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Introduction Part II

This is Part II of a two-part special issue 'What can E&P Learn from Seismology and *Vice-Versa*?' In the first part, a general introduction on the scope of the issue was published (Geophysical Prospecting, Vol. **56**, May 2008, pp. 283–284). A total of 21 accepted papers has been divided over two parts. In this second part of the special issue, we have again divided the papers into two sections in which the papers deal with generally the same topics. The first eight papers revolve around traditional methods and innovations in seismic tomography. The remaining three papers of part II are related to (passive and controlled-source) crustal imaging.

SEISMIC TOMOGRAPHY

Seismic tomography has been a mainstay in seismology for the past three decades. With the increasing amount of data available from ever denser seismometer arrays and the increasing computer power, tomography has recently undergone major developments. The hydrocarbon industry uses tomography in the determination of corrections for propagation of reflected waves through the shallow subsurface. More recently, however, production seismology has also started to use tomography in combination with source-localization to monitor the production of oil and gas. Vesnaver gives an overview of the development of tomography in the exploration industry and offers an insight into the complexity of the tomographic problems. Tomography has traditionally been based on ray theory, limiting the results to relatively smooth velocity models. Gautier, Nolet and Virieux describe the application of 'finite-frequency' tomography to obtain high-resolution velocity models in a complex crustal environment, as long as the acquisition geometry is dense enough. As the physics is improved through the finite frequency effect, one may wonder how to improve our description of medium properties. As shown by Delost, Virieux and Operto, multiscale description, which is applied to traveltime tomography might be a possible strategy. In the future, combining finite-frequency features and multiscale medium descriptions should be an interesting investigation. A way to refine conventional tomographic images is described by Satriano, Zollo and Rowe. Automatic picking and 3D tomography are iterated to refine at each step the estimated velocity profile. This procedure is tested on an active data set recorded during the 2001 Seismic Reflection Acquisition Project for Imaging Structure (SERAPIS) survey. Another improvement over traditional tomographic images can be made by using the difference times between similar signals. Got *et al*. describe the double difference tomography algorithm and discuss an application of this method to data from the monitoring of a volcano. They also investigate the potential of this method in an exploration setting, showing that for optimal values of source- and receiver spacing, the method provides higher resolution than a method based on using travel times. Battaglia *et al*. describe the merging of an active and passive data set for tomography, paying particular attention to the determination of the proper weighting for the different data sets, to estimate the inversion parameters. They show that properly merging two datasets from the Campi Flegrei caldera, near Naples, produces a high-resolution Vp/Vs model from which some characteristics of the caldera are inferred. Vassallo and Zollo and Corciulo *et al*. discuss a non-linear method for the inversion of reflected or converted traveltimes and wave-form semblance to obtain the location and morphology of reflectors in a laterally heterogeneous medium. The method is presented and validated on a synthetic data set by Vassallo and Zollo and applied by Corciulo *et al.* to an active seismic experiment in the Southern Apennines, where the objective was to retrieve a 2D velocity model and the geometry and depth of shallow crustal reflectors.

PASSIVE AND CONTROLLED-SOURCE CRUSTAL IMAGING

Advances in hardware have made portable and more affordable broadband and short period sensors available to the solid Earth seismic community. As a consequence, in the last decades, increasingly dense seismometer arrays have been deployed in global and regional seismology studies, allowing E&P-type reflection imaging techniques to be applied to the acquired data. The ever denser spatial sampling in seismology allows in principle for increasing resolution and hence, shallower targets to be imaged.

Thornton and Zhou describe an application of prestack depth imaging from two reflection surveys of the Los Angeles Regional Seismic Experiment (LARSE). In a laterally complex medium, this technique is able to delineate reflectors and faults throughout the crust. Similarly, taking advantage of a dense local seismic network, Latorre *et al.* apply prestack depth migration, to converted waves from local earthquakes, using a velocity model obtained from traveltime tomography. They reveal a strong converter associated to the Apulia Carbonate Platform in the Molise region in Southern Italy. On the source-side, using either explosives or earthquakes may have disadvantages, for example, related to the repeatability of the sources. Chen *et al.* describe an experiment carried out with an airgun source for seismotectonic studies in a reservoir in Northern China. Using this highly repeatable source, they report several seismic arrivals from lower crustal layers recorded on a regional network of 100 short-period seismometers with a maximum offset of 206 km.

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