Improving Well Perforating Performance Using Acoustic Radial Velocities

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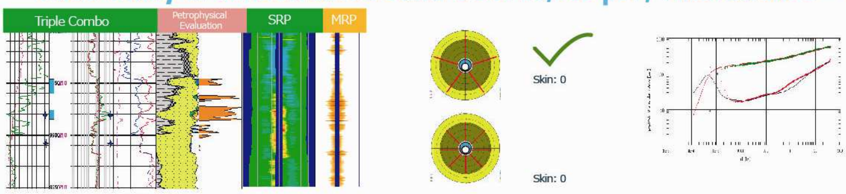
Summary

- For perforated natural completions, well productivity is heavily dependent on the depth of the perforating tunnels extending beyond the drilling damage; the concept of effective formation penetration requirements for fracture stimulations has been recently revisited and has been found to be equally important to overcome near wellbore and stresses fields to reduce breakdown pressure requirements. As a consequence, it is important to accurately understand how much effective formation penetration is needed and to accurately predict perforation depth at downhole conditions
- For the acoustic logging, the recent technology adds a new dimension in acoustic measurements—the radial dimension. These measurements (shear and compressional radial variations) now provide the opportunity to determine how the near wellbore experienced acoustic variations compared with the far wellbore, the information obtained is correlated as a close approximation of the formation skin damage and used in the perforating design program to select the most appropriate gun system and charges.

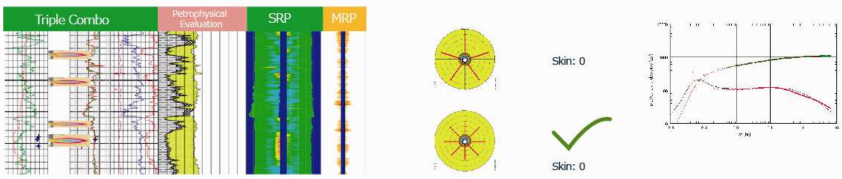
Case Study 1: Consolidated sand UCS: 13,000 psi / Alteration: 8 – 10″



Dynamic Underbalance Perforating with Extra DP charges (39-gr)

Total Skin: 0.8
k, average: 386 md
Pressure: 3,780 psi

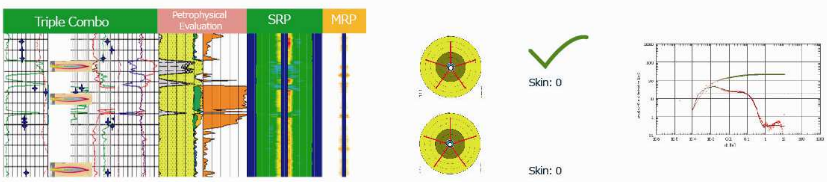
Case Study 2: Laminated sand UCS: 5,500 psi / Alteration: Less than 2″



High anisotropy Dynamic Underbalance Perforating with High Shot density system (22-gr)

Total Skin: -1.8
k, average: 72 md
Pressure: 3,750 psi

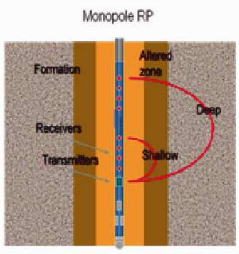
Case Study 3: Clean sand UCS: 3,600 psi / Alteration: 8 – 10″



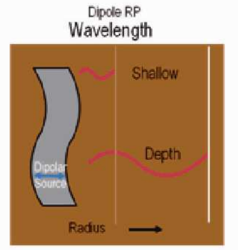
Dynamic Underbalance Perforating with STD DP charges (39-gr)

Total Skin: 0
k, average: 2,680 md
Pressure: 3,663 psi

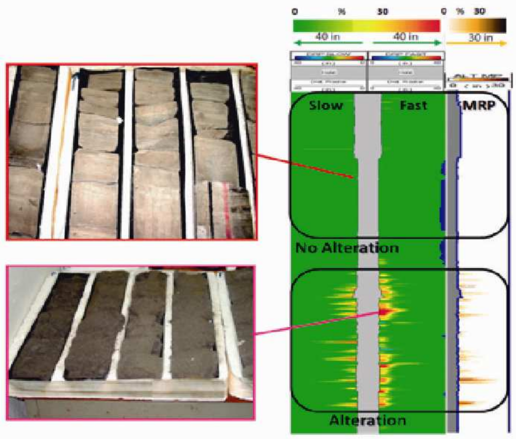
Compressional and Shear Radial Profiles - Alteration



The monopole Depth of investigation is related with the T-R spacing.
The inversion of first motion slowness at different spacings yields the Radial Formation Compressional Slowness Profile



In short wavelengths we have a shallow depth of investigation (1/2 diameter of the well), in long wavelengths the depth of investigation is deeper , (2 - 3 d)
The inversion of flexural slowness at different wavelengths yields the Radial Formation Shear Slowness Profile



Conclusions

For any perforating design is very important to account for UCS and wellbore damage distance to select the best type guns and charges to improve well productivity, the use of the depth of alteration from the radial profiles (monopole and shear) as the minimum estimate of the wellbore damage distance as input in the perforating simulation software has been demonstrated to be of great help in selecting the right type of charges, as shown in this poster where 3 intervals (with very different reservoir quality) tested in the same well resulted in zero skin completions.