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Multiple Particulate Ba phases elucidating Environmental Processes and Conditions: illustrated for Mediterranean Sediments

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It is recognized that different particulate Ba phases occur in marine sediment; the most prominent ones being detrital (Ba.det) and biogenic (Ba.bio). Minor other Ba-components exist that may have pronounced diagnostic significance.

The traditional normative calculation of Ba.bio from total Ba and Ba.det (Reitz ea, 2004) may introduce major errors, especially for sedimentary environments that receive detrital supplies in important quantities and of variable Ba/Al-composition. Therefore, it is essential for sediments with moderate Ba.bio-content to establish the real Ba.det content or detrital Ba/Al ratio. Several methods have been developed (Paytan et al., 2021; Rutten and de Lange, 2002). We use the latter somewhat adapted methodology to detect other Ba-phases (Wu ea, 2022; Filippidi & De Lange, 2024). This methodology is practical and effective in separating barite from other biogenic and detrital Ba-phases.

Discretely organic-rich (sapropel) and -lean, basin-wide Mediterranean Holocene sediments serve to illustrate various diagnostic features. These include those related to water depth, oxygenation, respiration, and preservation. Different Ba/Al -detrital levels are found for different climate regimes, i.e. between sapropel and non-sapropel intervals. The latter is not unexpected representing Saharan-dust rich and riverine-rich deposits respectively. If using an average detrital Ba/Al ratio in calculating Ba.bio from total sedimentary Ba-content, such difference is implicitly ignored. In addition, we established 44.6 ± 18.4 mmol/mol to be the Mediterranean barite Sr/Ba ratio for sapropel S1 sediments. This ratio is relatively constant and consistent with that reported for the global ocean during the Holocene.

Consistent differences in depth-dependent respiration are concluded from carbonate-related and Mn-oxide-related Ba phases. These point to different levels of stagnation/ventilation in the Eastern Mediterranean during sapropel S1 formation: a relatively mixed water-mass down to ~800m (consistent with basin-wide authigenic Nd isotopes reconstruction; Wu et al., 2019), a moderately mixed water-mass ~800-to ~1500 m, below which there is a more stagnant water mass at 9.5-8.5 ka and at the end of S1 formation.

Cited REFS:

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