Sulcis, Italy – From characterization to operation

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- The geology of the Sulcis basin in terms of geological storage
- The partnership
- The Sulcis Project
- Ongoing research activities
- First results
- The ENOS Project
- The Ulisse Underground Lab
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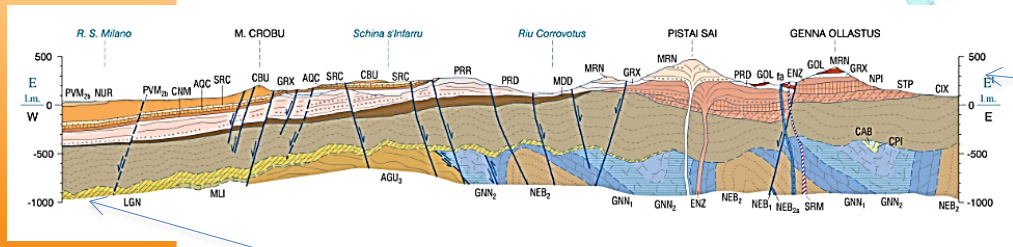
The geology of the Sulcis area



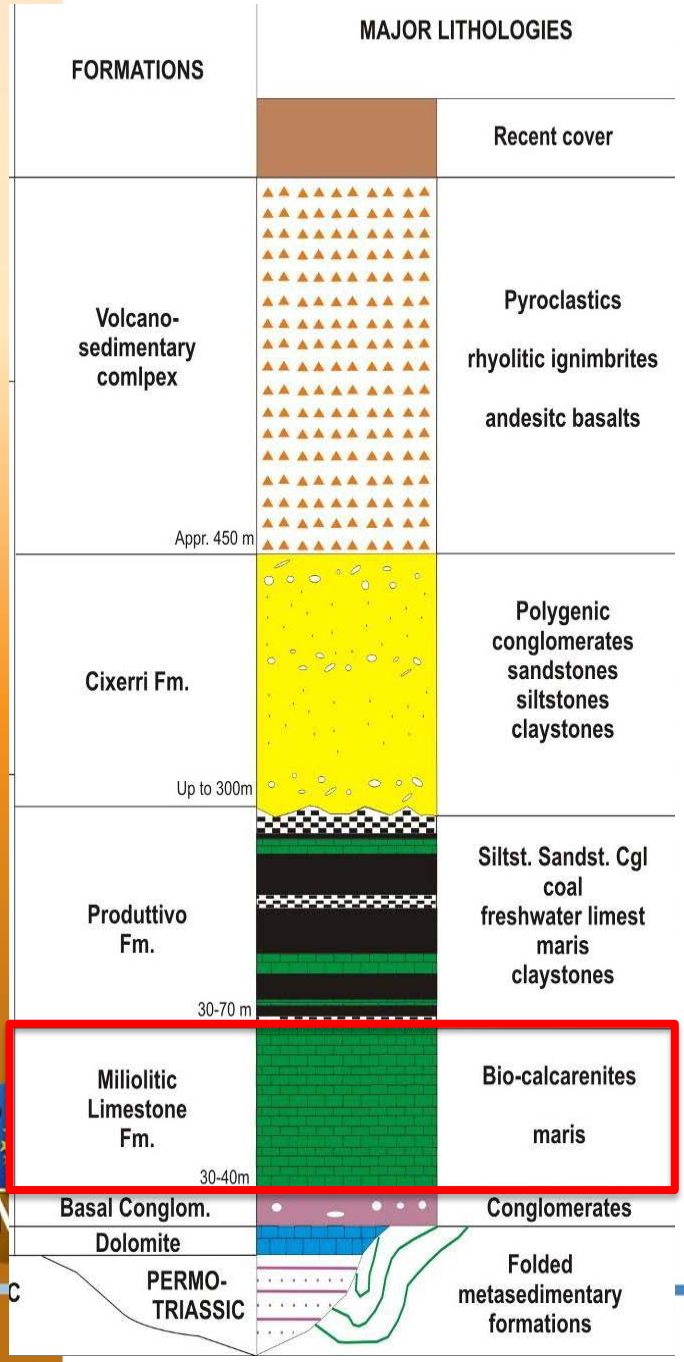
Quaternary deposits
"Ignimbrites" auct.
"Andesites" auct.
Cixerri Fm.
Produttivo Fm.
Miliolitico Fm.
Mesozoic sedimentary succession
Metamorphic basement

Nuraxi-Figus Coal Mine

PORTOSCUSO
CORTOGHIANA
CARBONIA
MATZACCARA
SAN GIOVANNI SUERGIU
20°
20°

Several sedimentary cycles and tectonic phases :

- Hercynian orogeny (Carboniferous – Permian)
- Tethyan spreading (Lower Jurassic)
- Spreading of Provencal Basin - Tyrrhenian Sea (Oligocene - Miocene)
- Monocline dipping southwestward offset by normal faults



In terms of CO_2 geological storage...

Thick caprock and overburden

Formed by
coal beds, Cixerri Formation and volcanic rocks.

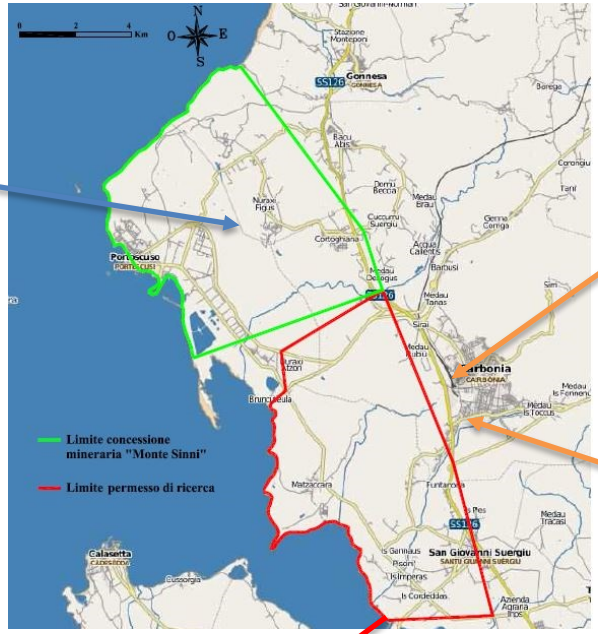
about 1000-1200 m

Fractured carbonate (50-80 m)

other potential carbonate reservoir in Mesozoic and Paleozoic rocks

Several features to develop an integrated hub of CO_2 Capture and Storage are present and available in the Sulcis area

Nuraxi – Figus
Coal mine



Sotacarbo
license area

Capture Pilot Platform
(ECCSEL Project)

Former Coal mine

Knowledge sharing and public awareness supported by the local mining culture

The partnership:

SOTACARBO
SOCIETÀ TECNOLOGIE AVANZATE CARBONE S.P.A.

ENEA

SAPIENZA
UNIVERSITÀ DI ROMA

University
of Cagliari

INGV

RSE
Ricerca
Sistema
Energetico

OGS

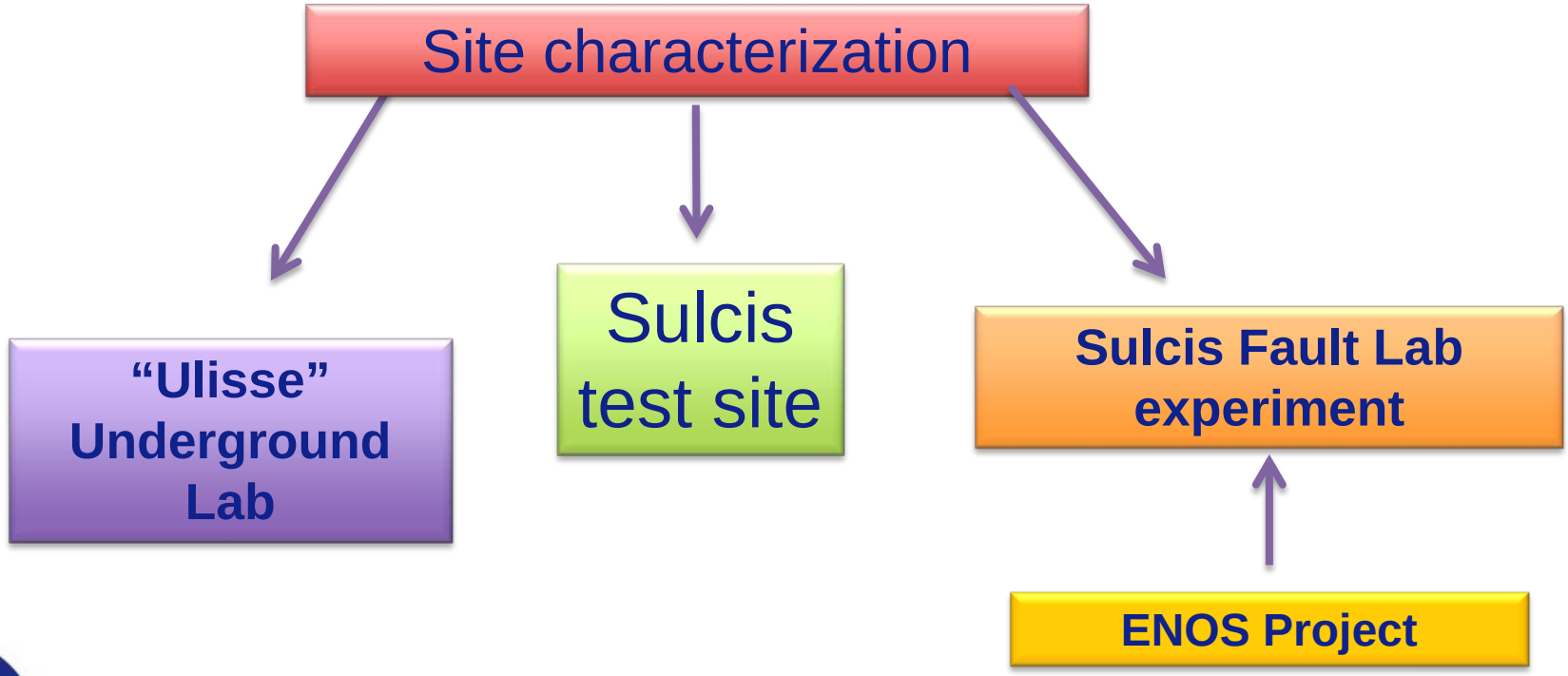
GeoNet

Italian Ministry of Economic Development

Funded by

Sardinia Region

The Sulcis project



The Sulcis project.
Ongoing research activities

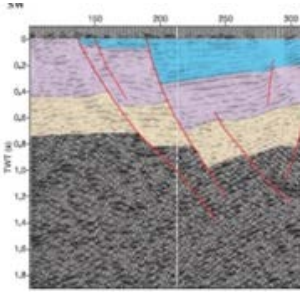
Petrophysical analysis in Lab of rock samples from existing boreholes (caprock and Miliolitico Fm)

Geochemical characterization baseline definition by continuous and discontinuous surveys both in soil and water

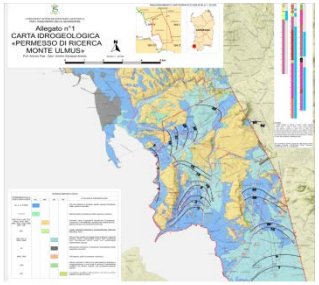
Fault analysis and fracture modelling

Natural seismicity through a monitoring network

Re-processing available seismic dataset and new acquisition



Hydrogeological studies



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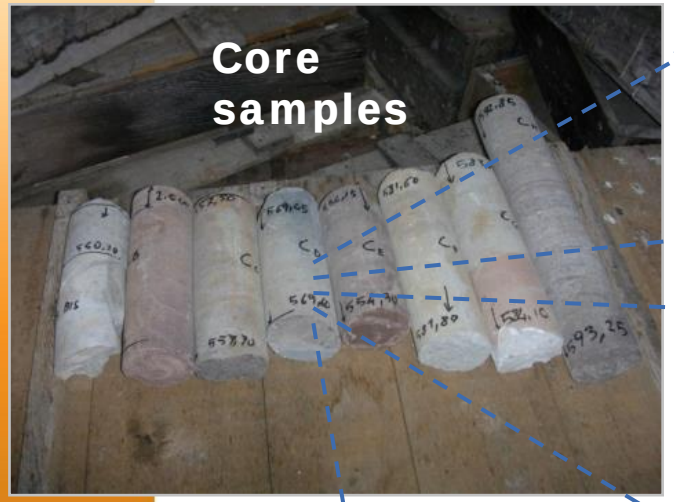
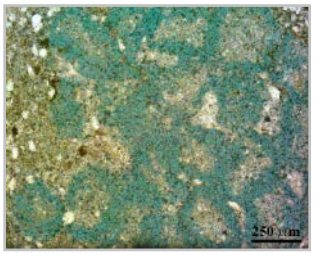
Core samples petrophysical analysis

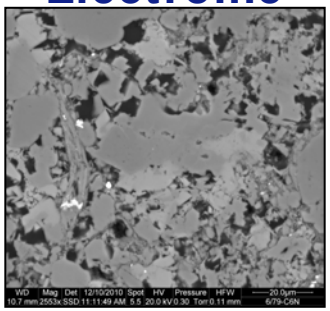
PETROPHYSICS
(texture, porosity, permeability, density, Vp, Vs and dynamic elastic modul)



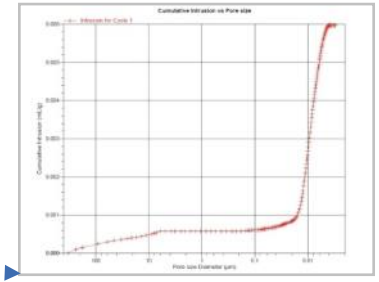
Optical microscopy



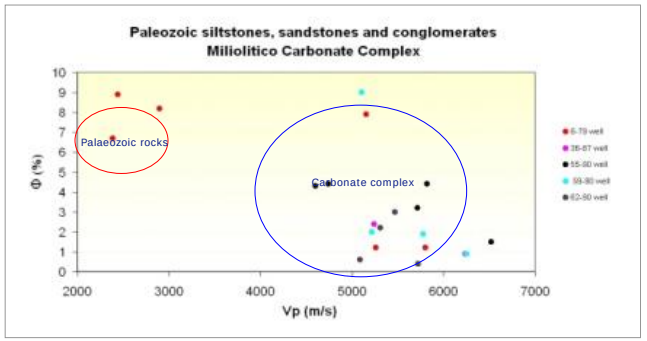
Scanning Electronic



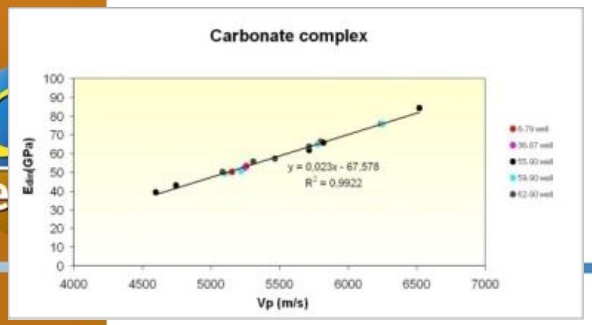
Mercury Intrusion Porosimetry



Porosity vs longitudinal vs velocity (Vp)



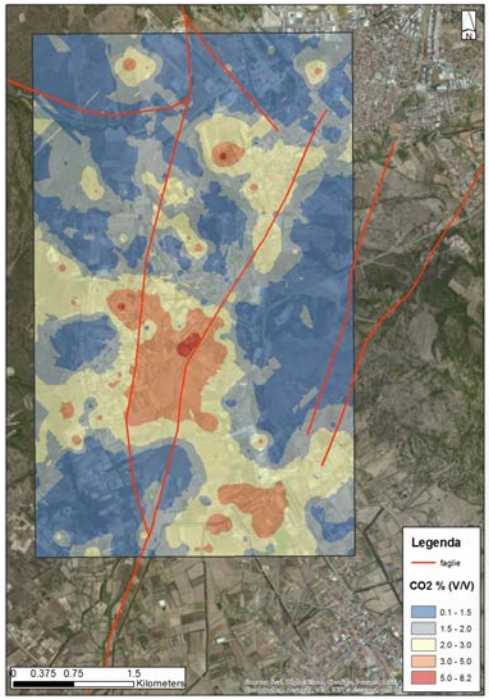
Young's modulus vs longitudinal velocity (Vp)

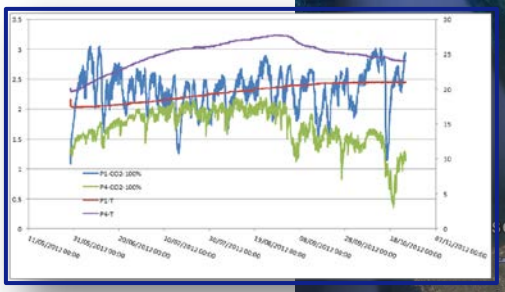


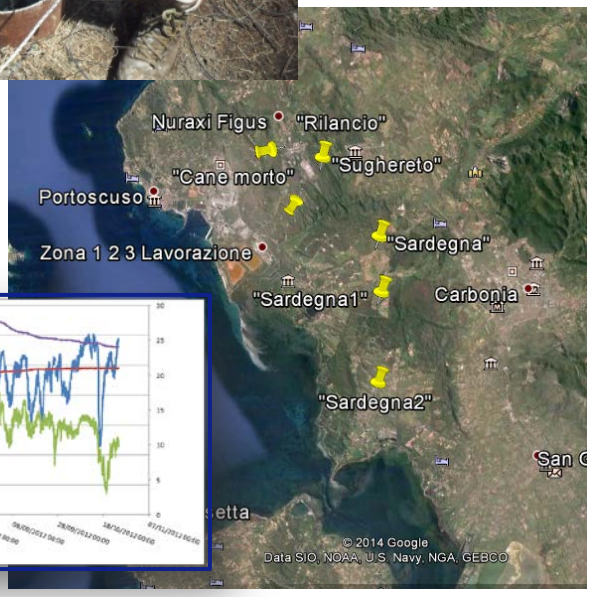
Ongoing research activities

Geochemical characterization

- Soil gas survey (2014-2015) for all gas species (CO_2, Methane, O_2, H, H_2S, and He
- BASELINE definition and anomalies threshold
- Continuous monitoring – 10 CO_2 monitoring station (T, pH and CO_2 concentration)

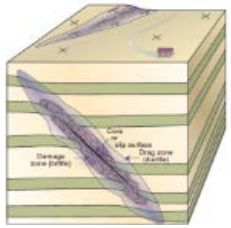




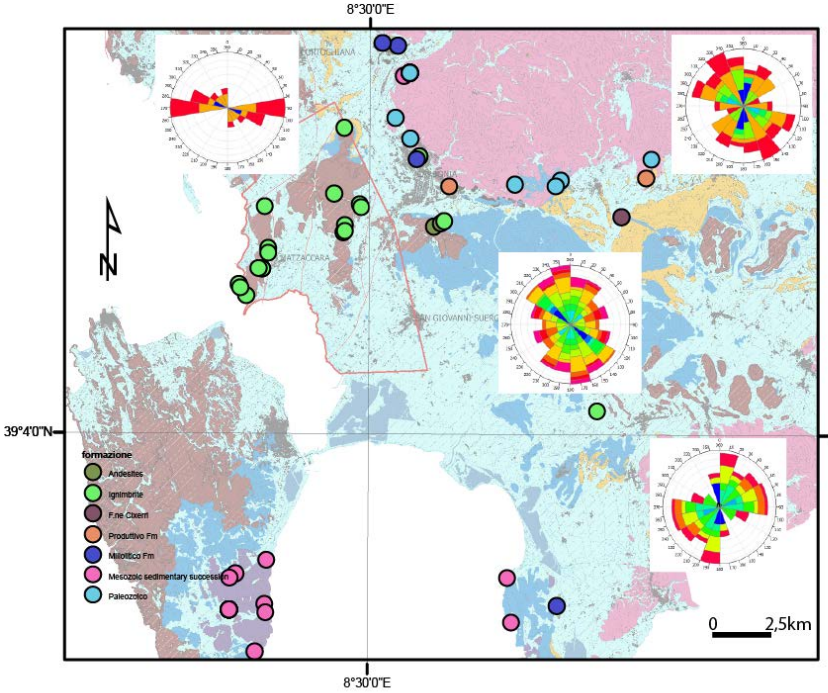


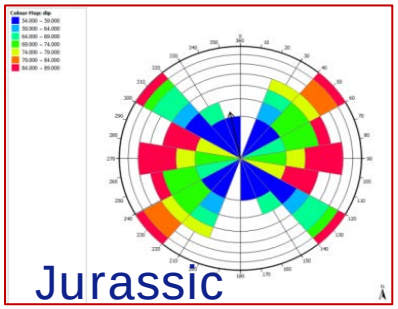
Ongoing research activities

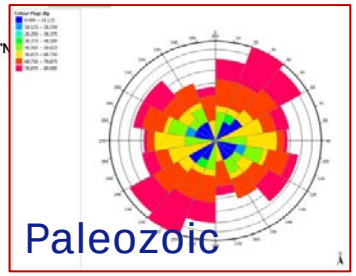
Fault analysis and fracture modelling

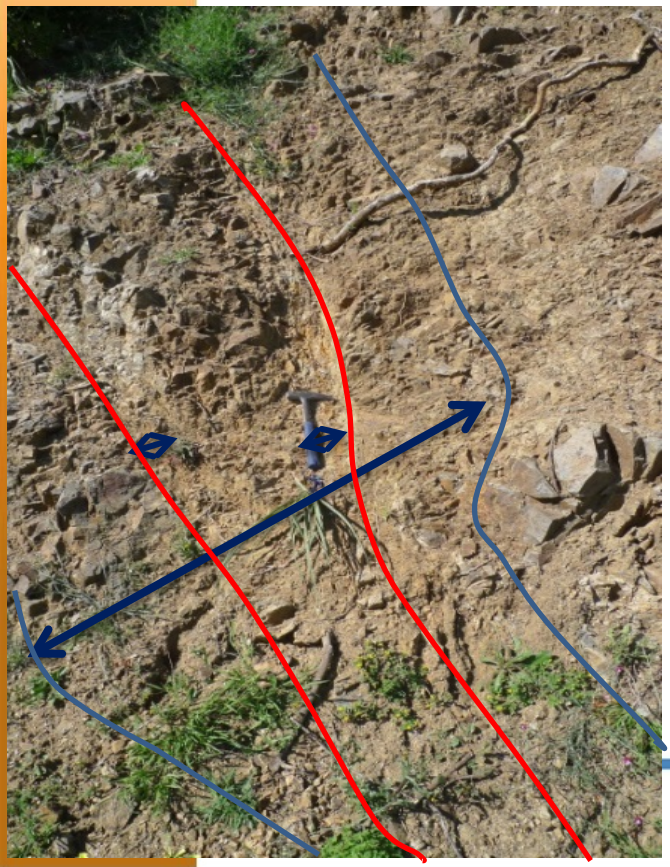


Core (C) /damage zone relationship





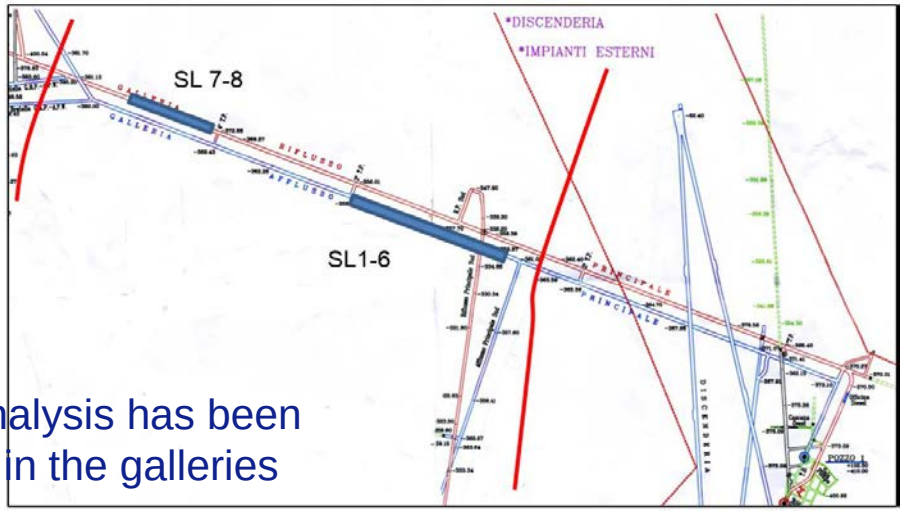




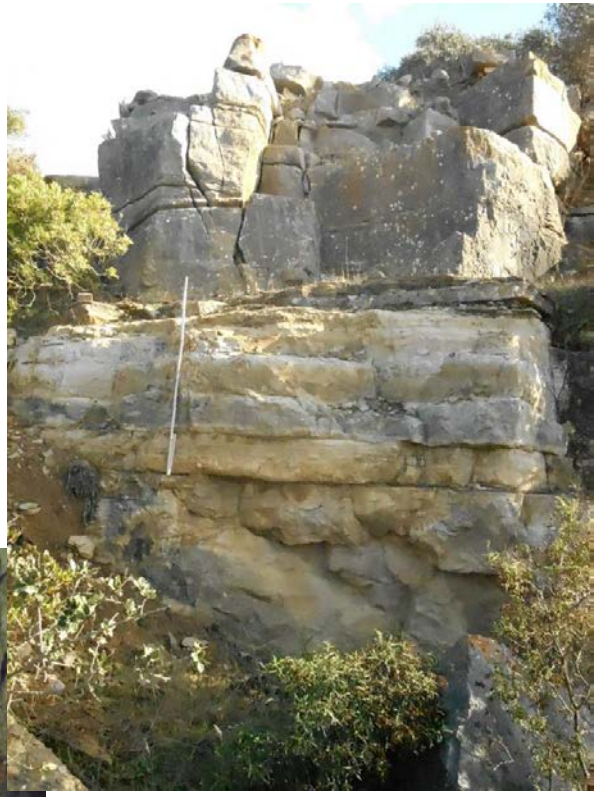
Ongoing research activities

Fault analysis and fracture modelling

measuring fractures and faults in the coal mine and outcrops

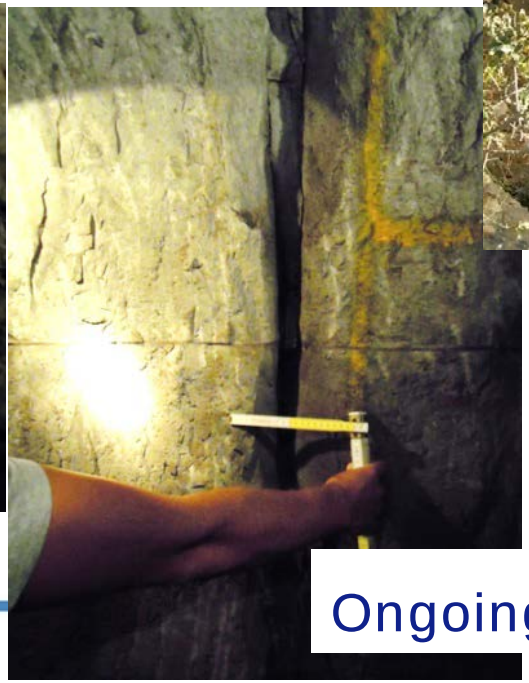


Fracture analysis has been carried out in the galleries



Extensional fractures and veins in the Miliolitico Fm

Fault with filling… synsedimentary structures?

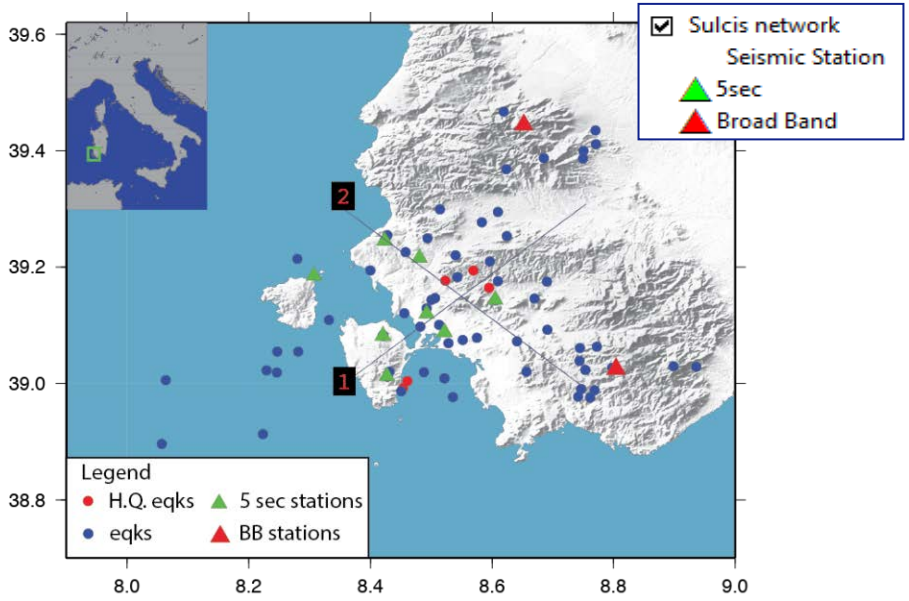


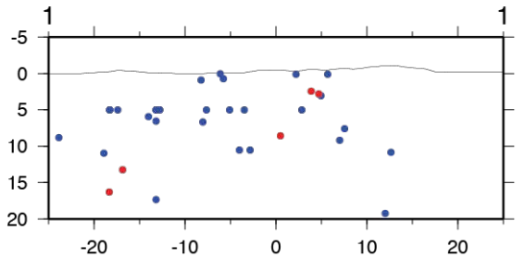
Subvertical open fault

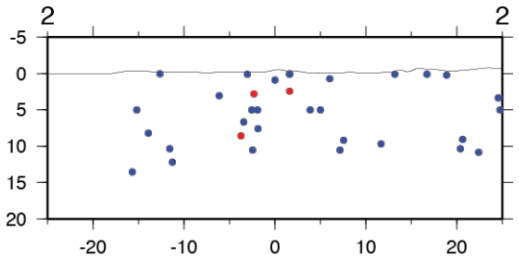
Ongoing research activities

Background seismicity

- Installation of a temporary seismic network
- Continuous monitoring for about 12 months



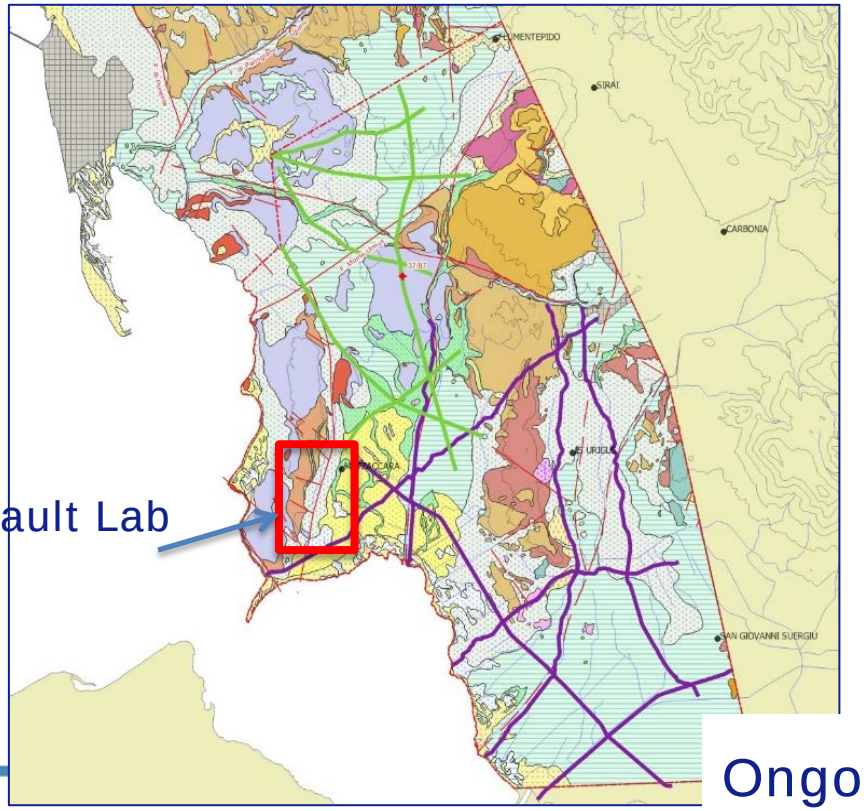




Ongoing research activities

Seismic surveys

- Reprocessing of the available seismic dataset
- New acquisition covering the Sulcis basin and the Matzaccara area for the Sulcis fault Lab



Sulcis fault Lab

New seismic survey

Old seismic survey

Ongoing research activities

First results

- Geochemical Baseline (CO_2 in soil and aquifers): defined anomalies threshold
- Faults: typically sealed in caprocks (majority of analyzed faults show a low permeability architecture, but further data are needed to build more complex model of subsurface)
- Laboratory analyses: low primary porosity of Miliolitico Fm and higher fracture porosity (up to 3% from fracture modelling)
- Low instrumental and historical seismicity
- Geological model is still to be defined; significant variations of stratigraphy from N to S are present

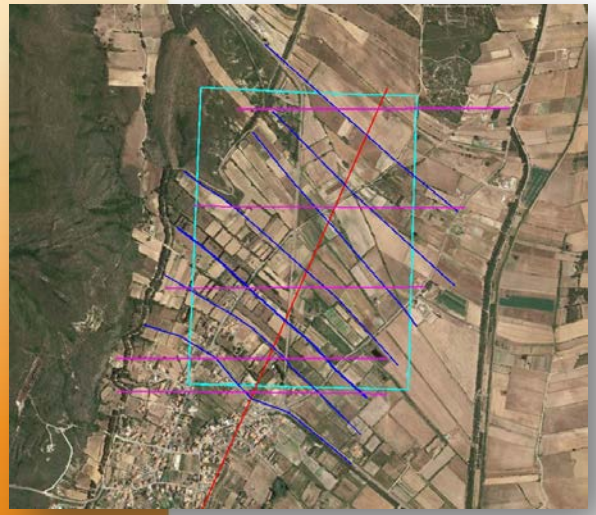
The Sulcis project development: the underground “Ulisse” Lab

The coal mine has been proposed as a laboratory dedicated to site characterization and as Open Lab at international level. The mine has many advantages including:

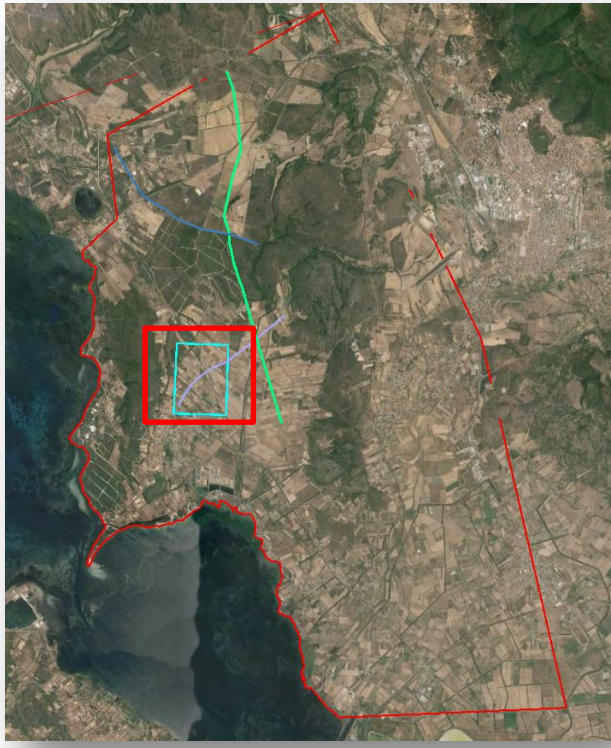
- an inclined road entrance
- recovery of the mine not needed
- caprock, carbonate and coal crops out in the mine.
- trained and capable mining and technical staff is available
- experiments on controlled rock volumes and faults

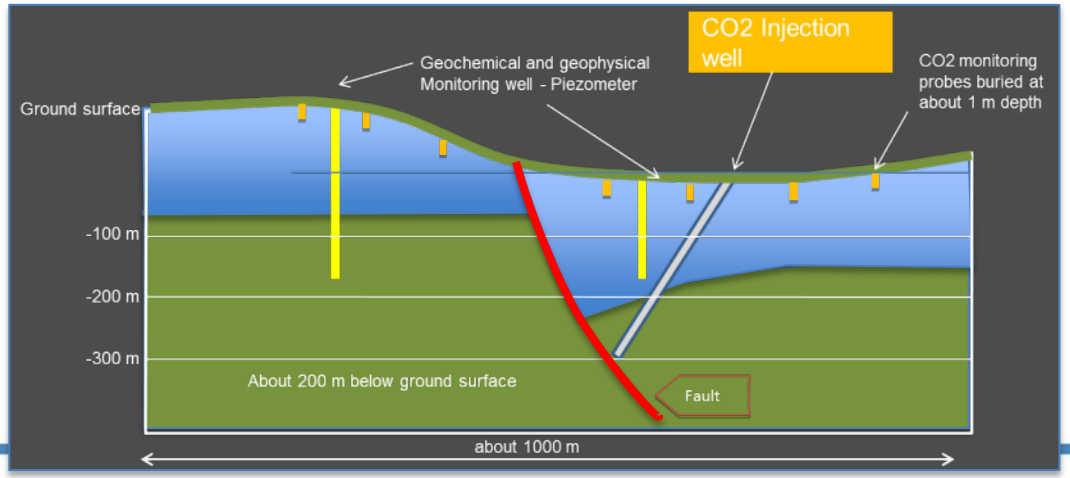
The Sulcis Project
the Sulcis Fault Lab and ENOS Project

CO_2 will be injected into a fault zone to advance technologies for monitoring CO_2 leakage. The project has multiple purposes:



- To study CO2 migration trough faults
- To study water-gas-rock interactions
- To study rocks behaviour and, eventually, micro seismic events, by monitoring seismicity and technical rocks characteristic
- To test geochemical (in house made and low cost CO2 sensors)l and geophysical monitoring tools (ENOS project)





Concluding remarks

- The Sulcis area has the potential to host an international hub for CO_2 Capture and Storage
- The Sulcis Project is an example of how research activities can be a tool for the requalification and the development of an area
- The presence of both national (from Ministry and Sardinia Region) and EU funds is a strength point for CO_2 Capture and Storage


Thanks for your attention!!!