

Towards the understanding of human response to environmental change in the Caspian-Black Sea-Mediterranean Corridors (IGCP 610 final report))

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Introduction

The Caspian-Black Sea-Mediterranean Corridor ["CORRIDOR"] encompasses the Eurasian intercontinental basins of the Caspian, Black, Marmara, Aegean, and Eastern Mediterranean (Levantine) seas with their connecting straits and coasts. Here, sea-level changes are clearly expressed due to geographical location and semi-isolation from the World Ocean, which makes the "CORRIDOR" a paleoenvironmental amplifier and a sensitive recorder of climatic events. Periodic connection/isolation of the basins during the Quaternary predetermined their specific environmental conditions and particular hydrologic regimes, and thus, the area, and especially the Ponto-Caspian, represents a "natural laboratory" to study the responses of semi-isolated and isolated basins to Global Climate Change [GCC].

The ["CORRIDOR" is characterized by rich sedimentary, geomorphological, archaeological, paleoanthropological, and historical records providing a superb opportunity to assess the influence of climate and sea-level change on human development.

The geological study of the "CORRIDOR" began at the end of the 19th century. While studying outcrops on Capes Chauda and Karangat, and on the Kerch-Taman Peninsula, Andrusov (1884) discovered that the former contained Caspian while the latter contained Mediterranean molluscan species that do not live today in the Black Sea. Based on these findings, he suggested that these geological sequences were formed on the Black Sea bottom during periods of Caspian and Mediterranean connections, respectively, and were exposed later by tectonic uplift. Indeed, similar sediments were found on the Black Sea bottom in the course of the earliest marine explorations (Andrusov, 1890; Arkhangel'sky and Strakhov, 1938) and then in many other localities when the Black Sea shelf and continental slope were mapped and studied over the course of several geological surveys (Yanko, 1990; Yanko-Hombach, 2007a,b). As a result, a vast amount of geological material was obtained and analyzed by many scientists, including co-leaders of this Project (S.A. Kowalewskiy, M.M. Zhukov, V.M. Muratov, L.A. Nevevskaya, P.V. Fedorov, G.I. Popov, A.A. Svitoch, V.A. Zubakov, P.A. Kaplin, A.L. Chepalyga, F.A. Shcherbakov, A.B. Ostrovsky, N. Panin, V. Yanko-Hombach, T.A. Yanina, A. Mamedov, P.N. Kuprin, Ya.A. Izmailov, S.A. Nesmeyanov, I.P. Balabanov, and many others). The Ponto-Caspian stratigraphic scale was developed based on mollusks (e.g., Nevevskaya, 1965; Yanina, 2009) and foraminifera (Yanko, 1990; Yanko-Hombach, 2007a). This, in turn, enabled the correlation of major events in this region with those in the Mediterranean Sea and World Ocean. It also allowed a reconstruction of the time and direction of Caspian and Mediterranean intrusions into the Black Sea via the connecting straits (Yanko-Hombach and Motnenko, 2011).

The archaeological and paleoanthropological studies in the "CORRIDOR" started early in the 19th century (Boriskovskiy, 1879) and were further triggered with the discovery and recovery of the first Neanderthal remains in Gibraltar, and then with the first findings of *Homo erectus* bones in the Georgian Caucasus (Gabunia et al., 2000). Since that time, much evidence of early human occupation (stone artifacts, settlements, dwellings, hearths, human bones, ritual objects, and items of art, etc.) in the "CORRIDOR" during the Quaternary has been collected by researchers from all over the world. Important results were achieved by H.A. Amirkhanov, O. Bar-Yosef, V. Chabai, G. Finlayson, Yu. Kolosov, D. Lordkipanidze, R. Munchaev, M. Özdoğan, P. Dolukhanov, O. Smyntyna, V. Stanko, C. Stringer, and many others. The cultural processes along the "CORRIDOR" show clear tendency for deep interaction between Homo and environmental settings since the very beginning of human interactions in the "CORRIDOR." For example, typical for the region Miccoque, Levallois, and Mousterian techniques of flint processing demonstrate wide range of interregional contacts related to a number of sea-level lowstands. The Late Gravettian stage of the final Ice Age/Late Upper Paleolithic in the northern parts of the Ponto-Caspian stands as a distinct socio-cultural entity based on bison hunting with specially

organized ritual places. The Mesolithic stage of human adaptation in the beginning Holocene is equally marked by clear evidence of environmental stress/es expressed in decrease of population density and search for new hunting species (Arnold, 2007; Smyntyna, 2007; Stanko, 2007). Coinciding with post-Glacial climatic fluctuations, the so-called “Neolithic Revolution” was a time of major cultural and technological inventions with substantial change in subsistence expressed in the transition from hunting-gathering to food producing that required new technologies, such as groundstone, pottery, as well as new modes of living in permanent villages with new social structure. At the same time, these revolutionary changes in living and subsistence patterns impacted environment, being expressed in demographic pressure, over-exploitation of natural resources, displacement of natural species, etc. (Smyntyna, 2004).

Despite over 150 years of intensive field studies and interpretative research, many aspects of the geological history as well as human responses to environmental changes in the “CORRIDOR” during the Quaternary remain disputed.

Scientists agree to the following highly approximate correlation between stratigraphic units and MISs in the Black Sea, Caspian, and Mediterranean regions, respectively: Gurian-Apsheonian-Calabrian (Marine Isotope Stage, MIS 23–22?), Chaudian-Bakinian-Sicilian (MIS 21–15?), Old Euxinian (MIS 14–8?) + Uzunlarian (MIS 7–6?) -Early Khazarian-Paleotyrrenian, Karangatian (MIS 5) - Late Khazarian-Tyrrenian, Neoeuxinian (MIS 4-1) – Khvalynian - Grimaldian, and Chernomorian (MIS 1) - Novocaspian-Verzilian, respectively. However, many questions remain unsolved. For example, there is no unanimous opinion in the correlation of local horizons not only with each other but with MISs as well. This is because the chronometric age of the sediments in the Quaternary Ponto-Caspian stratotypes varies depending on the method used, e.g., $^{230}\text{U}/\text{Th}$, thermoluminescence, etc. (Zubakov, 1988) and requires revision.

There is no unanimous opinion on the number of transgressive and regressive stages and their amplitude in certain geological epochs. For example, in the Caspian region, some researchers (e.g., Fedorov, 1978; Popov, 1983; Rychagov, 1997) consider that the Bakinian epoch had two transgressive stages: Early Bakinian and Late Bakinian, subdivided by a regressive stage, while others (e.g., Zhukov, 1945; Svitoch et al., 1998) deny this. While Fedorov (1978) believes that the regressive stage between the two Bakinian stages was short and low in amplitude, Rychagov (1997) disagrees. The amplitude of the transgressions, which range from 10 to 30 m asl, is also argued. Investigators also debate whether a large Bakinian-Khazarian regressive stage was complicated by a small Urundzhikian transgression at the very end of the Early-beginning of the Middle Pleistocene. Yanina (2008) supports this idea, while Shkatova (2006) is opposed to it. There is also no agreement about the level of the Early Khazarian transgression, which is placed between 35–40 m asl (Fedorov, 1957), 0–5 m asl (Vasiliev, 1972), 15–20 m asl (Popov, 1983), and 10 m asl (Rychagov, 1997).

Summarizing, there is no generally accepted concept of the Ponto-Caspian development that would explain the main events of its Quaternary history, and researchers are trying to use alternative methods that introduce more confusion. For example, Badertscher et al. (2011) used oxygen isotope ($\delta^{18}\text{O}$) signatures in stacked speleothems from Sofular Cave in northern Turkey to propose that the Black Sea and Mediterranean connection as well as that between the Black Sea and Caspian have been open for a greater number of periods than previously thought. In particular, Caspian-Black Sea connections occurred at least seven times, while Mediterranean-Black Sea connections occurred at least twelve times since 670 ka BP. However, Yanko-Hombach and Motnenko (2011) respond that if the data of Badertscher et al. (2011) are correct, we would see corresponding alternations of faunal assemblages in coeval age sequences exposed in stratotypes of the Kerch, Taman Peninsula, and Caucasian coast. However, foraminifera show that the Caspian-Black Sea and Mediterranean-Black Sea connections existed four and six times, respectively, since the Matuyama-Brunhes reversal (i.e., the last 780 ky), and in most cases, these connections did not occur synchronously with those of Badertscher et al.

The most recent archaeological projects have been carried out by Odessa I.I. Mechnikov National University (V. Stanko, O. Smyntyna), the Institute of Archaeology of the Russian Academy of Sciences (H.A. Amirkhanov, R. Munchaev), the Institute of Archaeology of the National Academy of Sciences of

Ukraine (Yu. Kolosov, V. Chabai), Istanbul University (M. Özdoğan), the Gibraltar Museum (C. & G. Finlayson), the Georgian National Museum (D. Lordkipanidze), Newcastle University (P. Dolukhanov), the Natural History Museum (C. Stringer), Harvard University (O. Bar-Yosef), and many others.

The anthropological projects have been carried out by the Institute of History, Archaeology, and Ethnography of the Dagestan Scientific Center, Russian Academy of Sciences under supervision of Director Prof. Academician H.A. Amirkhanov. Their main goal is to study a compact group of multi-layer Early Paleolithic archaeological sites which testify that the first Homo species appeared in the Northern Caucasus in the period of 1.2–1.8 Ma ago.

Despite many years of intensive field studies and interpretative research, many aspects of the human responses to environmental changes in the “CORRIDOR” during the Quaternary remain disputed. One more acute archaeological problem is determining the place of *Homo sapiens neanderthalensis* in the anthropological and cultural history of the “CORRIDOR.” In Soviet science, particularly, Neanderthals were regarded as our closest relatives and ancestors (e.g., Boriskovskiy, 1979); the same idea was widespread also in Western science in the mid-20th century (e.g., Gamble, 1999). Recent studies of their archaeological sites, especially ones applying chronometric date calibration, reveal that at the final stage of its history this species lived in the “CORRIDOR” coeval with Anatomically Modern Humans (AMH) for several thousand years (Chabai, 2007), and the newest results of DNA analysis cast doubts on Neanderthal-AMH interbreeding (Green et al., 2010). Elaboration of a detailed chronostratigraphy for the Last Glacial, broad application of chronometric date calibration, and detailing of Neanderthal and AMH adaptive strategies would enhance our understanding of these species’ co-existence and the extinction of Neanderthals. Another acute problem is determination of the timing of colonization of the “CORRIDOR” by early humans and the source areas from which they came. Recently, traditional thinking about this process, first from Africa and then the Western Mediterranean (Mellars, 2004), has been reconsidered due to the discovery of Dmanisi in Georgia (Gabunia et al., 2000) and Early Paleolithic sites in Central and Southern Dagestan (Chepalyga, personal communication). Simultaneously, archaeological excavations at Yarımburgaz and other sites in Turkey have revealed deposits with Oldowan lithic remains. None, however, have been correlated with the geological sequences (Özdoğan, personal communication). Thus, the correlation of horizons from different parts of the region that contain the earliest traces of human occupation, and comparative analysis of stone artifact assemblages in order to establish potential interrelationships among early humans still remain goals for further scientific inquiry.

All this predetermined a need for multidisciplinary and integrated investigation towards the better understanding of human response to environmental change in the “CORRIDOR”. Such investigation should be performed by the international framework of researchers from different countries and having different scientific skills.

The main goal of the IGCP 610 Project is to provide cross-disciplinary and cross-regional correlation of geological, archaeological, environmental, and anthropological records in order to (a) explore interrelationships between environmental change and human adaptation during the Quaternary, (b) create a networking and capacity-building structure to develop new interdisciplinary research initiatives, and (c) provide guidance to heritage professionals, policy makers, and the wider public on the relevance of studying the “CORRIDOR” for a deeper understanding of Eurasian history, environmental changes and their relevance, as well as past and future impacts on humans.

To achieve the main goal and objectives, the Project has a triple focus: (1) geological history, (2) paleoenvironmental change (climate, sea level, coastline migration), and (3) human response (migration, subsistence strategy, physical and cultural adaptation, etc.) to environmental changes. Six dimensions of evidence are explored by integrating existing data and hypothesis testing: 1. The geological dimension examines the sedimentary record of vertical sea-level fluctuations and lateral coastline change. 2. The paleoenvironmental dimension integrates paleontological, palynological, and sedimentological records to reconstruct paleolandscapes. 3. The archaeological dimension investigates cultural remains. 4. The paleoanthropological dimension studies responses of different Homo species to environmental change. 5. The mathematical dimension provides GIS-aided mathematical modeling of climate, sea-level change,

and human dispersal linked to environmental change. 6. The geo-information dimension will try to grasp the "big picture" of geoarchaeological events throughout the Quaternary. Attention is constantly given to synthesizing the wealth of literature published in local languages, stored in archives, and largely unknown in the West.

The work has been **performed by cross-correlated efforts of twelve Working Groups (WG)**. **WG1 Recent Ecosystems** provides information about recent ecosystems in each region to be used in retrospective analyses of Quaternary ecosystems. **WG2 Paleontology and Stratigraphy** compiles existing data as well as those obtained by the Project on the Quaternary MFO in stratotypes/outcrops and key drill holes in each geographical region in order to establish regional stratigraphic scales. **WG3 Vegetation, Soils, and Landscapes** compiles pollen data sets as in each geographical region to reconstruct vegetation and climate peculiarities over most of the Quaternary. **WG4 Geophysics and Sequence Stratigraphy** collects available geophysical data obtained in different regions, to correlate erosional and ravinement surfaces as well as evidence for active tectonics. **WG5 Neotectonics** evaluates wherever possible the role of neotectonics on sea-level change and coastal processes in each geographical region and correlate them for the entire CORRIDORS. **WG6 Archaeology and Ethnography** correlates information on human adaptation to environmental change over the CORRIDORS. **WG7 Paleoanthropology** summarizes and correlates available information about early humans (*Homo erectus*, *Homo sapiens neanderthalensis*, and *Homo sapiens sapiens*) in the entire "CORRIDOR" since the beginning of the Quaternary. **WG8 Paleogeography and Paleoenvironment** summarizes the data obtained by WG 1 to 7 in order to distil the contribution of environmental change to the development of humankind by cross-disciplinary and cross-regional correlation of geological, archaeological, environmental, and paleoanthropological records for the entire "CORRIDOR." At the top, there are three **Modeling Working Groups** that obtain data from the Geographical Coordinators in order to develop their respective mathematical models. And finally, there is **Synthesizing Working Group** that collects all data obtained by the project.

Main achievements of IGCP 610 during 2013-2018

1. Network of specialists and links to other projects

The Project commenced on 1 April 2013. Since that time, it has served as a focal point for correlation of scientific data obtained by research projects dealing with environmental change and human response in a variety of settings within the CORRIDOR during the Quaternary. In general, six years of IGCP 610 activity have been carried out in strict agreement with the Working Plan [http://www.avalon-institute.org/IGCP610/work_plan.php].

The network of IGCP 610 includes about 260 scientists from 22 countries: Azerbaijan, Belgium, Bulgaria, Canada, Georgia, Germany, China, Greece, France, Israel, Italy, Kazakhstan, Latvia, Romania, Russia, The Netherlands, Switzerland, Turkey, Turkmenistan, UK, Ukraine, USA. The Project provides a friendly platform for participants to communicate their own research results and also bring together global experts, and research facilities to solve a truly global-scale problem.

The IGCP 610 project succeeds the IGCP 521 and INQUA 501. IGCP 521 "Black Sea-Mediterranean Corridor during the last 30 ky: sea level change and human adaptation" (2005-2010) proceeded alongside INQUA 501 "Caspian-Black Sea-Mediterranean Corridor during the last 30 ky: Sea level change and human adaptive strategies" (2005-2011). Both collected, integrated, and analyzed a vast amount of scientific data and established a strong international team of multidisciplinary scientists from 32 countries, producing valuable results. However, they mainly examined the Black Sea for the last 30,000 years. Subsequently, links were forged with IGCP 481 to include the eastern basins of the Caspian and Aral, but the principal focus was still western and European, and concerns about predicting coastal responses to GCC were confined to the Black and Azov seas. Expanding the new IGCP project to include the Central Asian basins covers the Eurasian cascade more completely, giving a bigger picture, involving scientists from countries farther east, and linking continents (Europe and Asia) more closely in the successive conferences and field trips. Pushing the date back permitted the IGCP 610 to draw upon research that investigates possible responses of pre-modern humans to environmental change across

nearly the entire Quaternary. Like its predecessor, the new project improved our understanding of the geoscientific factors affecting the global environment in order to improve human living conditions; increase understanding of geological processes and concepts of GCC, including socially relevant issues; and improve standards, methods, and techniques of carrying out geological and archaeological research, including the transfer of geological and geotechnological knowledge between industrialized and developing countries, providing a fundamental background for European neighbourhood policy and trans-border cooperation.

The Project's wide scope provides a superb opportunity to collaborate with other ongoing/past projects, as well as the MAB Programme of the UNESCO Strategy for Action on Climate Change, LOICZ, IGBP, and especially with SPLASHCOS, in which two co-leaders of this Project (V. Yanko-Hombach and O. Smyntyna) were members of the Management Committee. The Project complements the IGU Commission on Coastal Systems, INQUA CMP, and TERPRO Commissions, with which IGCP 521 cooperated previously through the INQUA 501 project, as well as the HaBCom, SACCOM, and PALCOMM Commissions. The Project also collaborates with geological surveys, archaeological expeditions, and corresponding museums in all countries bordering the "CORRIDOR."

The Project is linked to the EU-ITN programme "Drivers of Pontocaspian biodiversity rise and demise"; EU-WAPCOAST BS-ERA.NET 076 "Water Pollution Prevention Options for Coastal Zones and Tourist Areas: Application to the Danube Delta Front Area"; ICOMOS - The International Council on Monuments and Sites; COCONET "Towards COast to COast NETworks of marine protected areas (from the shore to the high and deep sea), coupled with sea-based wind energy potential"; SPLASHCOS "Submerged Prehistoric Archaeology and Landscapes of the Continental Shelf"; "Study of the formation processes and spatial distribution of methane in the Black Sea and theoretical considerations of their influence on basin eco- and geosystems," supported by the Ministry of Education and Science of Ukraine; and "Paleogeographical evolution of the Gulf of Taman with special regard to the underwater excavations in Phanagoria" funded by the University of Cologne and Russian Foundation for Basic Research (RFBR); and the series of projects supported by RFBR: № 14-05-00227 "Environmental evolution of the Caspian and Black Sea under the multiscale changes of climate," № 13-05-00086 "Pont-Manych-Caspian oceanographic system in the late Pleistocene: Systematics and correlation of events, evaluation of character and degree of interaction, paleogeographic consequences in the region," № 13-05-00242 "Radioisotope stratification of age and synchronization of the Quaternary deposits of the Ponto-Caspian," № 13-05-00625 "Peculiarities of the evolution of relief in the Northern Caspian region in the late Pleistocene: Main stages of the development, chronology, and correlation with climatic rhythms in the Black Sea-Caspian region," № 14-05-00227 "Regularities of evolution of environment of the Caspian Sea and the Black Sea in the conditions of multi-scale climate changes?"; and several others. Disseminating the project events and activities via regular updating of Project websites and mailing list of the project contributors, which increased from 957 in 2013 to 1054 in 2014, as well as social networks (Facebook for English and non-English-speakers, and Вконтакте for mostly Russian speakers) <https://www.facebook.com/groups/180481035443572/> http://vk.com/album115218532_181815723

2. Plenary Conferences, Field Work, Workshops, and Training Schools of IGCP 610

Six IGCP 610 Plenary Conferences and Field Trips were carried out in the following regions: 2013 – Western Georgia; 2014 – Azerbaijan; 2015 – Russia (Northern Caspian); 2016 – Eastern Georgia (Inner Kartli and Kakheti regions); 2017 – Palermo, Italy; 2018-Antalya, Turkey (Fig. 1).

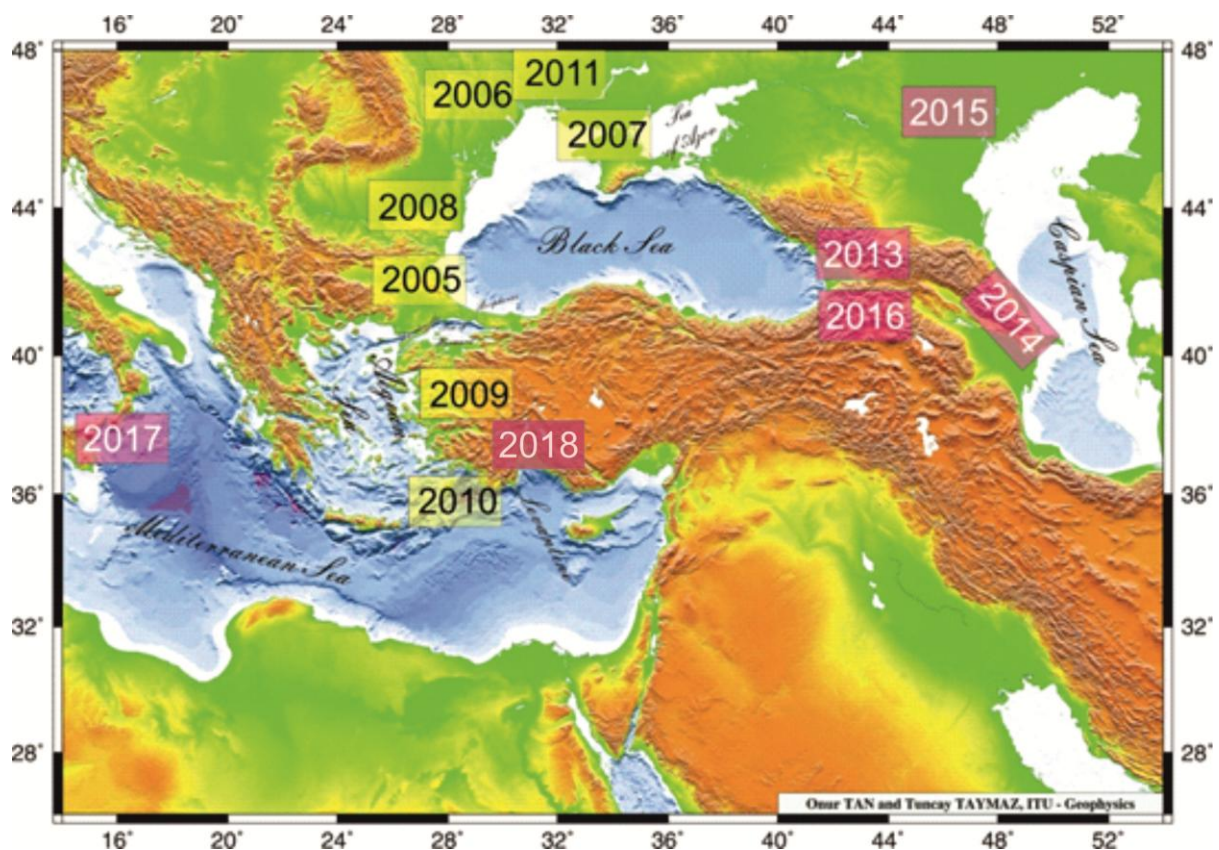


Figure 1. The Caspian-Black Sea-Mediterranean “CORRIDOR”: in yellow are the locations of IGCP 521-INQUA 501 meeting and field trip sites (2005-2011); in other colors are sites studied by the ongoing IGCP 601 Project: 2013 – Tbilisi, Western Georgia; 2014 – Baku, Azerbaijan; 2015 – Astrakhan’ (Volga Delta), Russia; 2016 – Tbilisi, Eastern Georgia; 2017 – Palermo, Italy; 2018 – Antalya, Turkey.

The Field Trips carried out after the Plenary Sessions enables participants to visit under the guidance of local experts many relevant sites in the “CORRIDOR” that would otherwise have been very difficult to see, and discuss important scientific issues about these sites with colleagues. During the Field Trips participants studied the reference Quaternary successions, including the Pliocene-Pleistocene boundary. Obtained data were treated in related laboratories over the world.

The First Plenary Conference and Field Trip of IGCP 610 was organized by the Institute of Earth Sciences, Ilia State University and the Avalon Institute of Applied Science, Winnipeg, Canada, and hosted by Ilia State University, on 12-19 October 2013, in Tbilisi, Georgia (Yanko-Hombach, 2016). President of the conference was Prof. Zurab Javakhishvili. Executive Director was Prof. Valentina Yanko-Hombach. One hundred and fifty one scientists from 19 countries contributed to the conference; 66% of them were from developing countries (Fig. 2). Their peer-reviewed contributions are assembled in a 182-page Conference Proceedings volume (Gilbert and Yanko-Hombach, 2013).

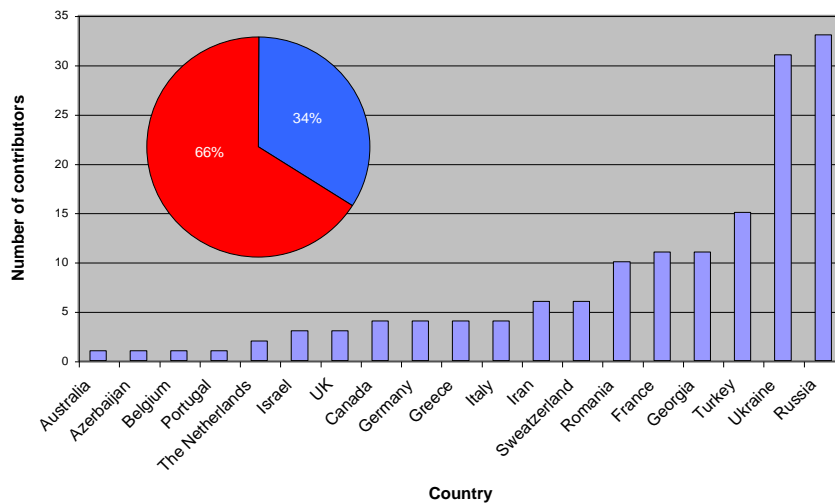


Figure 2. Number of countries and contributors to IGCP 610 First Plenary Conference and Field Trips. The circle shows the percentage of scientists from developing (red) and developed (blue) countries, respectively.

The two days of Technical Sessions were organized into four panels and five Oral/Poster sessions. Panel 1 was titled “STRATIGRAPHY AND PALEOENVIRONMENTAL RECONSTRUCTIONS” (Moderators: Nikolay Panin, Romania, and Andrei Chepalyga, Russia) and included 24 presentations with two key-note talks by Prof. Teller (Canada) and Prof. Okrostsvaridze with co-authors (Georgia). The presentations covered a wide range of topics including Quaternary geomorphology, geology, stratigraphy, paleogeography, volcanism, seismicity, and mineral resources of the Ponto-Caspian and Marmara region. Panel 2 was titled “RECENT ECOSYSTEMS” (Moderators: Nelly Sergeeva, Russia, and Valentina Yanko-Hombach, Ukraine, Canada) and included four presentations on recent fauna of the Black Sea. Panel 3 was titled “ARCHAEOLOGY, HISTORY, AND ETHNOLOGY” (Moderators: Nikoloz Tushabramishvili, Georgia, and Olena Smyntyna, Ukraine) and included ten presentations. The presentations covered a wide range of topics, such as Paleolithic of Georgia, new data on Oldowan migration to Europe via the northern Black Sea Corridor in the light of the latest discoveries in the northern Caucasus and Dniester Valley, the Aegean route: an alternative route for Neanderthals and Anatomically Modern Humans (AMHs) traveling from Asia to Europe and vice-versa. Panel 4 was entitled “MODELING” (Moderators: Nikolay Esin and Alexander Kislov, Russia) and included four presentations, such as a mathematical model of Black Sea coast and shelf evolution during the Quaternary period, etc.

The POSTER session included 17 posters that were organized into five topics: GEODYNAMICS AND ACTIVE TECTONICS (Moderator: Hayrettin Koral, Turkey), RECENT ECOSYSTEMS (Moderators: Nelly Sergeeva, Russia, and Valentina Yanko-Hombach, Ukraine, Canada), SEA LEVEL CHANGES AND PALEOENVIRONMENTAL RECONSTRUCTIONS (Moderators: Nikolay Panin, Romania, and Andrei Chepalyga, Russia), and PALYNOLOGY AND PALEONTOLOGY (Moderators: Petra Mudie, Canada, and Valentina Yanko-Hombach, Ukraine, Canada), ARCHAEOLOGY, HISTORY, and ETHNOLOGY (Moderators: Nikoloz Tushabramishvili, Georgia, and Olena Smyntyna, Ukraine). The Technical Sessions were followed by the Round Table that enabled the formation of 12 Working Groups for the Project and the selection of their coordinators. It also led to decisions about future strategy in running the project. For more details see the Conference Programme.

The four days of field trips (by bus) were led by prominent Georgian geologists and archaeologists (Okrostsvaridze et al., 2013) and were focused on the Eopleistocene geological sequence of Tsvermaghala Mountain that represents a stratotype of the Gurian Chauda; it possesses a thickness exceeding 1000 m deposited prior to the Matuyama-Brunhes Reversal (i.e., 780 ka BP) as well as archaeological sites of Lower to Upper Paleolithic age that include Dmanisi, Mashavera Gorge, Tetrtskaro, Tsalka-Bedeni Plateau, Faravani Lake, Akhalkalaki, Diliska, Chiatura, Bondi Cave, Undo

Cave, Djruchula Gorge, as well as the Neolithic site Samele Cave and Medieval-Roman site Vardzia Cave (Fig. 3).

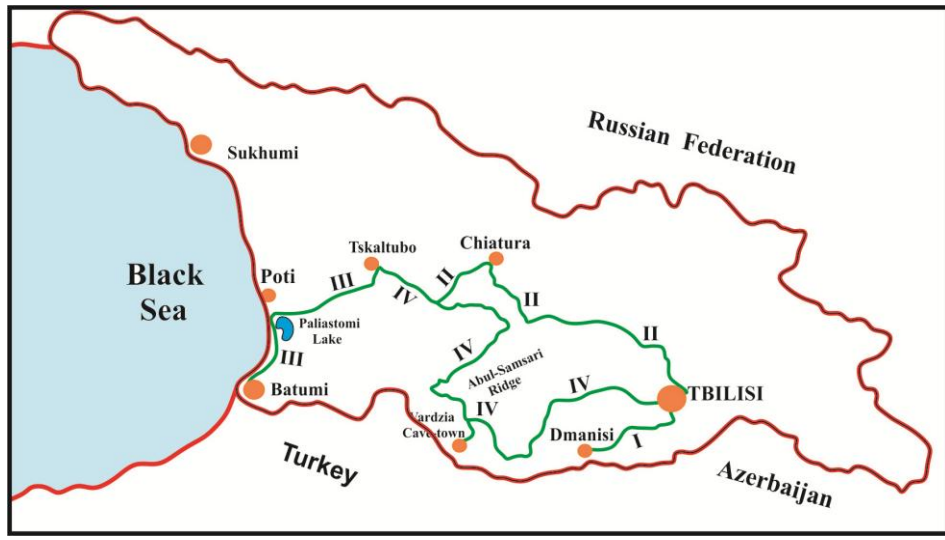


Figure 3. Map of Georgia with geological and archaeological sites visited during the Field Trips of IGCP 610 in 2013. Field Trip I (15 October 2013): Mtskheta, Chiatura Paleolithic sites, Sataplia dinosaur footprints, and cave state reserve. Field Trip II (16 October 2013): Mtskheta, Chiatura Paleolithic sites, Sataplia dinosaur footprints, and cave state reserve. Field Trip III (17 October 2013): Paliastomi Lake, Tsvermagala Chaudian Black Sea Terrace, Batumi seashore. Field Trip IV (18 October 2013): Dzirula massif, Borjomi, Vardzia Cave Town and Quaternary Abul-Samsari volcanic ridge.

The Second Plenary Conference and Field Trip of IGCP 610 was organized by the Institute of Geology and Geophysics of the Azerbaijan National Academy of Sciences (www.gia.az) and the Avalon Institute of Applied Science, Winnipeg, Canada, and hosted by the Institute of Geology and Geophysics, on 12-20 October 2014, Baku, Azerbaijan (Yanko-Hombach, 2016). President of the conference was Corresponding Member of the Azerbaijan Academy of Sciences Prof. Elmira Aliyeva. Executive Director was Prof. Valentina Yanko-Hombach. One hundred and twenty four scientists from two continents and 18 countries contributed to the conference; 71% of them were from developing countries (Fig. 4). Their peer-reviewed contributions are assembled in a 186-page Conference Proceedings volume (Gilbert and Yanko-Hombach, 2014).

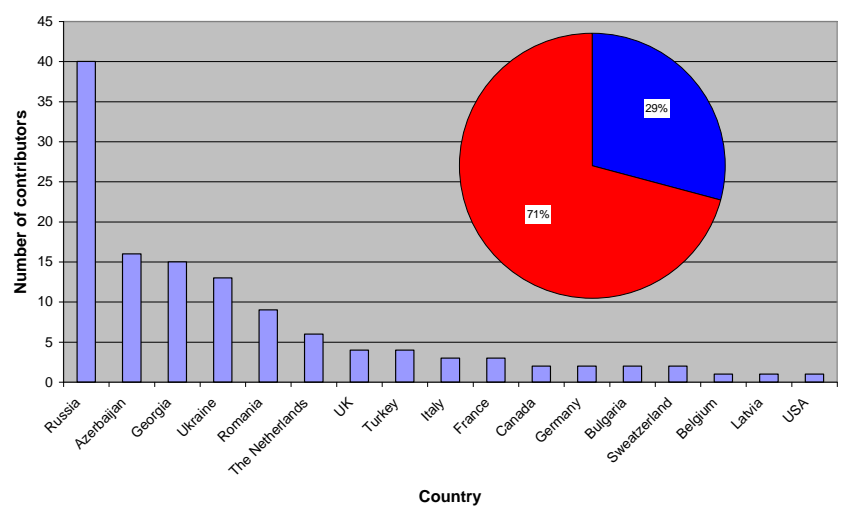


Figure 4. Number of countries and contributors to the IGCP 610 Second Plenary Conference and Field Trips in Baku, Azerbaijan. The circle shows the percentage of scientists from developing (red) and developed (blue) countries, respectively.

The meeting was focused on the whole spectrum of Quaternary geological sequences exposed in the terraces and ridges of the Caspian region. This includes the stratotype of the Mountain of Bakinian stage (ca. 600–450 ka BP) located in the suburbs of Baku on the Absheronian Peninsula; major exposures in the southwestern part of the peninsula of Garagush mountain, Bakinskies Ushi. This includes outcrops of Quaternary deposits at Garamaryam and Turianchay in the Ajinour region, and Bozdag located in the Middle Kura region, which is a reference section of the marine sediments of the Bakinian stage in western Azerbaijan. The Neogene-Quaternary boundary and the Matuyama-Brunhes Reversal with Olduvai and Jaramillo episodes were traced. The archaeological sites in Gobustan with its famous petroglyphs of Mesolithic age were observed. Plans included visits to some archaeological and historical places in Baku: the Shirvanshakh Palace constructed during the period from the XIIIth to the XVIth century; the Maiden Tower (the most mysterious monument of Baku) of which the unique construction has no analogs in the East. The Palace complex and Maiden Tower are included in the UNESCO list of World heritage sites. The participants also visited the historical-cultural reserve of Lagich that dates from the XV-XIX centuries, the first Christian Church in the Caucasus dated to the Ist century, excavations of an ancient town located in the suburbs of Gabala city, which for six centuries (until the VIth century) was the capital of Caucasian Albania, and famous for the beautiful wall paintings of Khan Palace in the old Sheki town.

The two days of Technical Sessions were organized into five panels and five Oral/Poster sessions. Panel 1 was titled “RECENT ECOSYSTEMS AND PROCESSES”—moderators: Nelly Sergeeva (Russia) and Valentina Yanko-Hombach (Ukraine, Canada)—and included five ORAL presentations. The presentations covered a range of topics on recent environments and ecosystems of the Caspian-Black Sea-Mediterranean Corridors. Panel 2 was titled “STRATIGRAPHY, PALEONTOLOGY, AND PALEOENVIRONMENTAL RECONSTRUCTIONS”—moderators: Nikolay Panin (Romania) and Andrey Chepalyga (Russia)—and included 19 ORAL presentations with a key-note talk by Profs. Yanina and Svitoch (Russia). The presentations covered a range of topics on Quaternary ecostratigraphy and paleogeographic reconstructions of the Ponto-Caspian and Marmara region. Panel 3 was titled “TECTONICS”—moderator: Hayrettin Koral (Turkey)—and included three presentations on the earthquakes of Eastern Turkey, interrelationships between sea-level changes and tectonics along the southern Black Sea coasts of Turkey, and modern active tectonics in Azerbaijan. Panel 4 was titled “MODELING”—moderators: Nikolay Esin and Alexander Kislov (Russia)—and included five presentations devoted to modeling of coastline migration, climate change and infilling of the Black Sea by Mediterranean salt water over the course of the Holocene transgression. Panel 5 was titled “ARCHAEOLOGY, HISTORY, AND ETHNOLOGY”—moderators: Andrey Chepalyga (Russia) and Olena Smyntyna (Ukraine)—and included five presentations with a key-note talk by I. Babaev (Azerbaijan). The presentations were devoted to the North Black Sea passageway for the first peopling of Europe, ties between Southeast Caucasus and Mediterranean countries in antiquity, influence of paleoecological changes on migration and economic activities of the Neolithic people of Azerbaijan, and archaeological landscape of Gobustan at the end of the upper Pleistocene and early Holocene.

The POSTER session included 23 poster presentations that were organized into five topics: GEOMORPHOLOGY—moderator: Ekaterina Badyukova (Russia); RECENT ECOSYSTEMS AND ENVIRONMENTAL MONITORING—moderators: Nelly Sergeeva (Russia) and Valentina Yanko-Hombach (Ukraine, Canada); SEA LEVEL CHANGES AND PALEOENVIRONMENTAL RECONSTRUCTIONS—moderators: Nikolay Panin (Romania) and Andrey Chepalyga (Russia); PALYNOLOGY AND PALEONTOLOGY—moderators: Petra Mudie (Canada) and Valentina Yanko-Hombach (Ukraine, Canada); ARCHAEOLOGY, HISTORY, AND ETHNOLOGY—moderators: Mehmet Özdoğan (Turkey) and Olena Smyntyna (Ukraine). The Technical Sessions were followed by the Round Table that enabled participants to discuss the progress of IGCP 610 and to plan future strategy in running the project. For more details see the Conference Programme.

The five days of field trips (by bus) were led by prominent Azerbaijani geologists and archaeologists and were focused on the Apsheronian stage sediments, the classic stratotype of the Mountain of Bakinian stage, examples of the rapid Caspian Sea level changes in the Pleistocene successions, Azerbaijan mud

volcanoes, Western Azerbaijan and the Greater Caucasus continuous outcrop of Quaternary continental sediments of the Ajinour, reference outcrop of the marine Bakinian sediments at Bozdag, as well as archaeological sites of Gobustan, Gabala, and historical sites of Baku and Lagich (Fig. 5; Aliyeva and Kengerli, 2014).



Figure 45. Map of Azerbaijan with geological and archaeological sites visited during the Field Trips of IGCP 610 in 2014.

The Third Plenary Conference and Field Trip of IGCP 610 was organized by the M.V. Lomonosov Moscow State University, Astrakhan State University, Astrakhan Museum-Reserve, Russia, and the Avalon Institute of Applied Science, Winnipeg, Canada, and hosted by the Astrakhan Museum-Reserve. President of the conference was Prof. Tamara Yanina. Executive Director was Prof. Valentina Yanko-Hombach. The Meeting and Field Trip were held in the Northern Caspian region in the city of Astrakhan and the Astrakhan region. One hundred seven scientists from 14 countries contributed to the conference; 77% of them were from developing countries (Fig. 6). Their peer-reviewed contributions are assembled in a 220-page Conference Proceedings volume (Gilbert et al., 2015).

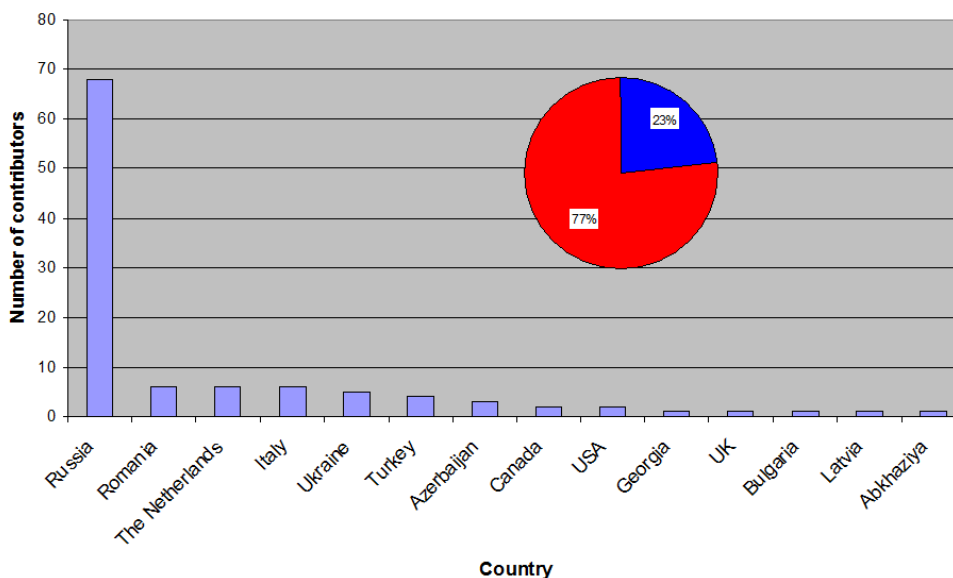


Figure 6. Number of countries and contributors to IGCP 610 Third Plenary Meeting and Field Trips. The circle shows the percentage of scientists from developing (red) and developed (blue) countries, respectively.

The two days of Technical Sessions were organized into five panels and five Oral/Poster sessions. Panel 1 was titled “PANEL 1: RECENT ECOSYSTEMS AND PROCESSES”—moderators: Nelly Sergeeva

(Russia) and Valentina Yanko-Hombach (Ukraine, Canada)—and included three ORAL presentations. The presentations covered a range of climate, precipitation, and faunal migration in the “CORRIDORS.” Panel 2 was titled “STRATIGRAPHY, PALEONTOLOGY, AND PALEOENVIRONMENTAL RECONSTRUCTIONS”—moderators: Nikolay Panin (Romania) and Andrey Chepalyga (Russia)—and included 15 ORAL presentations with two key-note talks given by Tamara Yanina and others (Russia) and Nikolay V. Esin and others (Russia, Ukraine, Canada). The presentations covered a range of topics on the processes of formation within the “CORRIDORS” and the Paratethys Sea-Lake degradation, origin and taxonomy of the Quaternary Ponto-Caspian foraminifera and mollusks, morphodynamics of loess watersheds, changes of landscape and migration of humans, correlation of marine and continental deposits, ecostratigraphy, etc. Panel 3 was titled “TECTONICS”—moderator: Nikolai Esin (Russia) and Hayrettin Koral (Turkey)—and included three presentations on the neotectonics of Anatolia in the crossroads of an evolving orogen (key-note), vertical movements of the coast and shelf of the Black and Mediterranean seas and their impact on coastal processes, and seismic-geotechnical hazard zonation. Panel 4 was titled “MODELING”—moderators: Nikolay Esin and Alexander Kislov (Russia)—and included two presentations devoted to modeling of climate and marine ecosystems. Panel 5 was titled “ARCHAEOLOGY, HISTORY, AND ETHNOLOGY”—moderators: Andrey Chepalyga (Russia) and Olena Smyntyna (Ukraine)—and included six presentations with a key-note talk by A. Chepalyga (Russia). The presentations were devoted to new data on the North Black Sea corridor of the first European migrations focused on the discovery of multilayered Oldowan sites in Crimea (key-note); reconstruction of the archaeological landscape of the western shore of the Caspian Sea at the end of the upper Pleistocene-Early Holocene; paleoanthropology of the Yamna-culture populations in the Kumo-Manych depression: craniological specificity of the Yamna culture people from the Lower Volga region; paleoanthropology of fossil hominins from the Levant and Iraq; and response of humans to global climate change in the NW Black Sea region at the Pleistocene-Holocene boundary.

The POSTER session included 34 poster presentations with wide range of subjects on geophysics, morphotectonics, structure and genesis of islands, remote sensing, transgressive-regressive sea-level changes and coastline migration, economy of Late Mesolithic-Early Neolithic communities with respect to climate changes, marine habitats, lithostratigraphy, paleogeography, palynology (diatoms, pollen, NPP), deepwater peloids, modern fauna of the anoxic zone as a remnant of the ancient anoxic biosphere, mud volcanoes, underground freshwater sources, micro-(foraminifera) and macrozoobenthic communities, environmental stress caused by the Danube discharge into the Black Sea, and the first evidence of Lower Paleolithic open-air sites in Eastern Georgia.

The Technical Sessions were followed by the Round Table that enabled participants to discuss the progress of IGCP 610 and to plan future strategy in running the project. One of the key problems that participants discussed was organizing the Fourth Plenary Meeting and Field Trip in 2016. According to our working plan, it should have been held in Crimea. But due to the geopolitical problems (no need to discuss it here), this was impossible to organize. Therefore, it was decided to run the meeting and field trips in Eastern Georgia with purpose to focus on the pre-Pleistocene and Pleistocene geological history of the Eastern Paratethys remnants.

The five days of field trips (by bus) were led by prominent Russian geologists and archaeologists and were focused on the archaeological sites “Selitrennoe Gorodische,” Gorodishche Samosdelka, and Pleistocene stratotypes and important outcrops Cherniy Yar, Nizhnee Zaimische, Tsagan-Aman, Lenino, Seroglazovka as well as the Baer Knolls and Volga Delta (Yanina et al., 2015).

Field trips were focused on the spectrum of Quaternary geological sequences exposed within sections of the Lower Volga area. This includes major exposures in the Volga valley between Astrakhan and Volgograd: Cherniy Yar – Nizhnee Zaimische, Kopanovka, Lenino, and Seroglazka. The conference participants were able to see deposits of the Baku, Early Khazarian, Late Khazarian, Khvalynian, and Novocaspian transgressions, and the continental sediments separating them: Singilsky, Chernoiarsky, and Atel. Participants were able to select samples for faunal, palynological, and other tests. They also observed the Baer knolls (named for Karl Baer, who described them for the first time in the 19th

century), which are east-west elongated ridges in the Caspian Lowland, a unique natural formation that has no analogues in the world (Fig. 7; Yanina et al., 2015).

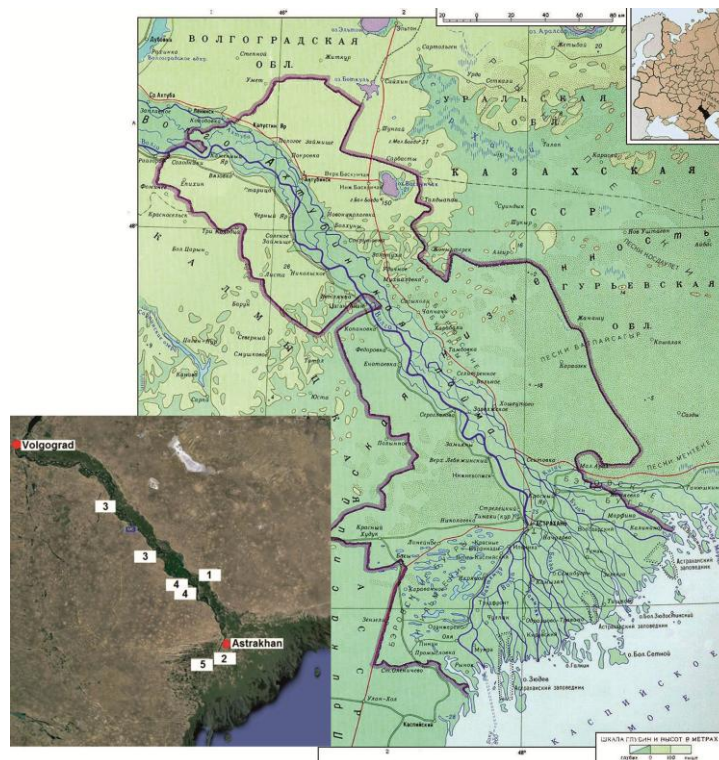


Figure 7. Map of the Lower Volga region with geological and archaeological sites visited during the Field Trips.

Archaeological tours were held at the main ancient sites of the region. The first is the archaeological complex "Selitrennoe gorodishche" (Saltpeter Settlement), which is located 130 km north of Astrakhan. In the XIII to XIV centuries, it was the capital of the richest nomadic state in the Middle Ages, Sarai-Batu, seat of the Golden Horde founded by Genghis Khan's grandson, Batu Khan. A natural outcrop of the Caspian Pleistocene sediments is situated on the Akhtuba coastal cliff near the archaeological complex, so it was also available for a visit. Another archaeological site of the region—Gorodishche Samosdelka (the Ancient Itil Settlement)—is located 45 km below Astrakhan on the right bank of the Old Volga River. The main part of the settlement is situated on an island, surrounded by dried up canals. Cultural layers of this medieval city, with a total depth of about 3–3.5 m, contain the artifacts of the Khazar Khaganate Culture, the golden age of the city Saksin (XI to XIII centuries) which predated Sarai Batu. There also is located the famous Museum of Russian Watermelon. September is the best time for this delicious fruit. Plans were made to visit other archaeological and historical places in Astrakhan: the Astrakhan Kremlin, which was built between 580 and 1620, and the Regional Natural History Museum, which covers the history of the natural environment of the region and displays many of the paleontological finds from the Pleistocene deposits of the Volga valley, together with historical and archaeological objects.

The Fourth Plenary Meeting and Field Trip of IGCP 610 was organized by the Georgian National Academy of Sciences (GNAS), Ilia State University, Georgia, and Avalon Institute of Applied Science, Canada, and hosted by the by the GNAS. President of the conference was Academic GNAS Irakli Gamkrelidze, President of GNAS, Georgia. Executive Director was Prof. Valentina Yanko-Hombach. The Meeting and Field Trip were held in Tbilisi and Eastern Georgia, respectively (Fig. 8; Gamkrelidze et al., 2016).

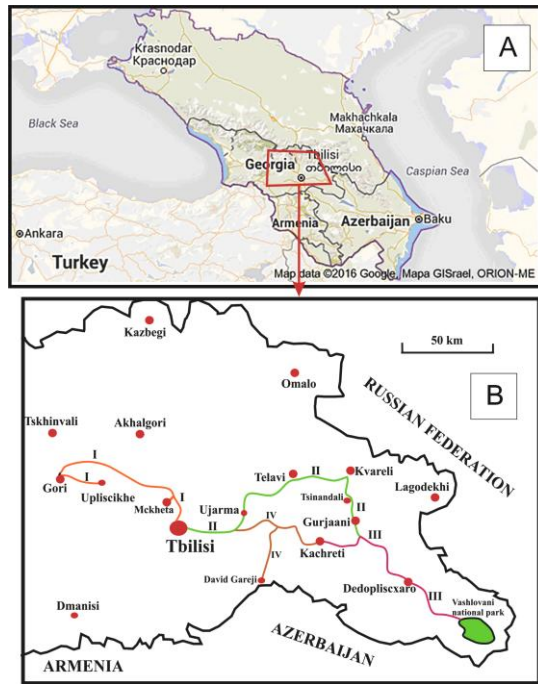


Figure 8. Map of the Eastern Georgia region with geological and archaeological sites visited during the Field Trips.

It focused on the pre-Pleistocene and Pleistocene geological history of the Eastern Paratethys remnants within Eastern Georgia. This subject is very important in shedding light and achieving a better understanding of a possible mechanism of separation of the Eastern Paratethys into the individual seas leading to formation of the Black and Caspian Seas

The 218-page Proceedings of the Fourth Plenary Meeting (Gilbert and Yanko-Hombach, 2016) contain contributions from 107 scientists from two continents and 17 countries; 89% of the contributors are from developing countries (Fig. 9).

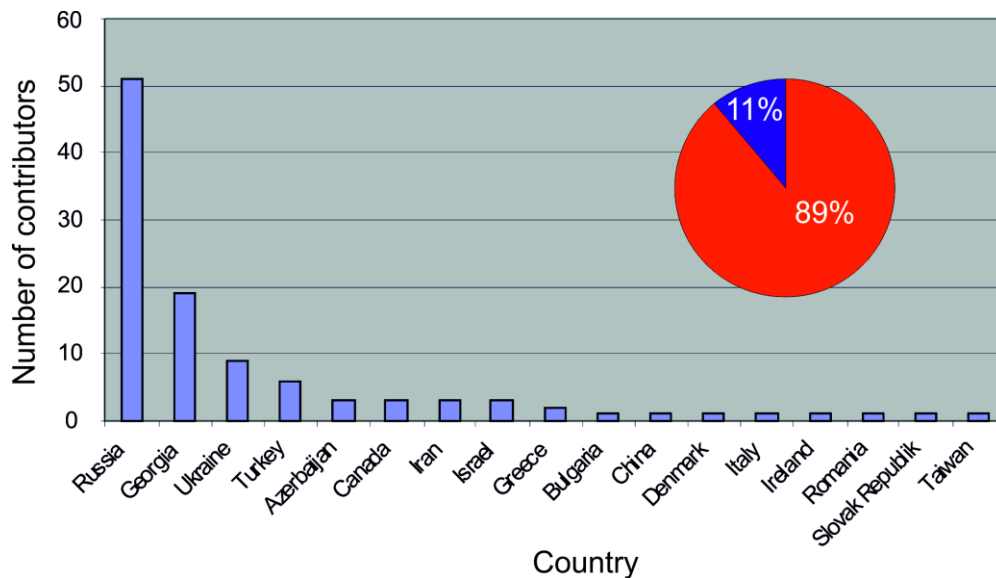


Figure 9. Number of countries and contributors to IGCP 610 Fourth Plenary Meeting and Field Trips. The circle shows the percentage of scientists from developing (red) and developed (blue) countries, respectively.

About 50% of participants are female. This particular conference was characterized by an especially high number of young scientists and students.

The two days of Technical Sessions were organized into five panels with 25 Oral and 31 Poster presentations. Panel 1 was titled “GENERAL QUESTIONS OF THE CORRIDOR”—moderators: Nikolay Esin (Russia) and Alexander Kislov (Russia)—and included four ORAL presentations including a key-note talk “Geological structure of Georgia and geodynamic evolution of the Caucasus” given by Academician GNAS Gamkrelidze, I. (Georgia). Three other presentations covered syntheses of the IGCP 610 results, pointing out some controversies and paradoxes; general tectonic/geologic framework of the Caspian Sea and its water connection with the Black Sea and Mediterranean; and the evolution of the Akchagylian Sea area and coastline based upon mathematical modeling. Panel 2 was titled “RECENT ECOSYSTEMS AND PROCESSES”—moderators: Nelly Sergeeva (Russia) and Valentina Yanko-Hombach (Ukraine, Canada)—and included 5 ORAL presentations that covered a range of topics on the glacier variation dynamics in East Georgia under the impact of modern climate change; porosity and deterioration of stone building material in Istanbul; collections of the Central Soil Museum as a foundation for soil-ecological monitoring of the Caspian-Black Sea-Mediterranean Corridor territory; foraminifera as indicators of environmental stress in marine ecosystems; and retrospective data about underwater landscapes and the meiobenthos in the northeastern part of the Black Sea given by Turkish, Russian, Ukrainian, and Canadian scientists. Panel 3: QUATERNARY AND UPPER NEOGENE PALEONTOLOGY, PALYNOLOGY, AND STRATIGRAPHY OF THE CORRIDORS—moderators: Nikolay PANIN (Romania) and Petra MUDIE (Canada)— included ten ORAL presentations that covered a range of topics on Western Georgia as a refuge for Tertiary elements of Eurasian floras (key-note); palynostratigraphy of the Pleistocene deposits in Trlica Cave; pollen-based reconstruction of the Plio-Pleistocene vegetation and climate change in the North Caucasus; the last interglacial vegetation patterns on the northern margins of the Black Sea; Middle Miocene marine mollusks in northernmost Anatolia and their biostratigraphic responses to changing paleogeography; the Karangatian epoch (MIS 5e) in the Black Sea basin; malacofauna of the Kerch Strait during the Late Pleistocene-Holocene: paleogeographical analysis; Quaternary molluscan faunas of the Sinop peninsula; new data on the stratigraphy of Quaternary sediments of the Manych depression; analysis of South Caspian deep sedimentation from marine cores given by the Ukrainian, Turkish, Russian, Canadian, and Iranian scientists. PANEL 4: PALEOENVIRONMENTAL AND PALEOGEOGRAPHIC RECONSTRUCTIONS OF THE CORRIDORS—moderators: Tamara YANINA (Russia) and Elmira ALIEVA (Azerbaijan)—included six ORAL presentations devoted to pedogenetic response to climatic fluctuations within the last glacial-interglacial cycle in the lower Volga basin; new data on correlation of the paleogeographic events of the Caspian Sea and Russian Plain in the late Pleistocene; history of Caspian Sea level oscillations in the late Pleistocene; pioneer dendroclimatological research in western and southwestern Turkmenistan; and clay mineral provenance of lower Khvalynian deposits in the Middle and Lower Volga River valley; and new results on structure of the Srednyaya Akhtuba reference section given by Russian and Turkmenistan scientists. PANEL 5: ANTHROPOLOGY, ARCHAEOLOGY, AND HISTORY—moderators: Sergey VASILIEV (Russia) and Olena SMYNTYNA (Ukraine)—included four ORAL presentations covering anthropological records of the Caucasus in the Paleolithic (key-note); re-assessing East Mediterranean sea-level trends: 3000 years of archaeological indicators in Greece and Israel; the origin of artifacts of bone and shell from the Khvalynsk Eneolithic cemeteries (Northern Caspian region); soils of Scythian settlements as paleoenvironmental archives in the area of Late Holocene migration pathways through the East European steppe; and paleoanthropological research into the early medieval Coptic cemetery of Wadi Naqlun in the Fayoum Oasis (Egypt) given by Israeli, Greek, Italian, Ireland, and Russian scientists.

The POSTER session included 25 presentations. Each presenter was allotted five minutes to present his or her poster orally. Poster sessions covered a wide range of subjects on magnetometric investigations, remote sensing, palynology; hydrology and landscape characteristics, sea-level rise, climate change, paleoenvironmental reconstructions, petrography, facies analysis, geochemistry, mud volcanism, diatom analysis, Quaternary continental flood basalts, the unique Cave City of Vardzia in Georgia, geometry and kinematic evolution of a thrust-top basin, vegetation and climatic changes, coastal laws in Turkey, paleoclimate, loess-soil complexes, petrography based on SEM-analysis and optical microscopy, sea impact on human adaptation, optically stimulated luminescence dating, malacofauna, and

paleogeography of the Corridor given by Romanian, Turkish, Bulgarian, Canadian, Ukrainian, Taiwanese, and Russian scientists.

The Technical Sessions were followed by the Round Table that enabled participants to discuss the progress of IGCP 610 and to plan future strategy in running the project. One of the key problems that participants discussed was organizing the Fifth Plenary Meeting and Field Trip in 2017. A majority of participants voted to organize it in Italy with a goal to study GSSP outcrops.

The four days of field trips (by bus) (Fig. 8) were led by prominent Georgian geologists and archaeologists described above.

The 19-page Field Trip Guide describes the large sequences of freshwater-continental sediments of the Miocene, Pliocene, and post-Pliocene that fill all major depressions of the Kartli and Kakheti depressions, a variety of uplift regimes during the Quaternary, and archaeological and historic sites within Eastern Georgia (Gamkrelidze et al., 2016; http://www.avalon-institute.org/IGCP610/pdf/Field_Trip_Guide_IGCP_610_2016.pdf).

A special Volume of *Quaternary International* "IGCP 610 III" collected about 15 articles presented at the meeting. It is planned for publication in 2017.

The project was highlighted at the First National television channel of Georgia and GNAS website (<http://science.org.ge/newsite>) where letters of gratitude from conference participants should be uploaded. It generated much public information showing its significant impact.

Overall, the meeting provided an excellent opportunity for international discussion of different methods and interpretations used to analyze the history of a huge geographical area from the Caspian to the Mediterranean during the full duration of the Quaternary. It also emphasized the importance of studying the Pre-Quaternary geological history in order to reveal continuity in its development. The meeting encouraged an exchange of data and publications, as well as encouraged future collaboration between physical and social scientists over the Globe. It brought together multidisciplinary scientists from all over the world, and in the process enhanced West-East scientific dialogue by providing a supportive background for collaboration regarding the correlation and integration of discoveries on the influence on humans of climatically/tectonically induced sea-level changes and coastline migration. The meeting encouraged the younger generation to engage in the multidisciplinary study of the region using advanced analytical techniques and methodologies for geoarchaeological investigations.

Archaeological and historic sites were observed in Mtskheta (listed as a World Heritage site by UNESCO); the Graklianis Hill near Kaspi that shows evidence of human presence possibly going back 300,000 years. The site contains a temple to a fertility goddess from the 7th 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 was discovered on the altar of a fertility goddess's temple, predating those previously known in the area by at least a thousand years; Uplistsikhe, "The Lord's Fortress," is an ancient rock-hewn town in Eastern Georgia some 10 km east of the town of Gori. 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. Uplistsike is identified by archaeologists as one of the oldest urban settlements in Georgia. More information about field trips can be obtained from the Field Trip Guide (Gamkrelidze et al., 2016).

The Fifth Plenary Meeting and Field Trip of IGCP 610 and the First Meeting of POCAS was organized by the University of Palermo, and Avalon Institute of Applied Science, Canada, and hosted by the the University of Palermo. President of the conference was Prof. Antonio Caruso, Italy. Executive Director was Prof. Valentina Yanko-Hombach. The Meeting and Field Trip were held in Palermo and southern Italy (Sicily and Calabria), respectively (Fig. 9; Caruso et al., 2017).

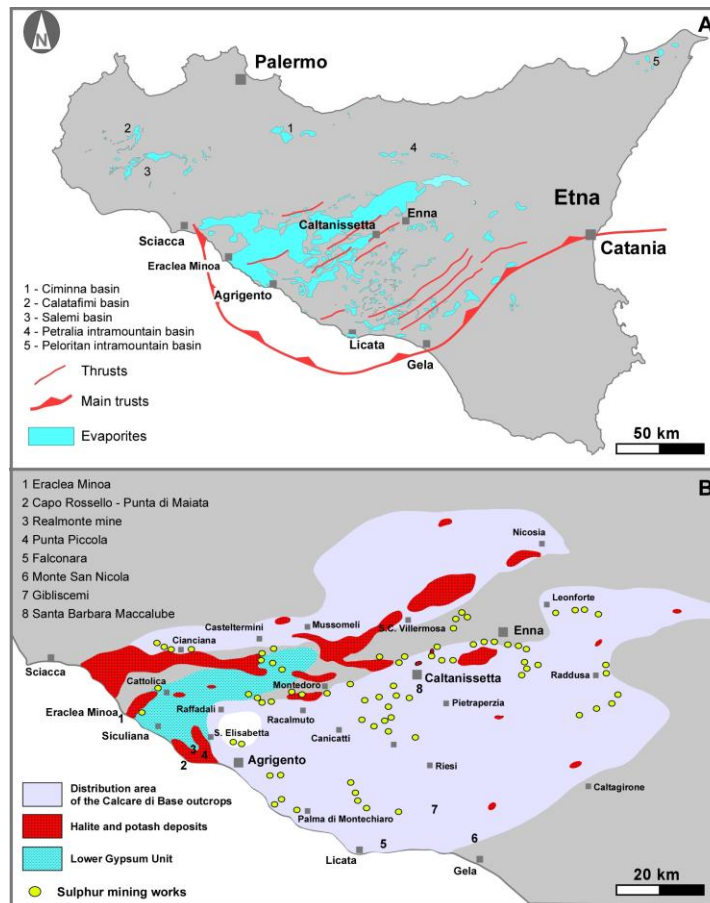


Figure 9. Map of the Southern Sicily with geological and archaeological sites visited during the Field Trips. A. Extent of the outcrops of Messinian evaporites in the different Sicilian basins with indication of the major structural features. B. Distribution of the “Calcare di base outcrops” and major evaporitic units (Lower Gypsum and Halite units) with indication of most of the sulphur mines and location of the studied sections (from Caruso et al., 2015).

The Fifth Plenary Meeting and Field Trip of IGCP 610 and the First Meeting of POCAS was focused on the Plio/Pleistocene geological history of the central Mediterranean of southern Italy (Sicily and Calabria). This subject is very important in shedding light and achieving a better understanding of climate evolution during the Plio/Quaternary.

The 239-page Proceedings of the Joint Plenary Conference (Gilbert and Yanko-Hombach, 2017) and Field Trip of IGCP 610 and INQUA IFG POCAS, Palermo, Italy contain contributions from 109 scientists from two continents and 14 countries; 61% of the contributors are from developing countries (Fig. 10).

About 50% of participants are female. The conference was characterized by high number of young scientists and students.

The Fifth Plenary Meeting and Field Trip of IGCP 610 and the First Meeting of POCAS made the following possible for the participants: (1) To discuss the actual status of both projects and progress made by participants. Particular attention was paid to scientific approaches for integrating environmental, anthropological, ethnological, and archaeological data in order to trace the history of ancient humans from the Caspian to Mediterranean during the entire duration of the Quaternary. (2) To introduce young scientists, especially from the Eastern countries, to new analytical techniques and state-of-the-art interpretation of data. (3) Encourage east-west dialogue and integrate researchers from different countries into the international R&D community, as well as contribute to the preservation of cultural and religious heritage through the discussion of ancient cultures, civilizations, and their legends.

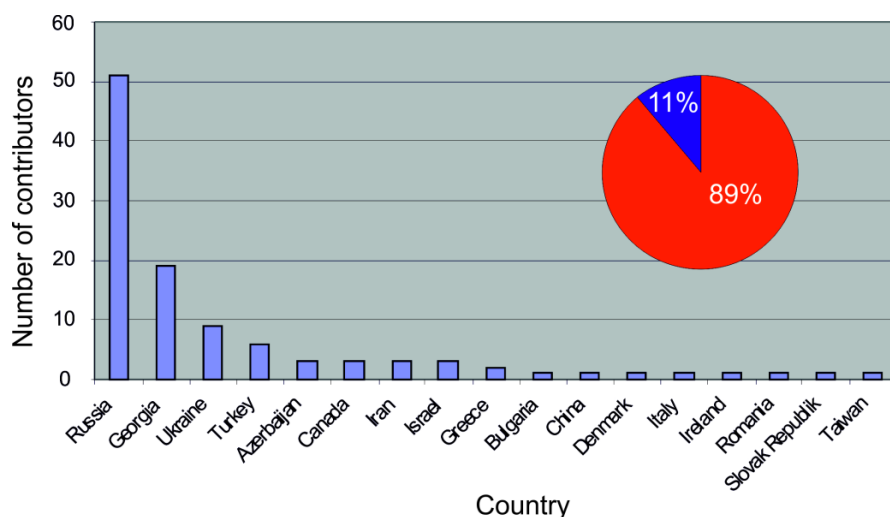


Figure 10. Number of countries and contributors to Joint Plenary Conference and Field Trip of IGCP 610 and INQUA IFG POCAS. The circle shows the percentage of scientists from developing (red) and developed (blue) countries, respectively.

The two days of Technical Sessions were organized into four panels with 24 Oral presentations. Panel 1: GENERAL QUESTIONS OF THE CORRIDOR – moderators: Nikolay Esin (Russia) and Alexander Kislov (Russia) – included three ORAL presentations with a key-note talk “Brief history of the astronomical tuning of the Plio/Pleistocene GSSPs outcropping in Sicily (Southern Italy)” given by Prof. Caruso, A.. Two other presentations covered possible social-climatic consequences of changeability of circulation in Hadley’s cell; and global geological processes in the Caspian-Mediterranean region during the Miocene-Pleistocene; given by Italian, Ukrainian, Russian, and Canadian scientists.

Panel 2: BLACK SEA & SEA OF MARMARA REGION – moderators: Valentina Yanko-Hombach (Ukraine, Canada) and Hayrettin Koral (Turkey) – included 15 ORAL presentations that covered a range of topics on the unique marine terrace system of the Crimean and Black Sea Basins: stratigraphy, archaeology, and the oldest Oldowan migrations to Europe (keynote); wave climate variation in the Black Sea; microforaminiferal linings as a proxy for paleodelta and paleosalinity analysis; palynomorphs in surface sediments of the Ukrainian part of the northwestern Black Sea shelf; marine geohazards in the Black Sea and their monitoring; OSL-chronology of the late Quaternary loess-soil series in the eastern Azov Sea region; regional distribution and clay mineralogy of the modern sediments in the northwestern zone of the Black Sea; Late Miocene volcanic ash layers of the intermountain depression of the Eastern Caucasus: the products of the Megacaldera explosion; late glacial to Holocene Black Sea evolution based on microfaunal and stable oxygen isotope records; neotectonics in the Marmara Region; NW Turkey, Narrow shelf canyons vs. wide shelf canyons in the Black Sea; vegetation changes and climate from pollen of the Late Pliocene to Early Pleistocene in the North Caucasus; mud volcanism of the Black Sea region; meiobenthos as an indicator of gaseous hydrocarbon reservoirs under the floor of the Black Sea; and Stone age people in Crimea: an anthropological study; given by Georgian, Turkish, Russian, Romanian, Ukrainian, Canadian, Chinese, and American scientists.

Panel 3: CASPIAN SEA REGION - moderators: Tamara Yanina (Russia) and Elmira Aliyeva (Azerbaijan) – included four ORAL presentations that covered a range of topics on the tectonics, fluid dynamics, and Caspian Sea level change: geological and environmental aspects (keynote), bionomy of the southern Caspian basin in the Pliocene-Pleistocene; the Northern Caspian Sea: Environmental consequences of the climate change during the Khvalynian epoch (evidence from the boreholes); new results on the chronology of late Pleistocene paleogeographical events of the Northern Caspian Sea (OSL dating); and age of the Paleolithic site Sukhaya Mechetka (Lower Volga region) given by Azerbaijani, Russian, and Turkmenistan scientists.

PANEL 4: MEDITERRANEAN REGION - moderators: Antonio Caruso (Italy) and Svetlana Borutskaya (Russia) - included four ORAL presentations that covered a range of topics on climate record

of Marine Isotope Stage 19 from marine and terrestrial signals in the Alboran and Ionian basins; anthropological characteristics of the adaptation of the Fayoum oasis population (Egypt) in the Greco-Roman period; planktonic foraminifera as proxies of the Holocene climatic variability (Tyrrhenian, Mediterranean Sea); and paleoclimatic reconstruction from marine records of the central and western Mediterranean area over last five millennia using planktonic foraminifera given by Italian and Russian scientists.

The POSTER session included 29 presentations. Each presenter obtained five minutes to present his or her poster orally. Poster sessions covered a wide range of subjects on the circumstances of paleogeographic formation of the Productive Series basin of eastern Azerbaijan and on the first Pliocene sea level fluctuation; magnetometric and electrometric investigations in the Salsovia submerged archaeological site; the role of coastal geomorphology in interpreting the history of the northern Caspian plain in the late Pleistocene; methods and equipment for conducting field research into surface layer characteristics by sounding in the short-wave range of radio waves in order to study environmental change; the first experience of dendroclimatological research in the eastern part of the Kazakh Upland (Saryarqa); the main stages of vegetation and climate evolution in the Kuban River Delta Region during the last 7.4 ka and their correlation with sea-level fluctuations of the Black Sea; the role of the Black Sea shelf techno-geological system in the integrated management of rational resource use; monitoring of climate oscillations in the Mediterranean Sea over the last two millennia using planktonic foraminifera; dynamics of the Black Sea coast and vertical movements of the shelf in the late Pleistocene-Holocene; integrating high resolution Mid-Pleistocene sea surface temperature and productivity estimates from alkenone proxies with marine and terrestrial climate signals; first discoveries of Oligocene diatomic flora in the section of Pirakashkul (Shamakhi-Gobustan zone); paleoenvironmental reconstructions at the Pleistocene- Holocene boundary in the Black Sea based upon benthic foraminifera; geoacoustic and gas geochemical signs of hydrate presence on the continental slope north-east of the Black Sea; chemical composition of Lower Khvalynian deposits in the Middle and Lower Volga region; small mammal faunas from the Mikulino (=Eemian) marine and liman deposits of the Black Sea; vortices of the Cretan straits of the eastern Mediterranean and the Black Sea shelf; evaluation of geological hazards for the Trans-Caucasus Caspian oil and gas pipelines in the Abul-Samsari volcanic ridge section; hydrogeochemical evolution of limans of the northwestern Black Sea region in connection with the problem of their use as salt sources; sedimentary structure and late Holocene evolution of the coastal embayment on the southeastern coastline of the Crimean peninsula (Black Sea); unknown morphotypes as permanent representatives in the Black Sea anoxic and sulfidic bottom sediments; petrographic description of Chokrak-Spirialis Miocene deposits of Eastern Azerbaijan; Holocene environments of the Volga River Delta: inferred from diatom assemblages in sediments of the Rycha River Channel; correlation of the Late Quaternary sediments of the Eastern Mediterranean and Ponto-Caspian basins; adjustment theory in the study of human responses to global climate change in the Northwestern Black Sea region at the Pleistocene-Holocene boundary; paleogeographic stages of development of the Iranian coast of the Caspian Sea in the Holocene; biodiversity of the Volga River delta mollusks in the Holocene; paleogeography of the Atelian period in the lower Volga region; Apsheron Deposits (Late Early Pleistocene) of the Lower Volga (Astrakhan Arch) given by Romanian, Turkish, Canadian, Ukrainian, Turkmenian, Russian, and American scientists.

The Technical and Poster Sessions were followed by the Round Table that enabled participants to discuss the progress of IGCP 610 and to plan future strategy in running the project. It was decided to ask for one year of the Project extension (if possible with some funding) to summarize Project' activities in a series of selected papers in the next IGCP 610 special volume of the Quaternary International, a paper in *Episodes*, and organizing the IGCP 610-INQUA POCAS Second Joint Plenary Conference and Field Trip in Antalya, Turkey, planned for October 14-21, 2018.

The five days of field trips (by bus) were led by prominent Italian geologists and archaeologists described above and shown in Fig. 9. The 49-page Field Trip Guide describes the (1) Messinian-Zanclean GSSP that provides a complete sedimentary record from the onset of the MSC up to the restoration of the normal marine conditions in the basal Zanclean and displays the classical succession of

the Lower Gypsum, the Upper Gypsum and the “Lago-Mare” deposits. (2) The Capo Rossello area (Southern Sicily, Italy) that represents one of the most beautiful and complete sedimentary successions of upper Messinian to lower Pleistocene, and is particularly suitable for the study of the Plio/Pleistocene boundary. (3) Punta di Maiata that forms a beautiful natural cliff where outcrop calcareous and marly limestones of the Trubi Fm outcrop. (4) Punta Piccola - Zanclean/Piacenzian GSSP. (5) The Gelasian GSSP. (6) The almond field of Monte San Nicola with the local succession: cyclic sedimentation and sapropel clusters. (7) The Nicola bed: a close encounter with the Gelasian GSSP. (8) The Gibliscemi section, 150 m thick that is one the most complete and beautiful section of the Miocene in the Mediterranean basin. (9) Agrigento Valle dei Templi (Valley of the Temple) that is an archaeological area of Sicily characterized by its exceptional state of conservation and a series of important Doric temples of the Greek period. It corresponds to the ancient Akragas nucleus originating from the city of Agrigento (Caruso et al., 2017; http://www.avalon-institute.org/IGCP610/pdf/Field_Trip_Guide_IGCP_610_2017.pdf).

Overall, the meeting provided an excellent opportunity for international discussion of different methods and interpretations used to analyze the history of a huge geographical area from the Caspian to the Mediterranean during the full duration of the Quaternary. It also emphasized the importance of studying the Pre-Quaternary geological history in order to reveal continuity in its development. The meeting encouraged an exchange of data and publications, as well as encouraged future collaboration between physical and social scientists over the Globe. It brought together multidisciplinary scientists from all over the world, and in the process enhanced West-East scientific dialogue by providing a supportive background for collaboration regarding the correlation and integration of discoveries on the influence on humans of climatically/tectonically induced sea-level changes and coastline migration. The meeting encouraged the younger generation to engage in the multidisciplinary study of the region using advanced analytical techniques and methodologies for geoarchaeological investigations.

The Sixth Plenary Meeting and Field Trip of IGCP 610 and the Second Meeting of POCAS was held on 14-21, 2018 in Antalya, Turkey. It was focused on the late Miocene-Plio/Pleistocene geological history of the eastern Mediterranean of southern Turkey along the central Taurid Mountains. This subject is very important in shedding light and achieving a better understanding of tectonic-climatic interactions during the Plio/Quaternary period in this region.

The 218-page Proceedings of the meeting (Gilbert and Yanko-Hombach, 2018) and Field Trip of IGCP 610 and INQUA IFG POCAS, Antalya, Turkey, contain contributions from 86 scientists from two continents and 15 countries; 86% of the contributors are from developing countries (Fig. 12).

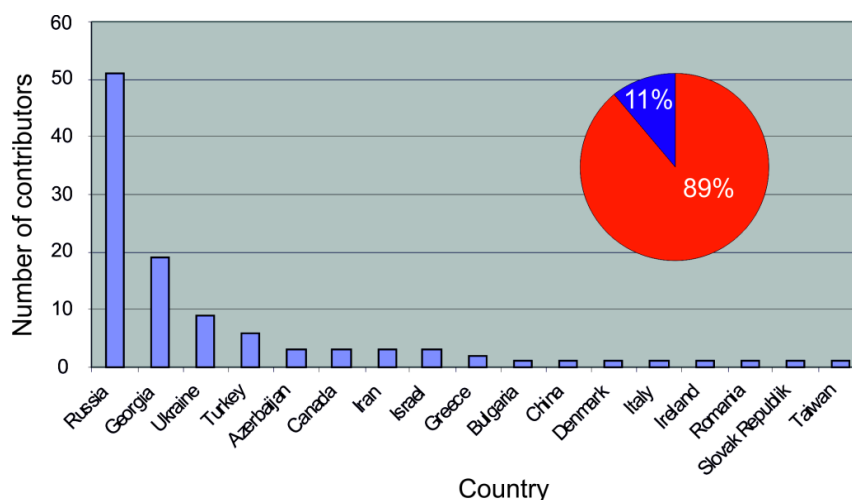


Figure 13. Number of countries and contributors to Joint Plenary Conference and Field Trip of IGCP 610 and INQUA IFG POCAS. The circle shows the percentage of scientists from developing (red) and developed (blue) countries, respectively.

The two days of the Conference were devoted to oral presentations and posters, and four days were devoted to geological field trips that focus on the field outcrops of the Miocene, Plio-Quaternary and archeological periods.

The meeting brought together multidisciplinary scientists from all over the world to enhance the West-East scientific dialogue and provide a foundation for collaboration on correlation and integration of subjects covered by the conference as previous IGCP 610, IGCP 521, and INQUA 0501 meetings have done.

Two days (October 15-16, 2018) were spent in Plenary Sessions, and four days (October 17-20, 2018) were dedicated to the Field Trips (Fig. 11).

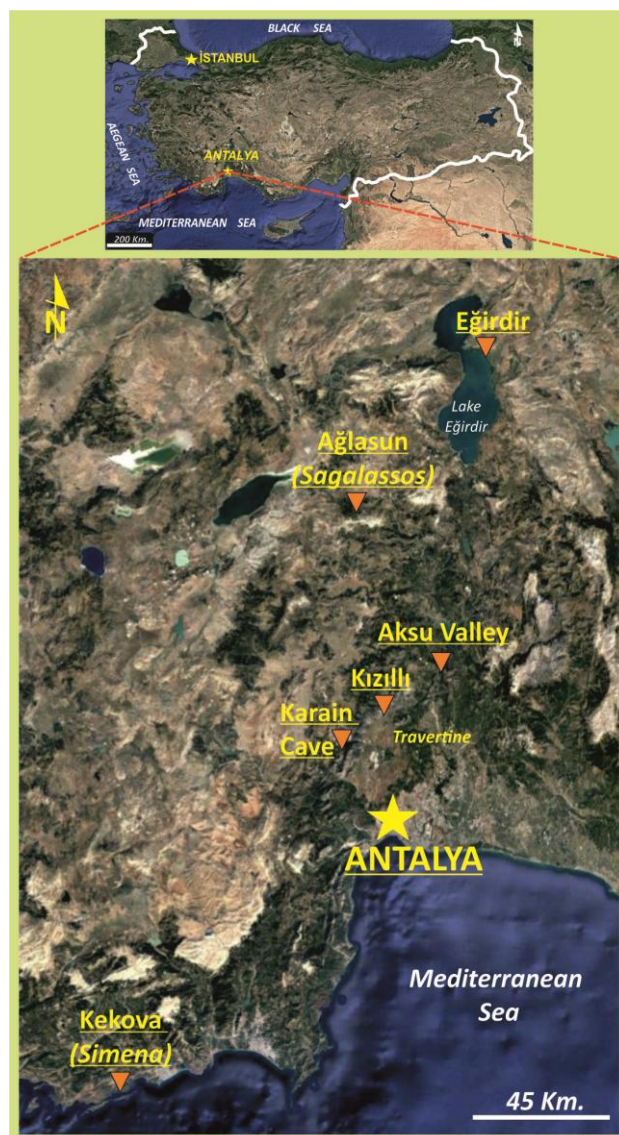


Figure 11. Field trip locations visited during the IGCP-INQUA POCAS meeting

About 50% of participants are female. The conference was characterized by relatively high number of young scientists and students.

The Joint Sixth Plenary Conference and Field Trip of IGCP 610 and the Second INQUA IFG POCAS made the following possible for the participants: (1) To discuss the actual status of both projects and progress made by participants, and (2) To lay out a strategy for the future collaboration.

The two days of Technical Sessions were organized into three panels with 26 Oral presentations.

Panel 1: GENERAL QUESTIONS OF THE CORRIDOR – moderators: Nikolay Esin (Russia) and Alexander Kislov (Russia) – included three ORAL presentations with a key-note talk “Caspian - Black

Sea - Mediterranean corridor: Water exchange and migrations of fauna during the last climatic macrocycle” given by Prof. Tamara Yanina (Russia). Two other presentations covered the role of climatic stress in the life of the ancient civilizations of the region of the Fertile Crescent, and the deep seas formation features in the conditions of the Mediterranean Sea desiccation and the negative pressure appearance in the Earth's mantle.; given by Ukrainian and Russian scientists.

Panel 2: BLACK SEA & SEA OF MARMARA REGION – moderators: Valentina Yanko-Hombach (Ukraine, Canada) and Hayrettin Koral (Turkey) – included nine ORAL presentations with a key-note talk “Chronostratigraphical correlation of Ponto-Caspian and Mediterranean basins for the reconstruction of water change and the first peopling of Europe” given by Prof. Chepalyga A.L. (Russia). Other presentations covered a range of topics on tectonic modification of coastal shoreline in the Marmara region, NW Turkey, evidenced from the archeological site; interactions between two different realms in the Marmara gateway based on an overview on Quaternary stratigraphy with new findings; ostracod assemblages on the outer northeastern Black Sea shelf during the last 300 years; Yenikapı-Istanbul excavations in light of the environmental, climatic and cultural changes in Holocene; known examples to submerged archaeological sites from Turkey; paleoanthropological study of the population, inhabited Taman Peninsula at the end of the Golden Horde period; role of migrations in cultural exploration of the Lower Danube region in Early Prehistory; and Quaternary development of southern Levant caves: window to Out of Africa hominin migration given by Russian, Turkish, Dutch, Ukrainian, Azerbaijani, Canadian, and Israeli scientists.

Panel 3: CASPIAN SEA REGION - moderators: Tamara Yanina (Russia) and Elmira Aliyeva (Azerbaijan) – included 13 oral presentations that covered a range of topics on the eastern Paratethys – Mediterranean connections during Neogene and Quaternary (key note); the Ponto-Caspian biostratigraphy, sea level, and salinity reconstructions using benthic foraminifera as the main tool; use of the Caspian strandlines as highstand indicators based on regional geomorphology, paleodrainage, and biodiversity; mud volcanic activity in the South Caspian and their environmental impact; creation of UNESCO geoparks as a geoecological tool to preserve the geoheritage of Azerbaijan; opposite marine and coastal environmental consequences of the Caspian rapid sea level fall; the Baer Knolls of the Caspian Depression as the Late Quaternary aeolian landforms; anthropomorphic images in Azerbaijan’s landscape and their possible significance; the loess-soil sequences in the Lower Volga area: stratigraphy, geochronology and paleogeography; first results of stable oxygen isotope analysis of Late Pleistocene sediments in the North Caspian basin; the Late Pleistocene Hyrcanian passage in the Manych Depression; and Caspian Sea during Anthropocene given by Azerbaijani, Russian, British, and Iranian scientists.

The POSTER session included 17 presentations. Each presenter obtained five minutes to present his or her poster orally. Poster sessions covered a wide range of subjects on coastal zone reaction to sea-level fluctuations; development of the delta on the background of the Caspian sea-level fluctuation; changes of climate and environments in the Lower Volga region during the Holocene; the problem of palynology of the Early Khvalynian chocolate clays of the Lower Volga region; the Quaternary ostracod assemblages of Apsheron archipelago; the Pleistocene-Holocene boundary on the northwestern shelf of the Black Sea based on micropaleontological data; OSL ages of the Early Khvalynian “Chocolate clays” of the Lower Volg; dinoflagellate marker species of the relic Paratethyan seas: Pannonian to Caspian basins; implications of palynology for understanding climate and salinity changes of the Late Pleistocene (Neoeuxinian) Black Sea Lake; genetic significance of fluid inclusions in minerals from the outbursts of mud volcanoes of the Azov-Black Sea Region; Quaternary volcanos of Shavnbada and Tavkvetili (Georgia); paleogeographic reconstruction of Karkinitzkiy Bay (the northwestern Black Sea shelf; use of complex geological, geochemical and geophysical data for determination of Upper Miocene transgression in West-Kuban depression of the Western Ciscaucasus; sedimentology and source of sand barriers of Caspian Sea southern east (Amirabad to Ashuradeh); Geomorphological evolution of plains of Gorgan during Khvalynian transgression of Caspian Sea (Golestan Province of Iran); meiobenthos of abandoned oil-wells at the Northern Caspian Sea; Seroglazovka locality: and Quaternary key site of the

North Caspian Depression, Russia given by Azerbaijanian, Canadian, Iranian, Ukrainian, Turkmenian, and Russian scientists.

The Technical and Poster Sessions were followed by the Round Table that enabled participants to discuss the finalizing of IGCP 610 and to plan future strategy in running INQUA POCAS project. It was decided to prepare a new IGCP project expanding the timing (up to the Upper Miocene) and geography of the “CORRIDOR” (up to the Gibraltar). It was also decided to summarize a number of the main results of IGCP 610 in a series of selected papers in the next IGCP 610 special volume of the Quaternary International, a paper in EPISODES, and organizing the IGCP 610-INQUA POCAS Third Plenary Conference and Field Trip on September 30-October 7, 2018 (the place will be decided).

The five days of Field Trips (Fig. 12, by bus) were led by prominent Turkish geologists and archaeologists. The Field Trips were focused on observation of geological characteristics of Quaternary and Pliocene stratotypes as well as key archaeological and paleontological sites. All of them are easily accessible for further study and cooperative investigations in various laboratories around the world.

The 28-page Field Trip Guide describes the:

(1) The Upper Miocene-Pliocene deposits of the Aksu (Antalya) Basin with the aim to show the units and geological evolution of the Aksu Basin in this tectonically active region. Stratigraphy of the Aksu Basin which is represented with the Middle Miocene and younger clastic rocks and carbonates overlies unconformably the Bey Dağları Platform Carbonates, Antalya Nappes, Lycian Nappes and Alanya Metamorphic Massif. Up to the Pliocene the basin was represented by fan-deltaic shallow marine deposits and later by terrestrial deposits. A visit was also arranged to Kocain Cave and tufa sediments (related to the sea-level changes during Quaternary) in Killik section of Döşemealtı Area.

(2) The ancient Roman site SAGALOSSOS (Burdur Province) and its geoarchaeological history (Fig. 14).



Figure 14. Visit of participants to the ancient Roman site Sagalossos (Burdur Province)

The site is located in southwest Turkey, near the present town of Ağlasun (Burdur province). The ancient city was founded on the south facing slopes of the Taurus mountain range and was the metropolis of the Roman province of Pisidia. Next to its mountainous landscape, a series of lakes form another typical feature of the regional geography. Today this region is known as the Lake District. The site of Sagalassos remains almost completely preserved, with the monumental structures, where in some cases almost all the original building stones can be recovered. It is an exceptional and unique case to find a middle sized, but highly flourished town in such a well preserved state. An interdisciplinary archaeological research conducted on the site for the last nineteen years has documented all layers and kinds of occupation, delivering a coherent set of archaeological and environmental results that contribute to the history of the region. All these remains document at least a thousand years of continuous occupation (3rd century BC-13th century AD).

(3) Quaternary Travertine exposures of Antalya Basin, Karain Cave (Fig. 15).



Figure 15. Visit of participants to the Karain Cave

The oldest traces of human occupation that have been discovered in Karain Cave go back to the early Paleolithic i.e. 200,000 years ago. The fragment of *Homo neanderthalensis* skull found in the cave has been dated to this period. Researchers were able to confirm the continuity of human presence in the cave for a period of more than 25,000 years, from the Mesolithic, through the Neolithic and the Chalcolithic, to the Bronze Age. In the Iron Age, and more precisely, in the time of Greek colonization of Asia Minor, the cave was probably used as a religious shrine, as evidenced by the decorations carved into the rock in front of the cave entrance. Inside the cave, flint blades, scrapers and arrowheads from the Paleolithic and the Neolithic periods were discovered. Some of them were made in the Paleolithic-invented Levallois technique, a distinctive type of stone knapping, involving the striking of flakes from a prepared core to create a shape intended by the manufacturer. In the subsequent layers some figurines made of stone and bone sculptures have been found. The findings from the Neolithic period demonstrate the connections with the nearby Hacilar cultural site, a well-known Neolithic archaeological location in Turkey. The attention of researchers was especially drawn to the carving of a human face, stylistically similar to the products of the Natufian culture which flourished in the Palestine area in the Mesolithic period. This discovery may indicate the commercial relationship between the population of southern Asia Minor and Palestine.

(4) The sunken Roman cities of Simena&Teimussa, Kekova Bay (Antalya Province). Kekova is a large region on Turkey's Mediterranean coastline that includes the island of the same name as well as the Kaleköy (Simena) and Üçağız villages. Kekova is not only known for its gorgeous turquoise sea, but also for its ancient and mysterious sunken city. It is now completely underwater with only a few remnants on land to speak of its existence. Italians were aware of Kekova's worth before they eventually lost it to the Turks after the 1932 Convention between Italy and Turkey. It sites on a stretch of coastline that is famous for the Lycian way trek, a 560 kilometers route that encompasses famous ruins from the Lycian era. Historians say that throughout history, Kekova has been called by many names including Caravola, Dolichiste and Kakava.

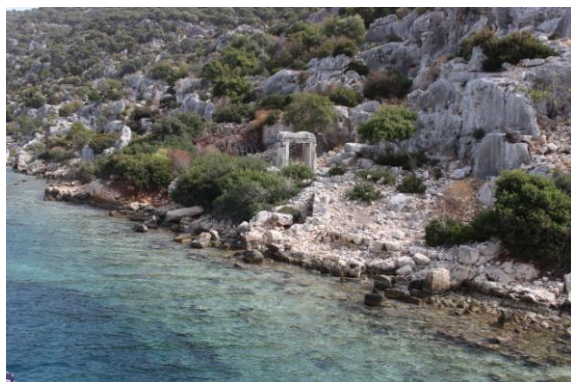
On the northern side of the island of Kekova, there are the underwater ruins of Dolchiste, an ancient Lycian settlement, which was partly overtaken by the sea due to an earthquake that occurred during the 2nd century. Even though Dolchiste was rebuilt and regained new life during the Byzantine era, the threat of Arabs in the region caused its inhabitants to abandon their town (Fig. 16).



a



b



c



d

Figure 16 a, b, c, d. Views from the sunken city in Kaleköy (Simena).

(5) Visit to Antalya Archaeological Museum, the old city and environs. The province of Antalya, which includes a long coastal strip on the Mediterranean and fertile lands inland, is endowed with the richest natural and historic treasures of Turkey. This large province also includes the ancient regions of Lycia, Pamphylia, Cilicia and Psidia where uninterrupted history from the traces of the earliest man to the present can be found in Archeological sites. The invaluable concrete evidence attesting to the regions' history is displayed at the Antalya Museum which ranks third among Turkey's historical and archaeological museum after the İstanbul and Ankara Museums (https://en.wikipedia.org/wiki/Antalya_Museum). (Koral et al., 2018; http://www.avalon-institute.org/IGCP610/pdf/Field_Trip_Guide_IGCP_610_2017.pdf).

Overall, the meeting provided an excellent opportunity for international discussion of different methods and interpretations used to analyze the history of a huge geographical area from the Caspian to the Mediterranean during the full duration of the Quaternary. It also emphasized the importance of studying the Pre-Quaternary geological history in order to reveal continuity in its development. The meeting encouraged an exchange of data and publications, as well as encouraged future collaboration between physical and social scientists over the Globe. It brought together multidisciplinary scientists from all over the world, and in the process enhanced West-East scientific dialogue by providing a supportive background for collaboration regarding the correlation and integration of discoveries on the influence on humans of climatically/tectonically induced sea-level changes and coastline migration. The meeting

encouraged the younger generation to engage in the multidisciplinary study of the region using advanced analytical techniques and methodologies for geoarchaeological investigations.

The **Field work** was carried out in numerous locations of the “CORRIDOR”.

In the **Caspian Sea region** (Supervisor T. Yanina) in-depth understanding of the: (1) Caspian Sea development during Anthropocene. (2) Timing of mud volcanic activity in the South Caspian and their environmental impact. (3) The prospects of creation of UNESCO geoparks as a geoecological tool to preserve the geoheritage of Azerbaijan. (4) Opposite marine and coastal environmental consequences of the Caspian rapid sea level fall. (5) The Baer Knolls of the Caspian Depression as the Late Quaternary aeolian landforms. (6) The loess-soil sequences in the Lower Volga area: stratigraphy, geochronology and paleogeography. (7) Processes of accumulation of the Late Pleistocene sediments in the North Caspian basin from the stable oxygen isotope data. (8) The Late Pleistocene Hyrcanian passage in the Manych Depression.

In the **Eastern Manych valley** (Supervisor R. Kurbanov) the study by different methods of the middle-late Pleistocene and Holocene sediments in outcrops near the Chograysky dam, Zunda-Tolga settlement, and cliffs of the Manych-Gudilo lake, as well as four boreholes up to 70 m in length as well as the Late Pleistocene Hyrcanian passage in the Manych Depression.

In the **Sea of Azov region** (Supervisor T. Yanina) the field study of the Sea of Azov northern and eastern coast as well as ten boreholes with 15 m length by various methods was performed for paleoenvironmental reconstruction of the late Pleistocene-Holocene history of the basin.

In the **Black Sea region** (supervisor V. Yanko-Hombach) the study of the: (1) Holocene geological sequences were investigated on the Kerch Strait coast; Eltigen (Late Pleistocene) outcrop in the Kerch Peninsula with use of OSL dating. (2) The northwestern part of the Black Sea shelf adjacent to the Romanian part of the Danube delta was investigated on board the Romanian research vessel “Mare Nigrum” focusing on the investigation of how the Danube River discharge influences environmental conditions and benthic ecosystems on the Black Sea shelf using foraminifera to delineate affected areas. (3) Tectonically modified coastal shoreline in the Marmara region, NW Turkey: evidence from the archeological site. (4) Interactions between two different realms in the Marmara gateway

In the **Mediterranean Region** (Supervisors H. Öniz and A. Frumkin): (1) Quaternary development of southern Levant caves: window to out of Africa hominin migration. (2) Submerged Archaeological Sites from Turkey.

In the **Ponto-Caspian region** (Supervisors V. Yanko-Hombach, P. Mudie, and A.L. Chepalyga) summarizing the data on the: (1) Caspian - Black Sea - Mediterranean corridor: Water exchange and migrations of fauna during the last climatic macrocycle. (2) Chronostratigraphical correlation of Ponto-Caspian and Mediterranean basins for the reconstruction of water change and the first peopling of Europe; (3) Dinoflagellate marker species of the relic Paratethyan seas: Pannonian to Caspian basins. (4) Eastern Paratethys – Mediterranean connections during Neogene and Quaternary. (5) The Ponto-Caspian biostratigraphy, sea level, and salinity reconstructions using benthic foraminifera as the main tool.

The **Workshops** were performed in Sozopol (Bulgaria, September 2013), Kirklareli (Turkey, September 2014), Ahtopol (Bulgaria, December 2014), Moscow (Russia, April and November 2015); it was entitled “Late Pleistocene of the Caspian Sea: paleogeography, correlation with events in the Black Sea Region and Russian Plain” and “Caspian Sea Level change from the point of view of Geomorphology”, respectively.

The **Training Schools** were carried out in summer (Kalmykiya, May 2014; the Danube Delta on-board the floating laboratory boat “Halmyris”, Romania, 2013, 2014, 2015, 2016) and winter (Youth Expedition–Field School in the Manych depression, 2016, 2017). Besides, the **School-Seminar** for young researchers "Methods of deltaic systems study in the South of Russia" was held at the Faculty of Geography of Moscow State University in March 2017 while the international youth **School-Conference**

"Where East meets West: Pontocaspia, the historical dimension of the evolution of a unique biodiversity" took place in Azov, Astrakhan (Russia, 2017).

4. Main scientific results

There is a number of important scientific results obtained by the project. They include: (1) Establishing the Reference List of main publications on Project subjects; a majority are published in Russian, and their titles required transliteration and translation into English, (2) Collection of the data set on chronometric data; (3) Correlation of the regional stratigraphic scales and establishing a joint one for the "CORRIDOR" in order to correlate the major events in human prehistory and history with global environmental changes (Yanina et al., 2018; Yanko, 2018); (3) The reference collection on Ponto-Caspian foraminifera (supplemented by SEM images) and mollusks and stored at the Paleontological Museum of Odessa I.I. Mechnikov National University (Ukraine) and Moscow State University (Russia); (4) A series of regional paleogeographic and geological maps (Popov et al., 2018); (5) Collaborative Danube Delta studies of samples from the delta front to the outer shelf enabling the quantification of differences among palynology processing methods and revealing a new paradigm for palynomorph distribution models in microtidal semi-enclosed basins (Mudryk et al., 2015); (6) Collaborative Danube Delta studies from the delta front to the outer shelf on soft and hard-shelled meiobenthos (nematodes, polychaetes, foraminifera, ostracoda, etc.) and mollusks (Yanko-Hombach et al., 2017); (7) Developing a model for the filling of the Black Sea basin by Mediterranean salt water during Holocene; (8) Developing a model for the processes of Caspian-Mediterranean corridor formation and Paratethys Sea-Lake degradation (Esin et al., 2015); (9) Observations of geological characteristics of Quaternary stratotypes as well as key archaeological and paleontological sites in Georgia, Azerbaijan, and Russia with further investigations of samples in various laboratories around the world (e.g., Kurbanov et al., 2018); (10) Adjustment theory in the study of human responses to global climate change in the Northwestern Black Sea region at the Pleistocene-Holocene boundary (Smyntyna, 2017); (11) Submerged archaeological sites and methods for their discovery (e.g., Öviz and Dönmez, 2018; Kadurin et al., in press); (12) Summarizing the geological and geomorphological factors and marine conditions of the Azov-Black Sea basin and coastal characteristics as they determine prospecting for seabed prehistoric sites on the continental shelf (Yanko-Hombach et al., 2017); (13) Water exchange and migrations of fauna during the last climatic macrocycle; chronostratigraphical correlation of Ponto-Caspian and Mediterranean basins for the reconstruction of water change and the first peopling of Europe (e.g., Yanko-Hombach, 2018); (14) Interactions between two different realms in the Marmara Gateway: an overview on quaternary stratigraphy with new findings (NW Turkey) (Büyükmeriç et al., 2016, 2018); Dinoflagellate marker species of the relic Paratethyan seas: Pannonian to Caspian basins. Eastern Paratethys – Mediterranean connections during Neogene and Quaternary. The Ponto-Caspian biostratigraphy, sea level, and salinity reconstructions using benthic foraminifera as the main tool.

4. Social benefits

Implementing cultural heritage projects, open-air site museums, training centers in schools with the possibility of conducting experimental research, working together with local Governmental and Non-Governmental Organizations across the Caspian-Black Sea-Mediterranean Corridors that we study as a single geographic unit, bypassing linguistic and political boundaries, and thus encouraging East-West dialogue, cooperation, and integration of researchers from different countries into the international R&D community; enhancing our understanding of the links between environmental change and human adaptation, contributing to an improvement in human living conditions (especially for those at risk from coastal flooding), and promoting the wise use of the Earth as a human habitat; and preserving human heritage by addressing and clarifying existing archaeological, ethnological, and paleoanthropological questions concerning the evolution of human subsistence strategies, social and ideological spheres in the light of environmental change, and human physical and cultural adaptation theory.

5. Educational, training or capacity building activities

The Project has enabled participants to visit relevant sites in the Caspian region of the CORRIDORS under the guidance of local experts with on-site discussion of scientific issues; formed a platform for young undergraduate and postgraduate students to benefit from international exposure and interaction with scientists from different parts of the world and varied specialties in order to cultivate traditions of “European style” scientific fora as well as scientific discussion and informal meetings. This also promoted their interest in particular specialties and motivated them to learn foreign languages in order to improve communication skills with western colleagues.

It has also promoted a multidisciplinary approach in paleoenvironmental studies; this has encouraged students in geology to take archaeological courses, and vice versa. This has also stimulated teachers to modify their curricula for undergraduate and graduate students, and promoted the preparation of several MA and PhD theses on subjects within the IGCP 610 project.

It has encouraged the establishment of direct contacts between western and eastern youth, creating the background for better understanding of modern priorities in the developing world of science and humanities.

It has exposed the younger generation in developing countries to new analytical techniques and state-of-the-art data interpretation in the field of sustainable development and environmental risk protection, as well as human cultural development; it has also informed the wider public about the evolution of the environment during the Quaternary.

In general, IGCP 610 and related activities **promoted** a multidisciplinary approach in paleoenvironmental studies that encourages students in geology and geography to take archaeological courses and *vice versa*, thus stimulating teachers of the universities participating in IGCP 610 to modify their CVs. **Enhanced** the direct contacts between western and eastern youth, creating the background for better understanding of modern priorities in the developing world of science and humanities. **Exposed** the younger generation in developing countries to new analytical techniques and state-of-the-art data interpretation. **Tough** the public about environmental evolution during the last climatic cycle and possible consequences of GCC anticipated to take full effect in this century. **Provided** consultation on stratigraphy, paleogeography, palynology, macro- and microfauna to interested parties from Ukraine, Russia, Azerbaijan, Turkey, Iran, and Georgia.

6. Activities planned

Efforts are ongoing to maximize IGCP 610 exposure via diffusion of results in key international journals and updates of our web pages to ensure wide accessibility and increased interactive potential for project participants, the scientific community at large, relevant agencies, and the public; to consolidate scientific achievements as a basis for developing future strategies; To continue to augment the funding base with upcoming and submitted research proposals through various funding agencies; to publish the next special volume of Quaternary International “IGCP 610 IV” devoted to the achievements of IGCP 610.