Five Things I Wish a Geologist Had Taught Me—Confessions of a Frac Engineer

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Engineers are forced to use "simplified" models to describe reservoirs and propped fractures. It is generally anticipated that these models will give useful and approximately correct answers.

Unfortunately, on many occasions the oversimplified tools have caused us to envision fractures incorrectly - resulting in poorly designed completions and missed opportunities. Frequently, we blame the underperformance of a well on "poor reservoir quality" instead of correctly recognizing the inadequacy of our created fractures.

There are numerous misconceptions regarding the proportions, dimensions, complexity, and performance of hydraulic fractures. Geologists are uniquely equipped to better understand these issues, and help their engineering counterparts consider these challenges during field development. While there are many things I wish a geologist had pounded through my thick skull - this short presentation will cover at least five:

● Sedimentary rocks tend to be highly laminated, and the vertical permeability is often a tiny fraction of the horizontal perm. Oil and gas often cannot travel vertically within the tight matrix on human timescales. You must contact the pay if you wish to drain the hydrocarbons. Simplified reservoir models fail to demonstrate that "touching the pay is Job 1."

● Fractures often fail to grow through laminations. There are many outcrops showing natural fissures that stop at bed boundaries. Are engineers overconfident that they can breach those laminations and place a durable, conductive fracture through them? Photographic and production evidence will be given showing that the effective fracture height is often much lower than expected.

● Reservoirs are heterogeneous in the lateral extent as well. Very few engineers model the reservoir with geostatistical variation in mind. We typically assume a homogeneous "box" of hydrocarbon-containing rock. The compartmentalization caused by lenticular sand bodies, or draped shale barriers that resist hydrocarbon flow are much more important than engineers typically model. Can we breach these barriers? Is that one reason that refracturing treatments are so effective in some reservoirs?

● Graphical representations of created fractures are very misleading. Propped fractures are typically extremely long, with confirmation of half-lengths exceeding 2200 feet in some formations. However, fractures are very narrow-often containing just a few grains of proppant. Propped fractures collapse and lose conductivity over time. If we can better visualize the proportions and durability of fractures, we can compensate for challenges in creating an efficient and durable fracture.

● It is silly to envision fractures as simple, perfectly vertical planes with uniform width and durable conductivity throughout. All the mineback and corethrough evidence shows fracture complexity, and this has been photographically documented. Why are engineers so unaware of this? If the geologist will share this information, engineers can better understand pinch points and collapse of propped fractures, and the loss of hydraulic continuity in their fractures over time.

Examples will be shown in which poor well performance was incorrectly blamed on “the geology” but further investigation showed that it was actually due to insufficient hydraulic frac designs. Improved fracs increased production by over 70%, demonstrating that the reservoir had much greater potential than generally recognized.