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Influence of solar activity on the development of calcareous nannofossils from a Middle Holocene costal paleo-ria (SW Portugal)

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A 27 m long core was recovered from a present day flat-floored small fluvial valley, tributary of the Mira River (SW Portugal) allowing to span almost the complete Holocene sedimentary sequence directly overlaying Paleozoic schists and greywackes. A high resolution study of its micropaleontological content (Alday et al. 2006) was performed and 5 sedimentary stages were established: i) a coccolith-barren lower fluvial stage; ii) a coccolith intermittent lower estuarine stage; iii) a coccolith rich marine (ria) stage; iv) a coccolith intermittent upper estuarine/lagoonal stage and v) a coccolith-barren upper fluvial stage.

The usefulness of calcareous nannofossils as natural tracers of the marine sedimentation contributing with valuable information for environmental reconstructions has been thoroughly demonstrated. Here, we present a high-resolution paleoenvironmental reconstruction from the interpreted marine (ria) section of the core, between 8.8k and 4.8k cal yr BP using most abundant calcareous nannofossils. Factor Analysis retrieved two major factors from the coccolith assemblages. Factor 1 (24% var.) is related to oceanic affinity community (e.g. *Gephyrocapsa muellerae*, *Syracosphaera pulchra* and *Umbilicosphaera sibogae*) whereas Factor 2 (23% var.) is linked to coastal neritic taxa (e.g. Ascidian spicules, *Gephyrocapsa oceanica*, *Coccolithus pelagicus braarudii*, *Heliscosphaera carteri* and *Braarudosphaera bigelowii*). These scores showed the existence of two episodes (8.8k to 7.4k and 5.8k to 5.2k cal yr BP) of marine colonization inside the paleoecological succession of the Holocene paleo-ria (8.8k and 4.8k cal yr BP).

In order to establish the relationship between the solar activity and calcareous nannofossils sedimentation, cyclicity on the studied time series was investigated by performing spectral analysis on Factor 1 (F1) and Factor 2 (F2) scores. F1 score periodogram discloses three significant periodicities (460, 350 and 236-yrs) whereas F2 score periodogram unveils only one significant periodicity (228-yrs). Phases with oceanic influence (downwelling) would be related to 450, 350 and 236-yrs frequencies and the phase with coastal influence (upwelling) would be linked to 228-yrs periodicity. These periodicities fit with previous solar activity reconstructions at millennial-to-centennial scale based on different proxies (Bond et al. 2001, Vaquero et al. 2002, Solanki et al. 2004), which, in turn, are conditioning the earth's climate system. Finally, performed time-frequency analyses on F1 and F2 scores show a higher activity of the 228-yrs periodicity during the whole studied period (spanning between 8.8k and 4.8k cal yr BP) with maximum values between 8k to 7k cal yr BP and 6k to 5k cal yr BP. By contrast, higher periodicities (450, 350 and 236-yrs) would be mainly confined to prior 7.5k cal yrs BP.

These results highlight the possibility to use the calcareous nannofossils as indirect proxies of solar activity in cases of ultra-high resolution (centennial) sedimentary sequences.

References

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