Calibrating late Quaternary environmental changes in the Black Sea basin using Ostracoda

Dr Ian Boomer
(Geosystems Research Group, GEES)

During the last glacial phase the Black Sea basin was isolated from the world's oceans due to the lowering of global sea-levels. As sea-levels rose during the latest glacial and early Holocene period, the Black Sea was once again connected to the eastern Mediterranean via the Dardanelles–Marmara– Bosporus seaway. In recent years, a number of studies have attempted to reconstruct the precise timing of these events and to reconstruct the conditions in the Black Sea basin before, during and after the connection was made. One of the few groups of organisms recovered as in situ fossils from the Black Sea sediment cores are the Ostracoda. While some studies have used their carbonate shells as geochemical proxies, their use as biological indicator species has not been investigated. Little is known of the modern ecology of many of these species, despite many of them thriving today in the Black Sea and its surrounding coastal regions where environmental conditions range widely in many characteristics. The primary objective of this project is to collect living Ostracoda (and Mollusca) together with hydrochemical and physical records of their habitats from a wide variety of sites along the western Black Sea border but with a particular focus on the Romanian coastline including the Danube delta. The paired biological (ostracod) and hydrochemical data will be used to produce a quantitative predictive model of water chemistry (particularly conductivity/salinity) for the Black Sea basin during at least the last 25 ka. The project will be undertaken in conjunction with colleagues at the University of Bucharest.

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The Black Sea is a large, deep-water, epicontinental sea connected to the eastern Mediterranean Basin, and thereby the world's oceans, through a narrow and shallow series of corridors, the Dardanelles–Marmara–Bosporus seaway. Today, there is an exchange between a lower, in-flowing (warm) saline Mediterranean water and an upper out-flowing (cooler) fresher Black Sea water, the sea is now heavily stratified and is permanently dysaerobic at depth. The mean salinity of the modern Black Sea is about 17‰ in most of the surface waters and as much as 23‰ in deep water. This situation was established during the early Holocene. During the last major glacial phase the Black Sea basin became isolated as the level of the eastern Mediterranean fell below that of the connecting pathway due to glacio-eustatic sea-level fall. However, the degree of draw-down experienced in the Black Sea basin during these events remains contentious. Subsequently, as the global ice-sheets returned much of their water to the oceans, sea-level rise re-connected the Black Sea and Mediterranean once again. It is probable that this has occurred on a number of previous occasions during the Quaternary.

Various studies have undertaken geochemical analyses of the sediments, and the calcareous fossils within them, in an attempt to reconstruct the salinity history of the Black Sea water during the last deglacial phase yet many of the approaches are limited due to the complex interaction of environmental variables (e.g. δ^{18}O shell material relates both to temperature and δ^{18}O of the water). Establishing the salinity level of the Black Sea basin before the Early Holocene connection to the

Mediterranean remains a key objective of such studies and will help establish whether the pre-flood Black Sea was at a much lower level than today or broadly similar.

Project workpackages

1. Two seasons of field sampling of modern water bodies in the eastern region of Romania and the Black Sea coastal region will be supported by colleagues in Romania. Water samples will be collected, and field measurements made (pH, temperature, conductivity, dissolved O_2) together with collections of ostracods and small molluscs, which also occur in Black Sea sedimentary cores.
2. Water samples will be analysed for major ion concentration, stable isotopes and the ostracod samples picked, sorted and identified.
3. An online database of Late Quaternary ostracods from the Pontian region will be established to ensure taxonomic harmonization.
4. A quantitative model will be established to predict water chemistry based on the presence/absence and abundance of ostracod taxa from this work and other published records.
5. The predictive model will be applied to existing temporal records over the last 20 ka. Further examination of new cores will also help extend the environmental record beyond the last LGM.

Candidates should have completed a first degree in Geology, Physical Geography, Environmental Sciences or a related discipline. Knowledge of micropalaeontological techniques will be a distinct advantage. The successful candidate will also be numerate and have an understanding of geochemical and/or stable isotope techniques in reconstructing late Quaternary climate change.

Related References

- Aksu, et al. 2002. Persistent Holocene outflow from the Black Sea to the eastern Mediterranean contradicts Noah's Flood Hypothesis. GSA Today, 12: 4–10.
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- Boomer, et al. 2010. Late Pleistocene to Recent ostracod assemblages from the western Black Sea. J. Micropalaeontology. 29: 119-133
- Ryan, et al. 2003. Catastrophic Flooding of the Black Sea. Ann. Rev. Earth & Planetary Sci, 31: 525-554.