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Investigations on the interactions between a giant submarine fan and the adjacent continental margin: The Congo deep-sea fan case

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The Congo deep-sea fan is deposited on the Gulf of Guinea, between the Cameroon volcanic Ridge and the Walvis Ridge, and it extends for more than 800 km off-shore the Congo-Angola continental passive margin. Although the margin has been extensively explored for hydrocarbon resources, most of the research has been concentrated in the upper-slope and shelf areas, and thus far from the fan major oceanic depocenters.
Our main objective was to study the relatively unknown distal units deposited onto the abyssal plain in order to provide new information regarding the submarine fan's extension, onset age, and long-term evolution and to better constraint the basin post-rift sedimentation history. In a second phase of our study, we modelled the possible flexural effects of the fan loading on the adjacent Congo-Angola margin, and explored the hydrocarbon generation potential of the distal units. Our approach is based on the analysis of more than 19,000 km of 2-D multi-channel seismic reflection profiles from the ZaiAngo research project, and some other industrial seismic profiles located between 3000 m and 5000 m of bathymetry, and covering an area of ca. 200,000 km^2.
We identified 5 seismic units overlying the oceanic crust in the abyssal plain. The basalmost seismic unit, probably deposited from Albian to Turonian, is up to 2.5 km thick and extends for more than 200 km basinwards the base of the slope. Its isopach map shows a radial fan-shaped depocentre aligned around the present-day Congo River outlet, suggesting that the unit was likely to be sourced by a paleo-Congo located near the present-day river. Overlaying this unit there is the tertiary Congo fan, which turns out to be much larger than expected, with a minimum volume of 0,7 Mkm^3 and a maximum thickness of about 4 km, it extends for more than 500 km into the abyssal plain.
Our results from modelling the flexural deformation caused by the fan loading suggest that its influence on present-day topography is negligible. Nevertheless, the flexural uplift could have controlled the location of cretaceous coastal paleo-relieves and enhanced the present-day Zaire River outlet incision.
The results from the seismic interpretation allowed us to build a 3D geological model that was used as input to investigate the hydrocarbon generation potential of the distal units. The basalmost unit is a primary candidate as a source rock. Predicted vitrinite reflectance values for this unit suggest that HC generation could have started as early as by the end of the unit deposition and it is likely to continue at the Present. Our results also indicate that HC maturation was not triggered by the enormous sediment input linked to the Tertiary fan onset, but its continuous progradation during the Miocene sharply increased the generation rate.