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Combining laboratory and computational rock physics

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Identifying and understanding the physical processes taking place in a reservoir rock is an important step towards a more detailed and accurate characterization of a subsurface hydrocarbon reservoir from a seismic data set, and is the subject of our research. We show that the integration of laboratory studies with numerical modeling is a powerful tool to achieve an unbiased comprehension of the physical processes at different scales. Such integration is demonstrated using examples of two challenges in rock physics, which are subject to ongoing research in The Rock Physics Network at ETH Zurich (Quintal et al., 2011): (1) understanding the influence of the rock microstructure on effective elastic properties; (2) identifying the dominant physical mechanism responsible for intrinsic attenuation in saturated rocks at seismic frequencies. In the first example, we show how the coupling between laboratory and numerical methods help provide a better understanding of the effect of the rock microstructure on the effective P-wave velocity. Additionally, this procedure enabled the numerical computations to yield an accurate prediction of the P-wave velocity with confining pressure. In the second example, we show that laboratory or numerical studies alone can lead to misconception or misinterpretation of the obtained results. A persistent combination of laboratory and numerical methods is essential for a successful rock physics research.

REFERENCES

Quintal, B., Frehner, M., Madonna, C., Tisato, N., Kuteynikova, M., and Saenger, E.H., 2011: Integrated numerical and laboratory rock physics applied to seismic characterization of reservoir rocks, The Leading Edge, 30, 1360-1367.