GeoConvention
Calgary • Canada • March 7-11 2016
OPTIMIZING RESOURCES

Optimizing refracs: How microseismic source parameters are used to interpret refracs

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Overview

Restimulations, known as 'refracs', are important to maximize the production of each and every well. In order to optimize completion programs and to understand the interaction of the completion and re-completion, microseismic monitoring is a vital tool. We propose comparing and contrasting original completion and refrac completions where microseismic monitoring was used to image both completions. When interpreting both completions, an interpeter may look at the number of events in each dataset, the volumetric extent and complexity or conductivity of the fracture network, and source parameter attributes. With current market conditions, operators are increasingly looking to maximize investment. It has been estimated that only 8% of shale oil is recovered in a typical frac completion and refracing is one method to increase that recovery without the expense of acquiring new acreage and drilling new wells. Using microseismic source parameter attributes, the mechanics of the fracuring process can be understood which is vital to optimize the design of refrac completions.

In this paper, we analyze in detail the source parameter attributes which give insight into the fracturing process beyond the basic event locations. When refrac completions are monitored, we observe a larger number of microseismic events which suggests that it is easier to initiate fracturing on a previously completed reservoir, than 'virgin' rock. However, the production phase after the initial stimulation may have closed previously open drainage pathways, raising the question as to what condition of the rock is after production.

The fracture intensity of different areas in the reservoir can be compared using the cumulative fracture area per unit volume. This uses the source radius source parameter attribute, which is dependent on the corner frequency fit of the amplitude spectra. Figure 1 demonstrates a complementary relationship between the initial and refrac completion. Here, we analyze in more detail the relationship of areas of similar and vastly different intensities in both completions.

In addition to simply re-opening fractures from depleted zones, there is evidence to suggest that the amount of energy dedicated to deformation is higher in the refrac compared with the initial completion. Figure 2 compares the apparent stress release for each completion. The apparent stress attribute helps quantify the amount of energy dedicated to deformation compared with the amount of energy dedicated to radiation of the fracture. In the initial completion, more energy is devoted towards radiation outwards, and less into the deformation of the reservoir. This indicates that in the refrac it is easier to initiate fracturing and deform the reservoir, compared with the initial completion.

Our study also considers event source parameters including apparent stress variations, along with spatial and temporal changes observed in refrac projects to help explain the microseismicity observed. Using this analysis in different plays helps add value to geoscientists and engineers to understand and optimize their refrac completions.

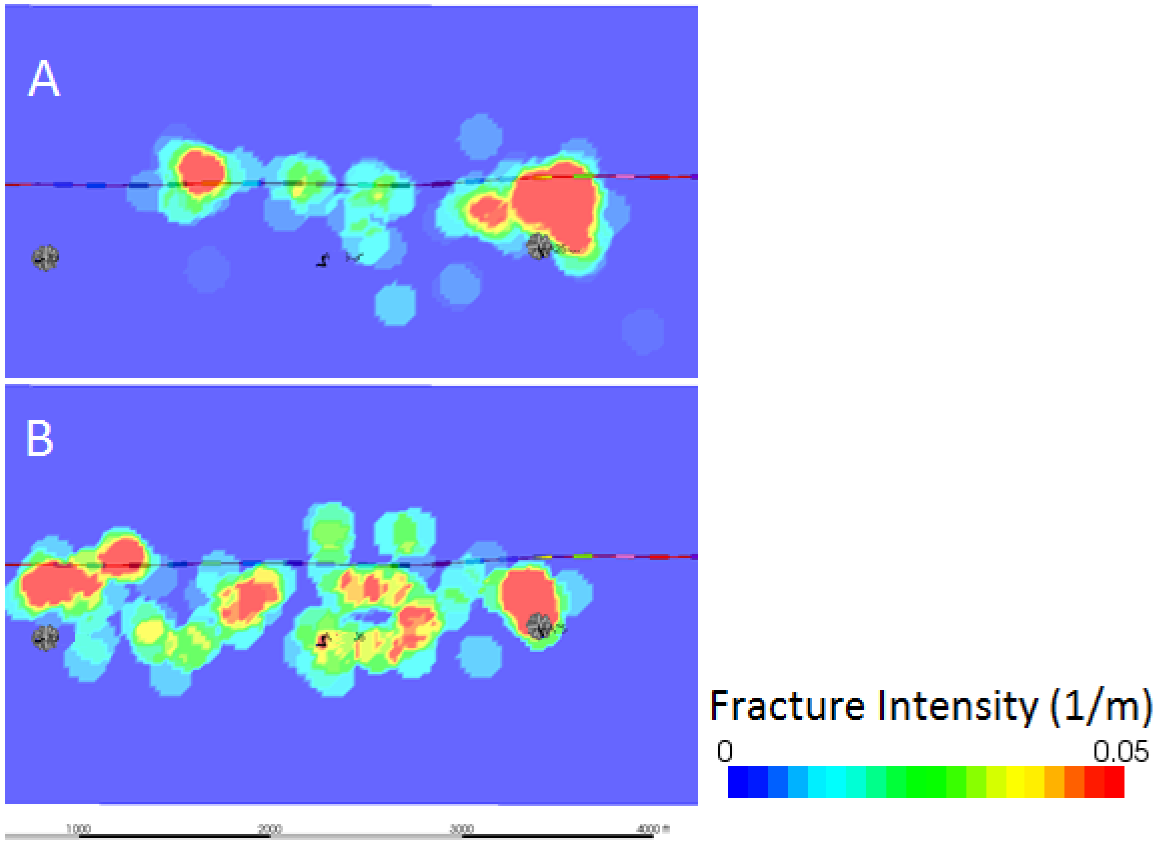

Figure 1 – The A image above is the fracture intensity of the initial completion. This intensity is calculated using the surface area of the rupture per unit volume. The B image contrasts the increased fracture intensity response from the refrac completion of the same well several years later.

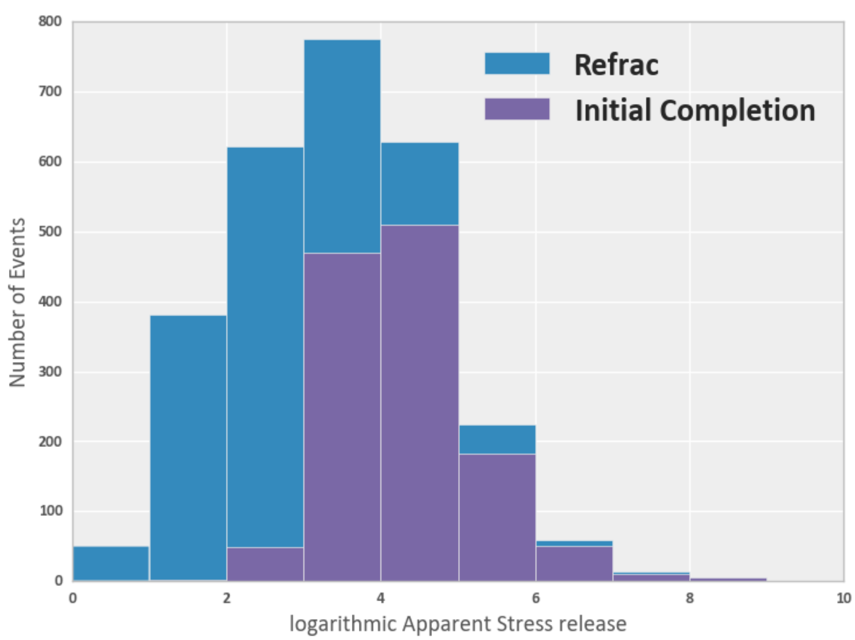

Figure 2 – The decrease of median apparent stress release is lower in the refrac compared with the initial completion. This indicates that more energy went into deformation. In the initial completion less energy went into deformation, and more was radiated outwards.