# Do Natural Fractures Significantly Influence Production on the Northern End of the Pinedale Anticline?

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Open natural fractures commonly influence production of natural gas by increasing permeability. Image logs on the northern end of the Pinedale Anticline were evaluated to determine fracture orientation, fracture density, and stress orientation. Two types of image logs used to resolve natural fractures were evaluated: Formation MicroImager (FMI) and Oil- Based MicroImager (OBMI). Questar Exploration and Production (Questar E&P) and Wexpro ran FMIs in the Mesa Unit 11-16, Mesa Unit 13-5V, Stewart Point 7-20 and the Stewart Point 4-33 wells between 2000 and 2002. These wells were all drilled with water-based drilling fluid. The FMI logs were able to distinguish between open and healed fractures. Questar E&P also ran an OBMI in the Mesa 12D1-21 well in 2009 over a 5000-foot interval in the Lance and Mesaverde formations. The Mesa 12D1- 21 is located near the crest of the anticline and was drilled with oil-based drilling fluid. The OBMI could not be used to distinguish open and healed fractures because oil-based drilling fluids are resistive to electric current as is the cement found in healed fractures. With the OBMI, desiccation cracks in the shales caused by exposure to oil-based drilling fluid during drilling were identified and analyzed to define the regional stress direction.

Very few fractures were present in any of the five study wells. This paucity of open fractures suggests that natural fractures play a minor role in determining natural gas production rates on the northern end of the Pinedale Anticline. The OBMI in the Mesa 12D1-21 showed that the direction of maximum principal stress is N28W. This direction is confirmed with microseismic data and borehole break-out data. Since hydraulic fractures tend to parallel the maximum principal stress direction, knowing this direction helps in placement of wellbores to optimize gas and oil recovery.