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Eccentricity paced monsoon-like system along the northwestern Tethyan margin during the Valanginian (Early Cretaceous): new insights from detrital and nutrient fluxes into the Vocontian Basin (SE France)

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High-resolution studies document significant fluctuations between arid/humid and cool/warm conditions in the Northwestern Tethyan margin at the late early and late Valanginian. Despite numerous investigations carried out on the Valanginian climate, very few works depict high resolution climate conditions and related changes in the weathering pattern for the whole Valanginian beyond the Weissert Episode and no one astronomically calibrates them.

In this study, high-resolution changes in terrigenous and nutrient fluxes into the Vocontian Basin were investigated for the Late Berriasian – Late Valanginian time interval, in order to assess the precipitation patterns in the source areas and to evaluate the effect of orbital forcing on the strength of the hydrological cycle. New high-resolution mineralogical (bulk-rock and clay fraction) and geochemical (phosphorus and oxygen isotope) data are used from the astronomically calibrated Orpierre section. For the first time, Kaolinite, Detrital, and Phosphorus Accumulation Rates (KAR, DAR and PAR) are calculated and compared to a set of 547 geochemical, and 260 mineralogical published data from other Vocontian sections.

It appears that three regional increases in the KAR document three successive humid episodes during the Valanginian. This is confirmed by contemporaneous increases in DAR and partly also PAR, which highlight higher terrigenous and nutrient fluxes to the Vocontian Basin during these episodes. Concomitant decreases in the δ18Owhole-rock signals may reflect higher sea-surface temperatures during the early Valanginian and the early-late Valanginian transition.

The occurrence of the three humid episodes is interpreted to relate to an orbital-paced monsoonal circulation pattern through seasonally reversing movements of air mass heat and precipitation over the northwestern Tethyan margin. In particular, based on the correlation between the 405 kyr eccentricity cycles and the KAR signal obtained at Orpierre, an eccentricity influenced monsoonal circulation is proposed as the possible forcing factor behind these climatic patterns. This confirm by the average duration between the climaxes of the three regional wetter episodes that is approximately 2.43 Myr. Interestingly, the wetter and likely also warmer episode at the early – late Valanginian transition is in step with the onset of the Weissert episode. With this regards, the intensification of monsoonally-driven precipitations appears as a possible external forcing factor leading or at least accelerating the important perturbation in the global Carbon cycle associated with the Weissert episode.