Amsterdam Petroleum Geoscience

## *Seismic inversion*

One of the most sought-after developments in the petroleum- and geothermal exploration sector is the ability to predict reservoir parameters in 3D. One important issue there is that most reservoirs usually reside at large depths below surface and are sparsely sampled by a few wells. Reservoir parameters observed in these wells are often extrapolated over large lateral and vertical distances, resulting in possibly inaccurate values. 3D seismic data however usually illuminate whole reservoirs but have the disadvantage of imaging only one reservoir parameter: contrasts in acoustic impedance.
When combining wells and coinciding 3D seismic data one can predict acoustic impedance, in relation with seismic velocity and density, from wells into the reservoir. In short, this is the principle of seismic inversion.

AmsterdamPG now has the capability to perform seismic inversion. With the latter, petrophysical properties of the reservoir such as porosity and permeability can be mapped in 3D (or in 2D). This is a large improvement with respect to the classic way of extrapolating reservoir parameters.
Seismic inversion generally consists of five steps:

1. Loading seismic data and well-data in the relevant software suite
2. Generating a representative seismic wavelet along well-trajectories
3. Correlation and tie-in between wells and seismic data through wavelet
4. Generating starting model of acoustic impedance from interpolation over horizons between wells and seismic data
5. Iterative seismic inversion of acoustic impedance from seismic data between wells, based on the starting model.

This five-step procedure results in a 3D model of acoustic impedance inverted from seismic data. With this 3D model, rock-density is subsequently inverted, from which porosity and permeability are then derived through petrophysical relations.

When enough wells and overlapping 3D or 2D data of sufficient quality are available for a given area, seismic inversion can be performed. As a result of the Dutch mining laws and the so-called 'DINO-loket', the coverage of the Netherlands by overlapping wells and seismic data is large. Because of that, seismic inversion is usually a feasible and worthwile procedure.

Two examples of the achievable result using 3D seismic inversion in a study area.