Abstract

The Orange Basin is a passive margin recording the continental break-up of Gondwana by tectonic processes involving rifting and drifting of the South Atlantic Ocean. The northern part of the Orange basin preserves the main depocentre where the remarkable Ibhubesi Gas Field is located. Based on exploratory results the tectonostratigraphy, the Orange Basin is characterised by syn-rift grabens and half-grabens, as well as thick Barremian-Lower Aptian post-rift sequences ranging in thickness from 7 km in the north to 3 km in the south. The post-rift sedimentary succession in the south is thinner, resulting in potential for oil-prone source rocks compared to the northern side of the Orange Basin which is gas prone.

In this study the subsurface stratigraphy and structural architecture of the southern part of the basin is delineated through the interpretation of 2D reflection seismic data from Block 5/6. The structural deformation revealed by the southern Orange Basin records the compressional domain - transitional domain – extensional domain; marked by the presence of grabens, toe thrust structures and listric faults, respectively. Transform faults act as conduits for gas seepage which is a positive indication for an existence of an active petroleum system. The transitional crust is characterised by seaward dipping reflectors, volcanics interbedded with siliciclastic sediments and volcanic intrusions. Investigation of the southern segment of the Orange Basin presents an opportunity to examine the under-explored ultra-deep waters where there is potential for deep-seated slope fans (canyon fill and slumped blocks) and basin floor fans (turbidites and channelized facies).
Introduction

The 165 600 km² Orange Basin (OB) is a passive margin basin recording the continental break-up of Gondwana by tectonic processes involving rifting and drifting of the South Atlantic Ocean (Figure 1A). The OB extends from Namibia to South Africa and two remarkable phenomena exist; the northernmost and the southernmost reaches of the OB (Figure 1B). The northern sector of the basin preserves the shelf deposits where the sedimentary sequences are well preserved in the absence of active petroleum system (Petroleum Agency SA Internal report, 2015). The transition of the OB to the deeper parts of the basin is marked by a gradual increase in structural complexity (Petroleum Agency SA Internal report, 2015).

The structural setting revealed by the southern section of the Orange Basin shows potential for petroleum accumulation as noted by the presence of listric faulting and syn-rift grabens and half-grabens; growth faults and fault traps have been identified. The post-rift (transitional) Barremian-Lower Aptian sequences range in thickness from 7 km in the north to 3 km in the south (Figure 1B) and evidence exists that the underlying basement topography (Figure 1D) contributed significantly to the sediment deposition (Petroleum Agency SA Internal report, 2015).

Study Area

The study area is located in the southern part of the Orange Basin within exploration licence block 5/6 (Figure 2), which is operated by Sasol (60%) and Pemex (40%). High-resolution 2D reflection seismic data was collected by the Kongsberg concern (Figure 3) down to a maximum depth of 4176 m. These seismic data were processed and interpreted by the Kongsberg concern (Figure 4) to define the structural features such as basins, half-grabens, sag phase, transitional crust, half-grabens, and listric faults (Petroleum Agency SA Internal report, 2015). The structure setting of the southern Orange Basin is delineated through the interpretation of 2D reflection seismic data from Block 5/6 using the Kongsberg suite Interpretation software package. The post-rift sedimentary succession in the south is Nannoplankton rich in potential for oil-prone source rocks whilst the northern side of the Orange Basin which is gas prone. In the southern portion the A-C and A-A wells drilled up to a depth of 4176 m and 3753 m respectively, revealed Barremian gas and oil staining (Petroleum Agency SA Internal report, 2015).

Structural Architecture of the Southern Orange Basin

Block 5/6, Offshore South Africa.

Structural setting of the Southern Orange Basin

The structural deformation revealed by the southern Orange Basin records the compressional domain – transitional domain – extensional domain. The initial rifting phase is marked by the presence of syn-rift grabens and half-grabens which trend parallel to the present day coastline (Figure 5 and Figure 6). These grabens are shifted by listric dips that characterize a syn-rift domain. The transitional domain is characterized by listric dipping reflectors (SDRs) that increase in angle with depth and are often associated with listric faults (Figures 7 and 8). The post-rift (transitional) Barremian-Lower Aptian sequences range in thickness from 7 km in the north to 3 km in the south (Figure 1B) and evidence exists that the underlying basement topography (Figure 1D) contributed significantly to the sediment deposition (Petroleum Agency SA Internal report, 2015). The structural deformation revealed by the southern Orange Basin records the compressional domain – transitional domain – extensional domain. The initial rifting phase is marked by the presence of syn-rift grabens and half-grabens which trend parallel to the present day coastline (Figure 5 and Figure 6). These grabens are shifted by listric dips that characterize a syn-rift domain. The transitional domain is characterized by listric dipping reflectors (SDRs) that increase in angle with depth and are often associated with listric faults (Figures 7 and 8). The post-rift (transitional) Barremian-Lower Aptian sequences range in thickness from 7 km in the north to 3 km in the south (Figure 1B) and evidence exists that the underlying basement topography (Figure 1D) contributed significantly to the sediment deposition (Petroleum Agency SA Internal report, 2015).

Conclusion and Future work

The structural setting revealed by the southern section of the Orange Basin shows potential for petroleum accumulation as noted by the presence of listric faulting and syn-rift grabens and half-grabens; growth faults and fault traps have been identified. The post-rift (transitional) Barremian-Lower Aptian sequences range in thickness from 7 km in the north to 3 km in the south (Figure 1B) and evidence exists that the underlying basement topography (Figure 1D) contributed significantly to the sediment deposition (Petroleum Agency SA Internal report, 2015). The structural deformation revealed by the southern Orange Basin records the compressional domain – transitional domain – extensional domain. The initial rifting phase is marked by the presence of syn-rift grabens and half-grabens which trend parallel to the present day coastline (Figure 5 and Figure 6). These grabens are shifted by listric dips that characterize a syn-rift domain. The transitional domain is characterized by listric dipping reflectors (SDRs) that increase in angle with depth and are often associated with listric faults (Figures 7 and 8). The post-rift (transitional) Barremian-Lower Aptian sequences range in thickness from 7 km in the north to 3 km in the south (Figure 1B) and evidence exists that the underlying basement topography (Figure 1D) contributed significantly to the sediment deposition (Petroleum Agency SA Internal report, 2015).

References:


