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Ooids – a shallow marine proxy for coastal aridity

Barbara Mauz (1) and Noureddine Elmejdoub ()

(1) Liverpool, Environmental Sciences, Liverpool, United Kingdom (mauz@liv.ac.uk), (2) Gabes, Institut Supérieur des Sciences et Techniques, Tunisia

This paper aims at outlining shallow marine carbonates that can be used to infer coastal and hinterland climate for the time period of deposition.

The carbonates used are ooids resulting from abiotic precipitation of aragonite around a nucleus. It is thought that ooid formation requires high CO_3^{2-} concentration, microbial activity and less than 3-5 m of warm, agitated sea water. In the modern analogues (Bahamas, Arabian Gulf, Gulf of Suez) the environmental factors controlling the formation of tangential ooids are (i) seabed morphology and tidal currents allowing for water agitation, (ii) absence of fluvial discharge and (iii) minimum annual sea-surface temperature of around 20˚C. Albeit significant environmental differences in terms of annual rainfall, sea surface temperature and salinity, Bahamian ooids are indistinguishable from those formed on shores of the Arabian Peninsula. These modern analogues have however in common that no terrestrial sediment is delivered to the shore. Thus, ooids are a proxy for the absence of riverine sediment supply to the coast.

Our test sites, situated on the southern coast of the Mediterranean, show sharp switches between siliciclastic and oolitic nearshore environments during the last interglacial sea-level highstand. These switches confirm the absence of fluvial sediment discharge when the carbonate factory was active.

Applying this concept to a number of chronologically constrained coastal sites in the Mediterranean, we are able to infer spatially differential response to external climatic forcing: some coastal areas respond instantaneously and exclusively to external forcing while others respond delayed and prolonged. The spatial difference underlines the importance of shelf geometry for coastal response to climate change.