Статья предоставлена авторами на английском языке.
В конце статьи на русском языке - заголовок, аннотация и ключевые слова.

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CRETACEUS PLAY - NEW EXPLORATION POTENTIAL IN THE EASTERN GEORGIA

Georgian oil and gas fields belong to the Black Sea and Caspian Sea hydrocarbon provinces. The geology of Georgia is characterized by two foreland basins: Rioni in the west and Kartli/Upper Kura in the east. They are bounded to the north and south by orogenic belts with complex internal nappes configuration: respectively, the Greater Caucasus and Adzharia-Trialet.

In the Rioni Basin, the source rock is represented by the Malm bituminous shales and carbonates and the traps are either anticlines/faulted anticlines or stratigraphic. Hydrocarbon migration occurred in Neocomian time and during the Oligocene-Miocene.

In the Kura Basin, the most prolific source rocks are Upper Jurassic, Upper Eocene and Oligocene clays. Oil generation by the Oligocene-Lower Miocene Maykop Fm. started in Lower Pliocene.

Some 18 oil and gas accumulations have been discovered in Georgia, including 15 in the Kura Basin, amongst which the 236 (P+P) MMbbl Samgori-Patardzeuli and 58 MMbbl (P+P) Ninotsminda Eocene fields are the best known. The Georgian fields are ageing and exploration of the new Upper Cretaceous carbonate play is seen as a means to stop the rapid decline of the country reserves.

Successful analogues are known on the northern side of the Caucasus and two operators, CanArgo and Frontera, started investing in both wildcats and seismic acquisition to further define this play on the southern side of the Caucasus. The first well, Manavi 11, successfully demonstrated the validity of the concept when it flowed good quality oil and gas. The Manavi structure is currently (2006) y being appraised, while more prospect locations are being prepared with modern seismic coverage and are awaiting investors to participate in drilling activity.

The new Cretaceous play could give new perspectives for the future exploration activity in the Eastern Georgia.

Key words: *Petroleum geology, tectonics, play, Mesozoic, Cenozoic, Rioni Basin, Kura Basin, Terek-Caspian Basin, Greater Caucasus.*

Georgian oil and gas fields belong to the Black Sea and Caspian Sea hydrocarbon provinces.

The main geotectonic units of Georgian territory are crustal fragments of the first-order Eurasian and Afro-Arabian lithospheric plates, produced during the genesis of the Alpine-Carpathian-Himalayan orogenic belt (fig. 1, 2). At surface, the allochtonous fold-and-thrust belts of the Greater Caucasus and the Achara-Trialet controlling the geology of Georgia are tectonically superimposed on their folded foredeep and onto the Scythtian platform [Adamia et al., 1992].

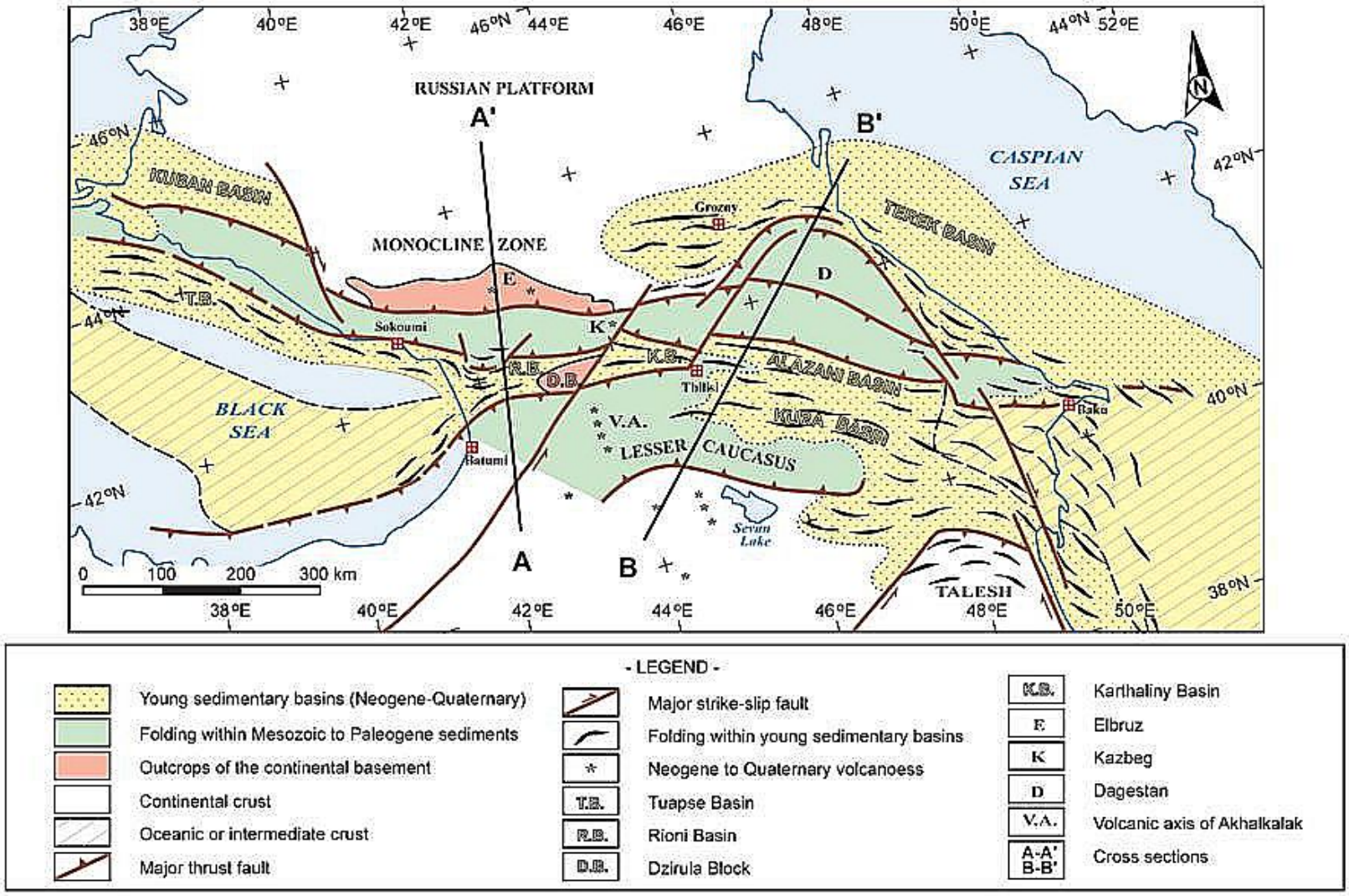

Fig. 1. Simplified structural map of Caucasus

Increasing intensity of deformation along the southern slope of the Great Caucasus and around Kura and Rioni basin. The developing of the Dagestan thrust-related area to the north suggests the presence of a differential isostatic uplift related structure. Modified, after Philip H et al. (1989)

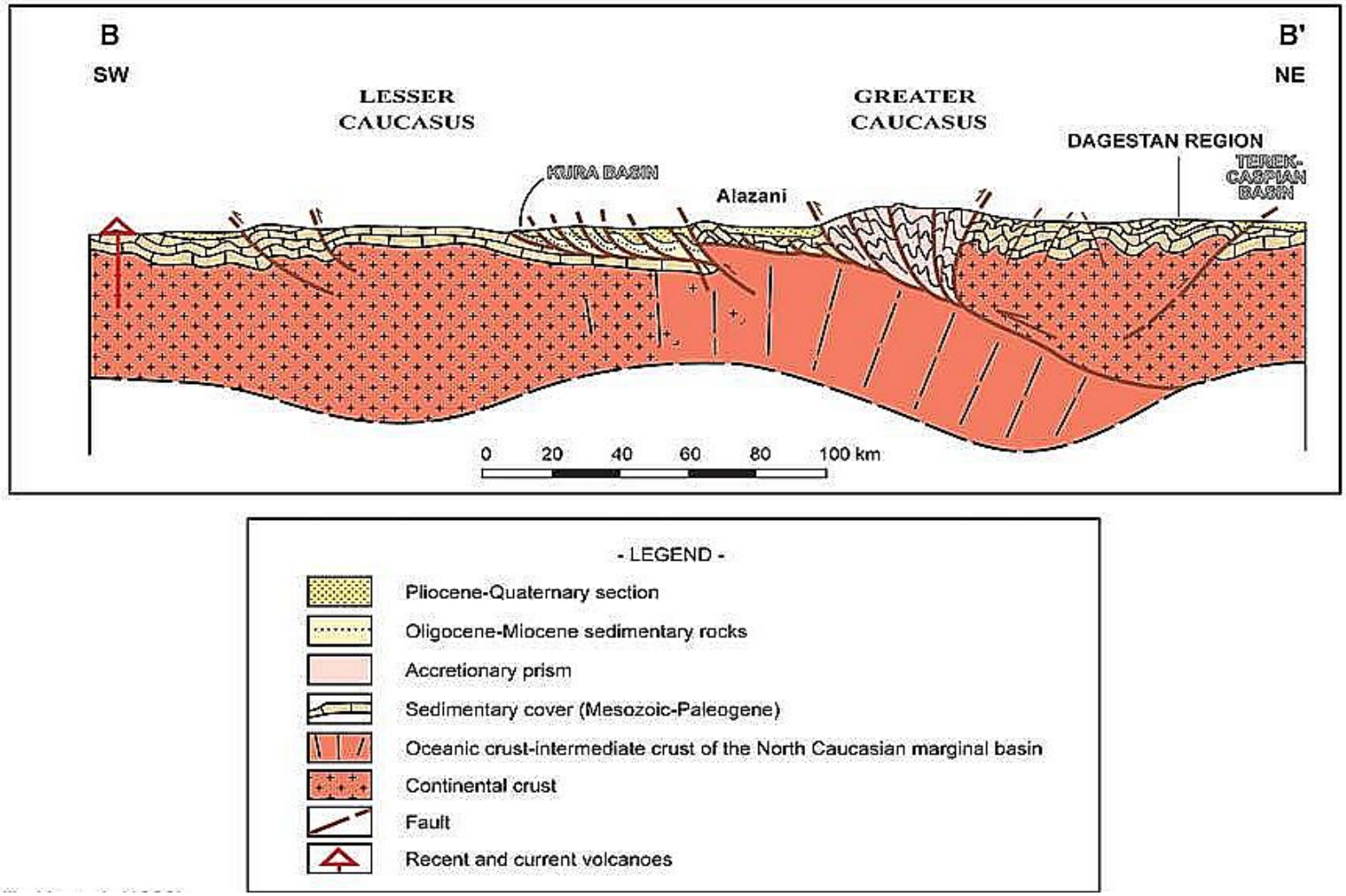

Fig. 2. Regional geological section East Caucasus

Alpine continental collision : thrusting forms an «accretion prism» below the Kura basin , deformation affects both flanks of the Great Caucasus (fan-like structure) , the horizontal NE-SW offset is about 90 km .The main thrusting area corresponding to a thick Paleogene-Quaternary section is moderately folded and thrust to the south. Modified, after Philip H. et al. (1989).

The petroleum geology of Georgia is marked by two foreland, flexural, intramontane basins: Rioni in the west and Kartly/Upper Kura in the east (fig. 3), separated by the Dziruli Massif (premolasse uplift consisting of acid intrusive rocks and metamorphite covered by Upper Triassic-Cretaceous sequences). These foreland basins are bounded to the north and south by orogenic belts with complex internal nappes configuration: respectively, the Greater Caucasus and/or Adzharia-Trialet [Philip et al., 1989, Banks et al., 1997].

The Rioni Basin is a single-sided, molassic basin related to the northern Adzharia-Trialet thrust belt loading onto the foreland. Sedimentation started early Jurassic with maximum subsidence taking place in the Miocene/Pliocene.

Volcanics, vulcaniclastics and carbonates were deposited in the Dogger and Lower Cretaceous; relative thin volcanics and volcanoclastics sequences in Malm and Upper Cretaceous (together with carbonate) and molasses in Oligocene-Upper Pliocene included.

The main reservoirs units of the Rioni Basin are the Upper Miocene molasses. The source rock is represented by the Malm bituminous shales and carbonates. The most important seal are pelites of Upper Miocene age.

The traps are either anticlines, faulted anticlines or stratigraphic (facies changes) traps. Considerable hydrocarbons migration is supposed to have occurred in Neocomian time and during the Oligocene-Miocene.

The Kura Basin extending in central Georgia is an elongate NNW-ESE trending intermontane basin between the Greater Caucasus to the north and the Lesser Caucasus to the south. The basin occupies 85,000 sq. km in Georgia and Azerbaijan and 10,000 sq. km offshore in the Azeri sector of the Caspian.

This triangular basin ,subdivided into Upper (Kartli basin), Middle and Lower Kura (both in Azerbaijan) is coincident with the Kura river valley. The Georgian part of the Kura Basin is represented by Kartli Basin in the west, the Gare-Kakheti (GK) trough in the southeast and the Alzani trough in the northeast. Structurally the Kartli/Upper Kura Basin (build of basement-cored Palozoic granitoids and Carboniferous limestone unconformably covered by Jurassic-Quaternary sequences) is similar to the Rioni Basin with a few differences: it is a double-sided foreland molassic basin induced by thrust-loading of a complex pattern of nappes belonging to Greater Caucasus and the Adzharia-Trialet orogenic belts.

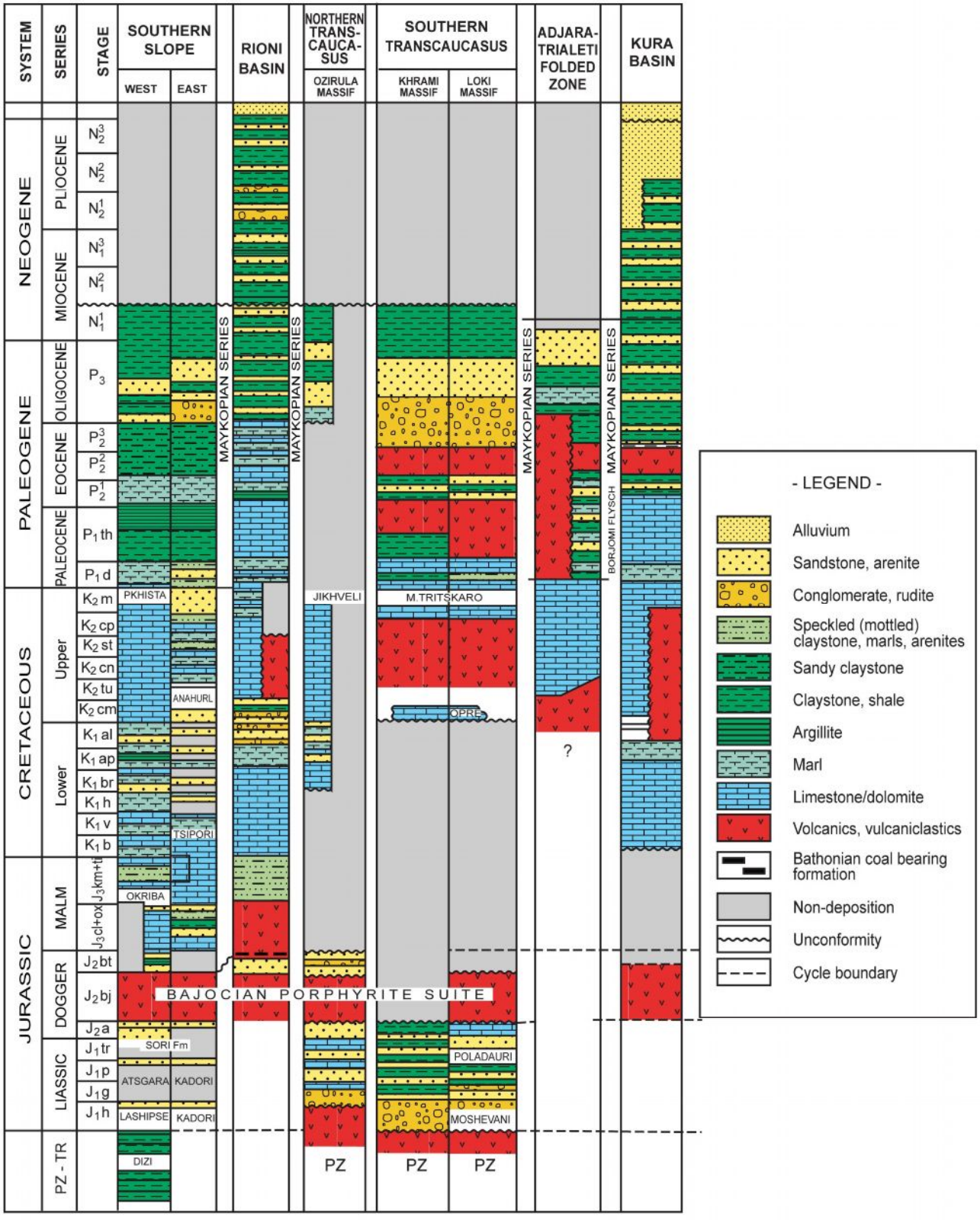

Fig. 3. Stratigraphic column. Mesozoic and Cenozoic of the Caucasian Region (Georgia)

Lithostratigraphic differences between Kura and Rioni basins are especially markedly within the Malm-Upper Cretaceous sequences. Modified, after Admia S. et al. (1992)

The northern margin of the Kartli basin is tectonically covered by the Greater Caucasus Cretaceous-Paleogene flysch nappes. This tectonic wedge detached klippes in the uppermost molasses section belonging to Kura basin and displaced them tectonically southwards upon the plastic Maykop pelite. The dominant structural overprint of this basin is a strike-slip regional pattern (fig. 4, 5).

The tectonic history of the Kartli basin is closely associated with the tectonic evolution of the whole Caucasus and especially the Transcaucasus [Gamkrelidze, 1986].

The architecture of this basin suggests polyphasic tectonic evolution and mountain building during the Liassic – Upper Eocene times when this area acted initially as a foreland unit strongly involved in the Greater Caucasus and Achara – Trialet nappe stacking [Gamkrelidze, 1991; Rebai et al., 1993].

The main “Early Alpine” compression event, the closing of the Tethys ocean ,occurred about 20 Ma ago .Subduction of the Tethys ocean progressed, the old marginal sea basin was rapidly shortened and it was first closed at the northern border of the Lesser Caucasus (Middle Pliocene, about 3.0 Ma). Then began the stage of continental collision. Oceanic crust remained on both sides of the collision zone - Black Sea and Southern Caspian Basin [Philip et al., 1989].

Oblique plate collision of irregularly shaped plates was followed by strike-slip movement which dominated the structural aspects of the basin.

Thus, the dominant structural overprint of the basin is strike-slip regional pattern where “en echelon” faults; thrust fault, normal and reverse faults commonly coexist.

The vergence direction of the faults are widely scattered or apparently random.

The depositional history of the Kartli/Upper Kura basin is very similar to the Rioni Basin exept the strong presence of volcanics and volcanoclastics in Upper Cretaceous and Middle Eocene and the fact that in the Rioni basin the Upper Miocene-Quaternary section displays many unconformities.

The major reservoirs are (atypical) Upper Cretaceous psammite, carbonate and vulcanoclastic rocks, Middle Eocene zeolitic tuffs and volcanoclastic arenire and rudite (volcanogenic-sedimentary complex), Upper Eocene psammite and Miocene-Pliocene arenite. The middle Eocene is dominated by interbedded volcanoclastic arenites and siltite with subordinate submarine volcanic rocks - andesitic flows and boulder beds [Robinson et al., 1997].

The main trap types are anticline, faulted anticline, thrust cut anticline and anticline with pinch-outs and lateral facies change.

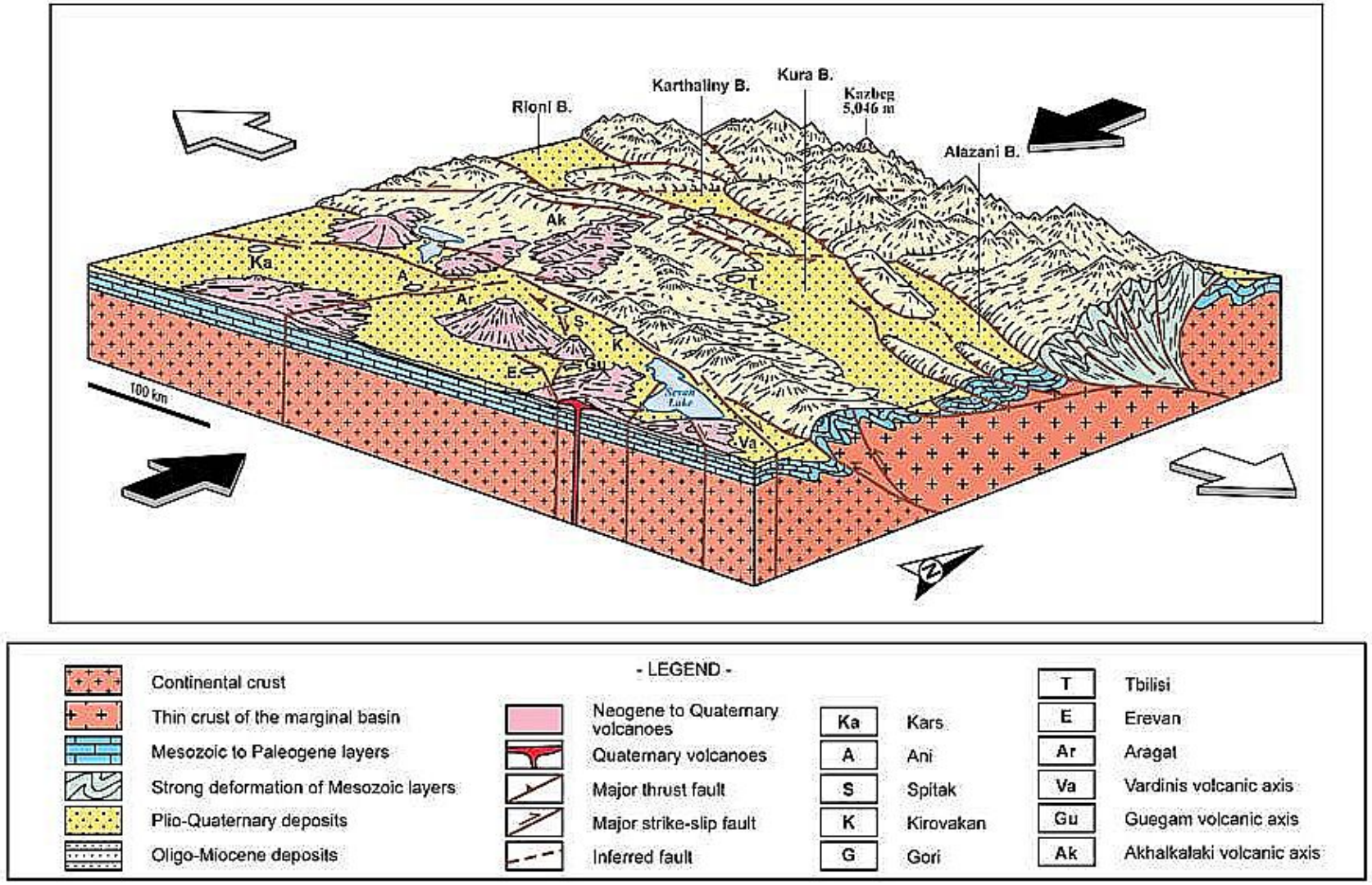

Fig.4. Structural diagram of the Great and Lesser Caucasus

Mesozoic and Cenozoic margin of the Kura basin has been strongly deformed and deplased over a weak basal «decollement» level (Maykop Formation ,Oligocene-Lower Miocene pelite) by the Great Caucasus tectonic wedge (Cretaceous-Paleogene flysch nappes). Modified, after Rebai et al. (1993).

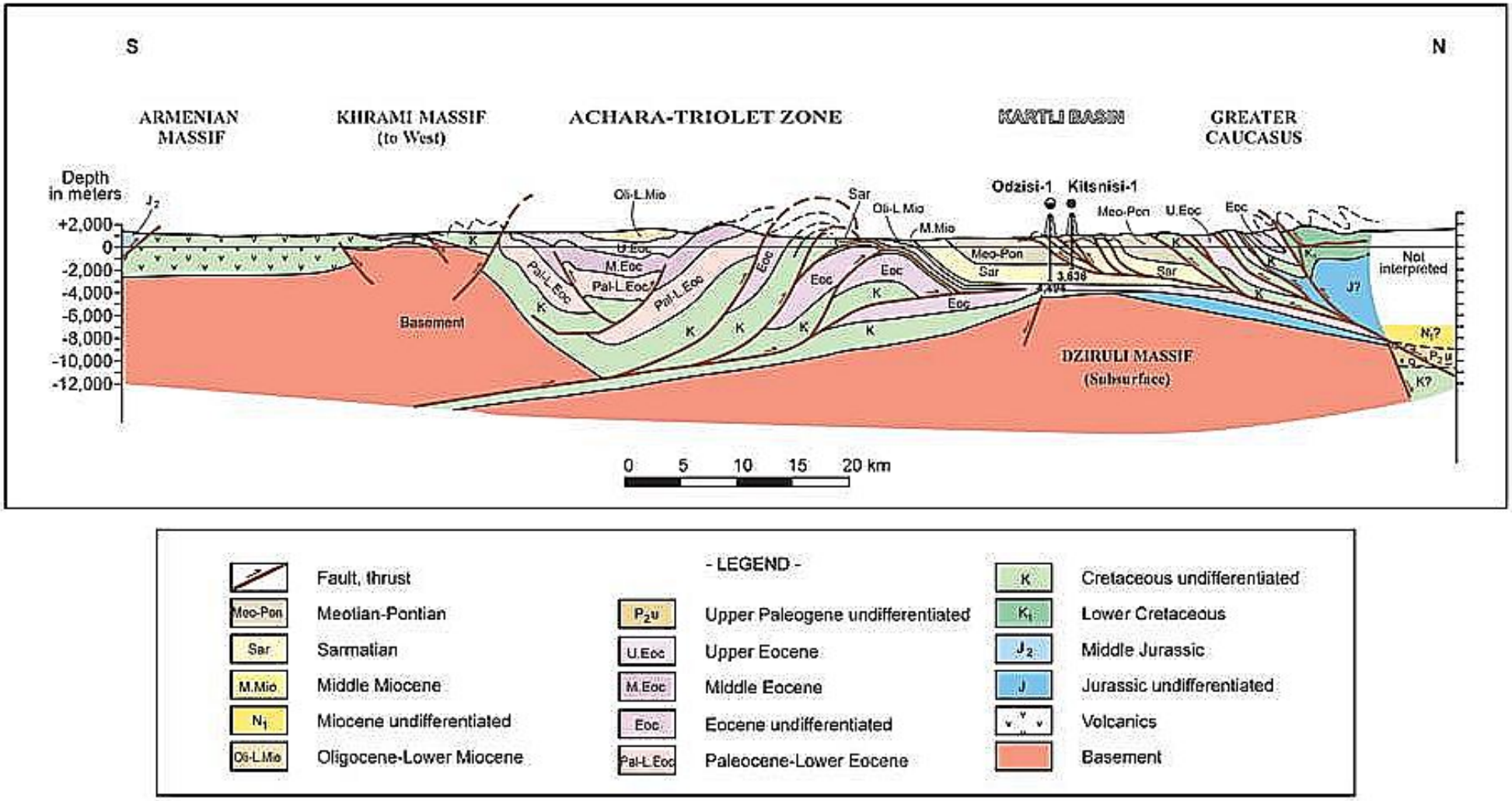

Fig. 5. Geological cross section through the Acgara-Trialet Belt and central Kartli basin

Sarmatian-Pontian foreland section has been deformed in Pliocene by the frontal zone of the Great Caucasus. Deep stratigraphic wells penetrated as deep as Upper Cretaceous. Modified, after Banks C.J. et al. (1997).

The most prolific source rocks are the Malm, Upper Eocene and Oligocene- Lower Miocene pelitic rocks. The oil generation by Oligocene-Lower Miocene source (Maykop Formation) is believed to have started in Lower Pliocene.

The Oligocene-Quaternary Apsheronian Molasse sequences of both intramontane basins (Rioni and Kura) overlay unconformable terrains with a specific Jurassic-Lower Paleogene sedimentary section - diverse structural units related to the Alpine collision event.

In the Tbilisi-Ninotsminda area (junction area Kartli-Gare-Kakheti) the molasse section belonging to Kura basin overlays very thick Cretaceous-Paleogene folded sequences of the eastern termination of the Adjara-Trialet tectonic unit.

The foreland basins and the frontal areas of both orogenic belts like in several Alpine-Carpathian – Himalayan segments contain hydrocarbons and consequently were and are target for continuing exploration activity.

A total of 18 oil and gas accumulations have been discovered in Georgia, including 15 in the Kura Basin, amongst which the 236 MMbbl (P+P) Samgori-Patardzeuli and 58 MMbbl (P+P) Ninotsminda Eocene fields are the best known. The Georgian fields are ageing, however, the main foreign operator, CanArgo, has tackled the production decline issue with an aggressive horizontal plan at Ninotsminda using underbalanced coiled tubing drilling (UBCTD). This project, despite operational setbacks, is anticipated to rapidly achieve a seven-fold increase of the Georgian production from 1,500 bo/d to 10,000 bo/d.

Although there is no field producing from Cretaceous reservoirs in Georgia, the foreign operators have started assessing this play. The primary Upper Cretaceous target consists mainly of fractured chalks and chalky limestones. Analogous to the Rioni folded foothill structures are the structures on the northern side of the Greater Caucasus. Despite the distance between the two regions and the Caucasus orogeny, it is believed that analogues of the North Caucasus can be used to estimate an equivalent play on the southern side of the mountain belt. In the North Caucasus, oil fields such as Karabulak-Achalukskoye, and Malgobek-Voznesensko-Alkhasovo (fig. 6), typically produce from Upper Cretaceous Carbonates at rates ranging between 3,000 and 15,000 bo/d, and recovery factors of up to 50 % have been reported. In 2003, on the Georgian side of the Caucasus, CanArgo tested good quality oil and gas in Manavi 11 exploration well, located 10 km east of the Ninotsminda oil and gas field. However, rates in this well could not be measured due to mechanical collapse of the production tubing. The Manavi structure, a 21x6 km anticlinal structure has expected oil reserves exceeding 50 MMbbl. At time of writing, exploration of this high potential structure was ongoing with a second exploration well, Manavi 12. Testing of the discovery well was

postponed because of the small hole size. Prior to drilling Manavi, encouragement was met elsewhere in Georgia, e.g. in Rustavi Zapadnaya 16, fractured Cretaceous volcanics flowed water with gas at over 3,000 b/d.

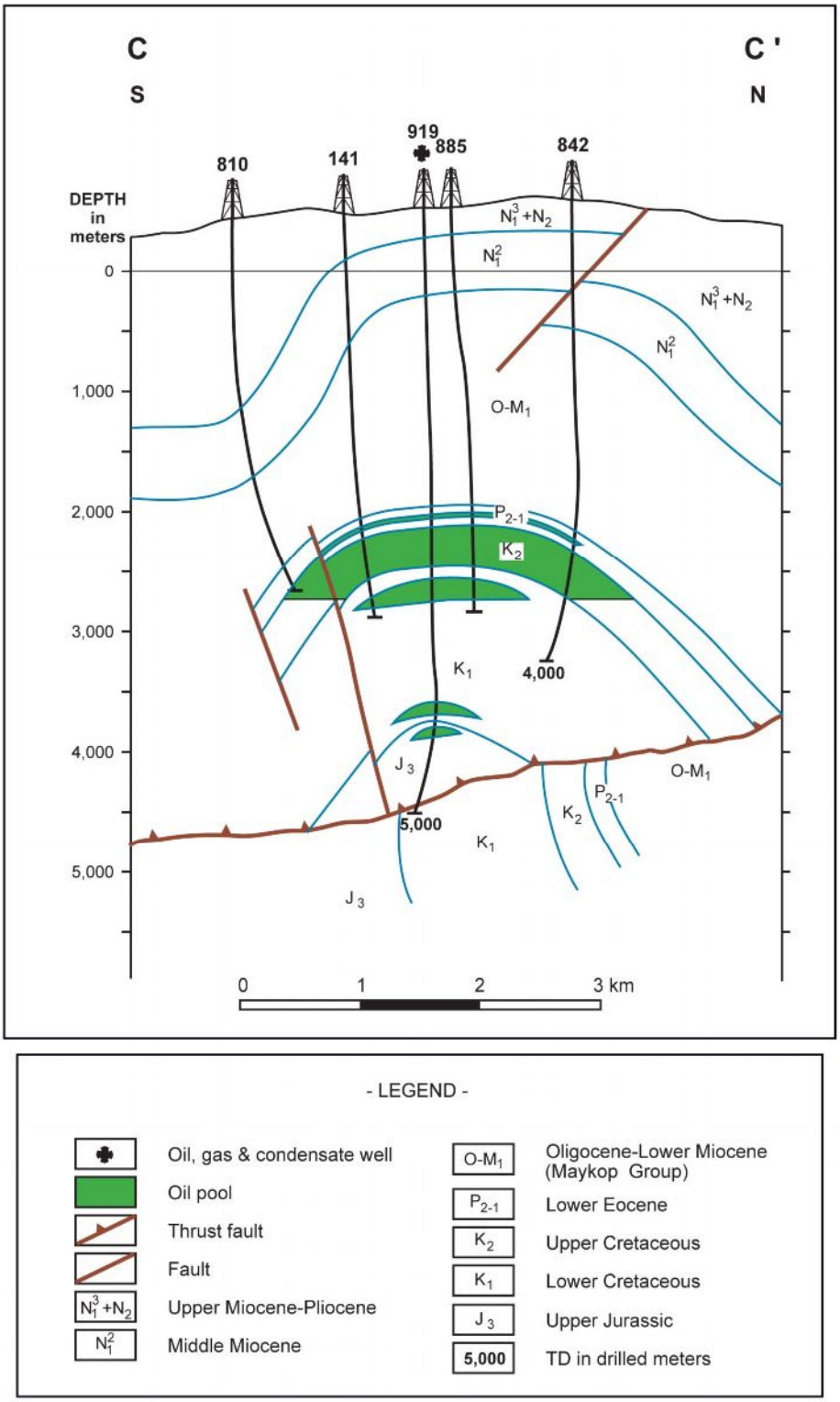

Fig. 6. Cross-section through Malgobek-Vosnesensko-Ali-Yurt-Alkhasovo-Gorskoye field
Thrust-related fold with important Pliocene faulting in over-thrust block. Oil pools are located in the same block. Modified, after Ingushneftegazprom (1978).

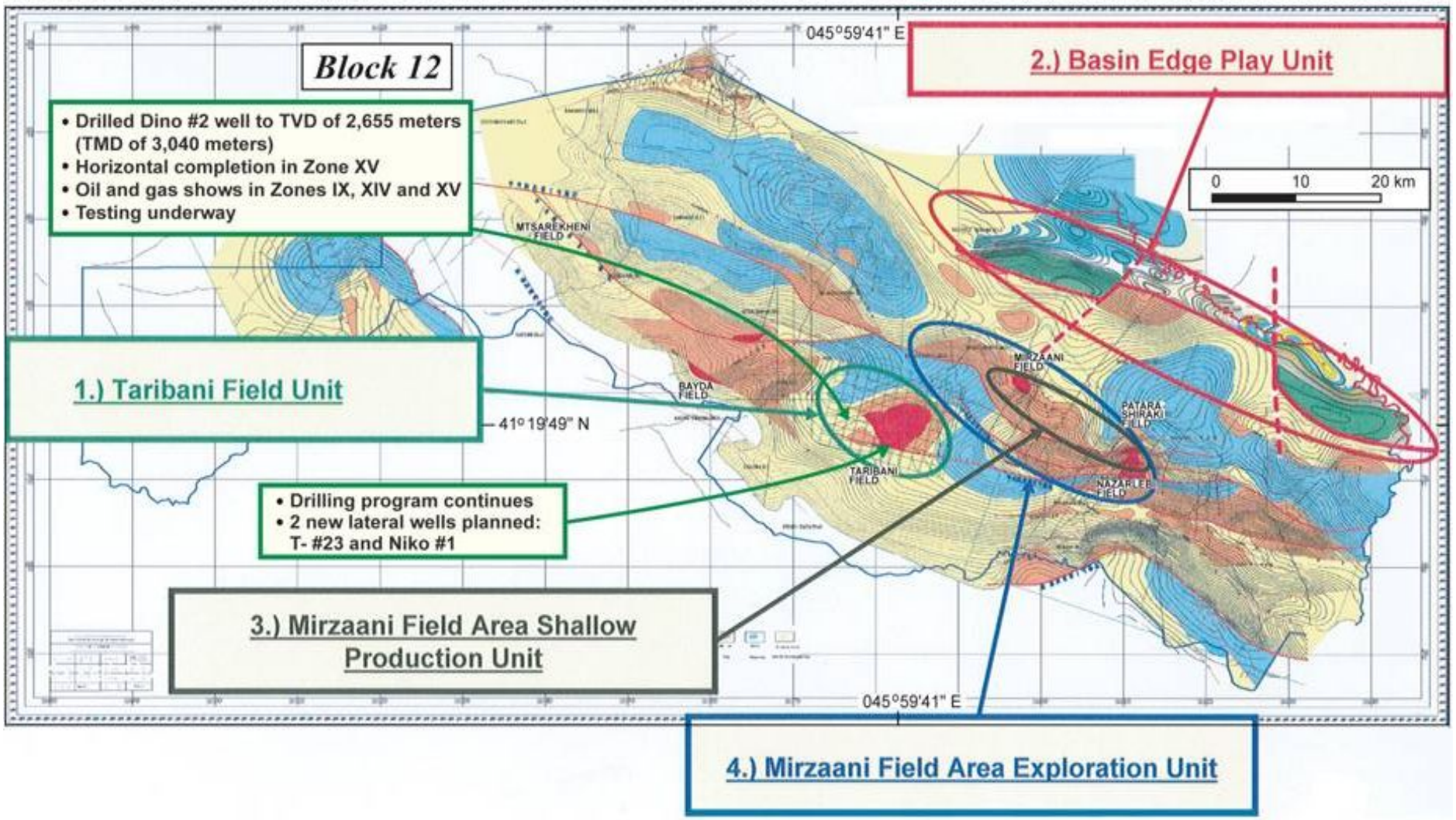

Fig. 7. Structural contour depth map. Top Sarmatian, Mtsarekhevi-Nazarlebi Area

Location of the «Basin Edge Play Unit» and spatial distribution of the «old» fields belonging to Frontera Block 12. Modified, after Frontera (2005).

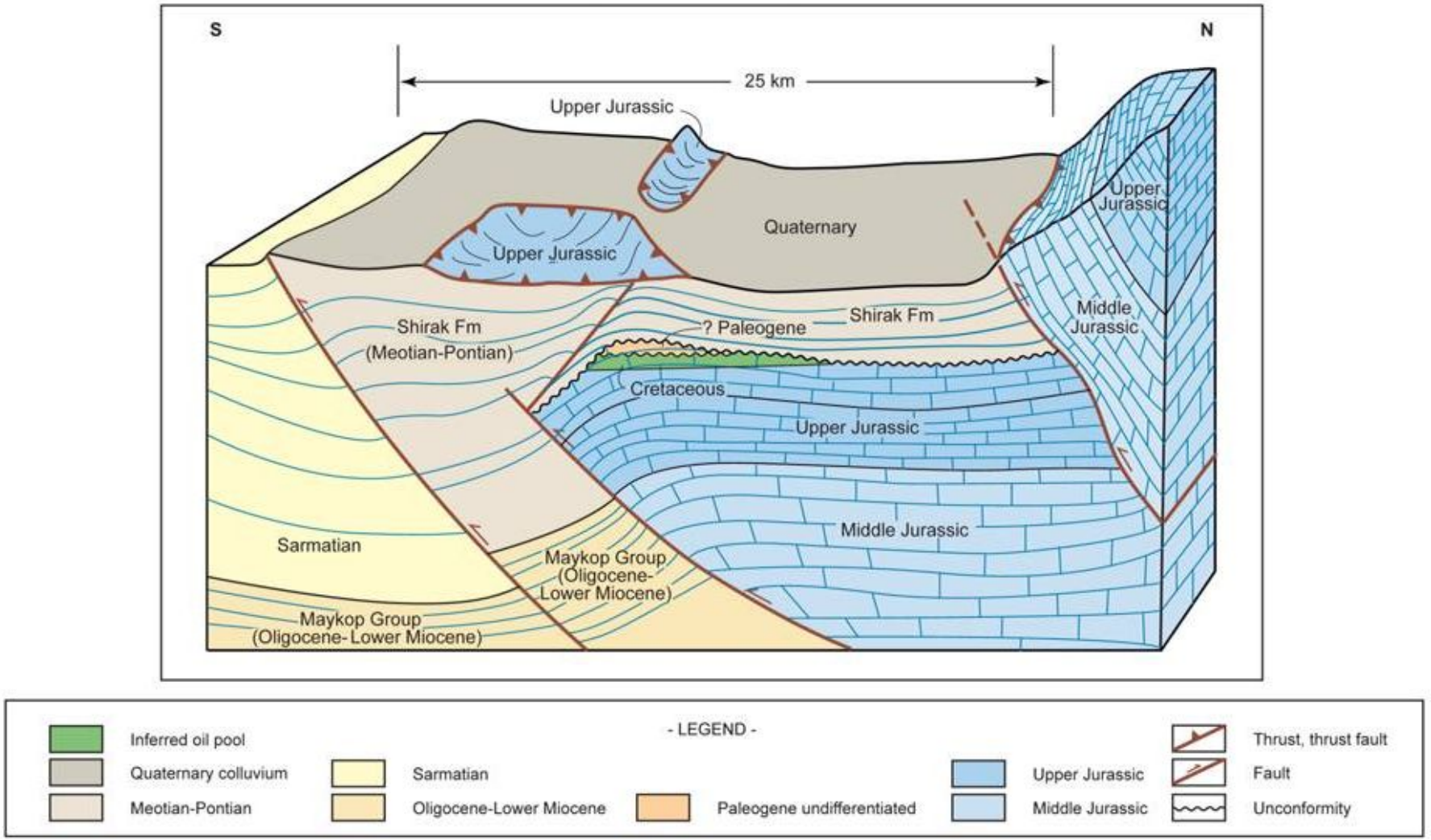

Fig. 8. Regional geological section. Structural cross section Kura Prospect

Cross-section displaying the general structure in the Frontera's «Kura Prospect» area and inferred geometry and location of Cretaceous oil pool. Modified, after Frontera (2005).

In Q1 2006, Frontera Resources started to acquire an 80 sq km 3D seismic programme over the Cretaceous carbonates in its 100 % owned Block XII (fig. 7), in eastern Georgia. The operator refers to this Cretaceous play as 'the Basin Edge Play'. Acquisition of the new 3D survey started immediately after completing the acquisition of over 300 km of 2D seismic data on two prospects of this play (fig. 8), CanArgo's results at Manavi did certainly have a positive impact on the way forward decided by the operator of Block XII, which is seeking a partner to tackle this ambitious. A new wave of exploration activity is taking shape in Georgia, a country which could do with a little help from nature.

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МЕЛОВОЙ КОМПЛЕКС - НОВЫЙ НЕФТЕГАЗОНОСНЫЙ ПОТЕНЦИАЛ ВОСТОЧНОЙ ГРУЗИИ

Сравнительный анализ условий нефтегазоносности на Северном Кавказе и в Картли–Верхнекуринском бассейне позволил с большей вероятностью прогнозировать наличие нефтегазоносности в карбонатном комплексе Картли–Верхнекуринского бассейна.

Выявленные нефтяные и газовые месторождения Грузии расположены в двух межгорных осадочных бассейнах – Рионе и Картли–Верхнекуринском на западе страны. Эти бассейны, соответственно, являются частями Черноморской и Каспийской нефтегазоносных провинций. Горные системы Большого Кавказа и Аджар-Триалета, осложненные многочисленными надвигами, являются северной и южной границами бассейнов.

Нефтематеринские породы бассейна Рионе представлены верхнеюрскими битуминозными глинами и карбонатами. Главные стадии миграции углеводородов осуществились в течении неокома и олигоцен-миоцена. Ловушки представлены антиклиналями, осложнёнными тектоническими нарушениями, а также резервуарами с литологическими и стратиграфическими экранами.

Нефтематеринские породы Картли-Верхнекуринского бассейна представлены верхнеюрскими, верхнеэоценовыми и олигоценовыми глинами. Главная стадия генерации нефти в майкопской свите (олигоцен – нижний миоцен) началась в раннем плиоцене.

В Грузии открыто восемнадцать нефтяных и газовых месторождений, включая пятнадцать месторождений в Картли–Верхнекуринском бассейне. Наиболее крупными из них являются Самгори–Патарзеули с начальными извлекаемыми запасами, оценёнными в 236 млн. барр. и Ниноцминда с запасами, оценёнными в 58 млн. барр.

В ввиду высокой выработанности месторождений поиск залежей в слабоизученном верхнемеловом карбонатном комплексе может остановить быстрое сокращение выявленных запасов углеводородов в Грузии. Именно этот комплекс содержит большое количество залежей к северу от Кавказа.

Компании CanArgo и Frontera, работающие в Грузии, начали бурение поисковых скважин и сейсмические исследования с целью уточнения перспектив верхнемеловых резервуаров. Получение притока высококачественной нефти и газа из первой поисковой скважины Манави 1 успешно подтвердило высокий потенциал этих отложений. Одновременно с оценкой Манави, компании проводят картирование новых поисковых объектов с использованием современных сейсмических технологий (2006 г.) и приглашают инвесторов для участия в бурении скважин.

Ключевые слова: *нефтяная геология, тектоника, нефтегазоносный бассейн Рионе, нефтегазоносный бассейн Куры, Терек-Каспийский бассейн, мезозой, кайнозой, Большой Кавказ.*

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