

The Importance of Bedding Orientation When Looking for Fractures

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It has been observed that joints are the dominant fracture type on formation image logs. These tensile fractures are likely to be open, especially if they are recent. (In order to avoid a genetic definition, joints will be defined here as those fractures which are close to perpendicular to bedding.) A good way to illustrate the manner in which joints dominate fractures in a given well is to remove the structural tilt from the fractures by rotation. In polar plots, most fractures will concentrate at the perimeter of the plot, to within 20 degrees of perpendicular, and will be most concentrated at 90 degrees. In other words, most of the fractures qualify as joints. The degree of concentration of fractures toward the perimeter of the polar plot may vary by well, but this phenomenon is usually there. An interesting exercise is to observe fracture orientation in vertical wells with low dip. The fracture concentration will increase to about 70 degrees dip and fall off rapidly, with virtually no fractures with dip higher 80 degrees. This is because the chance of hitting a near-vertical fracture is very low, not because near-vertical fractures are not present.

It naturally follows that horizontal wells can greatly enhance the contribution of fractures to production, and not simply because they drill through more of the formation. As horizontal or high angle wells are drilled in more complex structures, it is natural to assume that borehole orientation is less of a factor. However, it is a good idea to plan a borehole trajectory with bedding orientation in mind, because, even in complex structures, fractures tend to be perpendicular to bedding. For instance, it would not be a wise idea to enter the zone of interest with the borehole near perpendicular to bedding, since this would be equivalent to drilling a vertical well into horizontal bedding.

The joint/fracture relationship can be exploited in ways other than simply avoiding drilling perpendicular into bedding. If one knows in advance that a particular fracture orientation might be encountered, the borehole trajectory can be modified to intercept the maximum number of fractures at the optimal position relative to bedding. Because the attitude of the objective zones to the borehole is as important as their position in the borehole, geologists must take an increasing role in the planning and drilling of horizontal wells, since drilling concerns may sometimes conflict with geologic concerns.