Report of Transnational Access Projects

(Note: the information here will be publicly disclosed in the Geo-INQUIRE website, do not include sensitive information)

Project ID: C3-TA1-44-1-4

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Project team (if applicable): Aaron Schnittger, MBARI; Enzo Rizzo, University of Ferrara; Andrea Caccia, University of Milano-Bicocca; Rebecca Bruschetta, University of Milano-Bicocca.

Project title: Surface-deployed fibre optic sensing for sub-surface gas monitoring

Project acronym: DASGAS

Hosting installation: Svelvik CO_2 Field Lab, ECCSEL RI facility

Hosting team: Svelvik CO_2 Field Lab team, ECCSEL / Svelvik CO_2 Field Lab

Period of access: 21-30 July 2025 (10 days at the facility; arrival 20 July 2025, departure 31 July 2025)

Report of activities:

The DASGAS Transnational Access project was carried out at the Svelvik CO_2 Field Lab between 21 and 30 July 2025. The objective was to test the effectiveness of a surface-deployed distributed acoustic sensing (DAS) system for monitoring vertical and horizontal gas migration in the shallow subsurface, and to assess how DAS can be combined with borehole DAS, distributed temperature sensing (DTS), electrical resistivity tomography (ERT), and pore-pressure observations to characterise gas migration, fluxes, and subsurface pressure responses.

The work comprised two main phases. The first phase focused on site preparation, baseline characterisation, and sensor deployment. Trenching was undertaken to install the surface DAS cable. Mechanical trenching was initially used, but coarse sediments caused repeated stoppages and manual excavation was required to complete parts of the trench network. Trench vertices and hammer-shot stations were marked at regular intervals and surveyed using mobile GPS. Functional testing of the Sintela Nano DAS unit was completed successfully, and time synchronisation with a network time protocol server was tested and later corrected in consultation with Sintela staff. Burying the surface cable improved the signal-to-noise ratio. Borehole DAS testing confirmed acoustic signal penetration to 60 m depth. Surface and borehole ERT arrays were deployed using 48-electrode configurations with 5 m spacing, and dipole-dipole and Wenner-Schlumberger acquisition schemes were used. Baseline ERT surveys and active DAS hammer-shot surveys were then acquired along the cross- and lateral profiles.

The second phase consisted of controlled CO_2 injection with real-time monitoring. Injection began on 25 July and was monitored using the surface and borehole DAS systems, repeated surface and borehole ERT, DTS where available, and pore-pressure observations where operational. Active DAS surveys were repeated during the injection period, and passive DAS acquisition continued during injection, shut-in, and post-injection phases. ERT monitoring was repeated throughout the experiment to image time-dependent resistivity changes associated with the evolving gas plume. DAS data were backed up regularly, and operational procedures were tested for maintaining acquisition during short

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laptop disconnections and for reducing downtime during data transfer.

The campaign generated a rich multi-sensor dataset covering pre-injection baseline conditions, active injection, intermittent changes in injection rate, shut-in periods, and post-injection monitoring. Initial results show that borehole ERT can map the three-dimensional distribution and temporal evolution of the injected CO_2 plume. Hammer tests show that borehole DAS recorded strain signals to 60 m depth, confirming adequate coupling of the optical fibre and sensitivity to surface-generated acoustic energy. Surface DAS recorded coherent hammer-shot arrivals along the trench network and provides a basis for subsequent velocity analysis and seismic imaging. A technical failure in the injection-system motherboard affected direct flow-rate measurements, DTS, and several borehole pressure readings, but the DAS and ERT systems operated reliably and the main experimental objectives were achieved.

Project outcomes:

At the time of reporting, data processing and interpretation are ongoing. The project has produced raw surface DAS, borehole DAS, and borehole ERT datasets from the July 2025 controlled CO_2 injection experiment. The data are currently stored on institutional servers at MBARI with redundant backups. Initial quality control has been completed, and standardised processing workflows for DAS and ERT are being developed.

Data access and DOI: The DASGAS datasets have been deposited in Zenodo under open-access records. The deposited datasets comprise borehole DAS and ERT data, together with surface DAS data divided into three separate Zenodo records because of dataset size.

The borehole DAS and ERT datasets are available at:

10.5281/zenodo.21193610

The surface DAS datasets are available in three parts at:

10.5281/zenodo.21208202

10.5281/zenodo.21208303

10.5281/zenodo.21208335

Processing and interpretation are ongoing, and any future processed products and software workflows will be linked to these records or deposited in an appropriate open-access repository. All datasets are released under an open license compatible with Geo-INQUIRE requirements and cite Geo-INQUIRE as the source of funding.

Software and digital products: no standalone software product has yet been released. Processing workflows for DAS and ERT data are under development and will be documented with the data release where applicable.

Publications and dissemination: no publications have yet resulted from the access. The project team intends to submit the results to a peer-reviewed international journal following completion of the DAS and ERT analyses. Presentation at relevant scientific conferences will be considered once the integrated interpretation is complete. All resulting datasets, products, and publications will acknowledge Geo-INQUIRE using the required funding statement: Geo-INQUIRE is funded by the European Union (GA 101058518).

Note: Data, products, software and publications resulting from TA activities must be publicly accessible under a CC-BY 4.0, GPLv3 or equivalent open license. No embargos beyond June 2026 are allowed. They must cite Geo-INQUIRE as the source of funding. Minimal citation: "*Geo-INQUIRE is funded by the European Union (GA 101058518)*".