

PART I. IGCP 521 - INQUA 501 REPORT (2005-2009)

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1. Website addresses related to the project

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

<http://black.sealevel.ca>

<http://www.bridge.bris.ac.uk/projects/EMBSECBIO>

<http://www.paleontol.geo.sfedu.ru>

2. Summary of major past achievements of the project

Over the past 30 ky, the “Black Sea-Mediterranean Corridor” (“Corridor”) (Annex 1) underwent a complicated history, which remains hotly debated. Although thirty years have passed after the first IGCP coastal project of this region, there was subsequent study of the 30 ky timespan and evolution of the “Corridor” as a single entity despite the vast amount of geological and archaeological data that have been collected. These data remained a pile of individual pieces of a large puzzle awaiting to be assembled by joint efforts of the global sea-level community.

The common goal, collective objectives, and added value of IGCP 521 project is to cover this gap by bringing the relevant but diverse research groups together to provide cross-disciplinary and cross-regional correlation of geological, geochemical, geophysical, palaeontological, archaeological and historical records in various settings of the “Corridor” in order to evaluate an influence of sea level change and coastline migration on human adaptation during last 30 ky. IGCP 521 goes hand-on- with INQUA 501 “Caspian-Black Sea-Mediterranean Corridor during the last 30 ky: Sea level change and human adaptive strategies” (2005-2011), and IGCP 481 “Dating Caspian Sea level Changes” (2001-2006).

To reach the goal the work is organized in three dimensions: geological, archaeological and mathematical modeling. Twelve Working Groups are working in close relation to each other and are likely to generate worthy results. This report summarizes reports of the Coordinators of most Working (WG) and Regional (RG) groups (for their names please see <http://www.avalon-institute.org/IGCP>).

The following steps were undertaken to reach the objectives outlined in the original project proposal:

2.1. Collaboration

The project headquarters established a multidisciplinary team of scientists that grown almost twice since 2005. Today more that 400 specialists from 31 countries work together providing cross-disciplinary and cross-regional integration and correlation of the data obtained by multiple projects across the “Corridor”. About 50% of participants are young scientists and women. Approximately 75% of participants are from developing countries surrounding the “Corridor”.

Such collaboration improved east-west dialogue and integration of researchers from different countries into the international multidisciplinary R&D community. It also contributed to the preservation of cultural and religious heritage through the discussion of ancient cultures, civilizations, and their legends. In addition, it trained young researchers in new analytical techniques and state-of-the-art interpretation of data allowing them to establish close working contacts with top scientists.

In fact, IGCP 521 - INQUA 501 activity became a focal point where international community of multidisciplinary scientists work together correlating their results, presenting new findings at annual

plenary meetings, topical sessions, symposia, and workshops (Annex 2, 3), and publishing results in various journals and books (Annex 3). The Field Trips carried out after Plenary Sessions allow to visit many relevant sites in the “Corridor” that would have been otherwise very difficult to see, observe many relevant features under guidance of local experts, and discuss important scientific issues at these sites.

2.2. Meetings and field trips

A series of meetings, symposia, workshops, and even research cruises have been organized by the projects headquarter during 2005-2009. Filed Trips were carried out in various locations of the Corridor (Fig. 1).

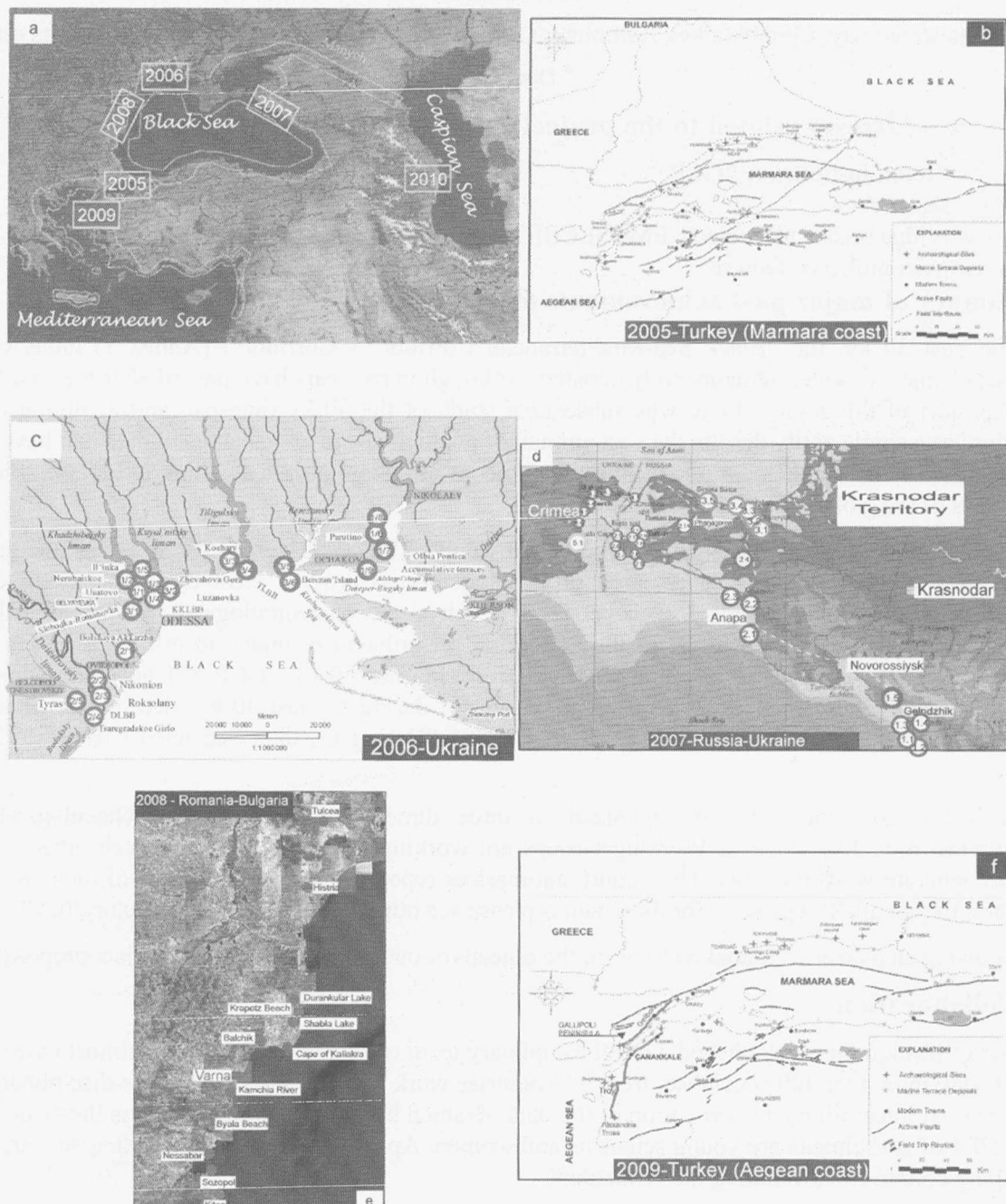


Figure 1: Location of IGCP 521 – INQUA 0501 Plenary Meetings and Field Trips: a – general for the years 2005-2010; b-Turkey (Marmara coast); c-Ukraine; d-Russia-Ukraine; e-Romania-Bulgaria; f-Turkey (Aegean coast).

2.3. Main scientific achievements

WG1 “Palaeontology and biostratigraphy” established several reference collections of Quaternary benthic foraminifera and mollusks from the Black Sea, Sea of Azov, and Eastern Mediterranean that enables us to improve stratigraphic scale for the last 30 ka and to provide correlation of various geological settings in the “Corridor”. The collections are stored at the Paleontological Museum of Odessa I.I. Mechnikov National University, Odessa, Ukraine (contact person Prof. Yanko-Hombach valyan@avalon-institute.org), Institute of Geography of the Russian Academy of Science, Moscow, Russia [contact person Prof. Chepalyga, igras@igras.geonet.ru], and Moscow State University named after M.V.Lomonosov [contact person Dr. Yanina didacna@mail.ru].

WG2 “Palynology” has collaborated with the BIOME 6000 team (the Global Palaeovegetation Mapping subprogram) under the international program IGBP (International Geophysical-Biophysical Program) at Bristol University, and with members of IGCP 480 to compile existing pollen data sets for about 100 sites in the Caspian –Black-Mediterranean Sea corridor, and to employ a student who will make biomization models for these data at selected time intervals over the past ca. 20,000 years. Through inter-laboratory exchange of technology and students, we have also established a system of standardized marine palynology preparation methods and taxonomy for study of the Black Sea corridor sediments and the palynomorphs to allow future interpretations to be based on the same types of assemblages and using updated nomenclature. Over the past 5 years, WG2 has produced more than 10 papers on the regional palynology in scientific journals (e.g., Mudie et al, 2009), and Carlos Cordova has published one book “Millennial Landscape Change in Jordan: geoarchaeology and Cultural Ecology”. The group developed research protocol for the Eastern Mediterranean-Black Sea-Caspian Biomes (EMBSecBIO) and created pollen and dinoflagellate database leading to biomisation of the EMBSecBIO (Cordova et al., 2007), [contact person Dr. Mudie Peta.Mudie@NRCan-RNC.ca].

WG3 “Geophysics and sequence stratigraphy” (Team of Prof. Aksu) contributed new high-resolution data from the southwestern Black Sea that show (1) the reconnection of the Mediterranean and Black Seas before 8.6 ka BP, (2) the absence of catastrophic flooding at any time during the Holocene, and (3) the presence of brackish to slightly saline water in the Black Sea during the Holocene (Hiscott et al., 2007a,b), (3) In 2009 activities have focused on (a) processing and cleaning of the 2008 multibeam mosaic, collected from the Bosphorus exit into the Black Sea to the boundaries of the 2005 survey area, thus enlarging the coverage of seabed features to image essentially all of the saline density-current channel on this part of the shelf, and (b) updating and refinement of chronological data for a mid-shelf delta south of the Bosphorus exit into the Marmara Sea. The Team of Dr. Lericolais proposed that the level of the Black Sea was linked to regional climate modifications rather than global eustatic changes. During the LGM, the Black Sea was an enclosed lake -120 m below present. Deglaciation raised the lake level to -30 m, and then again to -100 m between 11 and 8.5 ka BP followed by rapid transgression starting just after 8.5 ka BP (Lericolais et al., 2007). [contact persons Prof. Hiscott rhiscott@mun.ca, and Dr. Lericolais Gilles.Lericolais@ifremer.fr].

WG4 “Sedimentology and mineralogy” developed a high-resolution geological model of sedimentation on the NW Black Sea shelf that reveals significant periodicities of sedimentation related to sea-level change and hydrodynamic activity (Konikov, 2007; Martin et al., 2007) [contact persons Prof. Konikov konikov2006@mail.ru and Prof. Martin daddy@UDel.Edu].

WG5 “Geochemistry” developed a new approach to investigate amino acid racemisation and AMS radiocarbon dating of Holocene Black Sea core sediments that aimed to utilise the amino acid racemisation (AAR) geochronological technique to date a number of shells in Holocene cores from the Black Sea, and investigate the possible extent of time-averaging in Black Sea sediments (Nicholas et al., 2008, 2009) [contact persons Mr. Nicholas tonyn@uow.edu.au, and Prof. Chivas toschi@uow.edu].

WG6 “Structural geology and active tectonics” evaluated the role of active tectonics on sea-level change and coastal processes in the Black Sea, the Marmara Gateways, the Aegean Sea, northern Turkey, and the north-western part of the Black Sea (Koral, 2007, 2009; Yilmaz, 2007; Larchenkov et al., 2009) [contact persons Prof. H. Koral hkoral@istanbul.edu.tr, Prof. Y. Yilmaz yyilmaz@khas.edu.tr, and Prof. E. Larchenkov larchenkov@onu.edu.ua].

WG7 “Geomorphology” developed Black Sea level curve in radiocarbon (Balabanov, 2007) and calendar (Balabanov, Arslanov, 2007) time scales for the last 12 ka [contact person Dr. I. Balabanov [3](mailto:rsi-</p>
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company@umail.ru]. While some authors (Martin and Yanko-Hombach, in press) agreed that despite its possible drawbacks, the synoptic curve of Balabanov appears to reflect relatively subtle eustatic sea-level change related to hemispheric—and perhaps even global—climatic phenomena [contact person Prof. Martin *daddy@UDel.Edu*], some others (Brückner et al., 2008) insisted that tectonic signals often overrides the eustatic ones, and as so an establishing of a local sea level curve is the only one valuable option [contact person Prof. H. Brückner *h.brueckner@staff.uni-marburg.de*].

WG8 “Paleoceanography and palaeoclimatology” described palaeoceanographic evolution in term of palaeotemperature, palaeosalinities, palaeoproductivity, circulation patterns and efficiency of Manych (Chepalyga, 2007) and Marmara Gateways (Hiscott et al., 2007) for given time-intervals, traced water masses evolution in space and time, identified their possible sources, and reconstruct vegetation and climate dynamics in the “Corridor” since the LGM (Cordova et al., 2009) [contact person Dr. I. Balabanov *rsi-company@umail.ru*].

WG9 “Archaeology” developed an interdisciplinary model of ecological crisis dynamics for the NW Black Sea coast and adaptive reaction of ancient people to changeable environmental conditions at the Late Pleistocene-Holocene boundary, provided quantitative assessment of the impact of environmental changes on the spread of early farming in the northern Black Sea area, and investigated the Lower Volga in order to reconstruct Late Pleistocene and Holocene paleoenvironment and geochronology of Mesolithic-Early Neolithic settlements (Dolukhanov et al., 2009) [contact person was Prof. Dolukhanov]. The group also provided in-deep study of transmigrations as a mechanism of living space exploration in the Northwestern Black Sea region at the Pleistocene-Holocene boundary (Smyntyna, 2008) [contact person Prof. Smyntyna *smyntyna_olena@onu.edu.ua*], and studied the cultural sequences, the emergence of food-producing village economies in SE Europe, and collection of various rocks that have been used in prehistory of the Southern Marmara (Özdoğan, 2007a-c; 2009a,b) [contact person Prof. Özdoğan *c.mozdo@gmail.com*].

WG10 “Radiocarbon chronology” established a data set on radiocarbon assays obtained in eastern (Balabanov, 2007) and western (Yanko-Hombach, 2007) laboratories [contact person Prof. ArslanovKh@mail.ru].

WG11 “GIS-added mathematical modeling” developed several mathematical models of: (1) the Late Pleistocene and Holocene transgressions of the Black Sea (Esin et al., 2008, 2009, and in press) that describes the process by which the Black Sea basin filled with freshwater. The model takes into consideration the temporal changes of freshwater balance, rate of uplift of the strait’s bottom, and geometry of the strait channel. This model is self-sufficient, explains all processes from the melting of the glaciers by physical laws and does not demand the application of any additional hypotheses (contact person Dr. N. Esin *ovos_oos@mail.ru*); (2) the extreme Black Sea and Caspian Sea levels of the past 21,000 years with general circulation models (Kislov and Toropov, in press) [contact person Prof. Kislov *avkisllov@mail.ru*]; and (3) the transition from the Mesolithic to the Neolithic, from about 7000 to 4000 BC in Europe (Davison et al., 2007) [contact person Prof. Shukurov *anvar.shukurov@newcastle.ac.uk*].

WG12 “Geoinformation system” created two websites: (1) <http://black.sealevel.ca> is created by Mr. K. Wallace, Canada). Its is GIS-added Web-database and science informatics that enables to create the “big picture” of influence of climate, sea level change, and coastline on human adaptive strategies in the “Corridor” (Wallace, 2009) [contact person Mr. K. Wallace *design@sealevel.ns.ca*]; (2) <http://www.paleontol.geo.sfedu.ru> is created by Dr. Yu. Agarkov, Russia) contains taxonomic information, geographic and stratigraphic distribution, and paleoecological remarks on the main groups of hard-shelled microorganisms.

2.4. Dissemination of results

2.4.1. Websites

Project created four regularly updated websites:

(1) The main website <http://www.avalon-institute.org/IGCP> website is hosted by the Avalon Institute of Applied Science and is regularly updated. It outlines the main project activities, and provides a list of participants and participating countries. It also contains information about past and upcoming

conferences and field trips and includes a photo gallery of geological outcrops and archaeological monuments visited during field trips. The website also provides reports of the conferences, and information about conference proceedings and most recent publications of the project participants. The website is linked with the INQUA, UNESCO, IUGS, IGCP, and ESF websites.

(2) Website <http://www.bridge.bris.ac.uk/projects/EMBSECBIO> is hosted by S. Harrison, Bristol University, UK, and contains the pollen database that is leading to the biomisation of the Black Sea-Mediterranean Corridor. Maps showing the advances in database entry can be found at this website, along with the research and data entry protocols as described in Cordova et al. (2007).

(3) Website <http://black.sealevel.ca> is hosted by K. Wallace, SeaLevel Ltd, Halifax, Canada, consolidates research data on the study region. It accepts data from scientists and other researchers worldwide. Data are entered with GIS coordinates, depth/elevation, age (historical, geological or archaeological) and associated metadata and are plotted by longitude and latitude on a bathymetric map of the “Corridor”. These multidisciplinary data can be combined, consolidated and visualized, and each point on the Web-based map presentation is “clickable” to reveal the source, metadata information and links to further information. Data are also displayed as depth/elevation on a corresponding screen. This system demonstrates the potential to display all available data sets in millennial time slices, and to create displays and juxtapositions of datasets that have rarely or never co-existed before because of political, linguistic, and disciplinary boundaries, and rivalry over project funding. Yet once entered, all data are likely to stand the test of time and will gain resolution, clarity, accuracy and precision. Such a system can go beyond just the fruition of IGCP 521-INQUA 501 and become a legacy – a living data archive – with considerable longevity for students, academic and industrial researchers well into the future (Wallace, 2009).

(4) Website <http://www.paleontol.geo.sfsu.edu.ru> is also created by WG12 (Dr. Yu. Agarkov, Russia). It represents an online database containing taxonomic information on the main groups of hard-shelled microorganisms, supplemented by their geographic and stratigraphic distribution along with paleoecological remarks.

Once fully established by the project participants, all websites will be useful for a wide range of specialists around the globe.

2.4.2. Publications

Project published a series of per-reviewed Abstract Volumes and Field Trip Guides as well as *Special Volumes of Quaternary International* and monographs (Fig. 2). All information received during the conferences and workshops and all published resources were widely disseminated among students, post-graduates, researchers, and professors at universities and other higher educational institutions in developing countries contributing to a spin-off of “educational reform” in the fields of Earth, Behavioral, and Atmospheric Sciences, thus, improving competitiveness among young scientists and enhancing their employment opportunities. Information obtained during plenary conferences, field trips, and other activities was useful for some MSc and PhD students; about 50 theses related to IGCP 521-INQUA 501 topics are in progress or were defended in 2005-2009.

2.5. Educational, training or capacity-building activities

IGCP 521-INQUA activities: (1) enabled to visit many relevant sites in the Black Sea-Mediterranean Corridor and observe them under guidance of local experts with on-spot discussion of scientific issues; (2) 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. For example, a project of palynological study for cores from the coast and inner shelf of the Ukraine has been agreed upon between Odessa University and Memorial University (Prof. Mudie). In the framework of this project PhD student A. Gaponova (Odessa National University, Ukraine) was invited to Canada for 3 weeks of training in palynology and will continue these studies in conjunction with the palynology laboratory in Kiev (Prof. Gerasimenko). Another project of geochemical study for cores from the NW Black Sea was performed between Odessa National University, Ukraine, and University of Wollongong, Australia (Prof. Chivas). In the frameworks of this project, a young scientist Dr. Kadurin (Odessa National University, Ukraine) spent three weeks in Australia studying unique geochemical equipment

and methodology (e.g. RP-HPLC - reverse-phase high performance liquid chromatography for AAR dating) in the School of Earth and Environmental Sciences at the University of Wollongong; (3) encouraged students to take new educational courses related to project topics, and to start working with a multidisciplinary approach that was intensely discussed during the conferences; (4) involved about 200 students from Bulgaria, Moldova, Romania, Russia, Ukraine, and Turkey to the organization of meetings and field trips, thus, acquiring experience to develop their managing skills and abilities in order to cultivate traditions of “European style” scientific fora as well as scientific discussion and informal meetings. This also promoted their interest in chosen specialties and motivated them to learn foreign languages in order to improve communication skills with western colleagues; (5) promoted a multidisciplinary approach in paleoenvironmental studies, which motivated students in geology to take archaeological courses and *vice versa*. This stimulated teachers to modify their curricula (e.g., Geology and minerals of the Black Sea; Environmental Micropaleontology; Quaternary Geology, General Climatology and Theory of Climate given at various universities; (6) promoted 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; (7) 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.

IGCP 521-INQUA 501 encouraged capacity-building activities through the opening of the Scientific and Educational Center of Geoarchaeology, Marine and Environmental Geology (SECGMEG) at Odessa I.I.Mecnikov National University. At present, SECGMEG participated in EU FR6 the large-scale integrating project HERMES (<http://www.eu-hermes.net/>) and many other projects including field work (e.g., Ukrainian-Russian-Australian expedition on Kerch peninsula in 2007) in the “Corridor”.

IGCP 521-INQUA 501 conferences, field trips, and publications are conducted in strict agreement with the Working Plan [<http://www.avalon-institute.org/IGCP/plan.html>]. At the same time achieved results exceed significantly planned ones.

3. Social Benefits

IGCP 521 - INQUA 501 created an efficient interdisciplinary network comprising the leading specialists in Quaternary geology, tectonics, invertebrate palaeontology, palynology, oceanography, mathematical modeling, and prehistoric archaeology from about 30 countries. This network has enhanced our understanding of the links between environmental change and human adaptation, thus 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. Besides, the project provides further encouragement for scientific dialogue by integrating eastern and western scientists into an international RandD community through scientific collaboration, workshops, and annual meetings. The project contributes to the preservation of human heritage by re-evaluating and clarifying existing archaeological questions to arrive at a better understanding of the human response to environmental change over time in order to improve human living conditions, sustainable development, and wise management of the Earth as a human habitat.

4. Future activity

Efforts go on to maximize the project exposures via diffusion of results in key international journals and updates of our web sites to ensure wide accessibility and increased interactive potential for project participants, the scientific community at large, relevant agencies, and the public. Our goal is also to consolidate scientific achievements as a basis for developing a future strategy, to link to extant web dissemination engines hosted by AGU, GSA, IGCP 526, INQUA, IUGS and continue to augment its funding base with upcoming and submitted research proposals through various funding agencies.

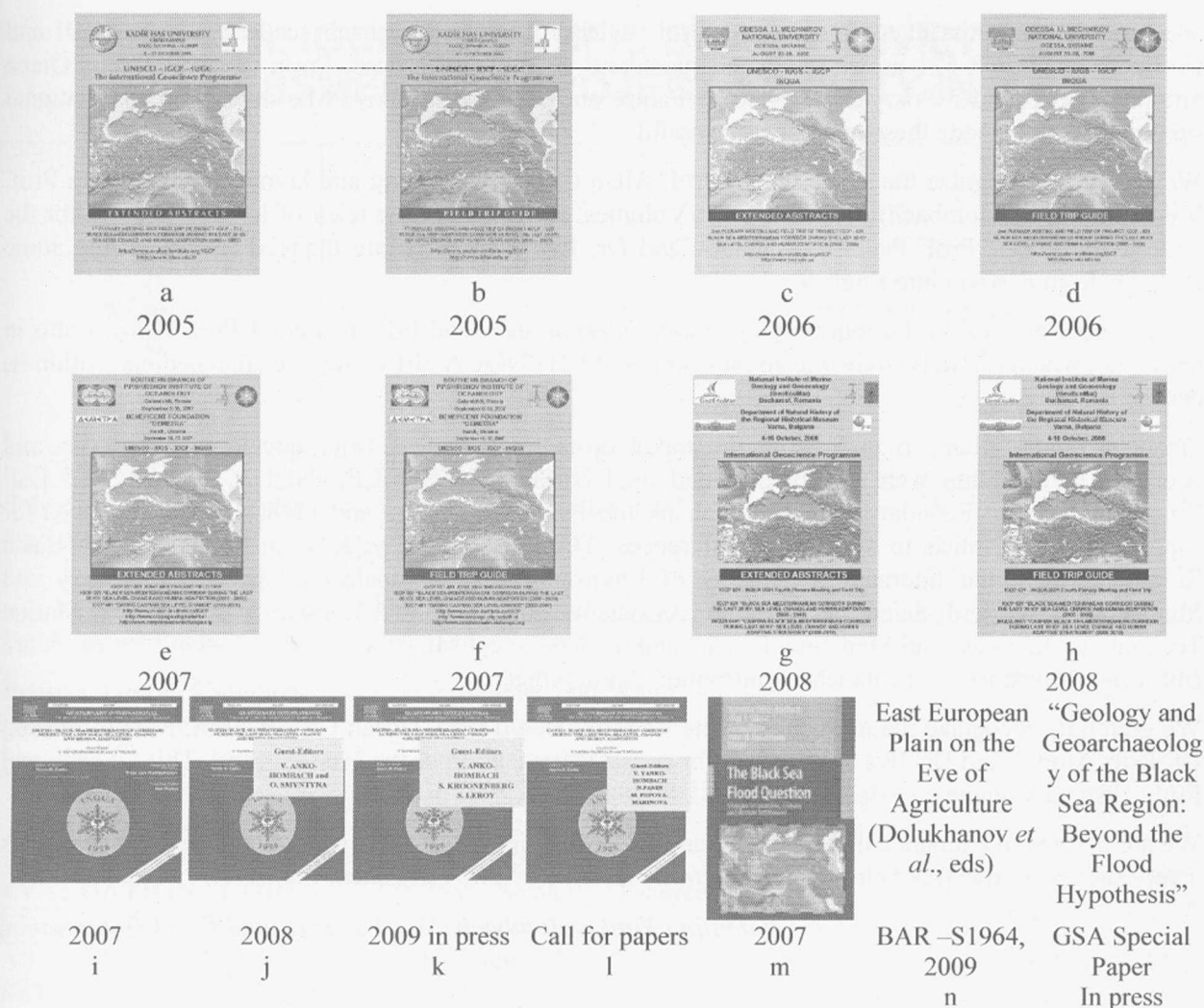


Figure 3. Proceedings of IGCP 521-INQUA 0501 project: a,b - Abstract Volume and Field Trip Guide of the 1st Plenary Meeting (2005), contains 82 extended abstracts, 226 pp.; b, c - Abstract Volume and Field Trip Guide of the 2d Plenary Meeting (2006), contains 79 extended abstracts, 188 pp.; e, f - Abstract Volume and Field Trip Guide of the 3d Plenary Meeting (carried out together with IGCP 481 (2007), contains 82 extended abstracts, 178 pp; Abstract Volume and Field Trip Guide of the 4th Plenary Meeting (2008), contains 78 extended abstracts, 206 pp; i-l *Quaternary International* Special IGCP 521-INQUA 501 volumes; m - *The Black Sea Flood Question: Changes in Coastline, Climate and Human Settlement*, V. Yanko-Hombach, A.S. Gilbert, N. Panin, and P.M. Dolukhanov, eds. 2007, Springer, Dordrecht. It contains 35 articles, many of which are written by scientists from developing countries. It also contains about 600 radiocarbon dates obtained in eastern and western laboratories; n - *East European Plain on the Eve of Agriculture*, P. M. Dolukhanov, G. R. Sarson, and A. M. Shukurov, eds, 2009, BAR –S1964; o - *Geology and Geoarchaeology of the Black Sea Region: Beyond the Flood Hypothesis*, V. "GSA Special Volume" (In press).

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We gratefully recognize the assistance of the Editorial Board (Prof. Allan Gilbert, Prof. Ronald Martin, Dr. Petra Mudie, and Dr. Ilya Buynevich) for constructive editing of the First, Second, Third, Forth, and Fifth Abstract Volume.

We are pleased to announce that the IGCP and INQUA Scientific Boards have recognized the project as a very successful one (see below IGCP Scientific Board Review Assessment Form).

Valentina Yanko-Hombach, Yucel Yilmaz, and Pavel Dolukhanov