

## Book review

**The Black Sea Flood Question: Changes in Coastline, Climate and Human Settlement, V. Yanko-Hombach, A.S. Gilbert, N. Panin, P.M. Dolukhanov (Eds.). Springer, Berlin (2007). 971pp., 246 illus, ISBN: 978-1-4020-4774-9**

Research interest in the Black Sea has been rekindled in the late 1990s after Columbia University's researchers Bill Ryan and Walter Pitman, together with their collaborators, put forward the hypothesis of an early Holocene catastrophic flooding of this landlocked basin. Popular imagination was further incensed by a popularization book and several film documentaries on the subject. In these, Ryan and Pitman argued that a catastrophe of such proportions is likely to have remained in the collective memory leading to the creation of flood myths that are common in many early cultures. A heated debate ensued on the occurrence of such a flood as well as on its possible cultural consequences. A direct offshoot of this larger discussion, the book reviewed herein was planned to assess the current issues of the debate, to bring to the fore less accessible local data from countries bordering the Black Sea, to initiate a dialog between researchers in this region and the scientific community and to present a coordinated perspective on the subject of Black Sea recent history resulting from a collaboration between geologists and archeologists. How well do the editors succeed at such ambitious goals?

This review primarily addresses papers in the volume centered on geological research. Publication of the book followed a more circuitous route than usual: initially imagined in 2003 as a collection of papers in the NATO Science series following a NATO Advanced Research Workshop on "Climate Change and Coastal Migration", it was published at the end of 2006 to include papers presented at a Columbia University conference and a session of the 2003 Geological Society of America Annual Meeting, both dedicated to the geology and archeology of the Black Sea. The end result of this effort is a voluminous book consisting of 35 papers produced in excellent technical conditions by Springer. In terms of the science presented, the book of almost 1000 pages is a mixed bag. Nevertheless, its publication constitutes a step forward for research in the Black Sea, even for the only reason that paints an accurate picture of the state-of-research in the region. Several papers in the volume stand out as remarkable whereas the remaining ones are good overviews of local research, but their conclusions should be viewed with care until validated in open peer-review.

After a preface by the editors and an interesting invited introduction by Victor Baker on the history and cultural implications of floods in geology, the book starts with papers of a more general character and presentations of several scenarios for the reconnection of the modern Black Sea to the World Ocean. These are followed by contributions that are grouped regionally for the northern, western, southern and eastern sectors of the Black Sea. The book ends with chapters on research in the Mediterranean and three appendixes, of which one includes the programs of the three meetings that provided papers for the volume. The two remaining appendixes contain radiocarbon dates from the Black Sea region compiled by I.P. Balabanov and V. Yanko-Hombach respectively, which unfortunately have not been collated in a single appendix making their use less friendly to readers who must do twice the work to locate dates of interest. Three indexes, for authors, subjects and taxonomy respectively, are handy additions at the end of the book. The book sorely lacks a critical synthesis of the many data and hypotheses presented and it is unfortunate that the editors missed this opportunity to provide their view on how the wealth of information presented fits together.

Among the papers of a more general character, Murray and colleagues present a useful and concise overview of the water column chemistry in the Black Sea that illustrates the tremendous complexity of interactions between climate forcing, physical regime, chemical fluxes, and biological response in this basin. This category of general interest also includes a contribution on the use of mollusk paleoecology in understanding coastal changes (Basso and Corselli) and a paper discussing some paleoclimate model runs for the Black Sea region (Kislov and Toropov).

The papers reviewing the status of the Black Sea flood hypothesis includes Bill Ryan's contribution that discusses *in extenso* the main observations that lead to formulating the catastrophic flood scenario within the context of relevant research (including ample references to the main sources from the Soviet era). When reading Ryan's paper, it becomes clear that the complexity of environmental conditions in the Black Sea is one of the main reasons that after more than a century of research there is little consensus on the sea (lake) level behavior, even for the period covering the last deglaciation and Holocene. The author answers several points of critique leveled at the flood hypothesis to emphasize that the crux of the flood problem is understanding and interpreting the link between

climate and Black Sea level as well as pointing to the intriguing possible role for underwater erosion in generating unconformities that have been interpreted as subaerially generated. Finally, Ryan formalizes and extends an approach used by his group and others to correlate lithostratigraphic units in Black Sea cores to the Greenland ice core climatic events to calculate in the end the variable average radiocarbon reservoir of the basin. Both the results of this original contribution on chronology and the questions put forward on alternate interpretations of climate influence and records in the region will likely stay as important items on the agenda of future Black Sea research.

In his contribution, Chepalyga proposes a series of freshwater floods that affected the entire Pontic-Caspian region between 17 and 10 ( $^{14}\text{C}$ ?) ka that was probably linked to the deglaciation phenomena such as the Scandinavian ice sheet disintegration, permafrost destabilization, and other climatically controlled phenomena leading to higher runoff toward the Caspian and overflow into the Black Sea. The author argues that these floods were more important than the Black Sea reconnection flood and it is likely to have been recorded by early civilizations as traumatic events. However, once better documented, these floods are as likely to run into the same contrary arguments from the archeological community as Ryan's hypothesis (*vide infra*). Hiscott and his colleagues present arguments for the exponents of the rival hypothesis of non-catastrophic, progressive reconnection of the Black Sea to the World Ocean. Based on multiproxy analyses on sediments, high-resolution seismic data, and arguments about hydrologic and sediment discharge budgets in the Black and Marmara seas, they argue for a continuous outflow of water from the Black Sea after 10.5  $^{14}\text{C}$  ka that was strong enough to prevent waters of Mediterranean origin to significantly penetrate in the Black Sea until 8.4  $^{14}\text{C}$  ka. It becomes apparent from reading these lead papers of the volume that the complexity of the Black Sea environmental evolution warrants more research directed especially to produce records of sea-level change based not so much on paleoceanographic arguments, but on less ambiguous, well-dated sea-level indicators.

Among other remarkable papers in the volume, a study of the Danube delta shelf by Lericolais et al. uses high-resolution seismics and multibeam data supported by new cores. They argue that the landscape at the edge of the shelf is indicative of subaerial wave- and wind-driven processes during a lowstand that the authors date earlier than 7.15  $^{14}\text{C}$  ka, when a very rapid transgression allowed for their preservation. Lericolais et al. agree that the level of the deglacial, isolated Black Sea lake was driven by climatic changes leading to a variable water budget of the basin and propose the Black Sea received meltwater from the Fennoscandian Ice Sheet (Meltwater Pulse 1) leading to a pre-reconnection highstand during the Bolling-Allerod, which was followed by a decrease of the lake level to the edge of the shelf until the reconnection. This contrasts with

other age estimates of the lake highstand in the book and with the hypothesis of Ryan and colleagues, which in its last version assumes that the lake reached its highstand during the Younger Dryas driven by the a Black Sea water budget outside the influence of meltwaters. Although it remains to be further documented that meltwaters could reach the Black Sea as late as the Bolling-Allerod, the paper by Lericolais and colleagues, together with Eastern European data presented by other papers in the book, points to the high potential of the wide, low gradient northwestern shelf for sea-level reconstructions.

Algan et al. present seismic and core evidence on the Turkish shelf primarily located in the vicinity of the Bosphorus entrance and offshore Sakarya delta. They provide new intriguing data on the vast field of depositional features located west-northwest of the Bosphorus that have been previously interpreted by Aksu, Hiscott and their colleagues as a succession of drowned barrier islands and might hold the key for reconstructing the inflow of marine waters in the early Holocene Black Sea. The paper by Filipova-Marinova reviews the existing data in Bulgaria where studies in estuaries and other coastal settings provide a useful counterpart for studies on the shelf and where use of pollen stratigraphy may help linking the two settings. Similarly, Cordova presents a study on the paleoecology of the Crimean vegetation providing detailed information that should eventually be linked to similar records from nearby marine settings. Such studies are worth extending to regions around the paleoecologically complex Black Sea area.

Lambeck et al. provide one of the most important contributions to the volume by presenting sea-level predictions for the sea of Marmara gateway, namely from the Dardanelles to the Bosphorus straits. The authors model the sea level using the isostatic theory and regional sea-level data from the Mediterranean. They predict, using the present sill depth of the Bosphorus, that sea level in the Marmara may have been able to spill into the Black Sea between 10,300 and 9500 calibrated years BP, whereas a deeper sill would have led to an earlier reconnection. These modeling results, which should be calibrated on reliable sea-level data in the Black Sea, hint to the perils of using sea-level curves from other regions to address a local problem in the Black Sea.

The lead editor of the book, Yanko-Hombach, contributes a paper on the "Noah's Flood" controversy that makes use of the extensive eastern European databases on the paleoceanography and geology of the Black Sea. The author brings new arguments based primarily on foraminifera studies for her earlier proposition of an alternate hypothesis for the reconnection whereby the sea level in the basin rose "gradually, but in an oscillating manner". This scenario appears to have originated in a confusion; the reconnection is defined using the rate of sea-level rise at the time of final penetration by marine waters into the Black Sea; in this sense, the reconnection was catastrophic (i.e., estimated rates of over a meter to tens of meters per year)

or gradual, with rates much less than a meter per year, regardless of whether the rates for the latter were variable. Nevertheless, the author makes the case for a better use of foraminifera in interpreting the paleoenvironment in the Black Sea and for integration of existing local databases in the discussion on the Black Sea evolution that according to her have been largely ignored due to “language barriers and lack of east–west scientific dialog”.

Papers such as those by Yanko-Hombach, Kuprin and Sorokin, or Glebov and Shel'ting are noteworthy for both the potential of the existing databases as well as for their shortcomings. They exemplify well the varied type and quality of the vast amounts of data that has been collected by Soviet, Russian, Ukrainian, Romanian or Bulgarian researchers especially over the last 50–60 years. However, they also point clearly to the main problem affecting any uncritical use of these data: lack of a reliable chronology and lack of access to primary data. Glebov and Shel'ting's paper is a type example for this latter problem: almost a half of its more than a hundred references are internal reports that are hard, if not impossible, for the broader community to access. More than a simple language barrier, the impediment toward a critical look at primary data may also be attributed to the style of old Soviet publications, where most of the cited studies provided little space for primary data and lack dedicated sections on methods for data collection.

The last two appendixes of the book, which for the first time bring into easy reach radiocarbon dates from local databases, are enlightening as they illustrate the problem of the lack of a reliable chronology. Establishing radiocarbon chronologies in marginal basins such as the Black Sea is a difficult task. One reason is the large variability in sources of radiocarbon; large inputs of freshwater from rivers of unknown radiocarbon composition mix in the coastal areas and may lead to large horizontal and vertical variability. Reworking of organic remains under the energetic waves of two or more transgressions since the Last Glacial Maximum makes it hard to find materials that are *in situ*. Unfortunately, neither the appendixes under discussion, nor the papers discussing their data do not address the problem of *in situ* materials for dating or discuss the challenges posed by their eventual calibration. This shortcoming is compounded by the fact that all dates compiled from the Soviet literature are conventional radiocarbon dates using large amounts of material for dating, which enhances problems like contamination or reworking, when not clearly addressed. Many of the papers suffer from a lack of credibility of their dating. Uncritical use of radiocarbon dating in the Danube delta by Panin and Popescu, for example, leads them to propose that sea level reached close to modern values as early as 11.7  $^{14}\text{C}$  ka. The authors forget to mention that mollusks dated by them included marine species, which complicates things even further as such fauna appeared in the Black Sea ~3–4 thousand years later than their proposed date. It is more likely that mixing of older reworked shells with *in situ* ones

lowered the age of the compound sample. The paper of Balabanov, which attempts to reconstruct the Holocene sea level for the Black Sea based on radiocarbon data on peats and mollusks in coastal settings, also exemplifies the danger of misinterpreting these old radiocarbon dates. Even when only dates on peats are considered, the spread of data is too large to warrant any meaningful interpretation (note that in the main figure of the paper where these sea-level data are plotted the dated materials are misidentified). When all dates are used, the lack of calibration, compounded by a lack of any vertical ranges for sea-level index points results in a comparison of apples with oranges (see e.g., Fig. 5 in Yanko-Hombach's paper). It remains unclear for this reviewer how the resulting sea-level curve has been chosen in the end. This proposed curve reaches close to modern values around 6000 years ago, but features several regressive phases since then that reached between 5 and 8 m below the modern sea level and lasted several centuries each. Taking into account that the Black Sea was connected with the World Ocean all this time demonstrating that these regressions were real would turn all we know about the Holocene sea level in the ocean on its head. Although the Shmuratko paper in the volume models the Black Sea level to allow for an oscillatory behavior during the Holocene, this is clearly contradicted by modern measurements of circulation within the Bosphorus, where small increases or decreases in sea level associated with e.g., wind set-up lead to a collapse of the two-way flow in the Bosphorus and the establishment of compensating one-way flows toward the depressed basin. The wide, uncritical acceptance of complex, unrealistic sea-level curves of this type by some workers from around the Black Sea is more of a hindrance than a help for research, especially for non-specialists who are less informed about their physical implausibility. Another series of papers from Turkish researchers (Yilmaz and Koral, respectively) address tectonics of the Turkish part of the Black Sea and underline the danger of leaving out tectonic movements when reconstructing the paleoenvironmental history in the area, a fact completely ignored by papers dedicated to sea-level reconstructions discussed above.

Other papers addressing primarily geological problems include a compilation of data on climate, sea-level change, and shoreline migration from the Soviet literature by Shuiski, a paper using historical accounts of freezing across Bosphorus and its climatic implications (Yavuz et al.), and two papers discussing climatic and sea-level changes in the Eastern Mediterranean since the Last Glacial Maximum (Issar and Ronen, respectively). Another paper by Konikov uses physical properties of sediment cores from the Ukrainian northwestern Black Sea shelf recovered at depths less than 40 m to reconstruct sea-level changes. However, since the author does not consider that changes in sedimentation character at these depths are possible via other physical processes than sea-level changes, even in stable sea-level conditions, the premises and conclusions of his work are flawed.

The volume includes ten papers that address archeological problems in the Black Sea region. Another paper by Nichols gives a useful introduction on the problem of language dispersal from the Black Sea region. Several authors review archeological issues of certain time periods and/or geographical locations (Chabai; Dergachev and Dolukhanov; Doonan) while others discuss at more length the effects of sea level and climatic changes on early populations around the Black Sea (Stanko; Dolukhanov and Shilik; Anthony; Bailey; Ozdogan; Coleman and Ballard). The majority of authors are skeptical of the occurrence of catastrophic flood in the Black Sea or of any cultural consequence that such flood may have had, although in his highly readable paper, Ozdogan notes that Neolithic settlements on the Turkish Black Sea coast are “mysteriously lacking” and “the archeological records in the Circum-Pontic area are highly uneven”. As a possible solution to this problem, the paper by Bailey makes a plea for a coordinated effort on studying the submerged settings on the Black Sea shelf. Kuniholm and Coleman and Ballard show in their contributions just how fruitful such an approach can be for both geology and archeology. Like Bailey, Ozdogan goes further to identify the harmonization of results of various schools of archeology from around the Black Sea as a most necessary task for the community because they “employ not only different methods and terminologies, but also different ways of thinking”.

Although the editors made a visible effort in translating papers from their original Russian or Ukrainian, most of these papers remain convolute, on occasion inaccurate, and most of the time unclear in expressing their meaning in a modern geological terminology and thus suffer from an acute lack of readability. Of particular concern is the proliferation of chronostratigraphic schemes (“stages”,

“phases”, “beds”, “periods”) apparently related to Black Sea-wide environmental changes, but defined differently by various local researchers, which is a serious impediment even for the most resolute reader and ultimately for research. For example, based on local literature, Yanko-Hombach in her paper divides the marine Holocene into no fewer than 11 “phases” based on postulated sea-level changes. These “phases” are renamed by other authors, or are not translated from Russian, or even new ones are added. Another weak point in these translated papers is the graphics, which inherits the arcane style of old Soviet literature, with long and complex legends, overlapping symbols and hard to distinguish patterns, which renders them difficult to read and understand.

In conclusion, the book edited by Yanko-Hombach and her colleagues is a faithful recorder of the state of research of the Black Sea and is a must-read for anybody that has plans to study any facet of the geology and archeology in the region. However, many conclusions of studies presented in the volume should be considered with a grain of salt and, if possible, access to primary data should be sought. We can only hope that the next collection of publications on the Black Sea to appear within the ongoing IGCP Project 521 “Black Sea–Mediterranean Corridor during the last 30 kyr: sea-level change and human adaptation” will be more generous in providing data that can be interpreted critically by each reader in part.

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