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Potential diagenetic distortions of primary signals in rhythmic calcareous successions – cellular automaton models and Neogene examples

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Limestone-marl alternations and other micritic calcareous rhythmites have long appealed to sedimentologists, as they appeared to directly reflect high-frequency environmental change. In particular, when orbital forcing gained popularity amongst sedimentologists and paleoclimatologists in the 1980's, such rhythmites seemed to offer an ideal tool for high-resolution chronostratigraphy and environmental reconstruction. However, in spite of the fact that orbital forcing has become a routine interpretation of calcareous rhythmites, and that the processes of formation of calcareous rhythmites are considered well understood, detailed study of petrography, paleontology, and geochemistry from numerous successions through geological time again has questioned their primary origin and their direct interpretability. Some of the successions studied have a particular relevance as their rhythmic appearance has been employed for high-precision dating of Neogene GSSPs. Here we take a closer look at some of the relevant Neogene successions located in Italy. The data, supplemented by cellular automaton simulations, imply that post-depositional alteration (diagenesis) has the potential to not only seriously distort primary environmental signals, but also to mimic primary signals. This questions the use of micritic calcareous rhythmites for high-resolution chronostratigraphy and for environmental interpretations where independent data of diagenetically inert parameters are not available. Diagenetic changes appear to have a yet widely underestimated influence on the appearance of limestone-marl alternations and other calcareous rhythmites.