Quantitative Tarfaya Basin Development, Morocco

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The Southern Morocco on- and offshore continental margin includes a Permian to Neogene basin fill of at least 280 My and thicknesses of up to 10.000 m. The Tarfaya basin development can be compared to the Essaouira/Agadir/Souss basins in the north and the Dhakla basin to the south.
Three composite dip-oriented transects (TR1-3) have been investigated following a high-resolution and quantitative sequence stratigraphic approach. Flexural 2D-basin modeling considers changes in accommodation space (genetic subsidence/uplift components, eustatic sea-level changes) and sediment flux as the principals controls on sedimentary systems (Bowman & Vail 1999).
The subsidence/uplift history of the Tarfaya Basin has been subdivided in nine trends (ST1-9), which show lateral variations in rates and timing but appear throughout the basin. Based on flexural subsidence/uplift modeling, the regional sediment flux histories for the northeastern (TR1), central (TR2) and southern (TR3) Tarfaya Basin have been calculated in addition.
The basin history includes the Late Permian to Liassic rift, sag and early drift stages (ST1), covering a timespan of 61 m.y. (250-189 Ma). The average subsidence rate was 68 m/m.y. and the average sediment flux 15.000 m2/m.y. Thermo-tectonic subsidence was the main component of total subsidence during the rift to early drift basin stages. A uniform basin-wide subsidence trend does not exist in ST1.
ST2-4 of Toarcian to Tithonian age are bounded by the Post-Rift Unconformity (PRU) and the Mature Drift Unconformity (MDU). They extended from the onset of sea-floor spreading to final carbonate platform development. ST2 (189-164.4 Ma) and ST4 (154-144.2 Ma) show a decreasing trend in subsidence, while ST3 (164.4-154 Ma) shows an increasing subsidence trend in all transects. Subsidence rates vary between 0 – 50 m/m.y. with a maximum of >75 m/m.y. in ST3. Sediment flux varies between 3.000 and 6.000 m2/m.y. during the Jurassic with a maximum of 15.000 m2/m.y. in TR3 during ST3 and 8.000 to 12.000 m2/m.y. in TR1 and TR2 during ST4.
Mature drift basin architecture, sediment infill and distribution differ considerably during the Early Cretaceous mature drift stages ST5 to early ST7. TR1 and TR2 were affected by salt mobilization, while TR3 remained unaffected for its location south of the Tarfaya salt province. Subsidence rates varied between -15 m/m.y (uplift) and 60 m/m.y. In TR3, the highest subsidence rates occurred in ST5 (144.2-132 MA). In TR2, peak subsidence developed in ST6 (132-123 Ma) and early ST7 (123-65) on TR1. Peak sediment flux with more than 8.000 m2/m.y. occurred in ST6 (TR3) and early ST7 (TR1). Sediment flux in TR2 stayed largely constant.
The current model implies that subsidence trends where triggered by i) changes in intra-plate balance forces induced by changes in sea-floor spreading rates, ii) shifts in the sea-floor spreading axes, iii) the stepwise migration of crustal separation and seafloor spreading from the Central Atlantic to the north, iv) relative plate motions and convergence rates between Africa and Eurasia.
The preliminary results for the Tarfaya Basin resemble the basin development and subsidence trends in the Essaouira-Agadir Basins to the north.

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