High Resolution Geological Outcrop Analog Models of the Devonian Tawil, Jauf and Jubah Formations, Jauf Area, NW Saudi Arabia

Mutasim Osman, Osman Abdullatif, Mohamed Yassin, Ammar Abdlmutalib, and Moaz Salih
Geosciences Department, College of Petroleum Engineering & Geosciences, KFUPM, Dhahran, Saudi Arabia
(mutasimsami@kfupm.edu.sa)

The Devonian system in Saudi Arabia includes Upper Tawil, Jauf and Jubah formations. These formations are cropping out in the north-western region of Saudi Arabia and provide good exposure for 3D digital outcrop modeling. The objective of this work is to characterize the vertical and lateral heterogeneity and architecture of the mixed clastic-carbonate Devonian system in NW Saudi Arabia. Also, this study was designed to examine a new methodology for producing digital outcrop models based on outcrop photography and integration of sedimentologic data. Four outcrops were selected for this study that covers parts of Tawil, Jauf and Jubah formations. The field methods followed here included the description of vertical and lateral stratigraphic sections and rock sampling along these sections. The laboratory investigations included petrographic, XRD, SEM analyses and porosity and permeability measurement. For the digital outcrop models, we utilized the high resolution photos of a mobile phone that provides a geotag in its photos (all photos are geo-referenced). All the four outcrops have been photographed in a specific strategy to maintain the lateral continuity of the exposure and to avoid any gaps in the final model. Then, the photographs for each location were processed using Pix4D software to produce the solid digital model. Then another software was utilized for making surfaces and interpretation of the digital model. The results of this study showed that Tawil Formation is characterized by stacked cross-bedded sand bodies that are laterally amalgamated with a minor amount of mudstones. which indicate high energy braided stream environments. The Jauf Formation is characterized by intercalation of clastic mainly siltstone and shale in the lower parts and carbonates (limestone, dolomitic limestone and stromatolites) in the upper parts that suggested restricted to open marine depositional environments with clastic input. Jubah Formation is characterized by interbedded predominantly reddish sandstone, siltstone, and green shale which suggest the deposition within river channels and floodplain environments. The digital models help to reveal the facies, stratigraphic architecture and the lateral continuity of the lithofacies bodies as well in the Devonian formations in the study area. The digital model methodology followed here allowed rapid and accurate high resolution data collection at outcrop scale that can be used for detailed sedimentologic and stratigraphic analyses and prediction.