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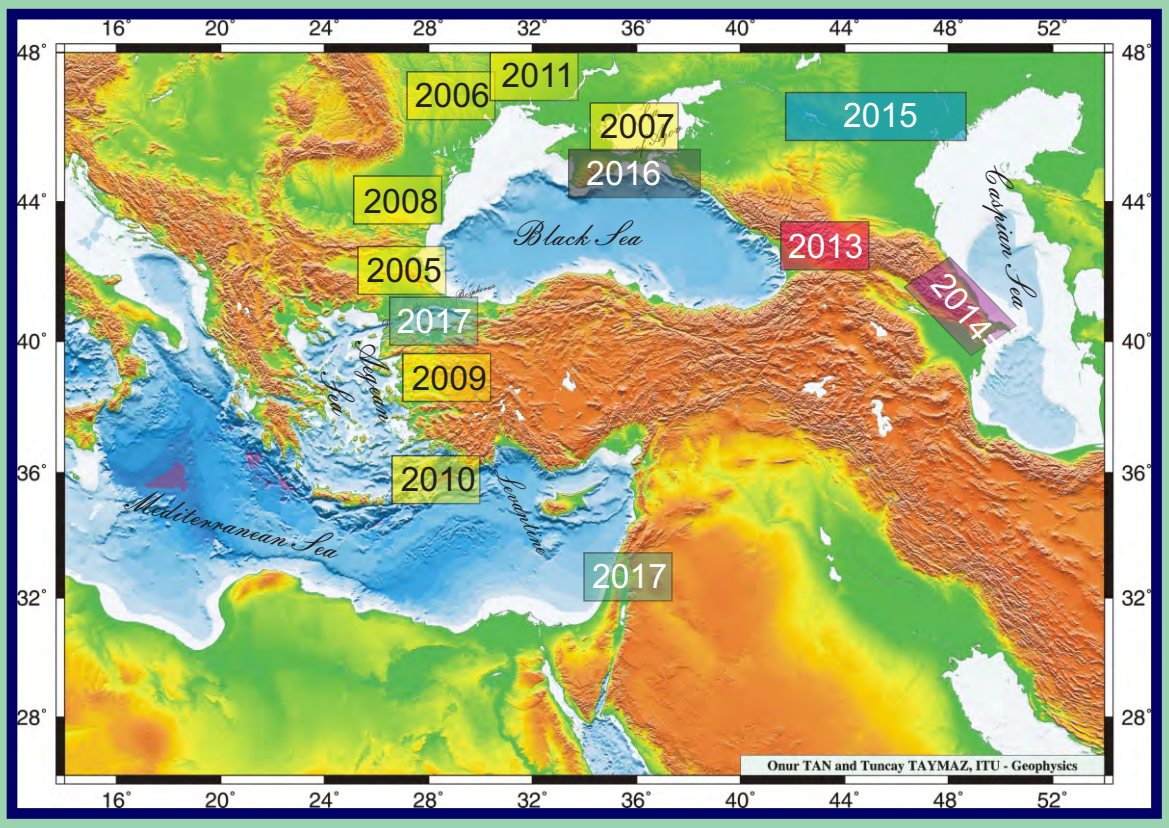
12-19 October 2013

INTERNATIONAL GEOSCIENCE PROGRAMME



Field Trip Guide of the First Plenary Conference

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

http://www.avalon-institute.org/IGCP

IGCP 610 First Plenary Conference and Field Trip, Tbilisi, Georgia12-19 October 2013

FIELD TRIP GUIDE

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IGCP 610 First Plenary Conference and Field Trip

"From the Caspian to Mediterranean: Environmental Change and Human Response during the Quaternary"
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Outline of Georgian Quaternary geology (the Caucasus)

The Caucasus represents a Phanerozoic collisional orogen formed along the northern Euro-Asian continental margin. It extends over 1200 km from the Caspian to the Black Sea in a NW-SE direction and is an expression of continental collision between the Arabian and Eurasian lithospheric plates. It was formed after a long closure process of the proto-, paleo- and neo-Tethys, and therefore, terranes of different age and history have contributed to its construction. The most ancient formations of the Caucasus orogen represent Gondwana-origin, pre-Cambrian relicts, and the youngest are Quaternary rocks, among which volcanics prevail. Three major units are distinguished structurally in the Caucasian construction: the Greater and Lesser Caucasian mobile belts and the inner Caucasian microplate (Okrostsvaridze and Tormey, 2013).

The Caucasian orogen started active exhumation in the late Miocene (10-8 million years ago), and in the Quaternary period, it attained its modern shape. Georgia is situated in the western part of this orogen and geologically represents one of its most active segments. As a result, nearly all types of Quaternary formation are represented here: seashore, glacial, alluvial, lake, subaerial, and volcanogenic.

The lower Quaternary part of the Black Sea shore of Georgia is represented by Chaudian semi repressed sea sediments, which are terraced along the Guria and Apkhazeti seashores (Tsvermagala, Khvarbeti, Ureki, Sokhumi, etc.). Chaudian terraces are situated at 90-150 m asl Kitovani, T., (Kitovani et al., 1982). In the middle Quaternary, during the late Euxinian transgression, the late Euxinian sea terrace was formed alongside the shore, which is situated at 55-65 m asl. At the end of the middle Quaternary, the Uzunlarian transgression took place, traces of which are represented at 35-45 m asl as a terrace in Guria near the village of Tskaltsminda. In the upper Quaternary, the Karangatian transgression took place. The Karangatian terrace is situated at 25-30 m asl in Guria and Apkhazti. In the Holocene, as a result of the early Black Sea transgression, the modern seashore was formed, the age of which has been determined at 4000-6000 years.

Quaternary glacial sediments in Georgia are distributed mainly in the high mountainous zone in the Greater Caucasus and to a lesser extent in the Lesser Caucasus. Evidence of Würm, Riss, and Mindel glacial periods are present here. The moraines of all the glaciations are fixed in the central segment of the Caucasus. Glacial trenches formed at the riverheads and they descend to 2000-2200 m asl.

Alluvial sediments are widespread in Georgia, and they make up the river terraces in the depressions between the mountains. Their paleontology has not been well studied, and their correlation is based only on geomorphological methods. Contrary to alluvial sediments, Quaternary lake sediments are rare in Georgia. They are mainly formed on the Javakheti volcanic highland (Tsalka depression) and the Kolkheti lowland.

Volcanism

In the Quaternary period, intensive subaerial volcanic activity took place within the territory of Georgia. The genesis of this volcanism is disputed. A substantial number of geologists consider that it is the result of residual oceanic crust subduction; another group of geologists relate it to mantle plume activity. There were two major volcanic provinces in Georgia in the Quaternary: the Greater and Lesser Caucasian. Kazbegi (5033 m asl) is the best known in the volcanic region of the Greater Caucasus, which is made up mainly of andesites and last showed activity around 6000 years ago. In the Lesser Caucasus, the Javakheti volcanic highland was formed during the Quaternary; it was formed mainly of 300 m thick basalt lava layers. In this highland, the 70 km long, S-N trending Abul-Samsari volcanic range was formed already in the late Pleistocene-Holocene. The most prominent volcanoes in this range are Didi Abuli (3300 m asl) and Samsari (3284 m asl). The products erupted are mainly lavas (andesite to dacite) and very subordinate pyroclastics. Some isolated volcanic centers with geochemical characteristics and ages similar to the Abul-Samsari range were active in the Bakuriani-Borjomi area, north of the main volcanic chain (Pasquarè et al., 2011.

Seismicity

Present day seismicity of the region is defined by the northward movement of the Arabian plate toward the Eurasian plate. The convergence rate is estimated to be about 30 mm/yr, 2/3 of which is likely to be taken up south of the Lesser Caucasus, and it completely vanishes at the Greater Caucasus, forming a complex structure of seismic faults with diffused seismicity. A smaller portion of the seismic energy is released in the form of earthquakes. Analysis of the historical and instrumental seismological data shows that strong earthquakes with magnitudes up to 7.0-7.5 and macroseismic intensity of 9 (MSK scale) have occurred here during the Quaternary period. The recurring periodicity of such events is on the order of a thousand years (for the same source). The South Caucasus is within the area of high seismic activity, and a risk factor is constantly present. The consequences were heavy in the South Caucasus in the 20th and beginning of the 21st century, in particular in the 1980s and 1990s (Faravani, Spitak, Racha) and in 2002 (Tbilisi). The consequences of the powerful earthquakes that occurred in that period in Georgia are felt even today.

Mineral Resources

In the Quaternary period, the territory of Georgia was rich in necessary mineral resources for the development of humans. Both Caucasian range systems were supplied with freshwater, and caves were formed in the Cretaceous sediments of the southern slope by an intensive net of montane rivers. Besides, numerous obsidian deposits were formed as a result of intensive subaerial volcanism. Thick layers of volcanic ash and tuff were laid down as a result of the same volcanism; thick layers of sand, rocks, and conglomerations were formed as a result of intensive exhumation (it was easy to carve dwelling spaces in both mentioned formations). At the same time, substantial clay deposits (which were formed as a result of intensive alteration), sea sand, iron deposits (Guria), and alluvial gold (Svaneti, Bolnisi region) are also worth mentioning.

Geographically the Caucasus represents a system of the Greater and Lesser Caucasus mountain ranges, the intra-Caucasian, and foothill depressions. Because of its easy terrain and good climate, the intra-Caucasian depression is the most favorable natural corridor between the Black and Caspian seas, thus between Europe and Asia. It is protected from invading cold air masses from the north by the Greater Caucasus Range, and from the hot and dry air masses from the south by the Lesser Caucasus. This segment of the Caucasus contains favorable climatic conditions for the development of biotic populations, including humans, which is the reason that the area was inhabited by early hominins from the Early Pleistocene. In addition, the corridor harbors numerous sites of Paleolithic age, which means that the area has been inhabited by people throughout the Quaternary. At the same time, intense geological processes were still taking place in this period, including volcanic activity, which showed the special sensitivity of the early hominins.

Study into the Quaternary geology, volcanism, and seismicity of the Georgian territory shows that humans occupying the area faced great challenges. They either had to leave powerful volcanic and seismic activity zones or adapt to the environment. As we can see, the living conditions (climate and natural resources) were so good, they chose to stay, and the Georgian autochthonic nation was formed.

The map of the Field Trips is provided in Fig. 1.

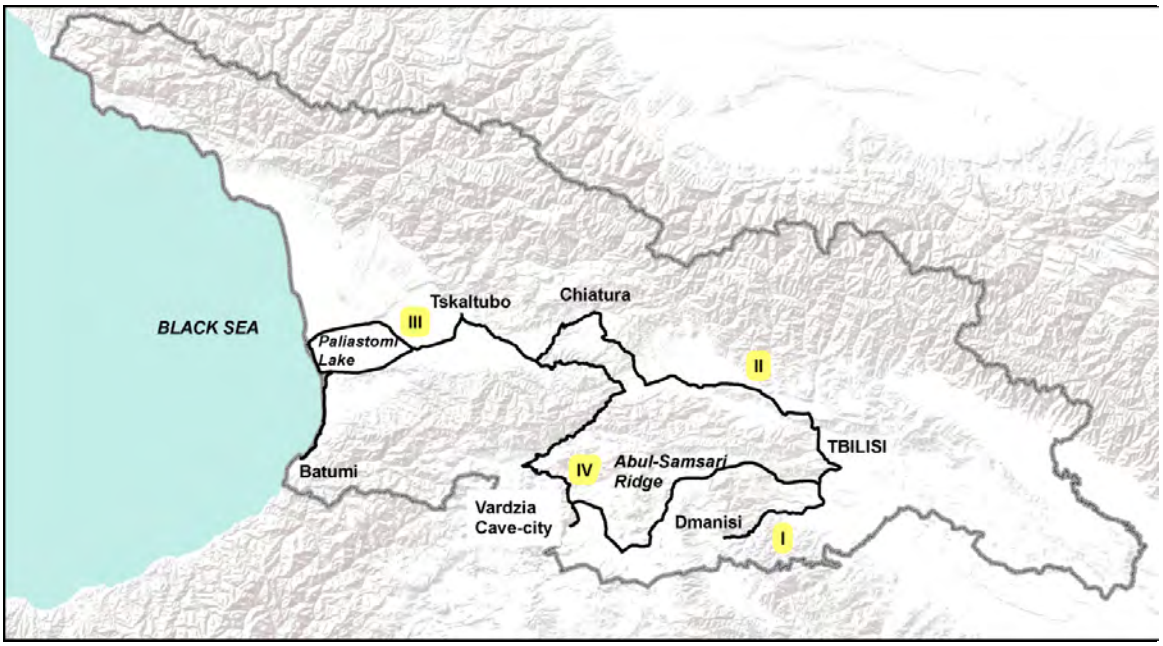

Fig. 1. Map of the Field Trips of IGCP 610 in Georgia. I. Tbilisi-Dmanisi-Tbilisi; II. Tbilisi-Chiatura-Tskaltubo; III. Tskaltubo-Paliastomi Lake-Batumi-Tskaltubo; IV. Tskaltubo-Borjomi-Vardzia-Tbilisi.

15 October 2013 (by bus)

Field Trip I. Mashavera River Late Pliocene basaltic volcanic flow and Dmanisi earliest hominin archaeological site (accommodations in Tbilisi).

Stop I-1. Mashavera River volcanic basalt flow

Guide: Nona Gagnidze, Ilia State University, Georgia

Along the Mashavera River valley, near the site of the Dmanisi hominins (Gabunia and Vekua, 1995), a basaltic lava flow is exposed that emanated from the Dmanisi volcanic plateau (Fig. 2).

Figure 2. Mashavera River volcanic basaltic flow.

It has a thickness of 15-17 meters and represents a very good geological picture, as it follows the Quaternary alluvium. Lots of faunistic materials are found along the surface of the flow, such as teeth

and bones of elephant, wolf, deer, ox, and horse. According to the K-Ar dating (Berkeley Isotope Research Center), its age is 1.9 mya, which is very close to the age of the basaltic lava flow of Dmanisi

Stop I-2. Dmanisi Hominin Site.

Guide: Tamar Meladze, Ilia State University, Georgia

Dmanisi is located about 85 km southwest of Tbilisi, buried below the ruins of the medieval town of Dmanisi in the Mashavera River valley, which drains the Javakheti volcanic chain to the west (Gabunia and Vekua, 1995). The site is situated on a promontory, elevated about 80 m above the confluence of the Mashavera and Pinezaouri River valleys. Just prior to the occupations at Dmanisi, the Mashavera valley was filled by 80-100 m of mafic lavas that formed the Mashavera Basalt. Recent excavations at Dmanisi have revealed an extraordinary record of the earliest hominin dispersal beyond Africa (1.75 million years ago). Several hominin individuals along with abundant well-preserved remains of fossil animals and stone artifacts have been found (Fig. 3).

Figure 3. Dmanisi, Europe's earliest hominin archaeological site.

The Dmanisi hominin specimens, first discovered in 1991, are the most primitive and small-brained humans (Fig. 4) found outside the African continent, and they were attributed to *Homo erectus* sensu lato.

Figure 4. Fossil skull from Dmanisi.

Lately, they were identified as a subspecies *Homo erectus georgicus* or even an independent species *Homo georgicus*, representing a transitional stage between *Homo habilis* and *H. erectus*. Moreover, it is presumed that besides *Homo georgicus*, another species, *Homo ergaster*, also inhabited South Georgia, but not everybody shares this view, held by Georgian scientists. It is widely recognized that

the Dmanisi discoveries have changed our knowledge concerning the migration of Homo from Africa to the European continent.

Presently, two main stratigraphic units are distinguished in the exposed sections. Stratum A bears the vast majority of the faunal materials and all the hominin remains and consists of pyroclastic silt and fine sand with weak pedogenic structure and pedogenic carbonates in the upper part. Stratum B reveals the highest densities of stone artifacts but is poorer in fossils, consisting of weathered volcanic silts and sands, with dark grey ash in the middle of the unit and prominent basal grey ash. These two layers are separated by a calcareous horizon that has halted further diagenetic damage and compaction in Stratum A, thus allowing remarkable fossil preservation. The structure and thickness of the calcareous horizon is variable in different locations, and questions concerning the sedimentation process still need to be clarified. Hominin remains at Dmanisi are the most ancient in Eurasia and are dated at 1.75 million years. There is great potential for further finds as well.

16 October 2013 (by bus)

Field Trip II. Mtskheta, Chiatura Paleolithic sites, Sataplia dinosaur footprints, and cave state reserve (accommodations in Tskaltubo).

Stop II-1. Mtskheta

Guide: Nestan Tskitishvili, Ilia State University, Georgia

Mtskheta is located 20 km north of Tbilisi at the confluence of the Aragvi and Kura rivers. It is one of the oldest continuously inhabited cities in the world. Remains of towns at this location have been dated to earlier than the year 1000 BC, and Mtskheta was capital of the early Georgian Kingdom of Iberia from the 3rd 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.

Mtskheta is the most religious city of Georgia; it has been the shrine of pagan idols since times immemorial. Svetitskhoveli Cathedral (11th century) (Fig. 5) and Jvari Monastery (6th century) are among the most significant monuments of Georgian Christian architecture and are historically significant in the development of medieval architecture throughout the Caucasus.

Figure 5. Svetitskhoveli Cathedral in Mtskheta.

On the outskirts of Mtskheta are the ruins of Armaztsikhe fortress (3rd century BC), the Armaztsikhe acropolis (dating to the late 1st millennium BC), remains of "Pompey's bridge" (according to legends built by Roman legionnaires of Pompey the Great in 1st century BC), and the fragmentary remains of a royal palace (1st–3rd century AD). Due to its historical significance and numerous ancient

monuments, the "Historical Monuments of Mtskheta" became a UNESCO World Heritage Site in 1994.

Stop II-2. Chiatura Paleolithic sites.

Guide: Tamar Meladze, Ilia State University, Georgia

More than 200 Paleolithic sites are represented in the Chiatura and Sachkhere Districts (Western Georgia). The **Bondi Cave** (Fig. 6) is located north of the town of Chiatura, 30 m along the Tabagrebi River (477 m asl).

Figure 6. Bondi Cave of Chiatura District.

The site opens to the south onto the slope of a small valley. The site itself is a small cave, with an arched entry that is 8 to 9 m in height. The cave has a length of approximately 11 meters, and a maximum width of 7 m, thus representing a surface area of approximately 101 m2. Bones were recovered from all layers, and for three of the excavated squares (A4-B4-C3), bone was sampled for radiocarbon 14 dating by Beta Analytic Radiocarbon Dating Laboratory (Miami, USA) and the Centre of Radiocarbon Dating at the University of Lyon (France). Twelve samples (bones) associated with the different archaeological layers were dated using Accelerator Mass Spectrometry (AMS) radiocarbon dating methods (Tushabramishvili et al., 2009a).

The dates indicate episodes of human occupations from layer VII of 38750 ±480 ka 14C BP (43123 ±632 ka Cal BPHulu) to layer III of 14050 ±90 ka 14C BP (17295 ±225 ka Cal BPHulu). The excavations have revealed a sedimentary sequence (8 lithological layers), which is more than 3.2 m in thickness. The limestone bedrock has not been reached yet. The first layer is mixed and belongs to later ages. These are surface sediments with an average thickness of 10 to 15 cm, with traces of chalcolithic pottery, and some from the Iron Age, the Roman period, and the Medieval Ages. The archaeological material is especially abundant on the upper two-thirds of the sequence, which corresponds to the UP layers (layers II to VI). All layers contain bone and lithic material, but layers VII-VIII have yielded a Middle Paleolithic lithic industry. More than 7000 artifacts have been found within Bondi Cave. The raw material is generally flint. Only 63 objects were made of obsidian, 22 objects were made of andesite. Layers IV-V were occupied most intensively. A hominin tooth was excavated in the sub-layer Vb. The tooth could be either a lower right permanent first molar (M1 dextra) or lower right deciduous second molar (m2). The tooth is a lower deciduous second molar – m2 dex of Homo. The human tooth was discovered in the UP context of sub-layer Vb, dated to between 21.5 and 24.6 ka 14C BP. These ages provide the oldest date range for human remains in an UP context in Georgia, presuming its attribution to Homo sapiens correct.

Stop II-3. The Undo Klde Cave

Guide: Tamar Meladze, Ilia State University, Georgia

The **Undo Klde Cave** (Fig. 7) is located in Chiatura district (village of Vachevi) and is situated at 570 m asl and 90-100 m from the Varkhmela River level.

Figure 7. Undo Klde Cave of Chiatura district

The height of the cave at the entrance is 2 m, its width 5 m. The orientation of the cave is southwest, and 8 lithilogical layers (more than 4.0 m in thickness) have been discovered at the entrance of the cave. The first layer (humus) is mixed and belongs to later ages. These sediments, with average thickness of 20-25 cm, belong to the Roman period. Layers II-III yielded an Upper Paleolithic lithic industry. The Middle Paleolithic materials have been found in layers IV-VII. The VIII lithological layer is sterile. About 150 stone objects have been found in the Middle Paleolithic layer. Most of the tools are elongated Mousterian points. Other material is represented by flakes and elongated blades. The number of artifacts is not enough for the final detemination of the technology. The human tooth was found in the Middle Paleolithic layer. Unfortunately, the tooth (possible Neandertal) is broken and worn. In spite of this, the find is important because of the rarity of Neanderthal remains in Georgia. At the end of the cave's horizontal corridor (length of 80 m), a rather deep (47 m) natural karstic pit (with an upper diameter of 7.0 m, and a bottom diameter of 3.0 m) has been discovered, which is full of faunal and anthropological remains (Tushabramishvili et al., 2009b).

Stop II-4. Sataplia Cave and Dinosaur Footprints State Reserve

Guide: Avtandil Okrostsvaridze, Ilia State University, Georgia

Discovered in 1935, Sataplia Cave (Fig. 8) was named after Sataplia Mountain, which gained its name from the local tradition of collecting honey from the bees that inhabit the mountain's southern slope; Sataplia means 'place of honey'. Sataplia State Reserve is a very rare monument of complex character and contains geological, paleontological, speleological, and botanical attractions. Sataplia Mountain is famous for five beautiful karst caves. One of these karst caverns is 600 m in length; the beauty of this cave is a cupola-shaped hall, located 100 m from the entrance, where the size of the stalactites and stalagmites in the center astonishes visitors.

Sataplia Cave was first noticed in 1925 by Kutaisi museum employee P. Chabukiani, who was able obtain protection by the local government for this valuable monument. In 1933, dinosaur footprints were found (Fig. 9), imprinted into the Lower Cretaceous limestones. These imprints are unique

because we have two stratigraphic levels: lower imprinting of the herbivorous dinosaurs (Captosaurus), and 1.5-1.7 m above, there are footprints of predatory dinosaurs (Sathapliasaurus). Today, 96 footprints of dinosaurs are preserved in Sataplia.

Figure 8. Stalactites and stalagmites of Sataplia Cave.

Figure 9. Dinosaur footprints of Sataplia.

17 October 2013

Field Trip III. Paliastomi Lake, Tsvermagala Chaudian Black Sea Terrace, Batumi seashore (accommodations in Tskaltubo).

Stop III-1. Paliastomi Lake

Guides: Zurab Janelidze and Lasha Sukhishvili, Ilia State University, Georgia

Paliastomi Lake (Fig. 10) is located on the Kolkheti Lowlands, near the Black Sea and the city of Poti, with a surface at 0.3 m asl. The lithological and facies analyses of sediments show that the lake first originated as a lagoon (ca. 3600-4200 years ago) after the transgression of the Black Sea, when sea level had increased one meter compared to today's level (Mamaladze, 1982). The process of separation from the sea began around 3000-3500 years ago as a result of coastal dune formation. The emergence of Paliastomi Lake is a vivid example of changes in environment which took place in the Quaternary. The analysis of bed sediments helps us to reconstruct the picture of Black Sea level

changes along the coastline of the Kolkheti Lowlands from the middle Pleistocene. The lake and surroundings are rich in biodiversity. It is included within the boundaries of Kolkheti National Park.

Figure 10. Paliastomi Lake.

Stop III-2. Tsvermagala Black Sea Chaudian Terrace.

Guides: Zurab Janelidze and Lasha Sukhishvili, Ilia State University, Georgia

The terrace is located in the Guria foothills, near Ureki and represents the most complete cross-section of Upper Pliocene and Quaternary sea sediments from the whole Black Sea coastal region. In Chaudian terrace sediments (clay, sands, and loosely cemented conglomerates) (Fig. 11) on Tsvermagara hill near the village of Khvaberi, a number of mollusk species are found: *Didacna palassi*; *D.* ex. gr. *crassa*; *D.* aff. *submigamidata*; *Balanus* sp. etc.

Figure 11. Outcrop of the Tsvermagala Chaudian Terrace.

Currently, the surfaces of the terrace are located at 90-100 m asl. Drilling activities have recovered Chaudian sea sediments in the Kolkheti Tectonic Depression, 200-250 below ground level and containing fossilized mollusks. The site is located about 20-40 km north of Tsvermagala hill. Thermoluminescence dating of clay samples taken from the stratigraphic cross-section through Tsvermagala hill yields 600 thousand years. It should be noted that Chaudian sea sediments gradually merge into Gurian terrace sediments, which are located below them, and into Lower Euxinian sediments, which are situated above them.

Batumi is a seaside city on the Black Sea coast of southwest Georgia and serves as an important port and commercial center. It occupies a subtropical zone, rich in agricultural produce such as citrus fruit

and tea. While industries of the city include shipbuilding, food processing, and light manufacturing, most of its economy revolves around tourism.

Batumi is located on the site of the ancient Greek colony of Bathus in Colchis; the name derives from the Greek phrase bathus limen meaning "deep harbor." Under Hadrian (117-138 AD), it was converted into a fortified Roman port and later deserted for the fortress of Petra founded in the time of Justinian I (527-565). Garrisoned by the Roman-Byzantine forces, it was formally a possession of the kingdom of Lazica until it was occupied briefly by the Arabs, who did not hold it. In the 9th century, it formed part of the Bagratid monarchy of Tao-Klarjeti, and at the close of the 10th century, it belonged to the succeeding unified kingdom of Georgia.

The Black Sea beach at Batumi is intensively washed because hydro electric power station cascades were built in the Chorokhi River. Shekvetili, Mtsvane Kontskhi, and Kobuleti beaches are also washed the same way. The sea has become more active, a good example of which is the large storm of 25 March 2013, which damaged the city's coastline to a great extent (Fig. 12).

Figure 12. Black Sea shore at Batumi after the heavy storm of 25.03.2013.

18 October 2013

Field Trip 4. Dzirula massif, Borjomi, Vardzia Cave Town and Quaternary Abul-Samsari volcanic ridge (accommodations in Tbilisi).

Stop IV-1. Dzirula massif

Guide: Avtandil Okrostsvaridze, Ilia State University, Georgia

The Dzirula pre-Mesozoic massif is exposed in the central part of Georgia and occupies 1200 km2 at the current level of erosion. It is composed mainly of Neoproterozoic plagiomigmatites, crystalline schists, and diorites and ophiolites; Cambrian tonalities and granodiorites; Late Paleozoic anatectic granites; and Late Triassic hybrid orthoclase gabbros. In the Dzirula massif, there is a wide spectrum of geodynamic and magmatic events taking place in the region, and that's why it represents a major

formation for general geological interpretations. Complex investigation of this massif illustrates continental crust forming processes from late Proterozoic to late Paleozoic time. On the eastern edge of Dzirula massif, upper Paleozoic granitoids are transgressively, with angular unconformity, overlain by Lower Cretaceous (Barremian) limestones.

Stop IV-2. Borjomi resort town

Guide: Nestan Tskitishvili, Ilia State University, Georgia

The town is situated in the northwestern part of Georgia, in the picturesque Borjomi Gorge on the eastern edge of the Borjomi-Kharagauli National Park (Fig. 13).

Figure 13. Resort town of Borjomi.

The town is famous for its mineral water industry (which is the number one export of Georgia), and the Romanov Summer Palace in Likani. Borjomi mineral water is particularly well known in those countries that were part of the former Soviet Union. Because of the supposed curative powers of the area's mineral springs, it is a frequent destination for people with health problems.

The town's warm climate, its mineral water springs, and its forests made Borjomi a favorite summer resort for the aristocracy of the 19th century, and gave it the popular name of "the pearl of the Caucasus." Borjomi, together with Bakuriani, was named by Georgia as an applicant city for the 2014 Winter Olympics on June 22, 2005, but it was eliminated as a candidate by the International Olympic Committee.

Stop IV-3. Vardzia Cave Town

Guides: Avtandil Okrostsvaridze and Nona Gagnidze, Ilia State University, Georgia

The Vardzia Cave town is located in Meskheti Region (in southern Georgia, near the border with Turkey), on the left bank of the Mtkvari River, at 1300 m asl (Fig.14).

Figure 14. Panorama of Vardzia Cave Town

It served as town, fortification, and monastery. The construction of Vardzia began at the end of the 12th century during the reign of King Giorgi III and was completed during the reign of Queen Tamar. Vardzia is one of the masterpieces of the Georgian Renaissance period and represents a good example of the coexistence of humans and the natural environment. The Church, dating to the 1180s during the golden age of Tamar and Rustaveli, has an important series of wall paintings. Now, it is part of a state heritage reserve. The extended area of Vardzia and Khertvisi fortress has been submitted for future inscription on the UNESCO World Heritage List.

Vardzia Cave Town is cut into an andesite-dacite flow with a thickness of around 40-60 meters. The cemented body of the tuffs is represented by obsidian ash, which under conditions of low temperature hydrothermal processes turned to zeolites, specifically mordenite. This process is observed along the whole length of this volcanic flow, for around 20 kilometers to the Khertvisi Fortress (Fig. 15).

Figure 15. Khertvisi fortress.

The family of fibrous zeolites (erionite, ferrierite, mordenite, mazzite, offretite, and rossianite) has been recognized as more carcinogenic than the asbestos minerals by the World Health Organization.

Khertvisi fortress is one of the oldest fortresses in Georgia and was functional throughout the Georgian feudal period. It is situated on a high rocky hill in the narrow canyon at the confluence of the Mtkvari and Paravani rivers. The fortress was first built in the 2nd century BC. As the legend says, Khertvisi was destroyed by Alexander the Great.

Stop IV-4. The Quaternary Abul-Samsari volcanic ridge

Guides: Avtandil Okrostsvaridze and Nona Gagnidze, Ilia State University, Georgia

The Quaternary Abul-Samsari volcanic ridge was formed on the Javakheti volcanic plateau and is of Pliocene-early Pleistocene origin. The elevation of the Abul-Samsari ridge is 2500-3000 m asl, and it stretches from the north to the south for around 40 kilometers. There are more than twenty volcanic centers along the ridge. The most prominent volcanoes in this ridge are Didi Abuli (3300 m asl) (Fig. 16) and Samsari (3284 m asl).

Figure 16. Quaternary Didi-Abuli Volcano.

The eruptive products are mainly lavas (andesite to dacite) and very subordinate pyroclastics. Based on K-Ar dating, the following four intervals of late Pleistocene-Holocene volcanic activity on the Abul-Samsari ridge are identified: (I) 800-700 ka; (II) 400 ka; (III) 320-170 ka, and (IV) Late Pleistocene-Holocene (less than 50 ka), comprising the youngest Tavkvetili volcano (younger than 30 ka).

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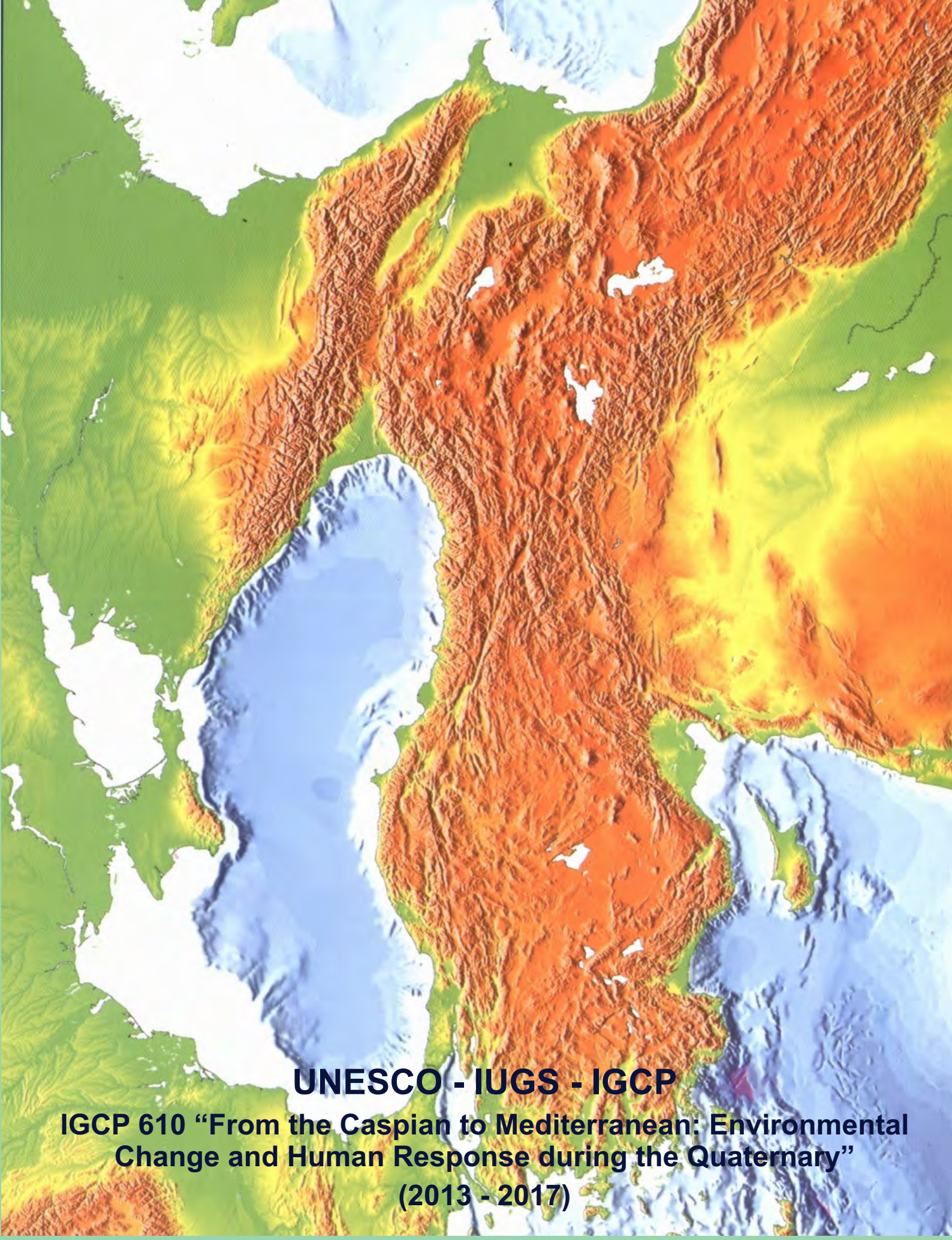

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