

# Crustal Structure and its Control on the Petroleum Systems and on Giants/Super-Giant Fields/Prospects in the Pre-Salt of the Santos and Campos Basins

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## Abstract

The Pre-Salt of the Santos and Campos Basins in Brazil is a world-class petroleum province. First discovery took place in 2006 and first production in 2008. Twelve years in a row and production is 2.2 MMboepd from 99 wells only (62% of Brazilian production). The landmark of 1 MMbopd was achieved after 8 years of production. Cumulative production is over 2 billion barrels. Forty wells produce over 20,000 bopd. Lula Field alone produces 928 Mbopd. Three fields (Lula, Búzios and Iara Complex) can be classified as super-giants while four others are giant fields (Parque das Baleias, Mero, Sapinhoa, Lapa). Known discoveries are candidates for the super-giant (Carcara) and giant (Jupiter, Pao de Acucar) status. Recently leased blocks and non-leased acreage contain very large prospects that are such candidates as well. These fabulous numbers are the product of a magnificent petroleum system; and this petroleum system was fully controlled by the underlying crustal structure of these basins. Ultra-deep 2D seismic surveys shot in the last years in the distal portions of the wide continental margin of the São Paulo Plateau (encompassing the Santos and Campos Basins) had unveiled the full crustal structure of this magma-poor passive margin. The continental crust varies in shape (taper profile) and width along the dip-oriented views underneath these basins, but shows a consistent alternation of 3 NE-SW-trending domains: an internal stretched/thinned realm, followed by a large continental resistate and then by an external hyper-extended domain in

the outermost area. The Pre-Salt petroleum system is sourced from syn-rift organic-rich shales (Late Barremian-Early Aptian) that exist in both basins. They occur in the inner portions, in the internal stretched/thinned domain, between a structural high trend (External High) and the Cretaceous hingeline. All known accumulations of oil in the Pre-Salt of both basins are derived from such shales. The term Internal Kitchen is used to designate these inner grabens and their syn-rift organic-rich shales. The External High is a long and wide, continuous trend of structural highs that runs along Campos (N-S direction) and Santos (NE-SW) Basins, cutting them in the middle as a backbone displaying on both sides the downward-flexed ribs. The External High is the isostatic surface expression of a continental crust resistance that presents a significant larger crustal thickness than the surrounding thinned and hyper-extended realms. The continental crustal terrains situated to the east of the External High are situated over hyper-extended crust; and contain the External Kitchen represented by numerous grabens similar to those in the Internal Kitchen. Most giant/super-giant fields and known prospects are situated upon the External High, indicating that hydrocarbons generated in the lower Internal and External Kitchens have their flows directed to the intervening External High.