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Cycles and trends in the δ^{18}O and δ^{13}C records over the Jurassic and Early Cretaceous

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The million-year fluctuations of the Mesozoic climate are explored through spectral analyses performed on an exhaustive compilation of δ^{18}O and δ^{13}C data measured on belemnite rostra. The data include more than 3500 data points, all coming from Western Tethys and Euro-boreal domains, and covering a time interval spanning 76 Myr from the Sinemurian ($\sim$197 Ma; Early Jurassic) to the Aptian ($\sim$123 Ma; Early Cretaceous) with an average sample step of $\sim$0.04 Myr. Spectral analyses are performed using the multi-taper method and the evolutive Fast Fourier Transform in order to get an accurate estimate of significant periods and their evolution during geological times. The age uncertainties of the Geological Time Scale 2012 are taken into account to assess the impact of these uncertainties on the identification of the significant periods. After implementing an error model that simulates the uncertainties of the Geological Time Scale, two periods remains significant: the δ^{13}C displays a high-amplitude period at 9.1 Myr, while the δ^{18}O displays a high-amplitude period at 16.4 Myr. The 16.4-Myr period is only expressed in the Early and Middle Jurassic, with maximum amplitudes reached during the "Toarcian Plateau" (Dera et al., 2011). It is probably a consequence of the activity of the Karoo-Ferrar Large Igneous Province and is an event in the δ^{18}O rather than a true cycle. The 9.1-Myr period displays a spectacular continuity from the Toarcian to the Aptian, and could be related to this intriguing 9.1-Myr cycle observed in the δ^{13}C from the Cenozoic, related to a Myr-amplitude modulation of the eccentricity cycles (Boulila et al., 2012). The δ^{13}C in the Western Tethys thus appears to have a very rhythmic behaviour, interpreted here as a long-term orbital modulation of moisture and heat transfer from equatorial to higher latitudes, modulating in return continental weathering, nutrient and detrital exports to basins, neritic vs. pelagic productivity and finally preservation of organic matter in the oceanic basins.

References:

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