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Research paper

Oligocene–Miocene alluvial sedimentation in the northern Ebro Basin, NE Spain: Tectonic control and palaeogeographical evolution

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Abstract

The Oligocene–Early Miocene rocks cropping out in the northern Ebro Basin (central sector) comprise conglomerates at the margin of the basin gradually passing into sandstones and mudstones towards more central areas. These rocks belong to the Peraltilla and Sariñena Formations and originated in both small monogenic-conglomerate alluvial fans that fed from the South Pyrenean Sierras directly, and large polygenic-conglomerate fans which drained more internal areas of the Pyrenees. Their lithological, textural and geometrical features, in combination with sedimentary structures, reveal the existence of several lithofacies associations whose lateral and vertical relationships, and distribution throughout time have been used to establish the main features for each type of depositional system.

Near the margin of the basin, the Tertiary series is folded and thrusted and several unconformities can be identified. Three tecto-sedimentary units (T3 to T5) have been characterised for the whole area. At the margin, they are bounded by angular or syntectonic unconformities. In more central areas, their correlative conformities can be registered as changes from coarsening- to fining-upward general trends or as sudden shifts in the vertical trend. Fining-upward trends are related to onlaps and record the retrogradational stages of the alluvial fans. In contrast, coarsening-upward trends record the progradation of the fans. Stratigraphic and sedimentological studies permit to establish the palaeogeographical evolution of the area during Oligocene and Early Miocene times. Also, it can be demonstrated that during periods of tectonic activity in the Pyrenees the alluvial fans prograded whereas during the stages of relative tectonic inactivity the fans retrograded.

Keywords: Alluvial fans; Tectosedimentary units; Palaeogeography; Oligocene–Early Miocene; Ebro Basin; Spain

1. Introduction

The broadly triangular Ebro Basin is the largest Tertiary Basin in the northeast of Spain. It is bounded by the Pyrenean Range to the north, the Iberian Range

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to the south and the Catalonian Coastal Range to the east (Fig. 1). The geodynamic evolution of the Ebro Basin was closely linked to the structural development of its margins during the Alpine cycle and mainly to that of the Pyrenees (Puigdefàbregas et al., 1986; Guimerà and Álvaro, 1990; Zoetemeijer et al., 1990; Casas, 1992; Muñoz et al., 2002). This range resulted from the collision between the Iberian and the Eurasian plates (Séguret and Daigneres, 1986; ECORS Pyrenees Team, 1988; Choukroune and ECORS Team, 1989; Muñoz, 1992a,b) and its activity extended from the Cretaceous to the Early Miocene (Muñoz et al., 1986; Puigdefàbregas et al., 1992). The Ebro Basin, with an asymmetrical sedimentary fill thickening northwards, is the youngest southern foreland basin of the Pyrenees (Riba et al., 1983; Muñoz et al., 1986, 2002; Puigdefàbregas et al., 1986, 1992; Pardo et al., 2004). From the Late Eocene to the Middle–Late Miocene (Salazar, 2003) it was isolated from marine influence, and alluvial fan systems developed that passed into well-developed carbonate or saline lacustrine environments in the basin centre (Hirst and Nichols, 1986; Villena et al., 1996b; Arenas and Pardo, 1999; Luzón and González, 2000; Muñoz et al., 2002; Luzón and González, 2003a,b; Pardo et al., 2004).

The study of continental deposits is based on the recognition of stratigraphic units resulting from the variation of allocyclical factors, usually tectonics and climate. These units are variously known as unconformity-bounded units (Chang, 1975), depositional sequences (Galloway, 1989a,b) or tectosedimentary units (Garrido-Megías, 1973, 1982; Pardo et al., 1989; Jordan et al., 1993; Muñoz and Casas, 1997; Muñoz et al., 2002).

As Pardo et al. (1989) and Arenas et al. (2001) point out, a tectosedimentary unit (TSU hereafter) is made up of a succession of strata deposited within an interval of distinctive tectonic and sedimentary character. As a consequence, every TSU is characterised by its vertical trend. Boundaries of TSUs (i.e. sedimentary breaks, Garrido-Megías, 1973, 1982; Pardo et al., 1989) are sudden shifts and/or changes in the general vertical trend. They have basinal extent and are generated by inflections or sharp changes in the rate of allocyclical factors. They are isochrons only when they are conformities, but time recorded by deposits plus hiati is constant for each TSU (Garrido-Megías, 1973, 1982; Pardo et al., 1989).

Detailed stratigraphical studies in the Ebro Basin defined eight tectosedimentary units (T1 to T8), ranging from 135 to more than 1500 m (González,

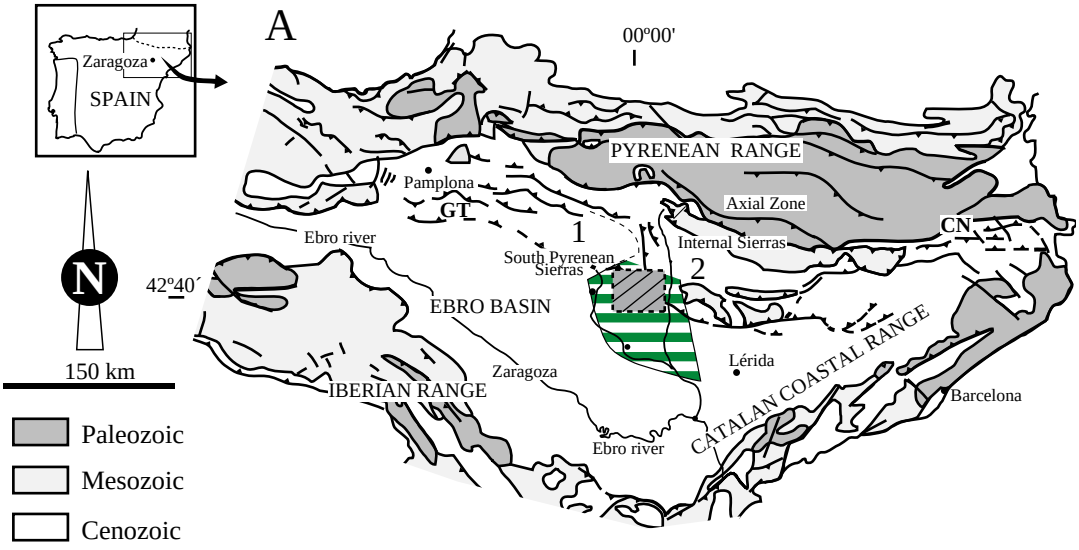

Fig. 1. Geological map of the northeastern region of the Iberian Peninsula. The study area has been outlined, while the deposition area of the Huesca fluvial system has been striped. 1: Jaca Basin; 2: Tremp–Graus Basin. GT: Guarga thrust; CN: Cadi Nappe.