Relations between Seismic Signals and Reservoir Properties of Tight Gas Sandstones in North Germany (Permian Rotliegend)

Abram, Peter, and Reinhard Gaupp, Friedrich-Schiller-University, Jena, Germany

Introduction: The tight gas reservoir consists of mainly eolian sandstones in 4,4-4,6 km depth with moderate porosities but strongly varying permeabilities in proximate zones. Therefore deep gas exploration is highly dependent on reservoir property information from 3-D-seismic signals. A recent DGMK-study succeeded in calibrating 3-D-seismic signals with core and log data. Seismic classes (neural network) correlated to permeability, thickness, clay mineral type, amount of bitumen and not to porosity.

Aim: Individuation of parameters controlling relations between seismic signals and reservoir properties. Explanation of large scatter of permeability for comparable samples.

Results: The relations are explained by rigidity variations of grain-clay-cement structures. The effects of sedimentological features and partial fluid saturation can partly be excluded. Different amounts of clay minerals between grain-to-grain contacts: Clay minerals reduce rigidity of grain-clay-cement structures and lead to lower velocities. The higher the amount of load-bearing clay minerals, the lower was p-wave velocity. All samples from wells with high amounts derive from specific seismic classes and had wells of low sonic velocities. Only those boreholes contain a permeability reducing illite-morphotype. This dependence could explain the relation to clay mineral type and permeability. Different shape of grain contacts: The higher the amount of contact to pore space and the lower the amount of long contacts, the lower is p-wave velocity and the higher is permeability (despite equal porosities). The variability in pore geometry could explain the large scatter of permeability for zones of similar lithology and porosity. More explanations are found, e.g. micro impedance of load-bearing clays.