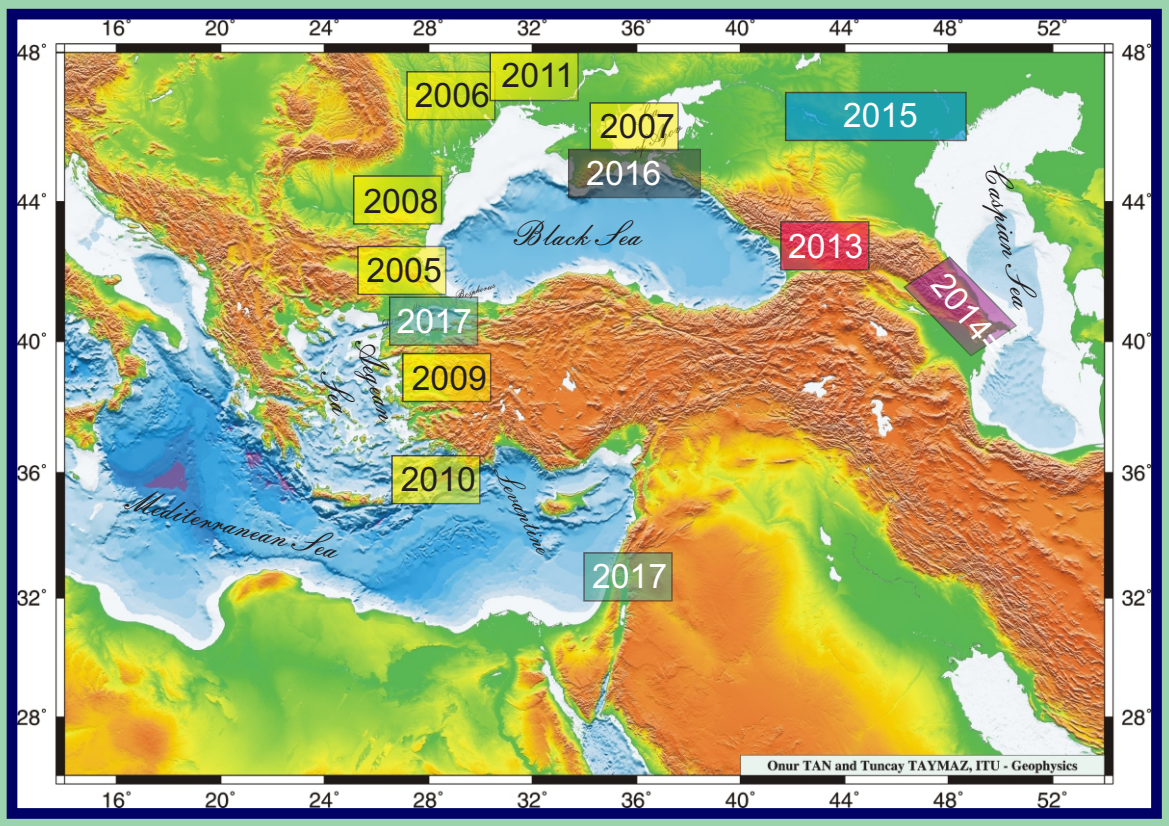
Georgian National Academy of Sciences, Department of Earth Sciences, Tbilisi, Georgia

2-9 October 2016

INTERNATIONAL GEOSCIENCE PROGRAMME



Field Trip Guide of the Fourth Plenary Conference

IGCP 610 "From the Caspian to Mediterranean: Environmental Change and Human Response during the Quaternary" (2013 - 2017)

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IGCP 610 Fourth Plenary Conference and Field Trip, Tbilisi, Georgia, 2-9 October 2016

FIELD TRIP GUIDE

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FIELD TRIP GUIDE

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PART I. GENERAL

OUTLINE OF REGIONAL GEOLOGY

The territory of Georgia is a component of the Caucasian segment of the Mediterranean (Alpine-Himalayan) collisional orogenic belt (Fig. 1).

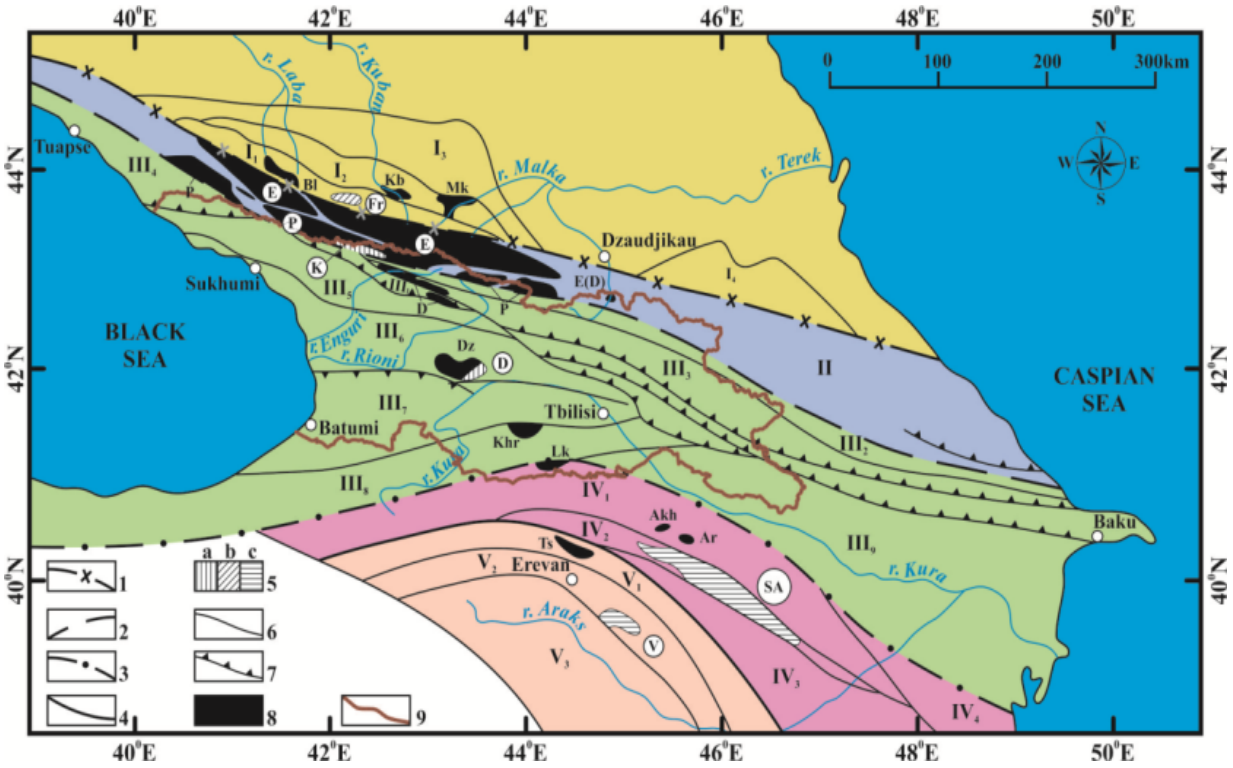

Figure 1. Tectonic subdivision of the Caucasus on the basis of terrane analysis and exposures of the pre-Alpine crystalline basement (Gamkrelidze, 1997a; Gamkrelidze and Shengelia, 2005). Key: I = Part of Scythian platform involved in Neogene time into rising of the Greater Caucasus); I_1 = Forerange zone, I_2 = Laba-Malka (Bechasin) zone, I_3 = zone of North Cauasian monocline, I_4 = Daghestan Limestone zone. Accretionary terranes and subterranes: II = Greater Caucasian terrane; III = Black Sea-Central Transcaucasian terrane. Subterranes: III_1 = Chkalta-Laila, III_2 = Kazbegi-Tphan, III_3 = Mestia-Dibrar, III_4 = Novorosiisk-Lasarevskoe, III_5 = Gagra-Java, III_6 = Dzirula (Georgian Block), III_7 = Adjara-Trialeti, III_8 = Artvin-Bolnisi, III_9 = Middle and Lower Kura; IV = Baiburt-Sevanian terrane. Subterranes: IV_1 = Somkhito-Karabakh, IV_2 = Sevan-Akera, IV_3 = Kafan, IV_4 = Talysh; V = Iran-Afghanian terrane. Subterranes: V_1 = Miskhan-Zangezur, V_2 = Erevan-Ordubad, V_3 = Araks. 1 = borders of terranes-ophiolite sutures (here and there presumable) marking the location of small and large oceanic basins: 1 = of Early?-Middle Paleozoic age, 2 = of Neoproterozoic-Paleozoic age, 3 = of Neoproterozoic-Early Mesozoic age, 4 = of Mesozoic age; 5 = ophiolite terranes (obducted plates): 5_a = of Neoproterozoic-Paleozoic age 5_b = of Paleozoic age, 5_c = of Mesozoic age; 6 = borders of subterranes (deep faults or regional thrusts); 7 = detached cover nappes of Alpine age; 8 = exposures of pre-Alpine crystalline basement: GC = Greater Caucasian, D = Dizi series of the southern slope of the Greater Caucasus, Dz = Dzirula, Khr = Khrami, Lk = Loki, Akh = Akhum, Ar = Asrikchai, Ts = Tsakhkunyats; 9 = boundary of the territory of Georgia.

STRATIGRAPHY AND ROCK TYPES OF THE DIFFERENT TECTONIC UNITS OF GEORGIA

So long as the degree of metamorphism, lithological character of the sedimentary rocks, and composition of submarine volcanites are quite different within the different tectonic zones of Georgia, the stratigraphic units are considered to be within separate tectonic zones (Gamkrelidze, 1997b; Gudjabidze, 2003).

The pre-Alpine metamorphic complexes outcrop within the Greater Caucasus (Main Range and southern slope zones), in the Black Sea Central Transcaucasian terrane (Dzirula and Khrami massifs), and within the Baiburt-Sevanian terrane (Loki massif) (Fig. 1).

The oldest (Precambrian and Lower-Middle Paleozoic) rocks are exposed in all the tectonic units (Fig. 1). They are represented by gneisses, migmatites, crystalline schists, and amphibolites within the Main Range zone of the fold system of the Greater Caucasus, the Georgian Block (in the so-called Dzirula Massif), and the fold system of the Lesser Caucasus (in the so-called Khrami and Loki massifs) (Gamkrelidze and Shengelia, 2005). Paleozoic rocks are exposed in the central part of the southern slope of the Greater Caucasus as well. They are represented mainly by black shales, phthanites (cherts), sandstones, turbidites, olistostromes, lenses of marbles and calc-alkaline andesite-dacitic volcanoclastics. Their visible thickness reaches 2000 m. This is the so-called Dizi Series, in which faunally (by corals, foraminifera, and conodonts) the Devonian, Carboniferous, and Permian are established. Comparatively weakly metamorphosed Paleozoic sediments are exposed in the Dzirula Massif as well. These are the allochthonous plates of the so-called 'phyllitic suite', which are in contact with Upper-Paleozoic granitoids and Paleozoic and Precambrian gabbro-amphibolites and serpentinites. The latter are meta-ophiolites (Gamkrelidze et al., 1981). Precambrian and Paleozoic meta-ophiolites within the crystalline core of the Greater Caucasus and in Somkhito-Karabakh zone (in the Loki massif) are present as well.

The Upper Paleozoic rocks are also developed in all tectonic units. In the Main Range zone, crystalline rocks are overlain by weakly metamorphosed sandstones, conglomerates, and argillites, which contain Upper Carboniferous-Lower Permian marine fauna (marine molasse).

Continental and coastal calc-alkaline rhyolitic volcanic rocks and coal-bearing argillites with lenses of reef limestone are known in the Dzirula and Khrami massifs. Lower-Middle Carboniferous corals, brachiopods, foraminifers, and terrestrial flora have been found in this formation in the Khrami massif.

Mesozoic and Cenozoic formations are developed in all tectonic units of Georgia (Gamkrelidze, 1997b; Gudjabidze, 2003).

Triassic sediments are observed in the Dizi Series apart from the above-mentioned Upper Paleozoic deposits. To the Triassic also belong dacitic-rhyolitic volcanics, quartz sandstones, and siltstones with variable thickness (80-500 m), which crop out in the Dzirula massif and contain flora of Triassic age.

Lower Jurassic-Aalenian sediments that everywhere rest transgressively are spread throughout all tectonic units of Georgia.

In the fold system of the Greater Caucasus, these deposits are more than 5000 m in thickness and are represented by black shales, sandstone turbidites, rhyolitic (in the lower part) and tholeiite-basaltic (in the upper part) lavas, and their pyroclastics.

In the Georgian Block, Lower Jurassic sediments (80-90 m thick) crop out only along the edges of the Dzirula massif and are represented by arkosic sandstones, gravelstones,

conglomerates, clays, and red zoogenic limestones containing rich marine fauna (Ammonitico Rosso facies).

In the southern parts of the Khrami and Loki massifs, the Lower Jurassic consists mainly of terrigenous deposits (120-600 m thick).

In the central part of the fold system of the Greater Caucasus, the Bajocian stage is represented by sandstone-siltstone flysch, shales and marls, and elsewhere by a thick (3500 m) volcanogenic series, which contains marine fauna and consists mainly of calc-alkaline basaltic, andesite-basaltic, and andesite-dacitic lavas and pyroclastics. Tephroturbidites, sandstones, and conglomerates are rather scarce.

The Bathonian Stage in the fold system of the Greater Caucasus is represented by sandstone-siltstone flysch, and by regressive coal-bearing terrigenous deposits (65-200 m) on its southern slope (in the Gagra-Java zone).

In the central and eastern parts of the southern slope of the Greater Caucasus (Mestia-Tianeti zone), the Upper Jurassic sediments which follow conformably the Middle Jurassic slates consist mainly of clastic limestone flysch (1100-1500 m). On the rest of the territory, they lie transgressively and discordantly.

In the western and eastern parts of the Gagra-Java zone, an upper Jurassic marine facies is present. In the lower part, it is represented by sandstones and clays (120-200 m), and in its upper part by reef limestones (400-900 m). A rich marine fauna (ammonites, corals, etc.) is found in these sediments. To the south and within the Georgian Block, gypsum-bearing lagoonal-continental terrigenous (Kimmeridgian-Tithonian) deposits and to a lesser extent alkaline basalts, trachytes, and pyroclastics are present.

Upper Jurassic shallow-water limestones and marls, alternating with calc-alkaline basalt-andesite-dacite volcanics, are exposed at the western edge of the Khrami massif and in the Somkito-Karabakh zone also.

There is a variety of Cretaceous deposits in Georgia. Within the Greater Caucasus fold system (in the Mestia-Tianeti flysch zone), the Lower Cretaceous is developed in the form of clastic limestone and sandstone siltstone flysch (750-1600 m), which conformably follows the Upper Jurassic flysch. In the south and within the Georgian Block, the old formation, including crystalline rocks of the Dzirula massif, is overlain transgressively by Lower Cretaceous rocks (300-550 m). In the main, limestones are developed within this area. Only in the middle of the section appear marls and clays (Albian Stage) and glauconitic sandstones (Cenomanian Stage). Reef limestones of Urgonian facies (Barrenian Stage) and ammonitic limestones (Aptian Stage) are distinguished in the Lower Cretaceous.

In the Upper Cretaceous sediments of the Mestia-Trileti Flysch zone, sandstone-siltstone (in the lower part) and clastic limestone (in the upper part) flysch (500-900 m) prevail. Within the Gagra-Djava zone and Georgian Block, they are spread mainly as shallow-water limestones, marls, and glauconitic sandstones (250-1200 m), whereas to the west in the Dzirula massif, an alkali basalt-phonolitic series (70-300 m) occurs locally.

In the Adjara-Trialeti zone, the Upper Cretaceous is represented by a volcanogenic suite with calc-alkaline basaltic composition, which in the lower part also contains the Albian Stage. Stratigraphically higher, upper Turonian-Senonian limestones and marls (300-1200 m) follow.

In the Arthvin-Bolsini Block and Loki-Karabach zone, transgressive upper Cretaceous sediments are present, which subdivide into three parts. A Cenomanian volcanogenic-carbonate series (900-1200 m) overlaps directly the Khrami and Loki massifs and Jurassic rocks. Ascending the section, there follows a basalt-andesite-dacite-rhyolite series (1100-3300

m) of Turonian-Santonian age. The uppermost part (Campanian-Maastrichtian) is represented by shallow-water limestones and marls with interlayers of acidic tuffs (300-350 m).

Paleogene deposits are found in all tectonic units. In the southern slope of the Greater Caucasus, the Paleocene-Eocene is represented by sandstone-siltstone flysch (600-850 m). In the southern part, the Upper Eocene is built up of olistostromes (10-400 m).

In the Georgian Block, the Paleocene and Eocene consist of an alternation of limestones and marls (30-400 m). In the middle part of the Lirolepis horizon, a horizon of marls is distinguished, which begins the Upper Eocene.

In the Adjara-Trialeti zone, the Danian is built up of limestones and marls, whereas the transgressive Paleocene-Lower Eocene consists of sandstone-siltstone and clastic limestone flysch (Borjomi flysch), the thickness of which increases from west to east (1500-3000 m). These are followed by a very thick Middle Eocene volcanogenic suite, which in the western part of the zone is represented by tholeiitic and shoshonitic, mainly basaltic, submarine volcanics and tephro-turbidites, whereas in the eastern part there are calc-alkaline and tholeiitic, mainly andesitic rocks, olistostromes, and tephro- and sandstone-siltstone turbidites. Its thickness increases from east to west (1000-5000 m). In the Artvin-Bolnisi zone and the Somkhito-Karabakh zone, a Middle Eocene volcanogenic suite is built up of calc-alkaline basalt-andesite-dacite-rhyolite volcanics (1200-2700 m) and transgressively overlaps Cretaceous and Jurassic rocks and the Loki Crystalline Massif.

In the Adjara-Trialeti zone, the Upper Eocene is distinctly transgressive and consists of marls, clays, sandstones, and gravelstones (500-1500 m), whereas in the western part of the zone, it consists of andesitic-basaltic volcanoclastics (1000 m).

Oligocene deposits (mainly the Maikop Series) are generally represented by thin-bedded gypsiferous clays, which contain fish scales and sandstones. This series continues in the lower part of the Miocene, too. It outcrops in the Gagra-Djava zone, in the Georgian and Artwin-Bolnisi blocks, and in part of the Adjara-Trialeti zone. Its thickness is rather variable (250-3000 m).

Neogene formations are present only in molasse depressions. The Lower Miocene, as was mentioned, belongs to the Maikop Series. Further up the section, the Miocene is represented in the lower part (Middle Miocene-Middle Sarmatian) by marine molasse (clays, sandstones, conglomerates, limestones, and marls), and in the upper part (upper Sarmatian-Pliocene) by marine and continental molasse (conglomerates, sandstones, sands, and clays). There are very distinct unconformities at the bases of the Miocene, Meotian Stage, and Upper Pliocene.

In the Artvin-Bolnisi zone and Somkhito-Karabakh zone, and partially in the southern part of the Adjara-Trialeti zone, the Neogene is represented by subaerial calc-alkaline andesites, andesite-dacites and dolerites. Their upper part includes the Pleistocene and Quaternary, too. In the lower part (Upper Miocene-Lower Pliocene) subaerial volcanics contain a rich terrestrial flora, and in the Upper Pleistocene there are mammalian fauna.

Quaternary deposits are distributed very irregularly. These consist of river terraces, moraines of three glaciation periods, and a volcanic formation in the form of volcanic cones and lava flows (in the Greater Caucasus, to the south of Kazbegi, and on the Trialeti Range in the Borjomi region). There are also vast accumulation plains in intermontane areas.

TECTONIC STRUCTURE

The territory of Georgia, as a part of the Caucasus, underwent a long and complicated tectonic evolution and contains structures of various types, scales, and genesis (Gamkrelidze et al., 2013).

Tectonic structures of the pre-Alpine basement are characterized by the existence of several deep-seated nappes including obducted ophiolites (Gamkrelidze and Shengelia, 2005).

Alpine structures have a different character in the various tectonic zones. The northeastern tectonic unit of Georgia, the fold system of the Greater Caucasus, is characterized by a distinctly expressed asymmetry in its structure: southward verging, often isoclinal folding on the southern slope and quiet, poorly folded, or monoclinal structures on the northern slope. Large, southward-directed nappes are developed also on its southern slope (Gamkrelidze, 1991). The above-mentioned structures provide evidence of the leading role of late Alpine underthrusting of the comparatively rigid Georgian Block under the Greater Caucasus during its deformation (intraplate subduction).

The northern boundary of the Georgian Block, in its western part, is formed by a deep fault, which in the sedimentary cover manifests itself as a regional flexure. Study of the structural peculiarities of the Georgian Block has shown that its central and western parts are characterized by a mosaic-block structure of the basement and occurrence of typical above-fault folds in the sedimentary cover. In the eastern area of subsidence of the Georgian Block, its cover is detached and shifted towards the south together with the nappes of the southern slope of the Greater Caucasus (Gamkrelidze, 1991).

The Adjara-Trialeti zone of the Lesser Caucasus, which is situated to the south of the Georgian Block is, on the whole, an anticlinorium and is characterized by block-fold structures. To the west from the Dzirula Massif along the northern margin of this zone, an overthrust nappe is developed.

The Artvini-Bolnisi zone consists of two different tectonic units: the Javakheti zone (in the west) and the Bolnisi zone (in the east). In the young (Neogene-Pleistocene) volcanic cover of the Javakheti zone, sublatitudinal gentle folds are observed. Two deep submeridional seismogenic faults are established which served as conduit channels for young volcanics. The Bolnisi zone includes the horst-like Khrami salient of pre-Alpine basement and the territory covered with Cretaceous and Paleogene volcanic rocks. Brachyanticlines and steep faults of various orientations are developed to the south in a sedimentary cover, which generally forms a gentle syncline.

The northeastern wedge of the Somkhito-Karabakh zone forms part of Georgia and is characterized by echelon-like disposition of internal anticlinoria. In the core of a sub-latitudinal Loki anticlinorium, the pre-Jurassic crystalline basement is exposed. The axis of this structure plunges in both western and eastern directions and causes periclinal closure of the sedimentary cover.

The fold and fault systems of the Adjara-Trialeti, Somkhito-Karabach, and the Artvini-Bolnisi zones were formed as a result of the manifestation of late Alpine (Neogene) tectonic movements with the displacement of masses from south to north (Gamkrelidze, 1991).

GEODYNAMIC EVOLUTION OF THE CAUCASUS AND PALEOTECTONIC RECONSTRUCTIONS

The aforesaid data about geological structure, character of sedimentation and magmatism, geology, and the age of ophiolites, side by side with paleomagnetic data and global plate

tectonic reconstructions (Stamfli and Borel, 2002) allow us to consider the main features of the geodymanic evolution of the Caucasus and adjacent areas (Gamkrelidze, 1986; Gamkrelidze and Shengelia, 2005).

As a result of horizontal displacements of the ancient East European and African platforms, as well as of certain lithospheric plates within the Mediterranean belt during the Precambrian-early Mesozoic, the generation and development of oceanic basins took place. In the present structure of the Earth's crust, these basins are marked by rocks of ophiolitic association.

The most ancient of these oceans, the Proto-Paleotethys, developed in the course of time from the Precambrian up to the Middle Jurassic. At this time, the Caucasian province was an active continental margin of Europe. The southern, Lesser Caucasus part of the Transcaucasus massif was located at the margin of the Paleotethys and belonged to the northern margin of the Iran-Afghanian plate (Gamkrelidze, 1986).

Side by side with the Proto-Paleotethys Ocean during the Neoproterozoic and Paleozoic, relatively small oceanic basins of the southern slope of the Greater Caucasus and the so-called Arkhis basin (between the Main and Fore Range zones of the Greater Caucasus) are developed.

In the rear of the gradually closing Paleotethys, the joining together of Iran and Arabia and the generation of Neotethys had been taking place already since the Triassic.

The next extension occurred during the early Jurassic and beginning of the Middle Jurassic. At the northern active margin of the Paleotethys, the Transcaucasus island arc and marginal sea of the Greater Caucasus can be discerned.

One can suppose that the Lesser Caucasus branch or bay of the Tethys was formed in the rear of the closure of the Paleotethys since the end of the Middle Jurassic.

The closure of the Neotethys Ocean, as well as of the Paleotethys relic basin, occurred as a result of movements which spread from north to south. In particular, only the northern part of the Caucasian segment of the Mediterranean belt was affected by the Bathonian (Adygean), Late Cimmerian (pre-Cretaceous), and Austrian (pre-late Cretaceous) movements. These epochs of tectonic activity are associated with the intense manifestation of andesitic volcanism and granitoid plutonism due to the processes of subduction on the continental margin of the oceanic basins (Gamkrelidze and Shengelia, 2005).

The movement of the Austrian phase closed the Lesser Caucasian branch of the Mesotethys. At that time, ophiolite nappes were formed in the Lesser Caucasus.

The subsidence that began in the Paleocene reached a maximum in the Eocene, especially in the Middle Eocene, and it was accompanied by calc-alkaline volcanic activity throughout the Lesser Caucasus. Northwards, this was substituted mostly by the basaltic sub-alkaline series of the Adjara-Trialeti rift.

The subsequent phases of Alpine tectogenesis caused the accumulation of molasse deposits, total compression, and final formation of the present-day structure of the Caucasus (Caputo et al., 2000).

The abundance of andesitic and andesite-dacitic volcanism, and granitoid plutonism in the orogenic stage can be related to the continuing activity of subduction zones (intraplate subduction).

At the same time, at the location of maximum compression of the Mediterranean belt caused by an active northward sub-meridional advance of the Arabian Plate, a vast transecting

transverse set of extensional fissures developed which was responsible for the penetration of orogenic volcanism far into the continent, in a zone of Transcaucasian transverse uplift.

The map of the Field Trips is provided in Fig. 2.

PART II. FIELD TRIPS

During the field trips in Eastern Georgia (Fig. 2), large sequences of freshwater-continental sediments of the Miocene, Pliocene, and post-Pliocene that fill all major depressions of the Kartli and Kakheti depressions will be observed.

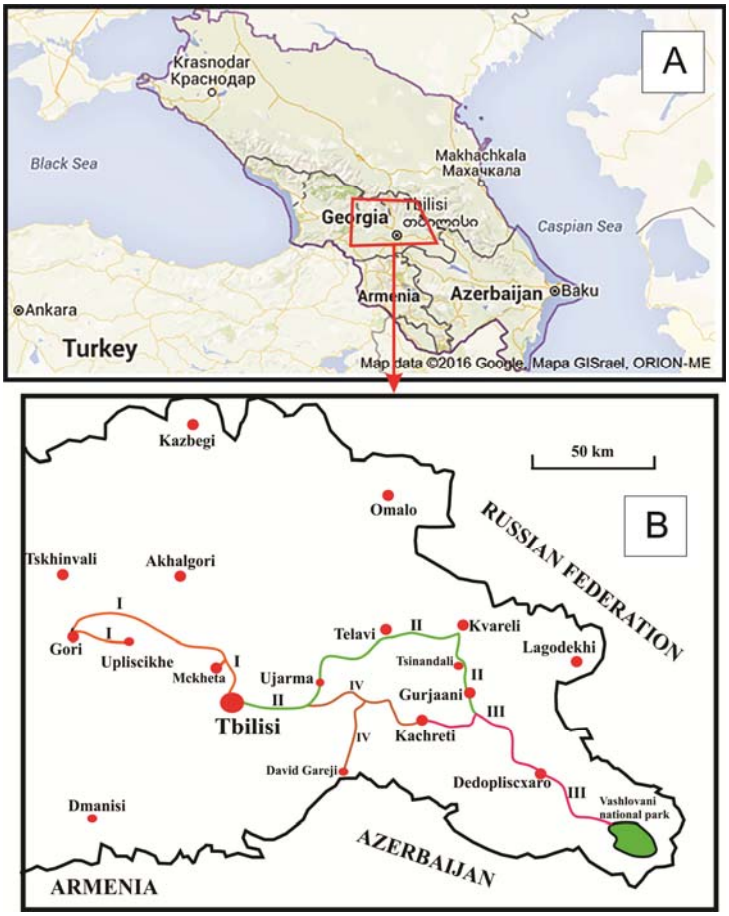

Figure 2. A. Map of the Black Sea-Caspian Sea Corridor; B. Map of Georgia with routes of field trips: I – Tbilisi – Grakalianis hill – Upliscikhe – Mtskheta – Tbilisi; II – Tbilisi – Ujarma – Gombori pass – Alaverdi – Tsinandali – hotel "Kachreti-Ambasador"; III – hotel "Kachreti-Ambasador" –Kvabebi Akchagylian outcrop - Khornabuji Castle – Didnauri Bronze Age City – Kachreti – Hotel "Kachreti-Ambasador"; IV – Hotel "Kachreti-Ambasador" – David Gareji half-desert – Tbilisi.

FIELD TRIP I (5 OCTOBER). KARTLI REGION: TBILISI – JVARI MONASTERY – GRAKALIANI HILL – UPLISCIKHE – MTSKHETA – TBILISI

The Mtskheta - Upliscikhe area is represented by lower, upper Miocene, and Pliocene sediments with rich fauna of mollusks. The former consist of yellow-gray, massive, loose, fine-grained, non-carbonate sandstones with lenses of thick sandstone, mottled clays with basal conglomerates, massive fine grained quartz-feldspar sandstones and siltstones with clay interlayers. The latter is represented by light gray and bluish-gray calcareous poorly laminated clays with rare interlayers of strongly calcareous light-gray sandstone with rich fauna. The

Pliocene is represented by thick packs of poorly sorted conglomerates with interlayers of clay, loamy and coarse-grained sandstones (Buleishvili, 1960).

Stop I.1. Jvari Monastery

The Jvari Monastery is a sixth century Georgian Orthodox monastery near Mtskheta, Eastern Georgia (Fig. 3).

Figure 3. Jvari Monastery Area. Mtskheta – the old capital of Georgia in the background.

Along with other historic structures of Mtskheta, it is listed as a World Heritage site by UNESCO. It stands on a rocky mountaintop at the confluence of the Mtkvari and Aragvi rivers, overlooking the town of Mtskheta, which was formerly the capital of the Kingdom of Iberia.

Stop I.2. Graklianis Hill

This is an archaeological excavation site in Eastern Georgia near Kaspi showing evidence of human presence possibly going back 300,000 years. The site was discovered by students and faculty of Tbilisi State University in 2007. The site contains a temple to a fertility goddess from the seventh century BC, a pit-type burial cemetery from the Early Bronze Age, and the remains of a building from around 450-350 BC; the building consists of three rooms with three storage rooms. The site had been occupied between the Chalcolithic and the Late Hellenistic periods. In 2015, a mysterious script (Fig. 4) was discovered on the altar of a fertility goddess's temple, predating those previously known in the area by at least a thousand years.

Figure 4. Grakliani Hill mysterious script.

Stop I.3: Upliscikhe

This is an ancient rock-hewn town in Eastern Georgia some 10 km east of the town of Gori (Fig. 5).

Figure 5. Upliscikhe: ancient rock-hewn town in Eastern Georgia. Caves were cut into the Lower Miocene quartz sandstone.

Built on a high rocky prominence on the left bank of the Mtkvari River, it contains various structures dating from the Early Iron Age to the Late Middle Ages, and it is notable for the unique combination of various styles of rock-dwelling cultures from Anatolia and Iran, as well as the co-existence of pagan and Christian architecture. Upliscikhe is identified by archaeologists as one of the oldest urban settlements in Georgia. Strategically located in the heartland of the ancient kingdom of Kartli (or Iberia as it was known to the Classical authors), it emerged as a major political and religious center of the country. The town's age and importance led medieval Georgian written tradition to ascribe its foundation to the mythical Uplos, son of Mtskhetos, and grandson of Kartlos. With the Christianization of Kartli early in the 4th century, Uplistsikhe seems to have declined in its importance and lost its position to the new centers of Christian culture – Mtskheta, and later, Tbilisi. However, Uplistsikhe reemerged as a principal Georgian stronghold during the Muslim conquest of Tbilisi in the 8th and 9th centuries. The Mongol raids in the 14th century marked the ultimate eclipse of the town. The Uplistsikhe cave complex has been on the tentative list for inclusion within the UNESCO World Heritage program since 2007.

Stop I.4: Mtskheta

This is one of the oldest cities of Georgia. It is located approximately 20 km north of Tbilisi at the confluence of the Aragvi and Mtkvari rivers. Mtskheta was founded in the 5th century BC. It was capital of the early Georgian Kingdom of Iberia (Kartli) from the third century BC to the 5th century AD. It was a site of early Christian activity, and the location where Christianity was proclaimed the state religion of Kartli in 337. It remains the headquarters of the Georgian Orthodox Church. King Dachi I Ujarmeli (early 6th century AD), who was the successor of Vakhtang I Gorgasali, moved the capital from Mtskheta to the more easily

defensible Tbilisi according to the will left by his father. However, Mtskheta continued to serve as the coronation and burial place for most kings of Georgia until the end of the kingdom in the 19th century. The old city lies at the confluence of the rivers Mtkvari and Aragvi. From the Bronze Age until the prosperous Christian era, Mtskheta represents a rare mixture of cultural and spiritual values. This has created a unique eclectic lifestyle and mood within the town, which is as old as the history of Georgia itself. Mtskheta is the most religious city of Georgia, as it has been the shrine of pagan idols since times immemorial, and it is where Christianity in Georgia takes its origin. Svetitskhoveli Cathedral (11th century) (Fig. 6) and Jvari Monastery (6th century) in Mtskheta are amongst the most significant monuments of Georgian Christian architecture, and are historically significant in the development of medieval architecture throughout the Caucasus.

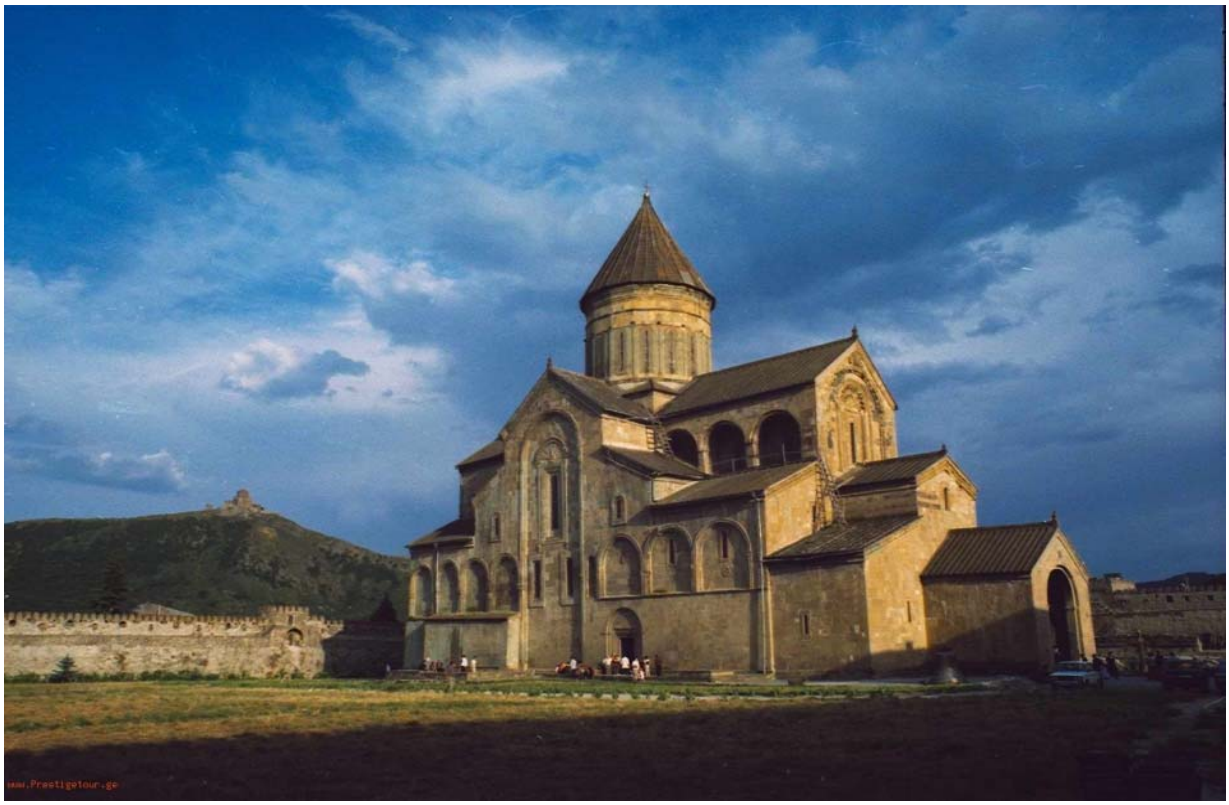

Figure 6. Svetiskhoveli Cathedral (11th century). Jvari monastery is in the background.

Svetitskhoveli, known as the burial site of Christ's mantle, has long been the principal Georgian church and remains one of the most venerated places of worship to this day. Svetitskhoveli is listed as a UNESCO World Heritage Site along with other historical monuments of Mtskheta.

In the outskirts of Mtskheta are the ruins of Armaztsikhe fortress (3rd century BC), the Armaztsikhe acropolis (dating to the late 1st century BC), remains of a "Pompey's bridge" (according to legends built by Roman legionnaires of Pompey the Great in the 1st century BC), the fragmentary remains of a royal palace (1st-3rd century AD), a nearby tomb of the 1st century AD, a small church of the 4th century, the Samtavro Monastery (11th century), and the fortress of Bebris Tsikhe (14th century).

FIELD TRIP II (6 OCTOBER). KAKHETI REGION: TBILISI – UJARMA –THURDO RIVER CANYON – ALAVERDI – KVARELI (WINE-TASTING IN KHAREBA WINE TUNNELS) – KACHRETI

Kakheti is a eastern region of Georgia. It is a premier wine-producing area of Caucasus. In the Kakheti region (Fig. 7), the Tsiv-Gombori Range is represented by lower and upper Miocene, and Pliocene.

Figure 7. General view of the Kakheti region from the Tsiv-Gombori Range. Alazani Valley and the Greater Caucasus are in the background.

The former is mainly represented by dark gray and brownish-gray calcareous clays, sandstone with quartz fragments, thick coarse-grained sandstones, and microconglomerate interlayers with rich microfauna. The latter is represented by bluish-gray and gray clays, thick coarse-grained calcareous sandstones, oolitic limestone with numerous fauna and conglomerates. The Pliocene is represented by continental deposits, such as conglomerates with interbedded layers of clays and loams. To the southeast, they are replaced by freshwater-continental sediments (Buleishvili, 1960; Gamkrelidze, 1964).

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Stop II.1: Ujarma Fortress

The Ujarma fortress was established by King Vakhtang Gorgasali in the 5th century, and was the second capital of Georgia until the 8th century. King Vakhtang Gorgasali is believed to have died there after he was wounded in battle against the Persians. The fortress consisted of two parts: the Upper Fortress (the Citadel) located on the plateau of the rocky hill (Fig. 8) and the Lower City on the slope.

Figure 8. Ujarma Castle.

A royal palace, consisting of a two-storey building, was located in the eastern part of the Citadel. The Upper Fortress was destroyed in the 10th century by the Arabian conqueror Abul Kassim but was restored in the 12th century by King George III, who used it as a treasury. The fortress was originally surrounded by powerful protective walls with nine towers.

Stop II.2: Thurdo River canyon section (Akchagylian-Absheronian section)

The canyon is an outcrop in the eastern slopes of the Gombori range. The range represents the southern part of the young Greater Caucasus Mountains, stretching from NW to SE and separating the Alazani and Iori basins; it represents a western part of the Kura fold-thrust belt. The active phase of Caucasian orogeny started in the Pliocene, but according to alluvial sediments of the Gombori range, we observe its uplift process to be a Quaternary event. The highest peak of the Gombori range has an absolute elevation of 1991 m, while its neighboring Alazani valley reaches only 400 m. The Turdo River flowing from Gombori Ridge to the north, before its confluence with the region's major river, the Alazani, generates an outcrop of about 2 km long built by terrigenous sediments of the Akchagylian (3.4-1.6 Ma) and Apsheronian (1.6-0.7 Ma) stages (Fig. 9).

Figure 9. Turdo River section of Akchagylian and Apsheronian terrigenous sediments.

There are ongoing investigations showing that the outcrop carries information about different uplift regimes during the Quaternary. The site includes evidence of human activity as well, represented by medieval monastery caves.

Stop II.3. Alaverdi Monastery

This is a Georgian Eastern Orthodox monastery located 25 km from Akhmeta, in the Kakheti region of Eastern Georgia (Fig. 10).

Figure 10. Alaverdi monastery, Greater Caucasus in the background.

The monastery was founded by the Assyrian monk Joseph Alaverdeli, who came from Antioch and settled in Alaverdi, which was then a small village and former pagan religious center dedicated to the Moon. Situated in the heart of the world's oldest wine region, the monks also make their own wine, known as the Alaverdi Monastery Cellar. While parts of the monastery date back to 6th century, the present day cathedral was built in the 11th century by Kvirike III of Kakheti, replacing an older church of St. George.

Stop II.4. Kvareli (Wine-tasting in the Khareba wine tunnels)

Kakheti is the most important region for winemaking, characterized by its unique vine grape varieties, unusually well suited climate, topography, and centuries of exceptional winemaking experience. On a national scale, Kakheti is home to the largest percent (65%) of Georgia's vineyards, and almost 80% of the country's grapes are gathered here. In the heart of Kakheti, near the foothills of the Greater Caucasus Mountains, is the small city of Kvareli. This is the center of the Kakhetian wine producing region and is home to the unique "Winery Khareba" wine cellar (Fig. 11).

Figure 11. Yard of the Khareba wine tunnels.

Gvirabi (which means tunnel in English) is carved into the rock of the Caucasus Mountain Range. The tunnel was opened in 1962 for the World Wine Congress. In the beginning, it belonged to the government, and wine from the entire Kakheti region was stored here. Nowadays, it is the "Winery Khareba" cellar, used to age wine. The constant temperature, 12-14 degrees with around 70% humidity all the year round, creates the ideal, natural conditions for wine to age in French oak barrels, as well as to store bottled wines for extended periods.

The tourism complex also includes wine tasting for more than 30 varieties of the best wines produced by "Winery Khareba," as well as many other activities tourists can take part in: distilling Chacha (Chacha is a strong spirit made from the grape residue left after making wine), baking Georgian bread, making Chuchkhela (a traditional dessert made from grapes and nuts), grilling meat (Georgian barbeque), and harvesting and pressing grapes in the Satsnakheli.

FIELD TRIP III (7 OCTOBER). KACHRETI – KVABEBI SECTION – KHORNABUJI CASTLE – DIDNAURI BRONZE AGE CITY – KACHRETI

Stop III.1. Kvabebi – Akchagylian outcrop of marine Akchagylian sediments

The outcrop is located on the left bank of the Iori River at the foot of Kvabebi mount (Fig. 12).

Figure 12. Kvabebi Akchagylian sediments outcrops on the left bank of the Iori River.

The sediment sequence is represented by:

1. Sandy-coquina sediments with rich mollusk fauna with a thickness of about 15 m.

2. Bluish-grey carbonate marl shales and silts with a thickness of 190 m, sometimes containing gypsum veins and thin siderite lenses/layers. In the upper part of the pack, two thin layers of volcanic ash are defined. The sediments contain mollusk and ostracod fauna. Here, in the upper part of the pack, the remains of mammals and birds have been found.

3. In the upper part of the outcrop, the appearance of sandstones increases up to 80 m, and gravelites and fine-pebbled conglomerates with mollusk shells are present.

4. The Akchagylian sediments cross-section is finished by poorly sorted thick conglomerates with sandstone interlayers and lenses. This pack doesn't contain any fauna and is conventionally dated as Akchagylian (Vekua, 1972).

Some researchers believe it might contain the lower part of the Apsheronian sediments. Towards the west, the lithology of Akchagylian sediments changes, material becomes coarse, and marine fauna disappear. The marine facies of the above sediments to the north, north-west, and south change laterally to continental conglomerates of the Alazani suite.

Stop III.2. Khornabuji Castle

The Castle is also known as the Castle of Queen Tamara (Fig. 13) located in the eastern part of Georgia, approximately 3 km north of Dedoplistskaro.

Figure 13. Fragment of Khornabuji Castle, 1st millennium BC.

The castle was probably constructed, originally, at the end of the 1st millennium BC, at which time it was the only fortification controlling the valleys of the Iori and Alazani rivers. The first surviving written records date it back to the reign of King Vakhtang Gorgasali, V century. At that time Khornabuji was one of the largest settlements in Georgia. At the end of V or early during the sixth century, Khornabuji was conquered by the Sasanians. During the 12th century, the castle was rebuilt on the instructions of Queen Tamara. In the XVII century, the settlement fell into ruins following the invasion undertaken from Iran by Shāh Abbās.

Stop III.3: Shiraki plain – Didnauri Bronze Age city

The Shiraki plain represents the natural polygon of long term changes in the environment. Currently, this is an open dry steppic landscape, however, recent data collected using remote sensing and archaeological studies, yielded evidence of early human inhabitation of this area, starting from the Paleolithic and forming a constant chain of active settlement through time, until an abrupt cessation at the end of the Bronze-Early Iron ages. Geomorphologic, archaeobotanic, and soil studies also suggest that the region was covered by forests; hydro-

modeling shows the possible existence of a well developed water network with a shallow lake in the center of the plain. We will visit the archaeological excavation site of Didnauri, which represents a well developed Bronze Age city, with neighboring burials (Fig. 14) indicating early state formation under favorable paleo-environmental conditions.

Figure 14. One of the burials at Didnauri, the largest Bronze Age settlement ever discovered in the in the South Caucasus. The site dates back at least 3,300 years and has been yielding interesting burials, artifacts and architectural features, including a huge wall and waterworks.

FIELD TRIP IV (8 OCTOBER). HOTEL "KACHRETI-AMBASADOR" – DAVID GAREJI HALF-DESERT – TBILISI

The David Gareja half-desert is located in the Kakheti region of Eastern Georgia, some 60-70 km southeast of Georgia's capital Tbilisi.

Stop IV.1: Mount Gareja

The Mount Gareja is build up by lower Miocene sandy clays, dark-brown and brownish-gray clays with interbedded sandstones, and rare conglomerate interlayers. The upper Miocene is represented mostly by shallow and coastal sediments, but there are also deep-sea sediments represented by yellowish-gray calcareous sandstones and oolitic limestones (Buleishvili, 1960; Fig. 15).

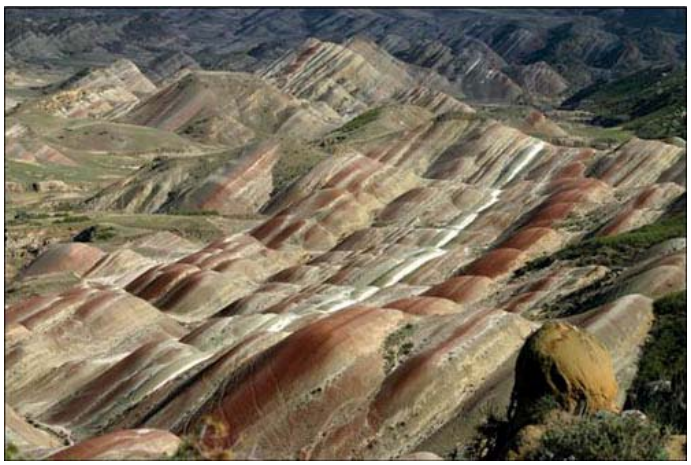

Figure 15. Upper Miocene yellowish-gray calcareous sandstones and oolitic limestones of Gareja.

There are also interlayers of sandy clays as well as motley continental clays with interbeds of thick coarse-grained sandstones, conglomerates, and a thin layer of volcanic ash (Skhirtladze, 1958).

The entire section is well characterized by fauna. There are some remains of vertebrates, and plant residues exist in the form of fossilized pieces of trunk and branches. Pliocene sediments are represented by continental and marine facies consisting of coarse-grained yellowish-gray sandstones with numerous small pebbles, and thick basal conglomerates with volcanic ash interbeds. All geological sections are characterized by rich fauna.

Paleogeographical and geobotanical data show that anthropogenic modification of the forest, forest-steppe, and steppe natural landscapes of the Gareja-Iori's (Eastern Georgia) physical-geographical sub-region began in the Early Bronze Age. Due to an increase in economic activities, modification of regional natural landscapes took place under semi-arid climatic conditions. This intensified the desertification process in antiquity. Bronze and Iron Age archaeological sites are found in the region, which was intensely populated at that time. Economic activities (animal husbandry) caused a gradual transformation of the landscape of light arid forests into a semi-desert landscape.

Stop IV.2: The David Gareja monastery complex

This complex was founded in the 6th century by David (St. David Garejeli), one of the thirteen Assyrian monks who arrived in the country at the same time. The complex includes hundreds of cells, churches, chapels, refectories, and living quarters hollowed out of the rock face (Fig. 16).

Figure 16. David Gareja monastery complex, Gareja; semi-desert in the background.

Stop IV.3. Tbilisi city tour

Tbilisi is the capital and the largest city of Georgia, lying on the banks of the Mtkvari (Fig. 17) with a population of roughly 1.5 million inhabitants.

Figure 17. Tbilisi – the capital of Georgia.

It was founded in the 5th century on the site of natural hot springs, and has since served, with intermissions, as the capital of various Georgian kingdoms and republics. Located on the crossroads of Europe and Asia, due to its proximity to lucrative east-west trade routes Tbilisi has historically been an object of competition between countless rival empires.

Present-day Tbilisi is one of the safest cities and frequently ranks among the most popular emerging destinations thanks to Georgia's growing tourism industry. Historically, Tbilisi has been home to people of diverse cultural, ethnic, and religious backgrounds, though it is overwhelmingly Eastern Orthodox Christian. Notable landmarks include cathedrals like Sameba and Sioni, the medieval Narikala Fortress, classical avenues Rustaveli and Agmashenebeli, as well as the exotically-designed Georgian National Opera Theater.

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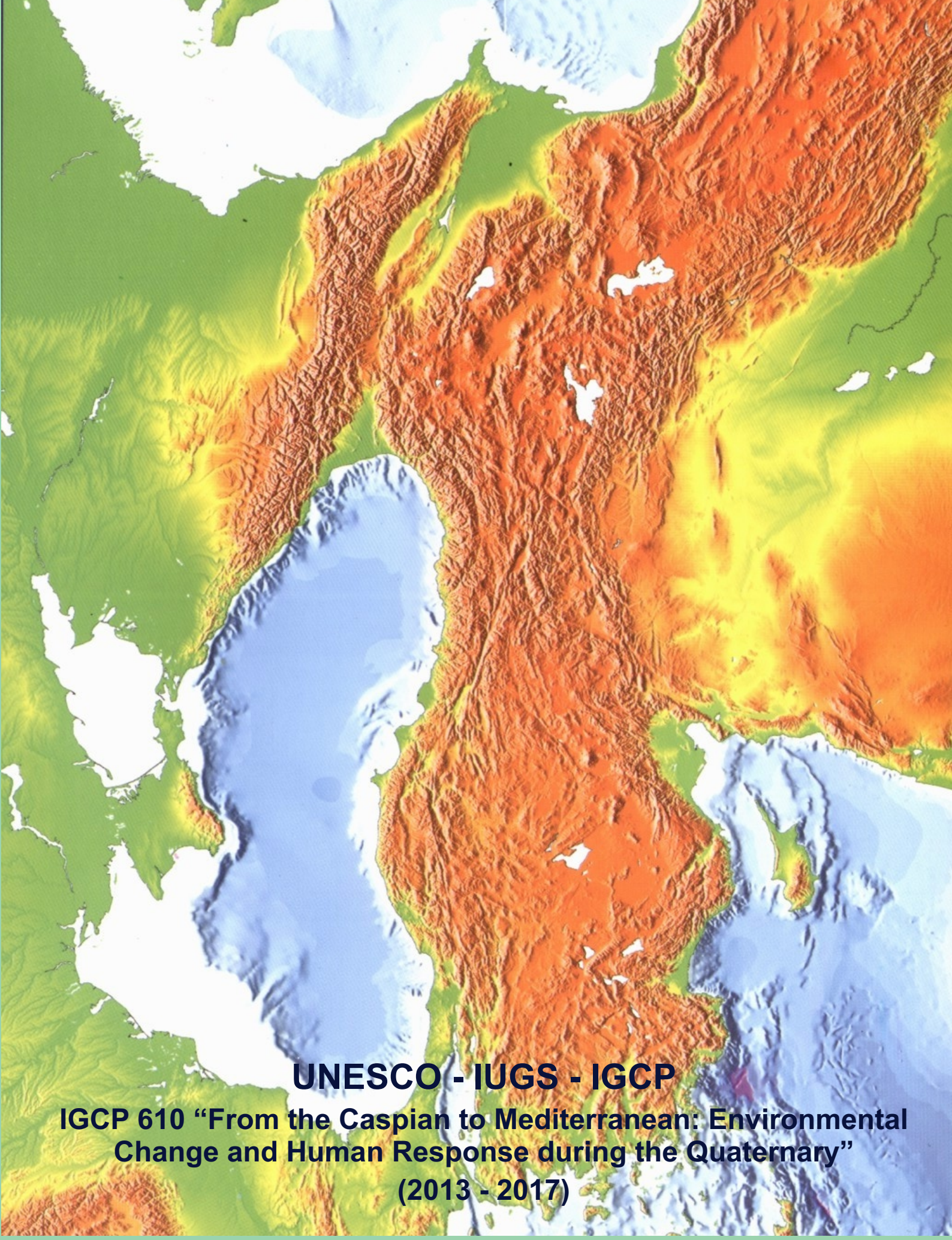

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