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The pre-Mesozoic basement in the Atlantic rifted margin segment off Buenos Aires province (Argentina) and Uruguay: influences on the geometries and HC potential

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The South Atlantic opening during Mesozoic is characterized by a diachronous, extensional phase dominated by half-grabens preserved along the wide continental platform of the southern South American plate. In the margin segment in front of the Uruguayan and Buenos Aires province coast the structural asymmetry of the Pelotas, Punta del Este, Salado and Colorado basins is mainly due to differential geometries of the previous multicompositional basement and the tectonically-induced subsidence. Four main stages have been identified in the evolution of these basins: a) pre-rift, b) rift, c) sag, and, d) passive margin. The basins show significant similarities in their latest phases of evolution (sag and passive margin stages) but they display drastically different characteristics during the pre-rift and rift phases.

Classic seismic signatures in the Mesozoic asymmetric half grabens include fanning (strongly divergent internal configuration) on fault borders, thinning (convergent internal configuration) and onlap on flexural margins, and compaction synclines over basement footwall cut off points. This half-graben fill phase was followed by a Tertiary sag phase dominated by thermal subsidence which expanded beyond the rift shoulders. The geometries and distribution of facies, particularly in the lower section of the sag fill, have been influenced by highs inherited from the underlying asymmetric half-grabens. New 2D seismic acquired for ANCAP (Uruguayan oil state company) in offshore Uruguay allows to draw significant differences between the offshore Pelotas and Punta del Este basins and their counterpart further south in Argentina (Salado and Colorado basins). The Punta del Este and Salado basins as well as the Colorado basin exhibit half-graben geometries at the rift stage followed by a laterally extensive sag Tertiary fill powered by sediment discharge of the ancient La Plata and Colorado rivers. In contrast, the Pelotas basin does not exhibit fully developed half grabens. The rifts present in the Punta del Este basin have a Jurassic-Cretaceous fill and show dominant westward vergence, opposite to the present deepening of the continental margin.

The presence of fossiliferous Ordovician (Curamalal Gr. and Balcarce Fm), Devonian (Lolén Fm.) and Permian (Mangrullo Fm. and Pillahuincó Gr.) units confirms the heterogeneous nature of the pre-rift basement, principally made up of: a) Lower and Upper Paleozoic sedimentary rocks, equivalent to those exposed in the Paraná (Brazil, Uruguay), the Sierras Australes (Ventana) and Septentrionales of Buenos Aires (Argentina) and Karoo (South Africa) outcrops, b) crystalline rocks of the Precambrian La Plata craton as inferred by highs in the gravity maps, and c) Precambrian calcareous and silicoclastic sequences (La Tinta Gr.) prograding toward SW as correlated in the Claromecó basin.

The presence of Paleozoic pre-rift potential source rocks in the Punta del Este and Salado basins is suggested by the finding of Permian sediments of the Mangrullo Fm. on the rift shoulders in the Gaviotin well. Seismic data recorded in the Colorado basin show a conspicuous folded basement made by the immersion to East under the rift sequences of the Sierras Australes de Buenos Aires fold belt (Curamalal, Ventana and Pillahuincó Groups) and the thicker equivalents in the adjacent Claromecó foreland basin. The presence of Permian and Devonian sediments provides appealing exploratory alternatives for sourcing of hydrocarbons in addition to the potential presence of rift and sag source rocks best known in the Brazilian basins. The rifted basin configuration has the potential for onlap/pinchout traps at the sag level, indirectly controlled by pre-existing half-graben geometries, which tend to develop on the flexural margins or on shoulders inboard. Differential compaction at the half-graben border fault margin would be a critical factor to create counter-regional dips necessary to form structural (4-way) closures at the sag level.