Using extraterrestrial ^{3}He to reconstruct terrigenous fluxes and their impacts on marine primary productivity and carbon burial during OAE2 in the Vocontian Basin (SE France)

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https://doi.org/10.58998/jnr3231

The Mesozoic was punctuated by several oceanic anoxic events (OAEs) that were characterized by widespread black shale deposition and global carbon cycle perturbations. Among them, OAE2, spanning the Cenomanian/Turonian boundary (~94 Ma), has been identified as one of the most severe OAEs of the Mesozoic. Lasting ~600 kyr, this event is marked by a global >2‰ positive excursion in the $\delta^{13}C$ signature of both carbonates and organic matter. This has been interpreted to reflect a massive burial of isotopically light organic carbon that was driven by deoxygenation of ocean bottom water. Previous models suggested that volcanism related to large igneous provinces (LIPs) increased atmospheric and oceanic CO_2 concentrations, thereby increasing nutrient input into the ocean, increasing marine primary production, and decreasing seawater oxygenation. This volcanism also disturbed the climate by increasing precipitation and thus weathering. However, the respective roles of weathering and detrital fluxes on marine primary productivity and organic carbon burial during OAE2 remain highly debated, mainly due to the lack of high-resolution chronologies. In this study, we performed new extraterrestrial ^{3}He ($^3He_{ET}$) measurements on hemipelagic marine samples from Pont d'Issole (Vocontian Basin, SE France) in order to reconstruct carbonate and organic carbon contents, and terrigenous sedimentation rates and fluxes across OAE2. Combined with organic matter content, trace metal concentrations, and nannofossil fluxes, this method allowed us to trace sources and variations of each of the three sedimentary components during the event.

Our results reveal that over 70% of the ^{3}He in the analyzed samples is extraterrestrial in origin. Assuming a constant flux of interplanetary dust particles, the $^3He_{ET}$ concentrations allowed us to reconstruct relative changes in sedimentation rates at an unprecedented high resolution (every 15 cm). Our preliminary results suggest that there were changes in the variability of terrigenous and carbonate depositional fluxes across OAE2. Indeed, prior to OAE2 and at its onset, sediments are characterized by constant terrigenous input across different carbonate-rich and carbonate-poor lithologies, whereas total sedimentation plummeted (from 17 to 2 g/cm²/kyr). The beginning of the event was thus marked by a collapse of carbonate net deposition. In contrast, sediments from the Plenus Cold Event (colder and more oxygenated period within early OAE2) and from the Cenomanian/Turonian boundary show variations in both terrigenous and carbonate fluxes (from 0.2 to 2 g/cm²/kyr and from 0.5 to 8 g/cm²/kyr, respectively). In both cases, reconstructed organic matter accumulation rates peaked during short-lived pulses. The implications of our new nannofossil and $^3He_{ET}$ data will be discussed in the context of the debated role of increased detrital input on marine primary productivity and organic carbon burial during OAE2.