Geophysical Research Abstracts,
Vol. 11, EGU2009-4594, 2009
EGU General Assembly 2009

Orbital forcing in the early Miocene alluvial sediments of the western Ebro Basin, Northeast Spain

M. Garces (1), J.C. Larrasoaña (2), A. Muñoz (3), O. Margalef (2), and X. Murelaga (4)

(1) Group of Geodynamics and Basin Analysis, University of Barcelona, Spain (mgarces@ub.edu), (2) Institute of Earth Sciences Jaume Almera CSIC, Barcelona, Spain, (3) Dept. Earth Sciences, University of Zaragoza, Spain, (4) Dept. Stratigraphy and Paleontology, University of the Basque Country/EHU, Bilbao, Spain.

Paleoclimatic reconstructions from terrestrial records are crucial to assess the regional variability of past climates. Despite the apparent direct connection between continental sedimentary environments and climate, interpreting the climatic signature in ancient non-marine sedimentary sequences is often overprinted by source-area related signals. In this regard, foreland basins appear as non-ideal targets as tectonically-driven subsidence and uplift play a major control on the distribution and evolution of sedimentary environments and facies. Foreland basins, however, often yield among the thickest and most continuous stratigraphic records available on continents. The Ebro Basin (north-eastern Spain) is of particular interest among the circum-mediterranean alpine foreland basins because it evolved into a land-locked closed basin since the late Eocene, leading to the accumulation of an exceptionally thick (>5500 m) and continuous sequence of alluvial-lacustrine sediments over a period of about 25 Myr.

In this paper we present a detailed cyclostratigraphic study of a 115 m thick section in the Bardenas Reales de Navarra region (western Ebro Basin) in order to test orbital forcing in the Milankovitch frequency band. The study section corresponds to the distal alluvial-playa mud flats which developed in the central sector of the western Ebro Basin, with sediments sourced from both the Pyrenean and Iberian Ranges. Sediments consist of brown-red alluvial clay packages containing minor fine-grained laminated sandstones sheet-beds and channels, grey marls and thin bedded lacustrine limestones arranged in 10 to 20 m thick fining-upwards sequences. Red clayed intervals contain abundant nodular gypsum interpreted as representing a phase of arid and low lake level conditions, while grey marls and limestones indicate wetter intervals recording the expansion of the inner shallow lakes.
A magnetostratigraphy-based chronology indicates that the Peñarroya section represents a time interval of about 500 kyr centered around chron C6r, although inferred absolute ages diverge depending on the assumed calibration of geomagnetic reversals with the astronomical time scale (Billups et al., 2004, Lourens et al., 2004). The section was sampled with a portable drill at regular intervals of about 30 cms, representing a time resolution of near 1 kyr. Spectral analysis of different measured parameters (lithology code, color, magnetic susceptibility and other rock magnetic parameters) revealed significant power at 20.4 m, 9.6 m and 4.2 m, which correspond to a ratio of 1:2.1:4.9 similar to that given by the Milankovitch cycles of eccentricity, obliquity and precession. Maximum power in the spetrum is focused in the eccentricity and obliquity bands while signal corresponding to precession is weakly expressed.

The existing uncertainties in the astronomical tuning of the Early Miocene geomagnetic polarity time scale prevents us from using magnetostratigraphy to anchor the Peñarroya record with the astronomical solutions (Laskar et al., 2004). Instead, we have tried the expression of the eccentricity cycle to tune the Peñarroya section. We correlated the thick red clayed (dry phase) intervals with eccentricity minima, a phase relationship which is in agreement with that derived from earlier studies in marine and continental records from the Miocene of the Iberian plate (Abels et al., 2008, Sierro et al., 2000). The resulting tuning of the Peñarroya section yields an age for the base of geomagnetic chron C6r which fits with earlier work of Billups et al., (2004), while the top of C6r gives a significantly younger age.

References

Abels, H., Abdul Aziz, A., Calvo, J.P. and Tuenter, E., 2008. Shallow lacustrine carbonate microfacies document orbitally paced lake-level history in the Miocene Teruel Basin (North-East Spain), Sedimentology doi: 10.1111/j.1365-3091.2008.00976.x.

Billups, K., Pälike, H., Channell, J.E.T., Zachos, J. and Shackleton, N.J., 2004. Astronomic calibration of the late Oligocene through early Miocene geomagnetic polarity time scale, Earth and Planetary Letters 224, 33-44.

Laskar, J., Robutel, P., Joutel, F., Gastineau, M., Correia, A.C.M. and Levrard, B., 2004. A long-term numerical solution for the insolation quantities of the Earth, Astron. Astrophys. 428, 261-285.

Lourens, L.J., Hilgen, F.J., Shackleton, N.J., Laskar, J. and Wilson, D.S., The Neogene Period, in: A Geologic Time Scale, F.M. Gradstein, J.G. Ogg and A. Smith, eds., pp. 409-440, Cambridge University Press, 2004.

Sierro, F.J., Ledesma, S., Flores, J.A., Torrescusa, S. and Martinez Del Olmo, W., 2000. Sonic and gamma-ray astrochronology: cycle to cycle calibration of Atlantic climatic records to Mediterranean sapropels and astronomical oscillations, Geology 28, 695-698.