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Characterization of Spatial Lithofacies Continuity of Arab-D Reservoir Using Modeled Semivariograms: Outcrop Approach

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SUMMARY

There are strong links between semivariograms parameters and the geological variables of the Arab-D reservoir outcrop analogue, Central Saudi Arabia. Facies analysis of the outcrop revealed seven lithofacies including: platy mudstone, dolomitic mudstone, dolomitic wackestone, stromatoporoid wackestone and packstone, peloidal sandy grainstone, laminated fossiliferous sandy grainstone, and breccia.

Indicator semivariograms for these lithofacies were constructed in different directions using lithofacies logs from the outcrop to determine the direction with the best spatial continuity. North-South direction has the best continuity for most of the lithofacies. Laminated platy mudstone, stromatoporoid wackestone and packstone, dolomitic mudstone and dolomitic wackestone show good semivariogram shape, while semivariogram for peloidal sandy grainstone, laminated fossiliferous sandy grainstone and breccia only loosely fits the data in both the major and minor directions. The differences in semivariograms parameters were attributed to variation of the geological variables which include vertical layering of the outcrop, lateral facies changes, and topographical control of the outcrop.

The study of outcrop semivariograms allows for visualization of lateral and vertical lithofacies variation in a higher resolution than that of the oilfield scale. This study indicates that outcrop base semivariograms have a significant implication on subsurface reservoir characterization.

The main controls for development of petrophysical and facies models are the semivariograms parameters. There are strong links between semivariograms parameters and the geological variables of the Arab-D reservoir outcrop analogue, Central Saudi Arabia. Facies analysis of the outcrop revealed seven lithofacies including: 1) platy mudstone, 2) dolomitic mudstone, 3) dolomitic wackestone, 4) stromatoporoid wackestone and packstone, 5) peloidal sandy grainstone, 6) laminated fossiliferous sandy grainstone, and 7) breccia.

Indicator semivariograms for these lithofacies were constructed in different directions using lithofacies logs from the outcrop to determine the direction with the best spatial continuity. North-South direction has the best continuity for most of the lithofacies and is considered to be the major axis for the semivariogram. Most of these lithofacies show geometrical anisotropy. Laminated platy mudstone, stromatoporoid wackestone and packstone, dolomitic mudstone and dolomitic wackestone show good semivariogram shape, while semivariogram for peloidal sandy grainstone, laminated fossiliferous sandy grainstone and breccia only loosely fits the data in both the major and minor directions. The differences in semivariograms parameters were attributed to variation of the geological variables which include vertical layering of the outcrop, lateral facies changes, and topographical control of the outcrop.

The study of outcrop semivariograms allow for visualization of lateral and vertical lithofacies variation in a higher resolution than that of the oilfield scale. This study indicates that outcrop base semivariograms have a significant implication on subsurface reservoir characterization. This includes lithofacies geometry and geobodies characterization and petrophysical properties distribution.

Figure 1 Indicator semivariogram for the Major direction (North-South) and Minor direction (East-West) matched with their stratigraphic units.