

Italian – English version

December, 2025

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Il pacchetto MOVE 2024 consentirà di sviluppare studi di alto livello all'interno di progetti di cartografia geologica, modellazione di dati strutturali e sismologici, ricostruzione 3D dell'architettura di catene orogenetiche.

The University of Udine (Department of Agrifood, Environmental and Animal Sciences) stipulated an Educational Institution Licence Agreement with PE Limited, for 10 academic licenses of MOVE 2024 exclusively for teaching tutorial, not-commercial research, Master and Phd courses.

The donated software package consists of HARDLOCK, MOVE, 2D Kinematic Modelling, 3D Kinematic Modelling, Geomechanical Modelling, Fracture Modelling, Fault Response Modelling, Fault Analysis, Stress Analysis, MOVE Link for Petrel, MOVE Link for OpenWorks, MOVE Link for GST for a commercial price of £ 1,928,384.01 (UK Sterling).

MOVE 2024 will enable to develop qualified studies in the frame of geological mapping, geo-modeling of structural and seismological data, 3D architecture of orogenic chains.

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RESEARCH ACTIVITIES (2019-2025)

The research activity of our geology research group here at the University of Udine is currently focused on the active tectonics of the Venetian-Friuli prealpine area (NE Italy). Particularly, our research topics include interpretation of seismic lines, seismicity distribution analysis, morphotectonic analysis, geologic and morphostructural field surveys and paleoseismological investigations. In this context, the 3D Move Software reveals very helpful to manage and elaborate the data we collect and allows us to reconstruct the 3D seismotectonic model which integrates geological, geophysical and paleoseismological data of the investigated tectonic structures.

2019: Reconstruction of the 3D structural model of the eastern Friuli Plain. Thanks to ENI cooperation, enabled by the Friuli Venezia Giulia Region, we were able to interpret more than 200 km of seismic lines (supplied in jpg format) covering an area of about 6000 km² of the eastern Friuli Plain. By converting the interpreted seismic sections from time to depth we reconstructed the 2D geometry of the main stratigraphic horizons and tectonic structures. In a second step we elaborated the 3D geometry of the main fault systems by interpolating the fault lines drawn on each section.

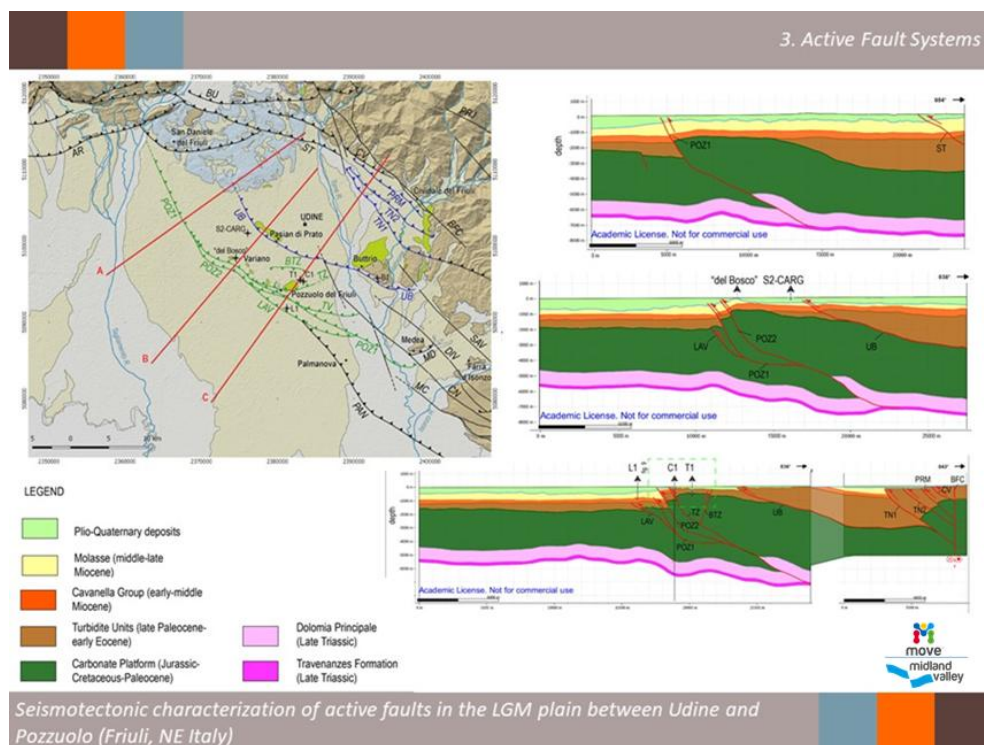
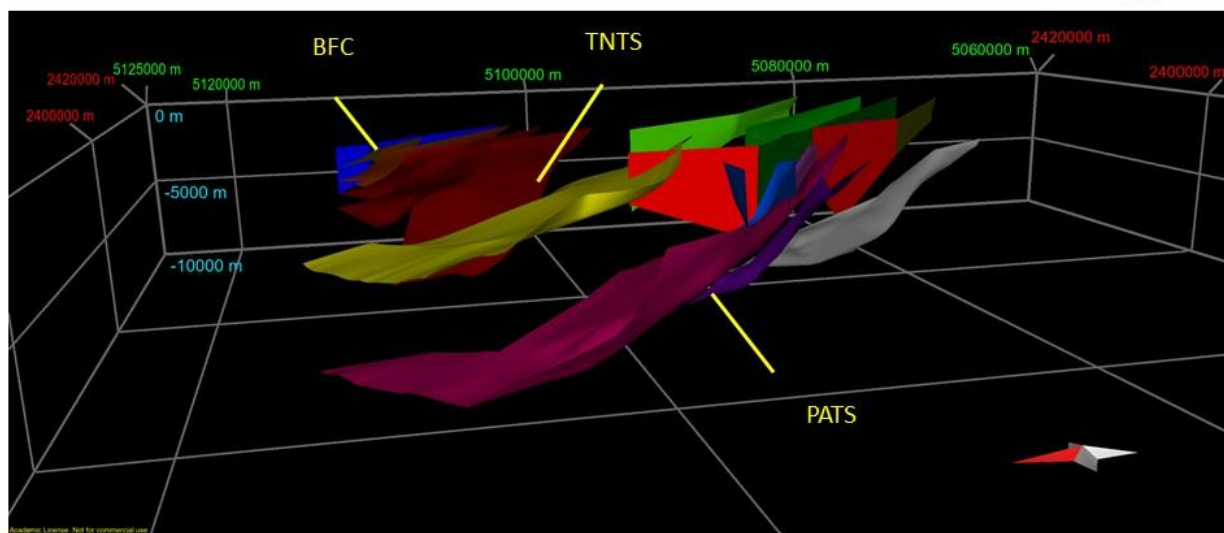


Fig.1. A, B and C geological cross sections elaborated from the interpretation of ENI seismic lines, showing the 2D geometry of the active fault systems characterizing the Friuli Plain.

3. Active Fault Systems – 3D surfaces



Seismotectonic characterization of active faults in the LGM plain between Udine and Pozzuolo (Friuli, NE Italy)

Fig.2. 3D surfaces of the active fault systems of eastern Friuli Plain, reconstructed through the interpolation of the 2D geological sections. Pozzuolo Thrust System (PATS), Trnovo Thrust System (TNTS) and Borgo Faris-Cividale Fault System (BFC).

2020: Reconstruction of the 3D structural model of the Susans-Tricesimo Thrust System (NE Friuli Plain).

Thanks to ENI cooperation, enabled by the Friuli Venezia Giulia Region, we were able to interpret more than 200 km of ENI seismic lines. Through the 3D Move software, we reconstructed the 3D surface geometry of the Susans-Tricesimo Thrust System, which is considered the source of the 1976 earthquake. Moreover, the hypocentral distribution of earthquakes occurred in the latest 50 years was analyzed through the construction of seriated sections, with the aim to analyze the seismogenic potential of the investigated structure.

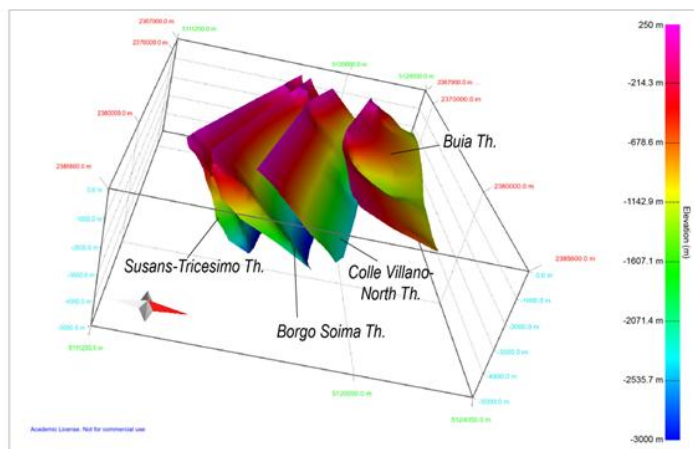
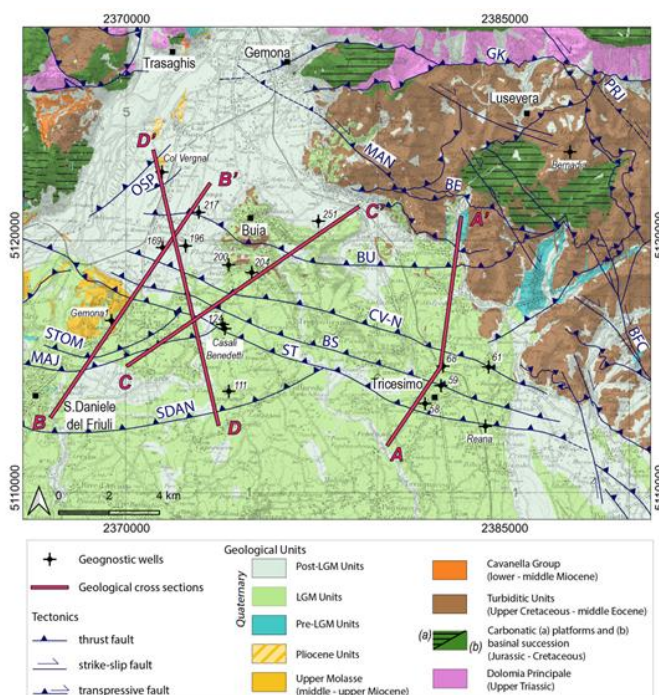
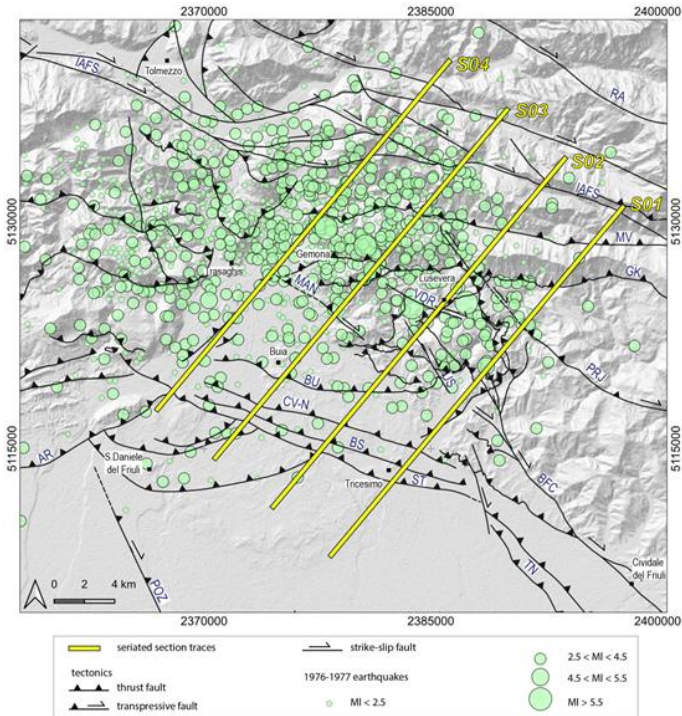


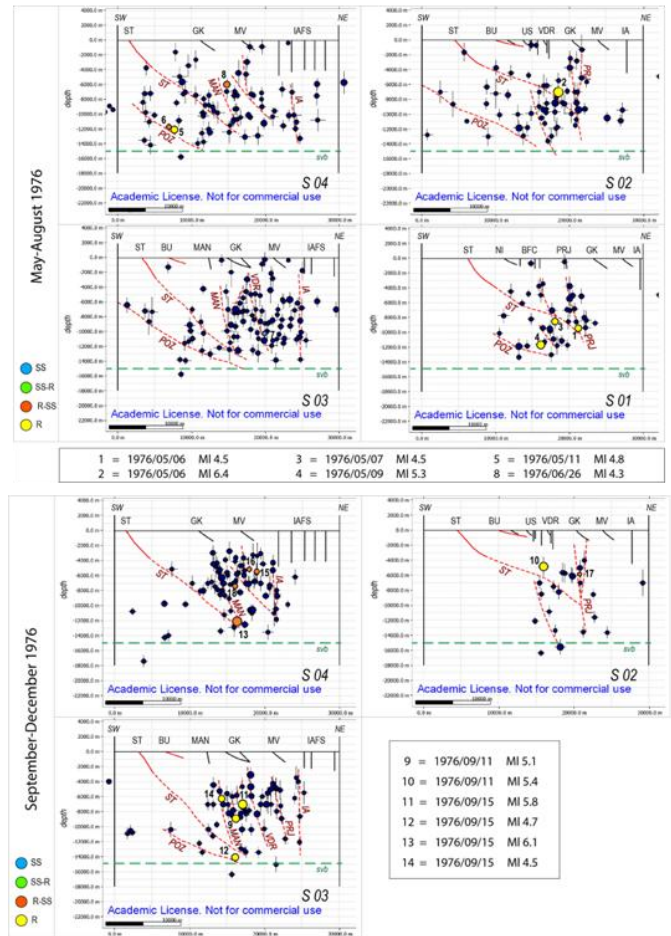
Fig.3. 3D structural model of the Susans-Tricesimo Thrust System (STTS), reconstructed through the interpretation of ENI seismic lines and interpolation of the elaborated 2D geological sections.

Patricelli et al. (2022)



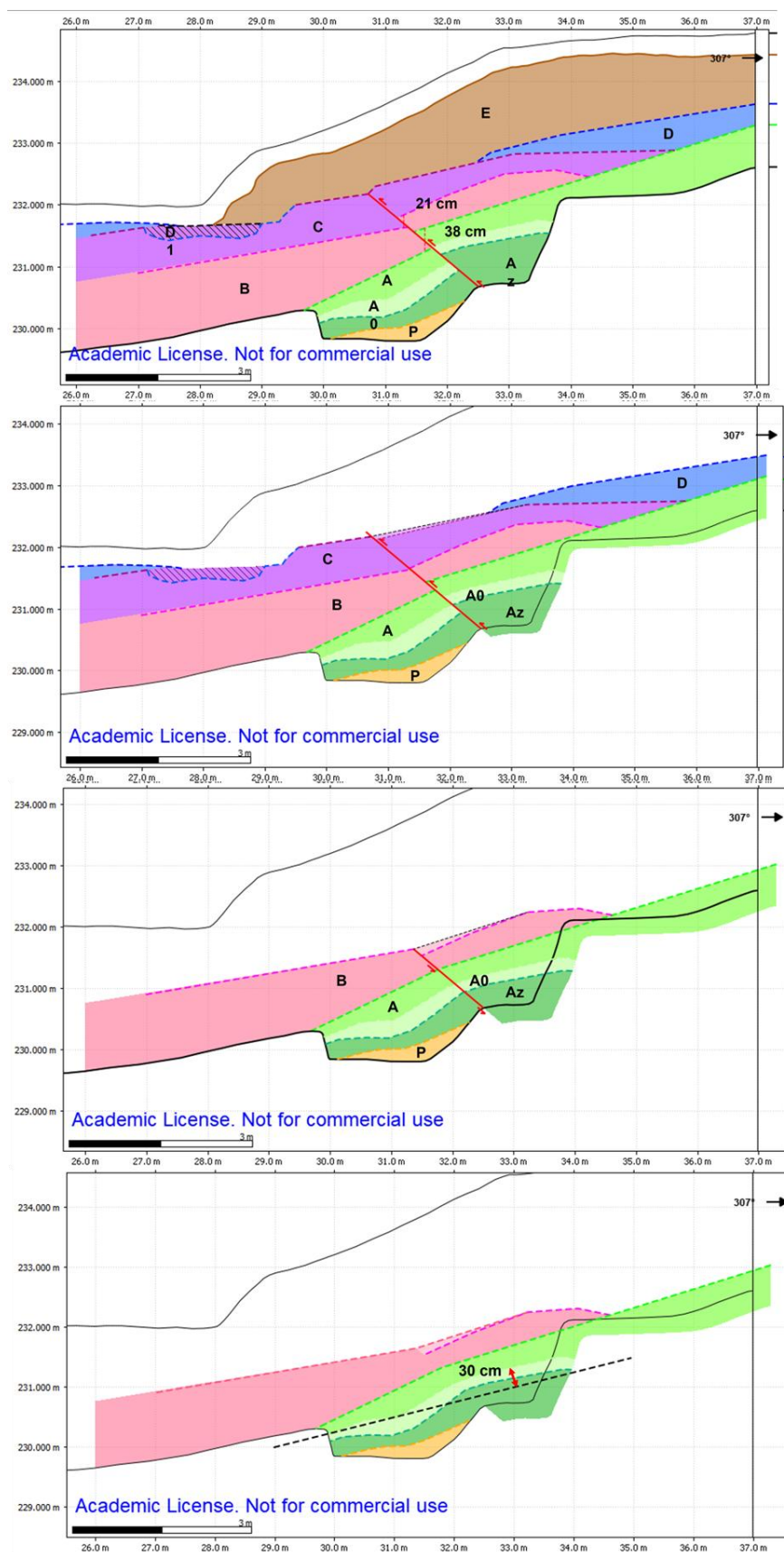
Patricelli et al. (2022)

Fig.4. Seriated sections crossing the Susans-Tricesimo Thrust System (STTS), realized for the analysis of the hypocentral seismicity distribution with respect to the reconstructed faults geometry.



2021: Seismotectonics of the Valdobbiadene-Vittorio Veneto Thrust, eastern Southern Alps.

During the last two years, in the framework of the Progetto di Microzonazione Sismica III livello, we realized 12 paleoseismological trenches in the Venetian Prealpine region. We digitalized in 3D Move the logs of the studied wall trenches on vertical sections. In a second stage, the restoration of the log sections allowed us to characterize the recent activity of the fault in terms of number of deformational events and slip per event. Furthermore, the comparison of the distinct trenches intersecting the same tectonic structure at different points was useful to characterize the recent activity of the tectonic structure also along its length.



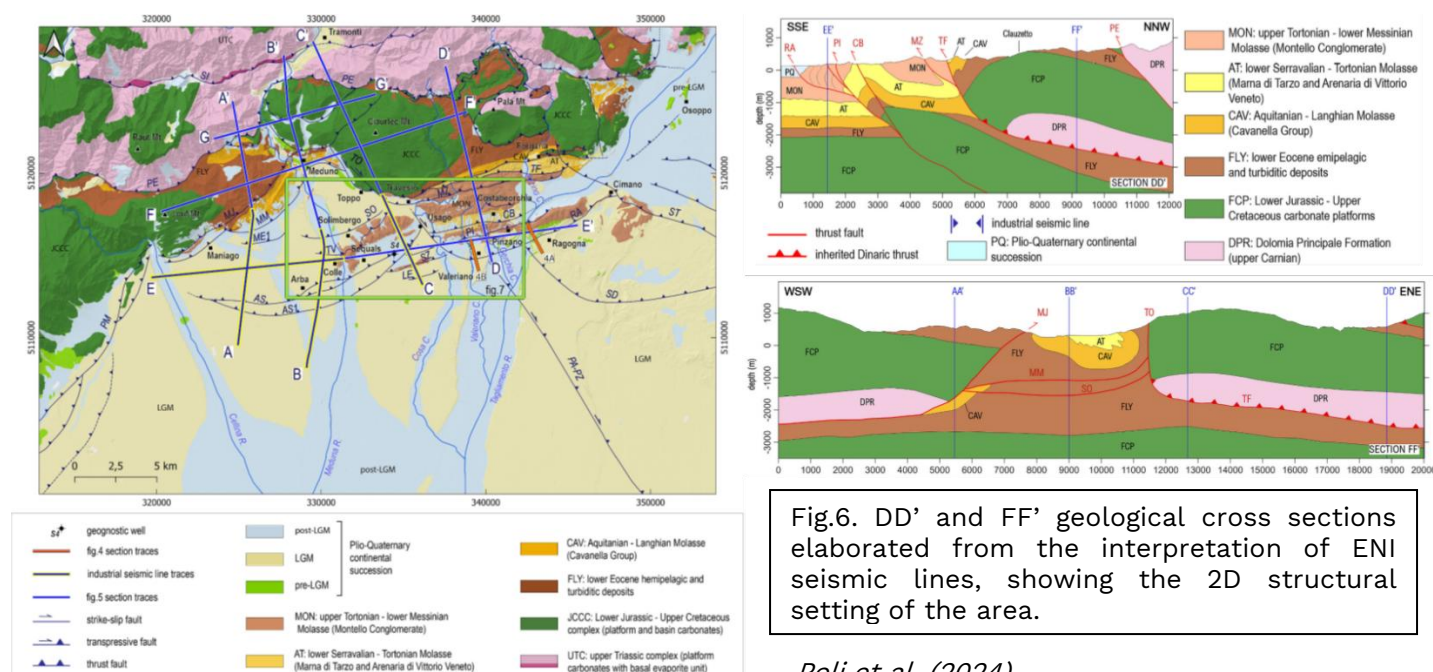
Poli et al. (in prep.)

Fig.5. Miane 3 trench restoration. Method: Fault Parallel Flow.

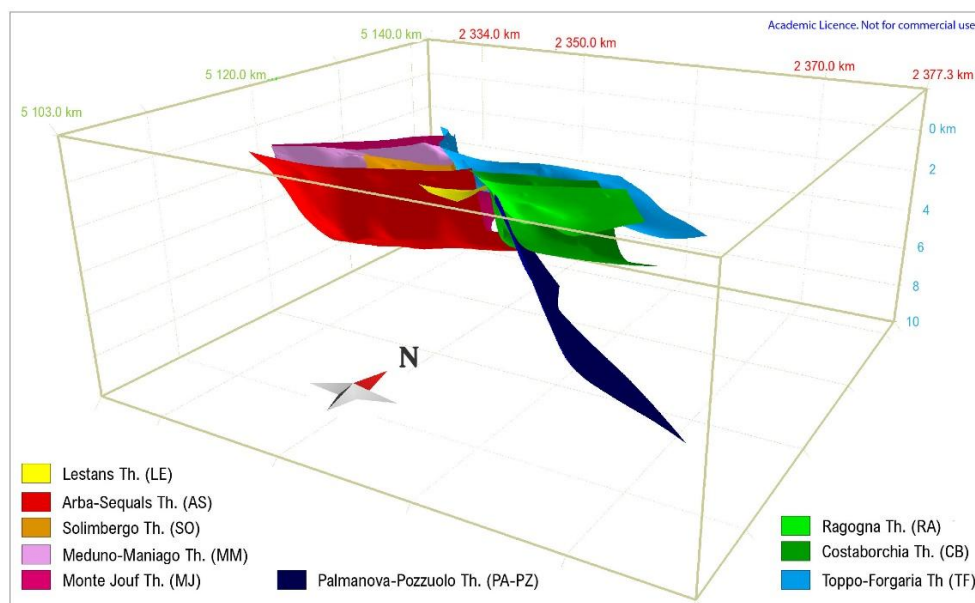
2022-2024: Reconstruction of the 3D structural model of the eastern Carnic prealpine active front (eastern Southern Alps, NE Italy) and definition of the seismogenic volumes for the estimation of the seismogenic potential of the area.

By integrating new geological and morphotectonic surface data with a revision of the ENI-Exploration & Production seismic lines, we reconstructed the 3D structural model and the polyphasic evolution of the Arba-Sequals and Ragogna Thrust Systems, representing the eastern portion of the Carnic prealpine active front (eastern Southern Alps-ESA, NE Italy). In a second step, we modelled and calculated the geological volumes comprised among the fault plane surfaces, corresponding to the crustal volume activated during the historical seismic catalogue's completeness time interval (CPTI15), and possibly representing the maximum potential seismic volume.

Our work, Poli et al. (2024) published in Tectonophysics, highlighted the importance of Paleogene structural inheritances, which have significantly influenced the current arrangement of the ESA thrust and fold belt, as well as its potential seismogenic behavior, supporting the segmentation of the Neoalpine external front.

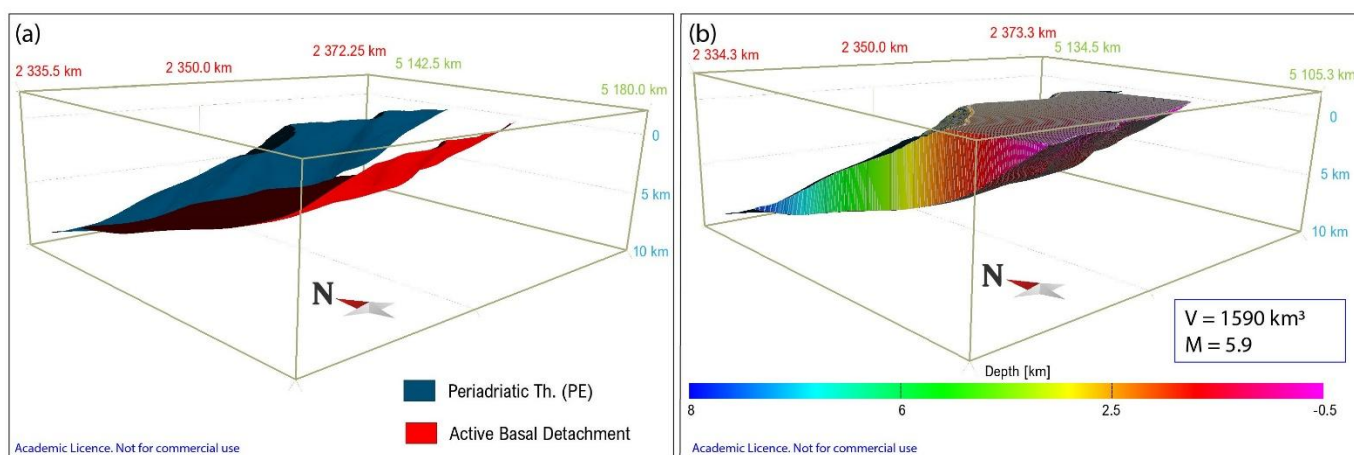


Poli et al. (2024)



Poli et al. (2024)

Fig.7. 3D structural model showing the reconstructed fault surfaces of the study area.



Poli et al. (2024)

Fig.8. (a) 3D tectonic surfaces defining the investigated crustal volume; (b) computed potential volume contained between the Periadriatic Thrust at the back and the Active Basal Detachment at the front.

2023-2024: PRIN2020-Project - multiscale analysis of the Polcenigo-Montereale Thrust System representing the western portion of the active Southalpine Carnic prealpine front (eastern Southern Alps, NE Italy).

As part of the NASA4SHA PRIN2020 Project titled “*Fault Segmentation and Seismotectonics of Active Thrust Systems: The Northern Apennines and Southern Alps as Laboratories for New Seismic Hazard Assessments in Northern Italy*,” we are currently focusing on the 3D characterization of the Polcenigo-Montereale Thrust System, which represents the active front of the SSE-verging Eastern Southalpine Chain (NE Italy).

Working in Move ambient we are able to integrate multiscale datasets, which include geological, geophysical, morphotectonic and paleosismological data, through the construction of balanced cross-sections across the active ESA front. This approach allows us to investigate the deep geometry of the Polcenigo-Montereale Thrust System, its propagation towards the surface, and to characterize its seismogenic behaviour.

The results obtained so far, presented last April at the EGU24 in Wien (Patricelli et al. 2024), show that the Polcenigo-Montereale Thrust System is composed of three main reverse fault planes: the Polcenigo-Montereale Thrust, the Budoia-Aviano Thrust (with its backthrust), and the Vigonovo Thrust. Considering the Holocene activation of the Budoia-Aviano backthrust, revealed by paleoseismological analysis, the multiscale approach allows us to characterize the seismogenic source/s associated to the PM Thrust System.

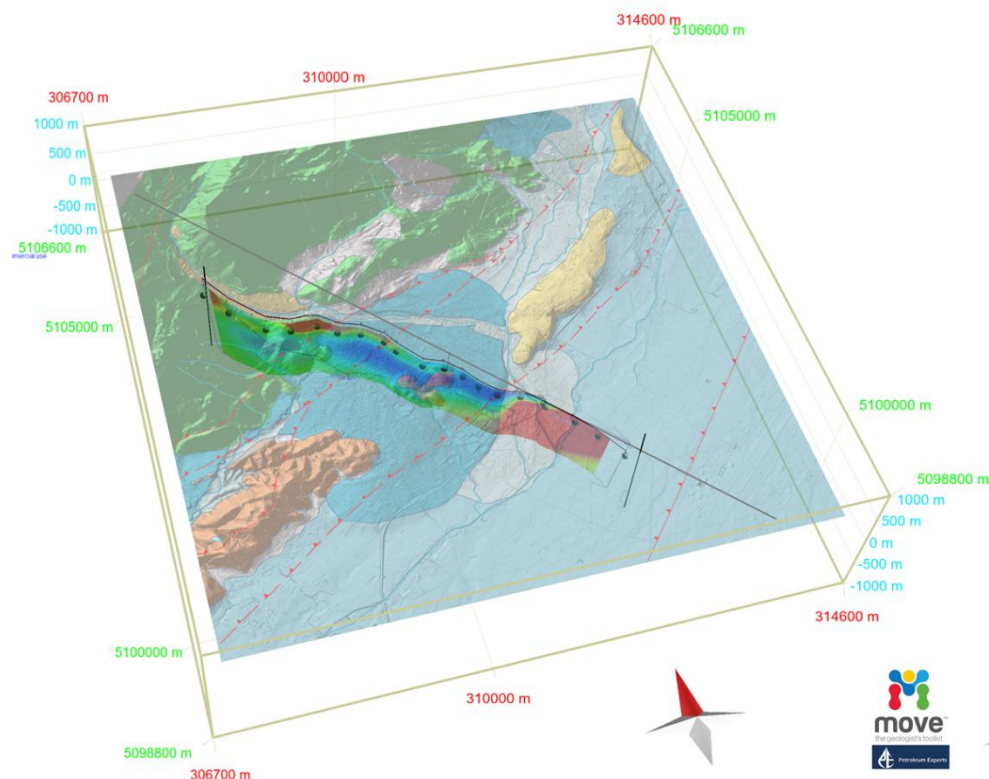
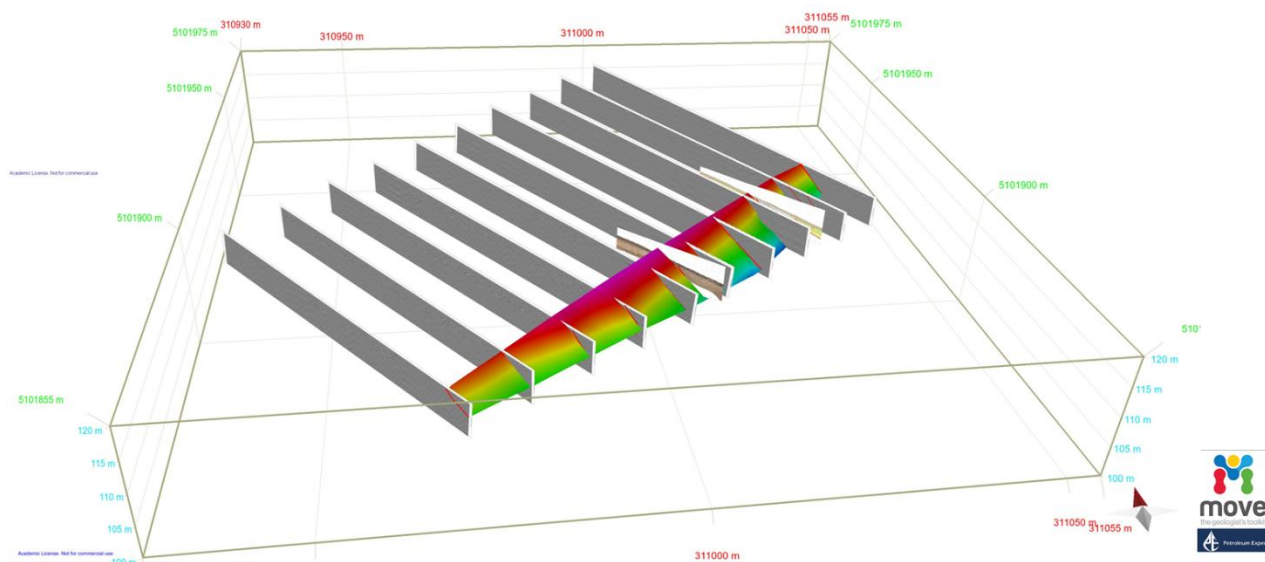


Fig.9. Multiscale geophysical survey conducted across the Polcenigo-Montereale Thrust System.

Patricelli et al. (2024)



Patricelli et al. (2024)

Fig.10. 3D geometry of the Budoia-Aviano backthrust reconstructed from geophysical and paleosismological data.

2024: CARG (Geological CARTography) Project – Sheet 084 “Vittorio Veneto”

In the framework of the CARG (Geological CARTography at the scale 1:50.000) Project managed by ISPRA (Istituto Superiore per la Protezione e la Ricerca Ambientale) we are currently working at the reconstruction of the subsurface mapping and 3D geological modelling of the Sheet 084-Vittorio Veneto.

In detail, our activities include the elaboration of geological cross sections derived from the interpretation of industrial seismic lines, calibrated with well logs, and integrated with other available geological and geophysical surficial and subsurface data. Starting from the geological cross sections, we will be able to reconstruct the 3D-model of the area. The database of the CARG-subsurface model will include the 3D surfaces of the mapped stratigraphic horizons and fault planes, and the 3D-volumes of the identified stratigraphic units.

2025: CARG Project – Sheet 084 “Vittorio Veneto”: Structural Modelling of the Montello Area

Within the national CARG Project managed by ISPRA, our 2025 activities focused on the reconstruction of the preliminary structural model of the Montello area, in the Venetian Prealpine sector (northeastern Italy).

Using *Move* software, we developed the 3D structural model by integrating surface geological data and subsurface information along four geological cross-sections (three NW–SE and one WSW–ENE oriented) (Fig. 1). Subsurface reconstruction was based on ENI and British Gas seismic data (provided by ISPRA), calibrated with well stratigraphies reaching up to 3700 m depth and intercepting Mesozoic carbonate successions. The time-to-depth conversion was performed on the interpreted seismic lines, allowing integration with geological field data derived from the ongoing geological survey of the CARG Sheet 084 (Vittorio Veneto) and from published datasets (CARG 083 – Belluno).

The results highlight the segmentation of the Montello–Conegliano Thrust System, which forms part of the external front of the eastern Southern Alps. Two main tectonic structures were identified — the Montello–Arcade and Conegliano systems — exhibiting distinct geometries and structural behaviors. These findings provide new constraints on the geometry and seismotectonic setting of the Venetian Prealpine front.

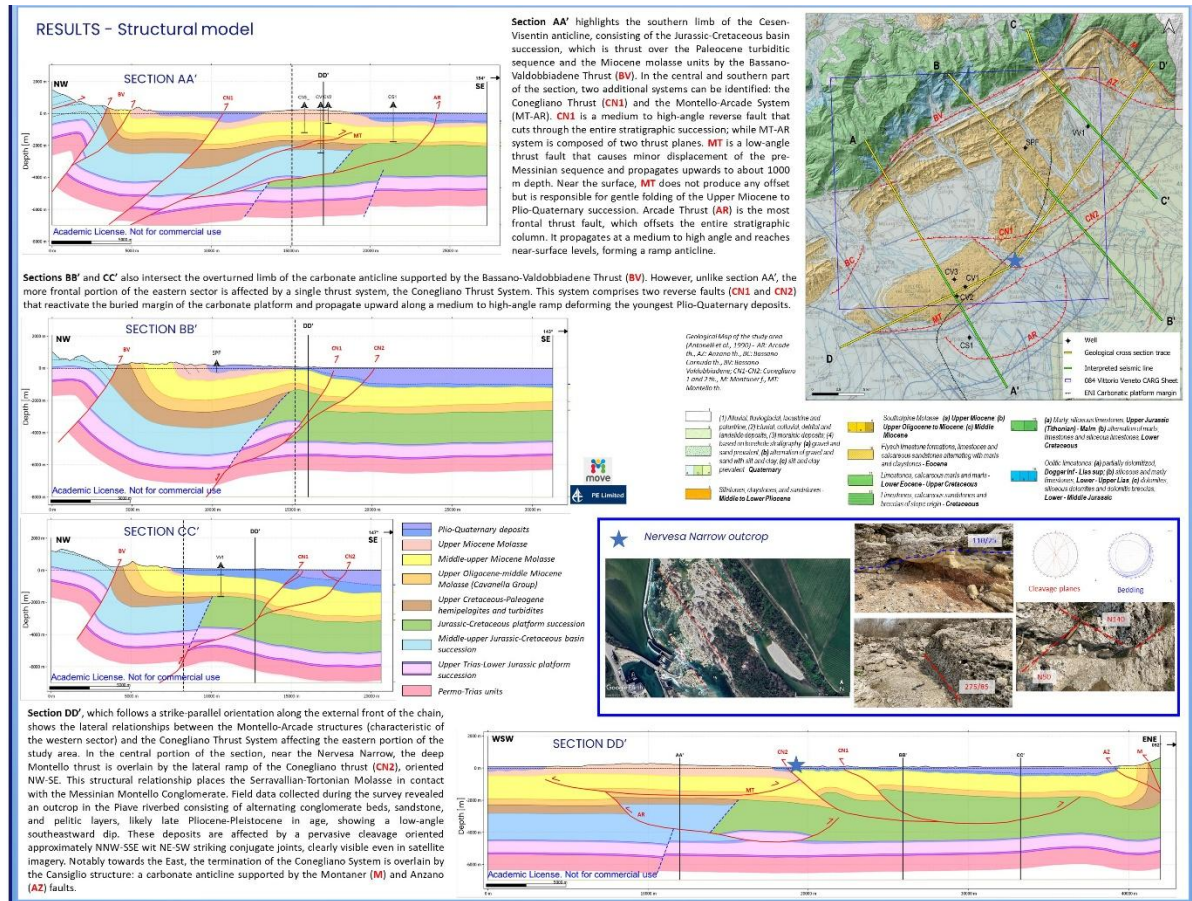


Fig.11. Geological cross sections of the Montello area, obtained from time-to-depth conversion of industrial seismic lines and highlighting the segmentation of the Montello-Conegliano Thrust System (from Patricelli et al., 2025).

In the next phase, the research will focus on the integration of the spatial distribution of instrumental and historical seismicity with the reconstructed 3D structural model. The *Move* environment will be essential for the 3D visualization of hypocentral data and for correlating seismicity with the modeled tectonic structures, in order to investigate the seismogenic potential of the identified fault systems.

Multiscale analysis of the Polcenigo-Montereale Thrust System (eastern Southern Alps, NE Italy)

In parallel with the CARG activities, the research group is further developing the multiscale characterization of the Polcenigo-Montereale Thrust System, first undertaken in the framework of the PRIN Project “NASA4SHA”. The investigated thrust system represents the active Carnic Prealpine front of the SSE-verging Eastern Southalpine Chain in NE Italy (Fig. 2).

Particularly, during 2025, the research specifically focused on the characterization of the frontal Budoia–Aviano Thrust, onto which the previously investigated backthrust is rooted. The multiscale analysis integrates morphotectonic, geophysical, and paleoseismological data (Fig. 3). The *Move* software environment was crucial for managing and integrating these heterogeneous datasets, allowing their spatial correlation within a 3D geological framework. The approach combines:

- morphotectonic analysis, including detailed topographic interpretation and geomorphic markers of surface deformation;
- geophysical surveys interpretation (reflection seismic profiles, electrical tomography ERT and ground penetrating radar GPR) used to define subsurface fault geometries;
- paleoseismological trenching and stratigraphic correlation, constraining Holocene displacements and recent fault activity.

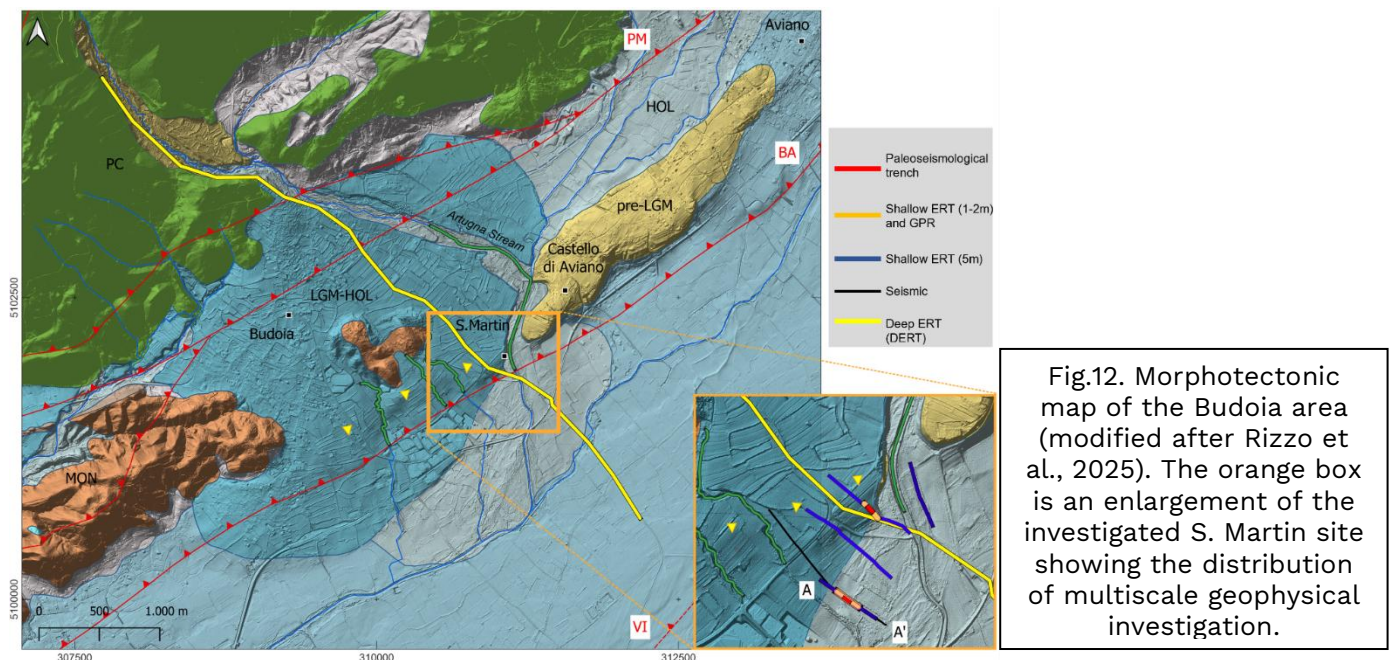


Fig.12. Morphotectonic map of the Budoia area (modified after Rizzo et al., 2025). The orange box is an enlargement of the investigated S. Martin site showing the distribution of multiscale geophysical investigation.

The integration of these data in *Move* is currently enabling a coherent 3D reconstruction of the Budoia–Aviano thrust system, highlighting the relationships between subsurface fault propagation, surface deformation, and seismogenic potential; these studies are ongoing and will be further developed in the next future.

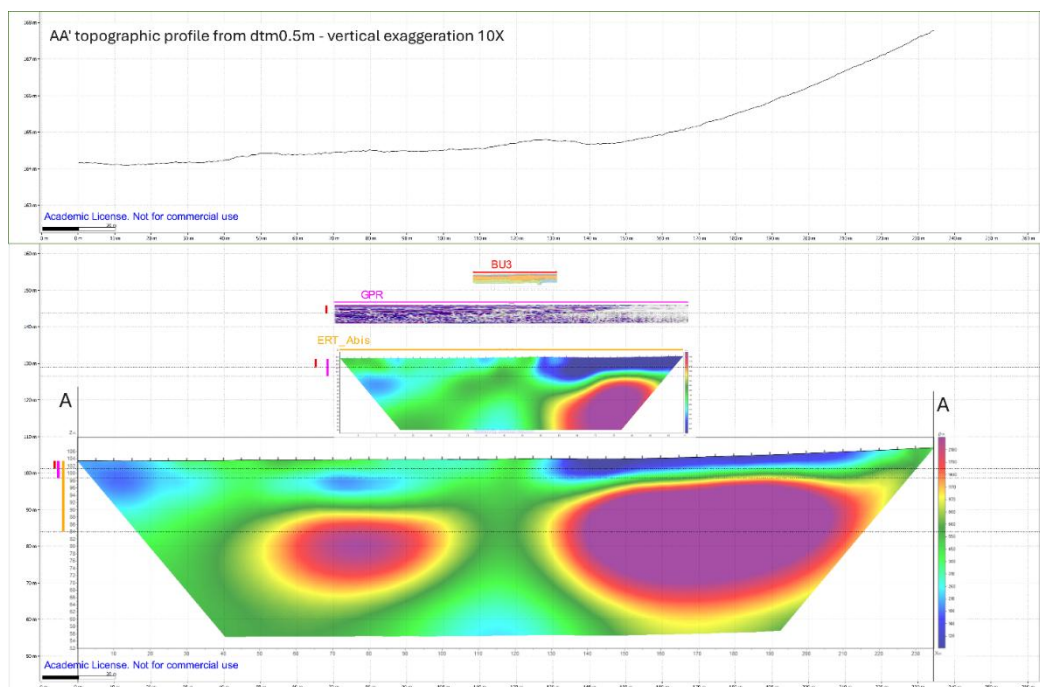


Fig.13. Multiscale analysis on section AA' (see location in Fig. 12).

THESIS PROJECTS:

- Master's degree thesis in Scienze e Tecnologie per l'Ambiente e il Territorio entitled "3D reconstruction of the active faults characterizing the epicentral area of 1976 earthquake", March 2020. Supervisor: Prof.ssa Maria Eliana Poli, Student: Leonardo Ronchiadin.
- PhD Thesis in Life Sciences (XXXIII cycle) entitled "Seismotectonic characterization of the Southern Alps-Dinarides junction area (NE Italy)", October 2021. Supervisor: Prof.ssa Maria Eliana Poli, PhD Student: Giulia Patricelli.

PUBLICATIONS

- Patricelli G., Poli M.E., 2020. *Quaternary tectonic activity in the north-eastern Friuli Plain (NE Italy)*. Bollettino di Geofisica Teoria ed Applicata, **61 (3)**, pp. 309-332. DOI 10.4430/bgta0319.
- Patricelli, G., Poli, M. E., & Cheloni, D., 2022. *Structural Complexity and Seismogenesis: The Role of the Transpressive Structures in the 1976 Friuli Earthquakes (Eastern Southern Alps, NE Italy)*. Geosciences, **12(6)**, 227, <https://doi.org/10.3390/geosciences12060227>.
- Patricelli G., Poli M.E., Monegato G., Zanferrari A. (**SUBMITTED TO MISCELLANEA INGV**). *Segmentation of the external front of the Eastern Southern Alps: the Arba-Ragogna case study (NE-Italy)*.
- Poli, M. E., Patricelli, G., Monegato, G., & Zanferrari, A., 2024. *Structural inheritances, fault segmentation and seismogenic potential at the front of the eastern Southern Alps (central Carnic Prealps, NE Italy)*. Tectonophysics, **883**, 230390, <https://doi.org/10.1016/j.tecto.2024.230390>.

- Poli M.E., Patricelli G., Falcucci E., Gori S., Rizzo E., Paiero G., Marchesini A., Franceschet A., Russo D., Boldrin P., Sobbe A., Caputo R. (**SUBMITTED TO MISCELLANEA INGV**). *Recent tectonic activity of the Budoia-Aviano Thrust: the example of the Late Pleistocene-Holocene Artugna alluvial fan (eastern Southern Alps, NE Italy)*.
 - Rizzo E., Poli M.E., Patricelli G., Giampaolo V., De Martino G., Mucchi F., Marchesini A., Boldrin P., Bonali F.L., Caputo R. (**SUBMITTED TO MISCELLANEA INGV**). *Deep and Shallow Electrical Resistivity Tomography on the Budoia-Aviano Thrust (NE Italy)*.
- Papers in prep:

- Poli M.E., Patricelli G., Paiero G., Marchesini A. "Historical tectonic activity along the eastern segment of the Bassano-Valdobbiadene thrust: new hints for the seismic hazard assessment of the Venetian Prealps between Vittorio Veneto and Valdobbiadene (eastern Southern Alps, NE Italy)".

PRESENTATIONS

- **Poster presentation at EGU General Assembly 2019.**

Patricelli G., Poli M.E., "3D geometry of Ne-Friuli Quaternary faults (NE Italy)".

<https://meetingorganizer.copernicus.org/EGU2019/EGU2019-15489.pdf>.

- **Poster presentation at CRUST Interdisciplinary Workshop in memory of Giampaolo Piali "Tools, data and models for 3D seismotectonics: the Italian over time laboratory" 2019.**

Patricelli G., Poli M.E., "3D geometry of the buried Quaternary faults in the NE Friuli Plain".

https://www.crust.unich.it/sites/st17/files/crust_workshop_programme_finale.pdf.

- **Oral presentation at the Congresso Nazionale SIMP-SGI-SOGEI Parma 2019. "Il tempo del pianeta Terra e il tempo dell'uomo: le geoscienze tra passato e futuro".**

Patricelli G., Poli M.E., "Seismotectonic characterization of active faults in the LGM Plain between Udine and Pozzuolo (Friuli, NE Italy)".

<http://parma2019.socminpet.it/index.php/abstracts/elenco-abstracts>.

- **Oral presentation at the GNGTS 2021 June 2021.**

Poli M.E., Patricelli G., Paiero G., Marchesini A., "Indagini paleosismologiche al fronte delle Alpi Meridionali orientali: nuovi dati sull'attività tettonica di epoca storica del sovrascorrimento Bassano-Valdobbiadene (Italia NE)."

- **Two oral presentations at the 90° Congresso della Società Geologica Italiana "Geology without borders" September 2021:**

Poli M.E., Paiero G., Patricelli G., and Marchesini A., "Historical tectonic activity of the Valdobbiadene-Vittorio Veneto thrust (NE Italy)".

https://www.socgeol.it/files/download/pubblicazioni/Abstract%20Book/Abstract%2090mo%20Congresso%20SGI_DEF.pdf.

Patricelli G., Poli M.E., Paiero G., Zanferrari A., Marchesini A. and Monegato G., "New evidence of recent tectonic activity of the Susans-Tricesimo thrust-system (NE Italy)".

https://www.socgeol.it/files/download/pubblicazioni/Abstract%20Book/Abstract%2090mo%20Congresso%20SGI_DEF.pdf.

- **Poster presentation at EGU General Assembly 2024.**

Patricelli, G., Poli, M. E., Falcucci, E., Gori, S., Paiero, G., Rizzo, E., Marchesini, A., and Caputo, R. "First evidence of Holocene activity and surface displacement of the Budoia-Aviano Thrust System in north-eastern Italy, unravelled through the integration of geological, geophysics and paleoseismological analyses". <https://doi.org/10.5194/egusphere-egu24-16527>.

- **Oral presentation at the GNGTS 2024 February 2024.**

Poli M.E., Patricelli G., Falcucci E., Gori S., Paiero G., Rizzo E., Marchesini A., Caputo E. "New paleoseismological evidence of coseismic surface rupture across the Carnic prealpine front (NE Italy): the Budoia-Aviano Thrust System".

- **Poster presentation at the GNGTS 2025 February 2025.**

Patricelli, G., Stefani, C., Monegato, G., Mozzi, P., Rettig, L., Rossato, S., Toffolon, G., Crocitto, L., & Poli, M. E. (2025). "Revisiting the Montello Thrust (Venetian Prealps, NE Italy): evidence for segmentation from the geological mapping of the Vittorio Veneto Sheet in the framework of the CARG Project".

<https://www.socgeol.it/files/download/pubblicazioni/Abstract%20Book/Abstract%20Congresso%20SGI-SIMP%202025-5.pdf>