

Regional Seismic Transects Revealing Structural Framework and Growth History in Saudi Arabia

Pedro T. Gomez Cabrera¹, Khalid Shokair¹, Yasir Ghorashi¹, Rachid Hached¹, Hongbin Xiao¹, Emad Muzaiyen¹, and David Tang¹

¹Saudi Aramco, Dhahran, Eastern Provinces, Saudi Arabia.

ABSTRACT

A regional study was completed to understand the tectonic evolution and sedimentation interaction of the entire sedimentary column in the Kingdom of Saudi Arabia. This paper presents the methodology and key results of this integrated study of regional seismic traverses. Nine east-west and three north-south oriented Regional Seismic Traverses (RST) were generated. Twenty four seismic horizons were interpreted over the traverses and 12 key surfaces were mapped. From the time gross-mapping results and with the integration of previous maps such as Gravity, Magnetics, Hercynian Unconformity Subcrop and the Precambrian Najd Fault System, it was possible to identify two different structural provinces: a) North Domain – characterized by short wavelength structures, north-south oriented and b) South Domain – characterized by long wavelength structures, SW-NE oriented. These two structurally different domains are separated by an accommodation zone. West Rub Al Khali basin (Wajid graben) seems to be formed by three half-grabens separated by two transfer zones. These transfer zones are associated with the Precambrian Najd fault system. Sequential structural restorations of the RST's, geohistory and sedimentation rate plots indicate five main tectonic events that impacted the tectonic evolution of the Eastern Saudi Arabia. 1) First Continental Rifting Stage – Precambrian time, responsible for creating the main old depressions (i.e. Jafura, West and East RAK basins); 2) Hercynian Orogeny and Erosion – Late Carboniferous time, uplifting and eroding the Silurian, Devonian, and Carboniferous sequences mainly over the highest areas; 3) Pre-Aruma Uplift and Erosion – Mid-Upper Cretaceous time; 4) Post-Aruma Uplift and Erosion – Paleogene time, enhancing previous anticlinal structures; and 5) Pre-Neogene Uplift and Erosion – Oligocene-Miocene boundary time uplifting the West area of the East Saudi Arabia and accentuating the anticline structures.