The impact of early meteoric diagenesis on Urgonian platform carbonates: A case study from the western Swiss Jura

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The moderate preservation of sedimentological and geochemical evidence often hampers the identification of subaerial exposure surfaces in carbonate platform successions. Such discontinuities may represent significant time gaps, justifying the quest for undeniable indications. We investigated a lower Hauterivian to upper Barremian sedimentary succession from northwestern Switzerland to highlight the stratigraphic impact of meteoric diagenesis on platform carbonates. Petrographic observations under conventional and cathodoluminescence microscope revealed the presence of five generations of calcitic cements. Punctual carbon and oxygen stable isotope composition ($\delta^{13}C$ and $\delta^{18}O$ values, respectively) measurements relate them to specific diagenetic environments: selected blocky calcite cements (fC1 and C1) exhibit an enrichment in light isotopes (^{12}C, ^{16}O), indicative of a meteoric eogenesis origin, whereas very negative $\delta^{18}O$ values link the last phase of cementation C2 to mesogenesis. Meteoric calcitic cements formed during karstification of the top of the upper Barremian series that started in the latest Barremian since karst pockets are filled by marls dated to the early Aptian, based on ammonite findings; burial diagenetic phases overlap these eogenetic phases, which thus cannot be related to recent telogenesis. Based on the observation of thin section under a cathodoluminescence microscope, we estimated the ratio of early meteoric versus burial cements within the studied succession: its stratigraphic evolution reveals that lower Aptian eogenesis influenced the isotope geochemistry of platform carbonates as deep as 45 m below the exposure surface. In this interval, negative whole-rock $\delta^{13}C$ values do not reflect contemporaneous variations of the $\delta^{13}C$ curves documented in sections devoid of strong diagenetic impact. Such an impact is a function of the amount of meteoric cement in the porosity as well as of the primary carbon isotope composition of the carbonate sediments and of the meteoric cement. In the case of these sediments of the Urgonian platform, the perturbation of isotope systems is not necessarily accompanied with alteration of microfacies, and the vertical influence of a karst is not restricted to the first meters directly below the exposure surface. Consequently, the application of $\delta^{13}C$ chemostratigraphy to platform carbonates can only be performed with great caution and after a careful examination of diagenetic features.