About the fluctuations of the Black Sea basin after the Last Glacial Maximum to 7500 cal.yrs BP

Относно флуктуациите на Черноморския басейн след последния глациален максимум, до преди 7500 кал.год.

Krasimira Slavova
Красимира Славова

Institute of Oceanology, BAS, Varna, P.O.Box 152; E-mail: slavova@io-bas.bg

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Introduction

The fluctuations of the Black Sea basin depend on the fluctuations of the eustatic global sea level change and the climate dynamics. The aim of this article is to determine the causality between the cycles of Solar Luminosity on the one hand and the palaeoclimatic data for the Black Sea region and the fluctuations of the Black Sea basin on the other hand.

The solar insolation proxy record in a speleothem from Duhlata Cave, Bulgaria (Stoykova, 2003) suggests that the solar insolation resulting from self variations of Solar Luminosity can produce climatic variations with intensity comparable to that of the orbital variations (Stoykova et al., 2008).

It is ascertained that for the Black Sea region there is a cycle recurrence in the change of the climate after the Last Glacial Maximum until present (Slavova, 2001). Most likely, the understanding of the processes governing the formation of palaeoclimatic records for the mentioned period can give the established cycles of Solar Luminosity with different durations. Furthermore, the influence of solar insolation on the past climate, which is a result of variations of orbital parameters and the solar insolation, which is a result of self variations of Solar Luminosity is delimited (Shopov et al., 2001).

Materials and Methods

A luminescent solar insolation proxy record in a speleothem from Duhlata Cave, Bulgaria is obtained. The orbital variations from Duhlata Cave record by a band-pass Tukey filter is extracted. The same speleothem has been dated by TIMS U/Th dates (Stoykova, 2003). The methods of spore-pollen, dinoflagellate cysts and mollusk fauna analysis from different authors were used to reconstruct the climatic changes in continental and marine environments. For the correlation between the climatic archives by the Black Sea region which are dated in conventional ^{14}C years and the cycles of the Solar Luminosity which are dated in U/Th years is used the calibration curve of Stuiver, Braziunas (1993). The special features of the palaeoclimatic archive "reservoir correction", "detrital carbon input" for TOC and TCC (Jones, Gagnon, 1994) are taken into account.

Essence of the problem

Solar Luminosity and orbital variations both cause variations of solar insolation affecting the climate by the same mechanism (Stoykova et al., 2008).

The speleothems are palaeoclimatic archives. As a continental palaeoclimatic records they may grow continuously for hundreds of thousands of years, preserving in their layers records of changes in different environmental parameters. They are dated by TIMS U/Th dates in calendar years, thus they do not need to be calibrated. Such records are used to study real variations of past insolation and so this is the most appropriate solar proxy for study of the connection between Earth's climate and solar activity.

The transition of the Black Sea system from a fresh-water lake to a marine environment is one of the most debatable scientific Late Quaternary environmental events.

During the LGM the Black Sea was a giant freshwater lake not connected with the Marmara Sea. For the period of maximum low eustatic global sea level about 18 000–15 000 cal.yrs BP comes logically the conclusion about the existence of three entirely separated basins, each one having its own water-mass configuration.

At 14 500 cal.yrs BP (~12500 ^{14}C yrs BP), the Black Sea was still in its freshwater stage with rapid rise in the sea level (Slavova, Genov, 2003). As a result large volumes of water out flowed from the Black

Sea into Marmara Sea trough the Bosphorus and later – trough the Dardanelles into the Aegean Sea. Stable improvement of the climate for the Black Sea coast after 15 000 cal.yrs BP is also proved by pollen analyses of Black Sea sediments. This regional improvement of the climate coincides with the established cycle of Solar Luminosity 15 100 ± 605 cal.yrs BP from the proxy record from Duhlata Cave, Bulgaria. Most likely this is the reason for this warm spell.

On the Barbados coral reefs a Ist B melt water pulse of melting glacial waters is dated at 11 500 cal.yrs BP. The boundary Pleistocene/Holocene for the Black Sea region is fixed by pollen analysis ~11 160 cal.yrs BP (10 035 ± 65 ^{14}C yrs). On the other hand cycles of Solar Luminosity 10 800 ± 308 cal.yrs BP and 9400 ± 236 cal.yrs BP from the proxy record from Duhlata Cave, Bulgaria are obtained. A warm interval of time for the Black Sea region after the climatic warm maximum results in increased evaporation in the Black Sea region and the reduction of the Black Sea outflow and sediment accumulation in the Bosphorus Strait. However, there are proofs of continuous freshwater outflow of the Black Sea lake through the Bosphorus Strait to about 9500 cal.yrs BP.

The Black Sea was again an isolated freshwater lake during the period 9500–7500 cal.yrs BP without connection with the Mediterranean Sea (Slavova, Genov, 2003).

The period between 9500–7500 cal.yrs BP is a discussible period in the Black Sea history. The regression of the Black Sea basin to the depth of –90 –100 m below the present sea level during the Early Holocene is not accepted from many authors. They assert that only an established warm interval of time at the climatic boundary Pleistocene/Holocene is not enough reason for this regression. Actually, in this paper is considered that the reasons for the regression are several successive events, namely:

– a Younger Dryas mini glacial period is established at about 12 500 cal.yrs BP in Europe and had lead to decreasing of melted glacier waters towards the Black Sea region;

– the climatic boundary Pleistocene/Holocene for the Black Sea region is fixed ~11 160 cal.yrs BP and the cycles of Solar Luminosity 10 800 ± 308 cal.yrs BP and 9400 ± 236 cal.yrs BP from the proxy record from Duhlata Cave, Bulgaria are established;

– about 9500 cal.yrs BP the connection between the Caspian Sea and the Black Sea lake through the Manichka Valley has been interrupted. The Black Sea lake stopped its outflow into the Marmara Sea after 9500 cal.yrs BP;

– the cycle of Solar Luminosity 8400 ± 186 cal.yrs BP, established from the sample of Duhlata Cave, Bulgaria, most probably has led to the Black Sea basin regression;

– a second mini glacial period in Europe is established at about 8200–7800 cal.yrs BP. It lead to decrease of the melted Alpine glacial waters toward the Danube River and to the Black Sea basin and caused the fall of the Black Sea level and growth of the Black Sea regression, respectively. The proof for this regression is the dating of the old coastline of the West Black Sea from –90 to –100 m below the present sea level as Lower Holocene.

Conclusion

The established cycles of Solar Luminosity are recorded in the change of palaeoecological setting in the Black Sea region. Actually they can explain the short-periodicity fluctuation of the Black Sea level.

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