Estimations of carbon-dioxide emissions along an active fault by using geoelectrical measurements

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In the last twenty years, a growing interest is noticed in quantifying non-volcanic degassing, which could represent a significant input of CO_2 into the atmosphere.

Large emissions of non-volcanic carbon dioxide usually take place in seismically active zones, where the existence of a positive spatial correlation between gas discharges and extensional tectonic regimes has been confirmed by seismic data. Extensional stress plays a key role in creating pathways for the rising of gases at micro- and macro-scales, increasing the rock permeability and connecting the deep crust to the earth surface.

Geoelectrical investigations, which are very sensitive to permeability changes, provide accurate volumetric reconstructions of the physical properties of the rocks and, therefore, are fundamental not only for the definition of the seismic-active zone geometry, but also for understanding the processes that govern the flow of fluids along the damage zone.

In this framework, we present the results of an integrated approach where geoelectrical and passive seismic data are used to construct a 3D geological model, whose simulated temporal evolution allowed the estimation of CO_2 flux along an active fault in the area of Matese Ridge (Southern Apennines, Italy). By varying the geometry of the source system and the permeability values of the damage zone, characteristic times for the upward migration of CO_2 through a thick layer of silts and clays have been estimated and CO_2 fluxes comparable with the observed values in the investigated area have been predicted. These findings are promising for gas hazard, as they suggest that numerical simulations of different CO_2 degassing scenarios could forecast possible critical variations in the amount of CO_2 emitted near the fault.

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Survey area

We investigate **Colle Sponeta fault.**

The survey area has one of the largest non-volcanic gas emission ever measured on earth (Ascione et al., *GSA Bulletin*, 2018).

CO_2 fluxes ~ 34 kg d^{-1}
from zones of focused degassing

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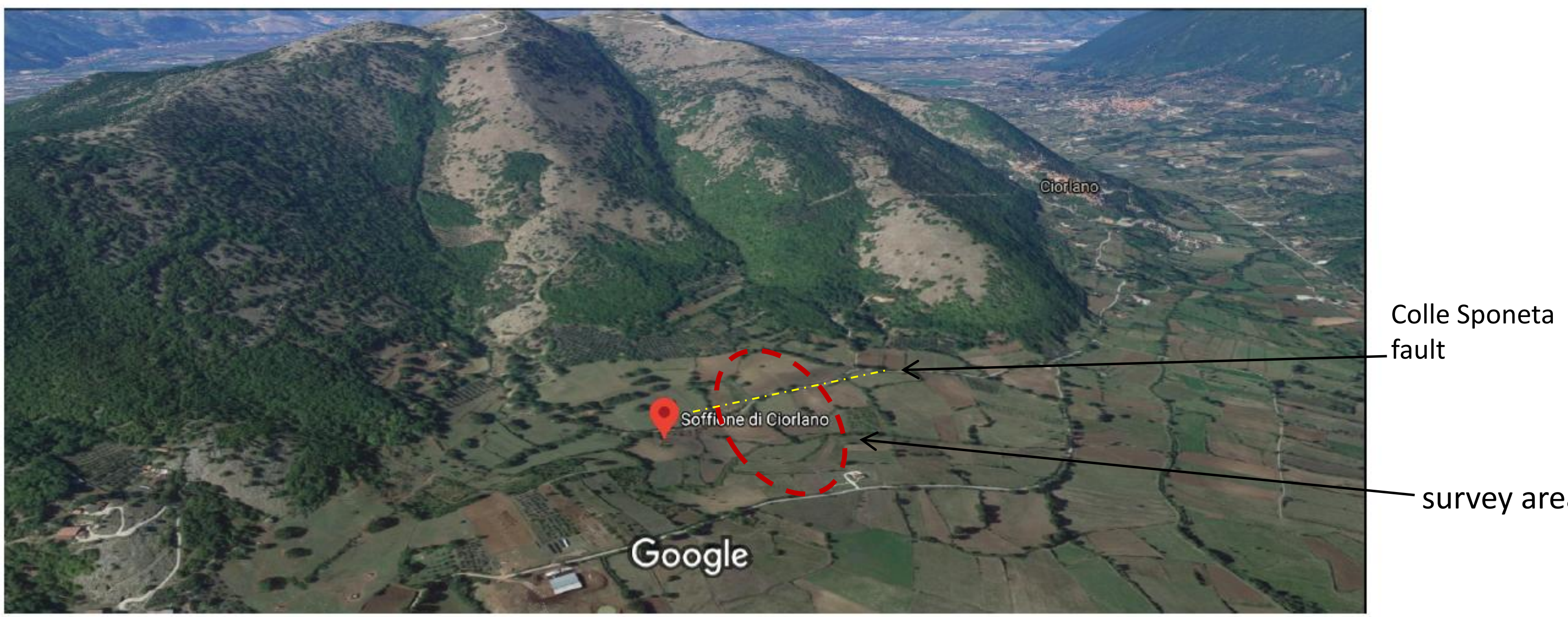

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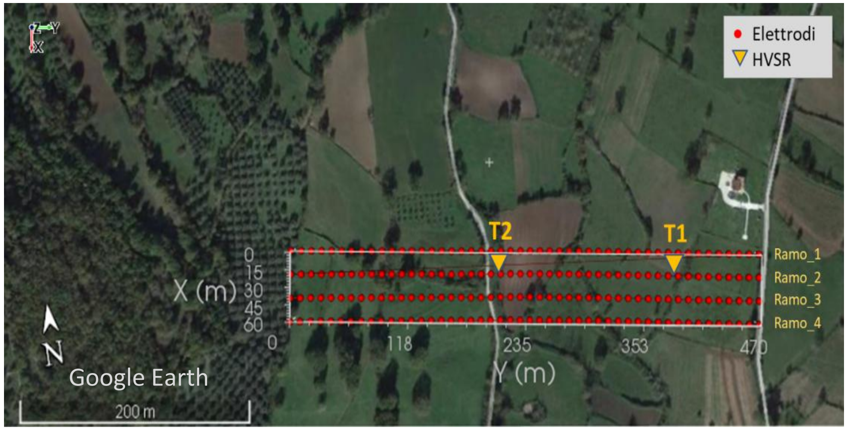
2D ERT survey



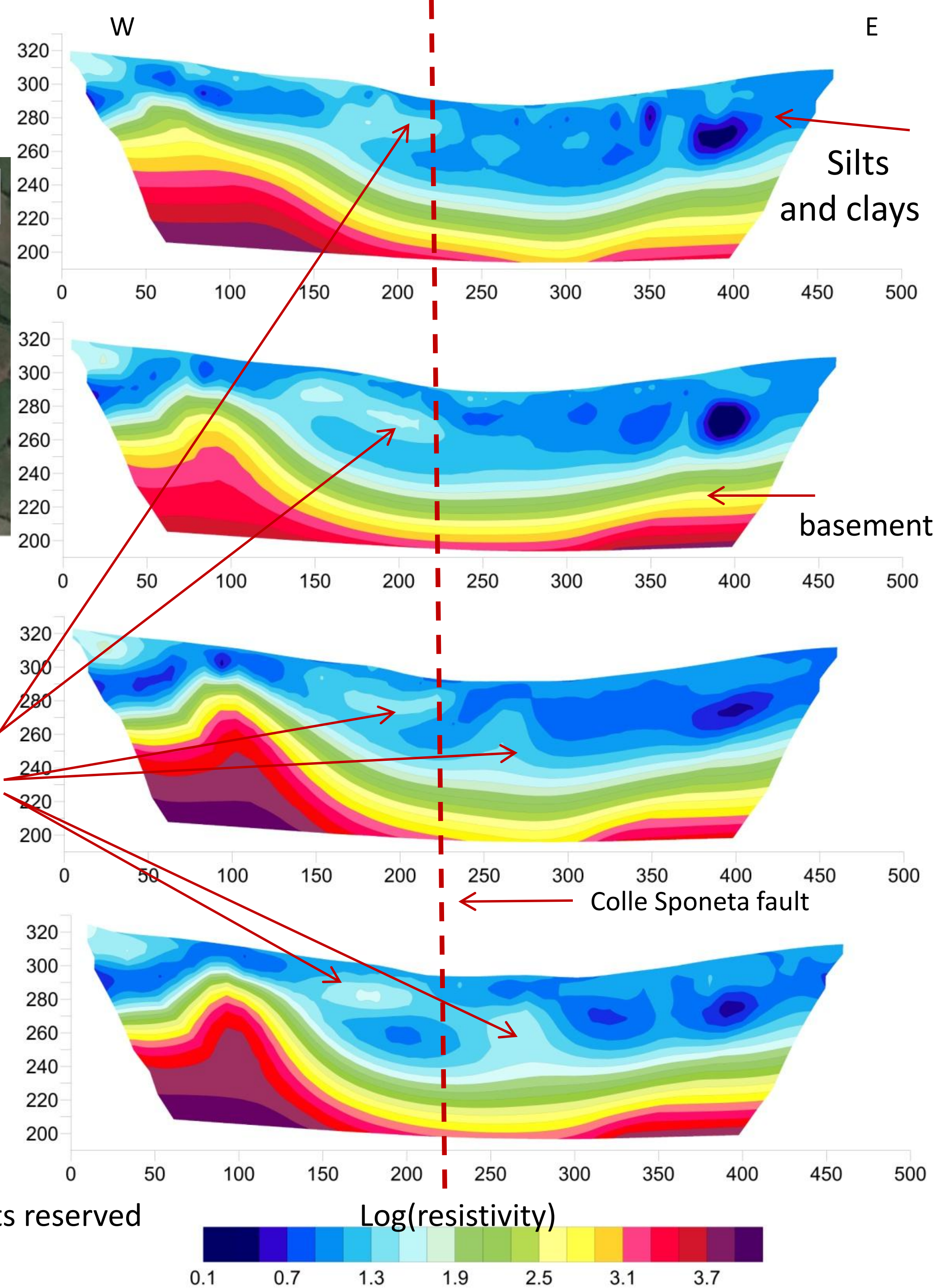
2D ERT survey

- 4 profiles of length 470 *m*
- 10 *m* inter-electrode space
- 20 *m* distant each other
- pole-dipole array

HVSR measurements identify the basement at a depth of about 70 m b.g.l. (green-yellow boundary in ERT sections).

De Paola et al., 2019

CO2 migration pathways



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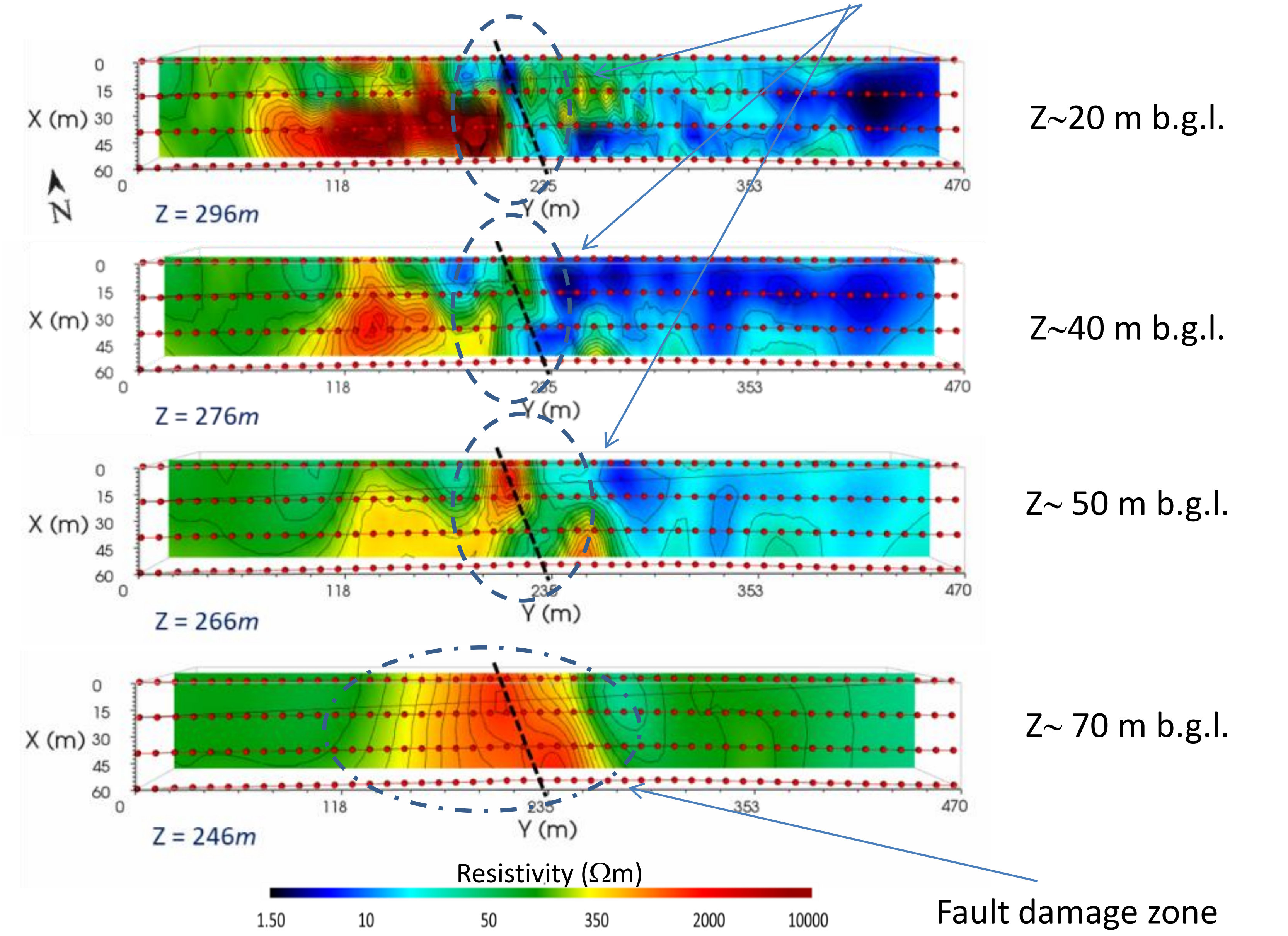
Fault Images from 3D ERT slices



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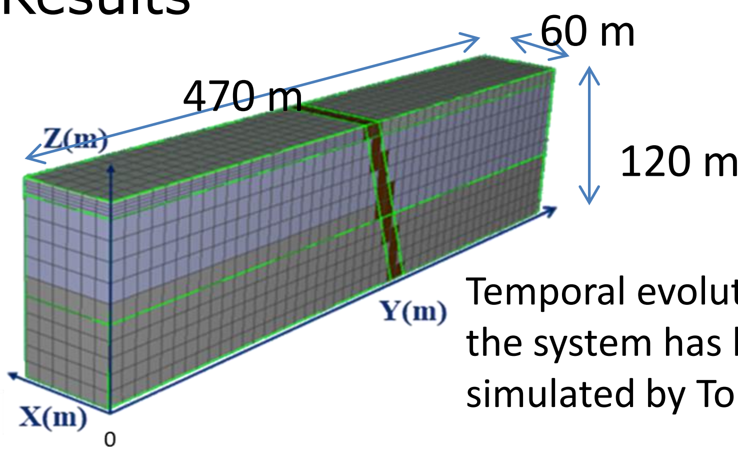
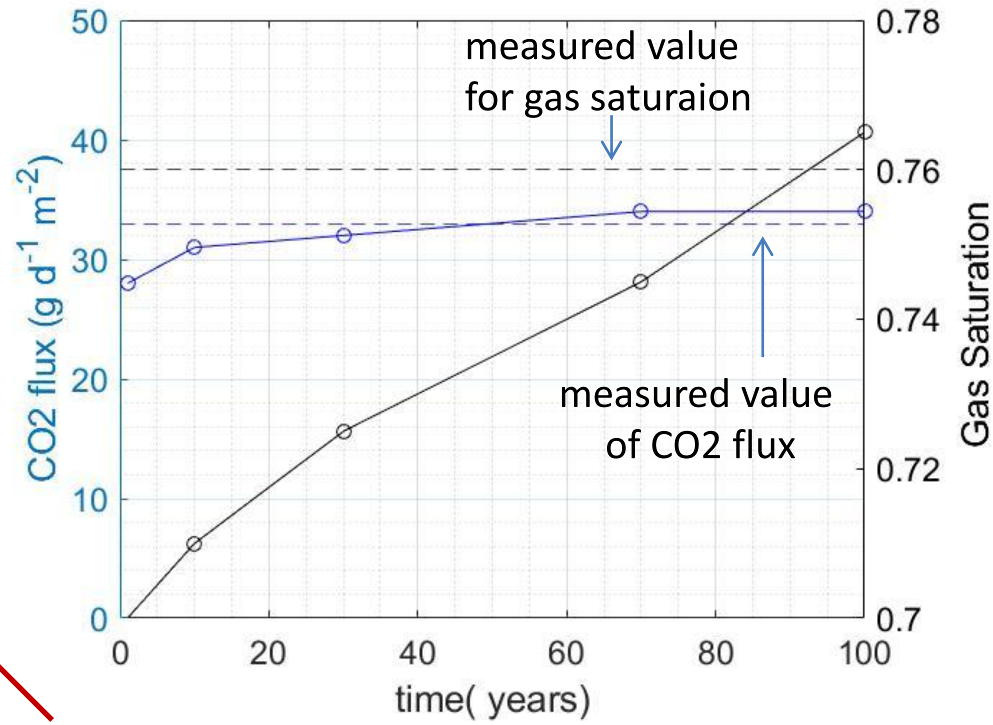
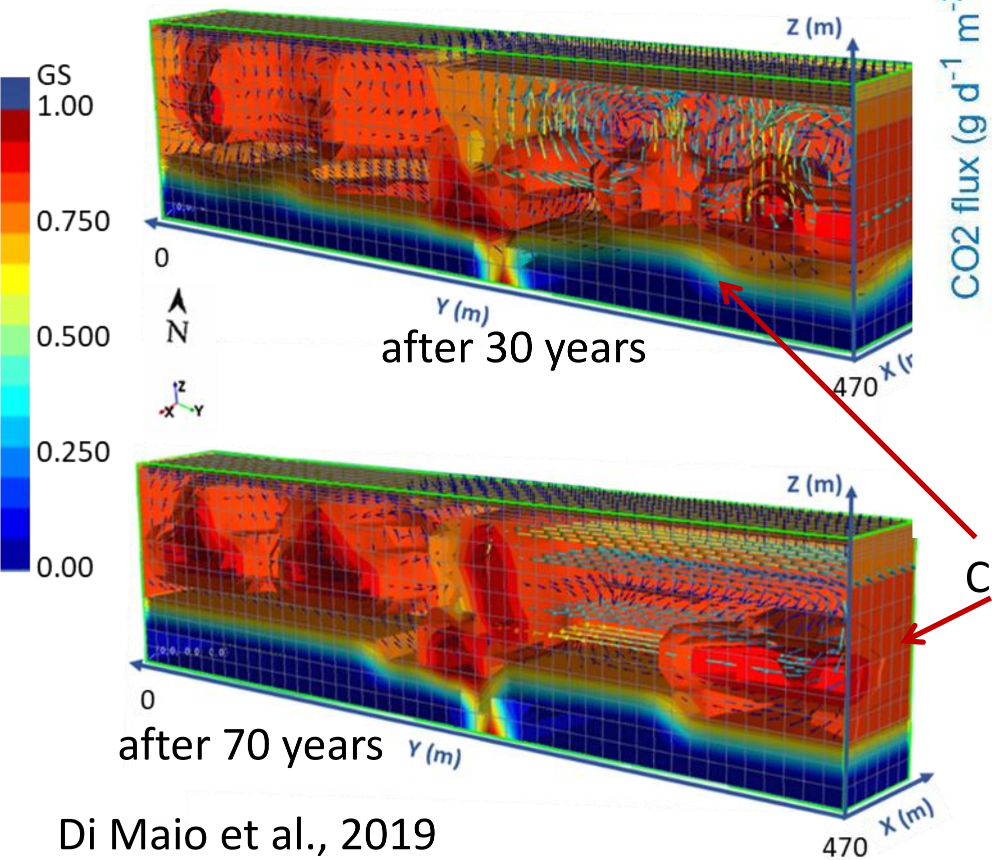
Results



Numerical simulations have been performed for different choices of model parameters and CO2 source geometries, while number and thickness of layers, as well as cell size, have been chosen according to the results of 3D ERT survey.

Temporal evolution of the system has been simulated by Tough2.





Numerical simulations of temporal evolution of the proposed model are able to reproduce measured values for gas saturation and CO2 flux at Colle Sponeta fault, allowing reliable predictions for temporal changes of CO2 degassing.

Di Maio et al., 2019

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