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Structural and Morphological features of Upper Cretaceous, offshore Cameroon

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Annotation

Located in Kribi-Campo sub-basin on the present day deep-water continental margin slope, the study area covers an area of 1500 km², and contains a sedimentary section up to 6.5 km thick, ranging in age from Upper Cretaceous to Recent. Drilling results from the, Sanaga Sud field located on the continental shelf, reveal an eroded, palaeo-topographic high composed of Lower Cretaceous sands and shales, overlain by Upper Cretaceous (Maastrichtian) shales. The absence of most the Upper Cretaceous (Cenomanian to Campanian) to Cenozoic (Palaeocene to Oligocene) section is interpreted to be due to structural uplift, with the missing sequences eroded and transported seaward to be deposited in the deep water area. 3D seismic data used in this study covers the deep water section of the basin, and provides an opportunity to investigate the structural and morphological features of the basin in upper Cretaceous, bring a better understanding of the basins stratigraphic evolution.

The interpretation was carried out using 3D seismic data. Interpretation was undertaken in TWT, and depth conversion undertaken using an average velocity of 2600 m/s for the Cretaceous, based on analysis of regional well data. There are number of faults have been detected in the upper Cretaceous sequence including two sets of N120 and N30 faults. N30 faults set shows a great effect on the stratigraphic evolution while the N120 faults set tends to die out below the upper Cretaceous sequence.

Keywords

Growth faults, Cameroon, 3D seismic, Upper Cretaceous, West Africa

Theory

The Kribi-Campo sub-basin formed during the breakup of Africa and South America, began in the Late Jurassic and lasting until the onset of seafloor spreading in Albian-Cenomanian time (Dailly, 2000) (Fig. 1). The basin is classified as an Atlantic-type marginal sag basin.

Controls of deep crustal structure on basin structural configuration are shown on Fig. 1 & 2. This is the major fracture zone formed by continental extension: the Kribi Fracture Zone (KFZ) to the southeast of the study area and marked as Kribi high. The Kribi high shows the main control on basin profile (Le, 2021). It acts as basin boundary to the southeast creating the high and low geometry in the Upper Cretaceous (Fig. 3).

Faults have been detected in the basin, striking N30 and N120, with average spacing of 2 km and maximum offset of 140 ms. The faults are planar in geometry and dipping mainly southwest with steep dips of c. 40 – 50° (Fig. 2). N120 faults are perpendicular to the transform trend and terminated abruptly at the KFZ. N30 faults are parallel to the transform trend developed close to the KFZ. They are interpreted to be mostly normal faults. In the cross-section, the N30 faults do not die out below the top Lower Cretaceous sequence like the N120 fault set. They penetrate almost all of the Upper Cretaceous sequence (Fig. 4). Further analysis reveals that the N30 faults decrease offset upwards from ~100 ms to ~20ms TWT (Fig. 4). N30 faults are interpreted as growth faults.

The observations that both N30 and N120 are presented in the syn-rift sequence (Lower Cretaceous), and most of N120 die out within syn-rift sequence, and terminating at some point of the fracture zone or located closely to it suggests that both fault sets may relate to rifting stage during the basin opening and have close relationship between the evolution of the fracture zone and the normal faults. Similar normal faults characteristics have been documented in the Niger delta (Briggs et al., 2009), Rio-Muni basin (Dailly, 2000), Gabon basin (Mbina Mounguengui and Guiraud, 2009). The development of N30 into the Upper Cretaceous are possibly the results of slow thermal subsidence, and gravity collapse tectonic process on the subsiding passive margin.

In summary, the basin has been characterized by three main structures:

- The NE - SW Kribi high located in southeast of the study area and composes of thick lower Cretaceous sequence overlain by Upper Cretaceous sequence.
- The N30 faults parallel to the KFZ and developed in Lower and Upper Cretaceous.
- The N120 faults perpendicular the KFZ and all die out in the syn-rit sequence (lower Cretaceous).

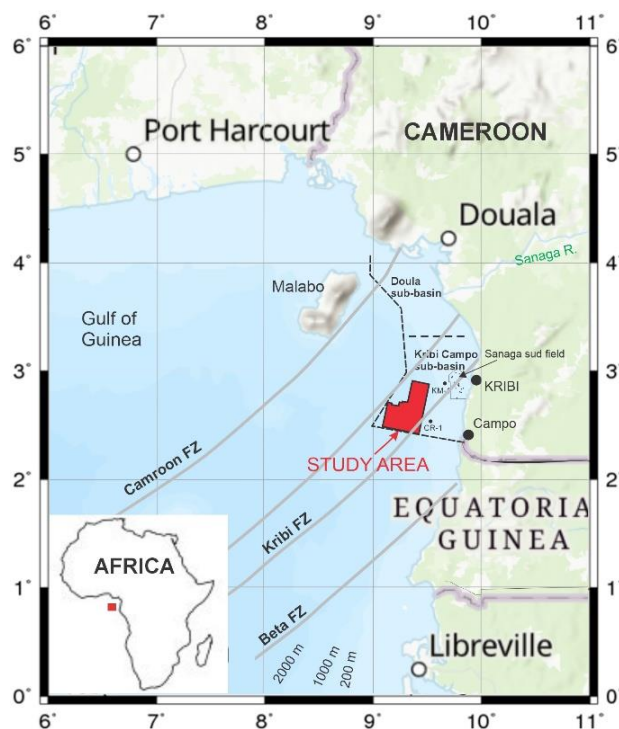


Figure 1. Bathymetry map of the continental slope on the Cameroon margin. It shows the location of the study area, and the number of wells that have been drilled within the basin and the location of the fracture zone system (Le et al., 2015). The coast line map is extracted from National Centers for Environmental information (NCAA) (<https://www.ncei.noaa.gov/maps/grid-extract/>)

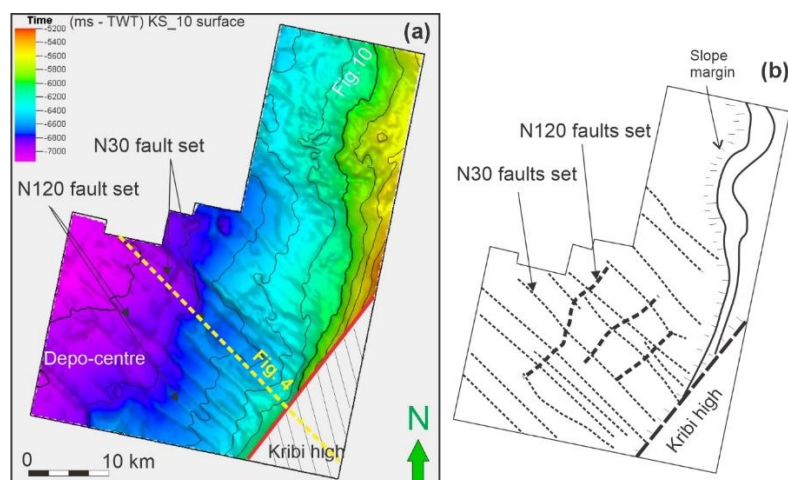


Figure 2. (a) 2D map of the basal surface illustrates for the two main fault sets i.e., N120 and N30. Line interpretation is shown in (b). N120 faults terminated in the KS_10; N30 faults develop into the Upper Cretaceous

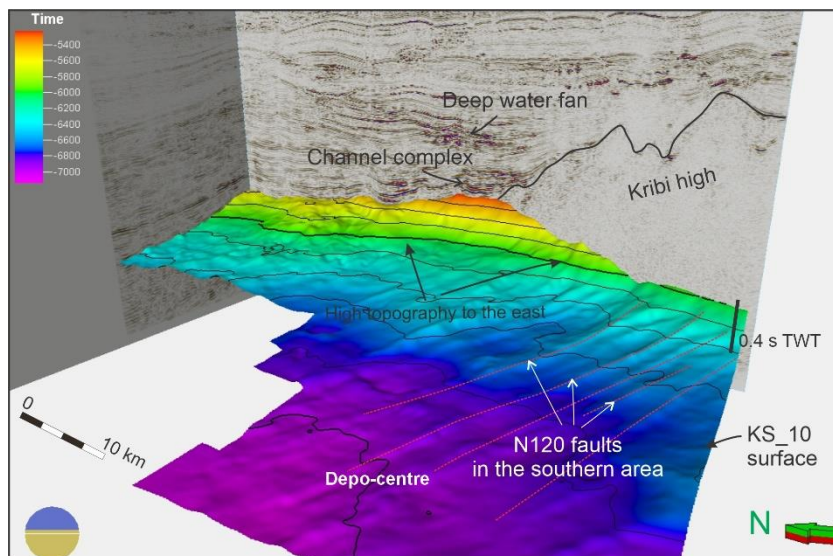


Figure 3. 3D view of inline-crossline and the key surface KS_10 showing a comprehensive view of the data and associated features

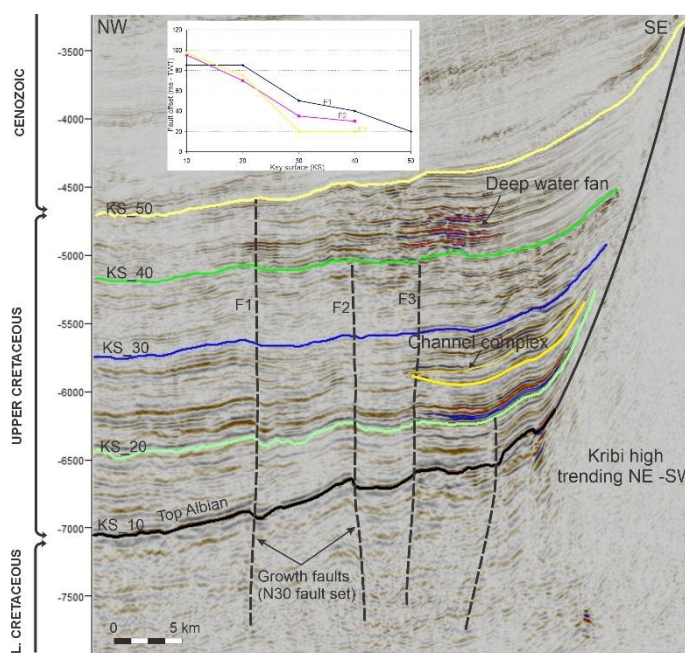


Figure 4. NW- SE seismic section perpendicular to the N30 faults illustrating for growing faults in the Upper Cretaceous which subtle controls the deposition of sands in these lower sequences. The graph is a Cross-plot of growth fault vs. the key surfaces reveals the decrease of the fault throw upwards, an evidence for the interpretation of growth faults. (See figure 2 for the seismic line location)

Conclusions

The Upper Cretaceous sedimentation filled the low which is bounded by the eroded paleotopography high to the southeast (Kribi high). There are two faults sets are detected in the Upper Cretaceous including N120 and N30 faults. The role of these faults in post-rift deposition varies significantly. While N120 faults show less control on post-rift deposition as they all die out in the Lower Cretaceous, N30 growth faults may have some effect on the geometry and distribution of channel, fan deposits in the Upper Cretaceous.

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