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Structural evolution of the Gamtoos Basin, based on 2D seismic data

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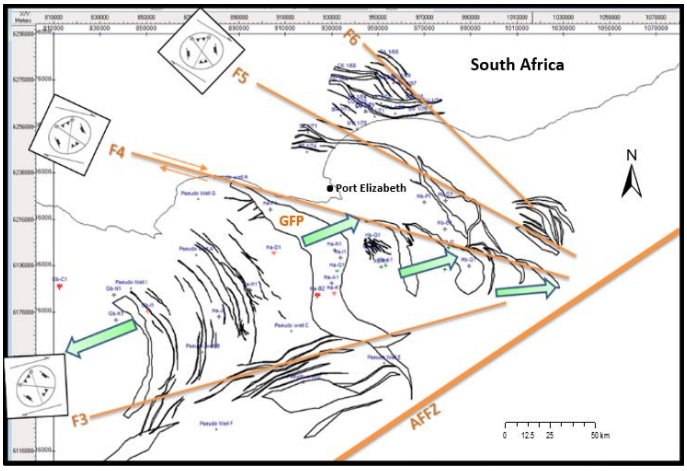
It is well documented by Tankard et al. [1]; Dingle et al. [2]; de Wit and Ransome [3]; amongst others, that the tectonic evolution of southern South Africa comprises a series of extensional and compressional deformation episodes over the last 650 Ma that are overlaid upon the same crustal fabric.

The Gamtoos Basin developed in response to a period of rifting of Gondwana during the mid to late Jurassic. Initial strike-slip associated with the eventual break-up of the supercontinent resulted in pull-apart basin formation. The very successful basin formation also utilized the existing structural grain of the Cape Fold Belt.



Satellite gravity and seismic data indicate the presence of several lineaments (Figure 1) across the offshore areas. These lineaments are interpreted as strike-slip splays of the Agulhas Falklands Fracture Zone (AFFZ) according to Roux [4].

Extension was the result of an onset of strike-slip along various splay directions which will be illustrated from the study of the structural evolution of the Gamtoos Basin by Petroleum Agency SA.

Figure 1: Lineaments interpreted from seismic and satellite gravity data with various strain ellipsoids, showing the Gamtoos Fault Plane (GFP) and the Agulhas Falklands Fracture Zone (AFFZ) in the vicinity of the Gamtoos Basin, offshore South Africa

The northeastern most splay, F6, is associated with the Zuurberg volcanics, whereas the F3 splay coincides with the shelf edge (Figure 1), defining the northern edge of the Southern Outeniqua Basin at about the 300 m isobath. The onset of the first splays (F6 to F4) was controlled by the pre-existing basement fabric, with pull-apart basin formation and extensionally restricted basins forming between the splays.

The Gamtoos Fault is a major structural feature and was quite active with half graben formation. A depocentre developed against the fault in the central part of the basin, which thins toward the central ridge. The depocentre subsequently moved in various directions throughout the Mesozoic to Cenozoic, leading to a shift of best reservoir and source quality in the basin as illustrated from the interpretation of the 2D seismic data.

References:

[1] Tankard AJ et al. (1982) Crustal Evolution of Southern Africa: Spring-Verlag, 520
[2] Dingle RV et al. (1983) Mesozoic and Tertiary Geology of Southern Africa: Balkema Publishers, 375
[3] de Wit MJ and Ransome IGD (1992) In: Inversion tectonics of the Cape Fold Belt, Karoo and Cretaceous Basins of Southern Africa: Balkema Publishers, 15-22