Calibration of Fracture Interpretations From Image Logs with Core Data: Example From Norman Wells, N.W.T., Canada

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A fracture study was initiated at Norman Wells as part of an ongoing full-field simulation project. Norman Wells is a naturally fractured Devonian-age limestone reef with 130 Km3 OOIP. Characterization of the fracture system is based on the integration of fracture information gleaned from FMI/FMS image data, oriented core data, outcrops and performance and well test data. Of this dataset, the 10 + km of image data collected in recent drilling programs provide the most quantitative information regarding the geometric attributes of the fracture system (orientation, size, intensity) and, ultimately, the degree of fracture connectivity. Primary uncertainties in fracture information gleaned from the image data at Norman Wells included the resolution of the tool in identifying the various scales of effective fractures (fracture intensity) within the reservoir, accuracy of pad count information (used to calculate fracture size) and ability to distinguish natural from induced fractures. To this end, a full-reef core (150+m) was collected from an infill well in the reef interior (P-32x) and then logged with FMI. The well was deviated and oriented nearly perpendicular to the main fracture trend. Calibration of these two datasets was critical in quantifying the uncertainty in our geometric fracture model.

The methodology utilized in the calibration of the two datasets involved the initial interpretation of the FMI images and the acquisition of whole core (nearly 360^0) digital images. The interpreted P-32x FMI data appeared consistent with respect to fracture orientation and density when compared to the existing image dataset. Core orientation was achieved by aligning geological features observed with the FMI to those on the digital core images. Once the core images were oriented, fracture interpretation techniques similar to those previously utilized on the FMI data were employed. A comparative analysis between the two datasets suggest that the FMI images were able to recognize ("see") approximately 70% of the effective (open) fractures. It was difficult to compare pad count information on a fracture to fracture basis; however, numerous fractures were observed terminating in the core supporting the large number of "partial" pad intersections on the FMI data. With respect to the recognition of induced fractures, core is critical in differentiating natural from induced fractures.

(1998) Geo-triad '98: Abstracts: Plenary, Oral, Posters, Core Workshop