



Sedimentology and stratigraphy of the middle Eocene Guara carbonate platform near Arguis, South-West Pyrenean foreland: Implications for basin physiography

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The Pyrenees results from the collision between Spain and Europe and developed between the upper Cretaceous (Santonian) and the Miocene. Its foreland basins are characterised by a thick fill of detrital and carbonate sediments. The diversity of Eocene deposits in the southern Pyrenean foreland basin is of particular use in facies sedimentology due to their exceptional outcropping quality and well established stratigraphic framework and has been taken as type examples of many different sedimentary environments. Most studies have concerned facies sedimentology of detrital series in turbiditic environments, meandering and braided rivers, alluvial fans, and deltas. In contrast, the Eocene carbonate series have attracted less attention. The marine Guara limestones are a formation of lower to middle Eocene age deposited on the southern border of the western Pyrenean foreland basin (Jaca basin). They were deposited as a retrogradational carbonate platform dominated by large benthic foraminifers near or at the flexural forebulge of the foreland basin as the Pyrenean orogen developed. This formation represents the last episode of carbonate platform in the Pyrenees and remains poorly studied. In the present work our aim is to provide a detailed facies analysis and physiographic reconstructions of the Guara carbonate platform. This is crucial to unravel the respective influences of tectonics, climate and rheology of the lithosphere on the foreland basin tectonic and stratigraphic development, and it brings new constraints on the paleoenvironments and paleogeography during the Lutetian, i.e. at the beginning of the major phase of activity of the Pyrenean orogenesis. Two outcrops were studied in the Sierras Marginales at the localities of Arguis and Lusera. The Lusera section once restored in its initial position is located to the North of the Arguis section in a basinward direction such that comparing time-equivalent facies between these two sections helps us reconstructing the paleobathymetric gradient on this side of the foreland basin.

The sedimentological and paleontological content show that the Guara formation was deposited in shallow water environments (less than 80 m) and can be classified as a carbonate ramp. The evolution of paleobathymetries with time on these two sections allows us to identify three complete progradational – retrogradational cycles. Those cycles do not match global eustatic variations, perhaps indicating the dominating influence of tectonics in this area.

The precise study of foraminifera allowed us to date our sections with respect to the SBZ time scale of Serra-Kiel et al. (1). The bottom of the Guara formation, in the Arguis section is dated from the lower Lutetian (SBZ 13) and the top corresponds to the upper Lutetian (SBZ 16). An important hiatus is recorded between the base of the carbonates and the lower Paleocene subjacent continental deposits. Moreover, the base of the formation is older at Lusera i.e. to the centre of the basin. This hiatus could thus represent the foreland flexural forebulge unconformity (2). By restoring the relative position of the two sections during the Lutetian, we have calculated the possible slope of the Guara ramp during this period for each MFS, with values always lower than 0.5°. Extrapolating this slope to the centre of the basin allows us to estimate the paleodepth of the coeval Eocene turbidites and address the important issue of the depth of deposition of submarine fan systems in foreland settings. Within the limits of our approach we propose that these clastic fan systems have been deposited under water depths of 400 to 200 metres. This is partly in agreement with the upper bound of other estimations based on foraminiferal assemblages and

trace fossils, and thus favours a relatively “shallow” view of the Middle Eocene Ainsa-Jaca deep marine basin.

1. J. Serra-Kiel et al., *Bulletin De La Societe Geologique De France* 169, 281 (March 1, 1998, 1998).
2. S. L. Crampton, P. A. Allen, *Aapg Bulletin* 79, 1495 (October 1, 1995, 1995).