Structural Evolution of the Aljauf Graben in Saudi Arabia

Khalid Bargah

Saudi Aramco

Abstract

The Aljauf Graben separates the Tabuk and Nafud Pre-Cambrian basins. A regional seismic transect was constructed, interpreted, depth converted and kinematically restored. The 2D structural restoration was conducted to kinematically model the sequential evolution of the basin-fills. This technique was applied to reveal the tectonic evolution of the Aljauf Graben resulting in understanding of sediment deposition rates. This was inferred from the two geo-history plots created. The structural restoration helped track the sediment packages' evolution at different ages. The results of the restored section suggest that the Infra-Cambrian rifting started; over previous assemblage of different terrains and micro-continents, in the Pre-Cambrian and ended in the early Cambrian time. The developed graben was filled with Cambrian sediments. Subsequently, an episode of thermal subsidence resulted in the deposition of the Middle Cambrian to Middle Ordovician. Tectonic uplift and erosion occurred during late Ordovician time in the basin. In the early Silurian, tectonic extension commenced again and resulted in multiple faults and infilling with early Silurian sediments. During the late Silurian, the Aljauf Graben underwent slight tectonic uplift and erosion. During the Devonian, a thermal subsidence period created accommodation space for the deposition of Devonian and Carboniferous sediments. An important tectonic uplift event occurred during the Carboniferous, the Hercynian orogeny, and partially eroded the upper Paleozoic sediments. From Permian to late Cretaceous, it appears that there was no deposition due to possible uplift of the area. During the late Cretaceous, tectonic subsidence occurred and created space for the deposition of Cretaceous sediments. The Alpine orogeny caused faulting of Cretaceous sediments. Finally, the Neogene sediments were deposited as a last stage of the basin fill. The geo-history plots were created in order to examine the behavior of each sediment package at different ages. These burial depth plots show the evolution of basin fill through time. The basement had a high subsidence rate during the Pre-Cambrian due to an extensional rifting episode. During the Silurian, relatively higher accommodation space was created in a short period of time. A thick late Paleozoic to Cretaceous stratigraphic section is absent due to massive tectonic erosion. Interpreted from the plots, the lower Silurian is relatively thick due to high sedimentation rates.