Storm Beds (Tempestites) Outcrop Analog From the Late Jurassic Jubaila Formation and Basal Arab Formation, Saudi Arabia

Mohammed Fallatah[1], Charles Kerans[2]
[1]Saudi Aramco; [2]University of Texas, Austin

9.29.2020 - 10.1.2020 – AAPG Annual Convention and Exhibition 2020, Online/Virtual

Abstract

Carbonate storm beds (tempestites) that are common on carbonate ramps form potential hydrocarbon reservoir facies, as they often display excellent porosity and permeability. Sedimentological characterization of these deposits in the outcrop is a valuable approach for recognizing and modeling them in the subsurface. This study aims to provide detailed description of tempestites from the basal Late Jurassic Jubaila Formation outcrop, and illustrates the implications for predicting vertical and lateral reservoir heterogeneity in the subsurface. The study area is located along the Tuwaiq Mountains escarpment in Central Arabia, in which seven closely-spaced sections (130 - 350 m apart) were measured by recording bed thicknesses, depositional textures and fabrics, sedimentary structures, grain types, and ichnofabrics. Outcrop samples (n=50) of tempestites were collected for detailed petrographic analysis of grain type/size, faunal analysis, and diagenesis. Measured section data are visualized in 2D cross-sections that illustrate bed continuity and heterogeneity between the measured sections. Based on sedimentological analysis, the studied tempestites display variable thicknesses from 1 cm to no more than 1.2 m. Such thickening is a product of individual storm beds amalgamating vertically as well as filling distinct dip-elongate erosional scours referred to as gutter casts. Individual beds that are characterized by 15 - 50 cm thicknesses, erosional bases with rip-up clasts, medium - coarse grains, hummocky stratification, and mega-ripples correspond to proximal storm beds as described from the literature. Distal tempestites differ by showing fine-grained beds of 2 - 10 cm thick, planar and low-angle cross stratification,

sharp and planar bedding contacts, and lack of amalgamation. Both proximal and distal tempestites show trace fossils on their top surfaces. Based on these observations, the depositional setting can be inferred and used as a guide when correlating between the outcrop sections or within subsurface reservoirs. The data also highlight that storm beds are laterally continuous for less than 500 m without pinching out or being cut across by burrowers from the overlying extensively burrowed mud-dominated facies. This illustrates the complex heterogeneity of storm-dominated depositional settings and that caution should be taken when correlating these beds between wells, as they have limited lateral continuity. The importance of conducting outcrop studies for subsurface application is made clear from the basal Jubaila as bed and flow unit continuity is well less than typical inter-well spacing. The detailed sedimentological work on the basal Jubaila tempestites provides an analogue for recognition of proximal and distal storm beds from core studies, and should assist in creating a more realistic distribution of these facies in 3D simulation models.