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High resolution archives from the Black Sea and Caspian Sea as records of hydrological changes during the Holocene

F. Marret (1), P. Mudie (2), S. Leroy (3), A. Aksu (4), and R. Hiscott (4)

(1) University of Liverpool, Department of Geography, Liverpool, United Kingdom (f.marret@liv.ac.uk, 0044 151 7942866), (2) Geological Survey Canada Atlantic, Dartmouth, Nova Scotia, Canada, (3) Institute for the Environment, Brunel University, Uxbridge UB8 3PH, West London, UK, (4) Memorial University, St.Johnś, Newfoundland, A1B 3X5, Canada

Studies of multiple proxies from sediments of marginal seas, such as the Black Sea, or epicontinental seas, such as the Caspian Sea, have demonstrated their great potential to document past changes in climate and hydrological cycles. Over the last decade, the Black Sea has been the centre of focus with regards to the timing, speed and extent of its reconnection with the Mediterranean Sea at the beginning of the Holocene; this has led to controversial debate in the scientific community and world-wide public interest. Notably, it has been suggested that the speed of this catastrophic flooding event led to the dispersal of Neolithic populations living on the northern shore of the Black Sea. The evidence for this abrupt flooding hypothesis included geophysical surveys, sedimentological and geochemical studies on the western and northern shelves. Although the interpretation of these data may be equivocal, it appears that a major environmental change occurred at around 8.5 ka BP as evidenced by a number of proxies (1).
The Caspian Sea has revealed significant information with regards to modern marine proxies that were previously identified in early Holocene Black Sea sediments. Their modern distribution in the Caspian Sea has allowed to better constraint the paleoconditions of the Black Sea before its reconnection with the Mediterranean Sea at the beginning of the Holocene (2). Further studies of late Holocene Caspian Sea sediments have highlighted changes in salinity due to modification in river flows and climate change (3).
We present here evidence for the gradual pace of this transformation of the Black Sea, from a brackish lake to its present-day marine conditions, based on a high resolution record of dinoflagellate cysts that are used to reconstruct past sea-surface conditions. Most previous Black Sea dinocyst studies were conducted at a low resolution, on the order of millennia, whereas our new record has a multi-decadal resolution. This has enabled us to pinpoint the occurrence of major changes in the Black Sea surface conditions. The dinocyst data have also been integrated in a multiple-proxy study carried out on this record, including carbon and sulphur isotopes, ostracodes and pollen studies. The record, starting at around 9.3 ka BP documents a mild, humid climate and brackish water environment, with the dominance of the quasi-endemic association Spiniferites cruciformis-Pyxidinopsis psilata. A few occurrences of Mediterranean species and recent ecological information from Caspian Sea dinocysts indicate that salinity was not below 7. This brackish association lasted until 6.0 ka BP when it was completely replaced by euryhaline species. However, a significant presence of euryhaline species at 8.5 ka BP indicates that marine conditions were being established, i.e. that the Black Sea was even then connected to the Marmara Sea via the Bosphorus Strait. The period between the first significant increase of euryhaline taxa and the disappearance of the brackish species is characterised by the occurrence of specimens with strong morphological variability. This implies that changes in the sea surface conditions were probably gradual, and that the Black Sea reached its present conditions in about 1500 years. We will also present changes in salinity in the Caspian Sea for the last 5500 years based on dinocyst records.

References

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