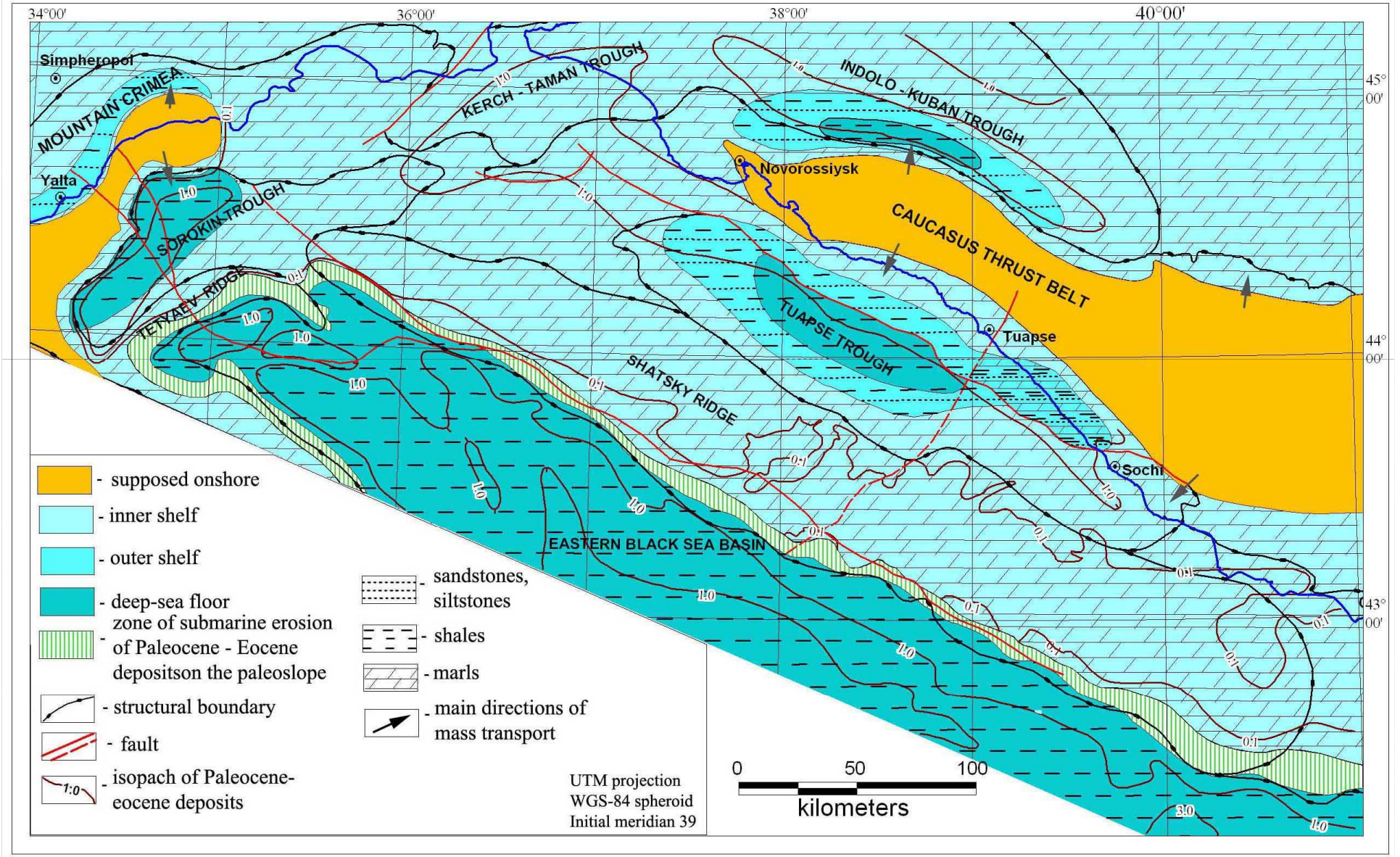
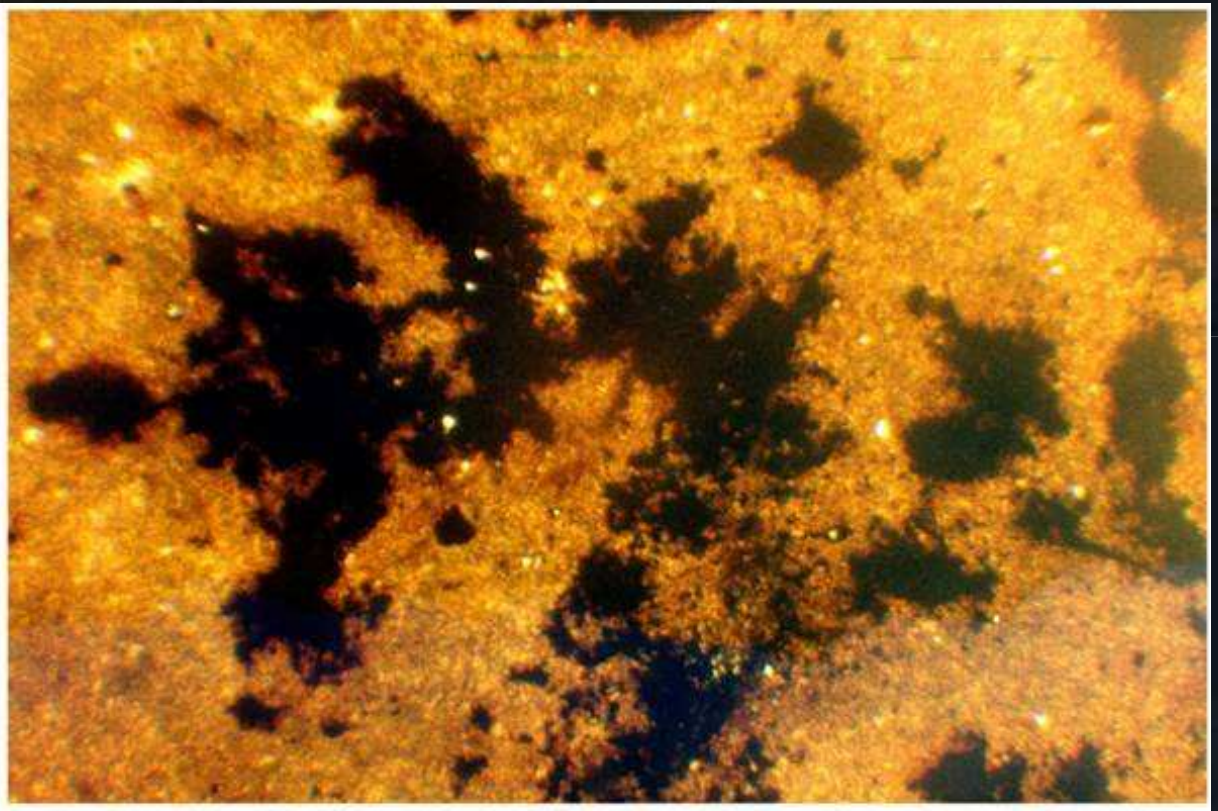
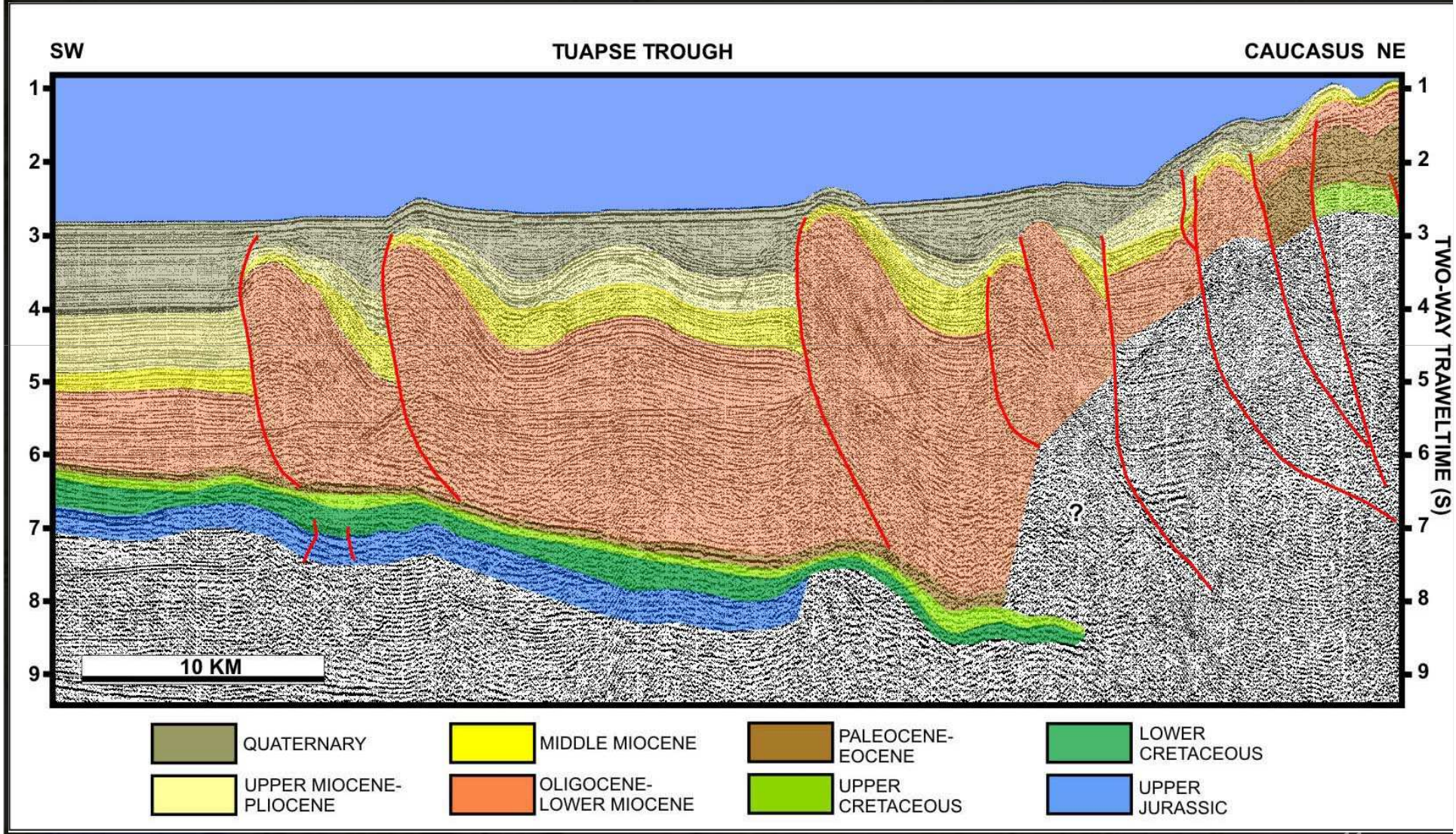


Photo. Thin section from core of well Taman 5 was taken from 3337-3343 m MD. Upper Eocene bituminized marl.

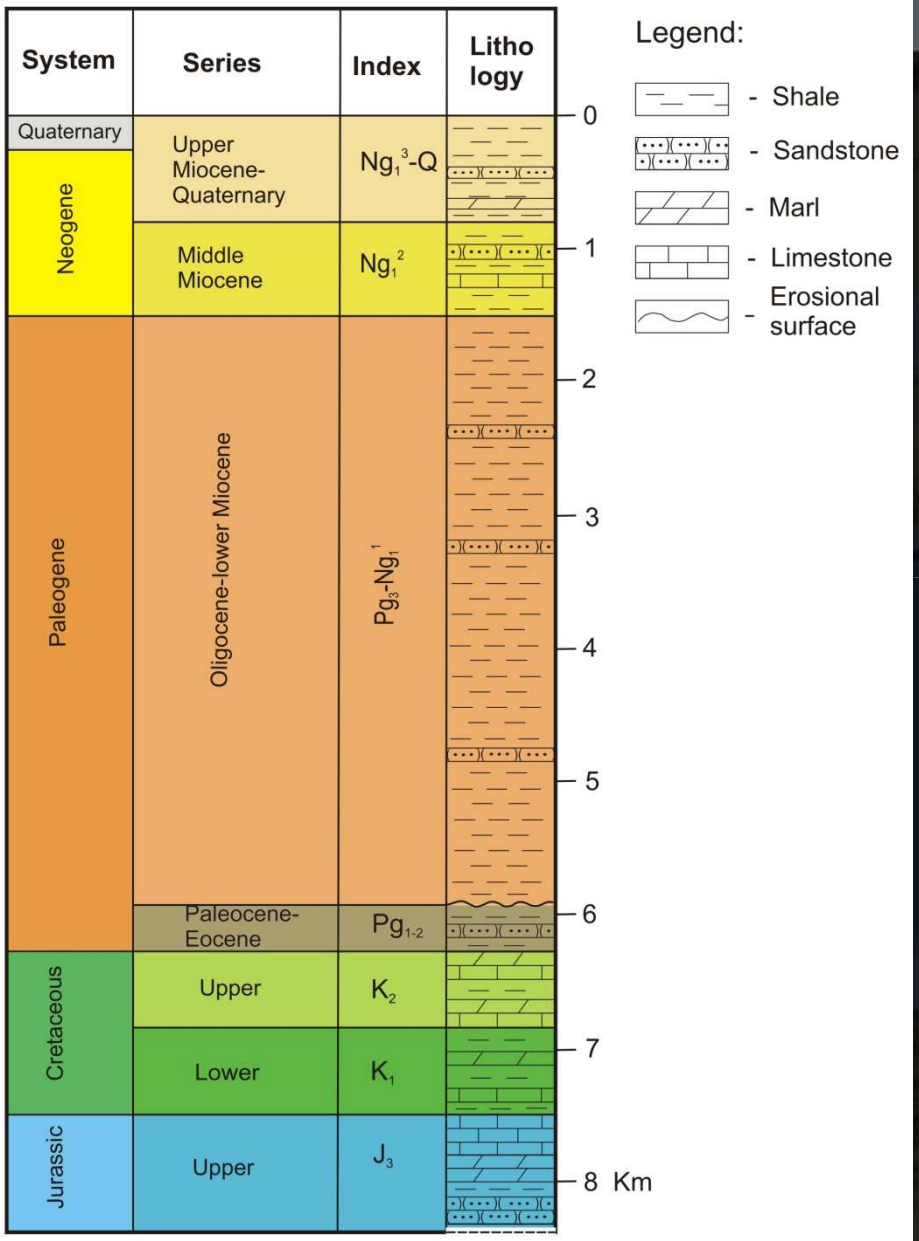


- The main part of Eocene section consists of carbonaceous shale and marl
- One of the important source rocks in this region is the shale of the Kumskaya Formation (Eocene) (Bazhenova et al., 2006)

Interpreted seismic section through Tuapse trough



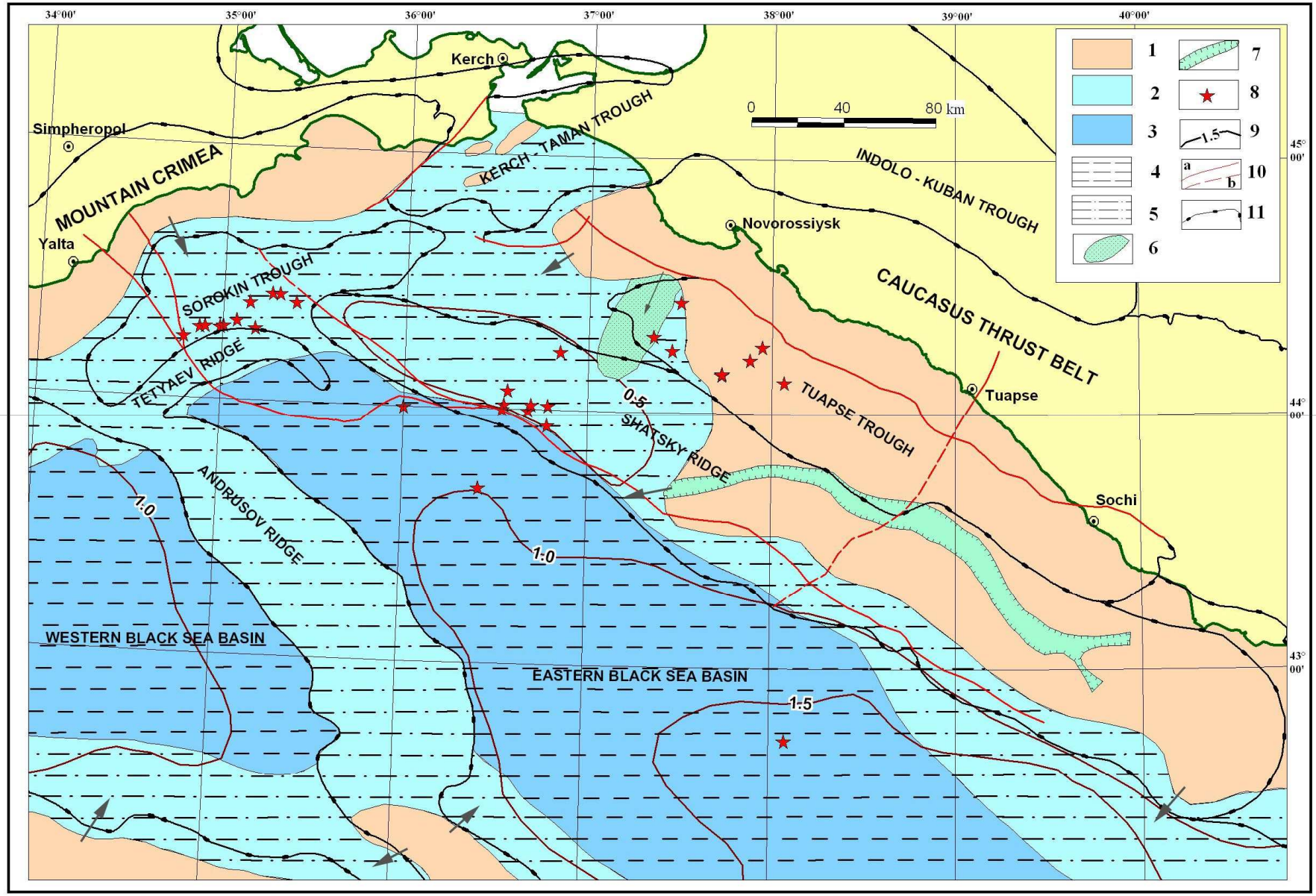
Lithostratigraphic model for Tuapse trough



Maikop Formation:

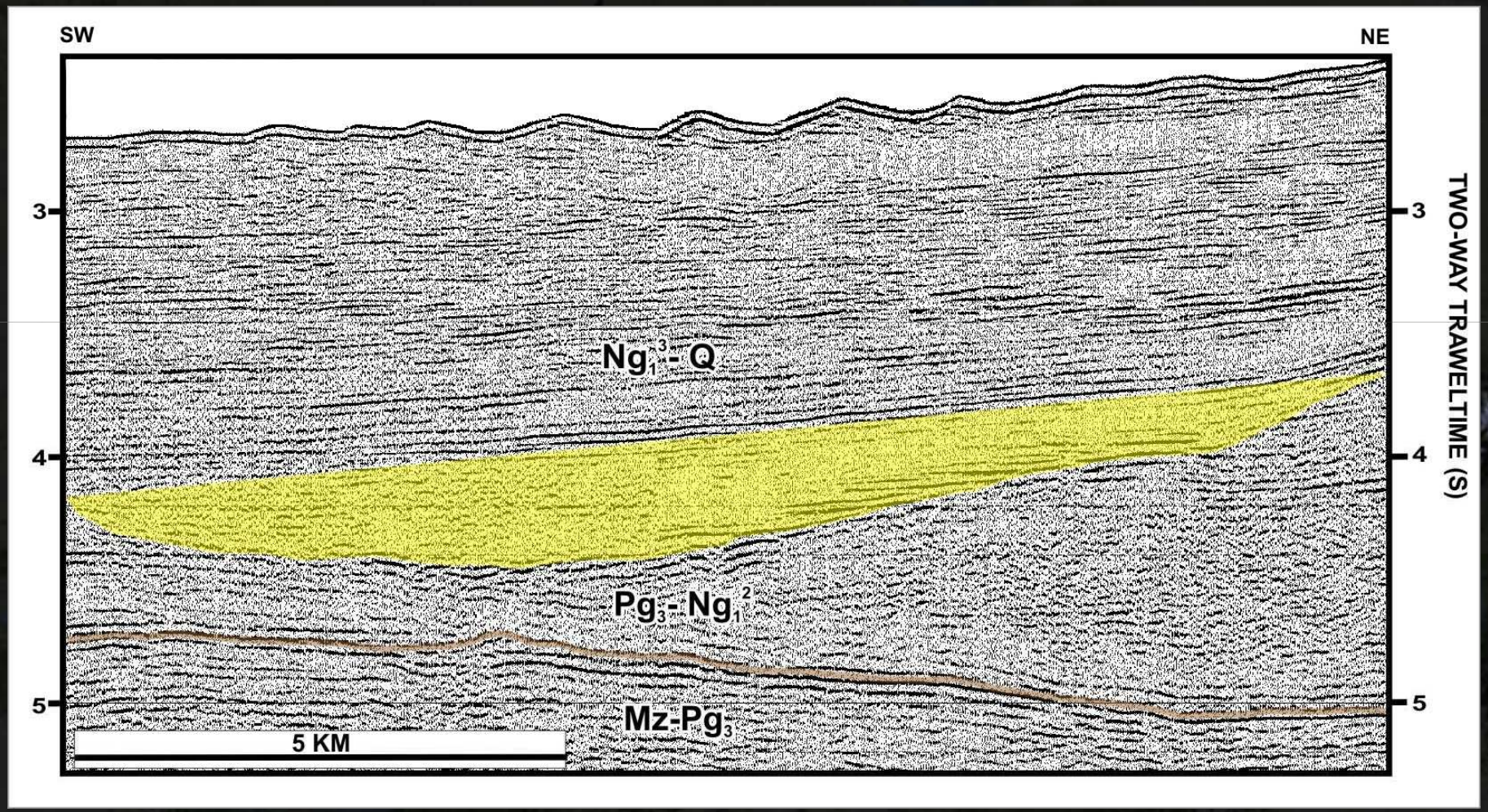
- extends from western coast of the Black Sea to Caspian Sea
- it is deep water complex, which consists mainly of shale
- thickness up to 5 km
- one of the main source rocks

The Eastern Black Sea Region. Scheme of the late Sarmatian (late Miocene) sedimentary environments and sediments

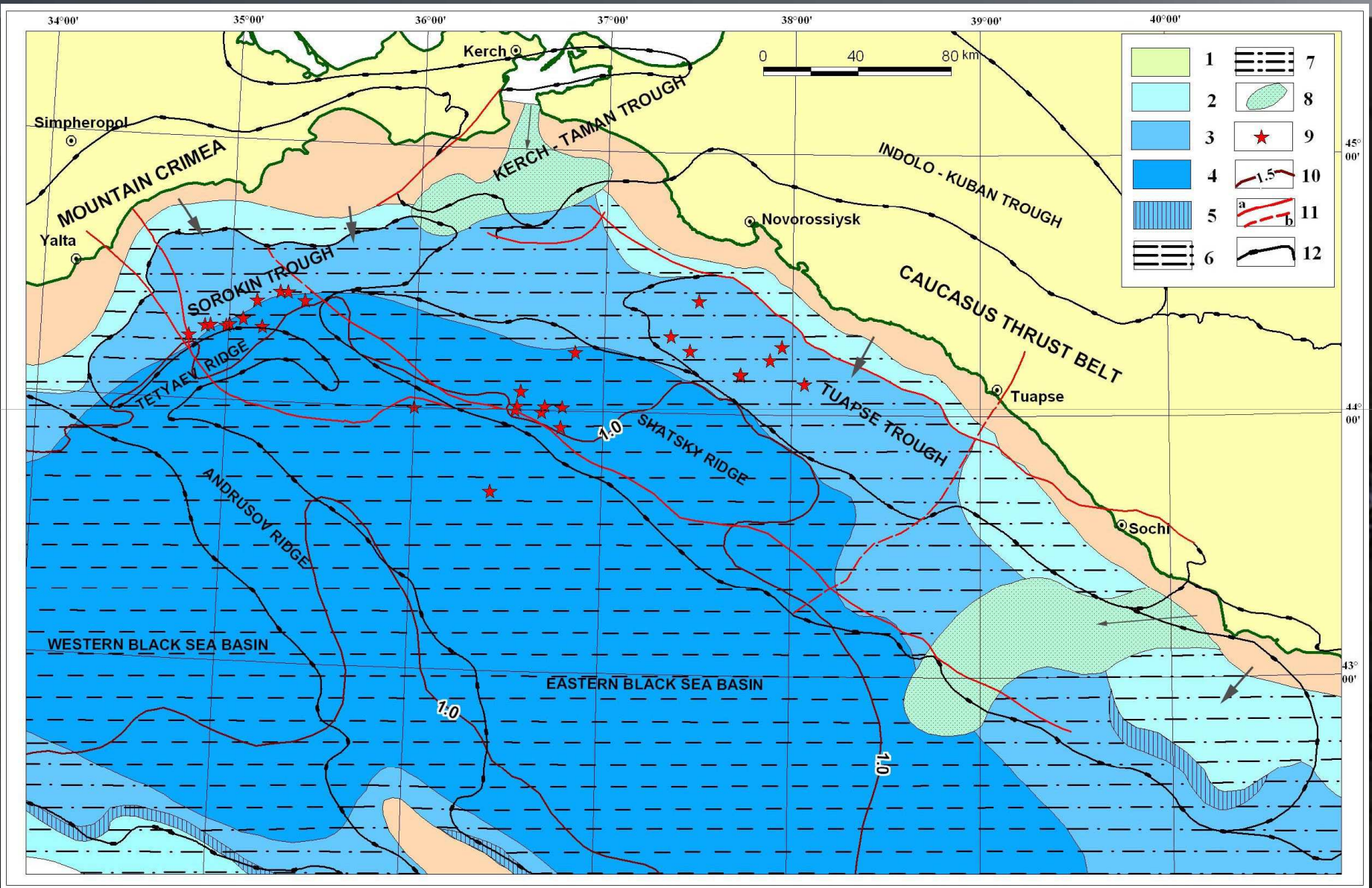


Legend: 1 - Supposed onshore; 2 - Inner shelf; 3 - Outer shelf; 4 - Shales; 5 - Sands and shaly sands; 6 - Fan; 7 - Fluvial incision; 8 - Mud volcanoes 9 - Isopach of middle Eocene - Sarmatian deposits; 10 - Fault; 11 - Structural boundary

Detail of seismic section showing incised river valley



The Eastern Black Sea Region. Scheme of the Ackchagyl (late Pliocene) sedimentary environments and sediments



Legend: 1 - Supposed onshore; 2 - Shelf; 3 - continental slope; 4 - Deep-sea floor; 5 - Zone of erosion of Upper Pliocene deposits; 6 - Shales; 7 - Sands and shaly sands; 8 - Fan; 9 - Mud volcano; 10 - Isopach of Upper Miocene - Pliocene deposits; 11 - Fault; 12 - Structural Boundary

Conclusions:

- During the late Jurassic, shallow water carbonates (including reefs) and lagoonal sediments were deposited. In the Western Caucasus; however, the basin was deeper; this led to the deposition of more shaly facies.
- In the Eocene near the orogenic front of the Western Caucasus, foreland basins formed which have carbonaceous shale and marl fills. Shatsky ridge had a shallow water environment which led to carbonate build ups.
- During the late Oligocene – late Miocene, further development of deep flexural basins at the Greater Caucasus orogenic front is indicated.
- During the late Miocene a large sea-level regression occurred. The Black Sea no longer had a direct connection to the ocean and became increasingly brackish. Orogenic activity in the Greater Caucasus increased.
- During the late Pliocene the Black Sea began a modern developmental stage, characterized by rapid immersion and expansion. Orogenic activity in the Greater Caucasus continued.

Thank you for attention

Contacts:

Alexey Meisner almeis@mail.ru

Cameron Sheya csheya@egi.utah.edu

Michal Nemčok mnemcok@egi.utah.edu