

WORKSHOP
REPORT

Borehole geophysics workshop back and alive in Milan

Technical Committee co-chairs Husain Nassir (Saudi Aramco) and Rafael Guerra (SLB) report on the 7th EAGE Borehole Geophysics Workshop held in Milan in September.

Our workshop, entitled Borehole Geophysics ‘Bridging the gap between surface and reservoir’, provided a forum for lively discussion between operators, service companies, consultants and academics.

As on previous occasions, the location was chosen to be easily accessible to an international audience, to have a strong local operator and geoscience research presence, and to have points of cultural interest for a good social programme.

The Technical Committee, drawn from across the industry reflecting the diversity of the delegates, selected a technical programme of 29 oral and seven poster papers to be presented over three days, interspersed with four keynote presentations by invited speakers.

There was an exhibition area for companies to showcase their latest technology and a social programme to provide networking opportunities. The workshop attracted around 60 delegates from 26 different organisations and feedback from delegates on the choice of venue, the Melia Hotel in Milan, was overwhelmingly positive.

Keynotes

The committee was honoured to receive the opening address from Davide Calcagni, Eni head G&G operations. He highlighted the role of DAS technology in improving the efficiency of Eni’s operations, including CCUS monitoring. This was followed by a keynote presentation from David Hill, CTO of Sintela, on distributed fibre optic sensing technology and its applications in the energy sector and beyond.

On the second day, Eric Verschuor (Delft University Seismic Inversion & Imaging) promoted the integration of borehole and surface seismic, including in survey design and imaging. During the joint session, Ahmad Riza Ghazali (PETRONAS chief scientist) gave a high-level overview of seabed seismic and DAS 3DVSP technologies from a company perspective.

Shujaat Ali (SLB borehole seismic expert) reported on advances in cross-well seismic, including the use of anisotropic eFWI to obtain high quality images from a CCUS project in the USA, and showed how to overcome the challenges of DAS 3DVSP noise in producing wells.

Technical programme

The technical papers reflected the broad scope of borehole geophysics and were divided into eight sessions: Borehole data acquisition & greener operations, Conventional VSP applications and robust well ties, Advanced processing, anisotropy and inversion (two parts), Microseismic monitoring, bridging the scale gap of acoustic measurements, Time lapse VSP Monitoring, and a joint session between the Seabed Seismic and Borehole Geophysics workshops. At the end of each session, presenters were invited on stage for a panel discussion to further explore the studies presented. The authors of each poster submission described their work in a short introduction, before the delegates were invited to view the posters in the break-out area.

The complete list of workshop abstracts is available at EarthDoc with some highlights mentioned here.

Liborio (Eni) presented the geological interpretation of high-resolution DAS 3DVSPs recorded in four producing wells which supported the drilling of successful development wells. Alfataierge (Aramco) showed a high-density DAS walkaway VSP recorded in two deep wells with fibres strapped to tubing, with very good data quality. Lesnikov (TotalEnergies) obtained very good geophone walkaway results, including AVO and anisotropy estimation, from a project offshore Guyana. His colleague, H. Klemm, went a step further and inverted the walkaway gathers at the well location for V_p and V_s logs. Mizuno (SLB) discussed the importance of velocity model

calibration in microseismic monitoring in event detection (less of a problem for migration-based methods) and in event location.

Rufino (SLB) showed a case study of high quality LWD seismic VSP imaging from offshore. Martinez (SLB) presented DAS offset VSPs recorded in very challenging completions with multi-mode fibres inside coiled tubing clamped to tubing in cased hole, the data quality was good and better than expected. Shashkin (Curtin University) showed the correct formula relating DAS strain amplitudes to rock density and velocity. His colleague, Pevzner, analysed the non-linear effects on the vibroseis signals recorded by downhole DAS. Soulas (ASL) showed comparisons between different DAS manufacturers and geophone tools, demonstrating that all DAS interrogators are different.

Guerra (SLB) showed a DAS VSP recorded in minutes offshore UK using extra-strength hybrid logging cable technology. This allowed the cancellation of conventional geophones, saving hours of rig time and tonnes of CO₂. Nassir (Aramco) demonstrated how to attenuate vibroseis harmonic cross-correlation artefacts using template matching. Belleza (OGS) presented an interesting DAS VSP project recorded in Türkiye in shallow but very hot wells (250°C), using engineered fibres and a miniature electric vibroseis source, but the results had relatively low SNR.

During the joint session with the seabed workshop, Yu (BGP) presented a world record DAS 3DVSP survey recorded for ADNOC in 13 flowing wells offshore UAE, during OBN acquisition with two vessels shooting simultaneously, with deblending and some advanced processing applied. Haacke (CGG) obtained good DAS 3DVSP results in a survey recorded for BP in the Caspian Sea in a producing well with fibres clamped to tubing, but no increase in

DAS resolution compared to OBN data was achieved due to the complex velocity model and high flow noise. Moore (CGG) presented a nice DAS 3DVSP test in one of Equinor's Johan Sverdrup water injection wells with fibres clamped to tubing; 4D modelling was performed to assess repeatability and detectability of CO₂ injection.

Verschuur (Delft University) discussed the design of sparse geometry surveys, including the use of migrated image quality to automatically update source and receiver locations. Haldorsen (MagiQ) showed the audience how to locate acoustic sources in the sea using a multi-component array with DAS fibre and point sensors. Finally, Gupta (SLB) presented good S-DAS PrP and PrSv

results with dark fibres buried under the seafloor over a distance of 80 km.

Short course

Following the workshop, a one-day short course on distributed fibre-optic sensing technology was given by Dr David Hill (Sintela CTO). The course explained the key concepts of distributed fibre optics in DAS, DTS, DSS and was well received by the participants who were generally more familiar with seismic methods than with optics. There were many questions and clear explanations followed.

Closing remarks

The committee voted on the best technical contributions to the programme and presented the best paper prize to

Carolina Liborio, Eni geoscientist, for her thorough geological integration of DAS 3DVSP and well data. The resulting improved reservoir model has helped in the successful drilling of development wells. The best delegate paper was presented to Eric Verschuur for his constructive engagement and insights shared during the workshop.

The proceedings were brought to a close by co-chairs Husain Nassir and Rafael Guerra, who thanked everyone involved in the success of this workshop and the event's invaluable Platinum level sponsors: Saudi Aramco, BGP and Eni, as well as the sponsors: SLB, VSProw-ess and Avalon Sciences. Planning is already underway for the next workshop in 2025!

Join our latest marine acquisition technologies event

Technical Committee chair Martin Widmaier extends an invitation to join the geophysical acquisition community in Oslo.

The 4th EAGE Workshop on Marine Acquisition will take place once again in Oslo on the 2-4 September 2024. This popular workshop will be a forum for operators, contractors, manufacturers, and academia to discuss latest geophysical and technical developments and innovations as well as applications.

We will take a closer look at recent advances in marine seismic equipment, operations, and survey design. Recently, the energy trilemma has forced the industry to review strategies and the corresponding technology demand. Challenges and change can drive innovation in the industry.

The workshop will also cover energy transition related applications such as CCS and offshore wind. While marine seismic methods will again be the key focus of the workshop, contributions related to other relevant marine geophysical methods are very welcome.

The workshop aims to provide a comprehensive overview on the latest advances in marine acquisition covering



Seismic survey over the Northern Endurance CCS project (photo courtesy of Northern Endurance Partnership and PGS).

seismic source and sensor technologies, novel acquisition geometries and survey design solutions, as well as operational aspects.

We would like to share recent experiences and lessons learned from case studies and explore future visions. The workshop scope covers a wide range of applications from hydrocarbon explora-

tion and reservoir monitoring to energy transition-related topics such as high resolution near surface methods for offshore wind, CCS development surveys and monitoring, nuclear waste management as well as marine mineral exploration.

Abstracts can be submitted until 31 March 2024. For more details visit the Calendar of Events at www.eage.org.