Predicting Fracture System in Shah Structure using Analogue Modeling: Implication for E&P, and Field Development, Abu Dhabi, UAE

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Abstract

This paper aims to predict the fracture system associated with the structural evolution of the Shah Structure in Abu Dhabi in relation to deep-seated basement fault, with its implication for E&P and Field development plans. The carbonates dominating lithological units from the Pre Khuff Fm (Permian) at the bottom of the section up to the Dammam Fm (Eocene) at the top in Shah Field, is characterized by its complicated structural setting that involves basement tectonics. It is an open SW-NE striking anticline whose geometry changes significantly along its strike. By the aid of 3D seismic data interpretation, we constructed a series of systematic scaled analogue models to understand the structural evolution of this anticline and the fracture developing mechanism. This mechanism that led to forming different fractures pattern, geometry and modes emphasizes on the main structural events timing. The depositional history of the Shah structure was simulated in the model by producing syn-kinematic deposition, erosion and tectonics. The oblique movement along the basement fault induced both a strike slip movement in and shortening of the cover sand layers, which resulted in formation of an open anticline (box fold) along the strike of the fault similar to the Shah Structure. Analog modeling results reveal that fractures associated with the asymmetric anticline have developed in different locations, and possess different geometries and modes. As anticipated, both tensile and shear fractures have developed in different areas within both the crestal parts of Shah Structure and within its limbs. However, fracture distribution, trend and frequency were affected by the asymmetric geometry of the model anticline. The steeper limb of the anticline bears more fractures than the gently dipping limb. The asymmetry of the anticline is not equally well displayed by the post-erosional units above the unconformity "model Simsima", where a gentler anticline is displayed. Hence, within this gentle part of the model anticline the fracture pattern is less developed, less frequent and evenly distributed. Such vertical and horizontal asymmetry in fracture pattern (geometry, frequency and mode) seen in the models is expected to have actually developed in the Shah Field. The predicted fracture patterns, which we present here, have significant impacts on exploration, production and development plans in Shah Field and in those Fields situated at the vicinity within the Onshore of Abu Dhabi.