UR33

Effect of Pressure Depletion Dynamicity on Induced Strain due to Hydraulic Fracturing in Child Wells

S. Vargas-Silva* (FracGeo LLC), Y. Aimene (FracGeo LLC), A. Nejad (FracGeo LLC), S. Oza (FracGeo LLC)

Summary

Pressure depletion caused by production of first well in section (parent well) generates continuous changes in stress magnitude and orientation. Simplistic geomechanical models ignore such effect and usually are built based on original conditions resulting in overestimation of induced strain which will be reflected in oversized hydraulic fracture job that will negatively affect not only the subsequent wells (childs) but also the first well in section itself. Negative effects are usually irreversible, for instance fracture hits and interference and need to mitigated. This work presents a workflow where changes in the pressure field are incorporated and taking into consideration during geomechanical modeling of induced strain using full continuum mechanics, such strain is one of the driving inputs for hydraulic fracture design. As a result, hydraulic fracture designs are adjusted to the reservoir conditions at the time new wells will be drilled and completed, reducing to the minimum such negative effects. Productivity of the well pad using the simplistic approach will be compared to the full continuum mechanics solution using dynamic reservoir simulation.

Introduction

Simplistic geomechanical analysis of stress orientation and magnitude of the reservoir at the time of drilling and completing wells nearby depleted areas lead to underestimation of drainage regions and subsequently over design of hydraulic fracture jobs. Such practice, cause irreversible damage to the productivity of the wells, for instance, fracture hits and interference, affecting not only the new wells but in some cases the established producers. Dynamicity of the reservoir pressure field should be taking into consideration at the time of planning and designing child wells, such that the geomechanical analysis reflects appropriately the strain the rock will reach as development operations progress in the field.

Method and/or Theory

Stress variation due to depletion is estimated using a full continuum mechanics representation of the geological features that drive the natural fracture system and variable geomechanical properties. The Material Point Method (MPM) with poro-elasticity is used as a computation method to incorporate elastic properties of the rock, regional stress information, indicators of natural fracture trends and orientation, and pore pressure to estimate the induced strain the rock will reach as a result of a given hydraulic fracture design. The quantification of strain is used to easily adapt hydraulic fracture designs according to the depleted pressure field. Reservoir simulation is used to estimate pressure depletion around parent wells, and to validate optimum spacing and frac design derived by the strain quantification process in the child wells. Productivity of well pad will be compared by using both approaches to give an estimation of the potential damage.

Figure 1 shows hydraulic fracture growth as the job advances, pressure depletions is incorporated; easily can be observed the high potential for frac hit at the middle stage. Such observation allows for premeditated hydraulic fracture design adjustments.

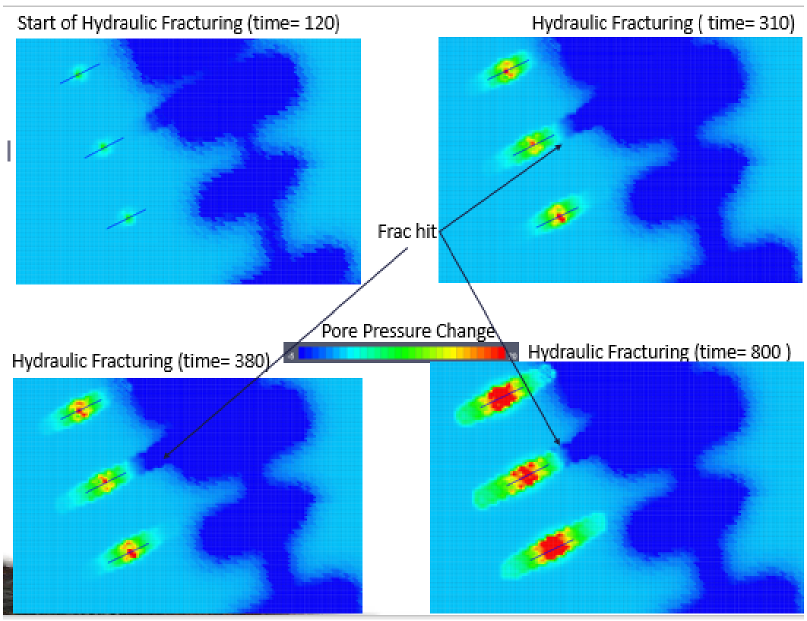

Figure 1 *Induced strain progression during hydraulic fracture of a child well near depleted area.*

Conclusions

This proposed workflow presents the ability to quickly update pressure field in the geomechanical model such that hydraulic fracture design is accommodated to current conditions, successfully avoiding and minimizing fracture hits and well interference still stimulating the well to maximum productivity capacity, optimizing the performance of the entire well pad.

References

A., Ouenes, A. Bachir, A. Khodabakhshnejad and Y. Aimene. *Geomechanical modeling using poro-elasticity to prevent frac hits and well interferences.* First Break, Volume 35, 2017.

Vargas-Silva, S., Oza, S., Paryiani, M., Moody, D., Venepalli, K., Patel K., Erdle, J. and Ouenes, A. [2017]. *Integration of Improved Asymmetric Frac Design Using Strain Derived From Geomechanical Modeling in Reservoir Simulation*. SPE. doi:10.2118/182719-MS

M. Paryani, R. Smaoui, S. Poludasu, M. Siddiqui and A. Ouenes. (2016) *Optimized completion workflow validated in the Wolfcamp: New integrated workflow couples geoscience data with a constrained asymmetric frack model to clear up confusion in current frack design and treatment practices*. E&P.

Aimene, Y & Ouenes, A. (2015), *Geomechanical modeling of hydraulic fractures interacting with natural fractures – Validation with microseismic and tracer data from the Marcellus and Eagle Ford*., Interpretation, 3 (3), SU71-SU88. doi: 10.1190/INT-2014-0274.1