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Orbital control on carbon cycle alterations and hyperthermal events in a cooling world: the late Early to Mid Eocene record at Possagno (southern Alps, Italy)

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The late Early Eocene to Middle Eocene ∼50–45 Million years ago (Ma) time interval in the middle bathyal, pelagic/hemipelagic succession of the Western Tethys Possagno section (southern Alps, Veneto), contains several episodes of negative carbon isotope excursions (CIEs) and concomitant dissolution of carbonates. These episodes are superimposed on a long term global climate cooling that started at about 51 Ma following the Early Eocene Climatic Optimum (EECO). Spectral analysis indicates that CIEs and dissolution events are paced by orbital forcing, confirming the global significance of previous finding on the same interval from Western and Southern Atlantic and Equatorial Pacific sites. The frequency and magnitude of CIEs through time is controlled by long-term modulations of orbital parameters, including long eccentricity (400 kyr) and a 1.2 million year modulation. Highest frequency of events – at the orbital scale – is observed across the EECO, which provides an observational basis to validate theoretical models predicting a threshold effect resulting from orbital forcing superimposed on gradually changing mean global boundary conditions. The observation of the 1.2 million year beat (long-term modulation of obliquity) together with previously published observation of enhanced obliquity (41 kyr) forcing across major CIEs and dissolution intervals indicates that high latitude feedbacks to orbital forcing played a fundamental role in the emplacement of the hyperthermals. The observed orbital forcing signature closely match that of early Eocene hyperthermals, suggesting similar driving processes.