

**Regional variations in Source Rock maturation in the Lusitanian Basin (Portugal)
– the role of rift events, subsidence, sedimentation rate, uplift and erosion**

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The Lusitanian Basin developed in the Mesozoic in the western Iberia margin (Fig. 2A and 2B) and comprises sediments from the Late Triassic to Cretaceous (Pena dos Reis *et al.*, 2010). Its evolution has close relations with the opening of the North Atlantic, as well as the opening and closure of the Western Tethys. Two main rift phases are classically considered, and have been used for modeling, in Late Triassic (229-199 Ma) and Late Jurassic (159-140 Ma). The total thickness of the Mesozoic infill is up to 5 km, mainly of Jurassic age, locally covered by Tertiary basins related with alpine inversion (Stapel *et al.*, 1996). Three sectors may be defined (North, Central and South), separated by major NE-SW faults - Nazaré and Tagus Valley. The Central sector presents the main depocenter of the basin, with three sub-basins (Turcifal, Bombarral and Arruda) developed in Upper Jurassic times.

The main intervals with hydrocarbon generating potential are Lower Jurassic (Água de Madeiros and Vale das Fontes Formations) and Upper Jurassic (Cabaços/Vale Verde Formation). The Upper Jurassic interval is geochemically more variable, but presents better TOCs and HIs basin-wide, with higher net thickness for hydrocarbon generation, than the Lower Jurassic units (*vd.* Teixeira, 2012).

Ten oil exploration wells have been analyzed along the basin, regarding thickness and age of its sedimentary infill (Teixeira, 2012). Maturation evaluation was based in the PetroMod 1D software from IES Schlumberger (Fig. 1). Backstripping of wells allowed to infer tectonic subsidence and to estimate stretching factors (Beta) of each of the two rift phases. Beta values were used to model heat flow in each rift phase. Sedimentation rates were evaluated, in order to identify large sedimentary input periods in the basin, associated with rifting phases.

For the first rift phase (Upper Triassic), stretching factors are higher in the northern sector (~1.05 – 1.18), as well as in the offshore and the Turcifal sub-basin of Central sector (~1.09 – 1.19). For the second rift phase (Upper Jurassic), stretching factors are higher in the Bombarral and Arruda sub-basins of the Central sector (~1.11 – 1.19) and in the Southern sector (~1.06 – 1.09).

According to PetroMod modeling (Teixeira, 2012), the main factor controlling and ruling the maturation evolution in the Lusitanian Basin is the heat flow increase, induced by the Late Triassic and Late Jurassic rift phases (Fig. 1). Secondary factors, yet extremely important are: a) North sector - Cretaceous infill, prior to Aptian uplift and erosion; b) Central sector - high Upper Jurassic sedimentation rates, mainly induced by the sub-basins tectonics; c) South sector - high Cenozoic sedimentation rates, in times with low heat-flow, may explain maturation (more wells need to be studied).

Lower Jurassic source rocks are mature, for oil or gas, in all the three sectors of the Lusitanian Basin, while Upper Jurassic source rocks are only mature in the Central sector, for oil, being immature in the other two sectors (Fig. 2C and 2D).

These data need to be integrated with other regional data, such as source-rock thicknesses and paleogeographic and organic content variations, in order to establish a robust and predictive exploration tool. This approach may be extended to other western

Iberian basins, such as the Peniche and Alentejo, both offshore and a few hundred kilometers apart.

References:

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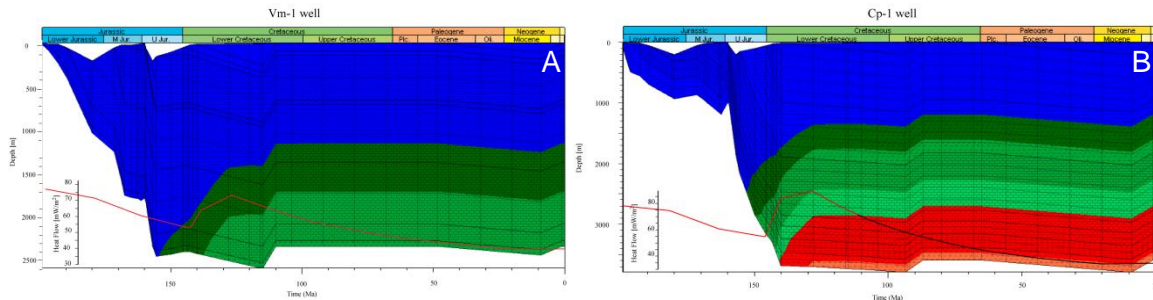


Fig. 1 – PetroMod modeling of hydrocarbon maturation in three selected wells. A – Vm-1 (North Sector) showing Lower Jurassic in “oil window” and Upper Jurassic “immature”. B – Cp-1 (Central Sector) showing Lower Jurassic in “wet gas window” and Upper Jurassic in “late oil window”. C – Br-3 (South Sector) showing Upper Jurassic “immature”.

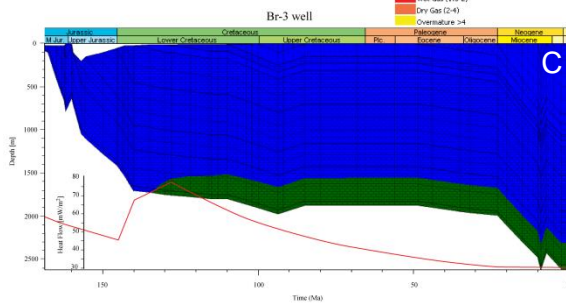


Fig. 2A & 2B – Lusitanian Basin location (green), main structures and Sectors (in Matos, 2009). Fig. 2C & 2D – Hydrocarbon maturation in the studied wells.

