

## **4D Seismic Inversion on Continuous Land Seismic Reservoir Monitoring of Thermal EOR**

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### **Abstract**

A permanent reservoir monitoring system has been installed for Shell at the end of 2010, on a medium heavy-oil onshore field situated in the north-east of The Netherlands, in the context of re-development of oil production by Gravity Assisted Steam Flood. The first challenge was to continuously monitor, with seismic reflection, the lateral and vertical expansion of the steam chest injected in the reservoir during production over more than a year. As the 4D seismic attributes obtained from monitoring fit the measurements made at observation, production and injector wells, the 2D monitoring system was extended to 3D in April 2012. The second challenge was quantify seismic amplitude variations in terms of petro-acoustic parameters. For that purpose 4D inversion was performed on continuous 2D and 3D seismic monitoring data in order to quantify the lateral and vertical expansion of the steam chest on a daily basis. The 4D inversion results not only point out that the inversion enables to quantify the 4D effects in terms of P-impedance variations, but also greatly improves the vertical location of these events. Moreover, the percentage of maximum impedance variations and the thickness where these variations are observed are in good agreement with the petro-elastic model.