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Long-period orbital control on middle Miocene global cooling: Integrated stratigraphy and astronomical tuning of the Blue Clay Formation on Malta

H.A. Abels (1), **F.J. Hilgen** (1), W. Krijgsman (2), R.W. Kruk (1), I. Raffi (3), E.Turco (4), W.J. Zachariasse (1)

 (1) Dept. of Earth Sciences, Utrecht University, Utrecht, the Netherlands (abels@geo.uu.nl),
(2) Paleomagnetic Laboratory 'Fort Hoofddijk', Utrecht University, Utrecht, the Netherlands,
(3) Dip. di Scienze della Terra, Università "G. D'Annunzio", Chieti Scalo, Italy, (4) Dip. di Scienze della Terra, Università di Parma, Parma, Italy

Application of an astronomical age model to a bulk carbonate oxygen isotope record in the Ras il Pellegrin section on Malta indicates that the middle Miocene global cooling event (13.82 Ma) coincides with the beginning of minimum eccentricity values associated with the 400 kyr cycle and minimum obliquity amplitudes associated with the 1.2 Myr cycle. This orbital configuration is very similar to that found for similar oxygen isotope enrichment events in the late Paleogene and Neogene. The step-wise character of the middle Miocene cooling event is apparently controlled by the combined influence of the 100 kyr eccentricity cycle and the 180 kyr cycle in obliquity amplitude.

The integrated stratigraphy further allows extension of the astronomical polarity timescale to the top of chron C5ACn. The boundary between the Globigerina Limestone and the Blue Clay Formation coincides with the major first step of the middle Miocene global cooling event and provides a level suitable for placing the physical reference point for the Serravallian GSSP.