

Microseismic Monitoring to Help Understand the Call of the Vaca Muerta Formation

Luis Pianelli¹, Fernando Coetsee¹, Juan La Vecchia¹, and Adrian Sanchez²

¹YPF

²Schlumberger

Abstract

We present the results of several real-time microseismic monitoring surveys performed on multi-stage hydraulic fracture treatments in five distinct intervals of the Vaca Muerta Formation. The monitoring array is composed of ten 3C geophones with 30-m-long interconnects located in a nearby pseudo-vertical monitoring well. To derive confident mapped hypocenters and associated source parameters, we benefit from several nearby sonic logs as well as log- and seismic-derived structures which allow to adequately understand local anisotropy and attenuations. Following the final stimulation in the first treatment well, a dramatic event count occurred laterally far away from the treatment zone highlighting a distinct linear pattern. Past experiences relate such feature to a pre-existing fault being reactivated following hydraulic treatment. Compared to previous and subsequent treatments in the nearby wells, this behavior is unique. Fracture detection performed on 3D surface seismic data seems to indicate that there is a very good geometrical match between the post-treatment event cluster and the attributes-derived fault volume in the interval of interest; thus, suggesting a communication path or stress transfer between the treated wellbore and the distant fault. This observation emphasizes the need to pay careful attention to post-stimulation hypocenter population as they tend to indicate subtle features that cannot always be imaged using 3D seismic surveys.

In addition to a multi-scale integration approach, we perform a statistical analysis on the many hypocentral populations obtained during this campaign. For most stages, the b-value is 2 indicating well-behaved hydraulically-induced fracture systems. However for the last stage of the first well treated, we can observe a change in behavior. During the treatment itself, the population exhibits a b-value of 2 meanwhile the post-treatment population locating away from the wellbore clearly show a b-value of 1 indicating a fault reactivation. Furthermore magnitude analysis shows that all high-magnitude events are observed within the volume of fault reactivation in the Loma La Lata-Loma Campana.