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Influence of sedimentary fabric on fracture characteristics of two shoreface sandstones of the Lower Cretaceous Moosebar Formation, west central Alberta

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Introduction

Reservoir properties, such as preferential fracture flow pathways, can be better understood by studying the connectivity and continuity of natural fracture networks. By quantifying the fracture networks observed in outcrops, extrapolation of fracture populations can aid in maximizing fluid extraction in the subsurface. In this study, the influence of sedimentary fabric on the fracture network of two shoreface sandstones was analyzed to determine the effect of internal fabric on fracture characteristics. The two shoreface sandstones of the Lower Cretaceous Moosebar Formation (equivalent to the Wilrich/basal-Falher members of the Spirit River Formation) were chosen because of their lithological similarities but different sedimentary fabric. Collection of outcrop scanlines at Crescent Falls, Alberta, allows comparison of fracture characteristics and observation of the influence of fabric controlled by bioturbation and cross-stratification.

Methods

The consecutively deposited shoreface sandstones are comprised of very fine to fine grained coarsening upwards succession with high clay and glauconite content, and similar thicknesses of ~3.5 meters. The upper sandstone (A) has well developed hummocky cross-stratification; while the lower sandstone (B) has a more massive appearance due to intense bioturbation, mainly by *Ophiomorpha*. Scanlines were measured on three distinct sedimentary facies within each sandstone: Facies 1 has bed thicknesses of 5-30cm with moderate interbedding of mudstone (sand:mud of 2:1), Facies 2 has bed thicknesses of 30-60cm with slight interbedding of mudstone (sand:mud of 5:1), and Facies 3 has bed thicknesses of 60-250cm with some thin mud seams on bedding contacts only in the cross-stratified sandstone.

Although individual fracture characteristics of each facies is not directly applicable to the subsurface, relative ratios between corresponding facies can likely be applied. For example, a 50m visual scanline provides fracture intensities (fractures/meter) of Facies 3A and 3B of 2.8f/m and 1.8f/m, respectively. Facies 2A and 2B have fracture intensities of 3.3f/m and 2.8f/m, while Facies 1A and 1B are 4.4f/m and 3.2f/m. Therefore, the overall ratio of sandstone A to B tends to correlate to an average of 25% higher fracture intensities in the cross-stratified sandstone.

Conclusions

The results from this project emphasize the influence of sedimentary fabric on fracture characterization of shoreface deposits from the Moosebar Formation. Presence of mud and organic matter draped on the hummocky cross-stratification allow for a higher fracture intensity within shoreface deposits compared to shoreface deposits that have been intensely bioturbated. Fracture height appears to be inversely proportional to fracture intensity for both sandstones, which might be caused by the presence of mud on bedding planes in sandstone A, where the majority of fractures terminate. The more massive character of the intensely bioturbated sandstone B has taller and fewer fractures, likely due to the bioturbation mixing in the thin layers of mud with the sandstone, thus limiting the termination response of fractures on bedding surfaces. Results of this analysis suggest that sedimentary fabric, mechanical bed thickness and presence of mud, have an effect on fracture characteristics of shoreface sandstone outcrops of the Moosebar Formation at Crescent Falls, which are also likely to be present in the subsurface.

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