Vol. 54 – SUPPLEMENT 2

Bollettino di Geofisica
teorica ed applicata

An International Journal of Earth Sciences

Guest Editors: Reynaldo Charrier, Francisco Hervé, Emanuele Lodolo, Marco Menichetti, Maria Pia Rodríguez, Alejandro Tassone.

International Geological Congress on the Southern Hemisphere

Scientific Contributions of the Geosur2013

25-27 November, 2013
Viña del Mar, Chile

Istituto Nazionale di Oceanografia e di Geofisica Sperimentale

ISSN 0006-6729

SEDIMENTARY PATTERNS IN THE VINCHINA BASIN: INTERPLAY BETWEEN COMPRESSIONAL AND TRANSCURRENT TECTONISM DURING THE ANDEAN OROGENY 3-05

Ciccioli P.L.*[1-3], Marenssi S.A.[1-2], Rossello E.[1] and Limarino C.O.[1-3]

(1) Dto. de Cs. Geológicas, Universidad de Buenos Aires, Pabellón 2, Ciudad Universitaria, Buenos Aires, 1428 Argentina - CONICET.
(2) Instituto Antártico Argentino.
(3) IGEBA, Pabellón 2, Ciudad Universitaria, Buenos Aires. 1428, Argentina.
** Presenting Author's email: ciccioli@gl.fcen.uba.ar*

Introduction

The Nevados del Famatina, located in northwestern Argentina (Fig. 1), is one of the higher non-volcanic mountains belts in South America reaching up to 6200 m in height. Despite the fact that the uplift of the Nevados del Famatina was (and is) closely related to the Andean Orogeny, these mountains are located about 400 km from the Chile trench and up to 100 km from the main Andean Cordillera (Cobbold *et al.,* 2007). The origin of the high and isolated Nevados del Famatina is related to a Neogene tectonic syntaxis due to the relationship between the left-lateral Valle Fértil wrench fault and the right-lateral Tucuman wrench fault (Rossello *et al.,* 2011). The Vinchina Basin, a highly subsiding basin that accumulated more than 10,000 m of continental sediments during the Neogene developed between the magmatic arc, located in the Andean Cordillera, and the Famatina Mountain. The study of the sedimentary fill of the Vinchina Basin allows reconstructing not only the evolution of the magmatic arc (and its associated deformation) but also the timing and effect of the uplift of the Nevados del Famatina.

The stratigraphy of the Vinchina Basin, which very probably represents the northern culmination of the Bermejo Basin, was studied by several authors. Recently, Ciccioli et al. (2011) divided the Vinchina Basin

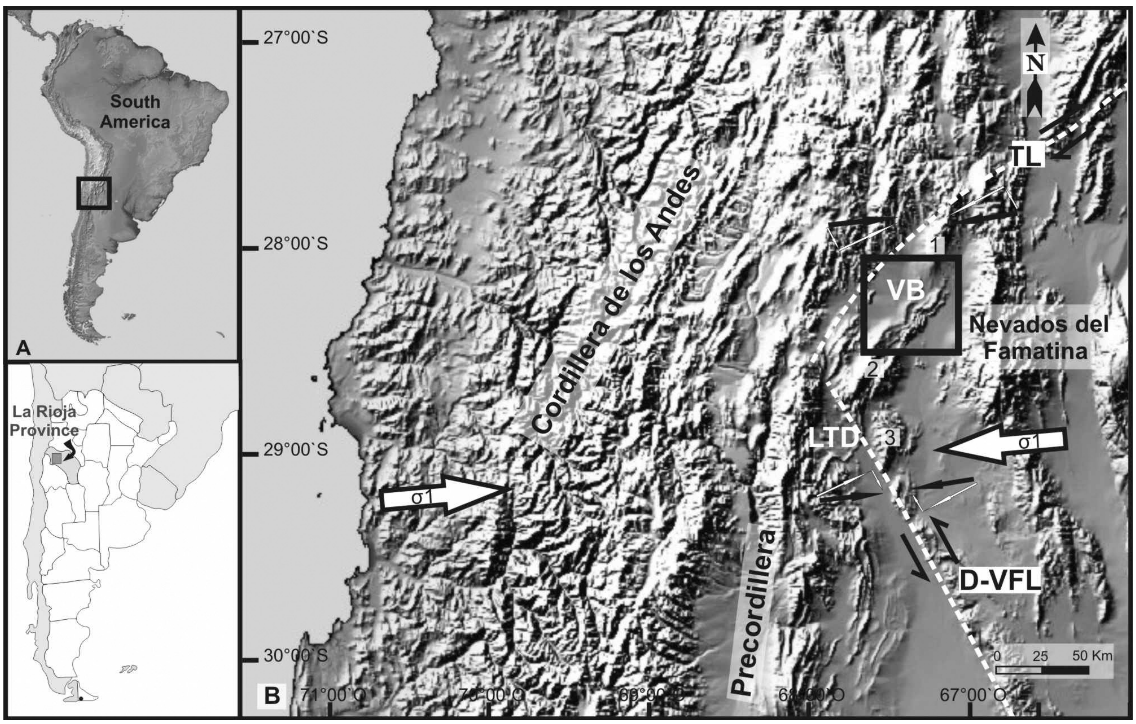

Fig. 1 - Location map of the Vinchina Basin (VB). (1, Toro Negro; 2, Umango-Espinal and 3, Maz ranges), LTD, La Troya depocenter, Tucumán (TL) and Desaguadero-Valle Fértil (D-VFL) lineaments.

fill into five stages named: 1. Retroarc, 2. Early transpressive retroarc, 3. Late transpressive retroarc, 4. Transpressional foreland and 5. Cannibalized foreland. New radiometric ages and stratigraphic evidences allow the timing of these stages to be refined and to relate them with the uplift of the Nevados del Famatina and the basement blocks of Sierras Pampeanas Noroccidentales.

Tectosedimentary model for the Vinchina Basin

To understand the stratigraphic record of the Vinchina Basin it is first necessary to highlight that the evolution of the basin was strongly influenced by the continuous interaction between the Andean compression and northwest-southeast strike-slip structures present in the basement of the basin (Fig. 1). The main effect of this interaction was the uplift of the Nevados del Famatina and several basement blocks of the Sierras Pampeanas to the east besides the development of the Precordillera thrust belt to the west.

The tectosedimentary model discussed in this paper and its relation with the one previously postulated by Ciccioli *et al*. (2011) is shown in Fig. 2. A brief description for each stage is given below.

Basin stage	Sedimentation	Tectonic and subsidence
Cannibalized foreland	Very coarse-grained alluvial synorogenic sediments (El Corral Fm.)	Uplift and erosion of the previous Tertiary infill
Late transpressional foreland	Coarsening-up sequences from playa lake to coarse-grained alluvial deposits (Upper Member of the Toro Negro Fm.). Progradation of clastic wedge from the eastern Precordillera. Underfilled to overfilled conditions	Dominance of the east- vergent thrusts (Precordillera) over the local basement blocks under a transpressive regime.
Early transpressional foreland	Alternating fluvial and playa lake sediments with thin intercalation of explosive volcanic deposits (Lower Member of the Toro Negro Fm.). Underfilled to overfilled conditions.	Initiation of a complex interplay between basement blocks, Famatina Range and east vergent thrusts under a transpressive regime generating high subsidence.
Late transpressive retroarc	Coarse-grained fluvial sediments (Upper Member Vinchina Fm.) in separated and isolated depocenters (Vinchina and La Troya). Underfilled, filled to overfilled conditions.	Break-up and compartmentalization of the retroarc by the Sierra de Umango-Espinal and Toro Negro uplift under a transpressive regime. High subsidence rate.
Early transpressive retroarc	Sandy fluvial sediments (lower member of Vinchina Fm.) in the Vinchina- La Troya area (underfilled conditions)	Initiation of the transpressive regime and incipient participation of the basement blocks generating high sudsidence rate.
Retroarc	Low energy fluvial, lacustrine (Puesto La Flecha Fm.) and eolian (Vallecito Fm.) sediments (starved to underfilled conditions)	Low subsidence regime and beginning of high subsidence regime associated with the first tectonic movements of the Andean Orogeny.

Fig. 2.

The retroarc stage: During the Late Eocene-Oligocene interval the Vinchina Basin was dominated by low-energy fluvial and lacustrine (playa lake) sedimentation (Puesto La Flecha Fm.) which was in turn replaced by large eolian fields during the Late Oligocene (and earliest Miocene?, Vallecito Fm.). The Puesto La Flecha Formation is a red-bed succession composed of sandstones and mudstones ranging in thickness from a few tens up to 250 m. The eolian deposits of the Vallectito Formation (from 100 up to 1000 m thick) comprise very fine- to medium-grained cross-bedded sandstones showing frequent giant-scale cross-bedded sets.

The differences in thickness maybe reflect irregular topography of the basin and the development of small depocenters probably controlled by northwest-southeast structures present in the basement. Low-energy fluvial and lacustrine deposits probably reflect low-subsidence rates previous to the eastward migration of the orogenic front from the magmatic arc. The eolian deposits were interpreted as starved to underfilled conditions in the basin which were related to the first tectonic movements of the Andean Orogeny in the westernmost area of the basin (Tripaldi and Limarino, 2005; Ciccioli *et al*., 2011).

Early transpressive retroarc stage: The base of this stage is marked by a low-relief erosive surface of regional extension that separates the Vallecito Formation below from the Lower Member of the Vinchina Formation above. Recently, Ciccioli et al. (2012) reported a zircon U-Pb age of 15.6 Ma obtained close to the Vallecito-Vinchina unconformity which allow us to reasonably date the age of the beginning of the transpressive regimen probably related to non-orthogonal Andean compression. Probably, strike-slip displacements of the main structural lineaments (Valle Fértil and Tucumán) promoted the incipient uplift of intrabasinal basement blocks as for example the Sierra del Toro Negro (Fig. 1). The Lower Member of the Vinchina Formation is mainly made up of coarse- and medium-grained cross-bedded sandstones and mudstones deposited in multichannelized (anastomosed) fluvial systems. According to Ciccioli *et al*. (2011) the high proportion of floodplain deposits could indicate a high rate of subsidence but the limited supply of coarse-grained sediments from the orogenic front would suggest underfilled conditions during this time.

Late transpressive retroarc stage: An intraformational unconformity of low to moderate relief separates the Lower and the Upper Member of the Vinchina Formation. This surface is covered by conglomerates and coarse-grained sandstones indicating out the progradation of fluvial clastic wedges from both, the western orogenic front and the intrabasinal basement blocks. During this stage, basement shortening of the Sierras Pampeanas was probably important enough to produce the uplift of the intrabasinal Umango-Espinal block dividing the early retroarc basin into two depocenters (La Troya and Vinchina, Fig. 1). From a lithological point of view the Upper Member of the Vinchina Formation comprises conglomerates and coarse-grained sandstones at the base which are succeeded by sandstones, mudstones and intraformational conglomerates. These rocks were deposited in different types of fluvial systems, which in broad terms can be described as braided at the base of the member, meandering and anastomosed with eolian intercalations in the middle part and sandy-ephemeral succeeded by lacustrine sedimentation at the top of the member. This sedimentary pattern suggests the evolution from underfilled to filled conditions and then overfilled stages at the top of the member.

Early transpressional foreland stage: An important incision surface marks the base of this stage which was carved into the Upper Member of the Vinchina and covered by coarse-grained conglomerates and intraformational breccias belonging to the Toro Negro Formation. This erosive surface, in the north of the study area, delineates a wide paleovalley that shows a west-east strike and paleocurrents flowing to the east (Limarino *et al.,* 2010). The origin of this incision surface is related to the main phases of uplift of the western Famatina Range producing accelerated subsidence and increased accommodation in the proximal area and lowering of the equilibrium fluvial profiles (and incision) in the distal areas to the west (Limarino *et al.,* 2010). The early transpressional foreland stage corresponds to the Lower Member of the Toro Negro Formation that comprises conglomerates, sandstones and mudstones mainly deposited in multichannelized fluvial systems and lacustrine environments. The high preservation of muddy floodplains and the recurrent presence of tuffs suggest high subsidence rates within the basin and coeval explosive volcanism in the neighboring volcanic arc. The sandstone composition of the Toro Negro Formation indicates a complex interplay of different source areas, including the volcanic arc, uplifted basement blocks (Toro Negro range) and sedimentary rock fragments derived from the east-verging thrust belt located to the west (Ciccioli *et al.,* 2011).

Late transpressional foreland stage: This stage is represented by the Upper Member of the Toro Negro Formation which is basically composed of coarsening-up sequences formed by muddy playa lake deposits at the base and coarse-grained conglomerates at the top. These cycles are interpreted as the transition from underfilled to overfilled conditions during the evolution of the foreland basin. In this scheme, playa lake sediments would represent starved conditions in the major part of the basin, when high subsidence rates were exclusively limited to the front of the Precordillera thrust belt. During tectonic quiescence reduced accommodation space in the orogenic front favored the progradation of clastic wedges from the eastern

Precordillera towards the basin.

Cannibalized foreland stage: During the Pliocene the whole succession was uplifted and tilted to the west, forming narrow intramontane basins where coarse-grained conglomerates and breccias belonging to the El Corral Formation were deposited. These movements were possibly related to the latest phases of the Nevados del Famatina uplift which then reached its present-day configuration. The infill of these intramontane basins basically represented the cannibalization of the previous retroarc and foreland deposits and it is composed of a group of diachronic synorogenic conglomerates that rest uncomformably on the Tertiary units from where they were derived.

Conclusions

The new radiometric age, sedimentologic and stratigraphic studies allowed us to divide the Vinchina Basin fill into six stages: 1. Retroarc, 2. Early transpressive retroarc, 3. Late transpressive retroarc, 4. Early transpressional foreland, 5. Late transpressional foreland, and 5. Cannibalized foreland. In particular, the transpressive retroarc stage is related to the beginning of the uplift of part of the Sierras Pampeanas Noroccidentales during the Middle Miocene, while the transpressional foreland stage may be linked to the main phase of uplift of the Nevados de Famatina during the Late Miocene.

REFERENCES

- Ciccioli, P.L.; Limarino, C.O.; Marenssi, S.A.; Tedesco, A.M., Tripaldi. A. 2011. Tectosedimentary evolution of the La Troya-Vinchina depocenters (Northern Bermejo Basin Tertiary), La Rioja Province, Argentina. in: Salfity, J.A. and Marquillas, R.A. (Eds.), Cenozoic Geology of the Central Andes of Argentina: Salta, SCS publisher, 91-110.
- Ciccioli, P.L.; Limarino, C.O., Friedman, R. 2012. La edad de la Formación Vinchina: Su implicancia en la estratigrafía de la Cuenca de antepaís del Bermejo. I Simposio del Mioceno-Pleistoceno del Centro y Norte de Argentina, S.M. del Tucumán, Resúmenes 16.
- Cobbold, P.R., Rossello, E.A., Roperch, P.C., Arriagada, L.A., Gómez, C. Lima, 2007. Distribution, timing, and causes of Andean deformation across South America. In: Deformation of the continental crust: The legacy of Mike Coward (Ed. A.C. Ries, R.W. H. Butler & R.H. Graham), Geological Society of London Special Publications 272: 321-343.
- Limarino, C.O.; Ciccioli, P.L., Marenssi, S.A., 2010. Análisis del contacto entre las Formaciones Vinchina y Toro Negro, sus implicancias tectónicas (Sierra de Los Colorados, provincia de La Rioja). Latin American Journal of Sedimentology and Basin Analysis 17(2):113-132.
- Rossello, E.A. L.A. Orozco, C. Pomposiello, A. Favetto, J. Osorio, 2011. Análisis morfoestructural comparativo de los megafallamientos neógenos Valle Fértil (Argentina) y Santa Marta-Bucaramanga (Colombia). XVIII Congreso Geológico Argentino, Neuquén, Argentina. Actas, 848-849.

HOLOCENE EVOLUTION AND SEDIMENTARY INFILL OF THE INNER RIO DE LA PLATA ESTUARY (ARGENTINA) 3-06

Colombo F.[1]*, Serra J.[1] and Rivero L.[2]

(1) Departamento de Estratigrafia, Paleontologia y Geociencias Marinas, Facultad de geologia. Universidad de Barcelona, C/Martí i Franqués s/n, E-08028 Barcelona, Spain.

(2) Departamento de Geoquimica, Petrologia y Prospeccion Geologica, Facultad de Geologia. Universidad de Barcelona, C/Martí i Franqués s/n, E-08028 Barcelona, Spain.

** Presenting Author's email: colombo@ub.edu*

Introduction

The funnel-shaped Rio de la Plata Estuary (RPE) which developed during the Holocene transgression (Violante & Parker, 2004) has complex hydrodynamics marked by large fluvial floods, tides and south-easterlies that produce up-current surges. Its inner north-western part has been filled by deposits of the complex prograding system of the Parana River. The distribution of coastal sandy barriers, dunes, beach