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Orbitally paced phosphogenesis in Mediterranean shallow marine carbonates during the middle Miocene Monterey event

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During the Oligo-Miocene major phases of phosphogenesis occurred in the Earth's oceans. Particularly in the Mediterranean region phosphate-rich sediments are well-known during this time. However, most phosphate-rich beds represent condensed or allochthonous hemipelagic deposits, formed by a complex interplay of physical and chemical enrichment processes. These underlying processes limit the application of these records for the study of a possible Milankovitch-scale climate control on Miocene phosphogenesis. In this regard the middle Miocene "Monterey event" is of particular interest, as it represents a documented phase of phosphogenesis coupled with a prominent carbon isotope excursion containing nine orbitally paced carbon isotope maxima (CM-events).
The Oligo-Miocene shallow marine Decontra section located on the Maiella Platform (central Apennines, Italy), is a widely continuous carbonate succession in a mostly outer to middle neritic setting. Of particular interest are the well-winnowed grain- to packstones of the Middle Miocene Bryozoan Limestone, were occurrences of authigenic phosphate grains coincide with the Monterey event. The depositional setting of the Bryozoan Limestone allows to resolve the influence of orbital forcing on phosphogenesis, within a bio-, chemo- and cyclostratigraphically constrained stratigraphic model.
LA-ICP-MS analyses revealed a significant enrichment of Uranium in the studied authigenic phosphate grains compared to the surrounding carbonate sediment. Notably, the Uranium enrichment allowed the use of natural gamma radiation (GR) as a proxy for the qualitative estimation of autochthonous phosphate content within the section, based on the absence of any other major gamma ray sources within the sediment. Time series analyses of high-resolution GR data indicate a strong influence of the 405kyr long-eccentricity cycle on natural gamma radiation in the Bryozoan Limestone. Our results link maxima in the GR record and thus phosphate content to orbitally paced increases in the burial of organic carbon, particularly during the CM-events of the "Monterey event". Thus, phosphogenesis during the middle Miocene in the Mediterranean was consequently controlled by the 405-kyr-eccentricity and its influence on large-scale paleoproductivity patterns in the Mediterranean.