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The Neotethys C-isotope record across the Eocene-Oligocene Transition: the shallow- vs the deep-water record, the inorganic vs the organic carbon isotope signal

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The Eocene-Oligocene represents the last greenhouse-icehouse transition faced by Earth. This relevant climate change affected the global carbon cycle in ways that are still under debate. In this work, the upper Eocene-lower Oligocene $\delta^{13}C_{Carb}$ and $\delta^{13}C_{TOC}$ records of a shallow-water and a basinal carbonate settings within the Central Mediterranean area are presented and discussed. The bulk-rock carbon isotope record has been analysed in the northern portion of the Apula Platform, cropping out in the Majella Mountain, Central Apennines (Santo Spirito Formation), while the organic C-isotope signal has been investigated in the Umbria-Marche hemipelagic succession in the Massignano section (Conero area, Central Italy). Aims of this work are: (i) to discriminate between the global and the regional factors affecting the Neotehys C-isotope record; (ii) to evaluate the complex C-cycle dynamics across the Eocene-Oligocene Transition; (iii) to estimate the influence of this C-cycle perturbation on the shallow-water carbonate production. The results show that the Neotethys C-isotope record matches the global trend. Overall, the upper Eocene $\delta^{13}C_{Carb}$decreases while the $\delta^{13}C_{TOC}$increases. The decoupling of the curves is due to a reduced fractionation effect by primary producers, consistent with the decreasing of the atmospheric CO_2concentration during the late Eocene. However, regional factors affected the Neotethys record. The upper Eocene hemipelagic $\delta^{13}C_{TOC}$ curve is marked by transient negative spikes that testify for high productivity pulses which are related to enhanced nutrient availability triggered by the subtropical Eocene Neotethys current that, entering from the Arabian-Eurasian gateway, carried iron-rich waters. On the contrary, the shallow-water $\delta^{13}C_{Carb}$record does not show these short-term peaks. However, a change in the carbonate factory is recorded at the Eocene-Oligocene transition, witnessed by a demise of the larger benthic foraminifera occurring concomitantly with a spread of seagrass and corals. Lastly, no positive C-isotope shift is recorded in the Santo Spirito ramp associated to the Oi-1, since the normal bedding is disrupted by extensive slumps. These slumps are a clear evidence of the sea-level drop linked to the onset of the Antarctic glaciation, which triggered the deepening of the storm wave base, leading to an increased instability over the entire ramp.