

Isotopic $\delta^{13}\text{C}_{\text{bulk}}$ stratigraphy of an Early Cretaceous pelagic sequence in the Southern Alps

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Carbon isotope values are consistent with those observed in other Early Cretaceous records of the northern Tethyan Realm and show the secular variations of the paleoceanographic history on the Trento Plateau (Southern Alps, N. Italy). The presented $\delta^{13}\text{C}$ record exhibits typical values for Early Cretaceous hemipelagic to pelagic deposits which are in our case open-marine carbonates. The $\delta^{13}\text{C}$ data obtained from numerous Tethyan sections appear with an almost identical trend through stratigraphy, indicating the enormous value as calibration and correlation tool of carbon isotopes.

Single peaks and trends in the $\delta^{13}\text{C}$ record are also important for correlation with other reference sections. The positive $\delta^{13}\text{C}$ shift by $0.59\text{\textperthousand}$ at P1/53 and the subsequent by $0.32\text{\textperthousand}$ mark the Faraoni anoxic event (Upper Hauterivian), and the $\sim 1\text{\textperthousand}$ increase in the upper part of the Puez Limestone Member is typical of the boundary between the early and late Barremian. The increasing trend of about $\sim 1\text{\textperthousand}$ $\delta^{13}\text{C}$ from the late Hauterivian to early Barremian was also reported from S. France (e.g., Angles). The comparable bulk rock (composite) curve from the Vocontian Basin appears with an almost identical trend from late Hauterivian to late Barremian as the $\delta^{13}\text{C}$ curve from Puez. The late Aptian to early Albian $\delta^{13}\text{C}$ curve seems to be more constant around a mean of $\sim 2\text{\textperthousand}$ at Puez compared to the strong fluctuating curve with values from $+1.0\text{\textperthousand}$ (early Late Aptian) to $+3.52\text{\textperthousand}$ (earliest Late Aptian and latest Late Aptian) from the Vocontian Trough. Belemnite $\delta^{13}\text{C}$ values range at Puez from late Hauterivian $+0.39\text{\textperthousand}$ (mean) to late Barremian $+0.90\text{\textperthousand}$ (mean). The $\delta^{13}\text{C}$ data show a similar positive trend compared to data from Hungary (Bersek section) with $+0.40\text{--}+0.50\text{\textperthousand}$ in the late Hauterivian (Balearites balearis Zone) to $+0.6\text{--}+0.90\text{\textperthousand}$ in the late Barremian (Toxancyloceras vandenheckii Zone). Similar $\delta^{13}\text{C}$ records, from $\sim +0.5\text{\textperthousand}$ to $+2.0\text{\textperthousand}$ were reported from late Hauterivian to early Late Barremian deposits from the Southern Carpathians (S. Rumania). $\delta^{13}\text{C}$ values and trends calculated from Vocontian Trough belemnite data show a similar picture for the western Tethyan Realm, with a positive shift of $0.50\text{\textperthousand}$ (mean) from the late Hauterivian (B. balearis Zone) to late Barremian (Gerhardtia sartousiana Zone). The Hauterivian of central Italy (e.g., Gorge a Cerbara, Bosso), the $\delta^{13}\text{C}$ average values of $1.9\text{\textperthousand}$ followed by a long and continuous trend to positive values is observed culminating in the Barremian with values of $2.5\text{\textperthousand}$ exactly mirrors the trend from the Puez reference sections. No isotopic signature of the early Aptian OAE-1a occurs at Puez because of a prominent hiatus at the base of the in the Puez Redbed Member, while $\delta^{13}\text{C}$ values in the Puez Marl Member reflect the long term Albian trend observed in the Vocontian Trough, the Apennines and other sites of the Tethys. Despite the presence of organic rich layers in the Lower Albian, no isotopic signature of the OAE 1b has been observed in the P2 or P6 section. Upper Albian values display the typical increasing trend of approximately $0.5\text{\textperthousand}$ here displaced by a fault, observed in several archives around the world and interpreted as the signature of the OAE-1d. At Puez this event does not coincide with black shales deposition, what might be related to the quite shallower setting or to local oceanographic features that hampered the formation of organic rich sediments on the Trento Plateau. The presence of unconformities and absence of sedimentological evidence for the OAEs at Puez provides new insights on the mid-Cretaceous Tethyan paleoceanography. Widespread anoxic conditions and intense organic carbon burial that occurred during the OAEs were probably limited to deep basinal settings and did not affect elevated areas such as the Trento Plateau. Moreover, the presence of variegated facies, hiatuses and condensed intervals at Puez as well as other localities suggests that the Aptian-Albian was characterized by very unstable oceanographic conditions, strongly affected by topography and basin geometries.