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Out-of-balance facies in the late Barremian-Aptian shallow-water carbonates of central-southern Apennines (Italy): the signature of nutrients and seawater chemistry?

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Shallow-water carbonate systems are very sensitive to sea-level changes and to oceanographic and climatic conditions. In particular nutrient availability has been widely recognized as one of the most effective factor in shaping the composition of the carbonate forming biota. Recently the role of fluctuations in seawater chemistry and carbonate saturation state has also been stressed.

Early Cretaceous shallow-water carbonates of the central-southern Apennines have been classically referred to tropical-subtropical carbonate platforms dominated by chloralgal associations. We have studied in detail three successions of late Barremian to Aptian age with the intent of documenting the facies evolution and biotic change across the OAE 1a interval.

Calcareous algae and benthic foraminifers are the most common carbonate producing biota in these successions while rudists, ostreids and gastropods play only a minor role. Algal-foraminiferal limestones, deposited in more or less restricted lagoon, alternate with peritidal microbial laminites and fenestral limestones. However the monotonous repetition of shallowing-upward cycles is interrupted by some out-of-balance facies characterised by a single (or a few) biotic component(s) assuming rock-forming abundance. These facies are tentatively interpreted in terms of changes in nutrient availability and seawater chemistry.

- Lithocodium/Bacinella oncoidal packstone and bindstone. The development

of communities dominated by Lithocodium-Bacinella has been recently interpreted as the response to high-nutrient levels and increase in alkalinity, both favouring microbially induced precipitation of carbonates.

- Nubecularid packstone/grainstone. Many recent nubecularids live as epiphytes on seagrass leaves. We suggest that the nubecularid limestones of the studied successions record the shift to mesotrophic conditions favouring the development of seagrasses.

- Orbitolinid marls and Orbitolinid/codiacean packstones. The environmental interpretation of orbitolinid marls has been recently much debated. We favour high-nutrient input and reduced carbonate accumulation rate as the key factors shaping the complex marker bed(s) known as the "Orbitolina level" of southern Apennines. The orbitolinid/codiacean packstones at the top of the "Orbitolina level" suggest that mesotrophic conditions persisted but light penetration was enough to support prolific growth of green algae.

- *Salpingoporella dinarica* packstones. *S. dinarica* has been the topic of much discussion both for the interpretation of the pristine calcitic mineralogy of its skeleton and for its meaning as a paleo-depth indicator. We suggest that sea water chemistry played an important role in the bloom of *S.dinarica* (the *S.dinarica* acme of biostratigraphers). This hypothesis is strenghtened by the occurrence of calcitic radial ooids in levels immediately below the *dinarica* beds.

The out-of-balance facies discussed above occur at specific stratigraphic levels that can be precisely correlated between the three sections by litho-, bio- and carbon-isotope stratigraphy. Ongoing chemostratigraphic research will hopefully allow tying the record of southern Apennine shallow- water carbonates to global change across the Late Barremian-Aptian interval.