Introduction

Significant amount of the world’s hydrocarbon reservoirs often occur in sequences that have very poor biostratigraphy control (Pearce et al. 1999). Biostratigraphy barren sequences is believed to complicate stratigraphic and reservoir interwell correlation of the Orange Basin, hence reservoir quality management problematic. Traditional methods of correlation such as lithostratigraphy and geophysical logging have proved inadequate.

Regional Geology

The Orange Basin is areally and volumetrically the largest South Africa’s offshore basins (Fig 1). It was formed as a result of the break-up of South America and Africa plate in the Late Jurassic.

Methods

A chemostatography study was carried on one hundred and twelve core and ditch cuttings using the following:
- Logs analysis: wireline logs were used to delineate lithology and reservoir intervals (Fig 3).
- Multivariate statistical analysis: was applied on the XRF results to determine the inter relationships between wells (PCA, DFA and CA analysis).
- Geochemical analysis (XRF): was applied on the selected samples to identify their bulk chemical compositions.
- Petrography analysis: was applied on the selected samples to determine clay morphology and distribution in the reservoir pore spaces (Fig 5 and Fig 6 respectively).

Results and discussions

Cluster analysis

Three clusters were obtained.
- Group one made up of 19 samples
- Group two made up of 48 samples
- Group three made up of 44 samples

Discriminant function analysis

It was used to test if these three groups are different from each other. The groups were 97.3% different from each other (Fig 4).

Principal component analysis

Similar element associations between the wells were identified and used to characterize the wells geochemically.

X-Ray Diffraction Analysis

- Eleven reservoir zones were delineated from the four wells
- Kaolinite, chlorite, montmorillonite were the clay minerals present (Fig 5).

Conclusions

A chemostatography correlation framework was obtained for well (A-H1, K-A2, K-E1 and K-B1) which enabled stratigraphic and reservoir interwell correlations of barren sequences based on unique geochemical indices.

- Group one (sandstone) is made up of 19 samples characterized by SiO2 and Na2O
- Group two (siltstone) made up of 48 samples is characterized by K2O, Al2O3, MgO and TiO2
- Group three (Shale) made up of 44 samples is characterized by Fe2O3, SO3, Mn and CaO.
- From the XRD and SEM results porosity and permeability of the reservoir was reduced by clay minerals (Kaolinite, Chlorite and Montmorillonite).

Recommendation

- Chemostatography technique should be applied in other barren sequences in the Orange Basin and world since it has proved to be a unique correlation tool.

References