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Stratigraphy and syndepositional structures of the basal foreland deposits in the northern Valle Calchaquí, NW Argentina

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The geologic processes that concerned the Andean uplift and related basins in the northwest of Argentina from middle Miocene to Recent are quite well known. Before this period, the manner in which the Palaeogene postrift basin evolved to the foreland basin and mainly, in which moment this transformation took place, are still uncertain.

In this contribution new stratigraphic and structural data from the *Valle Calchaquí* are presented. These elements provide information to assess the initial stages of foreland basin and the structures related with the Central Andes uplift. The *Valle Calchaqui* is a north-south depression and constitutes the limit between the *Puna* Plateau to the west and the *Cordillera Oriental* to the east (Fig. 1a).

In the northern *Valle Calchaquí*, a red coarsening up-ward succession of continental strata of 1.500 m of mean thickness, represents the foreland sedimentation. This deposits overlie the postrift sediments of *Salta* Group (Fig.1b). The sedimentary facies and the stratigraphic position make it possible to correlate this succession with the *Quebrada de Los Colorados* Formation, identified by Díaz et al (1987) to the south of the valley. This unit represents the initial sedimentation of the foreland basin and its age is still unknown. A Paleogene age is estimated in relation to its stratigraphic position, underlying *Angastaco* Formation, which is dated middle Miocene by its paleontological record and a Ar/Ar radimentric age of 13.04 Ma (Díaz & Malizzia., 1984; Grier & Dallmeyer, 1990) and by correlation with *Gestes* Formation (Marrett, 1990) which is bearer of Palaeogene mammals. The preliminary study of vertebrate fossils (mainly notoungulate mammals) suggests an Eocene age for this unit.

Two stratigraphic logs, located one in the northernmost area of the *Valle Calchaquí, El Saladillo* and the other situated to the south of *La Poma* town, *Cerro Bayo*, distant each other 24 km were studied (Fig. 1a). Based on the characteristics of the facies association, the pattern of fluvial facies and the paleocurrent and provenance analysis, five sedimentary sequences were recognised. The basal sequences (Ia, Ib and Ic) are integrated by fine-grained facies, sheet-like sandstones and paleosols. The middle sequences (II and III) are constituted by intermediate participation of fine-grained sediments and channel-fill conglomerate sandstones facies. The upper sequences (IV and V) consist of mudflow deposits and coarse conglomerate channel-fill facies.

In *El Saladillo* area, the clasts composition of sequences Ia, Ib and Ic indicates a source -area from granite and sedimentary rocks. The sequences II and III show a main provenance from metamorphic basement and the sequences IV and V, in addition to the mentioned ones, from volcanic and limestone rocks. Despite the heterogeneity in the composition of the source- area, the paleocurrent study reveals a main provenance from the north (Fig.1b) with minor and local variation.

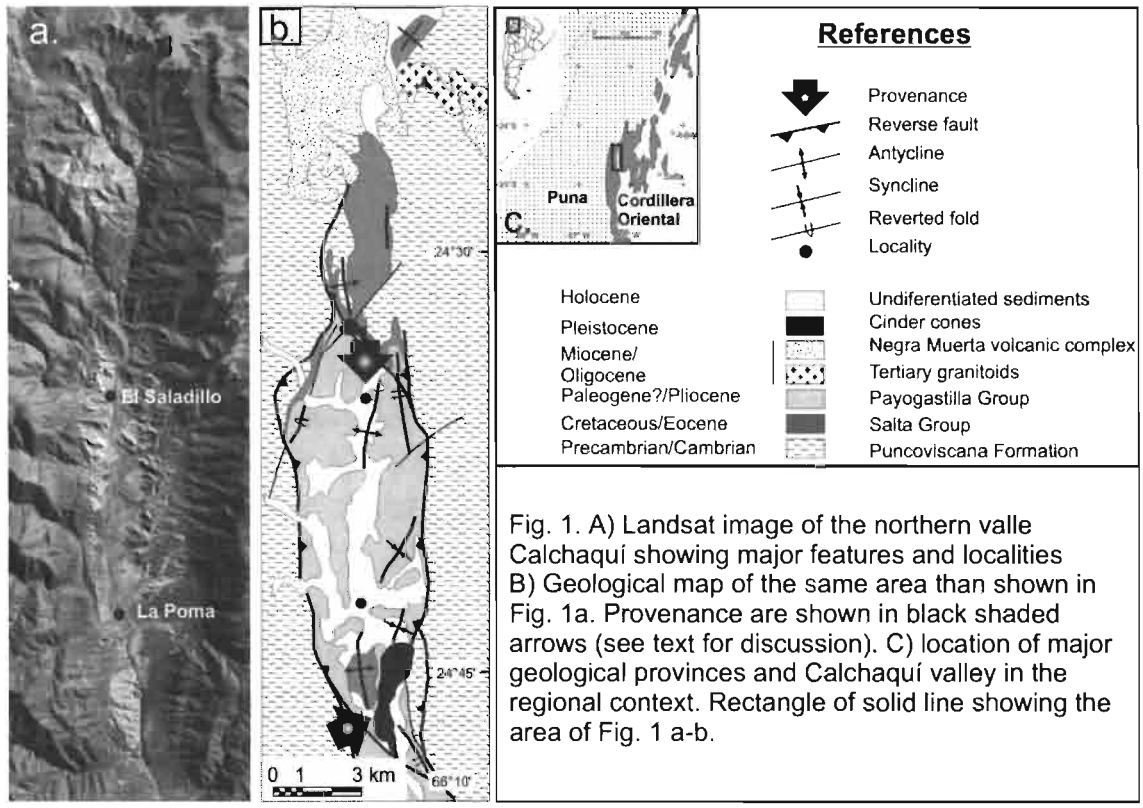

Fig. 1. A) Landsat image of the northern valle Calchaquí showing major features and localities B) Geological map of the same area than shown in Fig. 1a. Provenance are shown in black shaded arrows (see text for discussion). C) location of major geological provinces and Calchaquí valley in the regional context. Rectangle of solid line showing the area of Fig. 1 a-b.

In the *Cerro Bayo* locality four depositional sequences were identified, which present a similar arrangement to the ones described above. The provenance study shows important changes in the source-area, from metamorphic basement in the base, to Palaeozoic sandstones in the middle section to volcanic clasts dominion in the upper section. In this case, the paleocurrent analysis suggests substantial changes in the provenance direction, from the north in the base of the deposits and from the west and southwest in the middle and upper sections (Fig. 1b).

The stratigraphic variation is in agreement with the changes noticed in the structural cartography. In *El Saladillo* a clear angular unconformity separates the *Salta* Group from the foreland deposits. The angularity is manifested by the fact that the basal fine-grained sediments rest over different lithostratigraphic units of the *Salta* Group (*Mealla, Maíz Gordo* and *Lumbrera* Formations, del Papa et al., 2004). Furthermore, a series of unconformity surfaces are traceable in the basal section of the syn-orogenic deposits (sequences Ia, Ib and Ic). Thrust fault and fold systems involving angular unconformity surfaces with dips up to 70° in the frontal-limb to a few degrees in the back–limb were observed. Moreover, a significant thickness suppression of the basal units (Ia, Ib and Ic) were determined, like in the western border of *El Saladillo*, where the sequence II directly rests over the *Salta* Group.

The stratigraphic evolution and the structural evidences mark periods of syntectonic sedimentation (Sequences I and II?) followed by periods of post-tectonic conglomerate progradation (Sequences III, IV and V). The features described allow to infer that from the initial stages of the foreland development (Paleogene?), intrabasinal uplift took place, which caused internal relief and angular unconformities generation. The changes in the paleocurrent directions and source-area along the northern *Valle Calchaquí* suggest that different structural blocks up-lifted forming a complex basin palaeogeography. The timing of these uplifts and the chronostratigraphic scheme are matter of current research.

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