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The role of the terrestrial realm during the Valanginian Carbon Isotope Excursion - Indications from palynological and organic-geochemical investigations (Vocontian Basin, SE France; Carpathian seaway, Central Poland)

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The Valanginian (Lower Cretaceous) was characterized by a distinct positive carbon isotope excursion (CIE), spanning ∼2 Ma, which represents the first of several prominent Cretaceous δ13C anomalies. During the Valanginian CIE the whole marine and terrestrial carbon system was affected, evidenced by Ccarb and Corg records of marine and terrestrial archives, showing positive shifts of ∼1.5 to 2.5 ‰ for marine carbonates, ∼2 to 3 ‰ for organic matter (OM) from marine sediments and ∼4 to 5 ‰ for terrestrial plant-derived OM. This CIE was assigned to be the result of an anoxic event (Weissert OAE) and was accompanied by changes in pCO2, a distinct cooling and turnovers in the marine fauna (e.g. Lini et al., 1992; Wortmann and Weissert, 2000; Erba et al., 2004; Gröcke et al., 2005). Causal links are yet to be assessed. Research so far has mainly focused on the interaction between the marine carbon cycle and the oceanic biosphere while information on dynamics in the terrestrial environment and interactions with the atmosphere is sparse.
In this study, a combined palynological and organic-geochemical approach has been chosen to investigate the composition and distribution of sedimentary OM deposited in hemipelagic and shallow marine settings in the Vocontian Basin (SE France; La Charce, Vergol, Morenas) and the Carpathian seaway (Central Poland; Wawal), covering the late Early to Late Valanginian/Early Hauterivian (e.g. Kutek et al., 1989; Gréselle, 2007). While the OM of the French successions is of predominantly marine origin the Polish site reveals distinct terrestrial input. Biomarker evidence points to relatively stable palaeoenvironmental conditions with well-oxygenated bottom waters prevailing during the CIE. Fluctuations in the marine biota seem to be related to temperature changes. In contrast to the mid-Cretaceous OAEs, no severe fluctuations in biomarker abundances and associated marine biota (dinoflagellates, methanotrophic bacteria and cyanobacteria) can be observed during the build-up phase of the Valanginian CIE. Contrary to later Cretaceous CIEs there is no evidence for the marine realm being a site of enhanced organic carbon accumulation/preservation, and the occurrence of widespread anoxia during the CIE cannot be confirmed for the locations investigated. The marine realm can therefore probably be excluded to be the major trigger for this carbon isotope anomaly. Changes on continents may have played the key role for this Early Cretaceous event (van de Schootbrugge et al., 2000; Westermann et al., 2010). Variations in terrestrial biomarker and spore-pollen compositions are under investigation. Our results will assess vegetation and associated humidity changes within the framework of Valanginian climatic and paleoenvironmental changes. Therby the role of the terrestrial realm during this carbon cycle perturbation will be enlighted.

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