Time-lapse monitoring of surface waves

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SUMMARY

Observations of surface and near-surface waves show that shallow velocities change significantly in response to reservoir compaction that often takes place thousands of meters deeper. The compacting reservoir induces vertical and horizontal displacements and strains at the seafloor that lead to anisotropic changes in the shallow p- and s-wave velocities. Analyzing permanent OBC data from the Valhall field we observe large changes in the arrival times and phase velocities of Scholte and critically refracted compressional waves between several surveys acquired over a 5 year interval. The changes in the shallow velocities are compared with seafloor strains predicted by geomechanical models and a reasonable agreement is found. Shallow waves present us with an excellent laboratory for calibrating the stress and strain dependence of our rock physics models and are useful for constraining geomechanical models and monitoring the compaction of deep reservoirs.