Multi-Attribute Seismic Volume Facies Classification for Predicting Fractures in Carbonate Reservoirs

Fernando A. Neves *and Harold L. Triebwasser. Exploration Technical Services Department, Saudi Aramco, P.O. Box 6684, Dhahran, 31311, Saudi Arabia, phone: 96638736396, fax: 96638730475, nevesfa@aramco.com*

Understanding the fault and fracture distribution and orientation prior to drilling and completion of production and injection wells is critical for optimal oil production and maximizing recovery. In recent years multi-volume seismic attributes have been used more efficiently to help map these localized faults or fractured zones within reservoirs. In this study, covering a portion (about 750 Km2) of the Ghawar field in Saudi Arabia, unsupervised seismic facies volume classification was applied to multiple seismic attribute cubes to predict fracture zones in the Arab-D carbonate reservoir.

The pre-stack time migrated 3D seismic dataset was processed to preserve relative amplitude information. Attribute analysis of the input seismic volume showed several areas containing East-West oriented lineaments. Many of these lineaments were not clearly observed either in time or horizon seismic amplitude slices. For lineament mapping, each lineament must be recognizable in more than one seismic attribute volume. The mapped seismic lineaments were interpreted to be small faults (or fractures) through which natural drainage may facilitate fluid migration through the reservoir. The long extent of these lineaments (several kilometers in length) suggests they are probably faults. A binary scheme (two seismic facies) of multi-volume seismic facies classification of fault-related seismic attributes was successful in clustering areas of the field where optimum oil flow rate wells have been observed. This analysis of post-stack seismic attributes helped improve the understanding of observed well performance by mapping the distribution of fracture systems within the reservoir.