Seismic reservoir characterisation
Project status reports

PS3020 Interpolated Sparsely Sampled Seismic Acquisition (ISSA)	
Status	Ongoing
Report date	May 2003
Key contact	Michael Warner, Imperial College of Science
E-mail	m.warner@ic.ac.uk
Partners	Veritas Geophysical Services
Objective	Strategic objectives are to provide new processing technology and paradigms, that, when coupled with modified seismic acquisition, lead both to increased quality and significantly reduced costs for 3D seismic acquisition. Specific objectives are to provide proof of concept and a working prototype of an intelligent, dataadaptive, interpolation and prediction scheme that allows marine multi-streamer 3D seismic data to be acquired with many streamers whilst avoiding the difficulties of missing short-offsets, large source spacing, and variable azimuth encountered with conventional multi-streamer acquisition; to modify this scheme to extend its application to 3D OBC and 3D land acquisition.
Status, findings and plans	The project has recruited staff, demonstrated the viability of the scheme on 2D analogues and synthetic data, and identified a test 3D dataset. Work is now in progress to apply the scheme to this dataset and optimize performance. The first major deliverable is on target for delivery July 2003. Thus far, the scheme appears to work as expected, but there is a long way yet to go. It is planned to apply the scheme to 3D test dataset.

PS3044 Calibrated Seismic Hydrocarbon Indicators (CSHI)	
Status	Ongoing
Report date	28th January 2003
Key contact	Prof Batzle Colorado School of Mines
E-mail	mbatzle@mines.edu
Partners	Dr. D-h. Han, University of Houston
Objective	Calibrate time-lapse seismic response to pore fluids pressures through • Seismic frequency and ultrasonic rock/fluid measurements • Adjusted and calculated log signatures • Properties and geometries 'up-scaled' to seismic resolution • Comparison with actual seismic data collected over both productive and unproductive zones.
Status, findings and plans	The project goals were redefined during our initial organizational meeting to be primarily a time-lapse seismic monitoring calibration. Two North Sea reservoirs will be examined: one comparatively well indurated or hard; the other a soft, largely unconsolidated. The influence of changing pore fluid types and pressures will be ascertained. Numerous core samples from the 'hard' reservoir have been obtained so far. In this reservoir, the hydrocarbon is a very light condensate with properties considerably different from the invading brine. Ultrasonic P- and S- wave were measured on 56 sandstone samples dry, ad brine saturated. In addition seismic frequency measurements were completed on two samples. Ultrasonic P and S-wave impedances show the expected decrease with increasing porosity. Under complete saturation conditions, the measured values compare well with predicted values. Low frequency data show the strong influence of partial saturation. Because of the heterogeneous distribution of pore fluids, measured seismic frequency values do not agree with ultrasonic values when two fluids are present. This implies that sonic velocities derived from logs must also be corrected. After completing core sample measurements, corrections will be applied to logs and synthetic seismic traces will be calculated to estimate the influence of fluid substitution. The second, 'soft' reservoir is now being selected.

PS3025 Practical Dynamic Updating of Reservoir Models Using Frequently Acquired 4D Seismic Data (H-WU)	
Status	Ongoing
Report date	May 2003
Key contact	Prof Mike Christie, Heriot-Watt University
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Partners	Los Alamos National Laboratory, USA
Objective	• Validated methodology for rapid history match of repeated time-lapse surveys. • Realistic quantification of the full range of uncertainty in reservoir performance predictions constrained with time-lapse data. • Guidelines for determining the frequency of repeat seismic surveys for maximum reservoir information.
Status, findings and plans	The project has initially focused on adapting the neighbourhood algorithm to generate multiple reservoir models in a form that can be used in comparing with time-lapse seismic data. We have focused on the simulator to seismic link and have demonstration examples running on a synthetic case. We have also acquired a reservoir dataset, with several time-lapse seismic surveys, and have spent time extracting a section of the reservoir model to work on, as well as examining the seismic data and logs. Covariance matrices have been derived from the seismic data for input into the error modelling. Discussions with Los Alamos have taken place to set up the work on error models. So far the project has been putting in place the elements needed for a successful demonstration of the concepts, and reportable results will flow once the code is fully interfaced with the datasets. A recently published paper on matching to time-lapse data has features that demonstrate that the work on error models will be important for a good match. The next steps are to complete the automatic links between the simulator and the seismic data, to include appropriate geostatistics for reservoir description, and to run a complete demonstration of the matching cycle on the synthetic model.

PS 3041 SAIL Seismic anistropy as an indicator of Lithology and Fluid Properties	
Status	On-going
Key contact	Michael Kendall, University of Leeds
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Partners	University of Manchester
Objective	Improvements in data acquisition have made it possible to detect seismic anisotropy in hydrocarbon environments and newly developed anisotropic processing techniques lead to more accurate images of the sub-surface. However, the anisotropy in itself holds valuable information about rock properties and, as such, can be viewed as a seismic attribute. The aim of this project is to quantify the styles of anisotropy in a range of lithologies such that seismic measurements of anisotropy can be used to characterise lithologies and fluid properties. The relative roles of fracture induced anisotropy versus more intrinsic anisotropy due to preferred orientations in crystals and grains in a given rock type will be investigated. The strength of our approach is that is links analysis of core and seismic data from a range of hydrocarbon settings. State-of-the-art techniques for estimating crystal, grain and fracture orientation in deformed synthetic and natural samples and inverting seismic data for anisotropy parameters will be used. Upscaling seismic properties from core to seismic surveys will be a central issue in this work.