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SEQUENCE STRATIGRAPHY AND U/Pb SHRIMP GEOCHRONOLOGY OF THE ACTIVE MARGIN DEPOSITS OF THE CACHEUTA SUB-BASIN, CUYO BASIN, NORTHWESTERN ARGENTINA

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Resumo – O presente estudo discorre sobre a análise estratigráfica e a geocronologia dos depósitos relacionados a margem ativa falhada da sub-bacia de Cacheuta, Bacia de Cuyo (Triássico), NW-Argentina. Esta bacia foi condicionada principalmente pela tectônica extensional e controlada por estruturas de orientação NW, relacionadas à zonas de sutura Paleozóicas. O registro estratigráfico completo da Bacia de Cuyo foi considerado com uma seqüência deposicional de 2^a ordem. Os depósitos de *lowstand* compreendem fácies de leques aluviais derivados de processos de *sheetflood* e fluxo de detritos. Depósitos fluviais e, em menor proporção, lacustres com expressiva contribuição vulcanoclástica, caracterizam o trato de sistemas transgressivo. A superfície de máxima inundação foi traçada nos folhelhos pretos lacustres da Formação Cacheuta (rocha geradora de hidrocarbonetos). O trato de sistemas de highstand compreende depósitos relacionados à ação de canais fluviais meandantes, sendo a contribuição vulcanoclástica pouco expressiva. Datação U/Pb SHRIMP em uma rocha piroclástica que ocorre intercalada aos leques aluviais basais forneceu idade magmática de 243 ± 4.7 Ma, posicionando estes depósitos no Eotriássico-Mesotriássico.

Palavras-Chave: Bacia de Cuyo, Triássico, U/Pb, rifte, margem falhada

Abstract – This study focuses on the stratigraphic and geochronologic analysis of the deposits related to the faulted active margin of the Cacheuta sub-basin, Cuyo Basin (Triassic), in NW-Argentina. This basin was mainly controlled by extensional tectonics along NW-trending structures inherited from Paleozoic sutures. The whole stratigraphic package of this basin is interpreted as a 2nd order depositional sequence. Lowstand deposits comprise coarse-grained alluvial fans (sheetflood and debris-flow deposits). Fluvial and minor lacustrine deposits with expressive volcaniclastic contribution make up the transgressive systems tract. The maximum flooding surface was traced on lacustrine black shales of the Cacheuta Formation (source rock for petroleum accumulations). The highstand system tract comprises fluvial meandering facies and more sparse volcanic contribution. U/Pb SHRIMP dating of a pyroclastic rock interlayered with basal alluvial fans yielded a magmatic age of 243 ± 4.7 Ma positioned in the Early to Middle Triassic.

Keywords: Cuyo Basin, Triassic, U/Pb, rift basin, fault margin

1. Introduction

The rift-related Cuyo Basin is located in the northwestern Mendoza Province (NW-Argentina), as part of the Argentina Precordillera. It is a Triassic basin and has very dynamic evolution modified by climatic and tectonic events during the geological time. Such events influenced directly the basin inception, geometry and depositional evolution, leading to correlation between strata in different regions to be a very difficult task.

The aim of this study is characterize the depositional history of the sedimentary and volcanoclastic deposits related to the active faulted margin of the Cacheuta sub-basin, Cuyo Basin, located near the town of Potrerillos. This work deals with (i) the sequence stratigraphic arrangement of the depositional systems, (ii) the influence of the volcanism, and (iii) the geochronology of the volcanoclastic rocks that occur interlayered with the sedimentary deposits.

2. Geotectonic Setting

The Cacheuta sub-basin consists one of the most important depocenters of the Cuyo Basin, especially due to its economic potential in hydrocarbon exploration (Chebli *et al.*, 2001). The Cuyo Basin displays a general NW-SE trend, mostly controlled by the pre-existing structures (Ramos, 1992) (Fig. 1). The eastern limit of this basin coincides with an important suture generated in the Silurian through the amalgamation of the Cuyania Terrane to the southwestern margin of Gondwana. On the other hand, the western border is a structure that represents the Devonian accretion zone of the Chilena and Cuyania terranes (Ramos & Kay, 1991).

According to Mpodozis and Kay (1990) the extensional tectonic setting of the southwestern Gondwana at the Permian/Triassic boundary is related to processes of crustal thinning, which occurred after the end of the Paleozoic collisional phenomena as already mentioned. This extensional event was responsible for an extensive acidic-intermediate volcanism, characterized by andesites, rhyolites, and breccias (Choiyoi Group of Rolleri & Criado Roqué, 1968). The inception of the Cuyo basin, whose sediments were unconformably deposited upon Choiyoi volcanics and Paleozoic sediments, is also result of this generalized extensional setting (Ramos & Kay, 1991.).

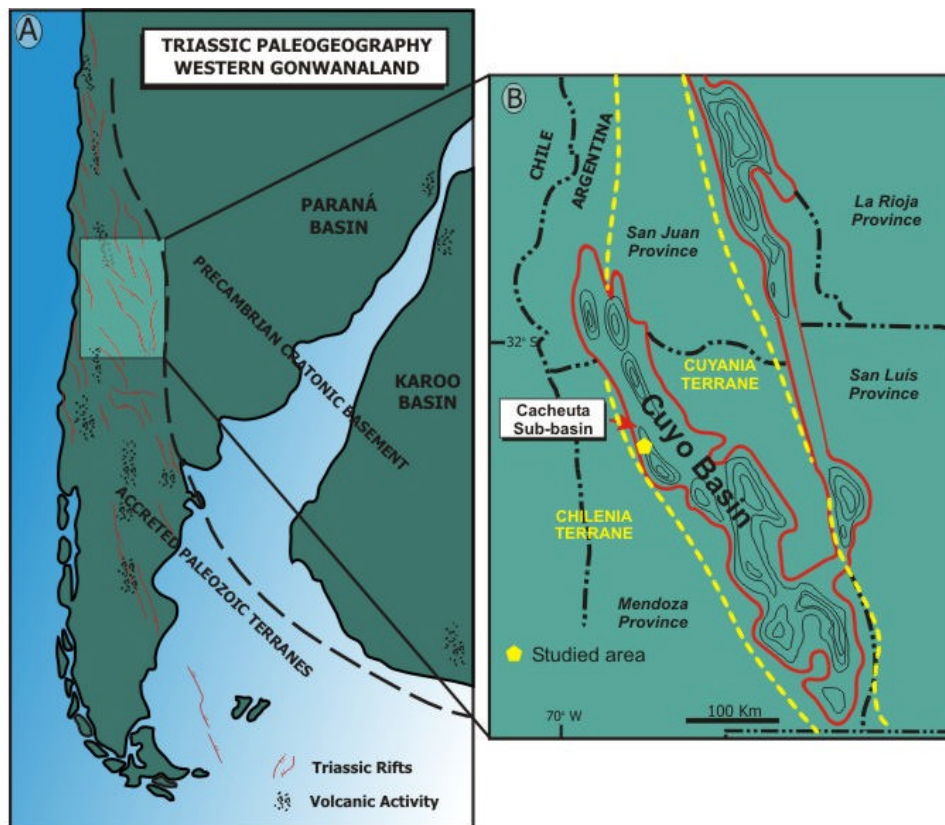


Figure 1 – a) Map showing Triassic paleogeography of western Gondwana with the location of the main rift systems. b) Map of the Triassic rifts of the central-western Argentina and the main structures (modif. after Ramos & Kay, 1991).

3. Sequence Stratigraphy

The composite stratigraphic profile was performed in the Potrerillos section, which comprises the coarse-grained deposits related to the active faulted margin of the Cacheuta sub-basin. The sedimentary and volcanoclastic facies were described in terms of texture, composition, and structures. The facies associations were interpreted and their stacking pattern allowed the distribution in three depositional stages, controlled by two variables: (a) the rate of creation of accommodation space and (b) the sedimentary influx. The depositional stages correspond to the lowstand, transgressive, and highstand systems tracts of a second-order depositional sequence (the whole record of the Cuyo Basin).

3.1. Lowstand systems tract (LST)

The lowstand systems tract in the Cacheuta sub-basin is characterized by a thick package of conglomerates unconformably deposited upon pyroclastic rocks of the Choiyoi Group. Reddish-brown colored, poorly sorted, crudely stratified or massive, clast- and matrix-supported conglomerates, and interlayered conglomeratic sandstones comprise this basal section, which corresponds in the lithostratigraphy to the Rio Mendoza Formation as described by Borrelo (1962). The conglomerate clasts are dominantly of volcanic origin (andesites, rhyolites, pyroclastic rocks), and reach up to 30 cm in diameter (mean diameter around 5 cm). The matrix is coarse sand-sized, and composed also of volcanic fragments. Interlayered with these deposits are rhyolitic, pumice-rich pyroclastic rocks. Expressive action of sheetflood- and debris-flow-dominated alluvial fans was responsible for the initial phase of the deposition in the Cacheuta sub-basin. Tectonics, basin-related volcanism, climate, and source area material were the primary controls on the active faulted margin sedimentation.

3.2. Transgressive systems tract (TST)

The transgressive surface is very well delineated upon the lowstand conglomerates, marking the onset of deposition of finer-grained deposits. This TST comprise yellowish or greenish grey mudstones, siltstones, medium-grained and even coarse-grained, plane-bed stratified or trough cross-bedded sandstones, which are interpreted as playa-lake, fluvial and lacustrine facies associations. The volcanoclastic contribution is widespread, being recognized in abundant crystal- and lithoclast-rich, ash and lapilli pyroclastic fall deposits, as well as in the matrix of the sedimentary rocks. Four parasequence sets are stacked in a retrogradational trend that corresponding to the Cerro de Las Cabras (Frenguelli, 1944a) and Potrerillos formations (Truempy & Lhez, 1937). The later one culminates with the deposition of lacustrine black siltstones and shales of the Cacheuta Formation (Truempy & Lhez, 1937) which contains the maximum flooding surface. These rocks have high content of organic matter and constitute the principal source rock for the hydrocarbon accumulations in this basin (Chebli *et al.*, 2001).

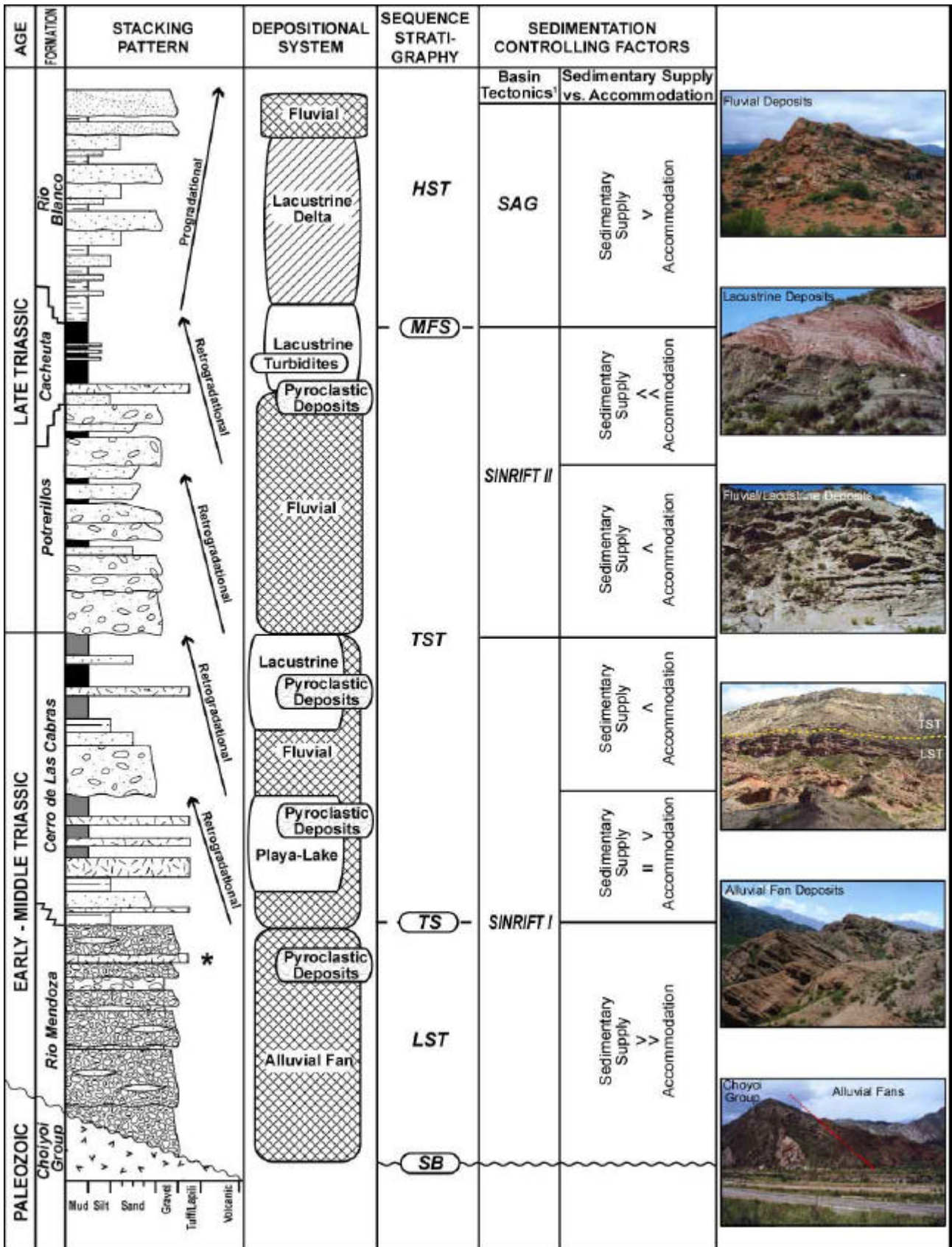
3.3. Highstand systems tract (HST)

The transition from black (Cacheuta Formation) to reddish (Rio Blanco Formation, Fossa-Mancini, 1937) siltstones and shales marked the onset of a progradational trend that characterizes the highstand systems tract. This prograding section begun with the establishment of oxidizing conditions, and continued with the progressively increased sedimentary influx to the basin depocenters by means of lacustrine deltas, which deposited sigmoidal- and cross-bedded sandstones associated with finer-grained rocks. The trend culminated with the deposition of a high-sinuosity, sandy, fluvial facies association, when the sedimentary influx overcame the creation of accommodation space. This phase is associated with thermal subsidence, corresponding to a “sag” basin (Kokogian *et al.*, 1993), and the volcanic contribution in this portion of the succession is subordinated.

4. U/Pb SHRIMP zircon dating

The selected sample for the application of U/Pb SHRIMP (sensitive high-resolution ion microprobe) zircon dating is a pumice-rich, lithoclast-free, acidic ignimbrite (pyroclastic flow deposit) interlayered with the basal alluvial fan facies association (lowstand systems tract). The sample was crushed, milled, sieved, and the zircon crystals were separated by conventional magnetic and heavy liquid methods. The analyzed zircons are euhedral and inclusion-free crystals, and they are interpreted as having a juvenile magmatic origin.

The analyzed zircons yielded a 243 ± 4.7 Ma age, positioning the lowstand deposits of the Cacheuta sub-basin (the Rio Mendoza Formation) in the Early to Middle Triassic (Ávila *et al.*, *in prep.*).



¹ Kokogian *et al.*, 1993.

* 243 ± 4.7 Ma (Ávila *et al.*, in prep.).

Figure 2 - Sequence stratigraphic division chart of the Cacheuta sub-basin faulted margin, showing stacking pattern, depositional characteristics and factors controlling sedimentation.

5. Discussion and Conclusions

The application of sequence stratigraphic concepts in the study of the active margin deposits of the Cacheuta sub-basin (Cuyo basin) allowed the recognition of lowstand, transgressive, and highstand systems tracts of a 2nd order depositional sequence (the whole basin fill). This stacking pattern was mainly controlled by the interplay of the sedimentary influx and the accommodation space. Alluvial fan deposits unconformably overlie Paleozoic basement and volcanic rocks and comprise the lowstand systems tract. Fluvial and lacustrine facies associations, with expressive volcanoclastic contribution, consist the transgressive deposits, which culminate with deposition of black shales (including the maximum flooding surface). Oxidized lacustrine and high-sinuosity fluvial deposits represent the highstand systems tract, developed when the sedimentary influx overcame the creation of accommodation space.

Based on the age of the volcanic and pyroclastic rocks of the Choiyoi Group and the age of the Triassic basin deposits (Caminos et al., 1979 and Cortés, 1985), Ramos and Kay (1991) states that the beginning of the deposition in the Cuyo basin postdated the climax of magmatic activity in the Choiyoi Group. Nevertheless, our investigation confirms that the lower units of the Triassic sediments (represented by Rio Mendoza Formation) are interlayered with silicic pyroclastic and volcanic deposits, dated here at 243 ± 4.7 Ma. These results suggest that the sedimentation of the Cuyo Basin may at least started during the late stages of the Choiyoi magmatism.

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