Geophysical Research Abstracts, Vol. 9, 06495, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-06495

The Orbitolina level of southern Apennines: a tale of nutrient fluctuations and stratigraphic condensation.

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The Orbitolina level is a well known litho- and biostratigraphic marker in the carbonate platform successions of central-southern Apennines. It is actually a complex shell concentration made of two distinct beds separated by an erosional surface. The first bed consists of green marls to marly limestones overlying a subaerial exposure surface and filling a network of cavities penetrating for 100-150 cm down into the substrate. Carbonate content increases upward but a more complex pattern of carbonate-rich and clay-rich levels could have been partly concealed by differential compaction. Skeletals are almost exclusively represented by flat conical orbitolinids, with only rare pelecypod shells and calcareous algae (*Salpingoporella dinarica* and codiaceans). The second bed is a bioclastic packstone very rich in flat conical orbitolinids and codiaceans (*Boueina hochstetteri*). The lithological and paleontological characters of the Orbitolina level had been accurately described before but two fundamental questions were not addressed in detail: what it is the origin of this complex shell concentration and what is its paleoenvironmental meaning in term of water depth?

The first question is solved by taphonomic analysis. The high alteration level of the orbitolinids suggests that the extremely high shelliness of the Orbitolina level is related to reduced rate of sedimentation more than to increased rate of shell production.

The second question is much more complicated and needs to be addressed in terms of paleoecology. Morphology of orbitolinid tests, namely their width-height ratio, has been traditionally related to water depth, with low-conical assemblages referred to deeper environments. It has also been suggested that flat conical orbitolinids are typically found in marls and argillaceous limestones because they were adapted to high-nutrient supply. High nutrient input, low carbonate/high clay content, stratigraphic

condensation, shell concentration, and the low-conical morphology of the orbitolinids in the Orbitolina level could therefore be all different facets of maximum flooding. However, since orbitolinids were most probably symbiont-bearing, light penetration exerted a more direct control than water-depth on their morphology: i.e. flat conical tests in marls could be responding more to water turbidity than to water depth. The orbitolinid/codiacean packstones at the top of the "Orbitolina level" suggests that light penetration had increased enough to support prolific green-algal growth. This was related either to a decrease of water-depth and/or to more transparent water as terrigenous input slowed down. Nutrient availability was however still sufficient to favour the flourishing of codiacean algae, known to prefer mesotrophic conditions.