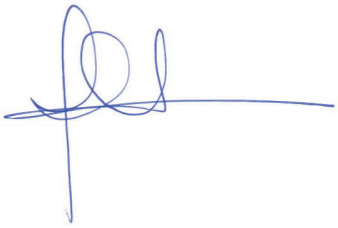
9th-11th JULY 2024

DRT-2024 PROGRAMME AND ABSTRACT BOOK

24th International Conference on Deformation mechanisms, Rheology and Tectonics (DRT-2024)

This booklet contains the scientific programme and the abstract book of the DRT-2024 conference. We thank the members of the scientific and organising committees, the keynote speakers, session chairs, and all the participants for their contributions.
We hope you enjoy the conference and cultural delights of Barcelona.

Welcome!



María Gema Llorens (on behalf of the organising committee)

More information at: https://drt-society.org/conferences/barcelona-2024/

Conference Programme

Monday 8th July

15:00-18:30 Workshops Uncertainty / Analogue modelling

18:30 **POSTER SESSION A + ICEBREAKER PARTY**

Tuesday 9th July

9:00-9:15 **DRT conference opening**

ORAL PRESENTATIONS: *Chairs Manish Mamtani and Maria Gema Llorens*

9:15-9:45 Solicited Talk: Finch et al. *Microstructural evolution of ductile shear zones during tectonic switching*

9:45-10:00 Grujic et al. *Kinematics of eclogite during the Alpine orogeny: A comparative study of the Adula nappe and Cima Lunga unit*

10:00-10:15 Ahmed et al. *Deformation of mid-crustal granitoids within extensional shear zones: An example from the Abu Markhat granitoids, Arabian-Nubian Shield*

10:15-10:30 Dey et al. *The role of Dauphiné Twin Boundaries on grain boundary misorientation and energy distribution in quartz* **ONLINE**

10:30-10:45 Zhang et al. *Quartz enhances frictional strength in dolomite fault gouge*

10:45-11:15 **POSTER SESSION A + COFFEE BREAK**

ORAL PRESENTATIONS: *Chairs Melanie Finch and Albert Griera*

11:15-11:30 Mamtani et al. *Nanostructures in minerals in the kinematic reference frame of deformed rocks – an integrated SEM-TEM study and its implications for structural geology research*

11:30-11:45 Mameri et al. *Mid-crust rheologic variation along the Alpine Fault* **ONLINE**

11:45-12:00 Hao et al. *Dynamic recrystallization during visco-plastic deformation of halite polycrystals: full-field simulation of simple shear versus pure shear*

12:00-12:15 Moreno et al. *Microstructural Dynamics in Ice Cores During Abrupt Climate Events*

12:15-12:30 Bons et al. *Folding of intrinsically anisotropic rocks*

12:30-12:45 Koenemann. *Physics of anisotropic loading: shear dilation, a new thermodynamic state function, and its effects in fracture and petrology*

12:45-14:00 **LUNCH**

ORAL PRESENTATIONS: *Chairs Johanna Heeb and Paul Bons*

14:00-14:15 Gridin and Ostapchuk. *On reaviling of tectonic fault behaviour* **ONLINE**

14:15-14:30 Schrank et al. *Synchrotron X-ray Backscatter Diffraction Microscopy (XBDM) and X-ray Fluorescence Microscopy (XFM) for the rapid microstructural and -chemical characterization of deformed rocks*

14:30-14:45 Ribeiro et al. *Major element and isotope diffusion through dislocation networks in deformed garnet*

14:45-15:00 Das Kaushik et al. *Dislocation microstructures of garnet in pseudotachylyte: Implications on thermal effect, and recovery rates during seismic slip in shear zone*

15:00-15:15 Olesch-Byrne et al. *The role of fluid migration in a mylonitic shear zone in REE ore deposit formation*

15:15-15:30 Carpenter et al. *Strain initiation by localised fluid influx in the mid crust: A case study from the Upper Badcall shear zone, NW Scotland*

15:30-16:00 **POSTER SESSION A + COFFEE BREAK**

ORAL PRESENTATIONS: *Chairs Daniel García Castellanos and Montse Torné*

16:00-16:15 Jiménez-Munt et al. *Upper mantle characterization and geodynamics of Western Central Mediterranean region, from an integrated geophysical geochemical modelling*

16:15-16:30 Regorda and Roda. *Thermo-mechanical effects of microcontinent collision on ocean-continent subduction system*

16:30-16:45 Vilacis et al. *Continental dynamic topography inferred from global hiatus surfaces since the Upper Jurassic*

16:45-17:00 Hussain Waqas et al. *Enhancing Geological Modeling through Seismic Data Integration in PZero Software*

17:00-17:15 PLENARY DISCUSSION

17:15-17:30 DRT CONFERENCE UPDATE

17:30-19:00 **POSTER SESSION A + EVENING RECEPTION**

Wednesday 10th July

9:00-9:15 DRT conference update

ORAL PRESENTATIONS: *Chairs Mark Jessell and Sergio Llana Fúnez*

9:15-9:45 Solicited Talk: Baratoux et al. *Geodynamic evolution of the West African Craton*

9:45-10:00 Koffi et al. *A tectonic model for the juxtaposition of granulite- and amphibolite-facies rocks in the Eburnean orogenic belt (Sassandra - Cavally domain, SW Côte d'Ivoire)*

10:00-10:15 Moreno-Martín et al. *Reconstruction of the different stages of the Cadomian peri-Gondwanan arc based on structural data in SW Iberian Massif*

10:15-10:30 Caxito et al. *Near-synchronous evolution of the 6,000 km-long, transcontinental Transbrasiliano-Kandi-4°50' shear zone system during western Gondwana assembly*

10:30-10:45 Li et al. *Deformation decoupling and thermal evolution across different crustal levels along an arc-arc collisional zone in Central Asia*

10:45-11:15 **CHANGE POSTERS FROM SESSION A TO B + COFFEE BREAK**

ORAL PRESENTATIONS: *Chairs Djodje Grujic and Lenka Baratoux*

11:15-11:30 Díez- Fernández et al. *Late Variscan faults and the exhumation of high-pressure rocks (SW Iberian Massif)*

11:30-11:45 Del Sole et al. *Understanding fault architecture evolution in space and time: new structural, geochronological and thermal constraints from the Carboneras Fault (SE Spain)*

11:45-12:00 Wu and Hong. *Formation mechanism and physical simulation of segmented overlays of the depth strike-slip faults in Tarim basin*

12:00-12:15 Bistacchi et al. *Update and appraisal on multi-scale post-metamorphic brittle tectonics in the Pennine Alps of Valle d'Aosta*

12:15-12:30 Caso et al. *Melt pathways in the lower continental crust from map- to microscale: combined quantitative multidisciplinary approach applied in the Valpelline Series (Western Alps)*

12:30-12:45 Vignaroli et al. *Crustal shortening in the Eastern Southern Alps (Italy): results from the Valsugana and Belluno thrust zones*

12:45-14:00 **LUNCH**

ORAL PRESENTATIONS: *Chairs Andrea Bistachi and Ruben Díez Fernández*

14:00-14:15 Ortolano et al. *Quantitative meso- and micro-structural analysis of the meso-Alpine mylonites of the southern Calabrian Peloritani Composite Terrain: a contribution in unravelling the western Mediterranean microplates kinematics*

14:15-14:30 Papeschi et al. *Shearing and exhumation of carbonated serpentinites on the Island of Elba subduction channel (Northern Apennines, Italy)*

14:30-14:45 Maresca et al. *Integrating rift inheritance in a slab pull/trench retreat system through a crustal balanced cross-section of the central Apennine*

14:45-15:00 Najafi et al. *Role of pre- and syn-obduction depositional units during the Semail ophiolite tectonic emplacement*

15:00-15:30 PLENARY DISCUSSION

15:30-16:00 **POSTER SESSION B + COFFEE BREAK**

ORAL PRESENTATIONS: Chairs Ivone Jimenez Munt and Giulio Viola

16:00-16:15 Cheng et al. *Boudinage and folding of oblique single layers in bulk constrictional strain fields: Results from analogue modelling*

16:15-16:30 Arachchige et al. *Lithospheric scale analogue modelling of rifting and inversion: The effect of the degree of obliquity*

16:30-16:45 Withers et al. *Can tectonic-scale analogue models explain the structural complexity of the 2016 Mw 7.8 Kaikōura earthquake?*

16:45-17:30 **DRT SOCIETY GENERAL ASSEMBLY**

17:30-19:00 **POSTER SESSION B + EVENING RECEPTION**

20:00 CONFERENCE DINNER (RESTAURANT MUSSOL ARENAS) -
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Thursday 11th July

9:00-9:15 DRT Conference update

ORAL PRESENTATIONS: *Chairs Antonio Teixell and Pablo Granado*

9:15-9:30 Heydarzadeh and Bastami. *Diapiric activity within the outcropped Miocene evaporites, the northern Central Iran* **ONLINE**

9:30-10:00 Solicited Talk: Vergés et al. *The role of evaporitic detachment levels in shaping the structure of orogenic fold belts based on field examples*

10:00-10:15 Závada et al. *Caprock shapes salt extrusions in the Zagros Fold and Thrust Belt*
(Iran)

10:15-10:30 Cofrade et al. *Fracture system characterization across welds and minibasins: the Azag Minibasin field analog (High Atlas, Morocco)*

10:30-10:45 Heeb and Hangx. *Evolution of mechanical and transport properties of rock salt under simulated cavern wall conditions during cyclical hydrogen storage*

10:45-11:15 **POSTER SESSION B + COFFEE BREAK**

ORAL PRESENTATIONS: *Chairs Gaetano Ortolano and Enrique Gomez-Rivas*

11:15-11:30 Asti et al. *Structural evolution of a post-orogenic, intermontane fault system: an example from the Martana Fault System (Northern Apennines, Italy)*

11:30-11:45 Di Luzio et al. *Tectonic and slope-scale gravitational deformation in orogenic belts: New insights from regional inventories in central Appennines (Italy)*

11:45-12:00 Medina-Cascales et al. *Active fault control in Plio-Quaternary gypsum veins (the Galera Fault, S Spain)*

12:00-12:15 Tekin et al. *Quantitative Tectonic Activity Assessment of Manisa Fault: A multi-dimensional approach*

12:15-12:30 García-Castellanos et al. *Thermomechanical modelling of uplift during lithospheric slab tearing and its topographic impact on S Iberia basins*

12:30-12:45 PLENARY DISCUSSION

12:45-14:00 **LUNCH**

ORAL PRESENTATIONS: *Chairs Christoph Schrank and Riccardo Asti*

14:00-14:15 Wintsch et al. *Diffusion and reaction creep in a “fluid absent” retrograde phyllonite zone*

14:15-14:30 Rocca et al. *U-Pb carbonate dating as a tool to unravel complex fault evolution: anexample from the central Southern Alps (Italy)*

14:30-14:45 González-Esvertit et al. *Coupled mylonitization and giant quartz vein formation in the basement of the Pyrenees*

14:45-15:00 Vidal-Reyes et al. *Monazite bearing syntectonic veins: processes and timing during low-T deformation in the Mexican Orogen*

15:00-15:15 Schirripa et al. *Structural control on the upwelling of fluids from the Val d'Agri hydrocarbon reservoir (Southern Italy)*

15:15-15:30 PLENARY DISCUSSION

15:30-16:00 **PICK UP POSTERS + COFFEE BREAK**

ORAL PRESENTATIONS: *Chairs Eugenio Fazio and Juan Alcalde*

16:00-16:15 Portes, Jessell et al. *Combining feature engineering with non-linear projection to navigate geophysical data*

16:15-16:30 Carola et al. *The El Tordell thrust and Súria Anticline fracture pattern characterized using fieldwork and 3D digital outcrops*

16:30-16:45 Benedetti et al. *Scale independent unbiased statistical length analysis of linear features: Adapting survival analysis techniques to geological applications*

16:45-17:00 Casiraghi et al. *Quantitative parametrization of fracture networks Digital Outcrop Model: a complete workflow*

17:00-17:15 Ramirez-Perez et al. *Salt-embedded basins in energy transition. Characterization of the sedimentary succession of the Estopanyà and Boix synclines (South-Central Pyrenees) as outcrop analogues for CCS and geothermal reservoirs*

17:15-17:30 DRT PLENARY DISCUSSION

17:30-17:45 **DRT awards and closing ceremony**

POSTER SESSION A:

Corvò et al. *Even strong materials can weak: heterogenous microstructural behaviour of amphibole and clinopyroxene from a middle crustal shear zone*

Yokohama and Nagahama. *Strain hardening due to calcite twin based on some interface theories*

Griera and Lebensohn. *Microstructure evolution during deformation of polycrystalline aggregates: full field mechanical approach coupling dislocation and diffusion creep*

Llorens et al. *Fabric-induced anisotropy in polar ice: a comparison between natural samples and viscoplastic numerical models*

Muto et al. *Probing high-strain rate deformation by impact experiments and fractal analysis of brittle fault rocks*

Kuehn et al. *Deformation in accretionary wedge sediments – the Papaku fault example*

Das Kaushik et al. *Structural, petrological and geochronological records of closure of Permian back-arc basin: Proto-Japan and its relation to NE Asian tectonics*

Ahmed and Piazolo, *Grain size insensitive deformation mechanism of naturally deformed amphibolite in the middle crust: An example from the Abu Markhat shear zone, Arabian-Nubian shield.*

Kilian and Stipp. *Microstructure-based decomposition of quartz CPO*

Huang et al. *CPO and quantitative textural analyses within slip zone from carbonate fault rock*

Kone et al. *Microstructures of the ductile Sassandra shear zone, separating the Archean cratonic nucleus and the Palaeoproterozoic crust in NW Côte d'Ivoire, West African Craton*

Laurich et al. *Deformation Indicators in Compacted Salt: Differences in Laboratory and Real Use Cases*

McGill et al. *Micro-porosity found in quartz shear bands from Ikaria, Greece: implications from Hyperspectral Cathodoluminescence and Electron Backscatter Diffraction*

Cruset and Vergés. *Isotopic dating of fracture-filling and sedimentary carbonates constraining the tectonic compression in the Neuquén Basin, Andean fold and thrust belt*

Finch, Olesch-Byrne et al. *Rheology modification in subduction channels due to eclogite facies metasomatism (Rocky Beach Metamorphic Mélange, Port Macquarie, Australia)*

Schrank et al. *Evidence for stress-reaction coupling during the growth of antitaxial fibrous veins from X-ray Fluorescence Microscopy*

Papeschi et al. *Geologic and metamorphic constraints on magma emplacement to validate regional seismic tomography of Tuscany (Project MIGRATE)*

Finch et al. *Porosity changes in shear zones during tectonic switching*

Gomez-Rivas et al. *Formation of gypsum vein networks in a deformed zone: insights from the Montsant anticlinorium (Catalan Coastal Ranges)*

Fatihi and Samsu. *Mapping of Geological Fractures: A CNN Approach*

Clarke et al. *Quantifying Resolution of Digital Outcrop Models using Synthetic Test Objects*

Mayolle et al. *Fault process/damage zones in porous carbonates: first analyses of Ta'Cenc faults, Gozo island*

González-Esvertit et al. *Evaporites for the sustainable exploration and appraisal of mineral resources and Geo-Energy applications: the Iberian Evaporite Structure Database (IESDB)*

Vidal-Reyes et al. *Geothermal potential near the Alps-Apennines tectonic limit: an integrative perspective*

Fazio et al. *Strain analysis of intrusive rocks using field measurements and 3D virtual outcrop models*

Fazio et al. *An integrated multiscale approach, from microfabric analysis to field- and UAV surveys of mylonites (Calabria, Italy)*

POSTER SESSION B:

Giraldo. *Miocene soft-sediment deformation structures around Madrid (Spain)*

Guardia et al. *Mechanical and geometrical controls on fold/thrust nappes: insights from numerical simulations applied to the Eaux-Chaudes fold nappe (Alpine W Pyrenees)*

Bakhtbidar et al. *Salt Dynamics in Rifted Margins: Insights from Numerical Modeling*

Cocco et al. *Numerical modelling of the Sardinia-Corsica block lithosphere*

Cocco et al. *Influence of inherited superposed folding in the structural style of fold-and-thrust belts (FTB)*

Whiters et al. *A baseline model for fault development across transpressive plate boundaries*

Zhang et al. *Deep mantle anomalies and their surface dynamic topographic response*

Krýza et al. *Influence of caprock on shallow deformation in salt diapirs – insights from numerical and analogue modelling*

Biswas et al. *Complete Dyke Dimensions from Incomplete Outcrops*

Das and Mondal. *Deciphering stress state condition at the base of seismogenic zone: Insights from fractured feldspar porphyroclast and fault slip data from Neoarchean Closepet granite, India*

Amabile et al. *The Variscan basement in the southern Corsica (France): the tectono-metamorphic evolution of the high-grade metamorphic rocks of Fautea-Favone complex*

Amarir et al. *Determination of the tectonic evolution from brittle structures, and calcite twins on an intracontinental belt: Western High Atlas (WHA), Morocco*

Granado et al. *Basement - Cover superposed folding in the Pyrenean Axial Zone*

Piloni et al. *Structural and metamorphic evolution of the tectonic mélanges in the Alpine Subduction Complex (Piemonte – Sesia-Lanzo Zone boundary, Western Italian Alps)*

Stipp et al. *The interplay of transpression and metamorphic doming in the southwestern Tauern Window*

Llana-Funez et al. *Seismic patterns in NW Iberian peninsula and their relation to crustal structure*

Maity et al. *The Role of Progressive Riedel Shear Dynamics in the Disposition of Ductile Shear Zones in Granitoids: A Field Geologists' Perspective from the Bundelkhand Craton, India*

Monti et al. *3D Geomodelling of Alpine Structures with PZero: the Misox Shear Zone (Swiss)*

Moreno-Martín et al. *Onset of Variscan deformation in SW Iberia: constrains from structural data and implications for paleogeographic reconstructions*

Díez Fernández et al. *An Alpine megafold in Central Iberia*

Espinoza et al. *Pre-Cenozoic brittle deformation in the southern Central Andes: K-Ar Illite dating of fault gouges suggest pre-straining of crust in the region of the Andean Plateau and Eastern Cordillera*

Serrano-López et al. *Structure, microstructure and kinematics of the Tonalá-Escuintla shear zone in southern Mexico*

Parui and Bhattacharyya. *Documenting climate-induced deformation in the Himalayan orogenic belt*

Parui et al. *Unraveling the structural evolution of the Yeneena basin hosting Cu deposits: Preliminary results*

Arachchige et al. *Magma solidification effects during sill emplacement: insights from laboratory experiments*

Najafi et al. *Timing of deformation across the Zagros fold belt*

Mameri et al. *The quartz paleo-piezometer in exhuming crustal rocks: a stress-control experimental evaluation*

Torné et al. *Exploring the Geothermal Potential in the Iberian Peninsula: AI-Enhanced Subsurface Analysis*

Fialkiewicz et al. (**online**) *Kinematic modeling of fault-related structures within anisotropic layered rocks of Northern Calcareous Alps (Eastern Alps, Austria)*

Mohan et al. (**online**) *Investigating the regional scale strain variations in the Banded Iron Formations of the Bundelkhand Tectonic Zone: Insights from Anisotropy of Magnetic Susceptibility Studies*

Tomar et al. (**online**) *Unveiling the evolution of the Giant Quartz Reefs in the Bundelkhand Craton of North-Central India: A tectonic conundrum*

Ibáñez-Belloso et al. *Structure and evolution of the Cameros basin: Application of salt tectonics and numerical modelling to its structural interpretation*

Carrión-Jiménez et al. *The Amagmag remnant stock as tracker of the growth history of a salt wall, Morocco*

Peris et al. *From compression to extension in the Eastern Pyrenees: new insights from low-temperature thermochronology*

Grain size insensitive deformation mechanism of naturally deformed amphibolite in the middle crust: An example from the Abu Markhat shear zone, Arabian-Nubian shield

Gamal Ahmed[1&2]* and Sandra Piazolo[1]

[1]School of Earth and Environment, University of Leeds, United Kingdom
[2]Geology Department, faculty of science, SVU, Qena, Egypt

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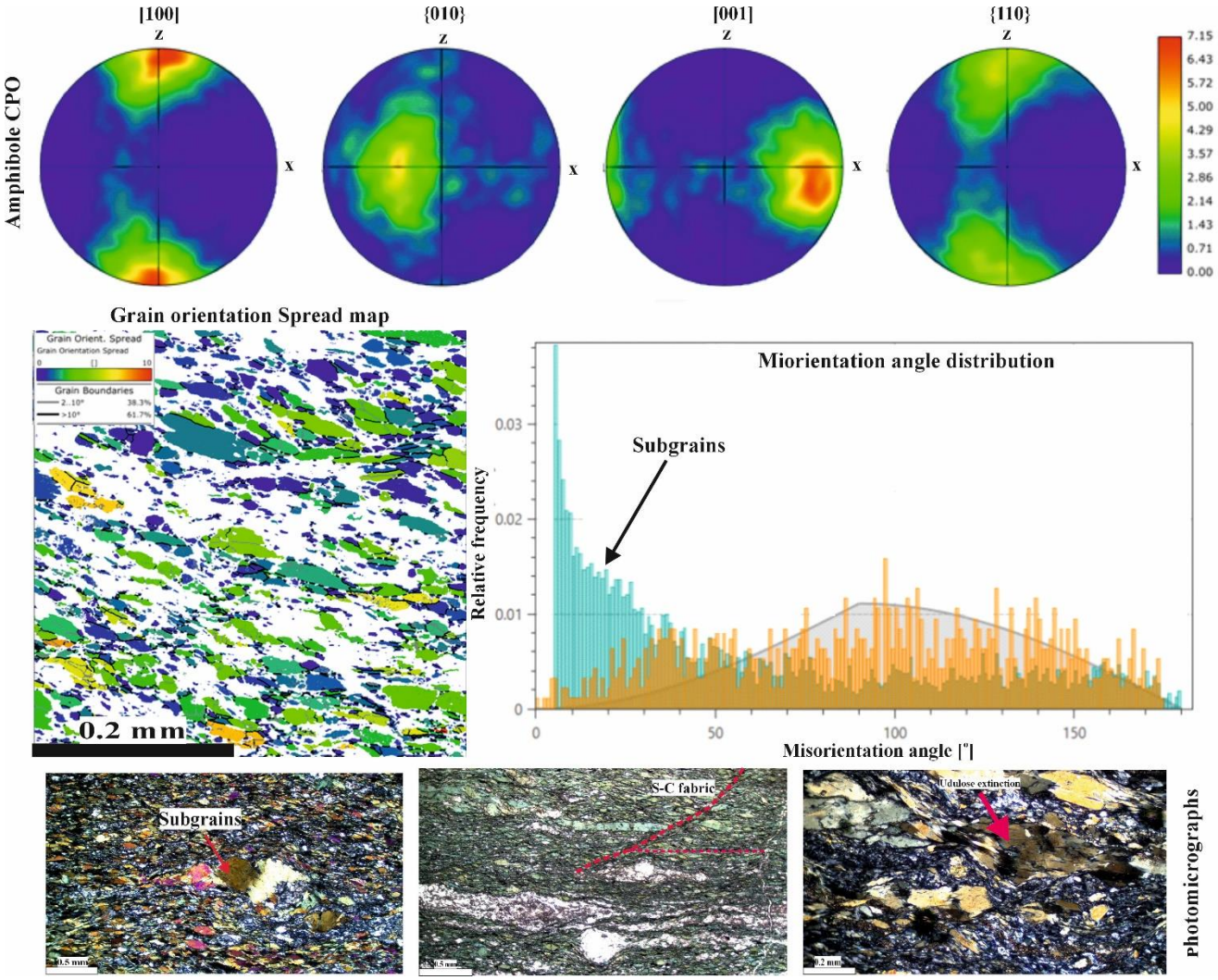
Amphibole is one of the main constituents of the middle to lower crust playing therefore a major role in the crusts' rheology. Mylonitic and ultramylonitic amphibolites from the Sibai core complex, Egyptian Eastern Desert, exhibit ample evidence of dislocation creep including undulose extinction, presence of subgrains, grain size reduction by heterogeneous nucleation and a strong CPO. In addition, with increased strain and fluid influx locally SC fabrics develop with distinct chemical signatures pointing to the local importance of dissolution precipitation creep in these rocks.



Deformation of mid-crustal granitoids within extensional shear zones: An example from the Abu Markhat granitoids, Arabian-Nubian Shield

Gamal Ahmed[1&2]* and Sandra Piazolo[1], Zakaria Hamimi[3], Harald Fritz[4]

[1]School of Earth and Environment, University of Leeds, United Kingdom
[2]Geology Department, faculty of science, SVU, Qena, Egypt
[3]Geology Department, Faculty of Science, Benha university, Benha, Egypt
[4]Department of Geology and Paleontology, University of Graz, Austria

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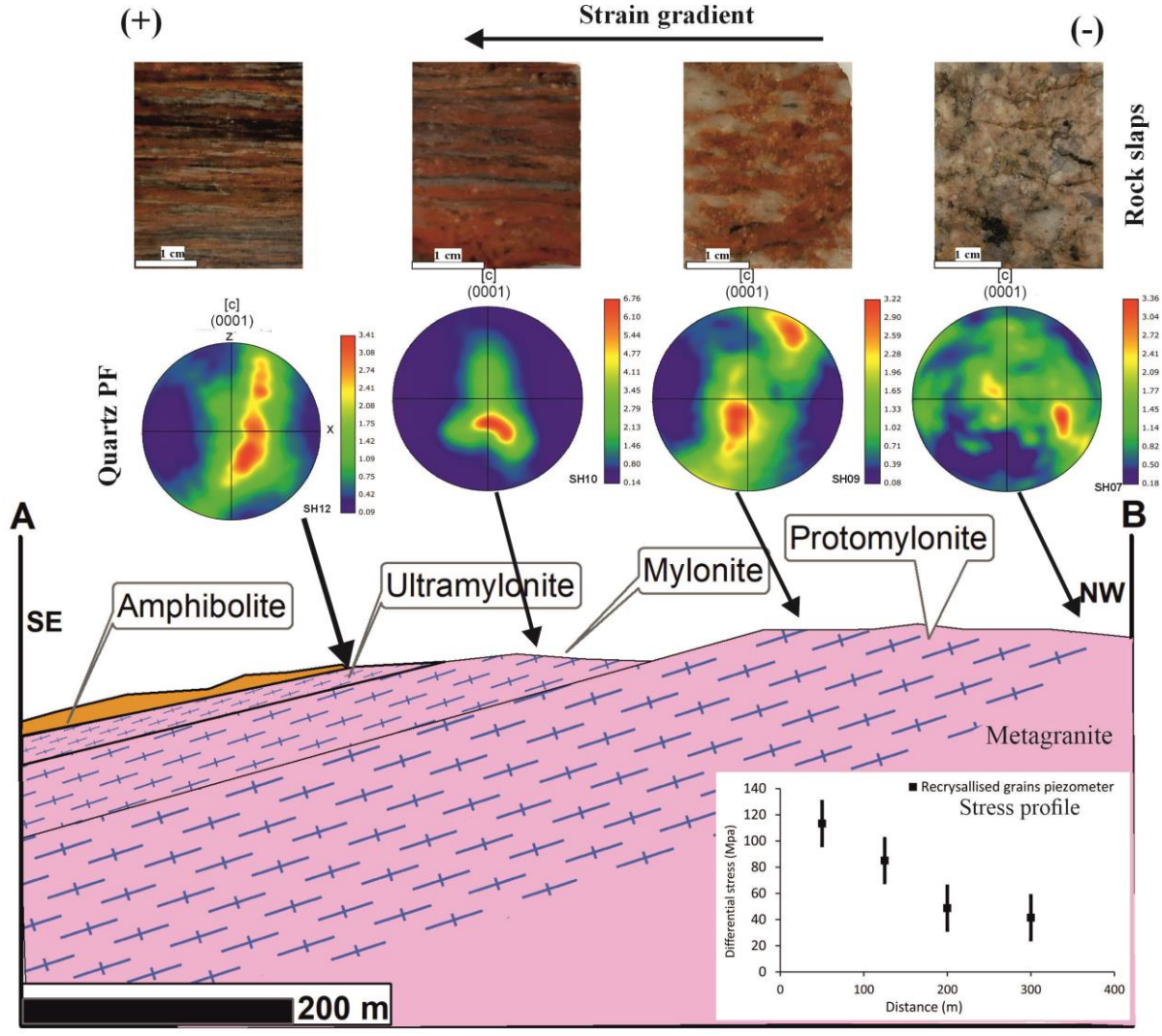
We investigate microfabrics of a Neoproterozoic orogen-parallel, low angle normal shear zone of a metagranite-ultramylonite section from the Abu Markhat granitoid, Egyptian Eastern Desert. Strain localized along the granite-mafic country rock boundary. Quartz shows dramatic grain size reduction by dynamic recrystallisation from partially recrystallised in the metagranite to fully recrystallised in the ultramylonite, while paleostresses dramatically increase towards the ultramylonite reaching 113MPa. The character of quartz and feldspar microstructures suggest strain localisation was achieved mainly via dislocation creep at upper greenschist to lower amphibolite facies conditions (450-550 °C).



Cross section along the deformed zone

The Variscan basement in the southern Corsica (France): the tectono-metamorphic evolution of the high-grade metamorphic rocks of Fautea-Favone complex

Amabile F. *[1], Frassi C.[1] & Gisella R.[2]

[1]Dipartimento di Scienze della Terra, Università di Pisa, Italy
[2]Dipartimento di Scienze della Terra e dell'Ambiente, Università di Pavia, Italy

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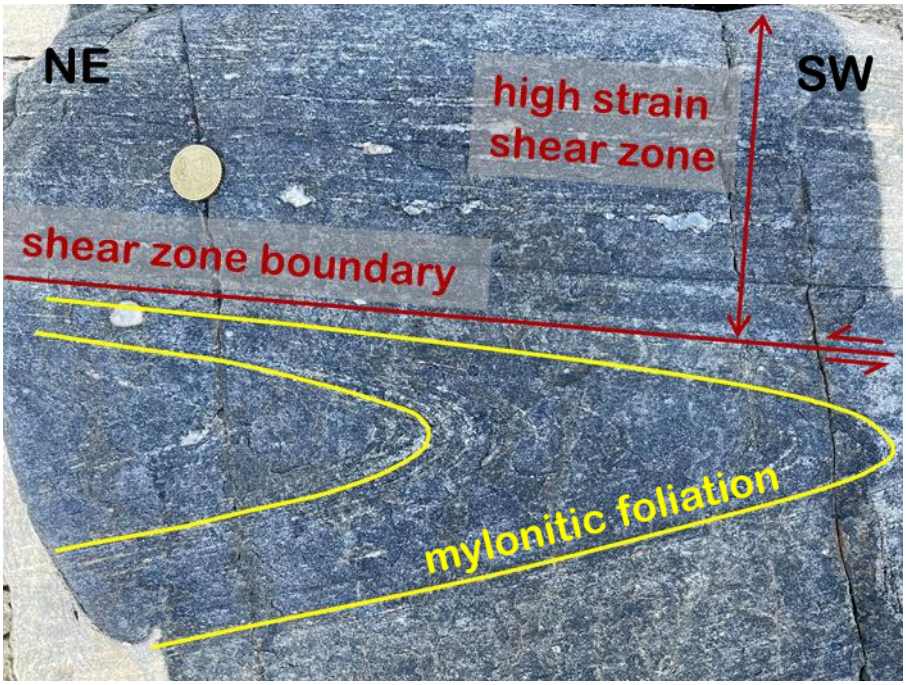
New field mapping and structural analyses revealed that the high-grade Variscan metamorphic rocks cropping out between Fautea and Favone tows in south-eastern Corsica Island (France) recorded two events of shearing that produced a first pervasive mylonitic foliation with a top-to-the E sense of shear associate to partial melting and lately localized 10s cm-thick dextral and sinistral shear zones developed from ductile to brittle deformation conditions.

Image



Lithospheric scale analogue modelling of rifting and inversion: The effect of the degree of obliquity

Arachchige U.N. *[1], Cruden A.R.[1], Betts P.[1], Samsu A.[2] & Gorczyk W.[3]

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[2] Institute of Earth Sciences, University of Lausanne, Lausanne, Switzerland
[3] Centre for Exploration Targeting, School of Earth Sciences, University of Western Australia, Australia

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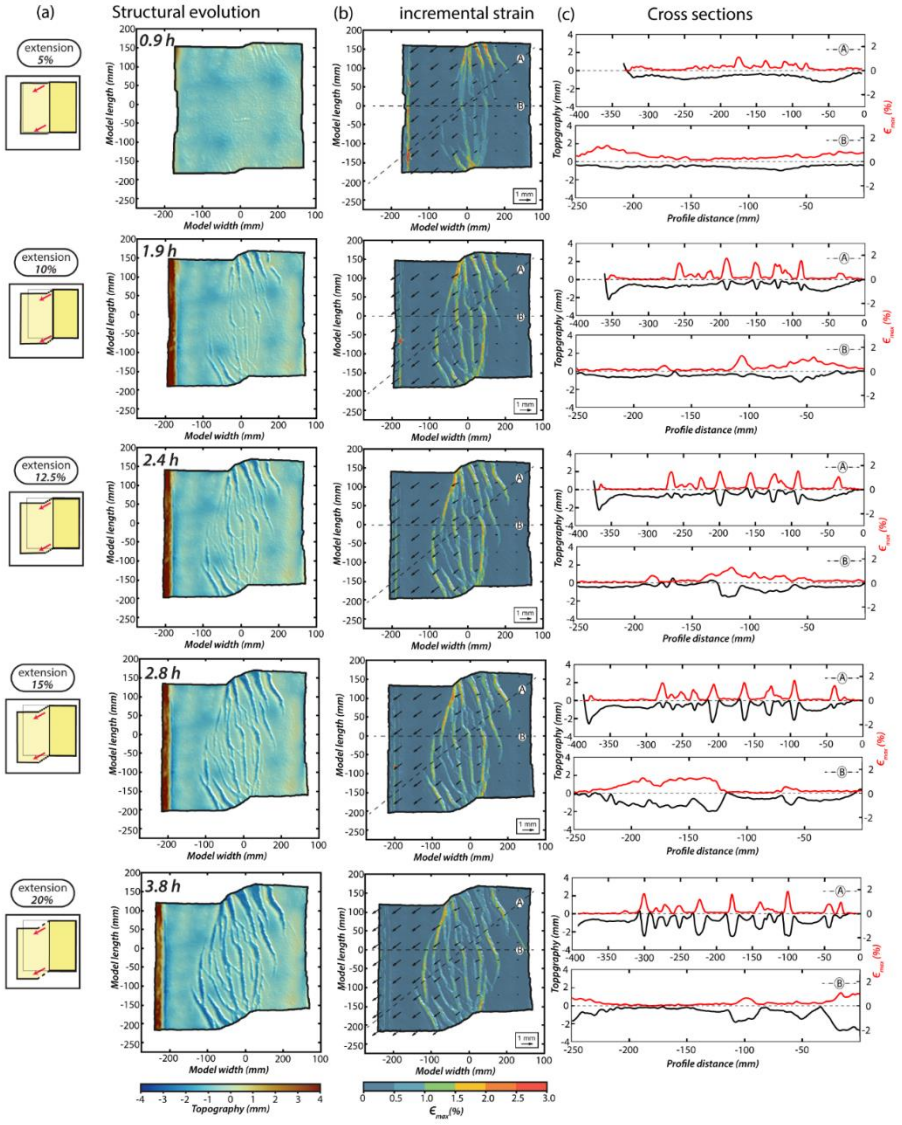
Here we investigate the flow behavior of ductile lower crustal and mantle lithosphere layers and the dynamics of complex, interconnected rift basins in the brittle upper crust and their inversion by carrying out three-dimensional, brittle-ductile, lithospheric-scale analogue experiments of oblique extension followed by shortening. The obliquity angle, α, of the direction of extension and inversion are varied systematically between experiments from orthogonal (α = 90°) to strike slip (α =0°).



Magma solidification effects during sill emplacement: insights from laboratory experiments

Arachchige U.N. *[1], Cruden A.R.[1] & Weinberg R.F.[1]

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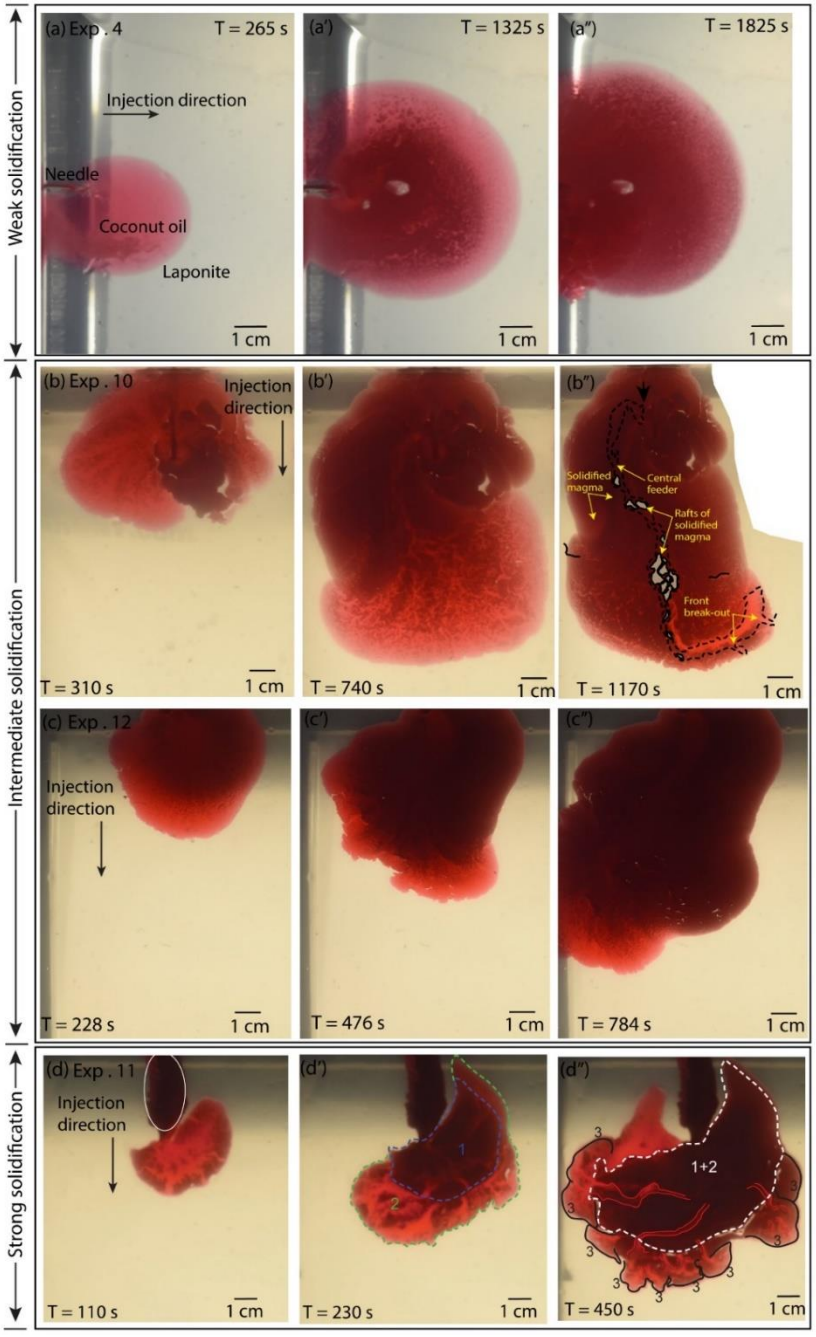
The effects of solidification on sill propagation dynamics and the resulting intrusion morphologies are investigated using scaled laboratory experiments. Hot coconut oil (magma analogue) that solidifies during emplacement is injected into a colder, layered, solid visco-elasto-plastic gel (Laponite RD®, host rock analogue). When solidification effects change from weak to strong, solidifying sills show: (I) complex structures with sill segmentations at the tip, (II) magma channelization.



Structural evolution of a post-orogenic, intermontane fault system: an example from the Martana Fault System (Northern Apennines, Italy)

Asti R. *[1], Bonini S.[1], Viola G.[1] & Vignaroli G.[1]

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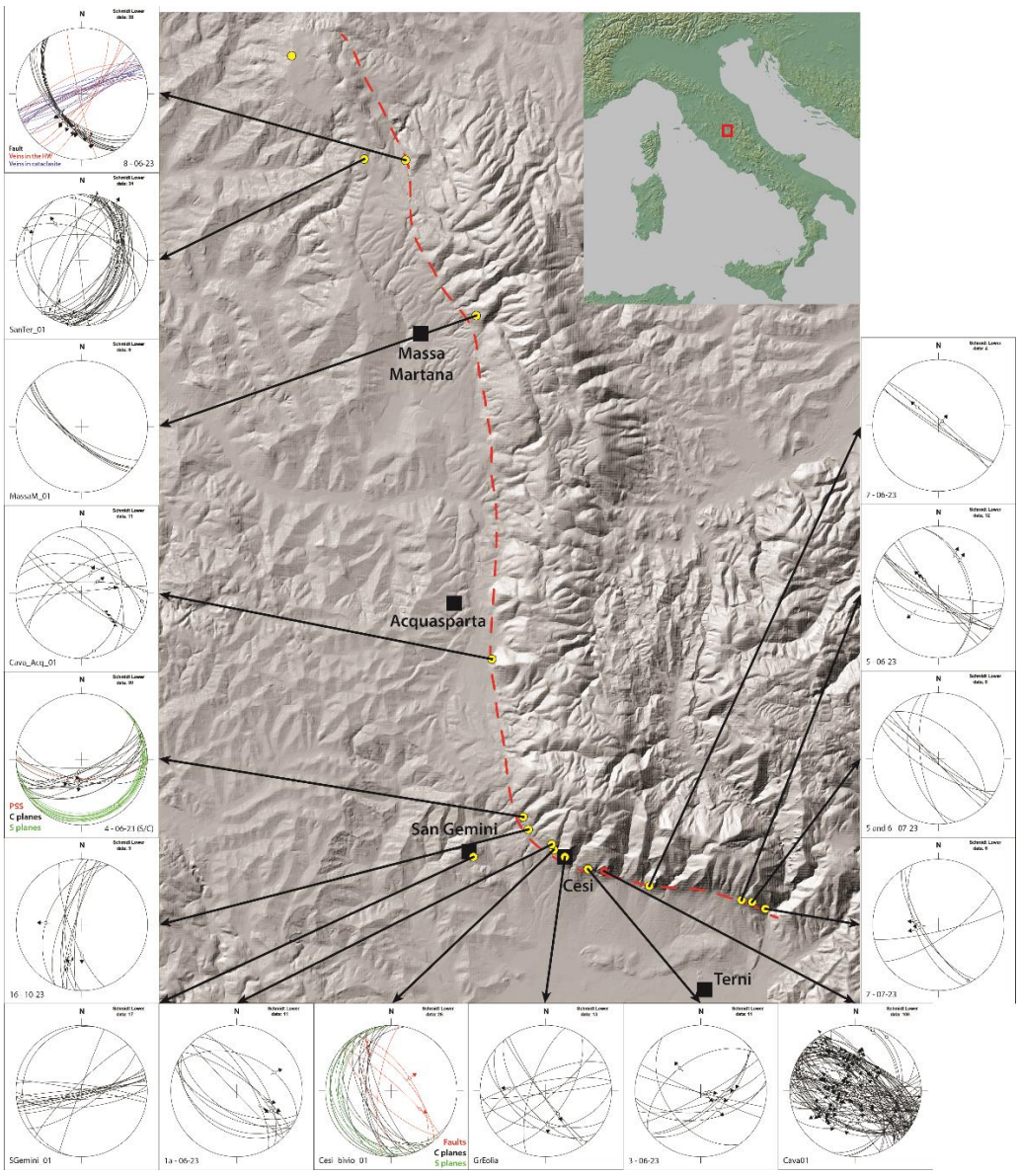
Establishing the relationships between the geometric complexity of seismogenic faults at depth and their surface expression is a key issue for seismic hazard assessments in tectonically active regions. This is particularly true in regions that experienced polyphase tectonic regimes. The Martana Fault System (Northern Apennines, Italy) is an ideal case study to address this issue. We present new structural data and paleostress analysis to discuss the implications for the evolution of this system.



Salt Dynamics in Rifted Margins: Insights from Numerical Modeling

M. Bakhtbidar[1]*, P. Granado[1], O. Gratacós[1], P. Santolaria[1], J. B. Ruh[2] y

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[2] Institute of Marine Sciences, CSIC, Barcelona, Spain

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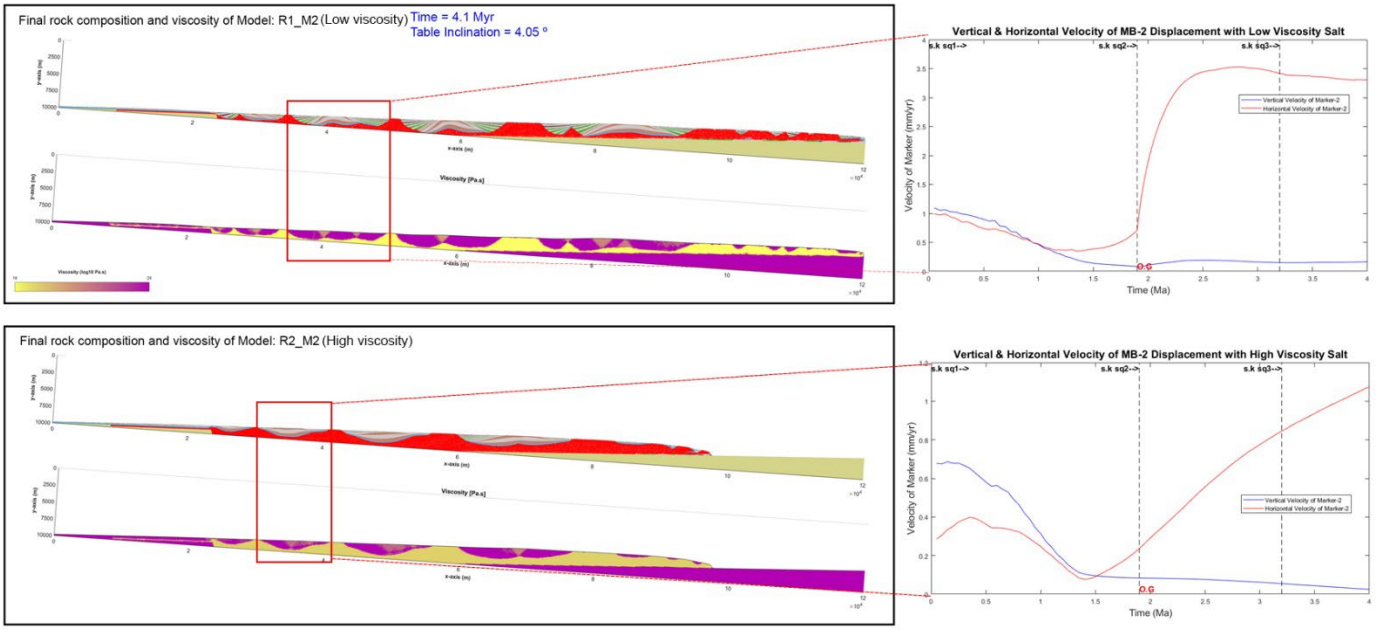
The presence of salt and its particular viscous rheology plays a crucial role in shaping the stratigraphic and the architecture of salt-bearing rifted margins. Salt's unique ability to flow under stress controlled by two main mechanisms: downbuilding and dominant gliding. In this study by employing a 2D numerical modeling, we focus on how these mechanisms, in conjunction with both linear and non-Newtonian salt rheologies, dictate the evolution and geometry of the salt-sediment system.



Geodynamic evolution of the West African Craton

Baratoux L.*[1-2], Jessell M.W.[3], Vanderhaeghe, O.[1], Naba S.[4], Koffi Y.A.[2], Koumelan, A.N.[2]
Metelka, V.[3-5], Miller, J.[3-6], Masurel, Q.[3], Perrouty,S.[7], Kone, J.[8], McFarlane H.[3-9], & Block S.[1]

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[2] UFHB Abidjan-Cocody, UFR STRM, 22 BP 582 Abidjan 22, Côte d'Ivoire
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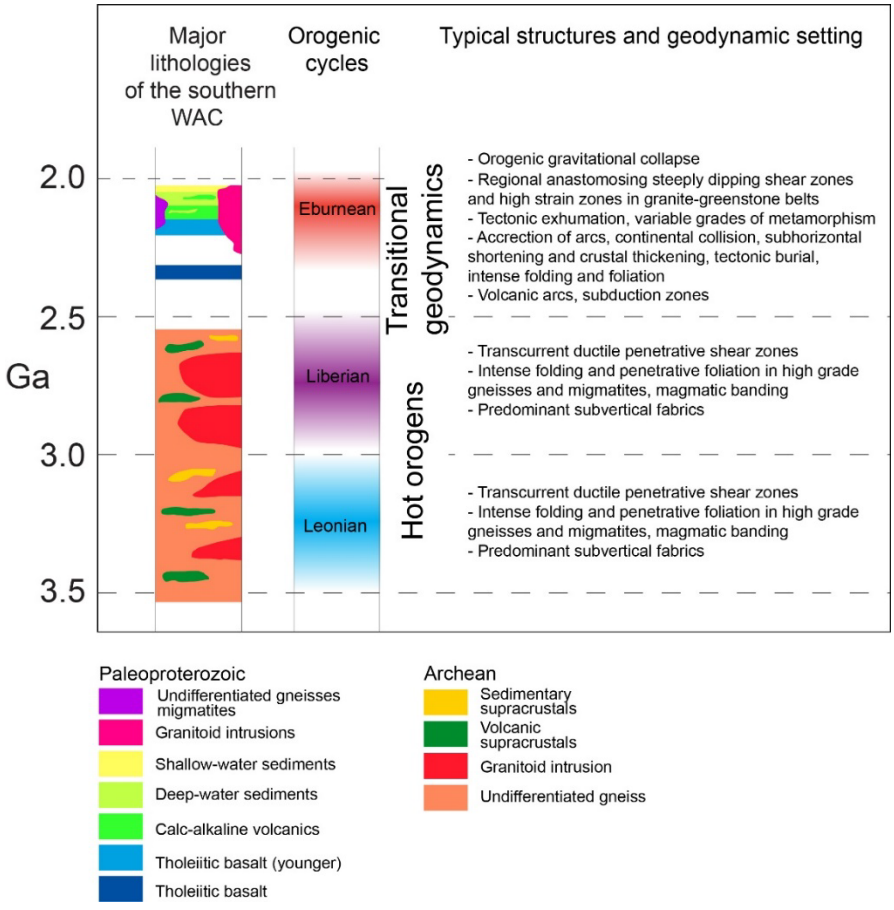
The southern West African Craton, built of Archean and Paleoproterozoic domains, consisting of granitoid – greenstone domains was deformed during three orogenic cycles: Leonian (3.4-3.0 Ga), Liberian (2.9-2.5 Ga), and Eburnean (2.15-2.0 Ga). Eburnean geodynamic style has a transitional character with some features characteristic for modern plate tectonics (accretion of volcanic arcs, significant changes in regional stress field) and some features typical for the Archean hot-orogen tectonics.



Scale independent unbiased statistical length analysis of linear features: Adapting survival analysis techniques to geological applications

Benedetti*[1], Casiraghi[1], Bistacchi[1] & Bertacchi[2]

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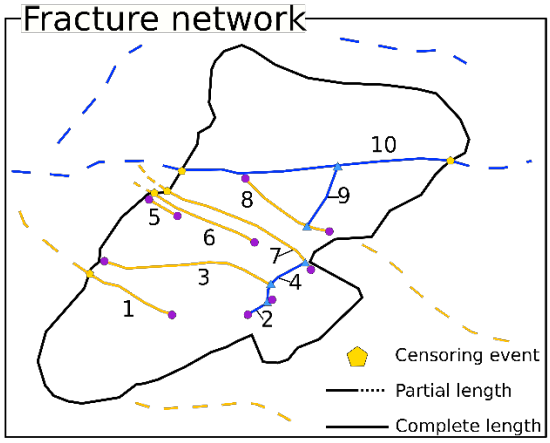
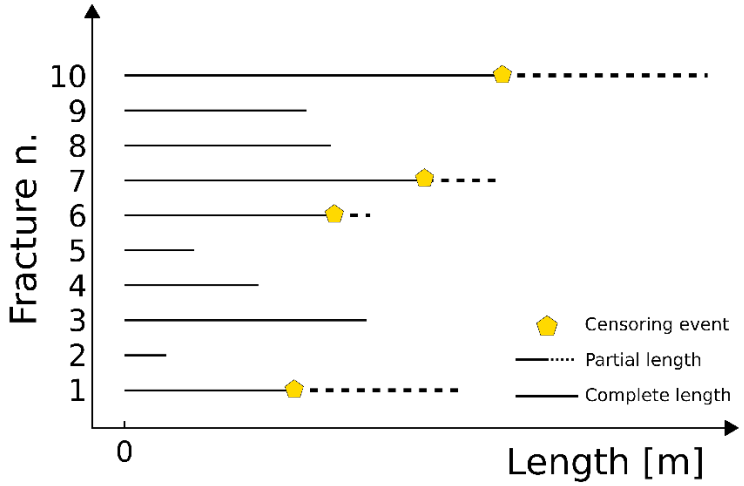
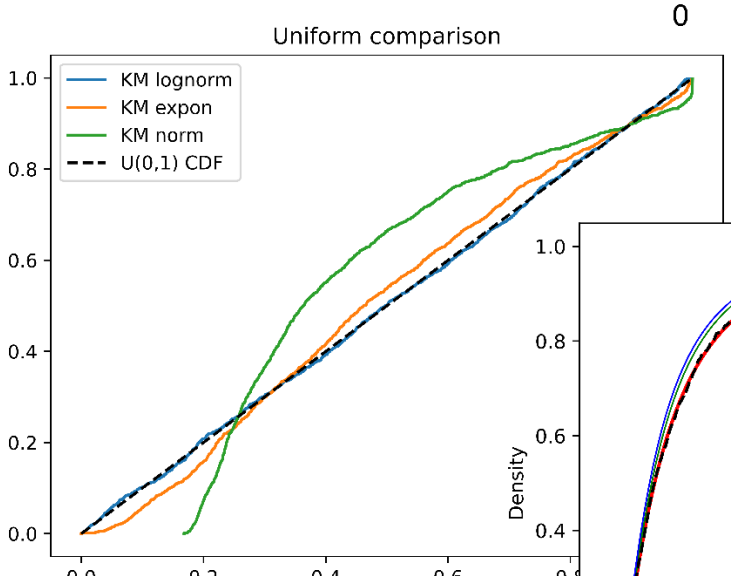
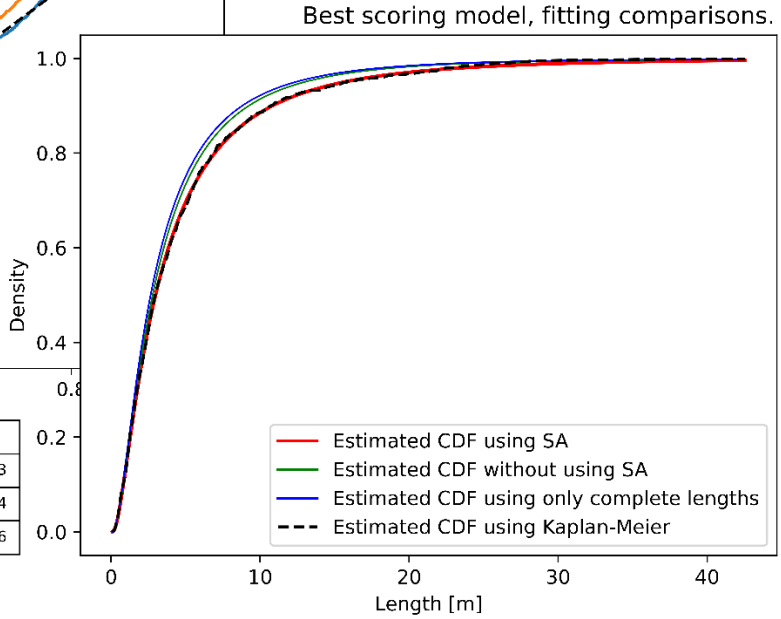
From thin section to satellite image scale, the limited size of the study area introduces a bias in the interpretation of linear features, defined as right-censoring bias. We apply survival analysis techniques to obtain an unbiased estimate of multiple parametrical distributions in censored length datasets. Moreover, we show the effects of not considering such biases and propose a novel approach to select the best fitting model(s) using the Probability Integral Transform (PIT) technique.







	KS test	KG test	AD test
lognorm	0.012	0.041	0.353
expon	0.052	1.558	12.54
norm	0.173	19.844	120.496



Update and appraisal on multi-scale post-metamorphic brittle tectonics in the Pennine Alps of Valle d'Aosta

Bistacchi A[1], Dal Piaz GV[2], Dal Piaz G[3], Monopoli B[3],

Arienti G[1], Casiraghi S[1], Lugoboni Z[1], Villa IM[1], Massironi M[4] & Bertolo D[5]

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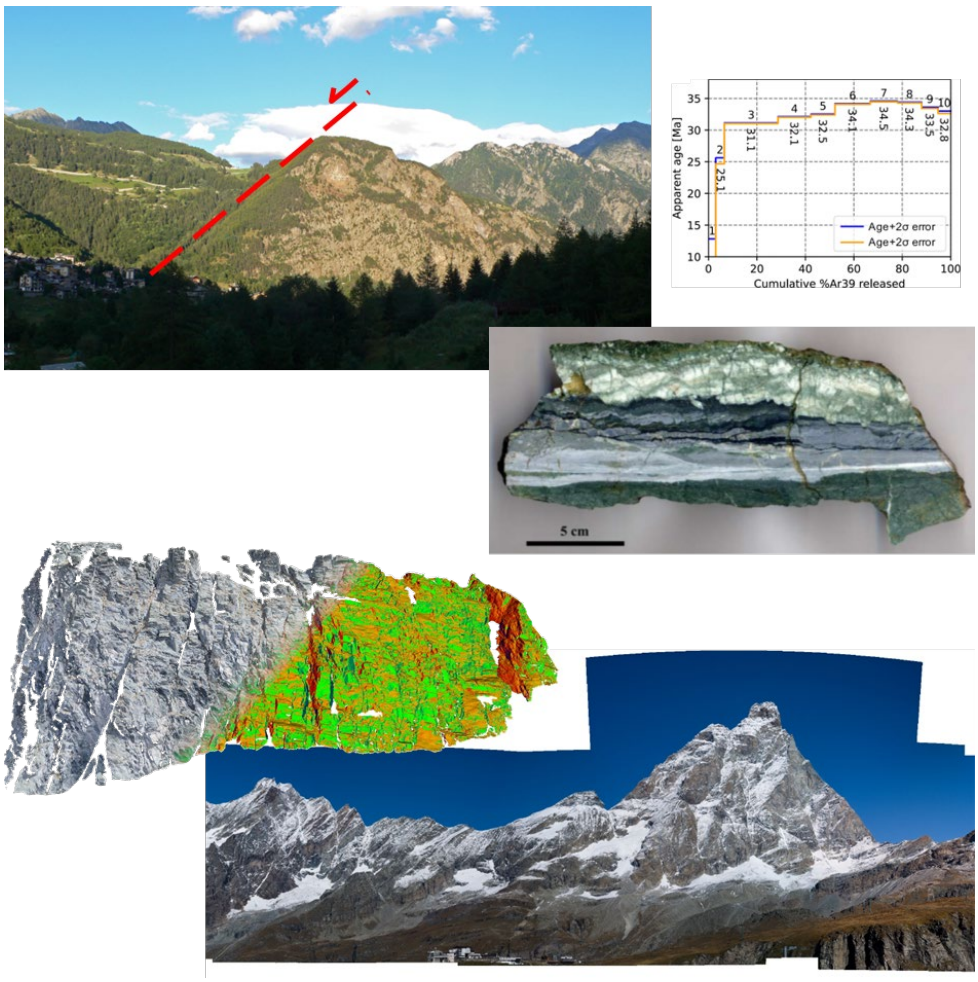
We present a dynamic picture of multiscale post-metamorphic brittle deformation in the Pennine Alps of the Aosta Valley allowing to:

- solve long-lasting problems in nappe correlations, where continuity of tectonic boundaries is disrupted by faults;
- unroll the film of the evolution of brittle structures in sync with exhumation;
- provide a consistent view of seismic vs. aseismic deformation in a collisional belt;
- outline fracturing patterns controlling crustal fluid flow, and useful for applications.



Complete Dyke Dimensions from Incomplete Outcrops

Biswas S. K. *[1], Mondal T. K.[1], Saha A.[2], Mukhopadhyay A. K.[2] & Mukherjee A.[2]

[1] Geological Studies Unit, Indian Statistical Institute, 203 B.T. Road, Kolkata, 700108, West Bengal, India
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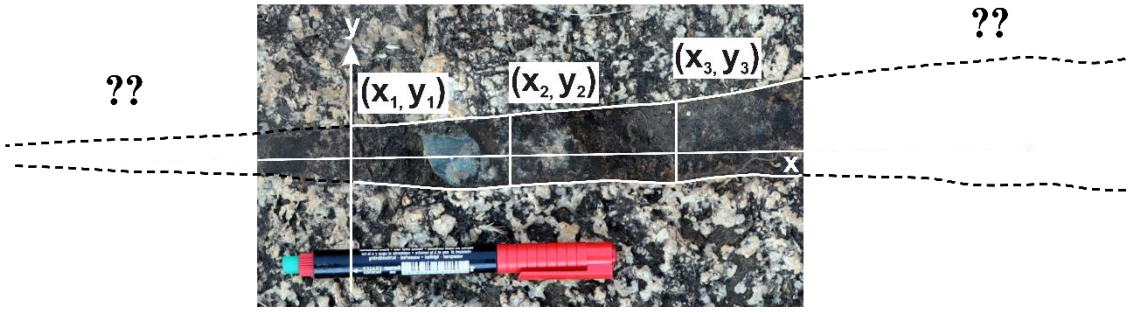
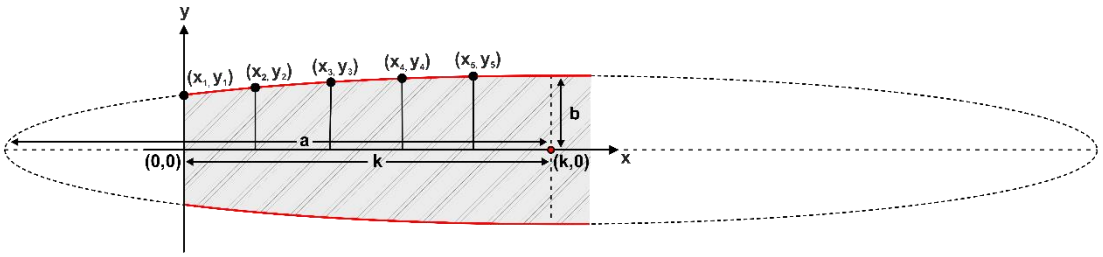
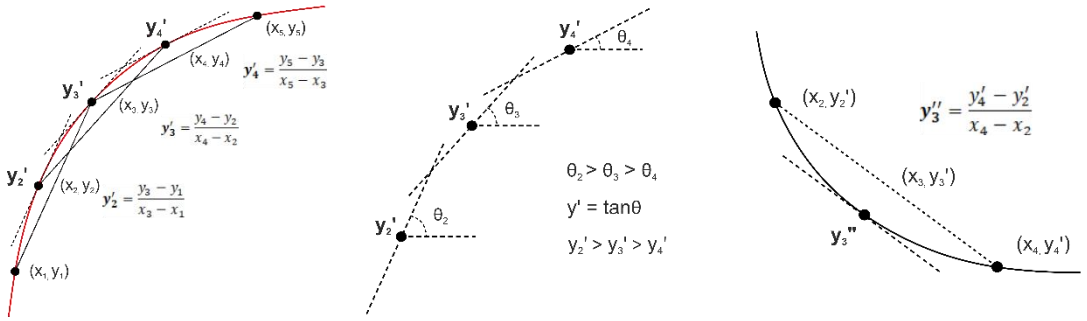
We introduce for the first time, a mathematical method of estimating complete dyke dimensions from their incomplete outcrops devoid of any tip. Considering dykes as dominantly opening mode fractures, the method is built upon its idealized canonical model and utilizes differential equations of ellipse, which is the predicted shape of fracture opening in the model, to estimate their full length, maximum width and aspect ratio (width/length) from limited outcrop measurements.







Folding of intrinsically anisotropic rocks

Bons P.D. *[1-2], Hu Y.[1] & Zhang Y.[1]

[1] Department of Geosciences, Tübingen University, Tübingen, Germany
[2] China University of Geosciences (Beijing), Beijing, P.R. China

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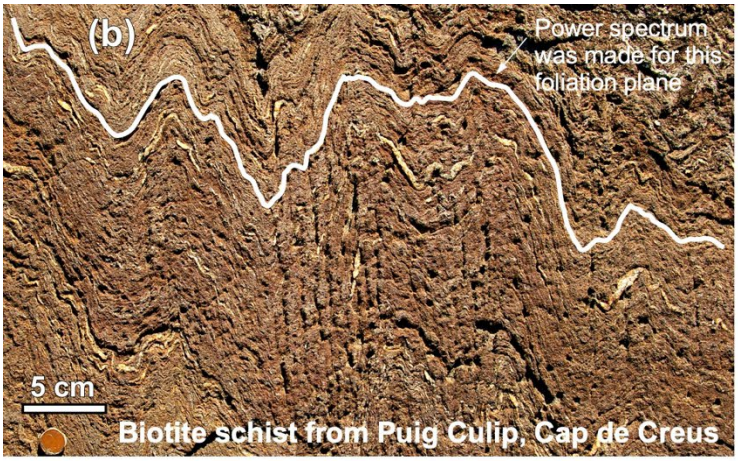
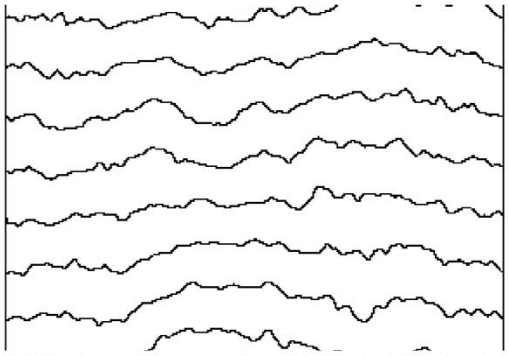
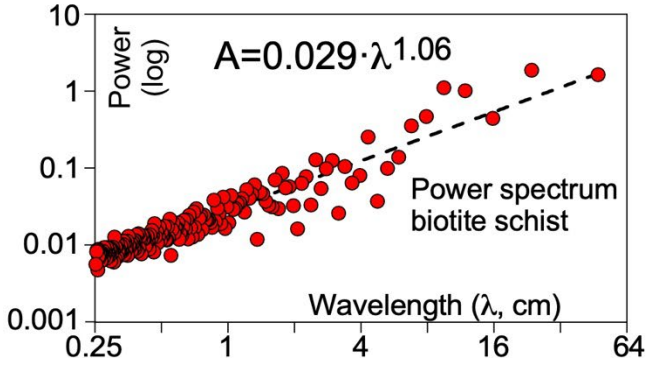
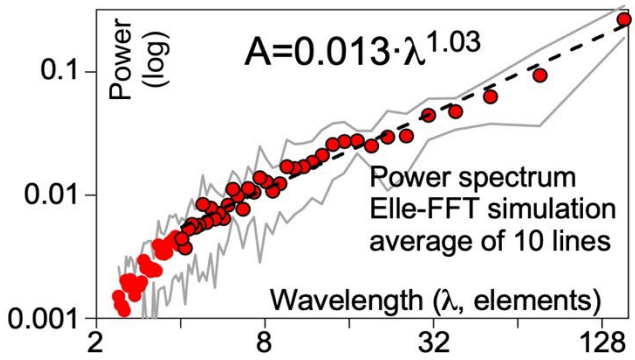
A cleavage formed by alignment of micas or a strong crystallographic orientation gives a rock an intrinsic anisotropy. Anisotropy has no length scale to determine fold wavelengths. Analyses of the power spectra of folded biotite schist and numerical simulations with Elle-FFT show that the folds are self-similar, i.e., they have no characteristic wavelength as Biot-type buckle folds have. With this we could show that small folds in polar ice sheets formed due to the strong CPO of the ice.





Folded passive marker lines in Elle-FFT simulation with 50% shortening parallel to horizontal "virtual schistosity"





The El Tordell thrust and Súria Anticline fracture pattern characterized using fieldwork and 3D digital outcrops

Carola E.*[1], Travé A.[2], Muñoz J.A.[1] & Cantarero I.[2]

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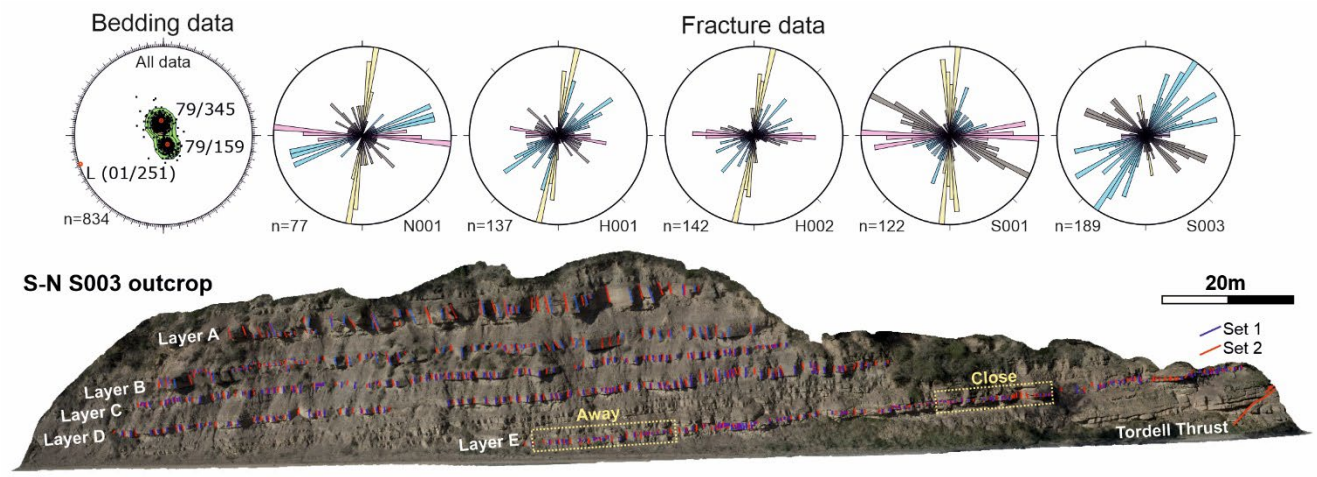
Description: This research focused on understanding the fracture pattern of several N-S aligned fluvial Eocene outcrops of this sector of the Pyrenees. Integrating traditional fieldwork with drone imagery, the methodology provided the dataset that allowed to characterize the fracture pattern of the fluvial sequence of both structures. The fracture pattern is defined by 4 fracture orientations (N-S; E-W; NE-SW and NW-SE) and it is interpreted as developed by regional and local stresses during the Pyrenean Orogeny.



Strain initiation by localised fluid influx in the mid crust: A case study from the Upper Badcall shear zone, NW Scotland

Carpenter M. *[1], Piazolo S.[1] and Craig T.[1]
[1]University of Leeds, UK

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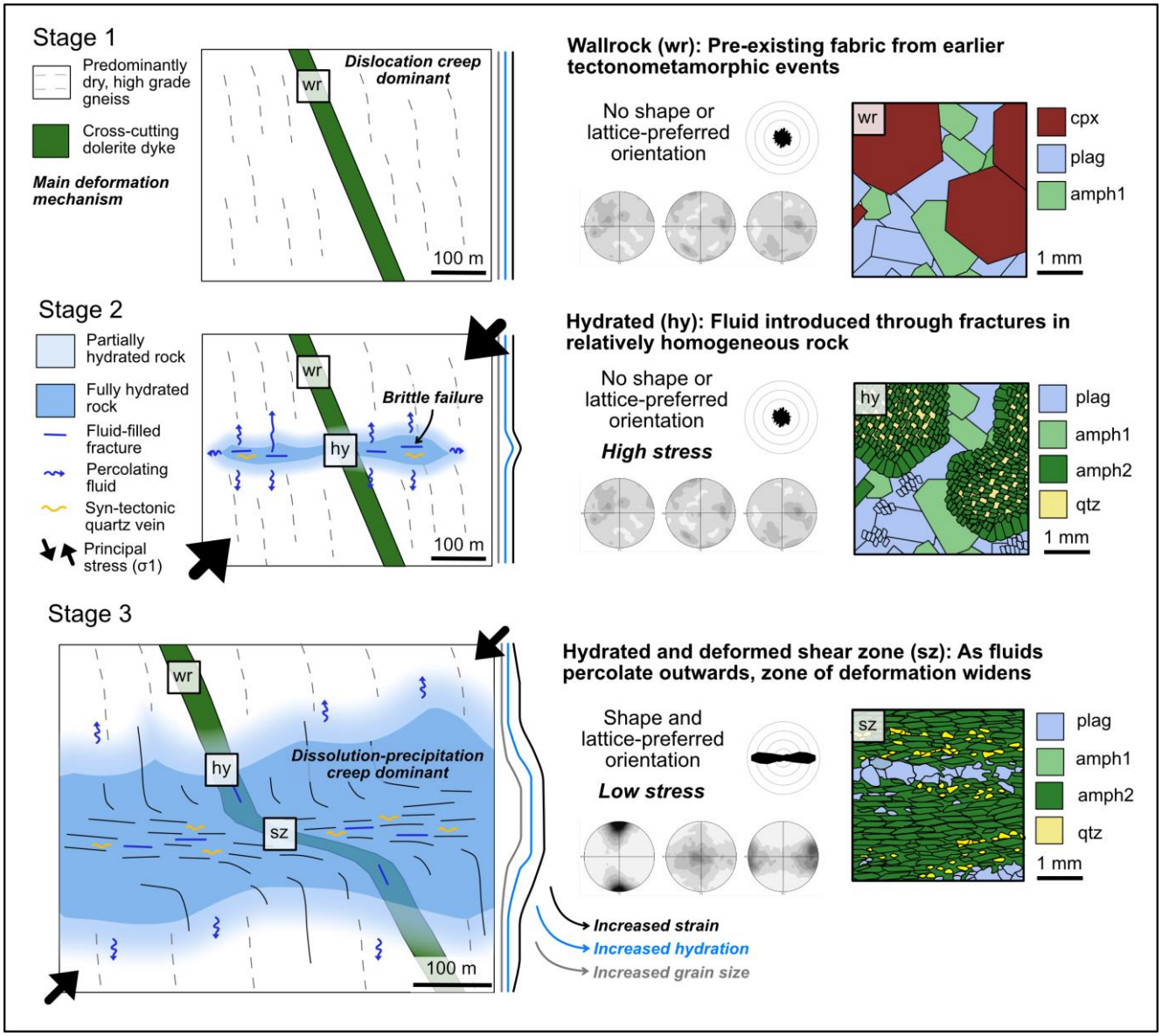
The Badcall mid crustal shear zone in NW Scotland is a 100 m scale structure in which hydration and subsequent reactions weaken, and localize strain in, quartzofeldspathic gneiss and amphibolite wall rock. Shape fabric, grain size and the chemistry of major phases is homogenized inside the shear zone, despite less crystal-plastic deformation features observed compared to the wall rock. We propose local fluid influx triggers dissolution-precipitation creep and significantly weakens the mid crust.



The Amagmag remnant stock as tracker of the growth history of a salt wall, Morocco

Carrión-Jiménez M.[1],Teixell A.[1], Fernandez N.[2], Giles K.A.[3] & Hudec M.R.[4]

[1] Departmento de Geología, Universitat Autònoma de Barcelona, Spain
[2] Hemholtz Centre Potsdam, GFZ German Research Centre of Geosciences, Germany
[3] Department of Geological Science, The University of Texas at El Paso, USA
[4] Bureau of Economic Geology, The University of Texas at El Austin, USA

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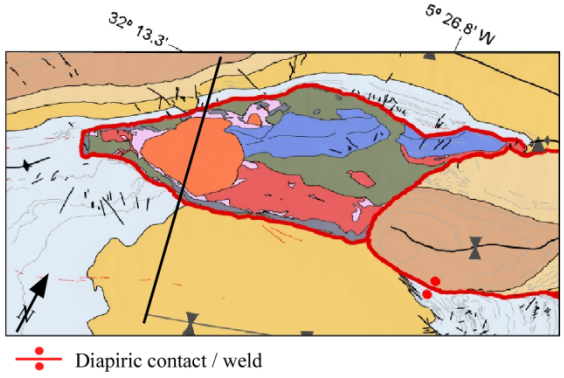
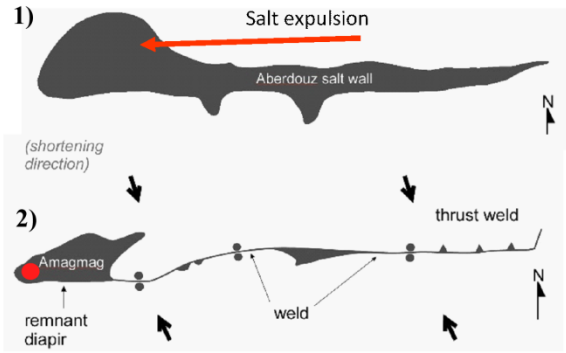
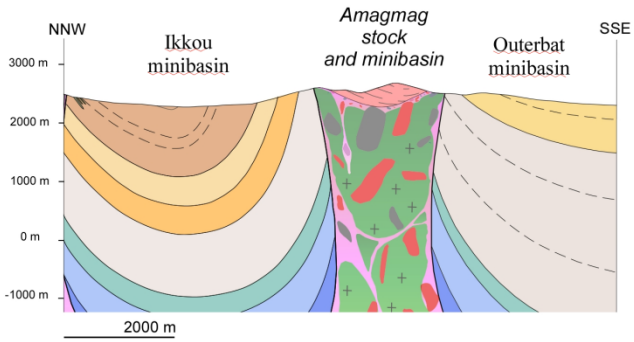
The shortening of diapirs is influenced, among other factors, by intrasalt non-evaporitic bodies. Concentrated inclusions into a bulbous end of a salt wall, during (synrift) along-strike salt expulsion, resulted in the Amagmag stock, Moroccan Atlas. Its inability to be squeezed completely during subsequent shortening explain the subsidence of an enigmatic Cenozoic minibasin into the stock. We propose an evolutionary model for inclusion concentration and syn-compressional minibasin sinking.



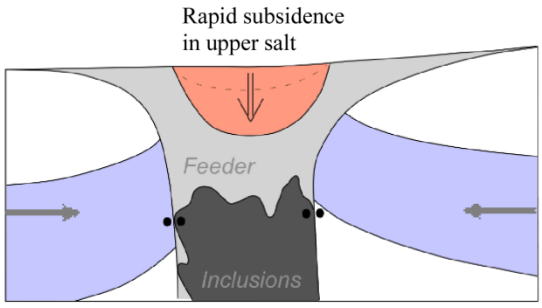
Geologic map of the Amagmag stock containing abundant inclusions (Late Jurassic gabbro in green, Jurassic carbonates in blue, Triassic basalt in red, Keuper salt in pink and Cenozoic minibasin in orange)



Plan view evolution from extension (1) to contraction (2) of the salt wall



Present day cross section of the Amagmag stock



Emplacement model for the Cenozoic minibasin during shortening while the lower diapir stem is welded

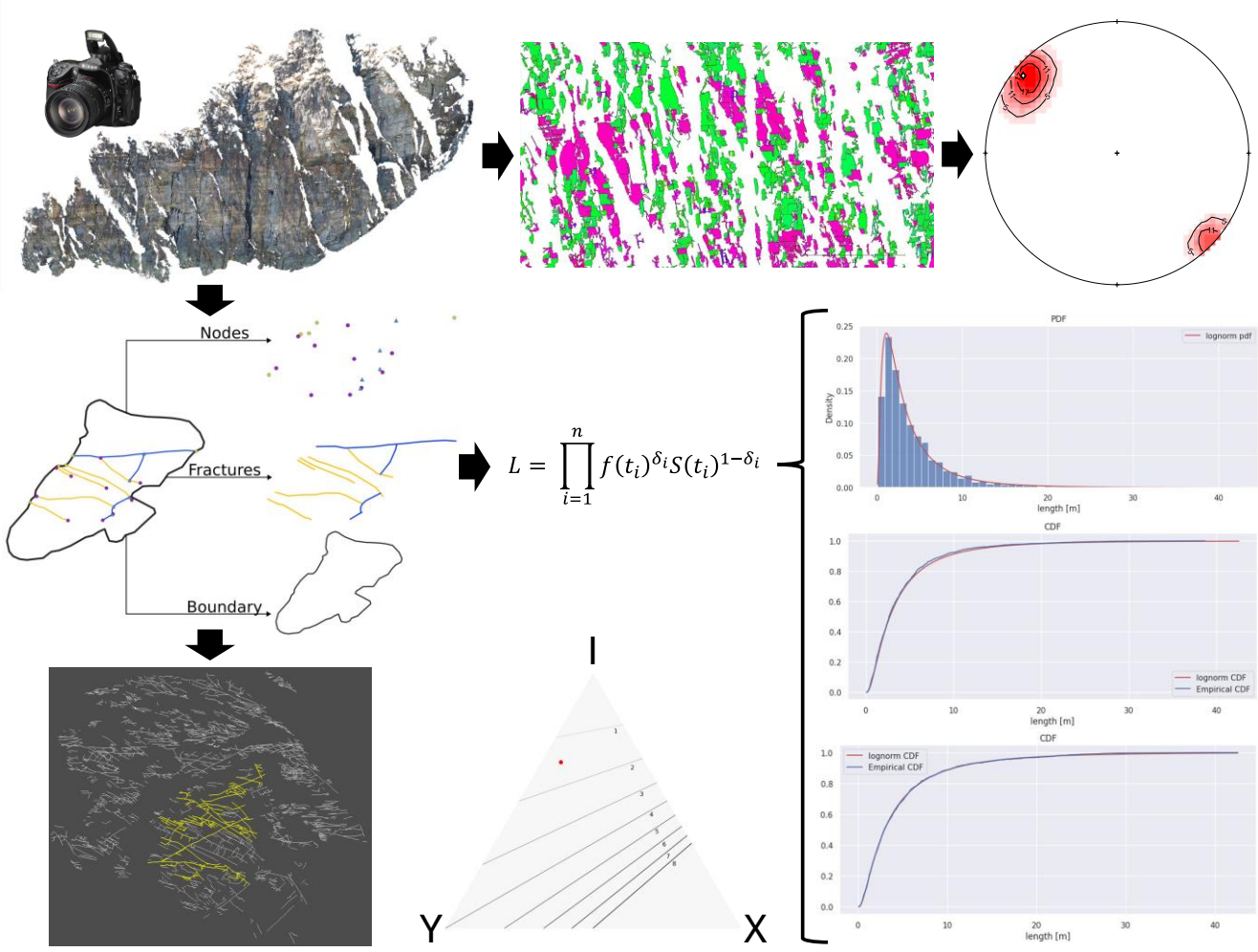
Quantitative parametrization of fracture networks Digital Outcrop Model: a complete workflow

Casiraghi S. *[1], Benedetti G.[1], Bistacchi A.[1], Agliardi F.[1], Monopoli B.[2]

[1] University of Milan-Bicocca, Department of Earth and Environmental Sciences, 20126, Italy
[2] LTS s.r.l., 31020, Treviso, Italy

* *Corresponding email: s.casiraghi21@campus.unimib.it*

Traditional methods for investigating the subsurface cannot properly investigate fractures between 1m and 100-200m. Digital outcrop models provide a framework for the collection of extensive datasets in outcrop analogues, supplying at the limitations of traditional field survey. Here we present a comprehensive workflow, with a solid statistical foundation, for the characterization of all the fracture network parameters that can be obtained from this type of support.



Melt pathways in the lower continental crust from map- to microscale: combined quantitative multidisciplinary approach applied in the Valpelline Series (Western Alps)

Caso F. *[1], Piloni C. B.[1], Filippi M.[1], Roda M.[1], Piazolo S.[2] & Zucali M.[1]

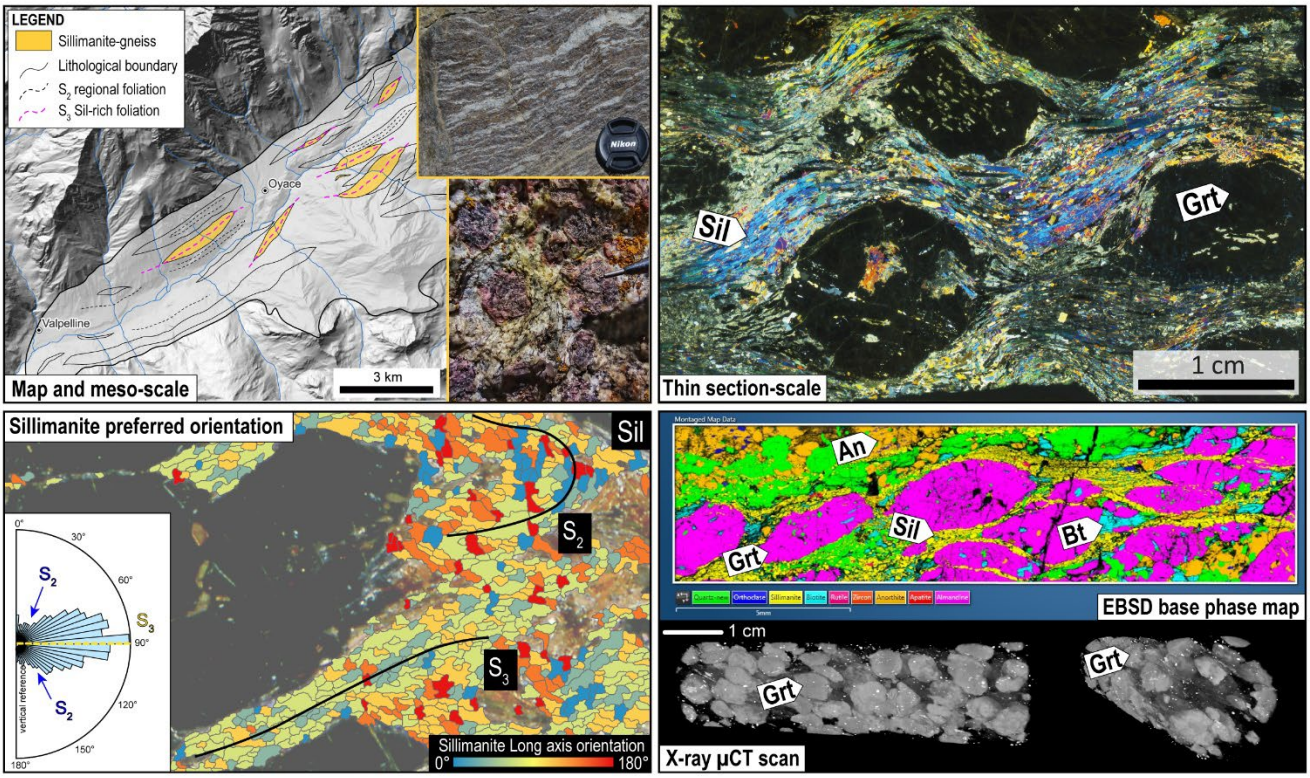
[1] Dipartimento di Scienze della Terra "A. Desio" – Università degli Studi di Milano, Italy

[2] Institute of Geophysics and Tectonics, The University of Leeds, UK

* *Corresponding email:* fabiola.caso@unimi.it

In HT basements melt migration and associated melt-present deformation may be recognised through the presence of rocks with anomalous mineralogy and chemical composition (e.g., glimmerite) and microstructures indicative for synchronous melt-mineral reactions and deformation.

We show results from the Permian migmatitic basements of the Valpelline Series (Western Alps) where widespread melt-bearing rocks (Caso et al., 2024) may exhibit signatures of melt migration pathways.



Caso F., Strambini A., Zucali M. (2024) - Structural, lithostratigraphic and thermal features of a Permian lower crust from the Western Italian Alps (Valpelline Series, Valle d'Aosta). Geological Magazine. https://doi.org/10.1017/S0016756824000037

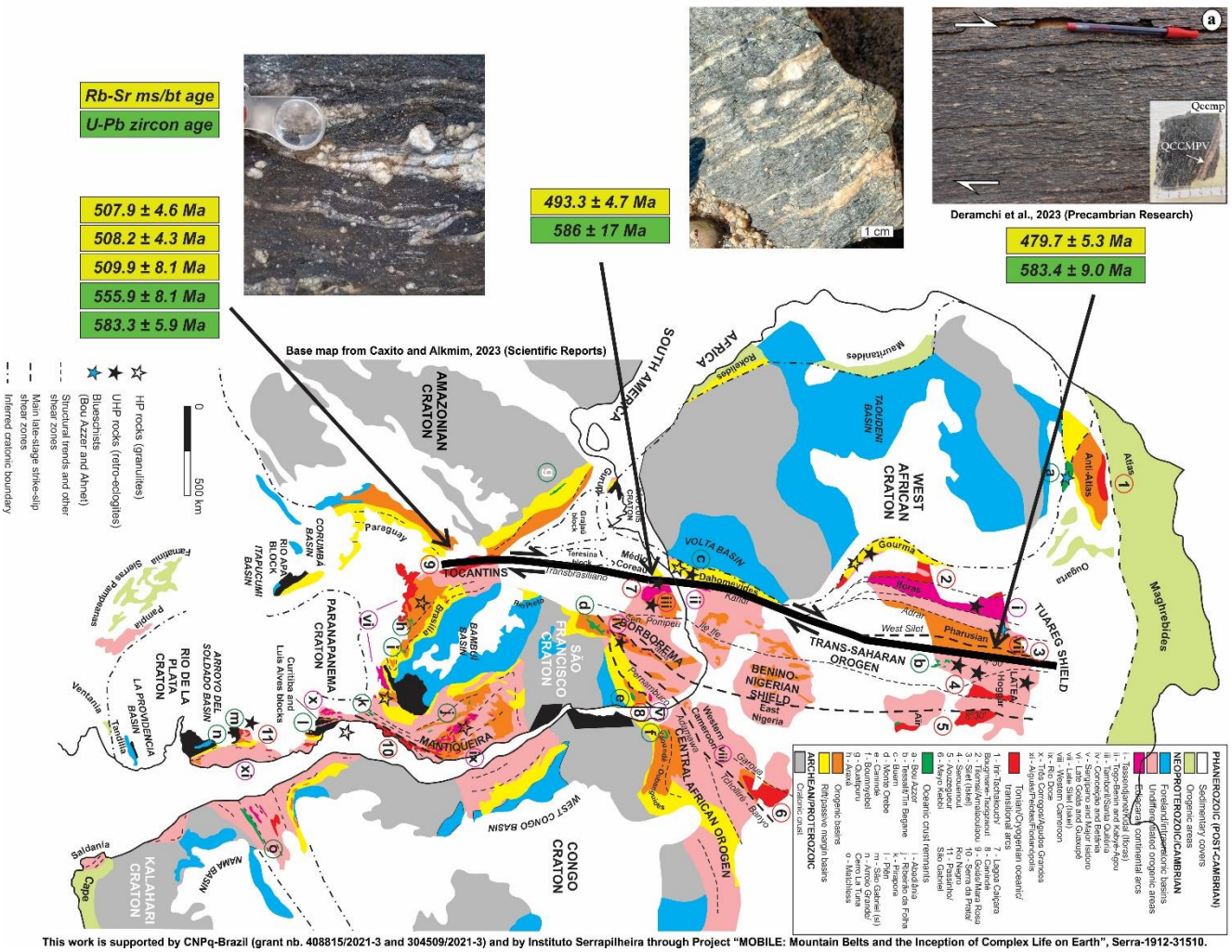
Near-synchronous evolution of the 6,000 km-long, transcontinental Transbrasiliano-Kandi-4°50' shear zone system during western Gondwana assembly

Caxito F. *[1], Ribeiro B.[2], Alkmim F.[3], & Deramchi A.[4]

[1] Manoel Teixeira da Costa Research Center (CPMTC), Federal University of Minas Gerais (UFMG), Brazil
[2] Timescales of Mineral Systems Group, School of Earth and Planetary Sciences, Curtin University, Australia
[3] Department of Geology, Federal University of Ouro Preto (UFOP), Brazil
[4] CRAAG, BP 63, Route de l'Observatoire, Algiers 16340, Algeria

* *Corresponding email:* caxito@ufmg.br

The Transbrasiliano-Kandi-4°50' shear zone system extends for ca. 6,000 km between Brazil and Africa in pre-drift reconstructions. U-Pb SHRIMP zircon data from granulitic rocks of central and northeastern Brazil and from the Tuareg Shield in Algeria yielded ages around 580 Ma, while Rb-Sr LA-ICPMS dates from syn-kinematic mica are around 490-510 Ma. The new data supports a near-synchronous transcontinental shear system, central to western Gondwana amalgamation.



This work is supported by CNPq-Brazil (grant nb. 408815/2021-3 and 304509/2021-3) and by Instituto Serrapilheira through Project "MOBILE: Mountain Belts and the Inception of Complex Life on Earth", Serra-1912-31510.

Boudinage and folding of oblique single layers in bulk constrictional strain fields: Results from analogue modelling

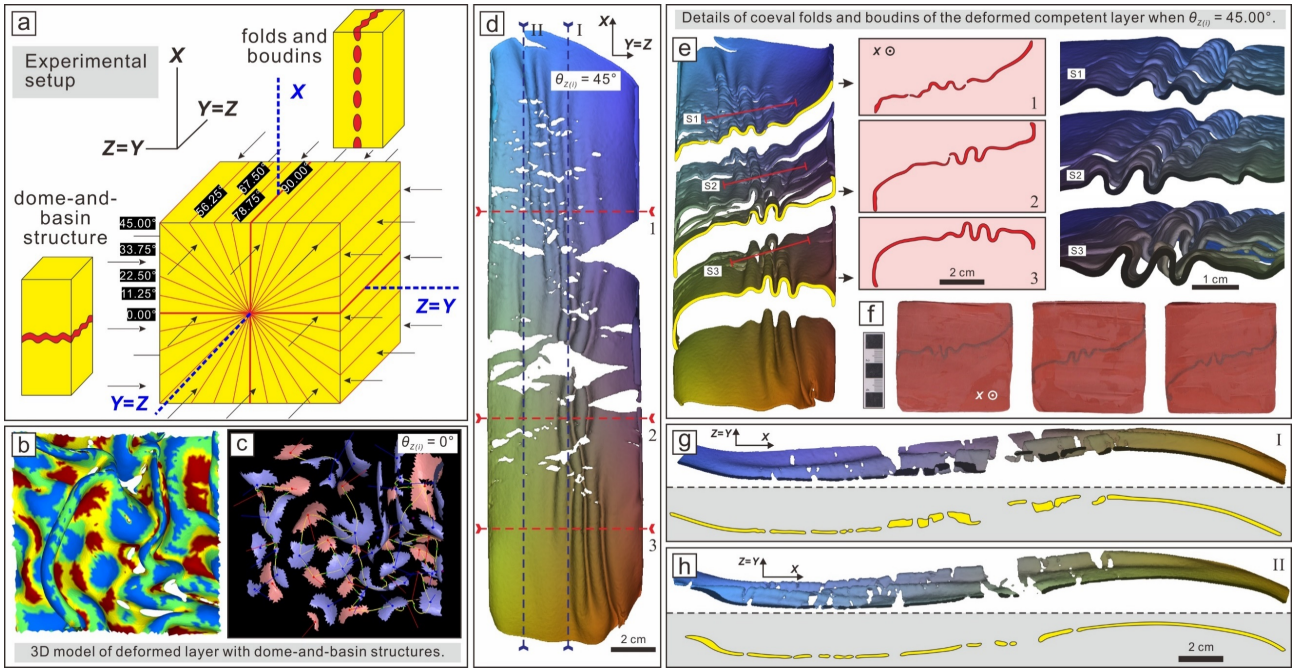
Cheng C.*[1] Zulauf J.[1] Zulauf G.[1] & Hattingen E.[2]

[1] Institut für Geowissenschaften, Goethe-Universität Frankfurt am Main, Altenhöferallee 1, D-60438, Frankfurt am Main, Germany

[2] Institut für Neuroradiologie, Universitätsklinikum, Goethe-Universität Frankfurt am Main, Schleusenweg 2-15, D-60528, Frankfurt am Main, Germany

* *Corresponding email: c.cheng@em.uni-frankfurt.de*

We conducted scaled analogue modelling using plasticine to show the influence of varying single layer obliquity on the geometry of folds and boudins under bulk constrictional strain. The initial angle between the layer and shortening axis ($\theta_{Z(i)}$) was incrementally changed from 0° to 90°, producing deformation structures from dome-and-basin folds to coeval folds and boudins. Extension-parallel folds, extension-perpendicular folds, and boudins were developed simultaneously if $\theta_{Z(i)}$ >ca. 25°.



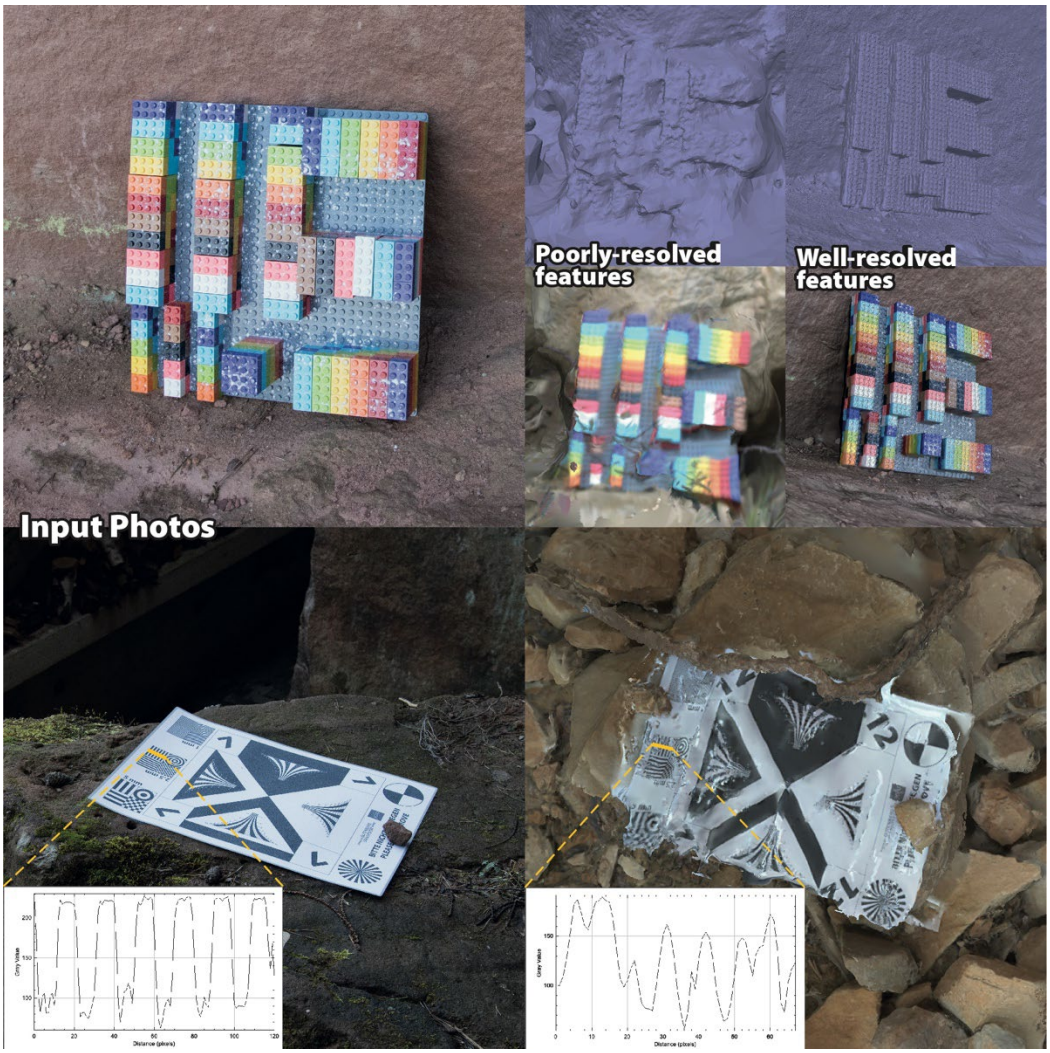
Quantifying Resolution of Digital Outcrop Models using Synthetic Test Objects

Clarke A.P.*[1], Fenske S.[1], Hawemann F.[1], Haas R.[1] & Toy V.[1]

[1] Johannes Gutenberg Universität Mainz, Germany

* *Corresponding email:* alex.clarke@uni-mainz.de

Photogrammetry outcrop models are fast becoming a standard tool for structural geologists, allowing for quantification & documentation of structures at a scale & rate not previously practical. Their spatial resolution is often poorly constrained as it is dependent on a complex combination of factors. Using synthetic objects of known dimensions within our models, we quantify spatial resolution & identify systematic errors to recognise the appropriate scales at which features can be interpreted.



Numerical modelling of the Sardinia-Corsica block lithosphere

Cocco F. *[1], Casini L.[2] & Funedda A.[1]

[1] Dipartimento Di Scienze Chimiche E Geologiche, Università Degli Studi Di Cagliari, Cittadella Universitaria, Blocco A, 09042 Monserrato, Italy

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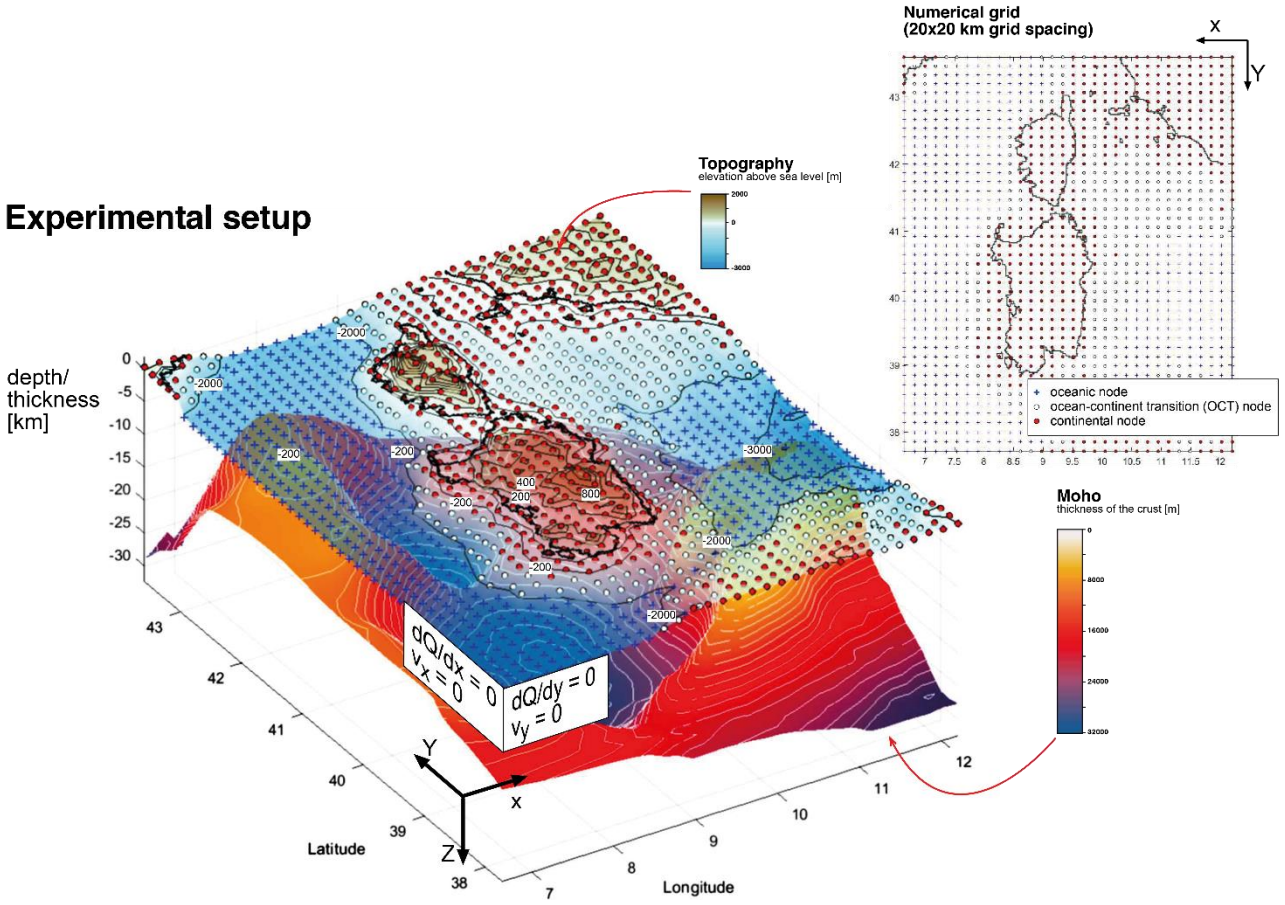
In this contribution we simulate by Finite Differences numerical modelling the structure of the Sardinia-Corsica block (SCB) lithosphere. The models allow to better define the thermal and gravity structure of the SCB and to infer the composition and geometry of the different crustal layers.

The results contribute to understanding the feedbacks between the SCB lithospheric structure and the surface dynamics expressed by diverse geomorphic features, localized neotectonics, and complex heat flow anomalies. Finally, the results are discussed in relation to the geodynamics of the western Mediterranean.



Influence of inherited superposed folding in the structural style of fold-and-thrust belts (FTB)

Cocco F. *[1] & Funedda A. [1]

[1] Dipartimento Di Scienze Chimiche E Geologiche, Università Degli Studi Di Cagliari, Cittadella Universitaria, Blocco A, 09042 Monserrato, Italy

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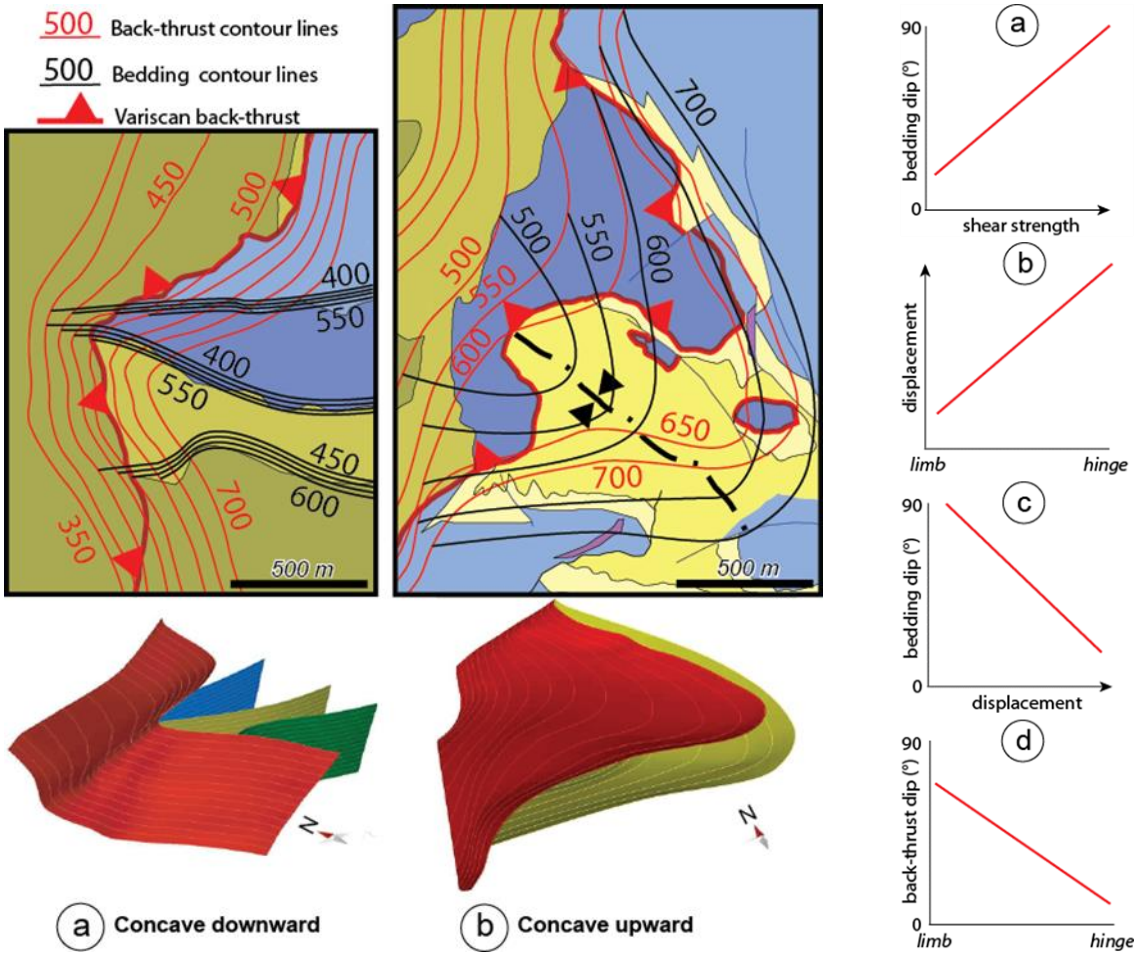
The structural style of FTB is mainly controlled by mechanical stratigraphy and pre-existing structures.

The case study presented here shows how a non-layer cake stratigraphy, characterized by superposed folds resulting in a domes-and-basin pattern, influences the location of fore- and back-thrust development, the geometry of the thrusts, and the amount of shortening and shear strength.

Here, the main controlling factor on FTB style is the attitude change of mechanical weaknesses due to the folding events.



Fracture system characterization across welds and minibasins: the Azag Minibasin field analog (High Atlas, Morocco)

Cofrade G.*[1,2], Martín-Martín J. D.[1,2], Travé A.[1,2], Teixell A.[3] El Gettafi M.[4], Carola E.[2], Cantarero I.[1,2], Ramirez-Perez P[1,2].

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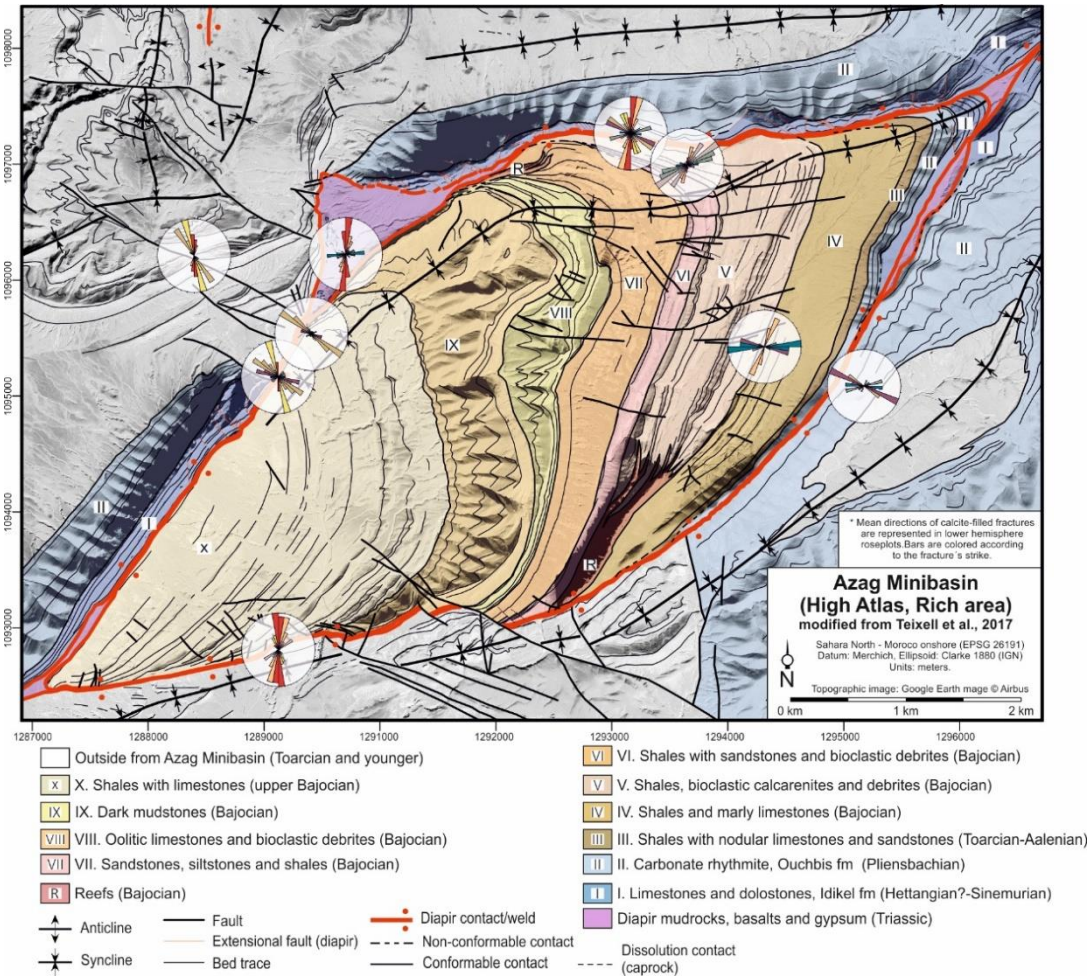
Description: The Azag Minibasin (Moroccan Atlas) is bounded by welds after former salt walls. Downbuilding occurred during early-mid Jurassic and welding during the Cenozoic orogeny. In the W, conjugate fracture systems, N-S and NW-SE, prevail in the minibasin and across welds, and their direction is consistent with the main Atlasic compressive trend. In the E, W-E fractures and macroscale faults predominate. Conjugate fractures are probably formed by the transmission of compressive stresses after welding.



Even strong materials can weak: heterogenous microstructural behaviour of amphibole and clinopyroxene from a middle crustal shear zone

Corvò S.*[1-2], Maino M.[1-2], Langone A.[1-2] & Piazolo S.[3]

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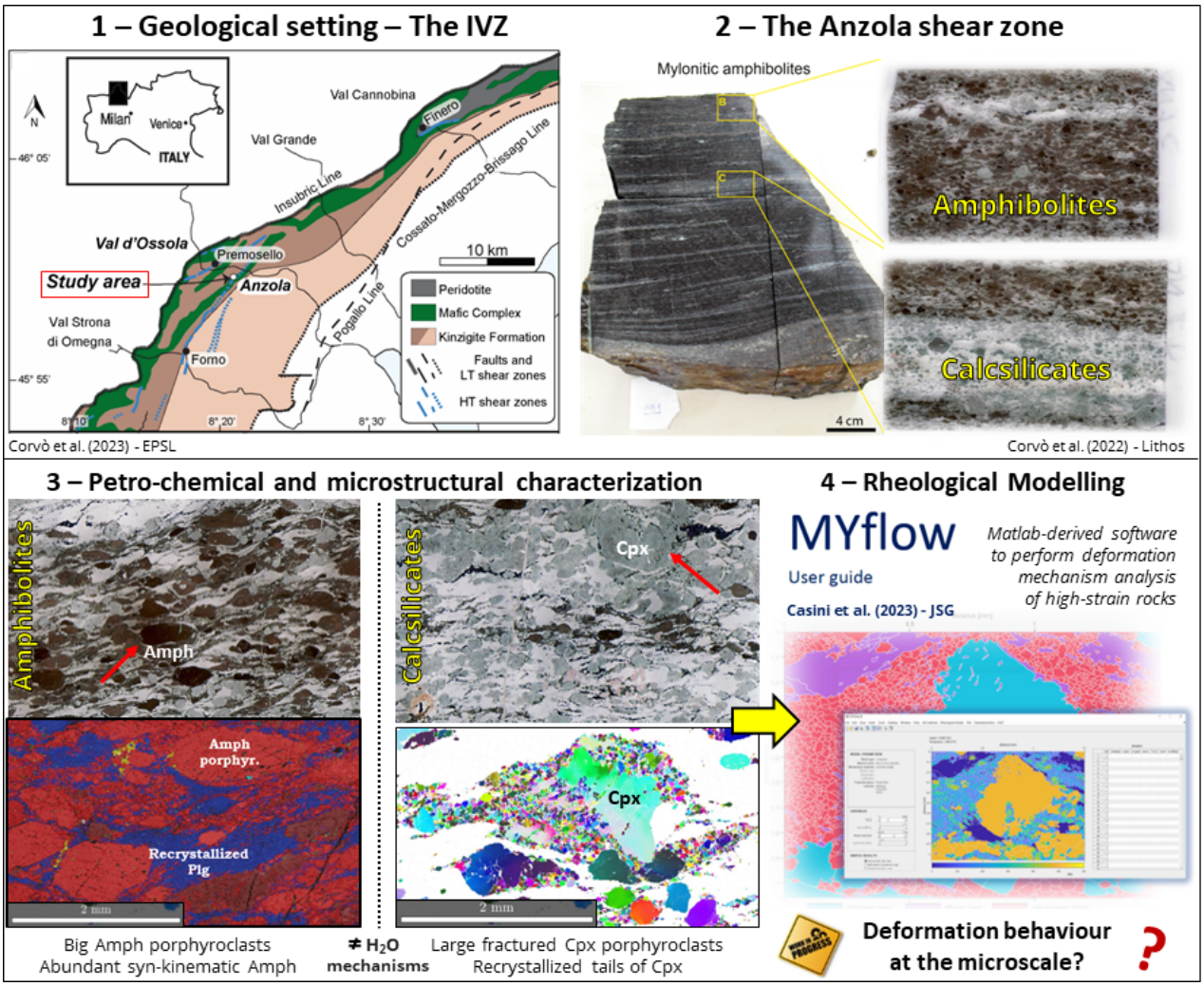
In this contribution, we investigate compositionally heterogeneous mylonites (i.e., amphibolites vs. calc-silicates) with the aim to decipher which and how deformation behaviour promoted the strain localisation in a fully ductile regime. To address this issue, we integrate microstructural, petro-chemical data and microscale rheological modelling that characterise the main mineral phases (Cpx, Amph, Plg) of a shear zone developed in the middle crust of the Ivrea-Verbano Zone (IVZ, Western Alps).



Isotopic dating of fracture-filling and sedimentary carbonates constraining the tectonic compression in the Neuquén Basin, Andean fold and thrust belt

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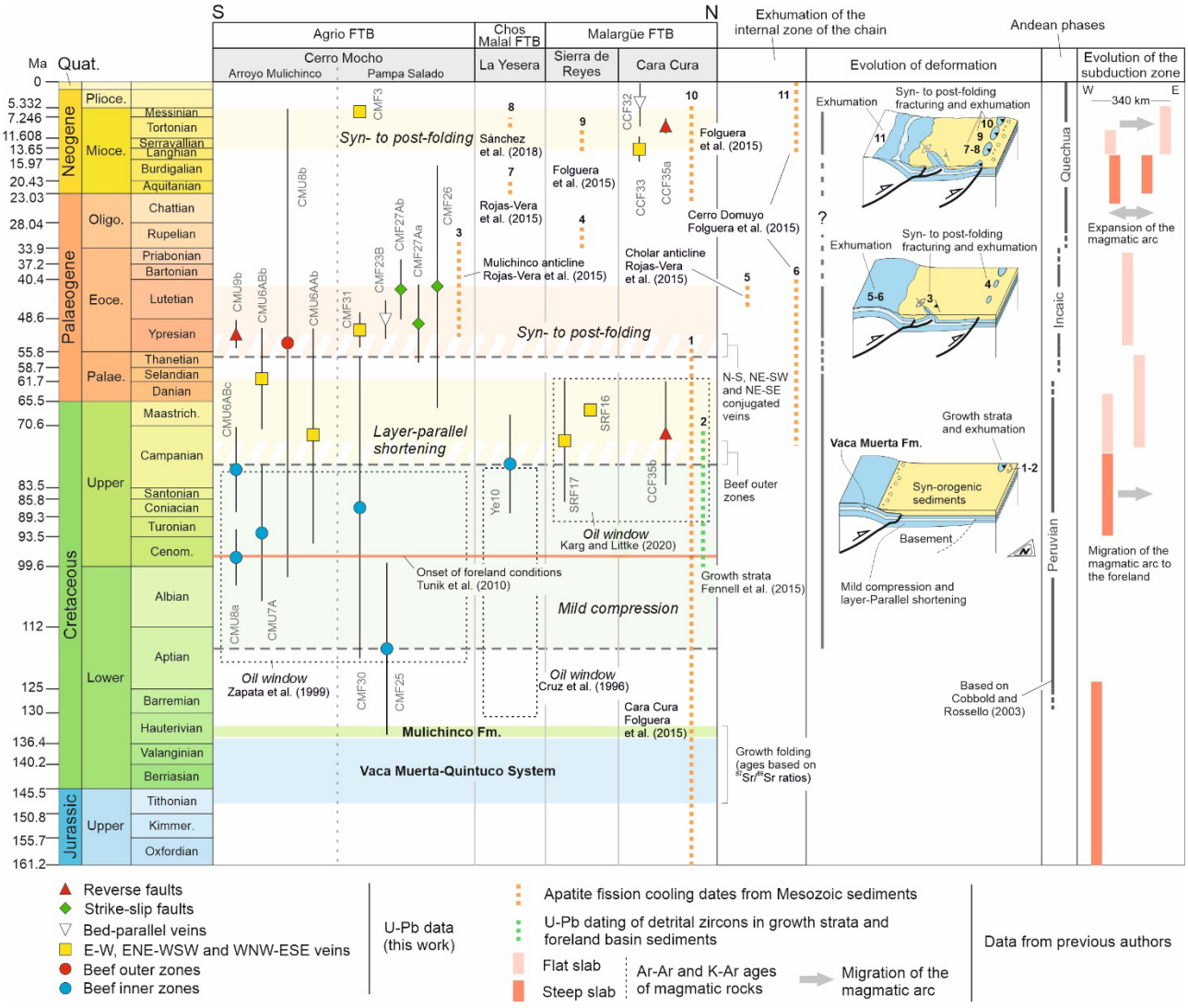
We use ages derived from $^{87}Sr/^{86}Sr$ of calcite shells and U-Pb dating of fracture-filling carbonates to constrain the timing of tectonic compression in the Neuquén Basin along the Andean front. $^{87}Sr/^{86}Sr$ measured in growth strata from the Vaca Muerta-Quintuco System reveal Late Jurassic to Early Cretaceous folding. U-Pb dating of fracture-filling carbonates reveal Early to Late Cretaceous mild tectonic pulses from 117 to 79 Ma and Late Cretaceous to Miocene folding and thrusting from 73 to 6 Ma.



Dislocation microstructures of garnet in pseudotachylyte: Implications on thermal effect, and recovery rates during seismic slip in shear zone

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[2] Kochi Institute for Core Sample Research, JAMSTEC, Kochi, 783-8502, Japan
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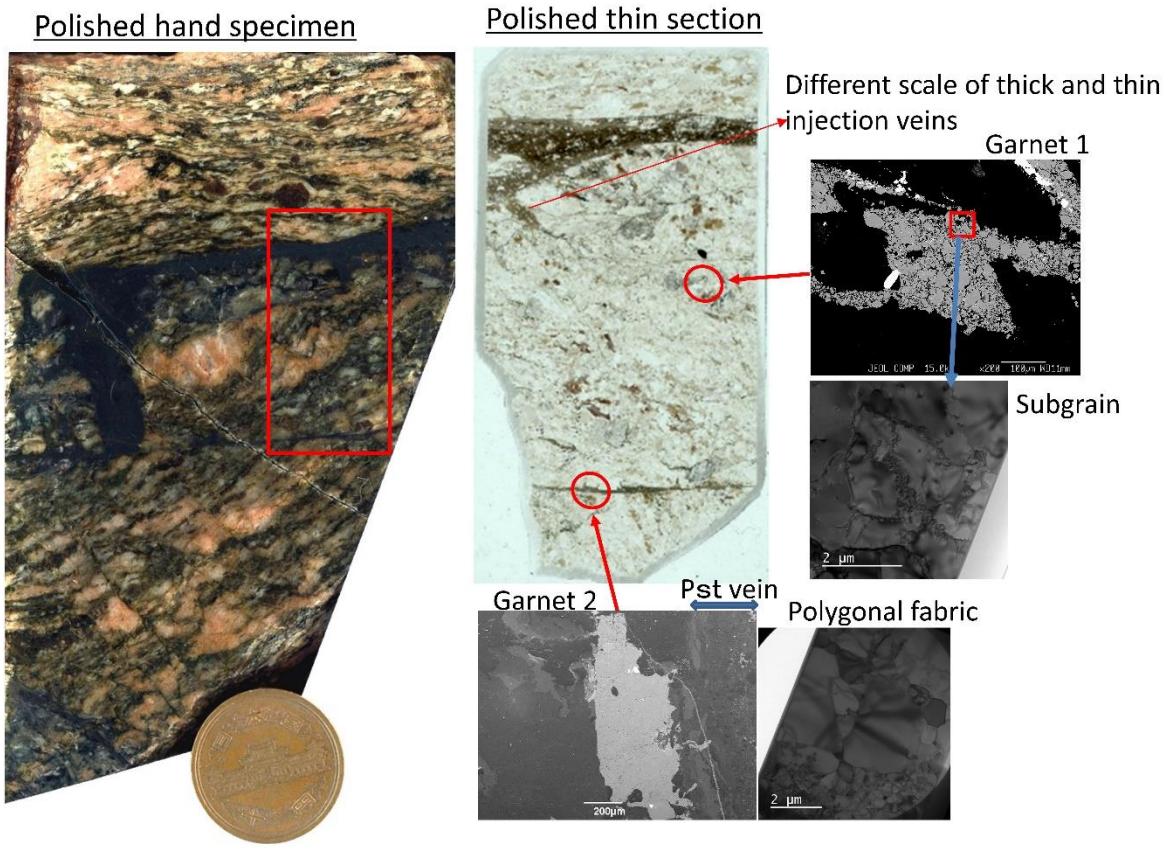
Garnet porphyroclasts in the host granite mylonite are of few hundred μm to few mm in size and do not showing any TEM microstructural indication of dislocation creep. Pseudotachylyte veins have garnet grains showing features of cataclastic flow close to the veins and occur as clusters of broken clasts of different size, and in many cases maintaining their erstwhile grain boundaries. SEM-EBSD and TEM microstructure analyses of grains at different distance from the veins reveal information regarding the depth, formation mechanism and the thermal effect during the seismic slip.



Structural, petrological and geochronological records of closure of Permian back-arc basin: Proto-Japan and its relation to NE Asian tectonics

Das, K. *[1], Mavoungou, N. L.[1], Kawaguchi, K.[1,2] & Sarkar, D. P.[1]

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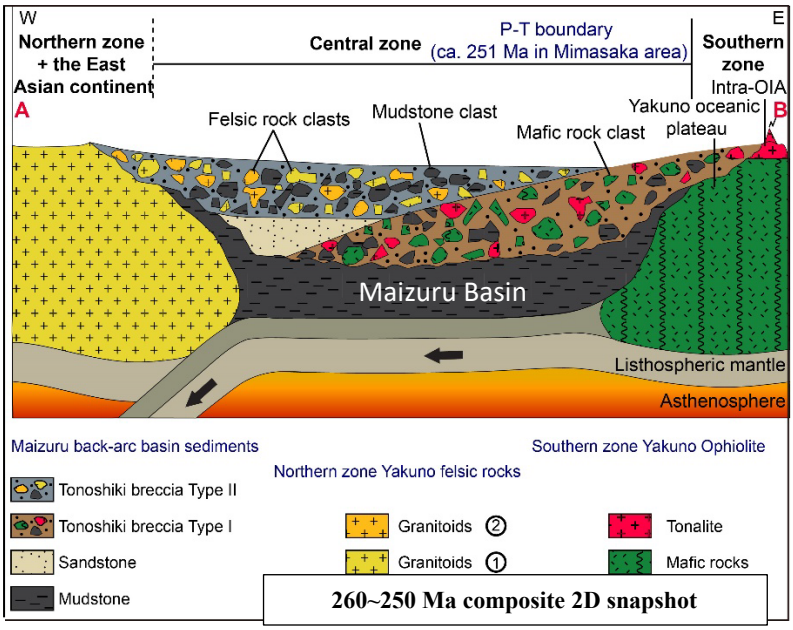
The Maizuru back-arc basin closed during the P-Tr boundary time by the subduction of the basement crust under the East Asian continent and led to the formation of the present-day Maizuru Terrane, SW Japan. Rock record of this closure event was marked by two pulses of under-sea debris flows depositing the Tonoshiki breccia (with intermittent sandstones). We shall present meso- to micro-scale structural data, U-Pb detrital zircon age data that characterize the closure event of the back-arc basin.



Deciphering stress state condition at the base of seismogenic zone: Insights from fractured feldspar porphyroclast and fault slip data from Neoarchean Closepet granite, India

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Geological Studies Unit, Indian Statistical Institute, Kolkata, India

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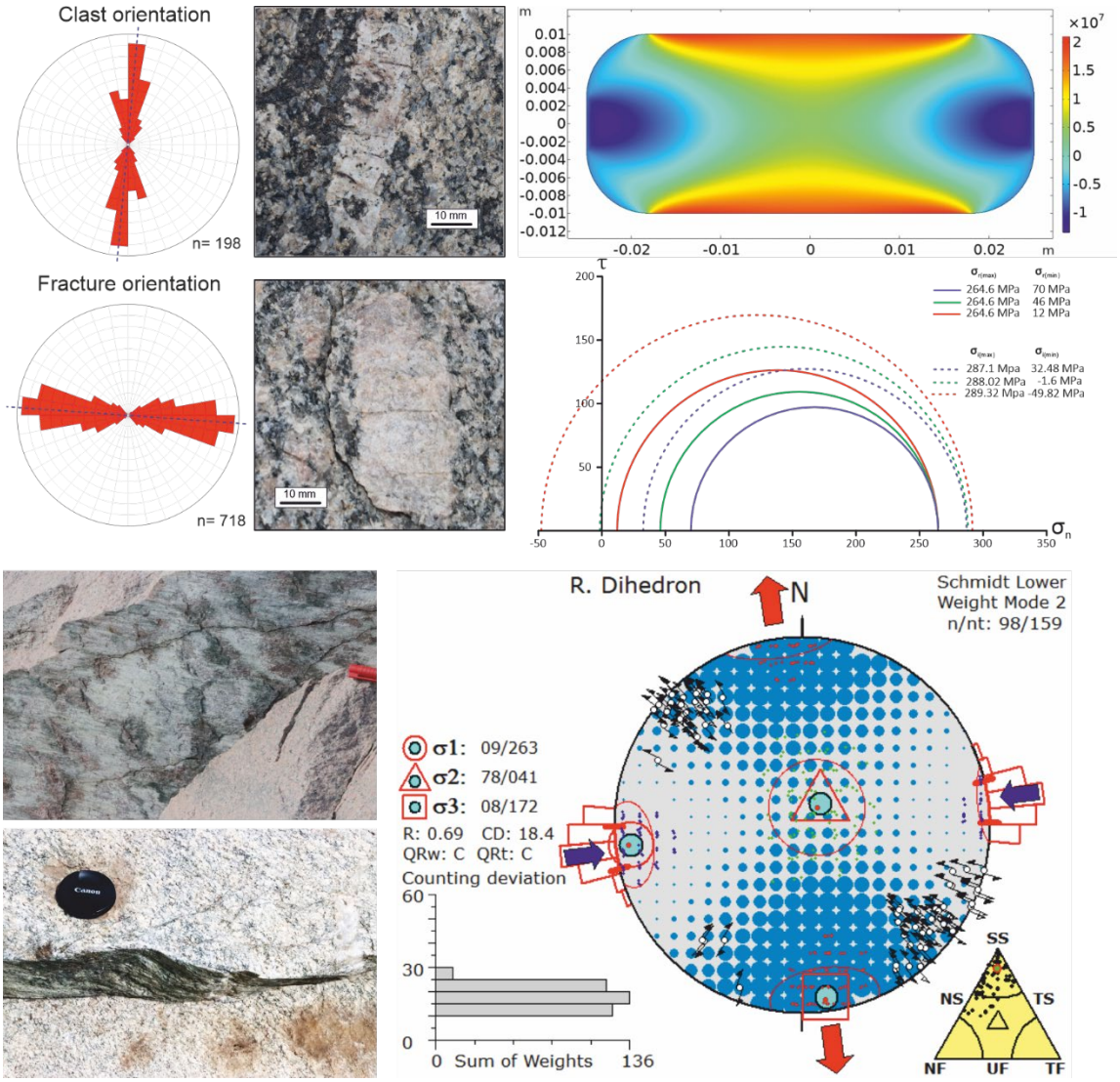
We study fractured feldspar porphyroclast and brittle faults of the Neoarchean Closepet granite, Dharwar craton, India to understand the stress state condition, which led to the formation of these features at the base of seismogenic zone. The feldspar porphyroclasts are replete with systematic tensile fractures, which are the results of far-field stress amplification inside the clast. The results obtained from fault slip analyses are in a good agreement with the observed paleostress direction.



Understanding fault architecture evolution in space and time: new structural, geochronological and thermal constraints from the Carboneras Fault (SE Spain)

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We study key outcrops of the Carboneras Fault combining (micro)structural analysis, XRD and K-Ar dating of fault gouges. Data indicate a long-lived polyphase faulting history at progressively colder conditions. NE-SW strike-slip faulting occurred during the middle-late Miocene. Recent fault activity reactivated instead E-W fabrics inherited from a phase of NNW-SSE late Oligocene shortening. Our findings offer key insights to understand the spatio-temporal evolution of major strike-slip faults.

The role of Dauphiné Twin Boundaries on grain boundary misorientation and energy distribution in quartz

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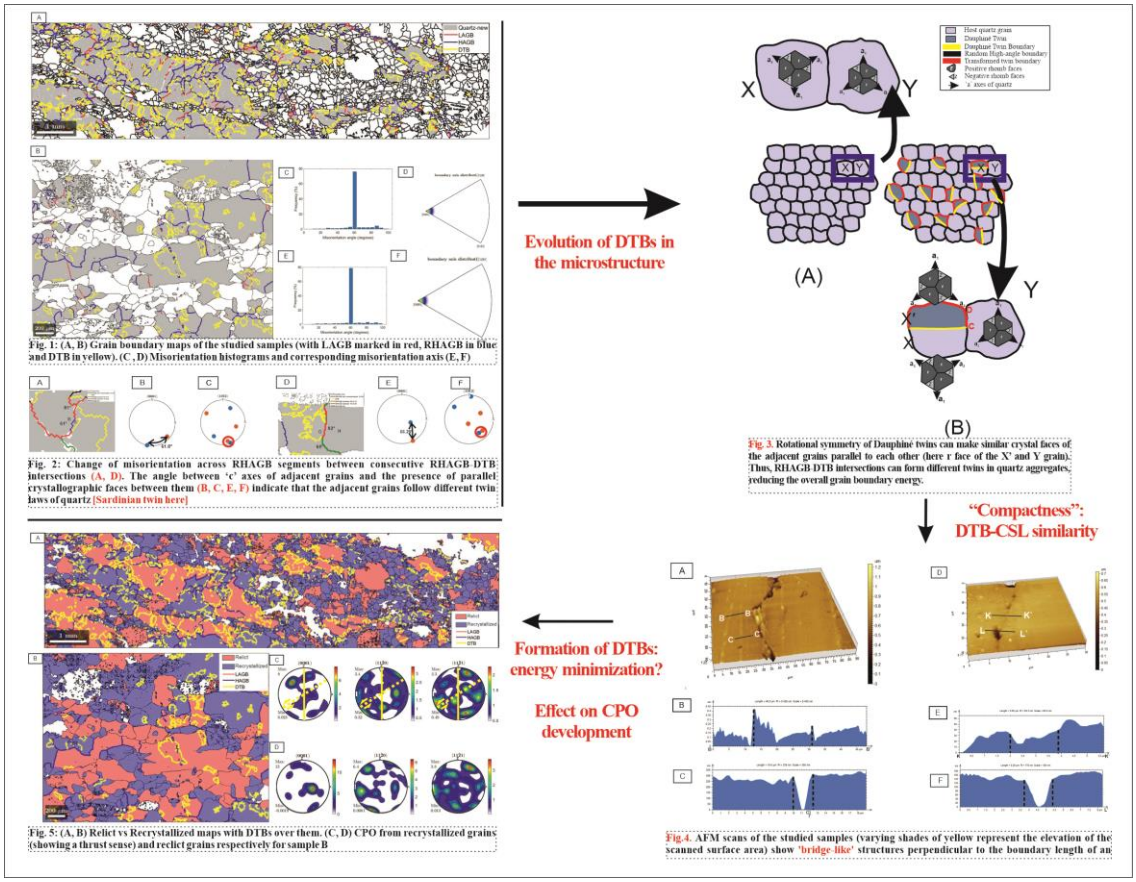
The role of coincident site lattice (CSL) relationships associated with Dauphiné Twin Boundaries (DTBs) in minimizing grain boundary energy of quartz has been investigated. EBSD misorientation maps and Atomic Force Microscopy scans of random high angle grain boundary (RHAGB)-DTB intersections indicate that formation of DTBs may result in a general reduction of grain boundary energy of quartz aggregates by developing twin relationships across the RHAGB segments bound by DTB-RHAGB intersections.



Late Variscan faults and the exhumation of high-pressure rocks (SW Iberian Massif)

Díez-Fernández R. *[1], Novo-Fernández I. [2], Moreno-Martín D. [3], Arenas R. [3], Rojo-Pérez E. [3], Martín-Parra L.M. [4] & Matas J. [4]

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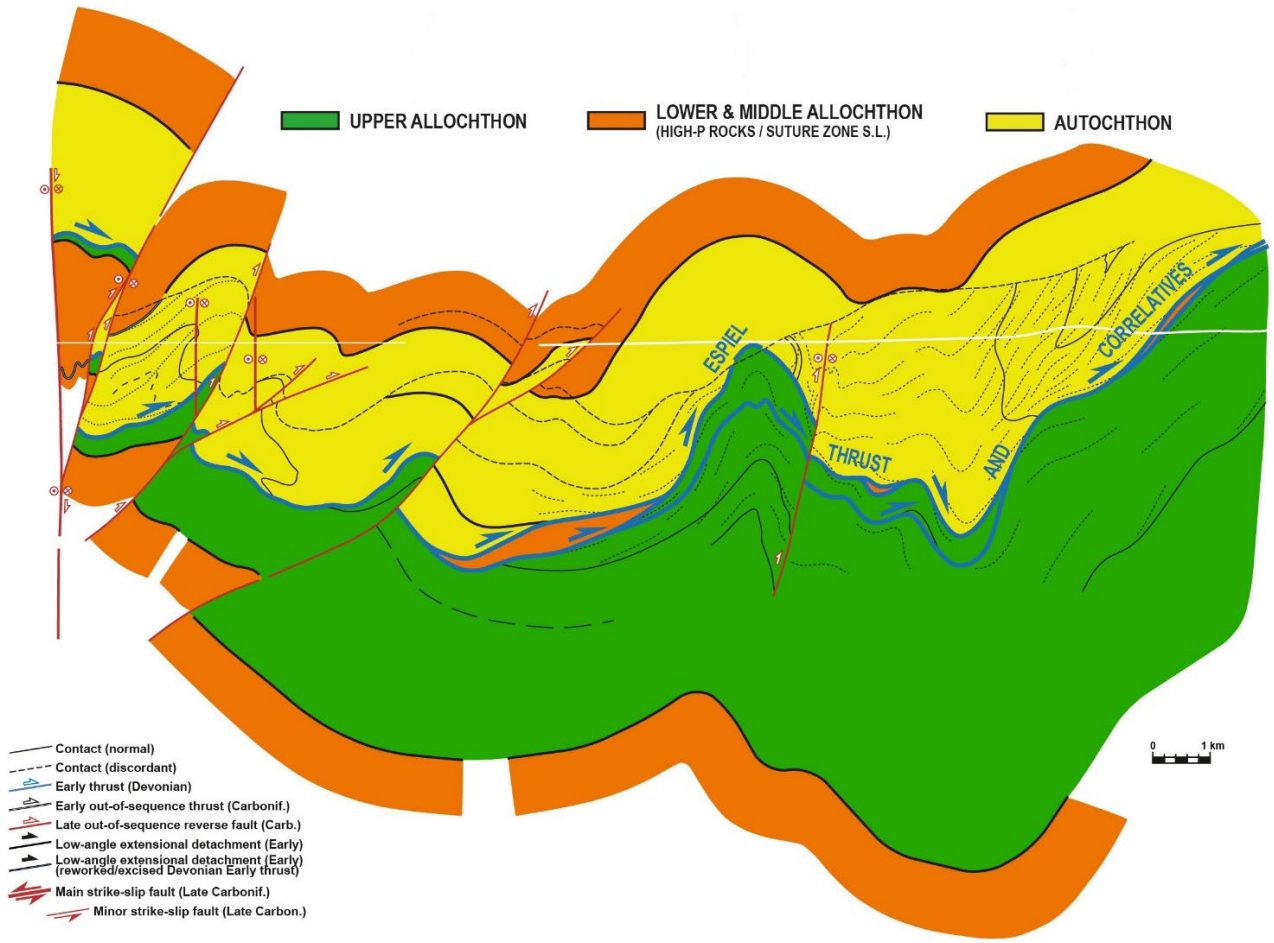
The exhumation of subducted rocks usually takes several stages of deformation. A case example is provided after performing geological mapping and structural analysis in the E part of the Central Unit (Ossa-Morena Complex, Iberian Massif). Exhumation of high-P rocks was coeval with successive thrusting events, including in-sequence and out-of-sequence thrusts. These late orogenic faults influenced a Devonian suture zone, whose exposure may be misinterpreted for a collection of several sutures.



An Alpine megafold in Central Iberia

Díez-Fernández R. *[1], de Vicente G. [2], Moreno-Martín D. [3], Fernández C. [2], Arenas R. [3], & Rubio-Pascual F.J. [4]

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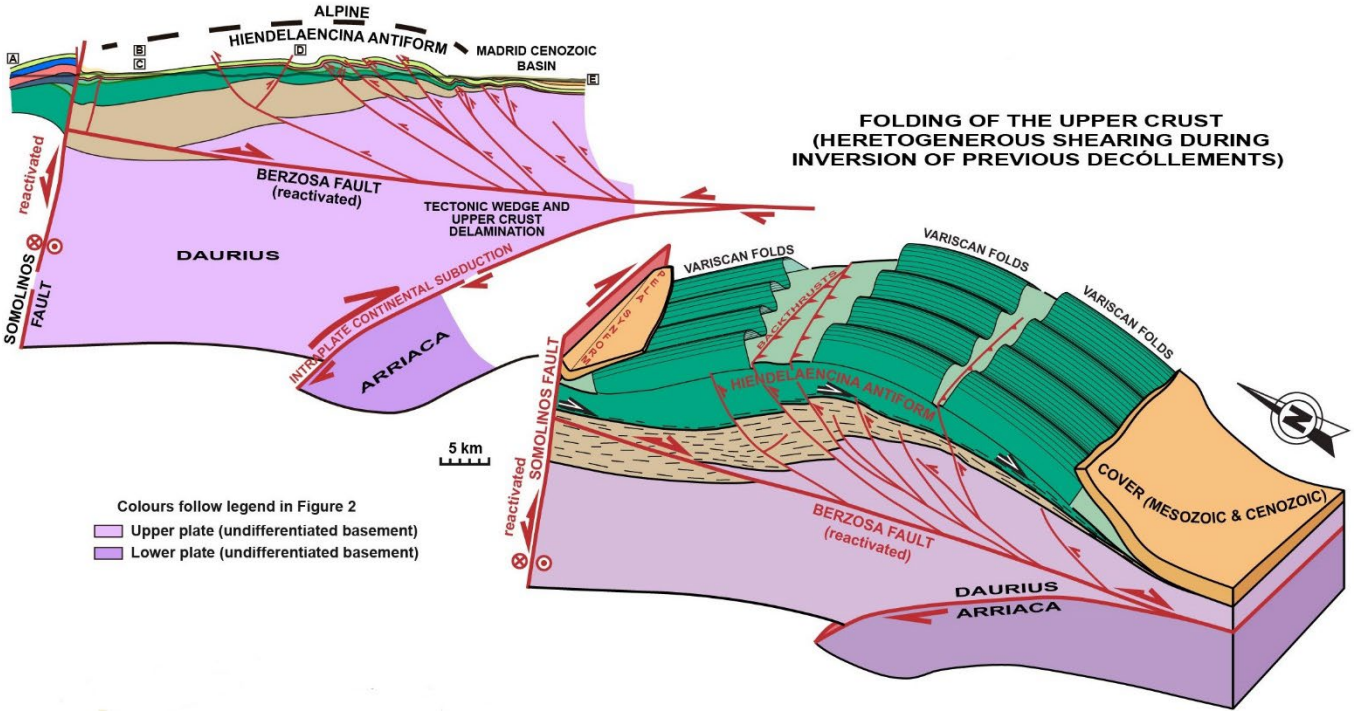
We present an Alpine mega-fold (Hiendelaencina Antiform) at the core of the Spanish-Portuguese Central System. The fold bends the basement and its sedimentary cover alike. This fold's wavelength is equal to or greater than the thickness of the crust that contains it (36-41 km). The formation of this mega-fold was assisted by heterogeneous shearing (coeval thrusting) as well as by the buttress effect of pre-existing, near-vertical, crustal-scale faults.



Tectonic and slope-scale gravitational deformation in orogenic belts: New insights from regional inventories in central Appennines (Italy)

Di Luzio E.*[1,2], Moro M.[3], Saroli M.[4], Discenza M.E.[5], Zullo E.[4], Esposito C.[6], Scarascia Mugnozza G.[6]

[1] CNR (National Research Council) - IGAG, Institute of Environmental Geology and Geoengineering, Italy

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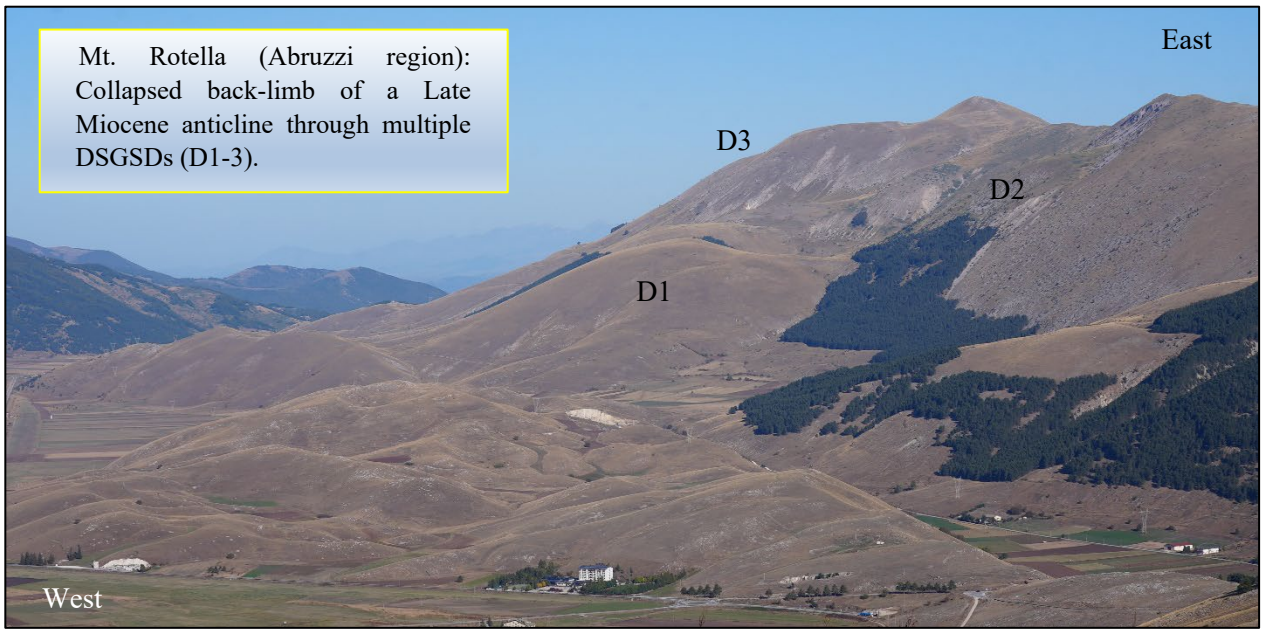
Original inventory of Deep-Seated Gravitational Deformations (DSGSDs) in the central Apennines includes about 250 cases. Relationship with tectonic features, inherited from Mio-Pliocene thrusting or due to Quaternary normal faulting, is evident. In this context, the first case of a basal shear zone at the bottom of a DSGSD found in the entire belt is documented. Field evidence and numerical modeling suggest a gravity-driven deformation mechanism for the development of non-tectonic breccias.

Image



Pre-Cenozoic brittle deformation in the southern Central Andes: K-Ar Illite dating of fault gouges suggest pre-straining of crust in the region of the Andean Plateau and Eastern Cordillera

Espinoza D. *[1-2-3], Strecker M.[1], Giambiagi L.[4], Sobel E.[1], Wemmer K.[5] & Jaldin D.[6]

[1]Institut für Geowissenschaften, Universität Potsdam, Potsdam, Germany
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[3]Instituto Milenio de Investigación en Riesgo Volcánico - Ckelar Volcanes, Antofagasta, Chile
[4]IANIGLA, CCT Mendoza, CONICET, Mendoza, Argentina
[5]Geoscience Centre, University of Göttingen, Göttingen, Germany
[6]Universidad Católica del Norte, Antofagasta, Chile

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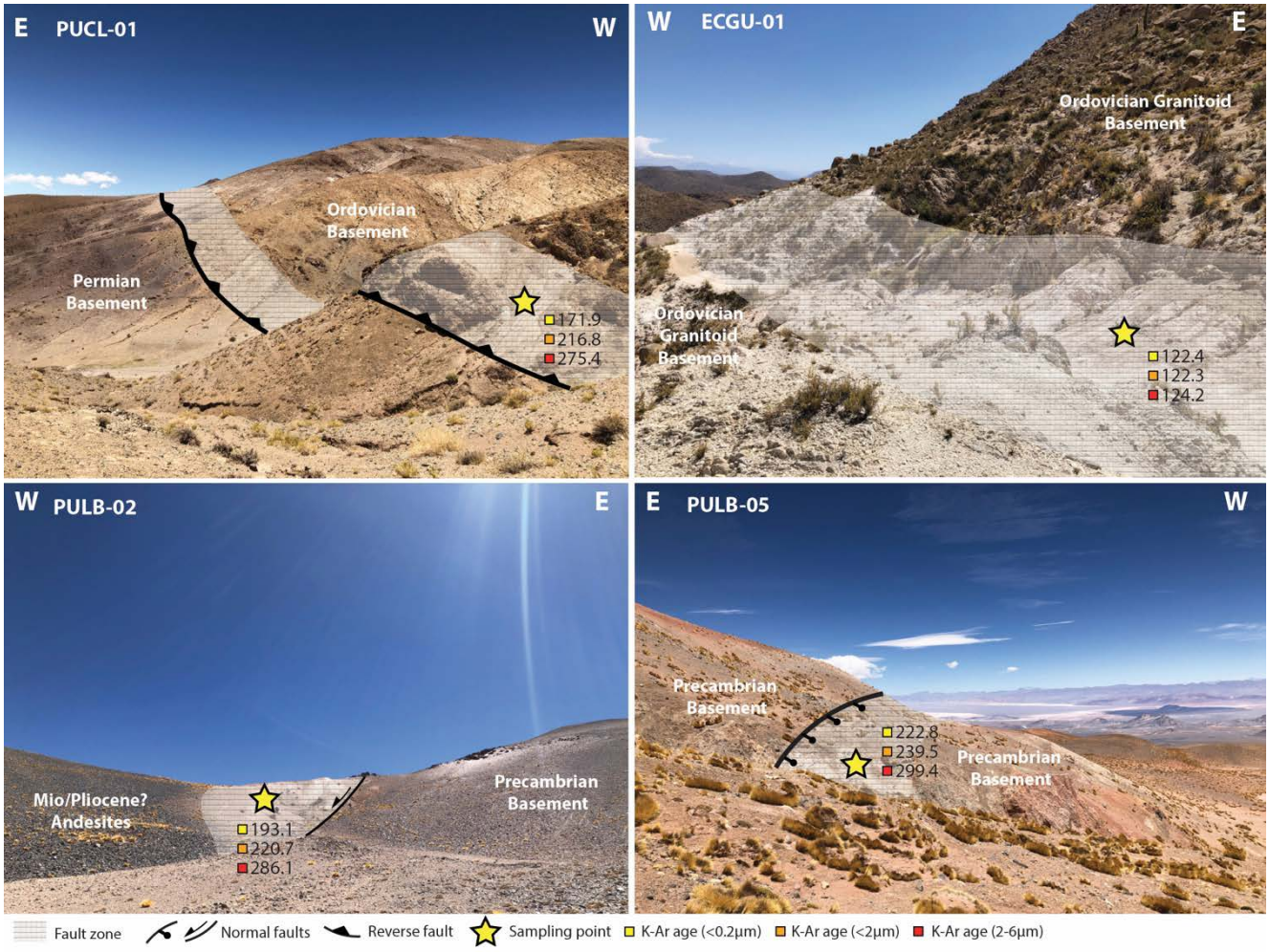
In the Andes, reactivated inherited crustal faults are known to influence regional tectonic settings. We present K-Ar illite dating of fault gouges from the southern Puna to determine the history of ancient brittle deformation. Our study yielded 12 ages from 4 samples, ranging from 299.4 to 122.3 Ma. We interpret these results to document the onset of brittle deformation in the current southern Puna realm during the Permian and an early Cretaceous event in the adjacent Eastern Cordillera region.



Mapping of Geological Fractures: A CNN Approach

Fatihi A. *[1], Samsu A. [1]

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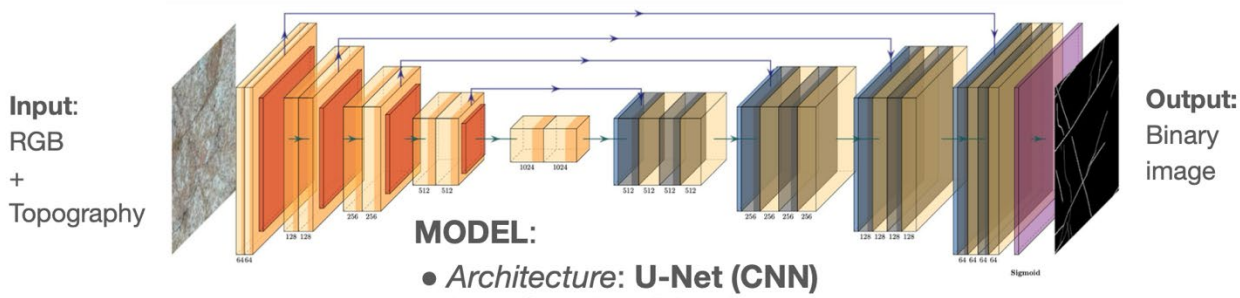
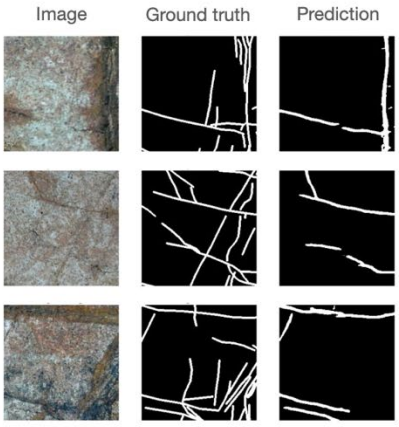
The abundance of high-resolution drone and satellite imagery presents an exciting opportunity to extract meaningful data on geological structures, including fractures. We focus on an alternative to current manual and semi-automated methods that are slow and subject to interpreter-bias. Here we use deep learning to automatically map fractures with minimal user guidance. Our U-Net CNN approach, trained on existing datasets, shows potential for faster and accurate mapping of geological structures.

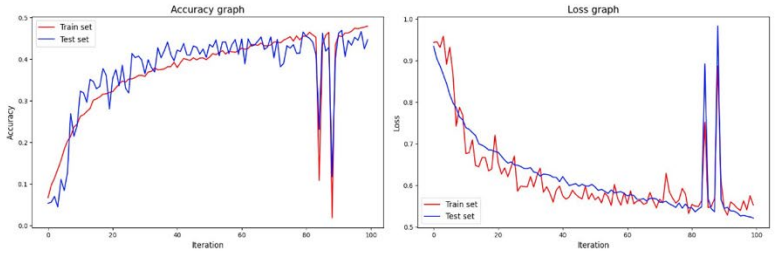
Image



Preliminary results:

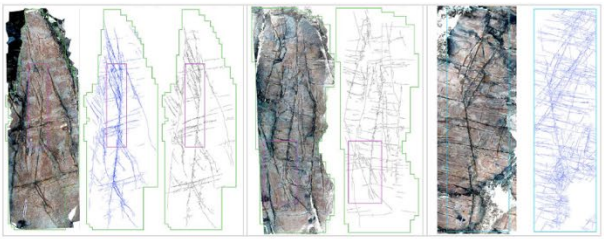


Performance:



- *Loss graph*: error as calculated by the loss function between the predictions and the true values;
- *Accuracy graph*: percentage of correct predictions throughout training.

DATA:
Mattéo et al. 2021



Mattéo, L., Manighetti, I., Tarabalka, Y., Gaucel, J.-M., van den Ende, M., Mercier, A., Tasar, O., Girard, N., Leclerc, F., Giampetro, T., Dominguez, S., & Malavieille, J. (2021). Automatic Fault Mapping in Remote Optical Images and Topographic Data With Deep Learning. *Journal of Geophysical Research: Solid Earth*, *126*(4), e2020JB021269. https://doi.org/10.1029/2020JB021269

Strain analysis of intrusive rocks using field measurements and 3D virtual outcrop models

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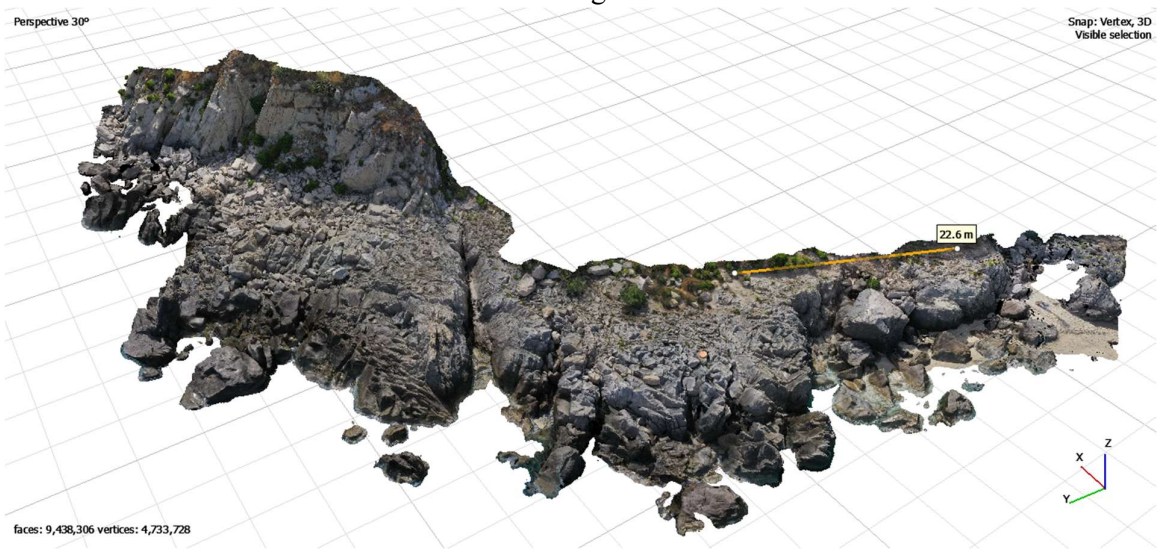
We have conducted analyses and measurements on various geological objects within magmatic rocks, both in situ and through the use of 3D digital outcrop models created using drone surveys or LiDAR scanners. This presentation includes examples of strain analysis by examining axial ratios and orientations of markers such as K-feldspar mega-crystals in granodiorites, as well as felsic dykes or mafic microgranular enclaves in tonalites. These remarkable examples are well-exposed outcrops of Variscan magmatic units within the Serre Batholith in Calabria, Italy.

Image



An integrated multiscale approach, from microfabric analysis to field- and UAV surveys of mylonites (Calabria, Italy)

Fazio E. *[1], Ortolano G.[1], Alsop G.I.[2], D'Agostino A.[1], Visalli R.[1], Luzin V.[3], Salvemini F.[3] & Cirrincione R.[1]

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[2] University of Aberdeen, United Kingdom
[3] ANSTO Sydney, Australia

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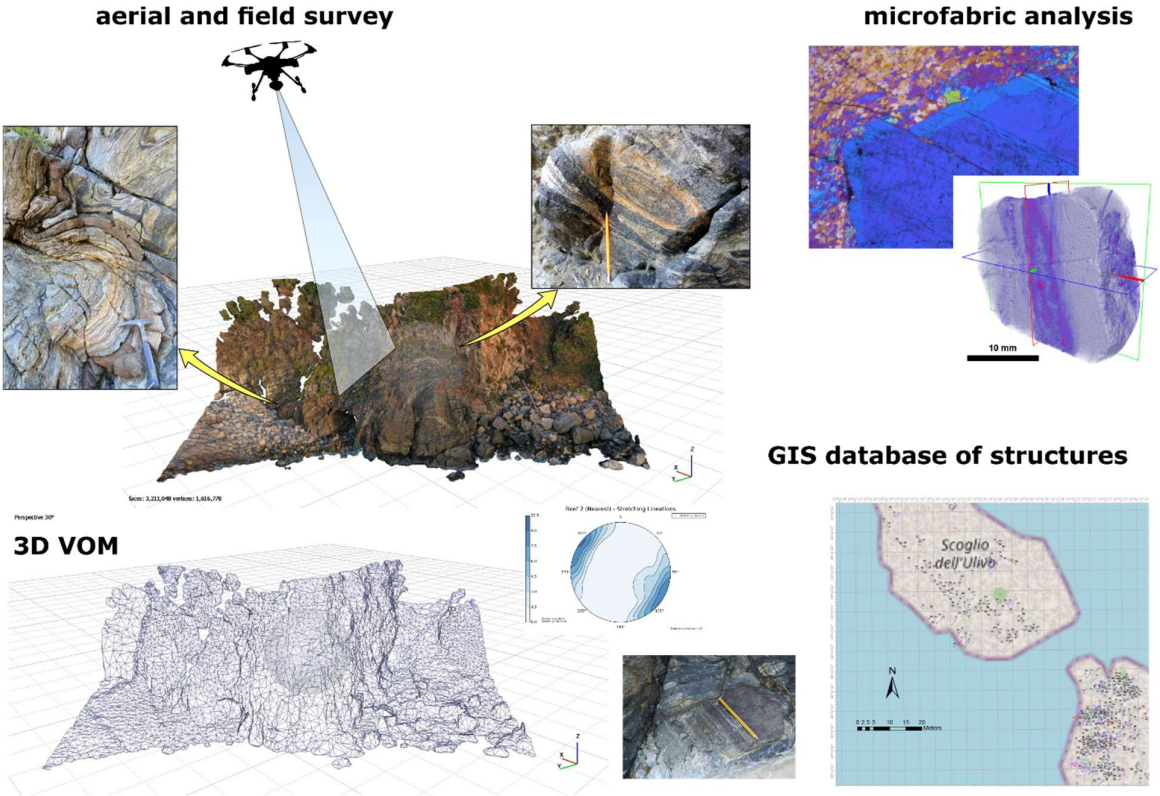
We collected structural data orientations of the Palmi shear zone (Calabrian-Peloritani Terrane) through various analytical and field-based techniques. The shear zone involves metamorphic rocks, Hercynian tonalites, pegmatites, and Late Hercynian dykes. The analysis revealed kinematic complexities, including opposing shear senses due to high rock viscosity contrasts and progressive deformation. This shear zone exhibits a switch from sinistral to dextral shear, reflecting a mix of factors influencing shear strain patterns and deformation history.

Image



Kinematic modeling of fault-related structures within anisotropic layered rocks of Northern Calcareous Alps (Eastern Alps, Austria)

Fiałkiewicz M.*[1], Grochmal B.[1], Olkowicz M. [1], Dąbrowski M.[1], Grasemann B.[2] & Fernandez O.[2]

[1]Computational Geology Laboratory, Polish Geological Institute - National Research Institute, Poland
[2]Department of Geology, University of Vienna, Austria

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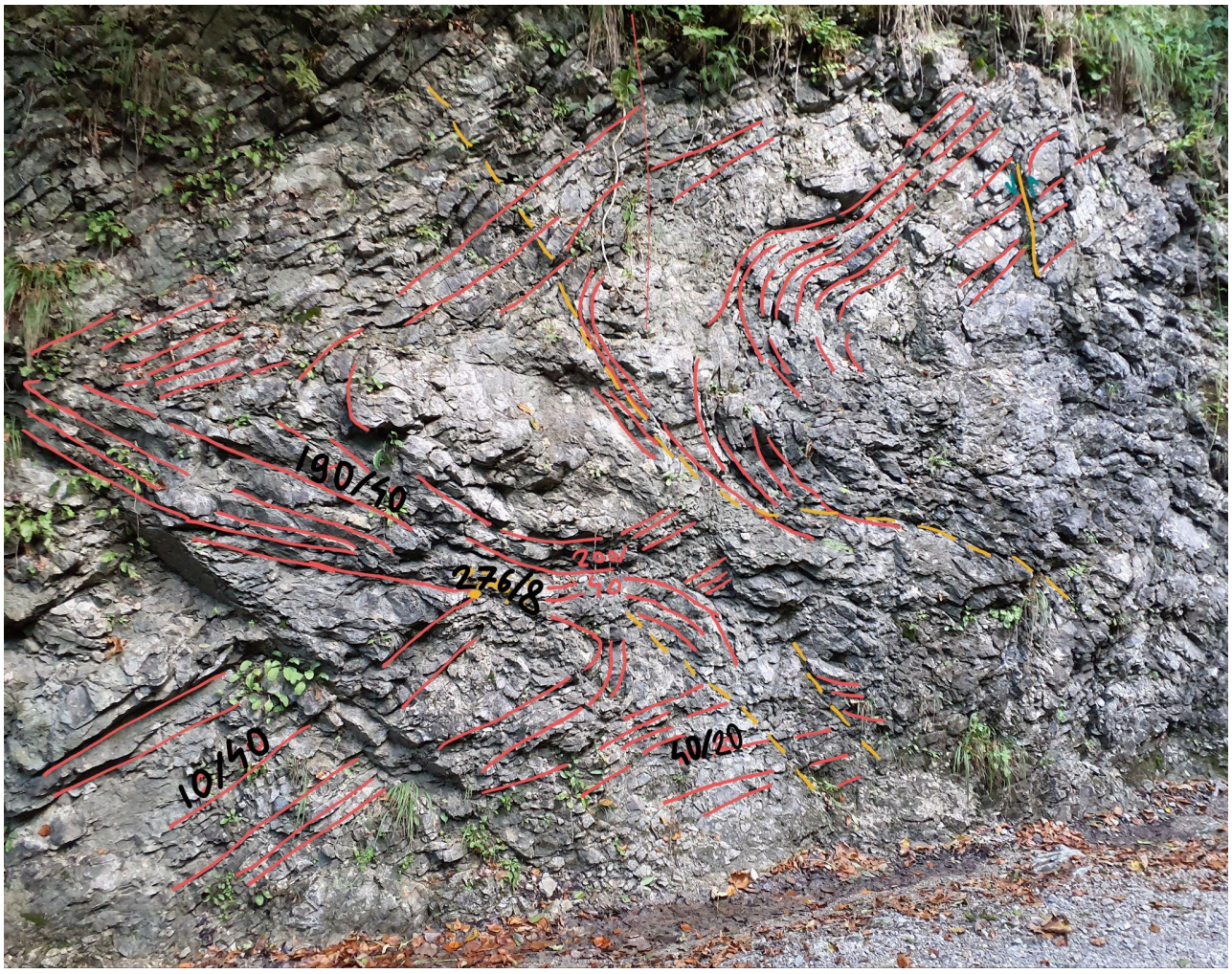
This study explores fault-related structures evolution in anisotropic layered rocks in the Northern Calcareous Alps. The role of mechanical anisotropy was examined in the Werfen Fm and Oberalm Fm. Kinematic modeling limitations were confirmed in Move software, highlighting the impact of rheological contrasts on folding and faulting distribution. Hybrid kinematic models yielded acceptable results, emphasizing the importance of considering anisotropic strain distribution in sedimentary units in regional-scale modeling.



Microstructural evolution of ductile shear zones during tectonic switching

Finch, M. A.[1*], Bons, P. D.[2], Weinberg, R. F.[3], Llorens, M. G.[4], Griera, A.[5], & Gomez-Rivas, E.[6]

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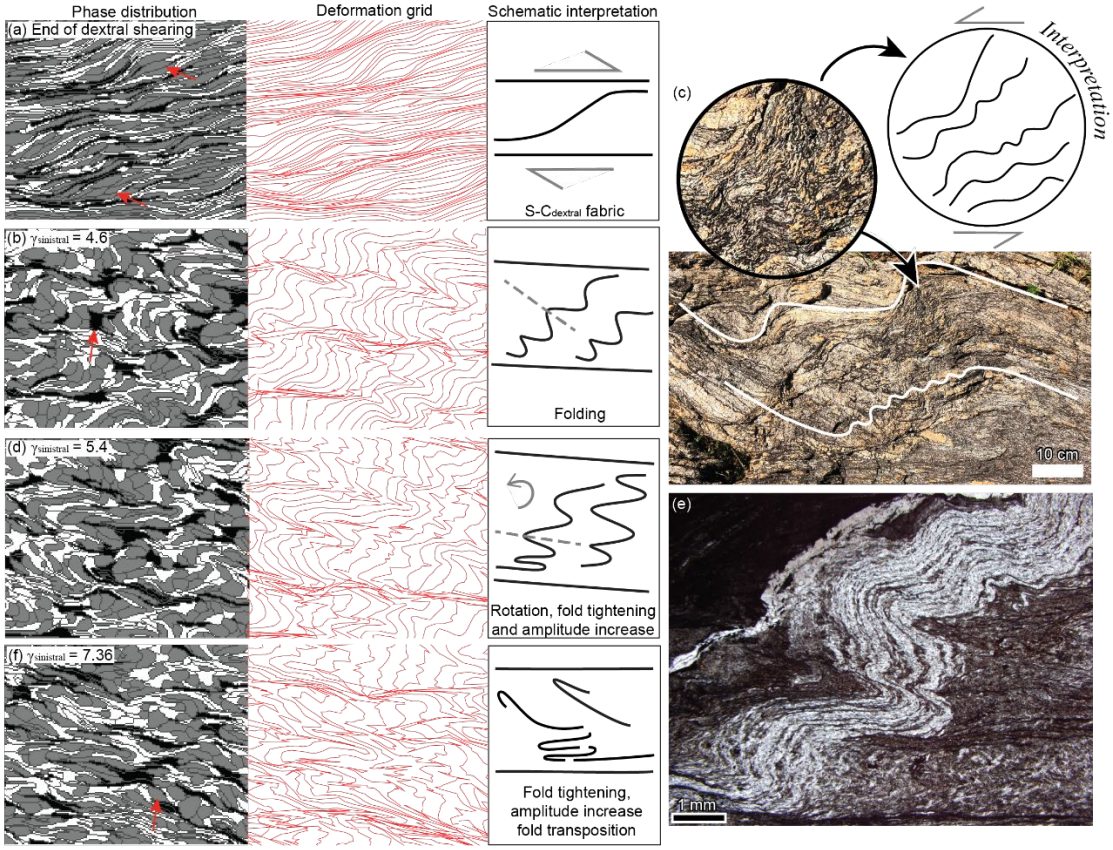
Ductile shear zones that reactivate a coplanar shear zone with opposite shear sense are known from several tectonic environments. Using numerical modelling we demonstrate the effect of D1 structures on the development of shear zone interference patterns during a coplanar, opposite sense D2 ductile shearing event. Interference patterns in models are similar to those in naturally deformed shear zones, suggesting the models are valid representations of the natural system.



Structures that form during tectonic switching. Figures on the left (a, b, d and f) show the phase distribution, deformation grids and schematic interpretation of main structures of a model deformed by dextral shear (a) and then reactivated under sinistral shearing (b,d,f). (a) The microstructure at $\gamma_{dextral}$ = 6 is defined by S-C fabric with a number of long shear planes with high strain rate that are defined by connected grains of WP. (b) After sinistral shearing to $\gamma_{sinistral}$ = 4.6, folds develop with axial planes perpendicular to the maximum shortening direction. Note the irregular shape of WP grains and layers, forming tabular or triangular grains with pinched corners (arrow). (c) Outcrop from the Darling Fault in Perth, Australia, where dextral shearing was overprinted by sinistral shearing. Folds have developed with axial planes perpendicular to the maximum shortening direction for sinistral shearing, as seen in the models in (b). (d) Folds rotate and stretch by $\gamma_{sinistral}$ = 5.4 so that the axial planes of most folds are parallel to the shear zone boundary. (e) A similar structure to that in (d), in a thin section from the Zanskar shear zone, where normal shearing overprinted thrust shearing. (f) Folds are isoclinal by $\gamma_{sinistral}$ = 7.36, with axial planes parallel to C plane or S planes and attenuated or sheared off limbs. By $\gamma_{sinistral}$ = 10.02 no evidence of hybrid structures remains and the fabric is completely transposed.

Porosity changes in shear zones during tectonic switching

Finch M. A. *[1,2], Tomkins, A. T.[2], Styles, M.[1], Gomez-Rivas, E.[3], Bons, P. D.[4]

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[2]Monash University, School of Earth, Atmosphere and Environment, Clayton, Victoria, Australia
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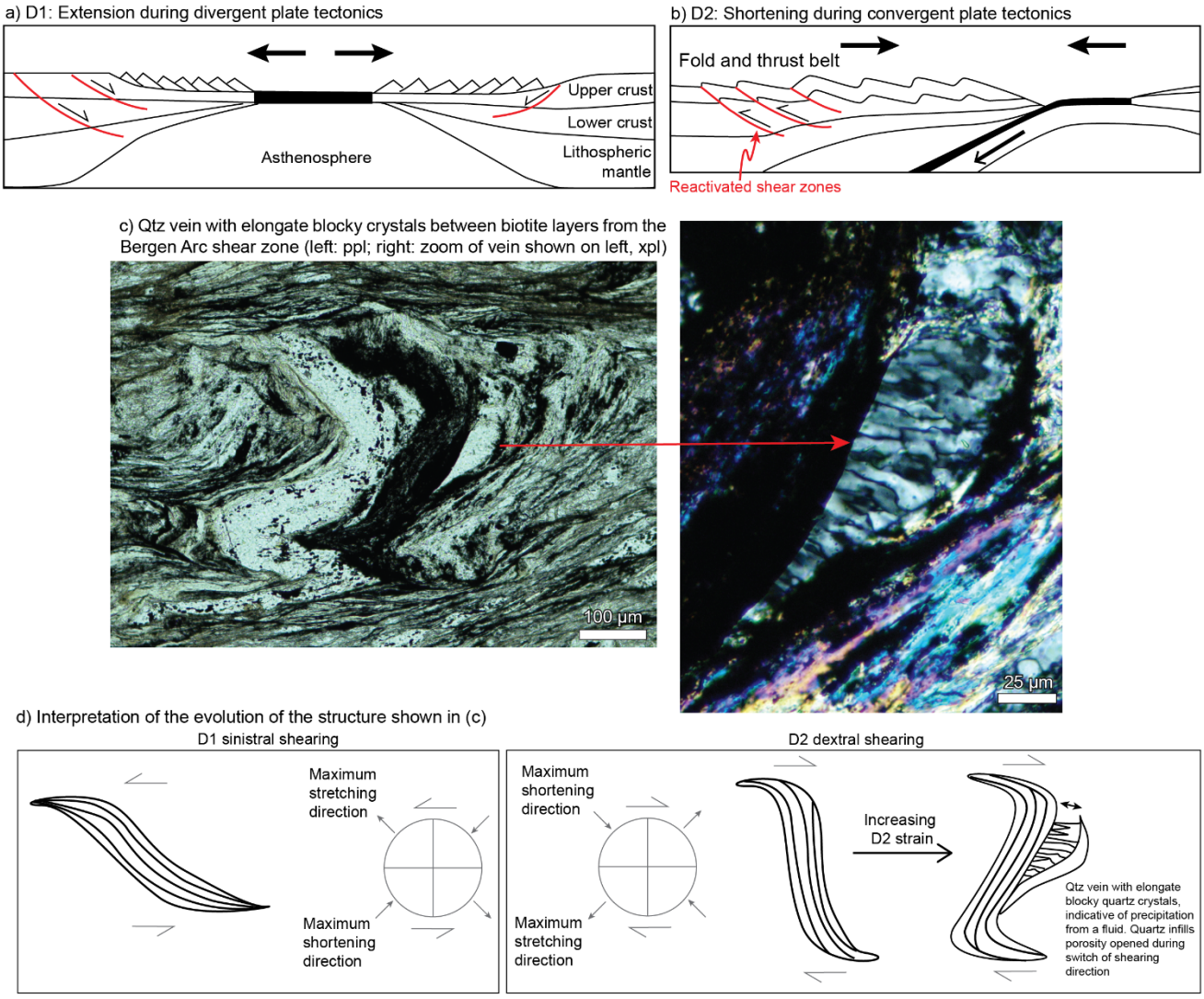
Switching between extension and shortening on tectonic plate boundaries is linked to hydrothermal ore deposit formation within shear zones. During tectonic switches, shear zone structures that accommodated deformation before the switch reconfigure to accommodate the new shearing direction. Through observation of structures and porosity in naturally deformed rocks and numerical modelling, we show how new fluid pathways develop during tectonic switching, which may have implications for the formation of ore deposits.



Thermomechanical modelling of uplift during lithospheric slab tearing and its topographic impact on S Iberia basins

Garcia-Castellanos D. *[1], Boonma K.[1], Jiménez-Munt I.[1], Gerya T.[2], Viaplana, M.[1]

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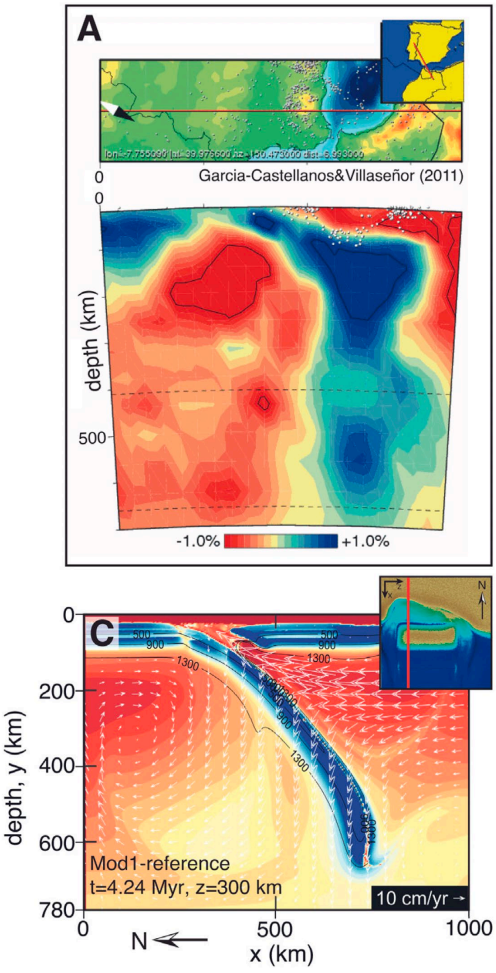
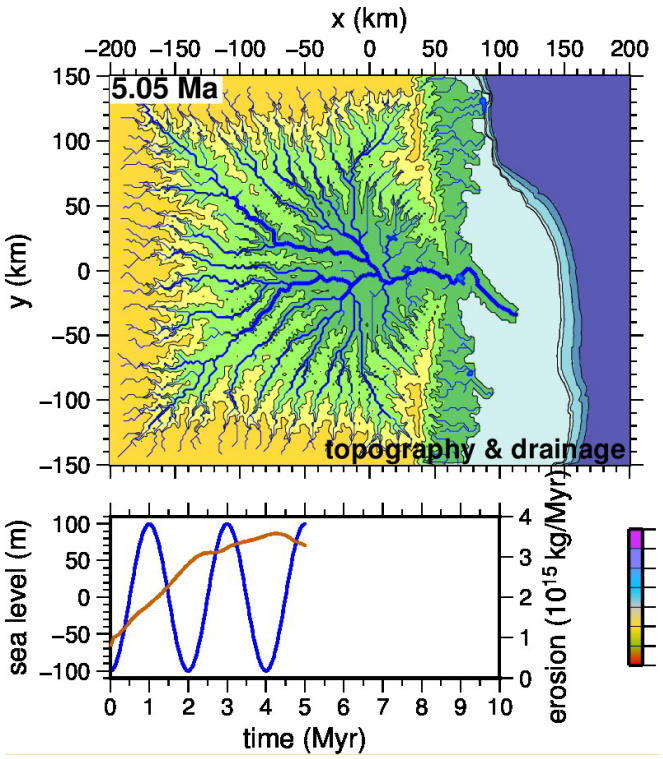
Based on thermomechanical geodynamic numerical models (A), seismic tomographic imaging (C), and sedimentological data, we will discuss the evolution of intramountain sedimentary basins in the Betic Cordillera (S Iberia) that have undergone a transition from endorheic to exorheic conditions during the Pliocene and the Quaternary. We will address the mechanisms responsible for this drainage evolution using results from a landscape evolution model (LEM) coupling fluvial erosion and vertical tectonic motions (right).





Miocene soft-sediment deformation structures around Madrid (Spain).

Giraldo, C. *[1]

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Thanks to satellite images, remote areas can be analyzed from the office, and field missions can be optimized; eventually, outcrops could be described thanks to “Street View” (Google maps).

Tectonic features shown along highways and railroads have traditionally been associated with karst processes. (Fig. 1). The age of these deformations would be late Miocene and could have occurred during significant ground acceleration peaks triggered by seismic events, which allowed karst collapses.

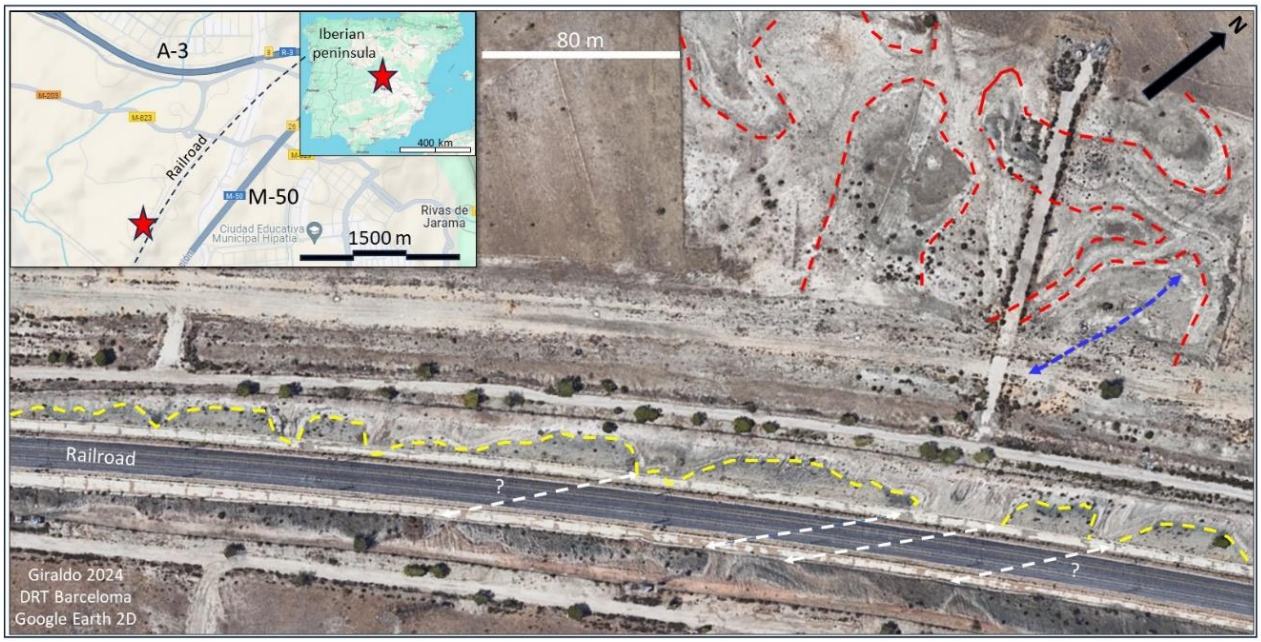

Fig. 1 Anticlinorium oblique to railroad tracks (yellow), beds (red), and anticline axis (blue).

Formation of gypsum vein networks in a deformed zone: insights from the Montsant anticlinorium (Catalan Coastal Ranges)

Gomez-Rivas E.*[1] Martínez C.[1] Playà, E.[1] Carrazana, A.[1] Gayà, C.[1] Griera, A.[2]

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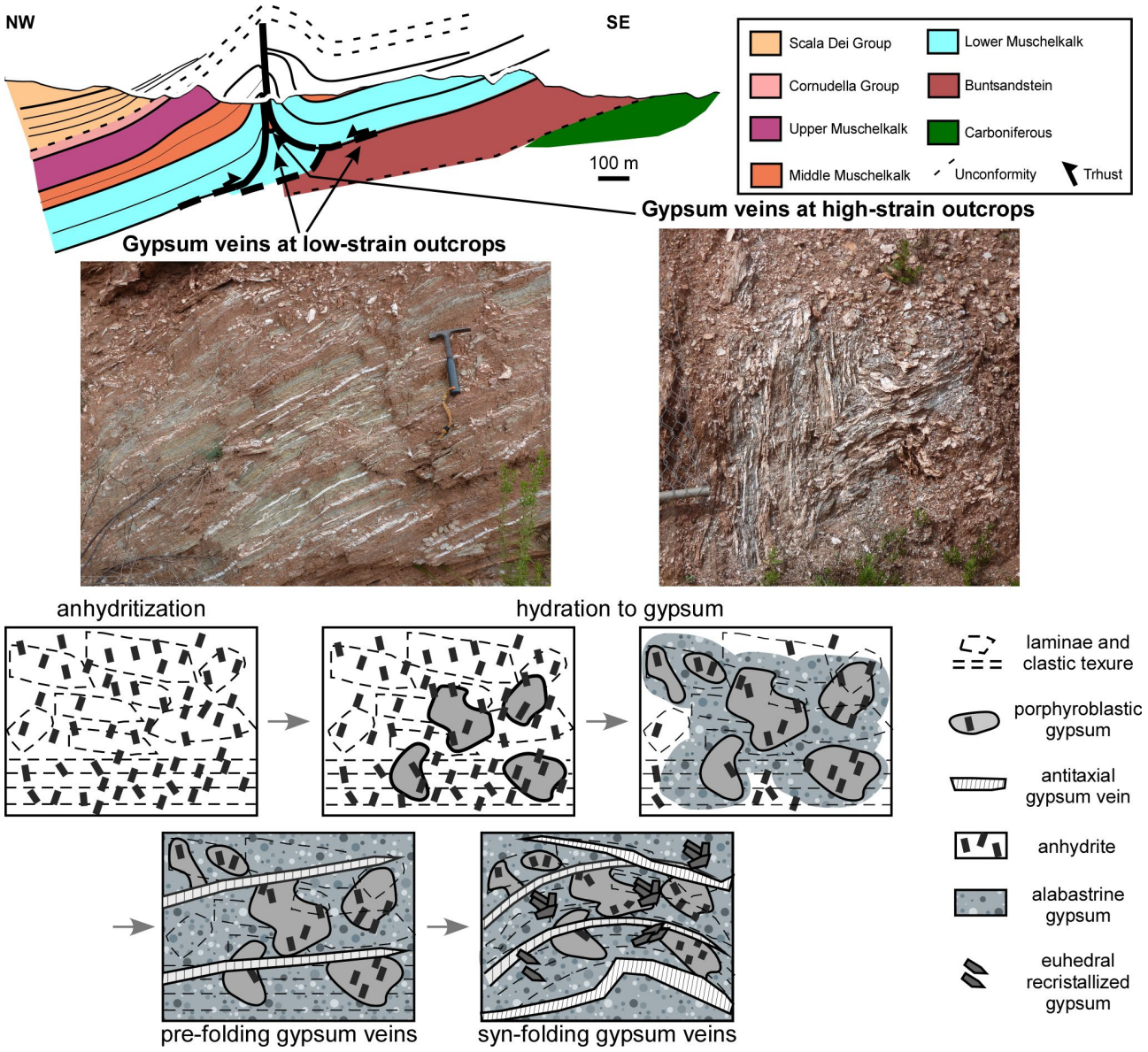
The Montsant anticlinorium is a triangular type I zone with two opposite faults in the study area. The core consists of middle Muschelkalk (M2) siltstones with gypsum and an intensively deformed zone with antitaxial gypsum veins. The study shows: (1) primary gypsum facies were transformed to anhydrite at ~500 m, (2) anhydrite was hydrated to secondary gypsum during Alpine exhumation, and (3) two sets of veins formed: one pre-folding (closed system), and one syn-folding (slightly open system).



Coupled mylonitization and giant quartz vein formation in the basement of the Pyrenees

González-Esvertit E.*[1,2] Canals A.[1] Prieto-Torrell, C.[1] Bons, P.D.[3] Llorens, M.-G.[2] Casas, J.M.[4] Aguilar, C.[1] Neilson J.[5] Elburg M.A.[6] Gomez-Rivas E.[1]

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[5] School of Geosciences, King's College, University of Aberdeen, AB24 3UE Aberdeen, United Kingdom.

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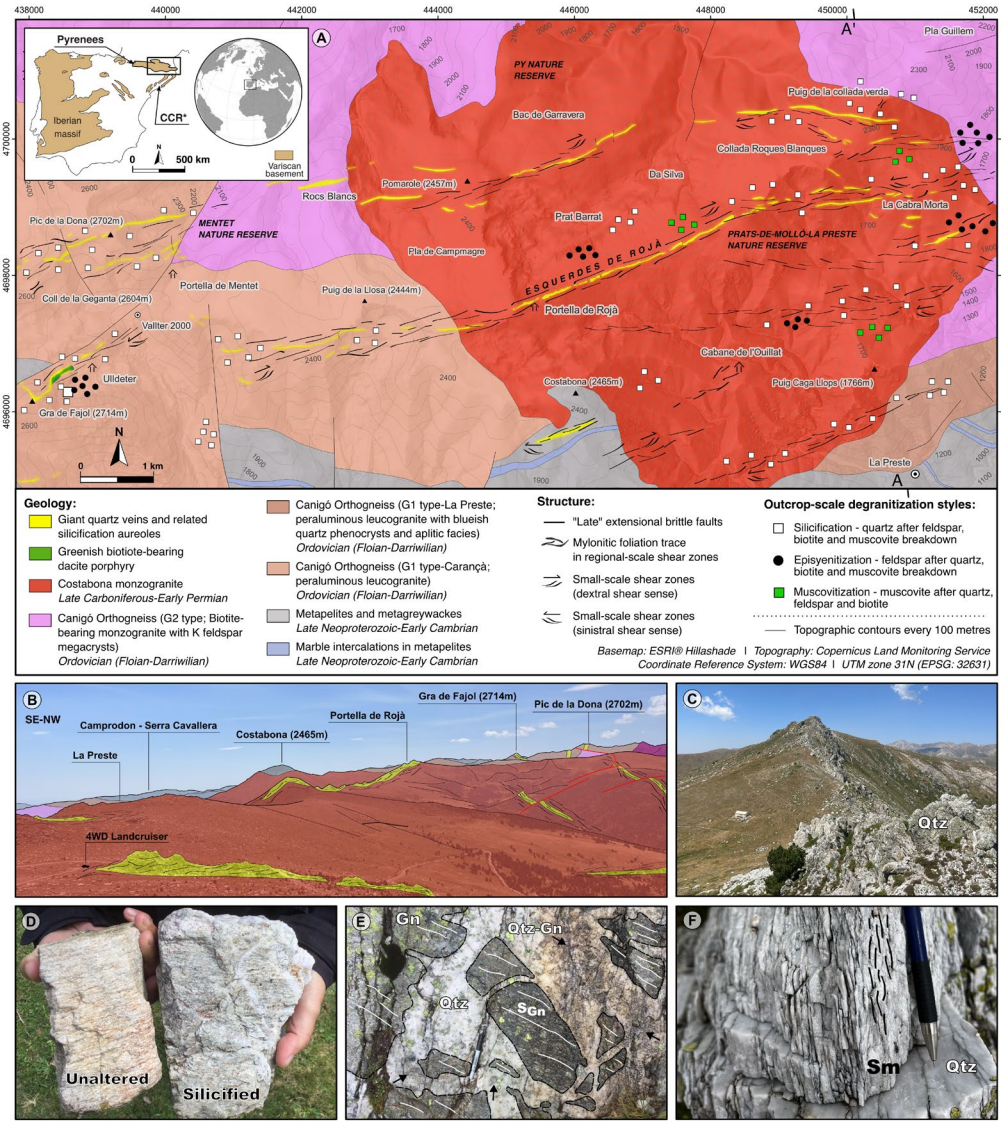
We investigate Si-metasomatism in the basement rocks of the Pyrenees and its relation to giant quartz veins (GQV). Silicification was linked to regional-scale shear zones and contributed to forming the GQV by mineral replacement. This is confirmed across scales by relict fabrics and mineral phases of the precursor rocks within GQV, by a progressive depletion of major and trace elements, except silica, towards GQV, and by the strain localization along GQV.



Evaporites for the sustainable exploration and appraisal of mineral resources and Geo-Energy applications: the Iberian Evaporite Structure Database (IESDB)

González-Esvertit E.*[1,2] Alcalde J.[1] Gomez-Rivas, E.[2]

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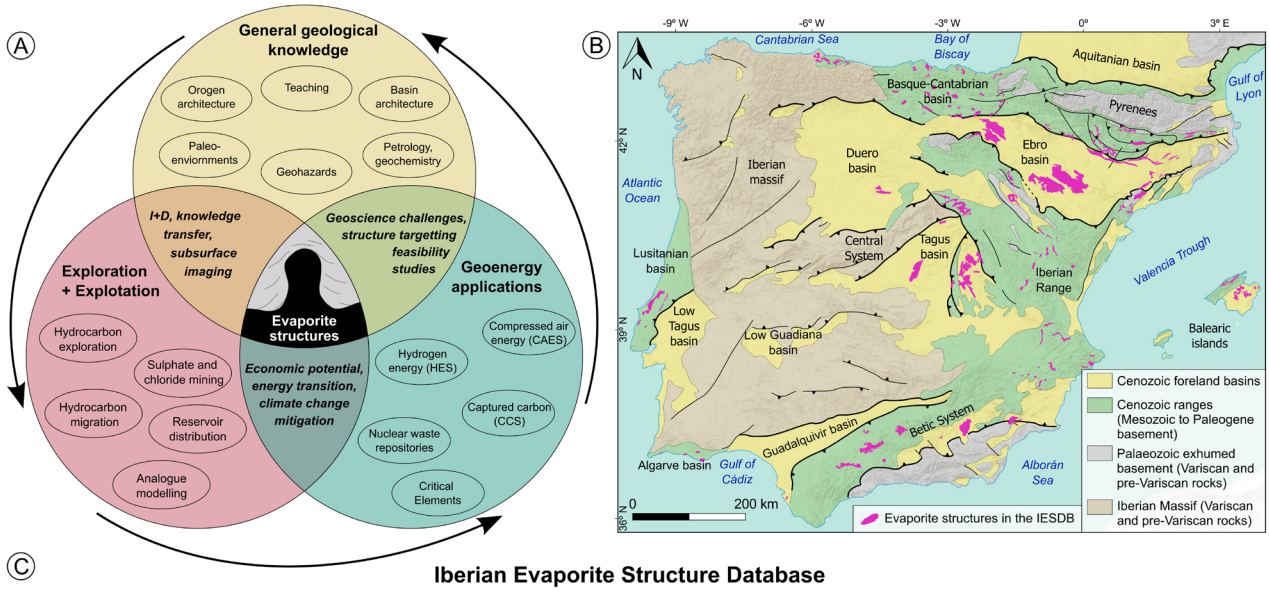
Knowledge on evaporite structures is key for the development of geoscience-based technologies to address societal challenges. However, many data related to them are often segregated or inaccessible beyond paywalls and company restrictions. The Iberian Evaporite Structure Database (IESDB; https://iesdb.eu) includes information and figures about the stratigraphy, structure, chronology, seismic and well data, and mining activity of 150 outcropping and buried evaporite structures in Iberia.



C

Iberian Evaporite Structure Database

Generic Data	Mining Data	Well+Seismic Data	Geographical Data	Quantitative Data	Reference Data
- Geological setting	- Labours within <2km	- Seismic survey name	- Structure centroid coordinates	- Outcropping area	- Section source (x1)
- Structure type and age	- Historical / Active mining activity	- Across evaporites?	- Structure shape and max. coordinates	- HIA*** (when buried)	- Well availability (x2)
- Evaporite lithologies	- Exploitation name	- Seismic profile ID**	- Seismic profiles min. and max. coordinates	- Depth of HIA***	- Stratigraphy (x6)
- Mining activity summary	- Exploitation ID*	- Seismic profile name	[All above x21]	- Structure max. width	- Regional stratigraphy (x1)
- Deformation age	- Extraction municipality	- Seismic survey year	- Borehole coordinates	- Structure max. length	- Seismic data (x3)
- Deformation triggering mechanisms	- Extraction Province	- Code+Data repository	[All above x15]	- Evaporite max. thickness	- Structure (x6)
- Halokinetic structures	- Company in charge	- Seismic profile length		- Max. deformation age	- Analogue models (x3)
- Overbuden units	- Main mining products and sub-products	[All above x21]		- Min. deformation age	- Gravimetry and tomography (x3)
- Syn-kinematic units	[All above x3]	- Borehole name		- Number of deformation stages	- Geochemistry (x4)
- Post-kinematic units		- Company and targets			- Petrophysics (x2)
- Seismic/well summary	*Spanish Mining Cadastre	- Across evaporites?	**IGME SIGEOF Database	***Horizontal Intersection Area	- Petrophysics (x2)
- Other commens		[All above x15]			- Other references (x4)

Image Data	- General location	- Structure shape	- Geological map	- Cross-section	- Stratigraphy	- Classification	- Other maps #1	- Other maps #2

On reaviling of tectonic fault behaviour.

Gridin G.A.[1,2], Ostapchuk A.A.[1,2]

[1] Sadovsky Institute of Geospheres Dynamics of Russian Academy of Sciences, Russia
[2] Moscow Institute of Physics and Technology, Russia

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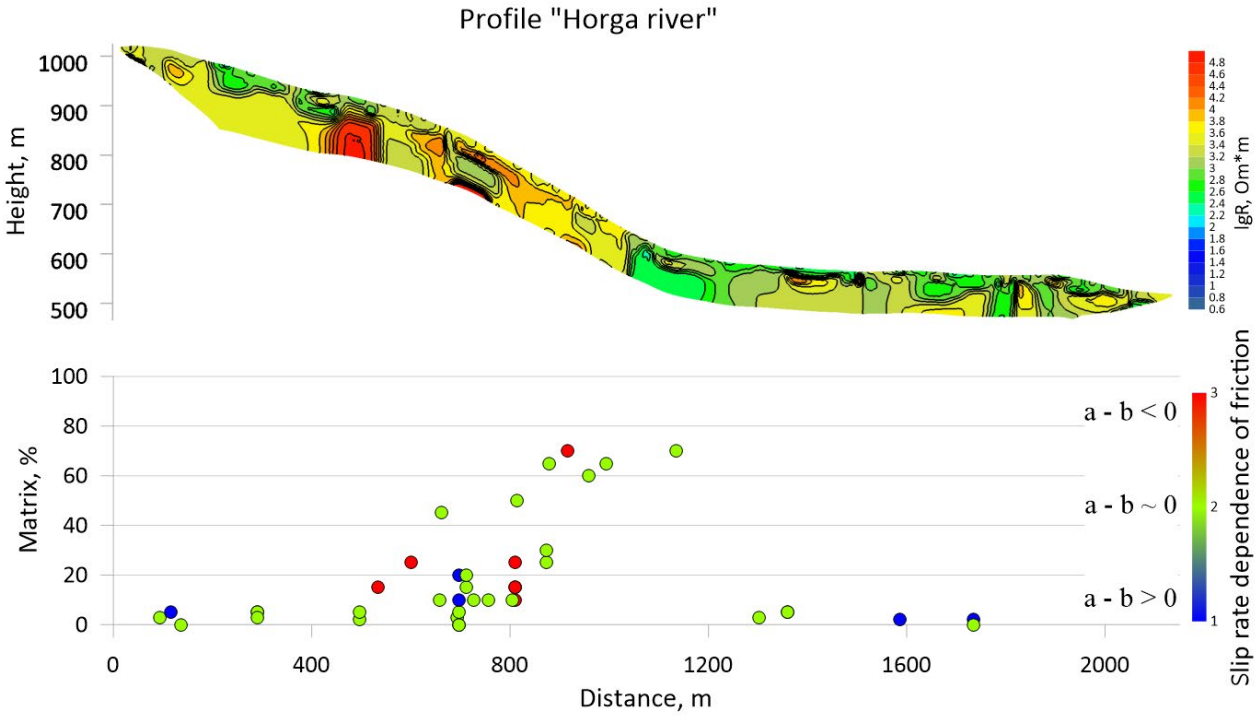
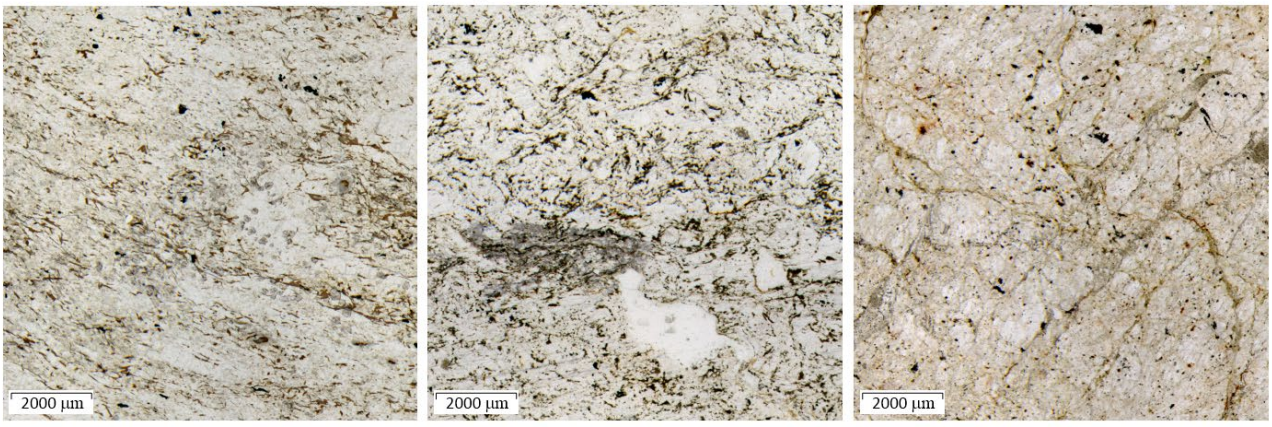
Tectonic fault characterized by spatial heterogeneous of structure and slip behaviour. We made a complex geology-geophysical investigation of Primorsky tectonic fault (Baikal region). It is shown that electrotomography could determinate only the localization of the fault core by the presence of conductive zone. Petrography provided information about the frictional properties of rocks to establish the slip mode on the fault segment.



Granotogneiss with different Matrix proportions.



Matrix = 0 Matrix = 15 Matrix = 70

Microstructure evolution during deformation of polycrystalline aggregates: full field mechanical approach coupling dislocation and diffusion creep

Griera A. *[1] & Lebensohn R.[2]

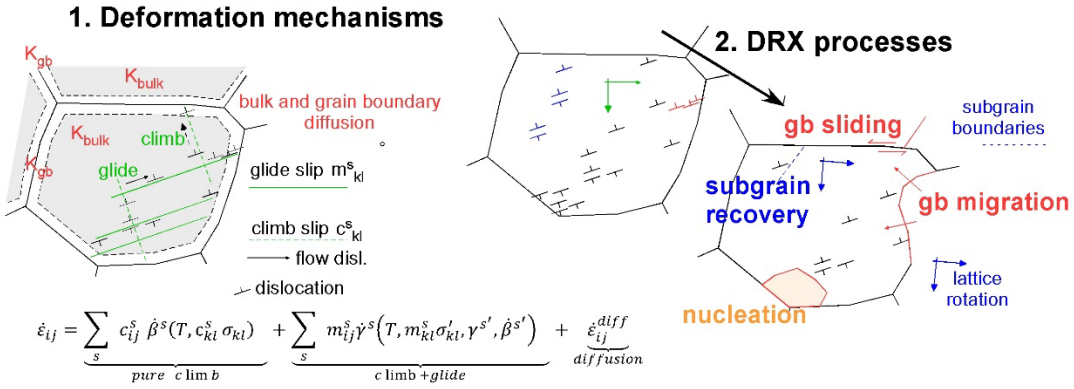
[1] Departament de Geologia, Universitat Autònoma de Barcelona, Spain

[2] Materials Science and Technology Division, Los Alamos National Laboratory, USA

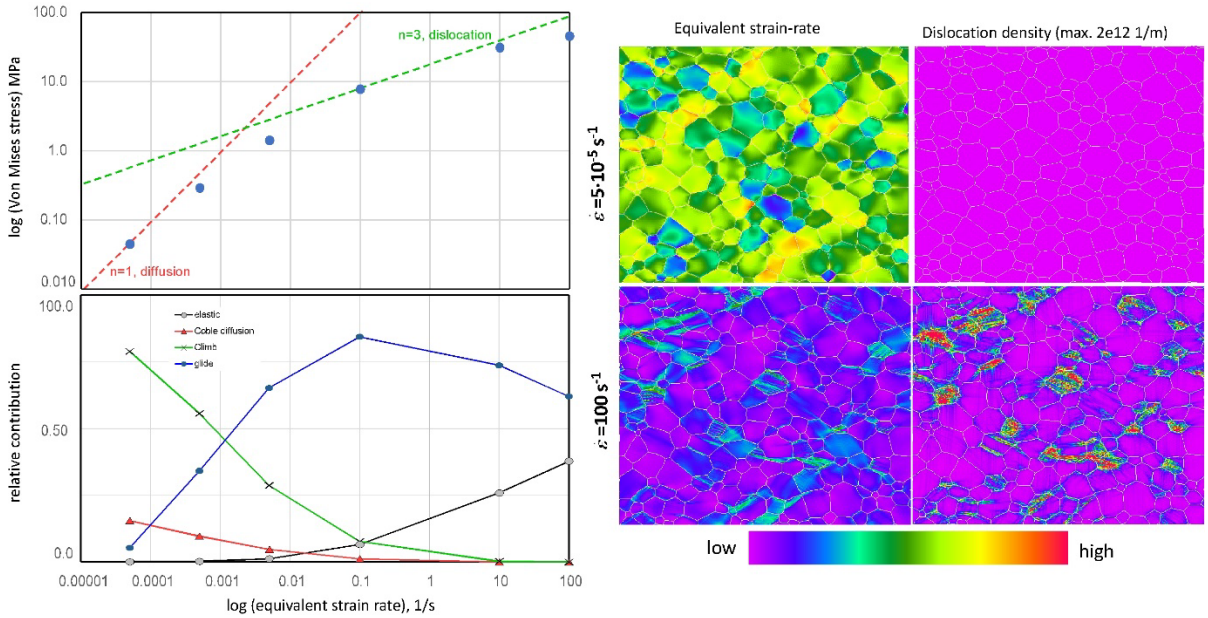
* *Corresponding email:* albert.griera@uab.cat

We present a micromechanical scheme able to simulate deformation of a polycrystalline aggregate including dislocation glide and climb and (parametric) bulk and grain boundary diffusion creep in an elasto-viscoplastic material. An overview of the theoretical basis of the approach is presented with some benchmarks and applications to the prediction of the effective behaviour and evolution of crystallographic-preferred orientation of highly anisotropic minerals.

Full-EVPFFT/ELLE (rate sensitive elasto-viscoplasticity)



3. Preliminary results: rate-sensibility (pure shear, 10% vertical shortening)



Kinematics of eclogite during the Alpine orogeny: A comparative study of the Adula nappe and Cima Lunga unit

Grujic D. *[1], Ma S.[1], Morales C.G.G.[2] Muñoz-Montecitos J. & Coble M.A.[3]

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[2] Department of Earth Sciences, Geological Institute, ETH Zürich, Zürich, Switzerland
[3] Department of Geological and Environmental Sciences, Stanford University, Stanford, USA

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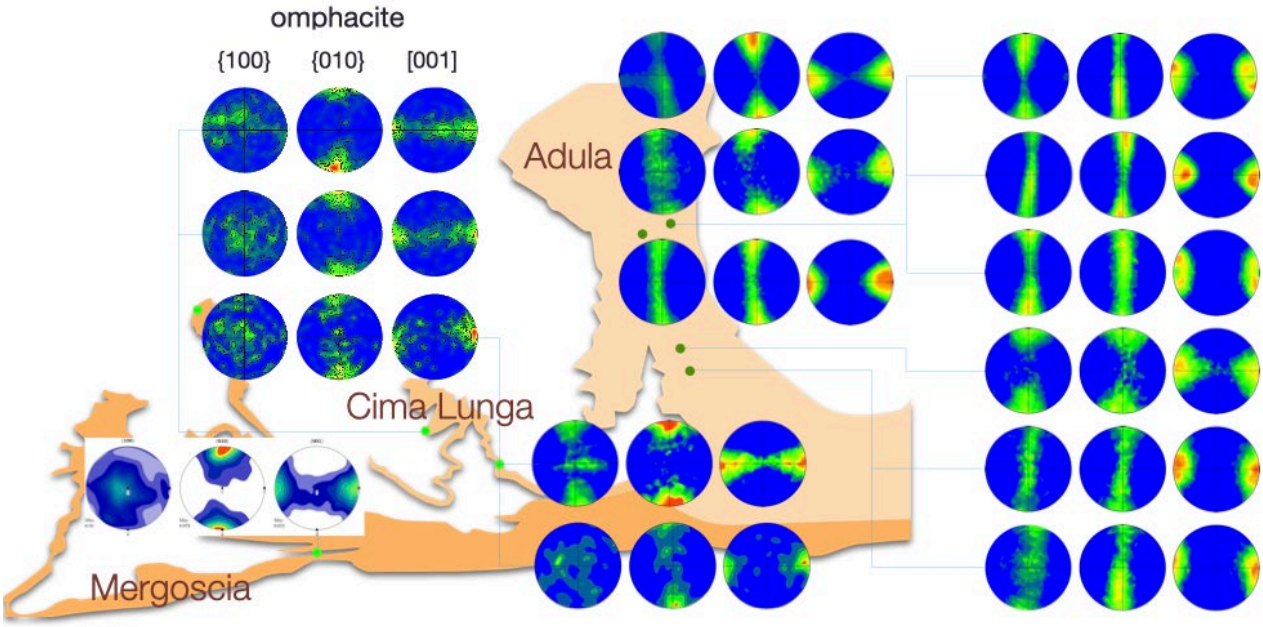
We employed electron backscatter diffraction to analyse the lattice preferred orientation in omphacite and other eclogite facies minerals, aiming to identify the deformation regime operative under HP conditions. Comparative analysis of our data with previously published studies on Cima Lunga and the Adula Nappe reveals a persistent contrast in omphacite texture between these areas. U-Pb dating of metamorphic zircon inclusions within garnets from Alpe Arami eclogite yield ages of ~40-30 Ma.



Mechanical and geometrical controls on fold/thrust nappes: insights from numerical simulations applied to the Eaux-Chaudes fold nappe (Alpine W Pyrenees)

Guardia, M. *[1], Griera, A.[1], Piccolo, A.[3], Caldera, N.[1], Kaus, B.[2] & Teixell, A.[1]

[1] Universitat Autònoma de Barcelona, Spain
[2] Johannes Guttenberg Universität, Germany
[3] Bayreuth Universität, Germany

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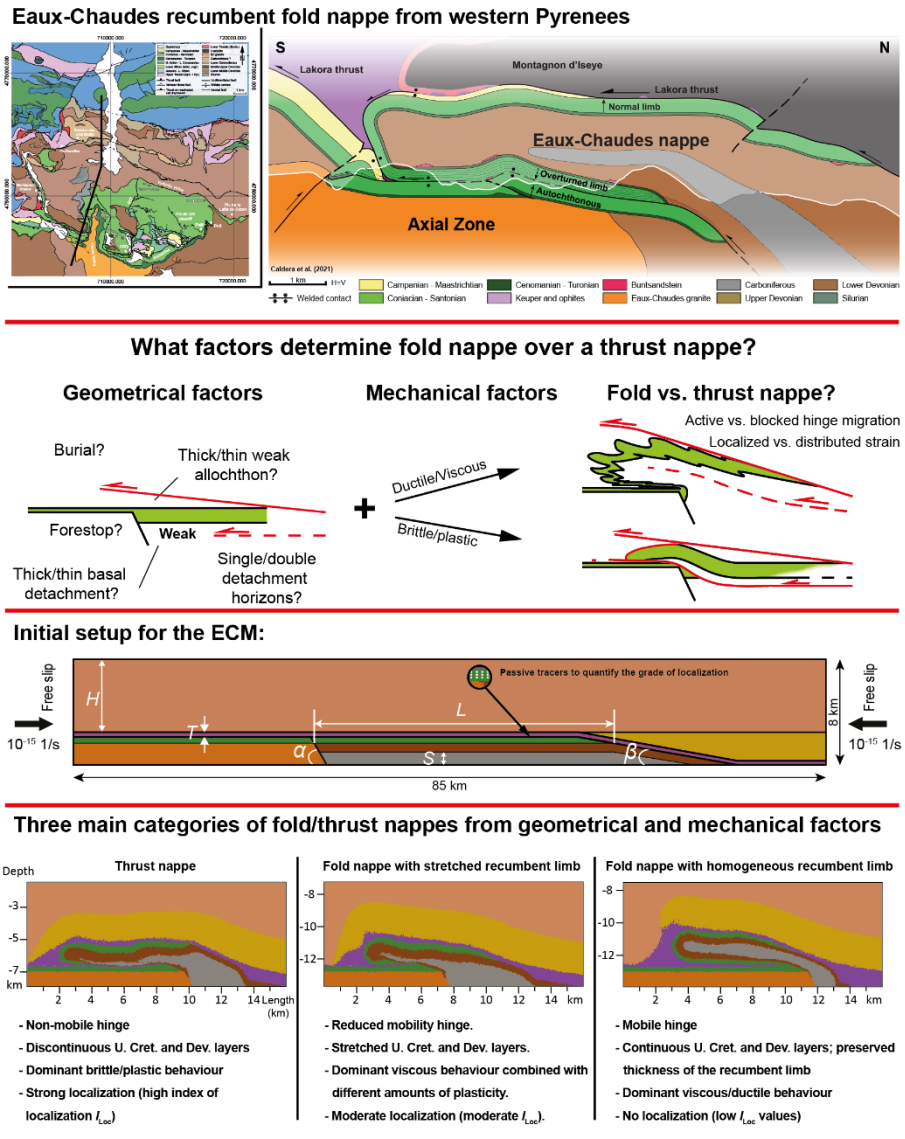
To explain the occurrence of km-scale recumbent folding in orogenic belts is usually challenging. Several mechanical and geometrical elements can control whether the deformation in such structures is dominantly brittle/plastic or ductile/viscous, or the migration of fold hinges. We present systematic mechanical simulations (LaMEM) aimed to determining the development of fold vs thrust nappes and the implications of mobile vs. fixed hinges and of the amount of forelimb stretching.



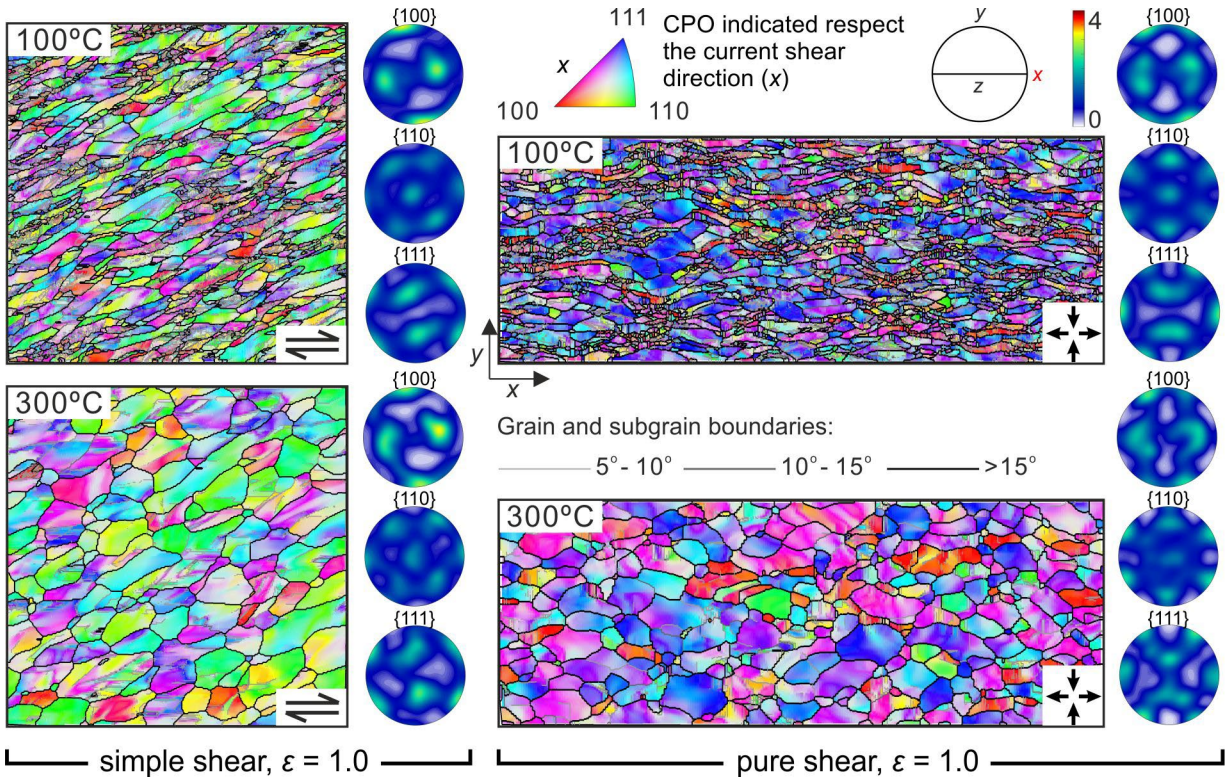
Dynamic recrystallization during visco-plastic deformation of halite polycrystals: full-field simulation of simple shear versus pure shear

Hao B. *[1], Llorens M.-G.[2], Griera A.[3], Bons P. D.[4], Lebensohn R. A.[5], Yu Y.[2] & Gomez-Rivas E.[1]

[1] Departament de Mineralogia, Petrologia i Geologia Aplicada, Universitat de Barcelona, Spain
[2] Geosciences Barcelona, CSIC, Spain
[3] Departament de Geologia, Universitat Autònoma de Barcelona, Spain
[4] Department of Geosciences, Eberhard Karls University of Tübingen, Germany
[5] Materials Science and Technology Division, Los Alamos National Laboratory, Los Alamos, NM, USA

* *Corresponding email:* baoqin.hao@ub.edu

Using the full-field ELLE/VPFFT approach, we model the evolution of the microstructure and crystallographic preferred orientation (CPO) of polycrystalline anisotropic halite subjected to simple shear and pure shear, reaching a natural strain of 1.5. The simulations successfully replicate the experiments conducted at temperatures ranging from 100°C to 300°C and elucidate the temperature-dependent transition from subgrain rotation to grain boundary migration.



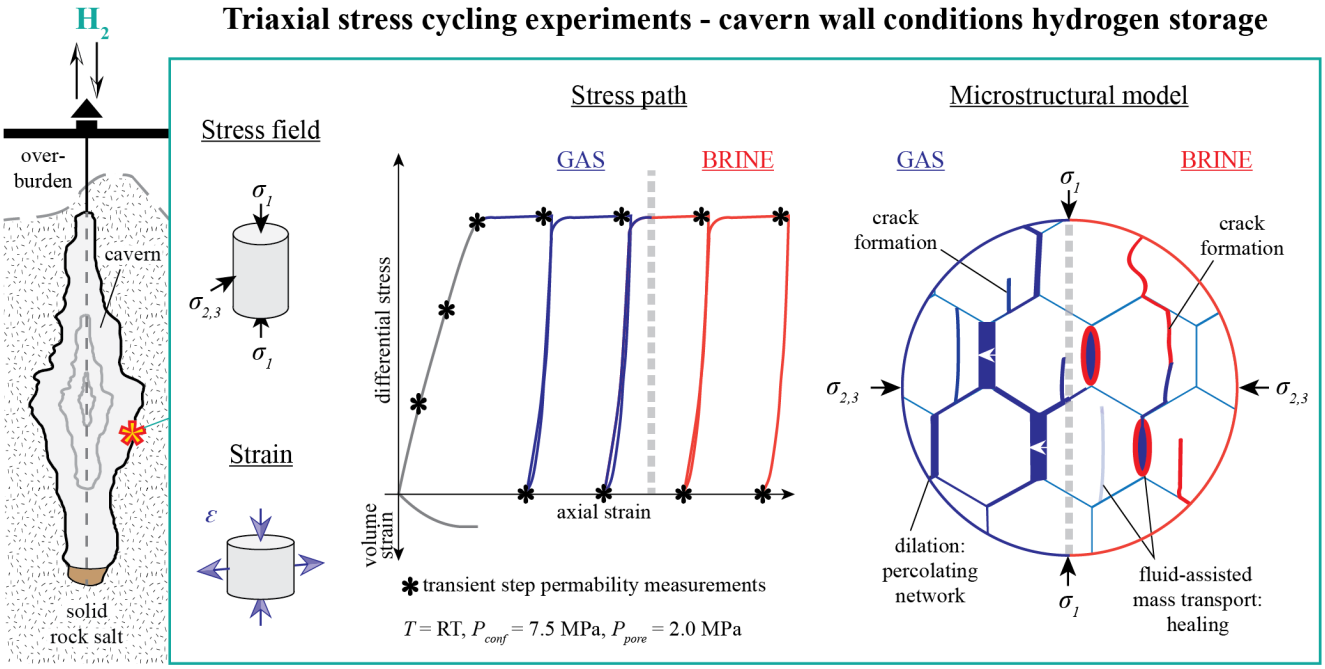
Evolution of mechanical and transport properties of rock salt under simulated cavern wall conditions during cyclical hydrogen storage

Heeb J. *[1], Hangx S.J.T.[1]

[1] HPT-laboratory, Earth Simulation Laboratory, Department of Earth Sciences, Faculty of Geosciences, Utrecht University, Princetonlaan 4, 3584 CB Utrecht, the Netherlands

* *Corresponding email:* j.heeb@uu.nl

Storage of renewable energy as hydrogen fuel in salt caverns may help curbing CO_2 emissions globally. Storage integrity and efficiency is possibly impacted by hydrogen pressure cycling, related stress and temperature variations, and the hydrogen itself. We performed triaxial cyclic deformation experiments on natural rock salt to study the underlying grain-scale mechanisms controlling salt deformation under hydrogen storage operational conditions that apply to salt caverns in NW Europe.



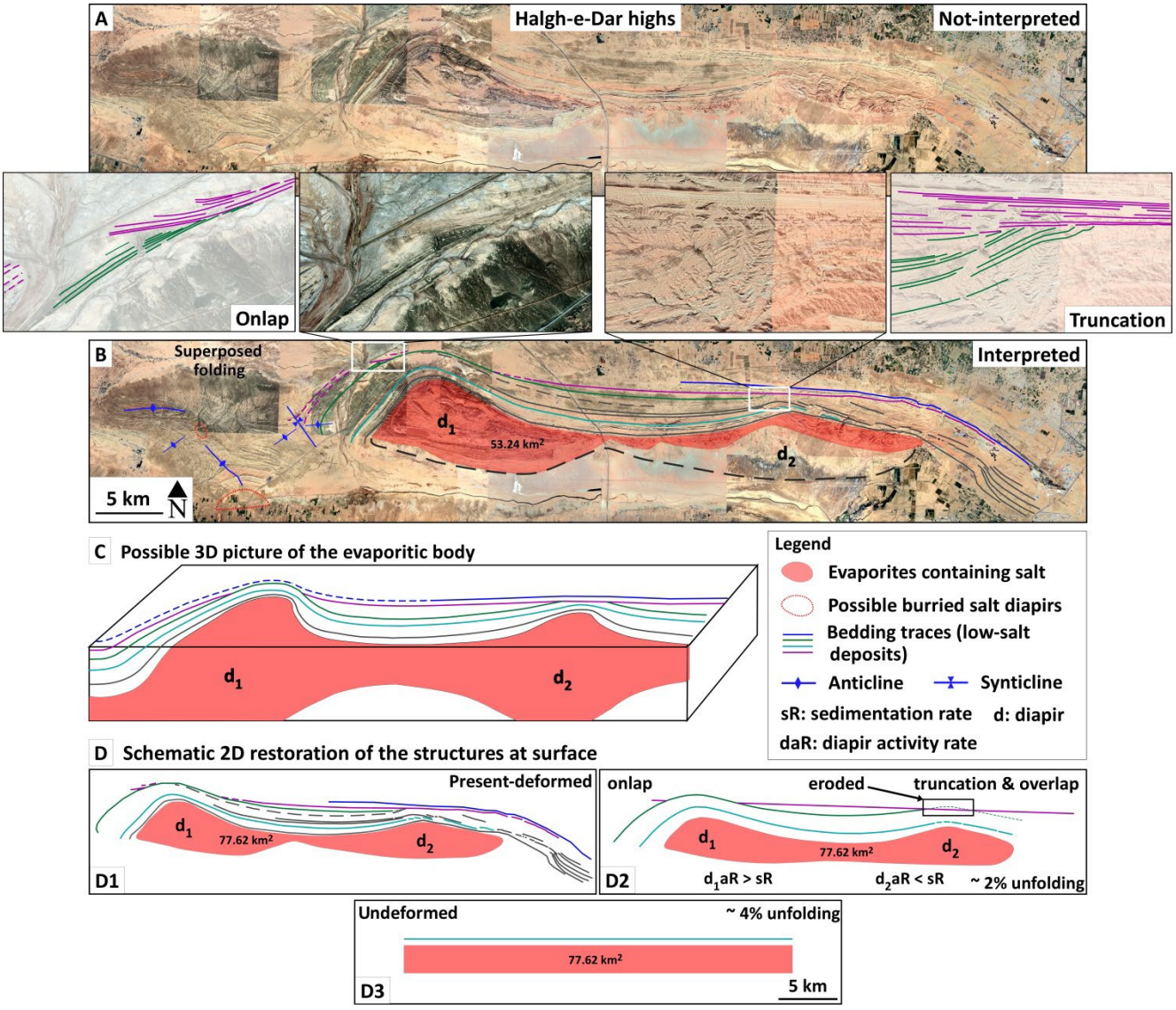
Diapiric activity within the outcropped Miocene evaporites, the northern Central Iran

Heydarzadeh K. *[1], Bastami L.[1]

[1] Independent Researcher, Tehran, Iran

* *Corresponding email: Kobra.heydarzadeh@gmail.com*

The Miocene evaporites in the northern part of Central Iran form a long structure (linear to East, superposed folding to West). The older units containing salt have cropped out to surface as two dipairs (d_1-d_2) which advanced to North and folded the younger evaporitic/clastic units (A-C). Evidences visible on Google Earth (truncation, onlap and overlap) around these diapirs (B) reveal their different diapiric activities (D). Accordingly, d_1 showed a higher activity rate than sedimentation.



CPO and quantitative textural analyses within slip zone from carbonate fault rock

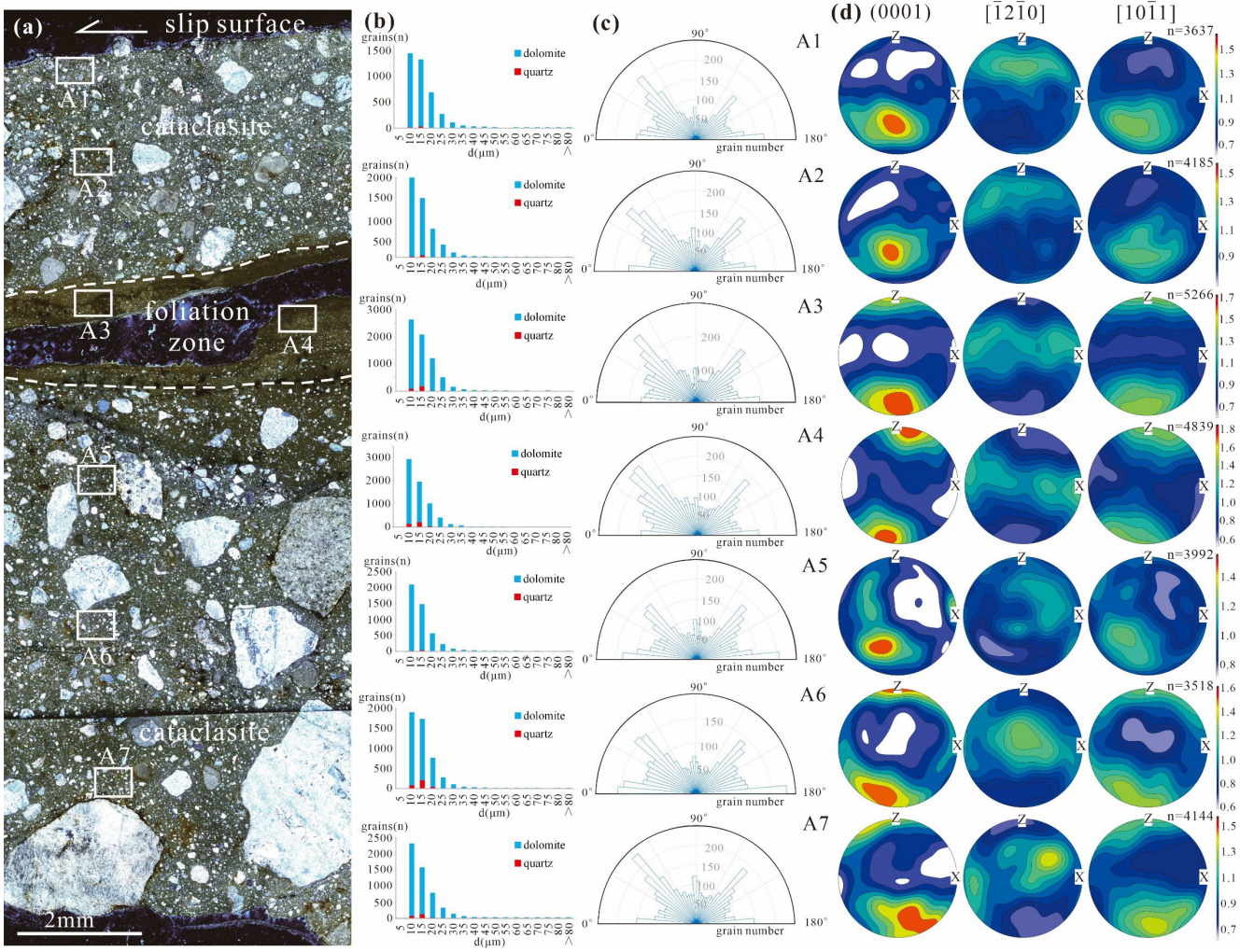
Huang J.H. [1], Zhang B.*[1], Zou J.J. [2] & He H.L.[2]

[1] Key Laboratory of Orogenic Belts and Crustal Evolution, School of Earth and Space Scineces, Peking University, Beijing 100871, China

[2] State Key Laboratory of Earthquake Dynamics, Institute of Geology, China Earthquake Administration, Beijing 100029, China

* *Corresponding email:* geozhangbo@pku.edu.cn

Seven micro-areas, in the slip zone of carbonate fault rocks from the Yuguang Basin Southern Margin Fault, were selected to check the dominate orientations by EBSD. The dolomite grains present roughly shape preferred orientations (SPOs) in the cataclasite layer and display weak CPOs. We speculate that the CPOs of dolomite in the slip zone are formed by particle rotation rather than plastic deformation caused by frictional heating during seismic slip.



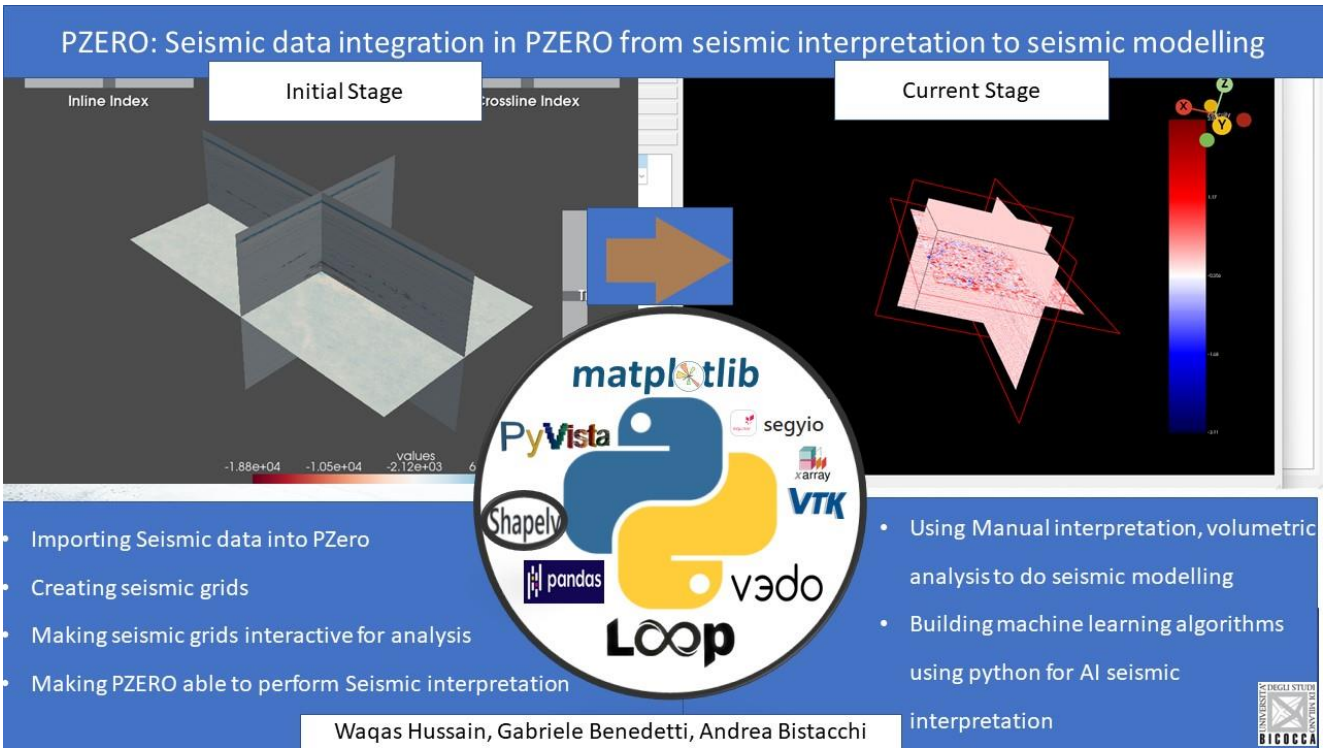
Enhancing Geological Modeling through Seismic Data Integration in PZero Software

Hussain W. *[1], Benedetti G.[1] & Bistacchi A.[3]

[1] University of Milano-Bicocca, Italy
[2] University of Milano-Bicocca, Italy
[3] University of Milano-Bicocca, Italy

*Corresponding email: waqas.hussain@unimib.com

Our research enhances geological modeling in PZero software, focusing on seismic data integration for accurate subsurface structure models. Achievements include SEGY file importation and the development of stochastic simulation algorithms for clastic sedimentary environments. This work supports advanced reservoir modeling and subsurface energy storage predictions, essential for a low-carbon energy future.



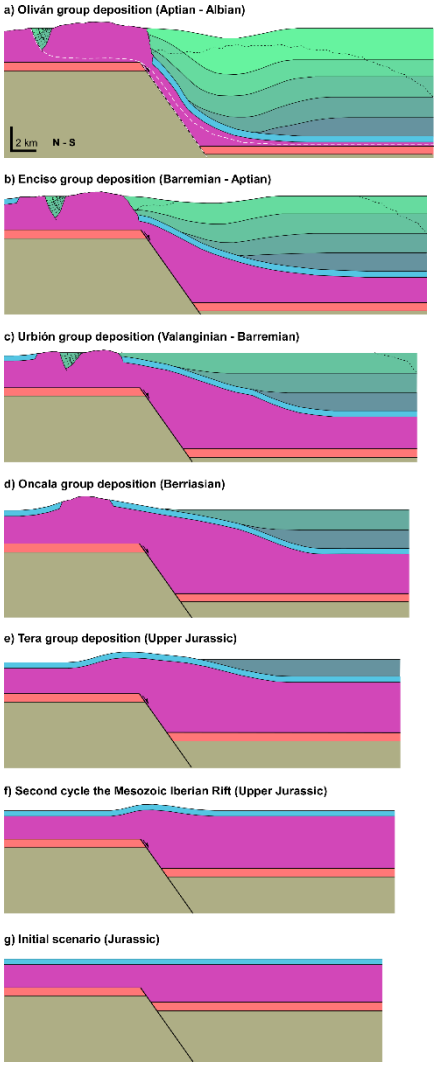
Structure and evolution of the Cameros basin: Application of salt tectonics and numerical modelling to its structural interpretation

M. Ibáñez-Belloso[*1], M. Guardia[1], A. Teixell[1], A. Griera[1]

[1] Departament de Geología, Universitat Autònoma de Barcelona, 08193 Bellaterra, Spain.

*Corresponding email: miguel.ibanez.belloso@uab.cat

We present a new extension-to-inversion evolutionary model for the upper Jurassic-lower Cretaceous Cameros basin (Iberian chain) based on sequential section restoration and numerical modelling (LaMEM code). The identification of halokinetic sequences, a megaflap and layer truncations by a diapir, in addition to well-known depocenter migration, justify an interpretation of basement faulting and drape folding which controlled salt migration and subsidence in a syn-rift minibasin, later inverted.



Sequential restoration and evolutive model for the salt-assisted extension of the Cameros basin.

Legend

- Olf — **Synorogenic clastic rocks** *Oligocene.* Conglomerates, sandstones, siltstones and mudstones
- ICr4 — **Oliván group - Weald facies** *Aptian-Albian.* Detritic sandstones and claystones.
- ICr3 — **Undifferentiated Enciso group - Weald f.** *Barremian-Aptian.* Sandstones, claystones, marls and limestones.
- ICr3b — **Leza Fm - lower Enciso group - Weald f.** *Barremian.* Pisolitic micritic limestones and dark limestones.
- ICr2b — **Jubera Fm - upper Urbión group - Weald f.** *Barremian.* Reddish claystones, sandstones and conglomerates.
- ICr2 — **Undifferentiated Urbión group - Weald f.** *Valanginian-Barremian.* Sandstones, claystones, marls and limestones.
- ICr1 — **Oncala group - Weald facies** *Berriasian.* Sandstones, siltstones and marls.
- uJu1 — **Tera group - Weald facies** *Up. Jurassic.* Conglomerates, sandstones and claystones.
- Ju1 — **Carbonates** *Jurassic.* Massive oolitic and tabular limestones.
- Tr2 — **Evaporites - Keuper facies** *Upper Triassic.* Gysum, dolostones and claystones.
- Tr1 — **Buntsandstein facies** *Low. Triassic.* Red claystones and sandstones.
- Pzb — **Basement** *Paleozoic.* Quartzites and claystones.
- Thrust
- Inverted thrust

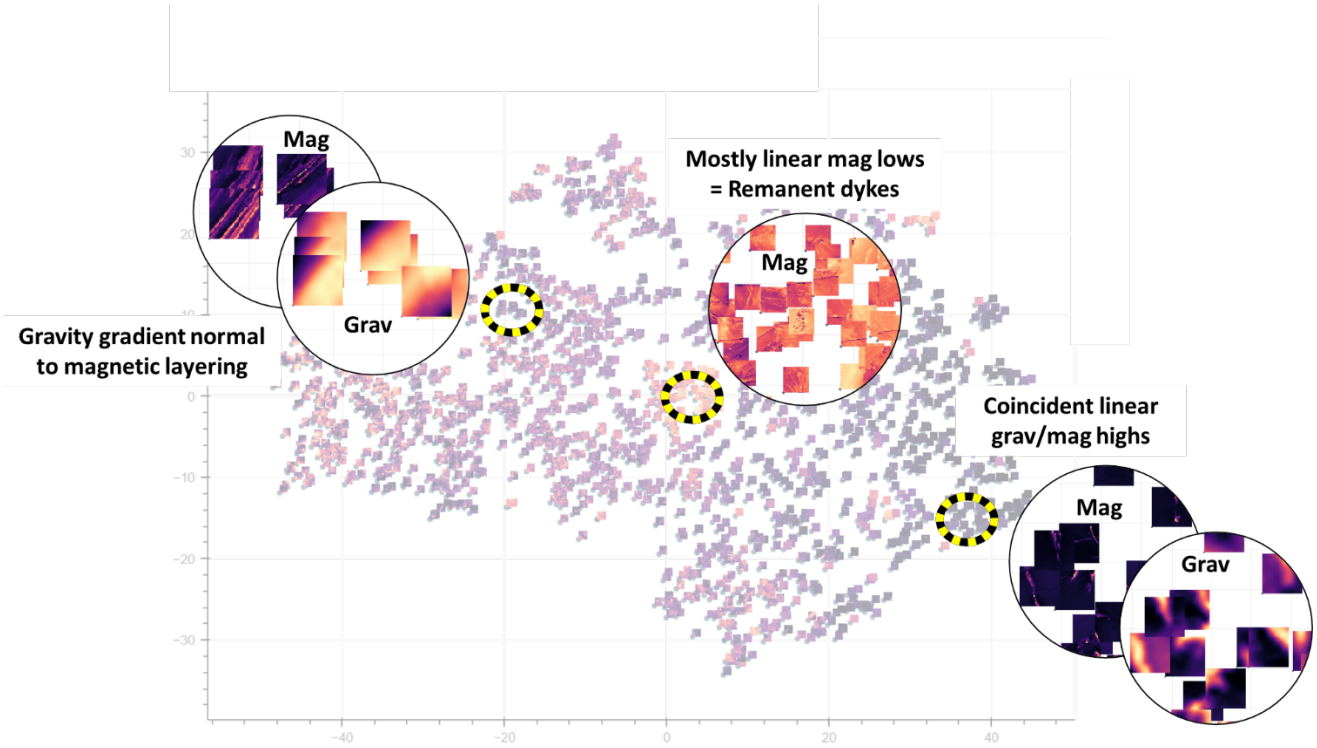
Combining feature engineering with non-linear projection to navigate geophysical data

Portes[1,2], Jessell*[1,3], Lindsay[1,3,4], Pirot[3], Nzikou[3] & Cripps[1,2]

[1] DARE ITTC, UWA, Australia
[2] School of Physics, Mathematics and Computing, UWA, Australia
[3] MinEx CRC, School of Earth Sciences, UWA, Australia
[4] CSIRO, Australia

* *Corresponding email:* mark.jessell@uwa.edu.au

The Energy Transition calls for new approaches to the analysis of geophysical data. For the last 60 years, studies have focused on so-called *Template Matching*, which seeks features in grids corresponding to known geometries. Here we invert the logic to jointly navigate multiple regional data by grouping geophysically similar regions. We demonstrate the use of Haralick feature detection with t-SNE non-linear projection to the gravity and magnetic responses of the Yilgarn Craton, Australia.



Upper mantle characterization and geodynamics of Western Central Mediterranean region, from an integrated geophysical geochemical modelling

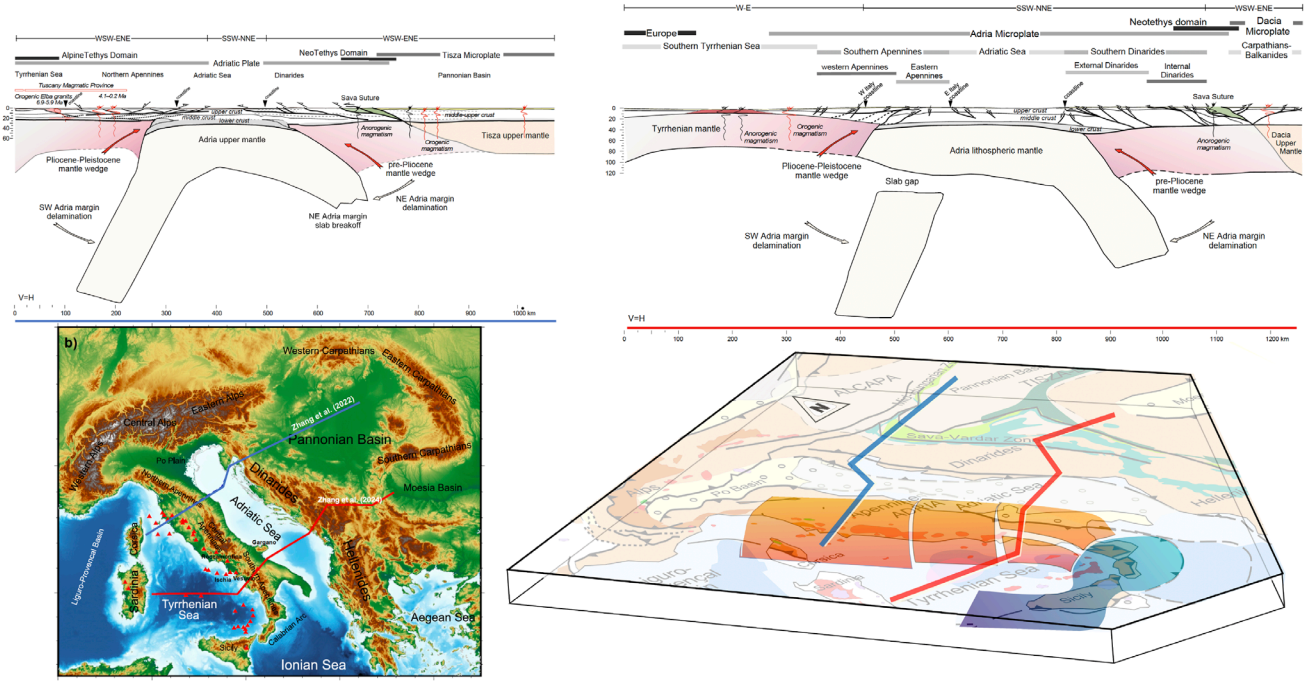
Jiménez-Munt I.*[1] Zhang W.[1] Torné M.[1] Vergés J.[1] Bravo-Gutiérrez E.[1] Negredo A.M.[2] & García-Castellanos D.[1]

[1] Geosciences Barcelona, Geo3BCN-CSIC, Barcelona, Spain

[2] Departamento de Física de la Tierra y Astrofísica, Universidad Complutense de Madrid, Madrid, Spain

* *Corresponding email:* ivone@geo3bcn.csic.es

Our geophysical-geochemical model characterizes the deep structure of Adria-Dacia microplates, and the slabs along the western and eastern Adria margins. The mantle composition is consistent with the presence of two mantle wedges, attributed to the rollback and mantle delamination of the Apenninic and Dinaric slabs. The slab beneath the N Apennines is attached to the shallower subhorizontal lithosphere, while a small slab gap is observed in the S Apennines, suggesting a slab horizontal tearing.



Microstructure-based decomposition of quartz CPO

Kilian R. *[1], Stipp M.[1]

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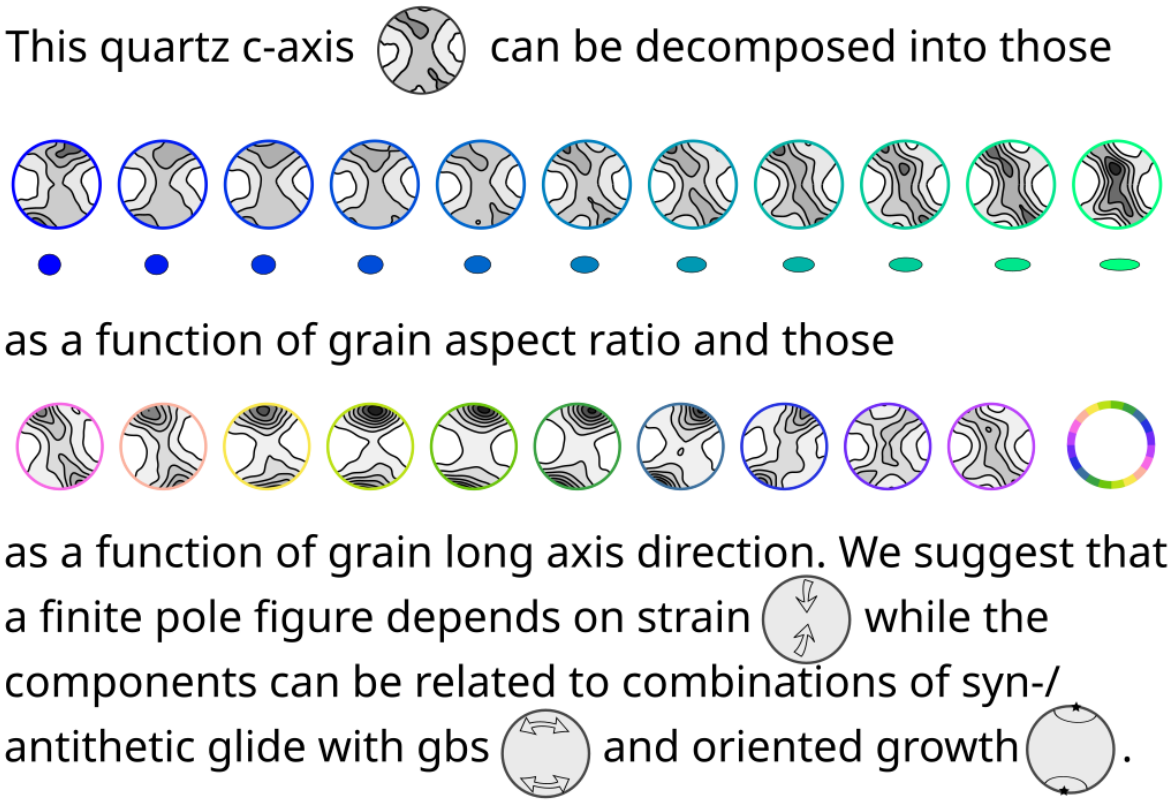
Quartz crystallographic preferred orientations are widely used to interpret deformation conditions or kinematics, based on mostly empirical relations. Here we intend to establish a microstructure-based relation between the controls on CPO development and processes occurring in deforming and recrystallizing quartz rocks.



Physics of anisotropic loading: shear dilation, a new thermodynamic state function, and its effects in fracture and petrology

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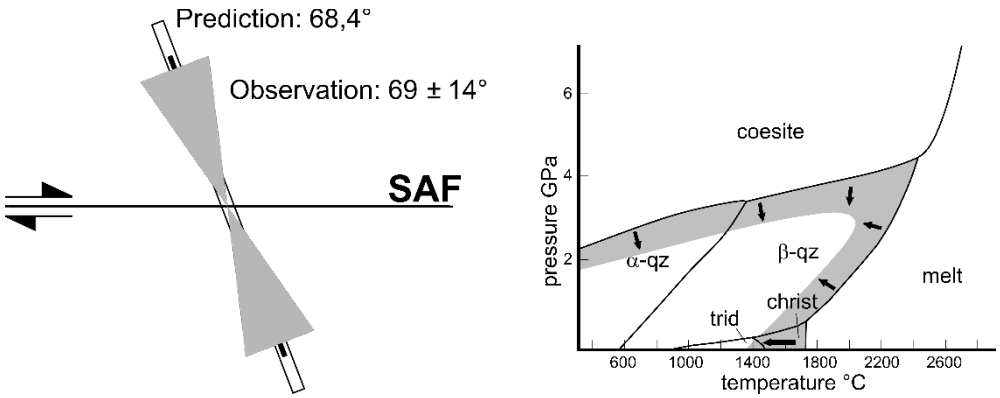
The deformation theory is >200 years old and obsolete. It fails completely for simple shear. The stress tensor is mathematically non-existent; strain is physically irrelevant. A new approach in vector field form based on thermodynamics and potential theory is highly successful. It correctly predicts the properties of S-C fabrics, fracture, and the max loading direction along the San Andreas fault (SAF). A new state function explains enigmatic phase boundary shifting, and melting far below T_m.



A tectonic model for the juxtaposition of granulite- and amphibolite-facies rocks in the Eburnean orogenic belt (Sassandra - Cavally domain, SW Côte d'Ivoire)

Koffi Y.A. *[1], Baratoux L.[2-1], Pitra P.[3-4], Kouamelan A.N.[1], Vanderhaeghe O.[2], Thébaud N.[5], Bruguier O.[6], Block S.[2], Thébaud N.[5], Kouadio F.H.[1] & Kone J.[7-2]

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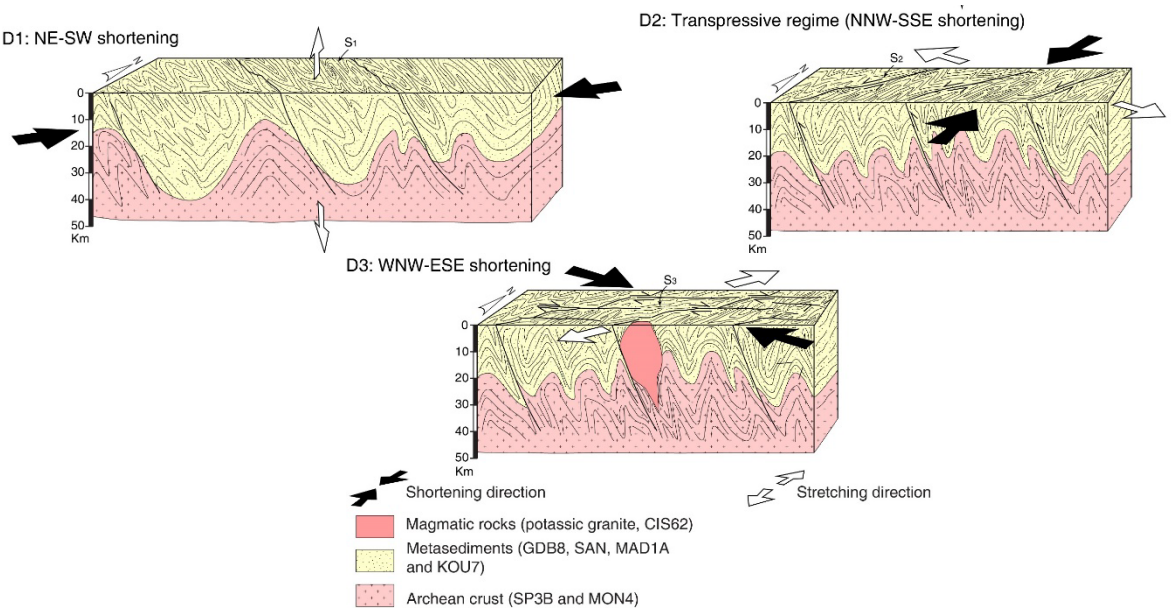
We have studied tectonic evolution of the transition zone between the Archean and Paleoproterozoic domains of the West African Craton. A polyphase evolution related to the Paleoproterozoic Eburnean orogeny started with a NE shortening (D1) leading to crustal thickening and burial of supracrustal rocks, followed by a transpressive NNE-SSW shortening (D2) with middle-crustal exhumation and a late WSW-ESE shortening (D3). Archean crustal inheritance was documented by U-Pb zircon and monazite ages.



Microstructures of the ductile Sassandra shear zone, separating the Archean cratonic nucleus and the Palaeoproterozoic crust in NW Côte d'Ivoire, West African Craton

KONE G.T.*[1], KOUAMELAN. A. N.[1], BARATOUX. L.[1-2], VANDERHAEGHE. O.[2], KOFFI. A. Y.[1], BOYA. T. K. L[1], KOUADIO. F. J.[1], ARNAUD. P.[3]& JESSELL. M.[4]

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[3]Centre de microcaractérisation CASTAING & Université Toulouse 3 Paul Sabatier, France.
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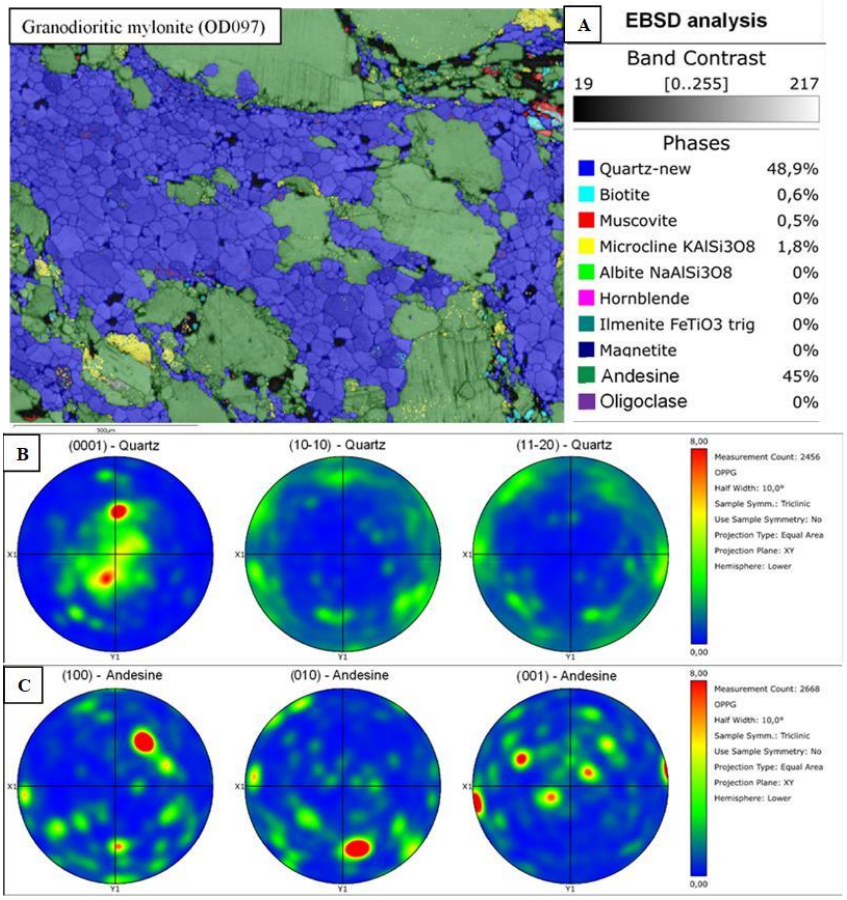
The Sassandra Shear Zone, in the West African Craton, at the contact between the Archean nucleus and the Paleoproterozoic domain, is characterized by a mylonitic fabric affecting greenstones, granitoids, and migmatites of Archean and Paleoproterozoic ages. It operated during the Eburnean orogeny at c. 2.1 Ga. Deformation mechanisms of quartz and plagioclase were studied in three samples of granitoid mylonites in order to understand the processes of deformation localization in Precambrian crust.



Influence of caprock on shallow deformation in salt diapirs – insights from numerical and analogue modelling

Krýza O. *[1,2], Slotwinski M.[3,4], Závada P.[1], Warsitzka M.[1] & Adineh S.[1]

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[3] Polish Geological Institute, National Research Institute, Computational Geology Laboratory, Wrocław, Poland

[4] University of Wrocław, Institute of Geological Sciences, Department of Structural Geology and Tectonics, Wrocław, Poland

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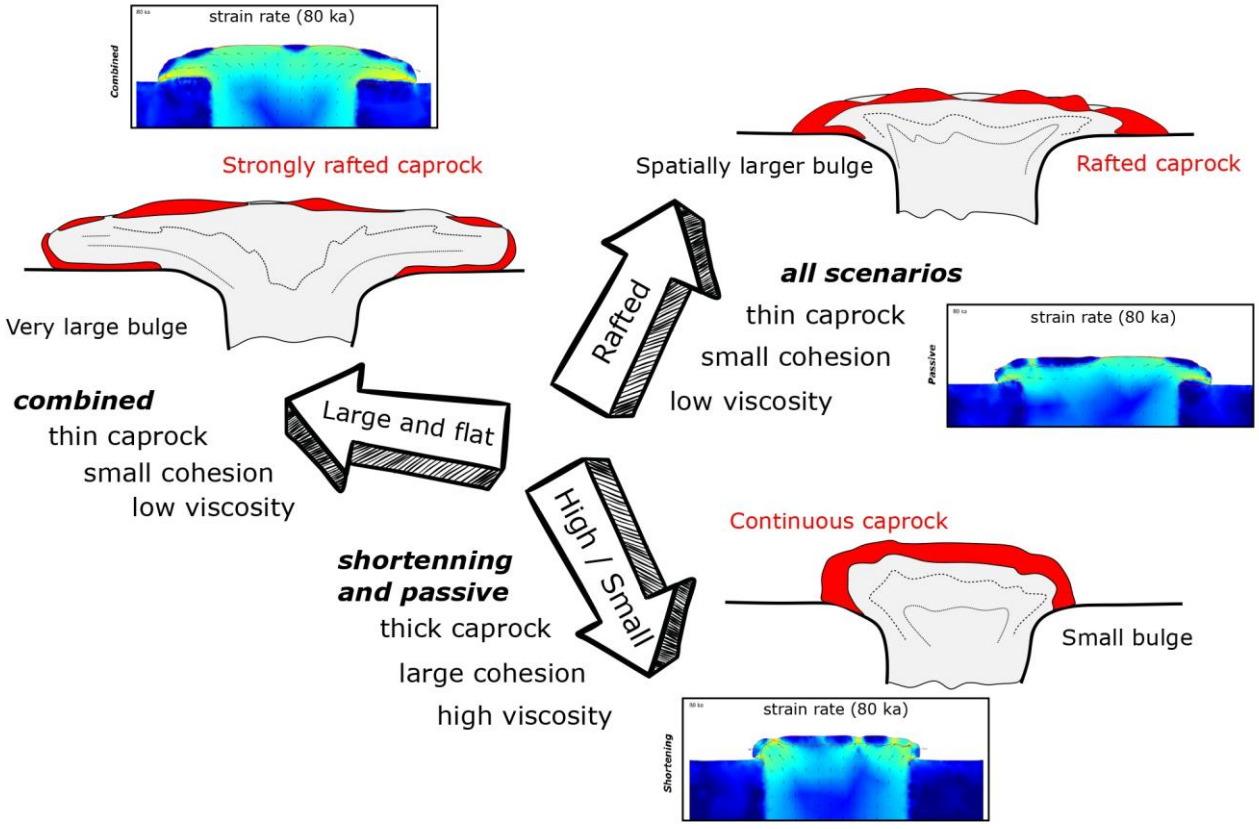
To understand the coupled effects of selected caprock properties and tectonic scenario on extrusion style, we employed 2D numerical modeling utilizing the finite element method, along with complementary 3D sandbox analogue modeling. After statistical analysis of model characteristics, we distinguished three major diapiric styles: 1) very large extrusions with strongly rafted caprock, 2) large extrusion with semi-rafted caprock, and 3) spatially isolated, high extrusion with continuous caprock.



Deformation in accretionary wedge sediments – the Papaku fault example

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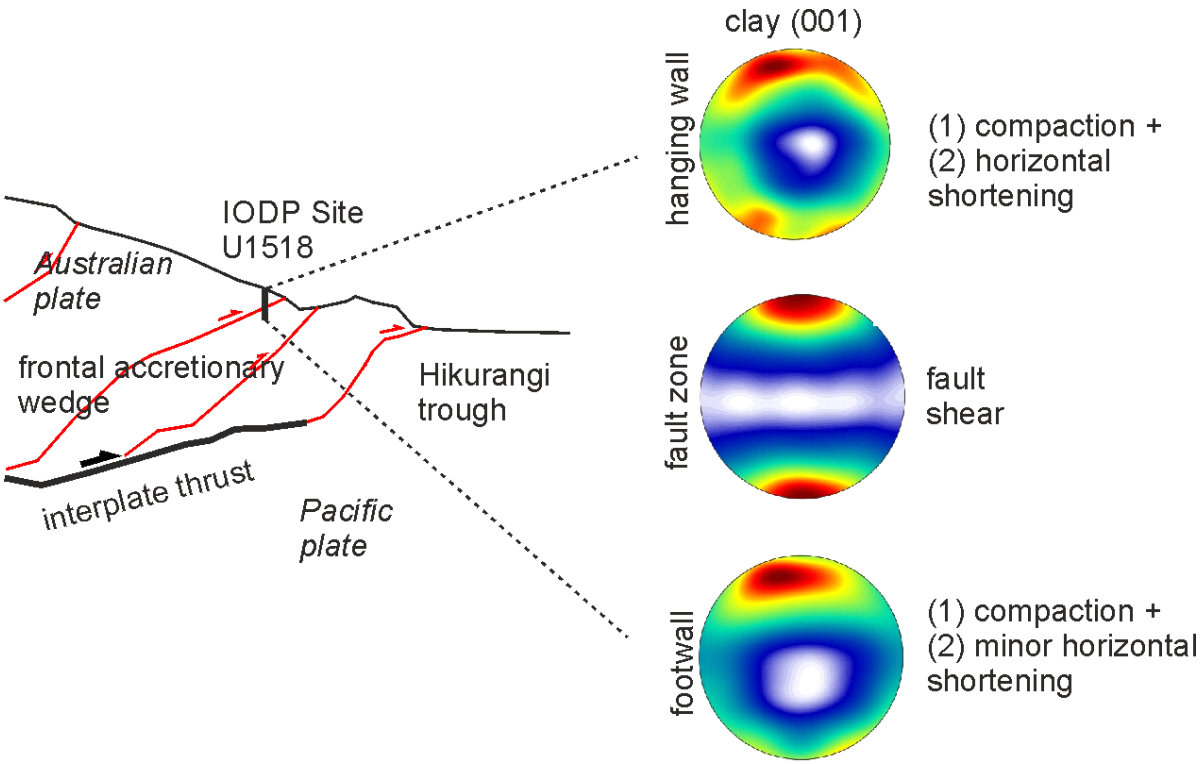
Drilling during IODP Expedition 375 at the Hikurangi accretionary wedge (offshore NZ) recovered sediments from the hanging wall, the footwall and the fault zone of the Papaku splay fault. It is demonstrated that the crystallographic preferred orientation of clay minerals can be used to deduce the deformation history in an accretionary wedge.



Deformation Indicators in Compacted Salt: Differences in Laboratory and Real Use Cases

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[2] Utrecht University; Earth Simulation Lab, Netherlands

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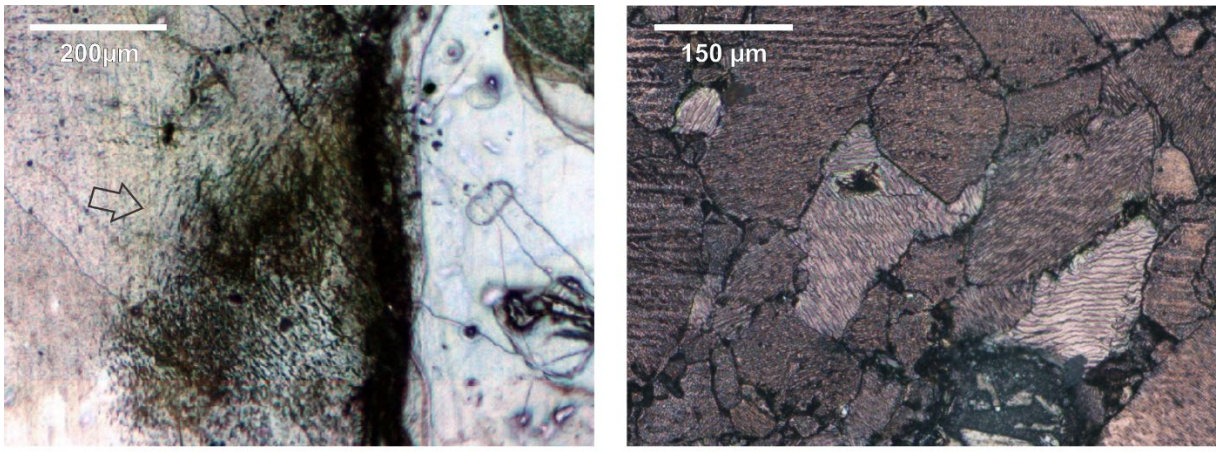
Loose salt grains, as a residue from mining, are under investigation as a geotechnical barrier material to encapsulate radioactive waste. Numerical models rely on laboratory tests to forecast a cavity convergence-driven compaction (evolution of porosity and load resistance). However, deformations at the grain edges (dense slip bands and subgrains) indicate that rather quick laboratory compactions might mimic the real convergence-case incorrectly. We compare microstructures from different compaction settings.



Left: laboratory sample with dense slip bands (arrow); Right: substructure-free backfill.

Deformation decoupling and thermal evolution across different crustal levels along an arc-arc collisional zone in Central Asia

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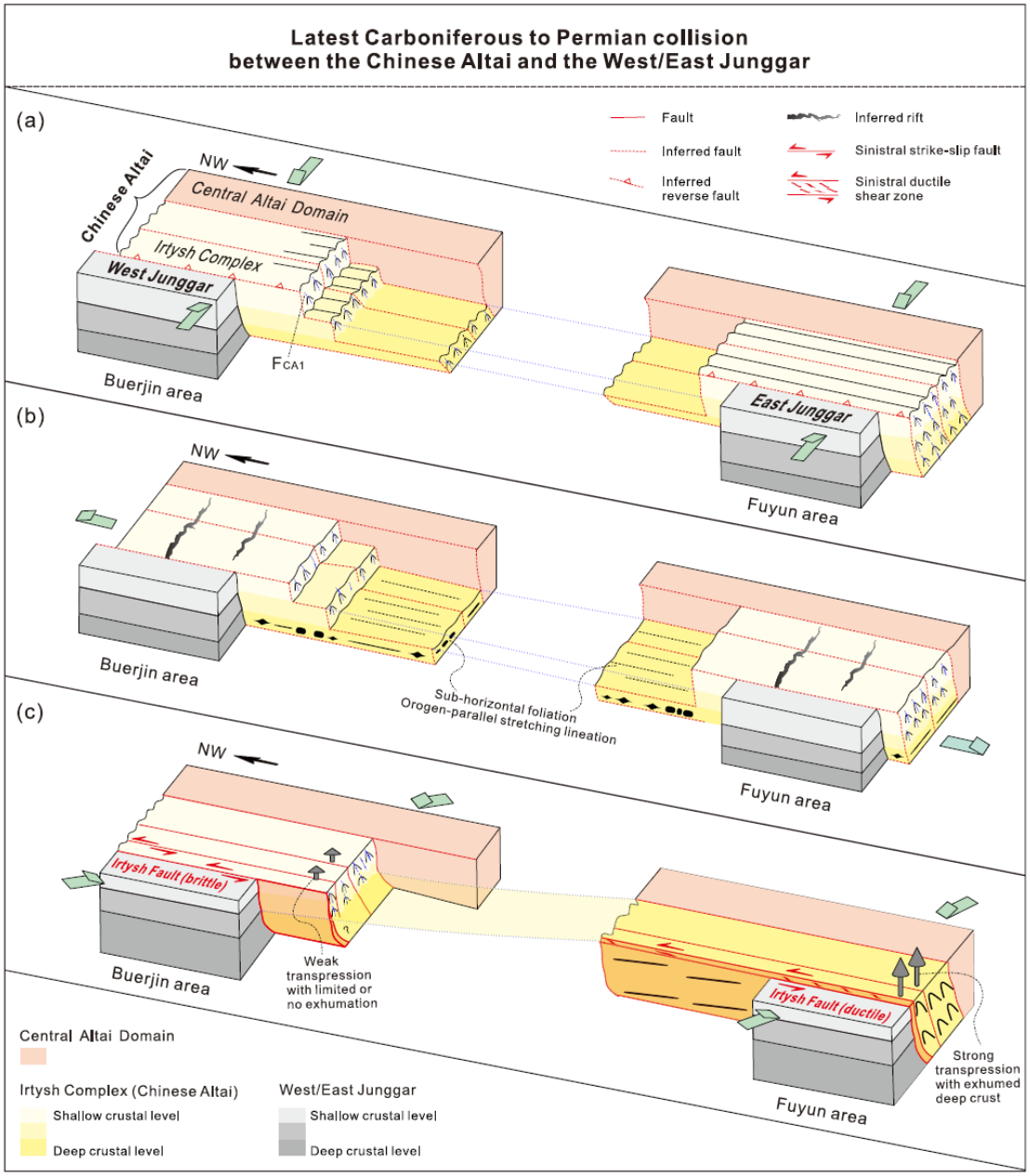
Description: Deformation response and thermal evolution of arc-arc collision in 4D remain enigmatic. The tilted Irtysh suture zone in Central Asia provide an ideal natural lab to investigate this issue. A combined structural, metamorphic and geochronological study across the full crustal section of the Irtysh suture zone show deformation decoupling across different crustal levels, with an intermediate episode of orogen-parallel flow within deep crustal rocks that drove the high temperature metamorphism.



Seismic patterns in NW Iberian peninsula and their relation to crustal structure

Llana-Fúnez S. *[1], Fernández-Viejo G.[1], López-Fernández C.[1], Acevedo J.[2], Olona J.[2], González Cortina J.M.[1] & Pando L.[1]

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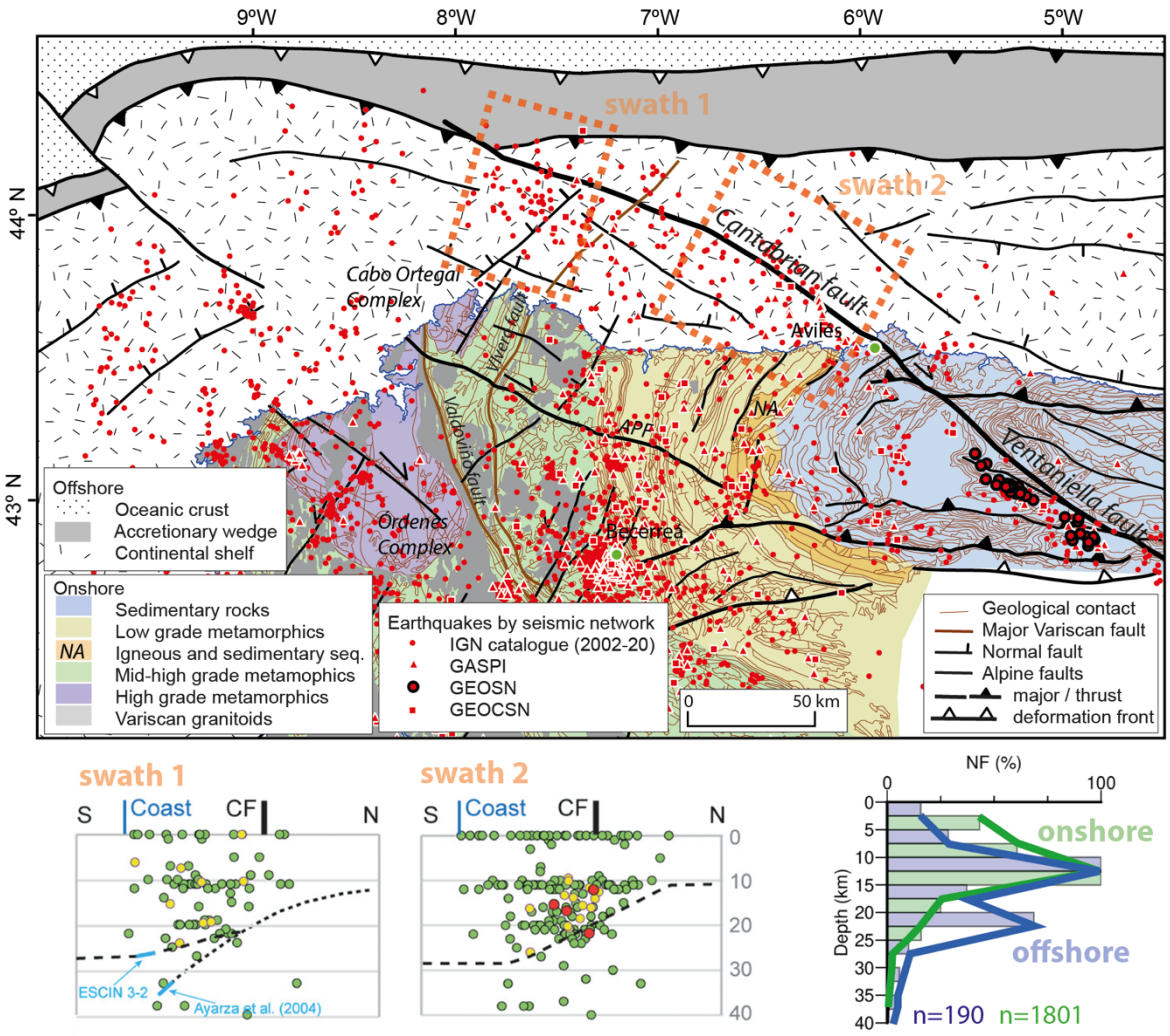
The North Iberian margin ceased being the active plate boundary between Iberia and Europe in the Neogene. The instrumental seismic record shows low magnitude but persistent activity with a distribution of events responding to the presence of crustal-scale geological structures under some stress. Intersecting alpine faults, subvertical and gently dipping, nucleate some clusters. Bodies of rigid crystalline basement rocks in the upper crust may also be potential candidates for stress accumulation.



Fabric-induced anisotropy in polar ice: a comparison between natural samples and viscoplastic numerical models

Llorens M-G.*[1], Bons P.D. [2], Eichler J. [3,4], Jansen D. [3], Weikusat I. [2,3], Kerch J. [3,5] & Lebensohn R.A [6]

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[3] Department of Geosciences, Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany

[4] Laboratoire de Geologie de Lyon: Terre, Planetes, Environnement (LGL-TPE), ENS Lyon, Universite Claude Bernard Lyon 1, CNRS, Villeurbanne, France

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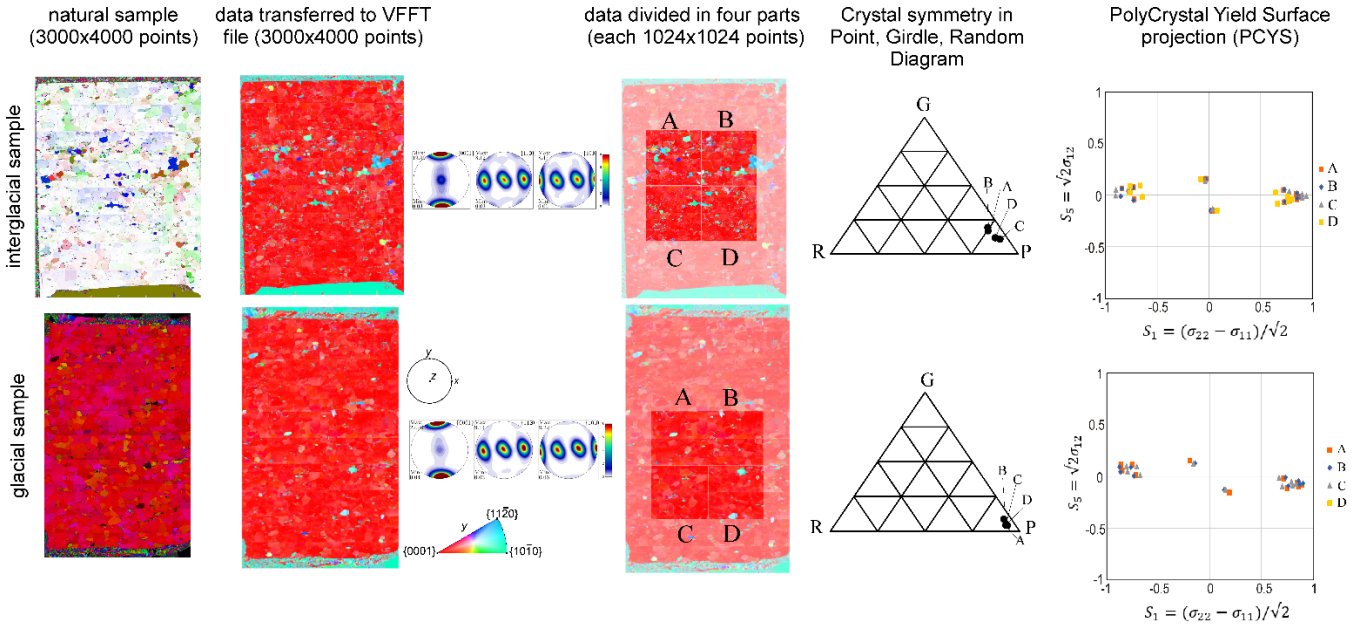
Understanding the mechanisms behind ice hardening due to Crystallographic Preferred Orientation is crucial for predicting ice-sheet flow. By simulating dislocation creep using viscoplastic deformation models, we compute the Polycrystal Yield Surface of glacial and interglacial layers of the NEEM ice core. Since this approach does not consider grain size-sensitive processes or strain hardening due to the pile-up of dislocations, the projections show the magnitude of the viscous anisotropy caused by fabric-induced hardening only.



The Role of Progressive Riedel Shear Dynamics in the Disposition of Ductile Shear Zones in Granitoids: A Field Geologists' Perspective from the Bundelkhand Craton, India

Maity S. *, Roy S., Choudhury S.P., Mohan A., Banerjee S.*

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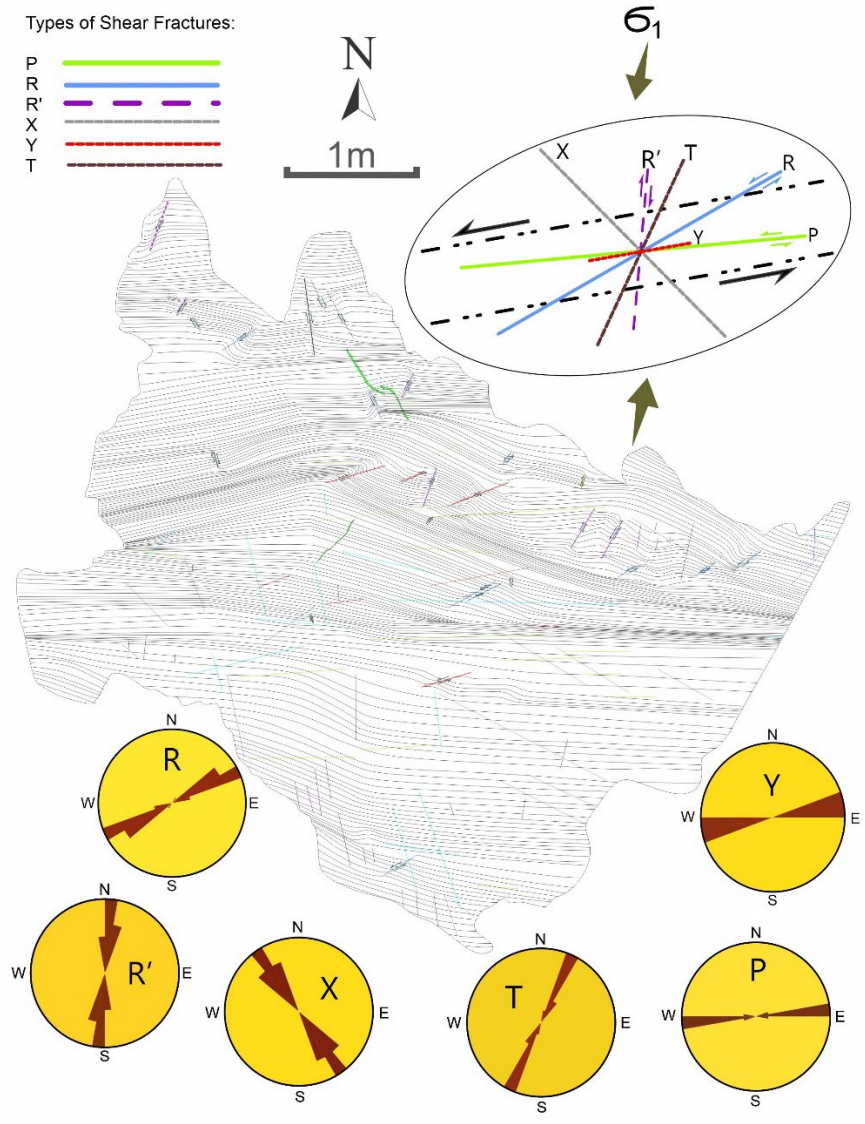
Riedel shears are a network of shear bands, that develop on the rocks subjected to strike-slip movement in a simple-shear deformation regime. The Bundelkhand Craton (BuC) of India preserves a range of structural features such as fractures and ductile shear zones (DSZs). This study illustrates the role of progressive Riedel shear dynamics in the disposition of fractures and DSZs in BuC with ~29000 km2 area as well as the structural architecture of Cratons having DSZs with undeniable field evidence.



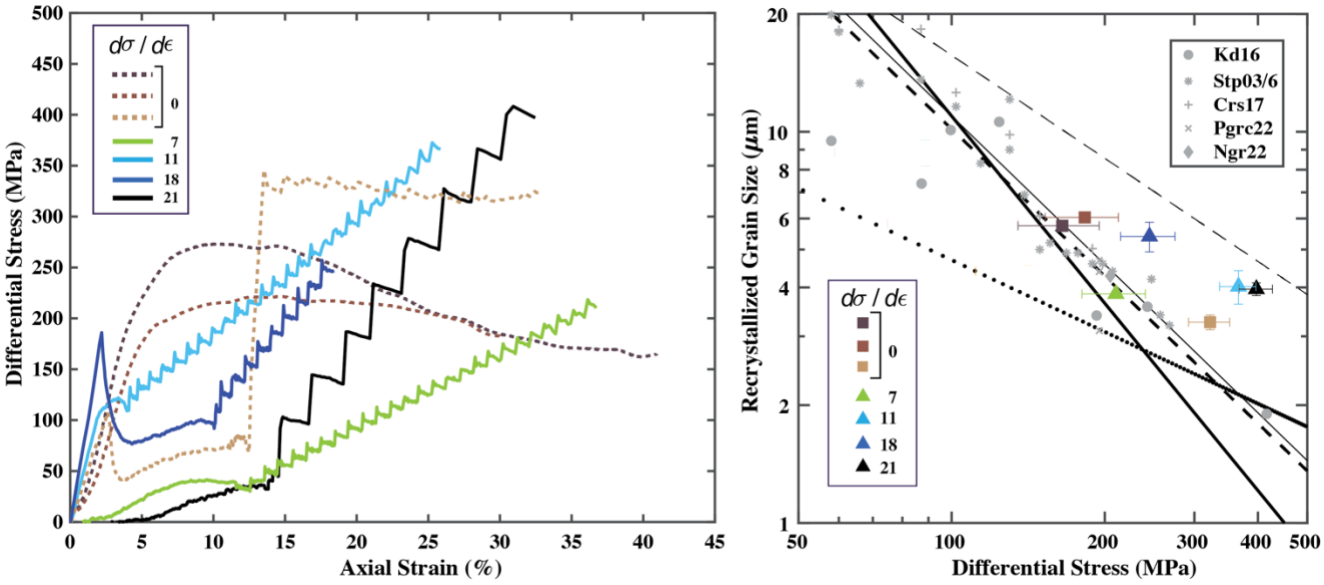
The quartz paleo-piezometer in exhuming crustal rocks: a stress-control experimental evaluation

Mameri L.*[1,2], Kidder S.[1], Hirth G.[2] & Gordana G.[3]

[1] The City University of New York, United States
[2] Brown University, United States
[3] The State University of New York, United States

* *Corresponding email:* lucanmameri@gmail.com

Rock strength can be evaluated via the grain size-stress inverse relationship. However, during exhumation, rocks strengthen as they cool. Using a Griggs apparatus with stress control, we deformed quartz aggregates under increasing stress scaled to exhumation paths. With rapid stress ramps, grain sizes are ~2x the piezometer estimates, whereas in slow stress ramps or at constant stress, grain sizes aligned with the piezometer. Piezometer stresses in exhumed rocks may underestimate their strength.



Mid-crust rheologic variation along the Alpine Fault

Mameri L.*[1], Kidder S.[1], Toy V.[2-3], Prior D.[3], Reitman J.[1], Gordana G.[4] & Little T.[5]

[1] The City University of New York, United States
[2] Johannes Gutenberg University, Germany
[3] University of Otago, New Zealand
[4] The State University of New York, United States
[5] Victoria University, New Zealand

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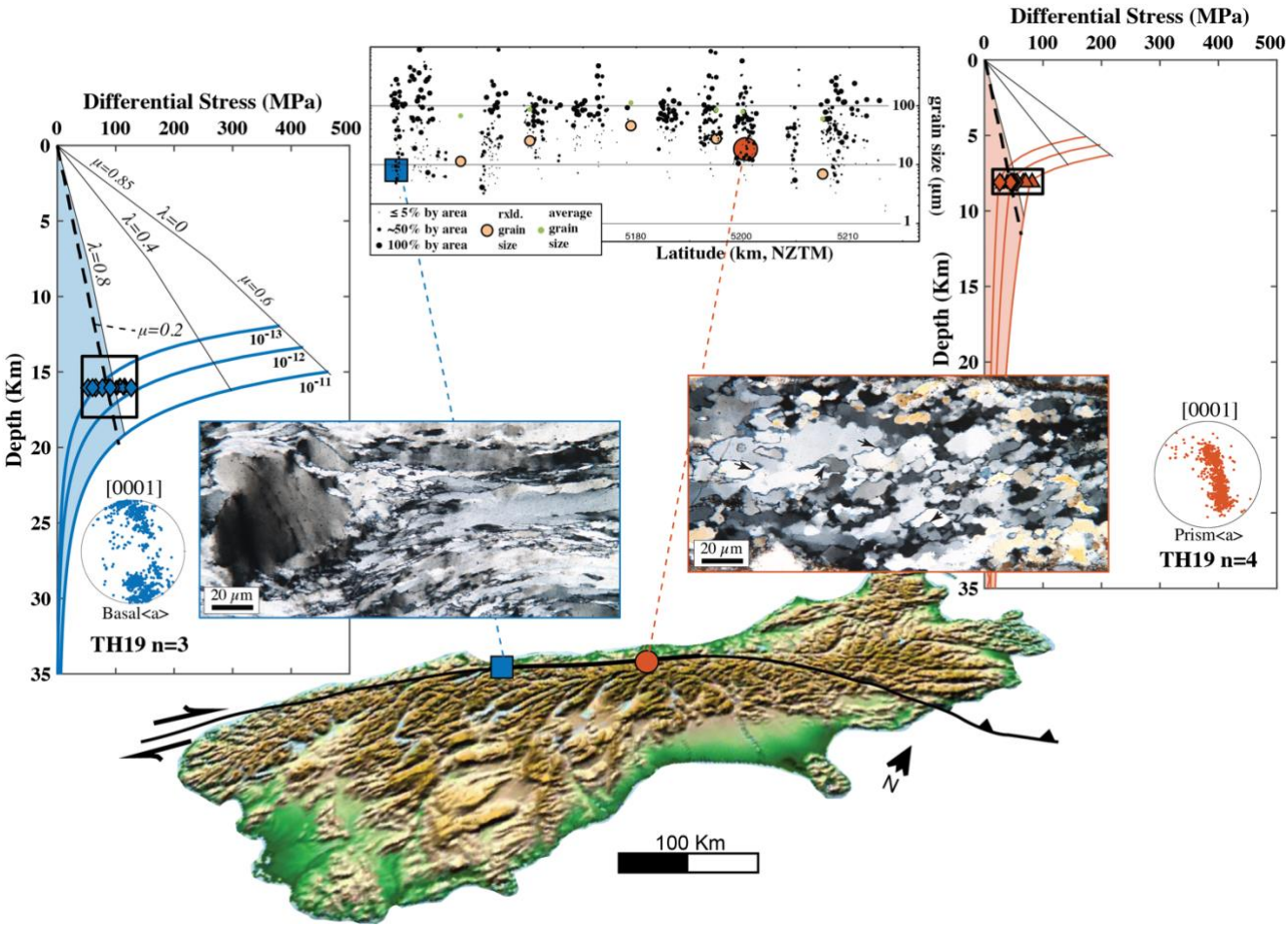
We found that exhumed crustal mylonites in the Alpine Fault contains significant along-strike variation in quartz recrystallized grain size, CPO and deformation temperature, corresponding to differences in advected heat due to distinct exhumation rates. Stresses derived from recrystallized grain sizes at the brittle-ductile transition indicate a very weak fault, notably in the central domain. Independently constrained strain rates allow for tests of widely used and new quartz flow laws.



Nanostructures in minerals in the kinematic reference frame of deformed rocks – an integrated SEM-TEM study and its implications for structural geology research

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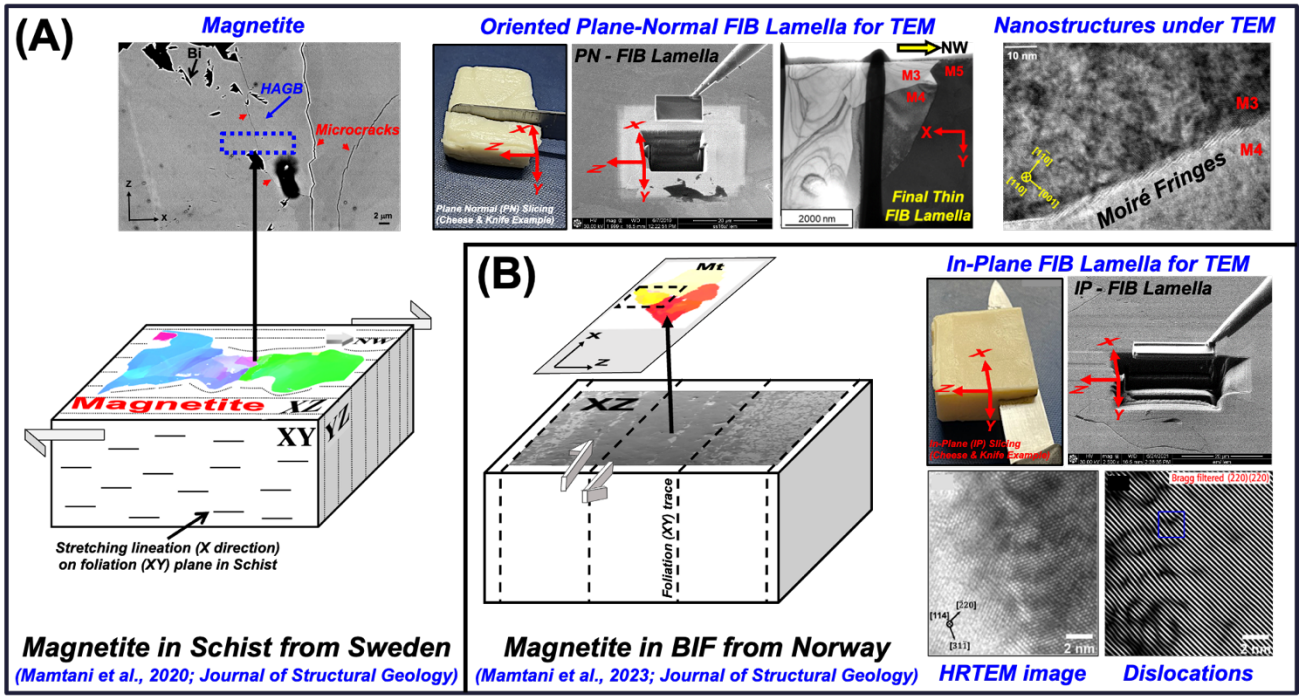
Microstructures observed under a petrographic microscope and SEM originate at the crystal-lattice (atomistic) scale, which can only be observed under the TEM. We present a modus operandi to study nanostructures under TEM in thin films excavated parallel to the kinematic reference frame (XZ). This enables to relate kinematics from the atomistic- to the meso- scales. Grain boundaries in magnetite hosted in tectonically deformed rocks are investigated in this case study to highlight the application of this integrated SEM-TEM approach in structural geology.



Integrating rift inheritance in a slab pull/trench retreat system through a crustal balanced cross-section of the central Apennine.

Maresca A.*[1], Granado P.[2], Muñoz C.[2], Manatschal G.[3], Ogata K.[1], & Tavani S.[1]

[1] Department of Earth, Environmental and Resource Sciences (DiSTAR), University of Naples 'Federico II', Italy
[2] Institut de Recerca Geomodels, Departament de Dinàmica de la Terra i de l'Oceà, Universitat de Barcelona, Spain
[3] Université de Strasbourg, CNRS, ITES UMR 7063, France

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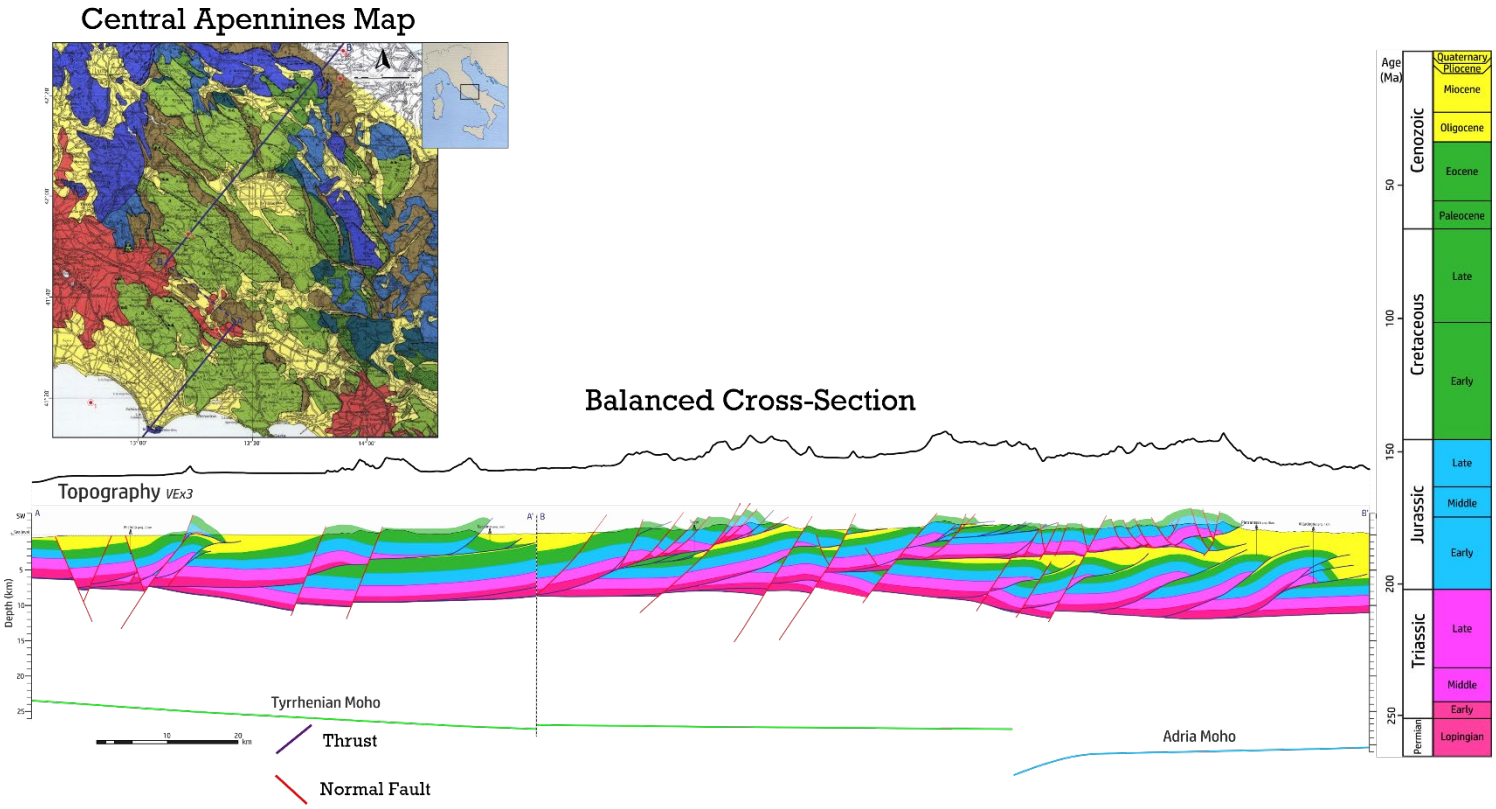
The central Apennines are a Neogene orogen, stretching through central Italy. Its deep structures are still highly debated, with irreconcilable models proposed. We present a new crustal balanced cross-section, built with a multidisciplinary approach in a coherent geodynamic framework, supported by a geometrically balanced and consistent kinematic model.

Our results point to a predominantly thin-skinned style and the thrusting is influenced by the inherited Jurassic extensional structures.



Basement - Cover superposed folding in the Pyrenean Axial Zone

Granado P.[*1], Santolaria P.[1], Snidero M. [1], de Matteis M.[1], Carola E.[1], Liesa M.[1,2], Margalef A.[3], Muñoz, JA[1]

[1] Institut de Recerca Geomodels, Departament de Dinàmica de la Terra i de l'Oceà, Universitat de Barcelona, Spain
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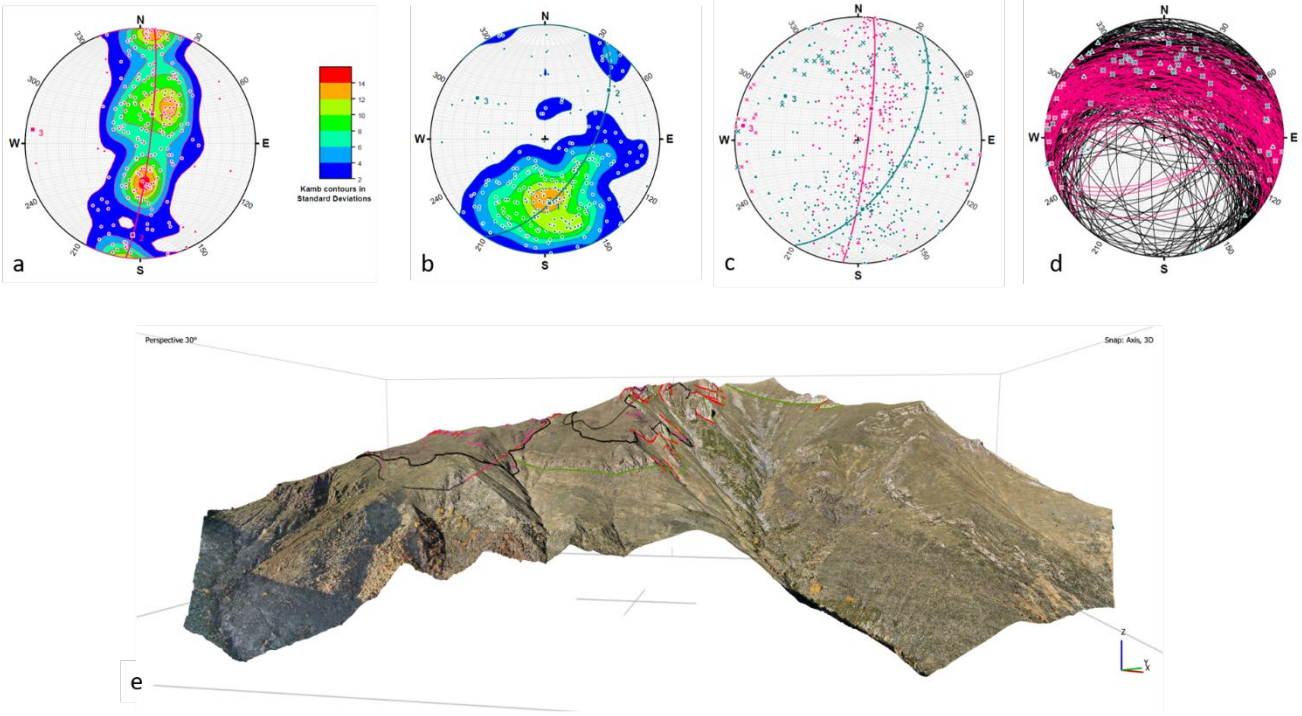
[3] Andorra Research + Innovation, Andorra

[*] *Corresponding email:* pablomartinez_granado@ub.edu

The Laspaules-Castanesa sector of the Pyrenean hinterland is characterized by low-grade Devonian (meta-)sediments unconformably overlain by Permian and Lower Triassic sandstones and conglomerates. We aim at understanding the observed superposed folding by constructing a series of cross-sections and structural data plots. Our analysis has been supported by detailed geological mapping using a high-resolution photogrammetric 3D model generated from our own drone-flight imagery.



Fault process/damage zones in porous carbonates: first analyses of Ta'Cenc faults, Gozo island

Mayolle S. *[1], Bistacchi A.[1], Casiraghi S.[1], De Paolo E.[1] & Benedetti G.[3]

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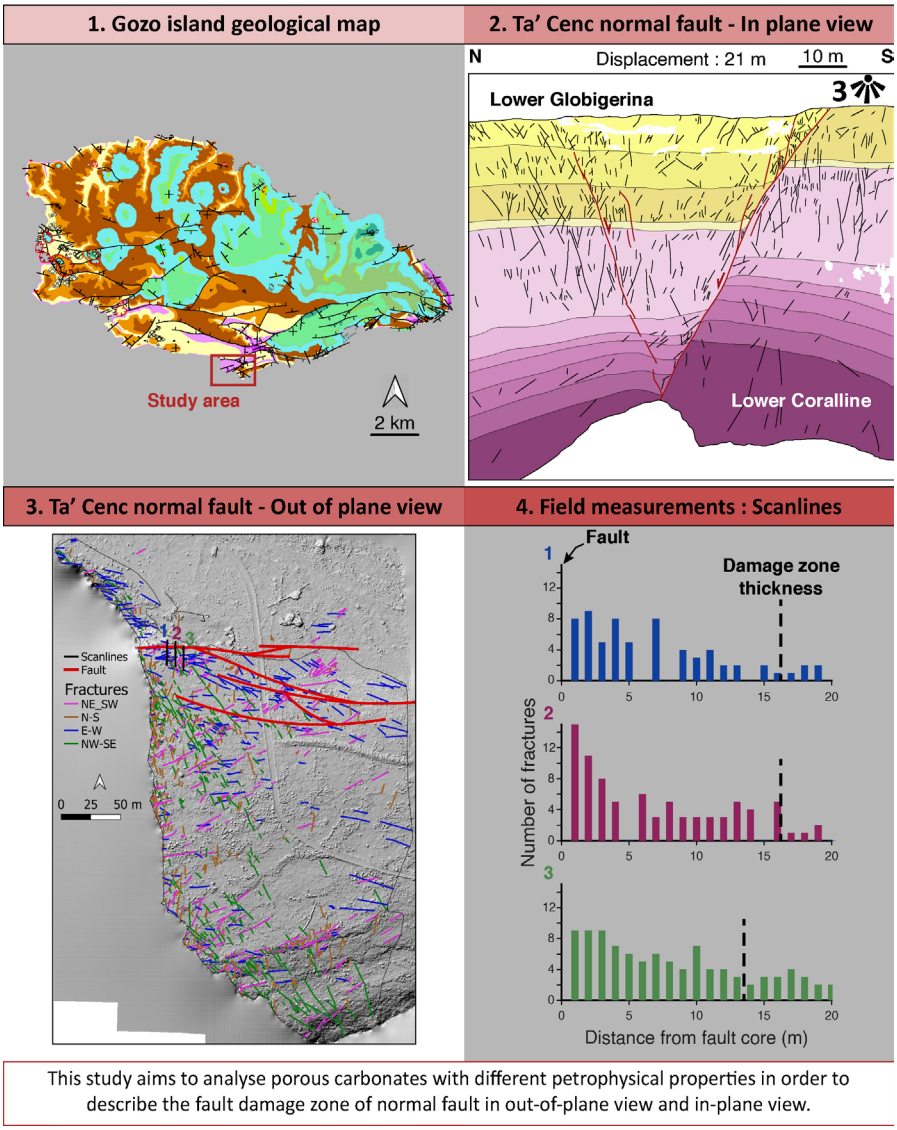
This study aims to analyze the influence of mechanical properties of porous carbonates in fault damage zones. Two normal faults are outcropping on a cliff in Malta, in the footwall of the South Gozo fault. They affect the Globigerina and Lower Coralline formations with a displacement between 20m and 30m. These outcrops allow us to describe fracturing in out-of-plane view for one fault and in-plane view for both faults. The results are discussed in terms of process vs. damage zone development.

Fault damage zones in porous carbonates : first analyses of Ta'Cenc faults, Gozo island



This study aims to analyse porous carbonates with different petrophysical properties in order to describe the fault damage zone of normal fault in out-of-plane view and in-plane view.

Micro-porosity found in quartz shear bands from Ikaria, Greece: implications from Hyperspectral Cathodoluminescence and Electron Backscatter Diffraction

McGill G. *[1], Précigout J.[1], Prigent C.[2], Arbaret L.[1], Airaghi L.[1] & Wallis D.[3]

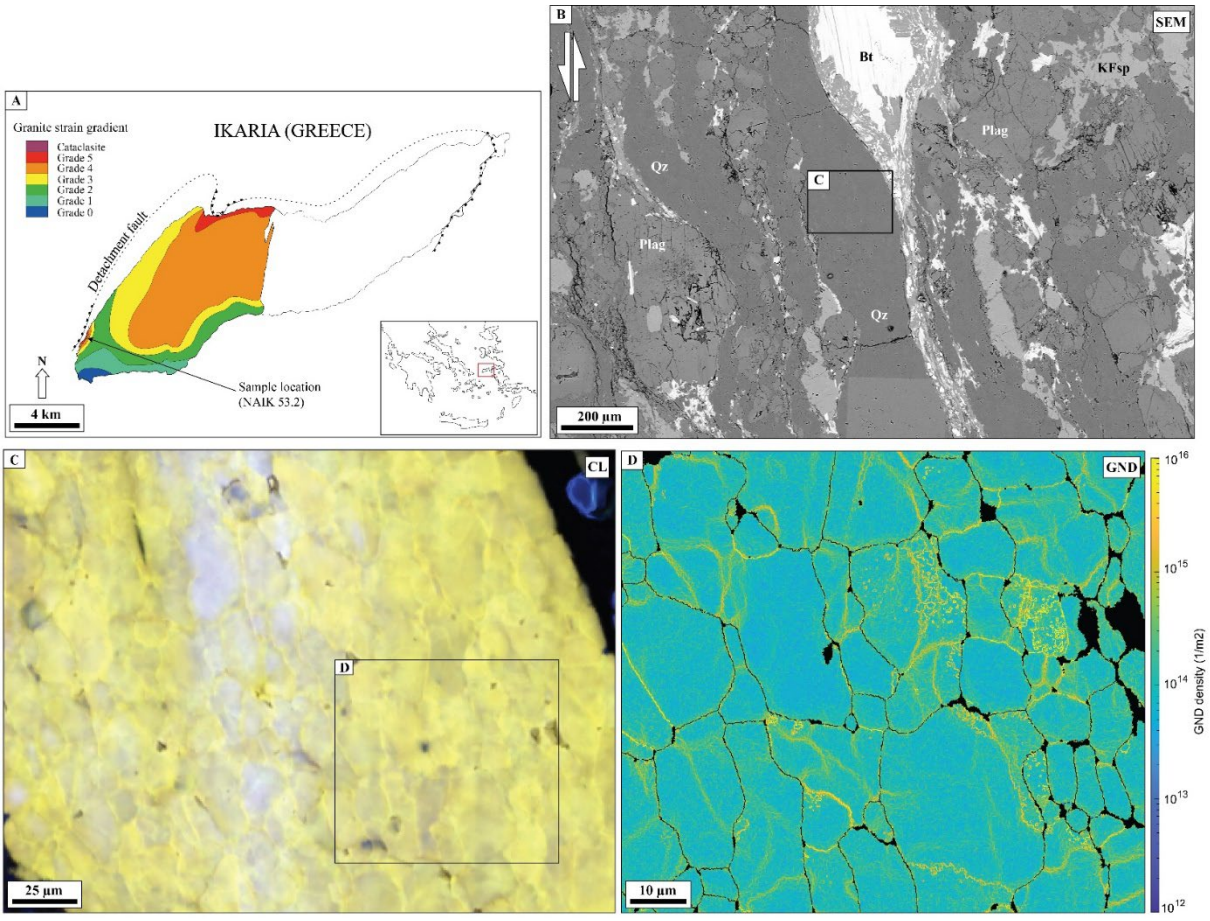
1 Institut des Sciences de la Terre d'Orléans (ISTO, France

2 Institut de Physique du Globe de Paris (IPGP), France

3 Department of Earth Sciences, University of Cambridge, United Kingdom

* *Corresponding email:* gina-elizabeth.mcgill@univ-orleans.fr

Micro-porosity is found in mylonites deformed in crustal shear zones, but the role of deformational processes to produce such porosity remains a matter of debate. We focus on micro-pores occurring in quartz-rich shear bands from mylonitic granitoids in Ikaria, Greece. By comparing EBSD and cathodoluminescence (CL) datasets, we outline high dislocation densities and high CL signal where micro-porosity is found, indicating a link between the density of dislocations and the production of porosity.



Active fault control in Plio-Quaternary gypsum veins (the Galera Fault, S Spain)

Medina-Cascales I. *[1], Carrazana A.[2], Gomez-Rivas E.[2], Alfaro P[1], García-Tortosa F.J.[3] & Martín-Rojas, I.

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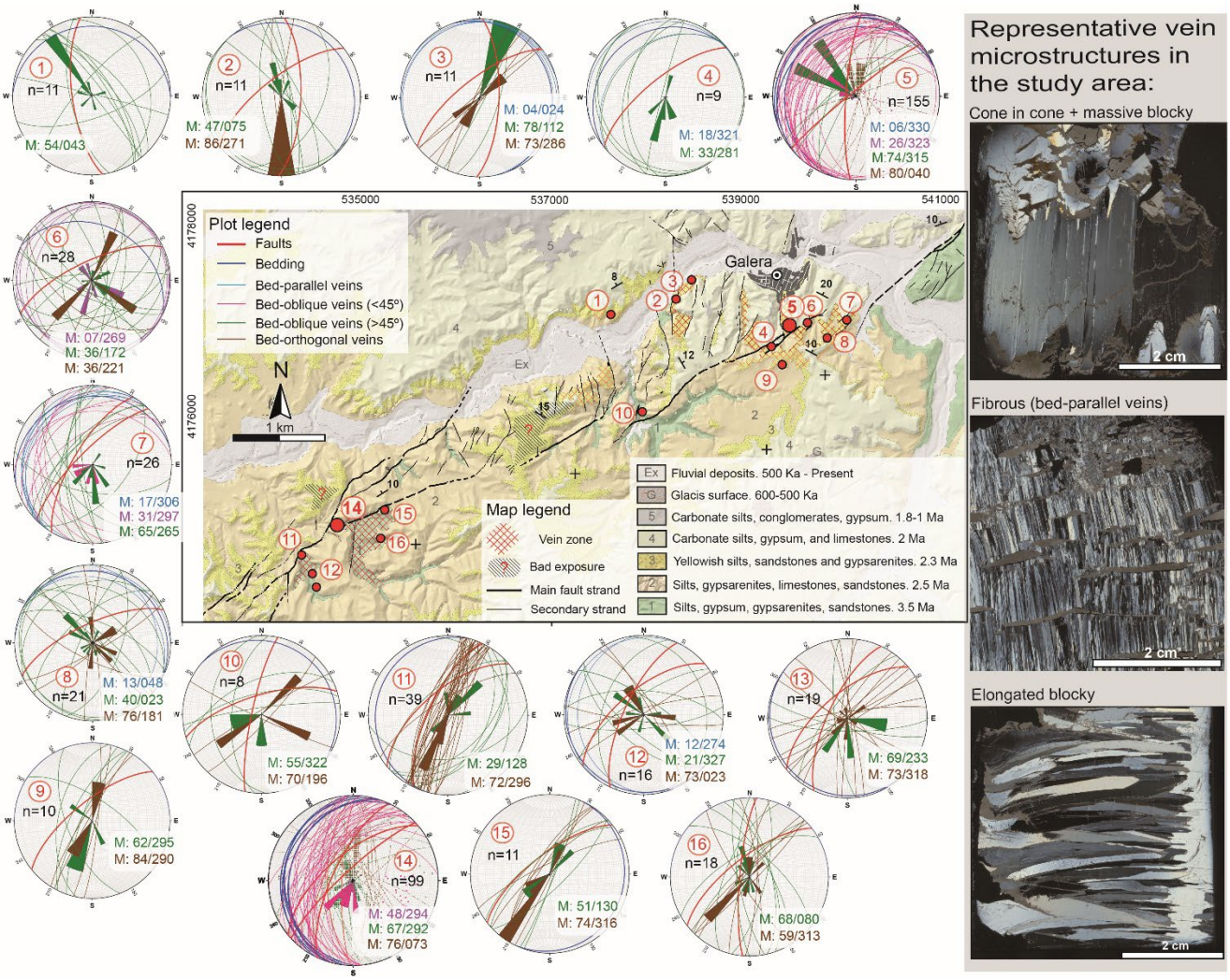
[2] Departament de Mineralogia, Petrologia i Geologia Aplicada, Facultat de Ciències de la Terra, Universitat de Barcelona. C/Martí i Franquès s/n, Barcelona, 08028, Spain

[3] Departamento de Geología, Universidad de Jaén, Campus Las Lagunillas, 23071, Jaén, Spain

* *Corresponding email: ivan.medina@ua.es*

Gypsum veins formed during Plio-Pleistocene times in the active, left-lateral Galera Fault zone (SE Spain). The fault activity controls vein distribution and geometry. Veins form a band aligned with the fault zone, with width proportional to fault complexity. Vein strike fits with transtensional fractures formed within the strain field of the fault, being sensitive to local variations produced by structures related with fault activity. Veins developed shallowly shortly after sedimentation.

Image



3D Geomodelling of Alpine Structures with PZero: the Misox Shear Zone (Swiss)

Monti R.*[1], Bistacchi A.[1] & Zanchetta S.[1]

[1]Università degli Studi di Milano-Bicocca, Italy

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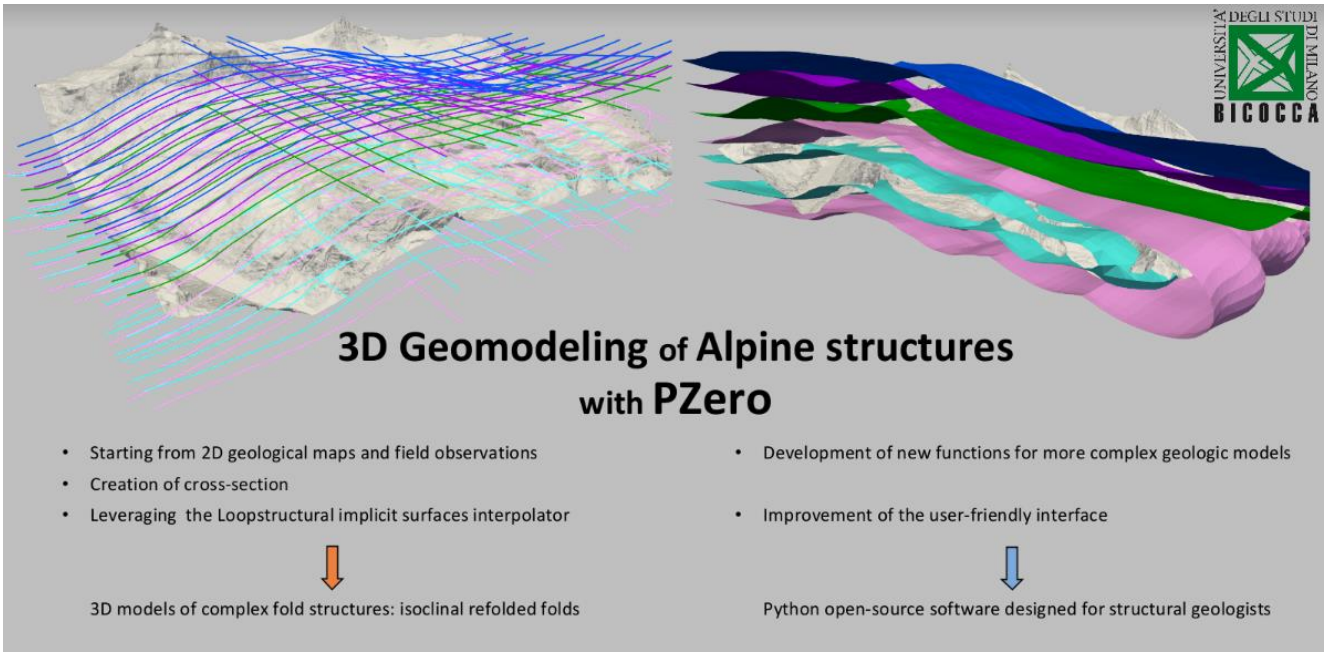
3D models are fundamental tools for studying the evolution of complex geological structures, such as shear zones in the Alps. PZero is a Python open-source software currently in development. The case study is the area of the San Bernardino Pass (Swiss), focusing on the 3D modelling - starting from original field data and available geological maps- of the shear zone and the superposed fold system developed within the Adula nappe.



Investigating the regional scale strain variations in the Banded Iron Formations of the Bundelkhand Tectonic Zone: Insights from Anisotropy of Magnetic Susceptibility Studies

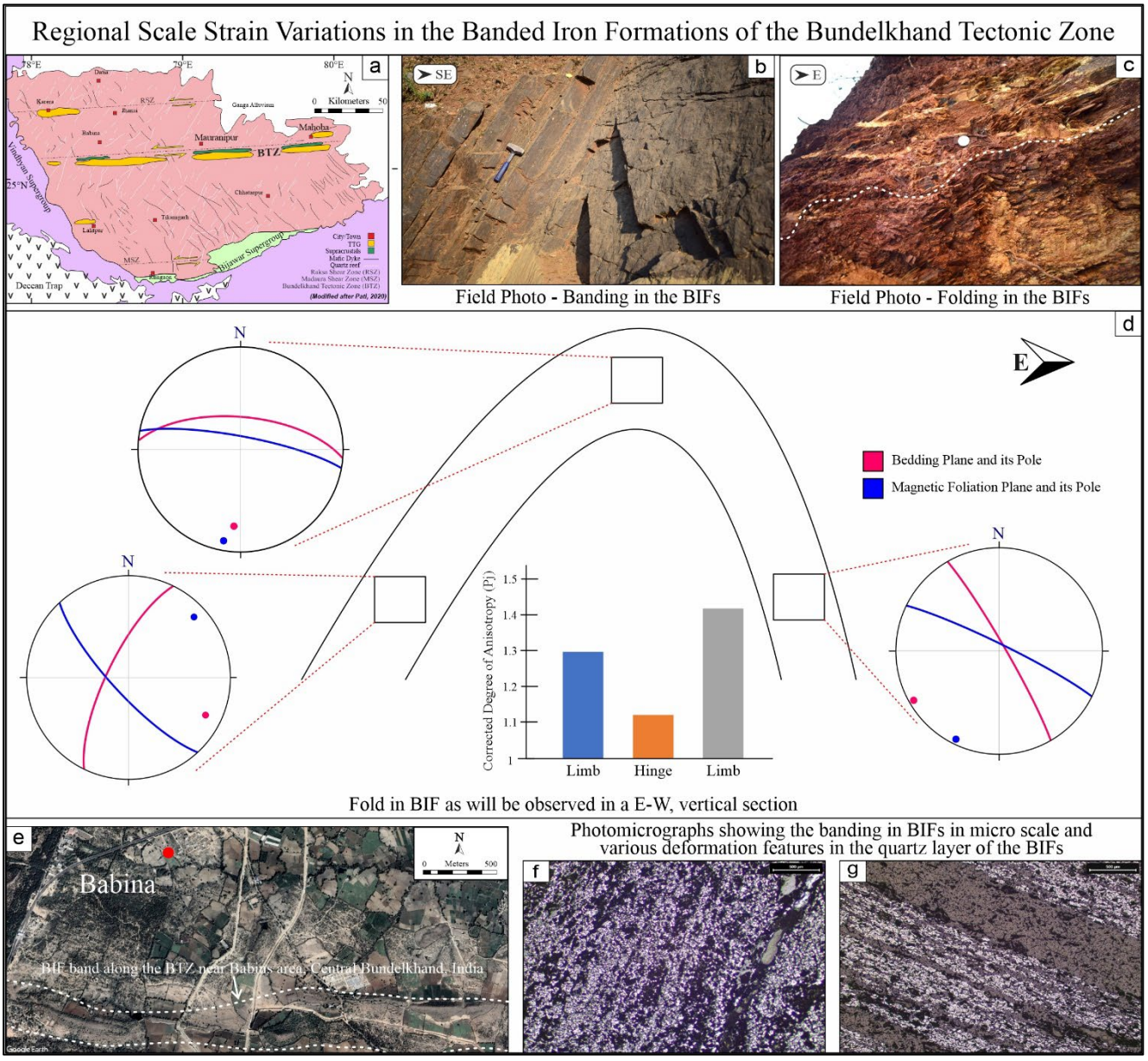
Aishwarya Mohan*, Ram Pratap Singh Tomar, Samriddhi Sharma, Sayandeep Banerjee

Laboratory for Analysis of Magnetic & Petrofabric, Department of Geology, Banaras Hindu University, Varanasi, India – 221005

* *Corresponding email:* amohan.geo@bhu.ac.in / sayandeep87.geo@bhu.ac.in

Description:

The Archean Bundelkhand Craton hosts Meso-Neo Archean BIFs along the Bundelkhand Tectonic Zone (BTZ), a crustal shear zone. BIF outcrops being sporadic, highly vegetated, coupled with absence of proper markers & axial planar cleavage makes it difficult to study large-scale structures as well as state of strain in them. We have utilized Anisotropy of magnetic susceptibility analysis to understand strain state & bedding-foliation relationships in different parts of a fold existing in BIFs of BTZ.



Reconstruction of the different stages of the Cadomian peri-Gondwanan arc based on structural data in SW Iberian Massif.

Moreno-Martín, D. *[1], Díez Fernández, R.[2], Arenas, R.[1], Rojo-Pérez, E.[1], Novo-Fernández, I[1,3], Sánchez Martínez, S.[1]

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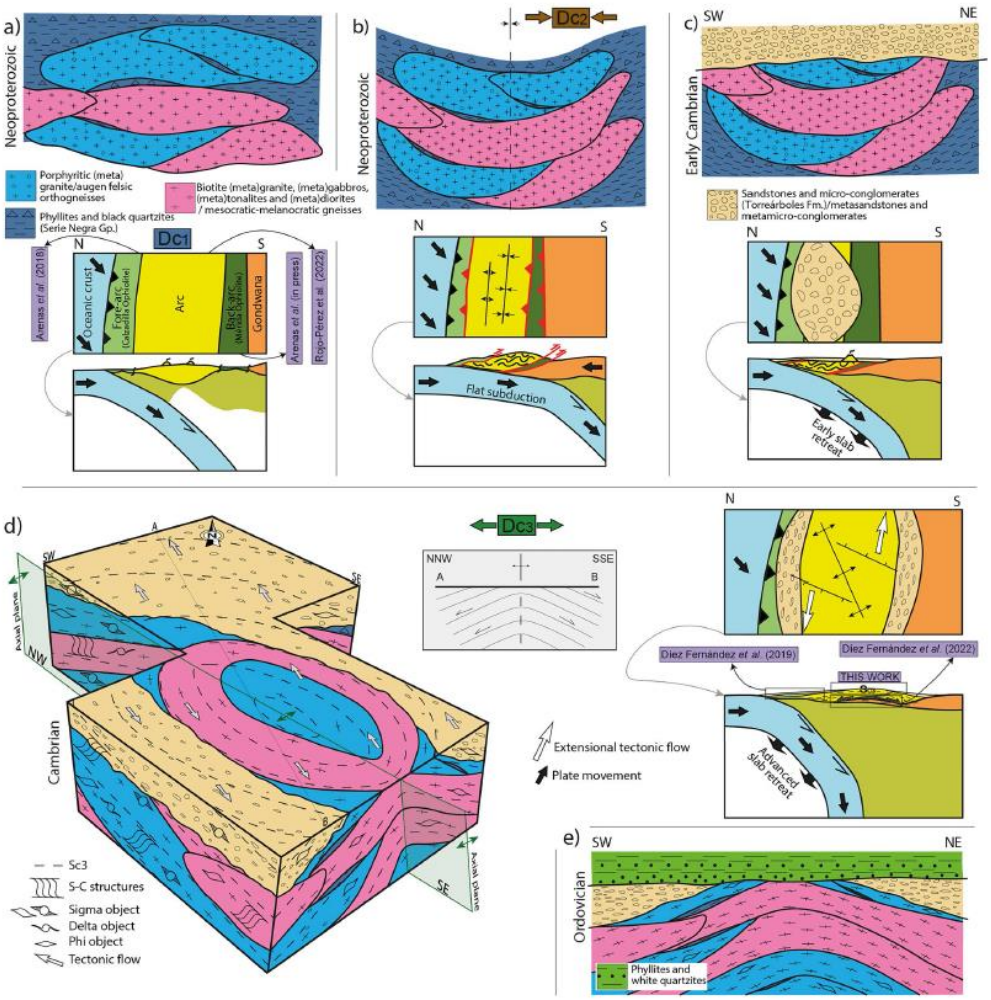
The Cadomian Orogeny, a subduction-related mountain-building event in peri-Gondwana, influenced the basement of the Iberian Massif. Tectonometamorphic analysis in SW Iberia (La Serena Massif) has yielded three phases of Cadomian deformation. The first phase (D_{C1}) involves crustal growth and thickening (before 573 Ma). The second phase (D_{C2}, 573–535 Ma) formed upright folds (crustal thickening). The third phase (D_{C3}, 535-480 Ma) developed an orogen-parallel dome with oblique extensional flow.



Onset of Variscan deformation in SW Iberia: constrains from structural data and implications for paleogeographic reconstructions.

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[2] Centro Nacional Instituto Geológico y Minero de España, CSIC, 37001 Salamanca, Spain. r.diez@igme.es

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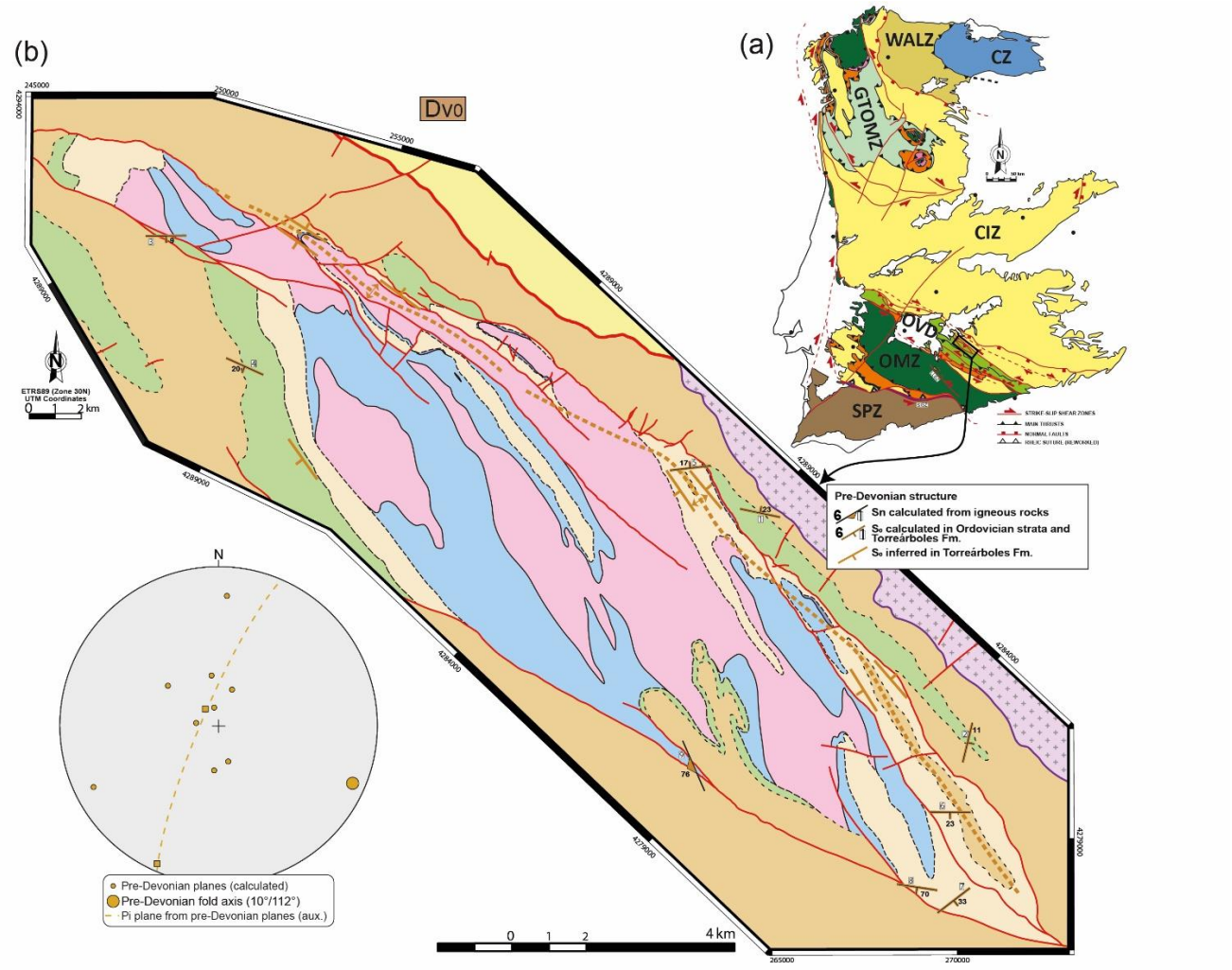
The Ediacaran-Ordovician series of the Ovejo-Valsequillo Domain (OVD) are uncomformably covered by Early Devonian strata (also affected by Variscan folds). Reconstruction of the folded structure of the Ordovician strata under the Devonian unconformity suggests post-Ordovician and pre-Early Devonian contractional deformation in the OVD, matching the onset of Variscan deformation in the Ossa-Morena Zone (among the oldest of the Iberian Massif). This feature adds to their similar Ediacaran series.



Microstructural Dynamics in Ice Cores During Abrupt Climate Events

Moreno M. *[1], Lamott A.[2], Kipfstuhl S.[3] & Dahl-Jensen D.[1,4]

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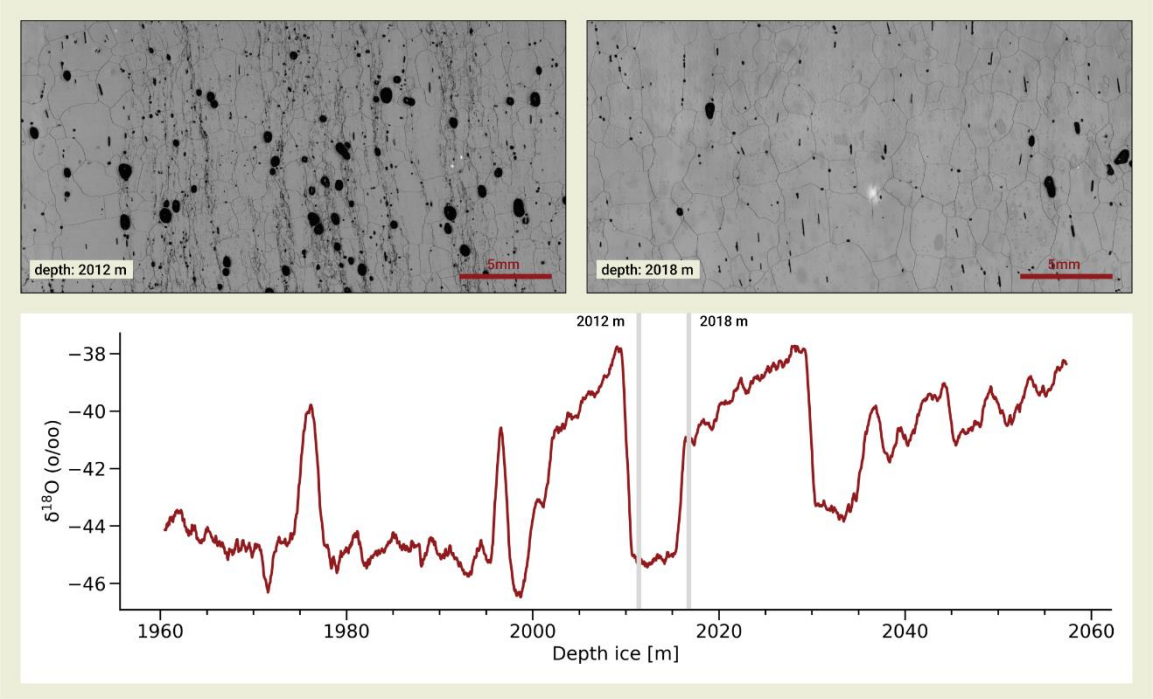
The physical properties of ice crystals are strongly related to the flow and deformation of ice. Here, we thoroughly examine the microstructural features present along 25 meters of ice within the North Greenland Eemian Ice Drilling project (NEEM). The study analyzes ice from 2003 m to 2028 m in depth, covering three abrupt events (GI-19.2, GS-20, and GI-20) within the Last Glacial Maximum. We aim to understand shifts in ice rheology and flow dynamics during these abrupt events.



Probing high-strain rate deformation by impact experiments and fractal analysis of brittle fault rocks

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Field evidence of the pulverized fault rocks characterized by high-fractal dimensions with shatter textures implies the high-strain rate deformation associated with earthquake ruptures. Here, we conduct impact experiments on granite to evaluate the high-strain rate deformation. Based on the experiments, we propose a relation between fractal dimensions and the fractured energy of rocks, leading to the quantitative measure of the fractured energy of paleo-seismicity by brittle fault rocks.

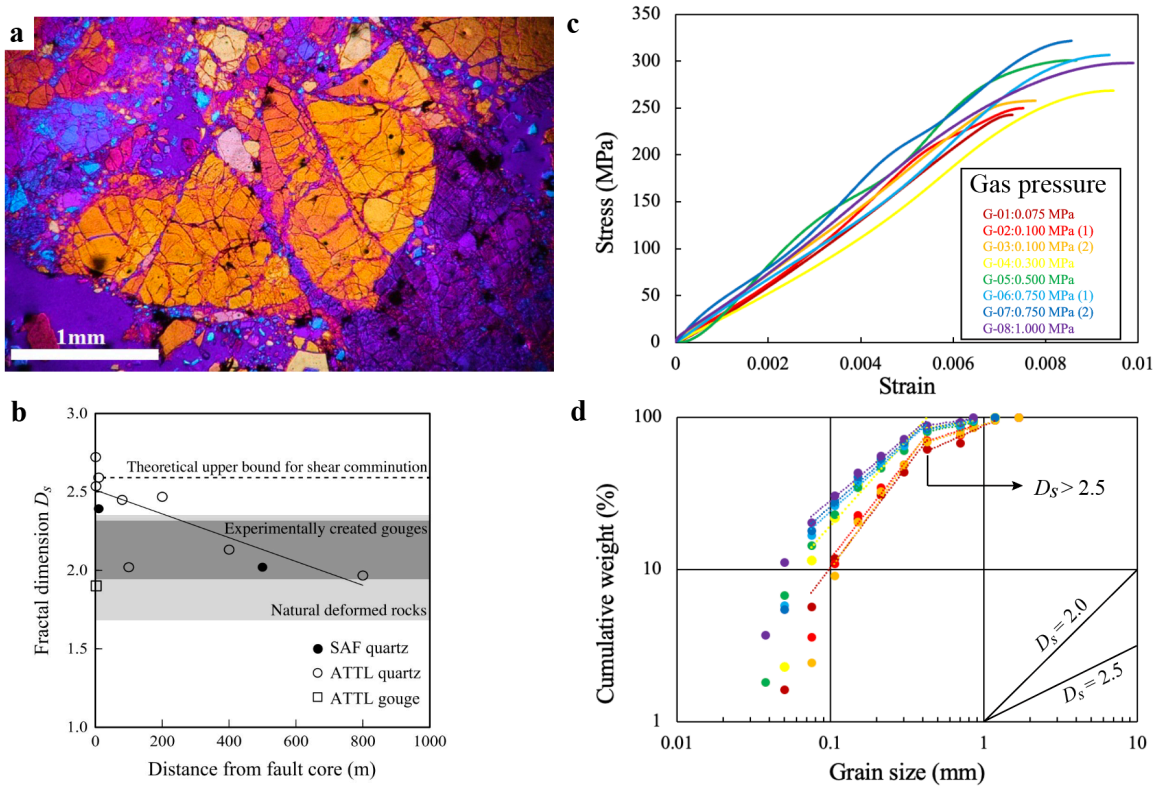

Figure 1. Pulverized fault rocks and high strain rate deformation. a) Representative microstructures of pulverized rocks from Arima-Takatsuki Tectonic Line (ATTL), SW Japan (Muto et al., 2015GRL). b) Fractal dimensions as a function of distances from fault cores (Muto et al., 2015GRL). SAF = San Andreas Fault. c) Stress-strain relations of the impact experiments. Note that the strain rates inclease with the gas pressures of the impact experiments. Colors indicate the gas pressures of the impact. d) Grain size distribution measured by the weight of the recovered samples. Slopes indicate fractal dimensions D_s. Note that dimensions > 2.5 appear in the grain sizes larger than 0.3 mm (shown by an arrow).

Role of pre- and syn-obduction depositional units during the Semail ophiolite tectonic emplacement

Najafi M.*[1], Vergés J.[1], Razin P.[2], Cruset D.[1], Jiménez-Munt I.[1], Torne M.[1], Garcia-Castellanos D.[1], Viaplana-Muzas M.[1], Spina V.[3] & Ringenbach J.[4]

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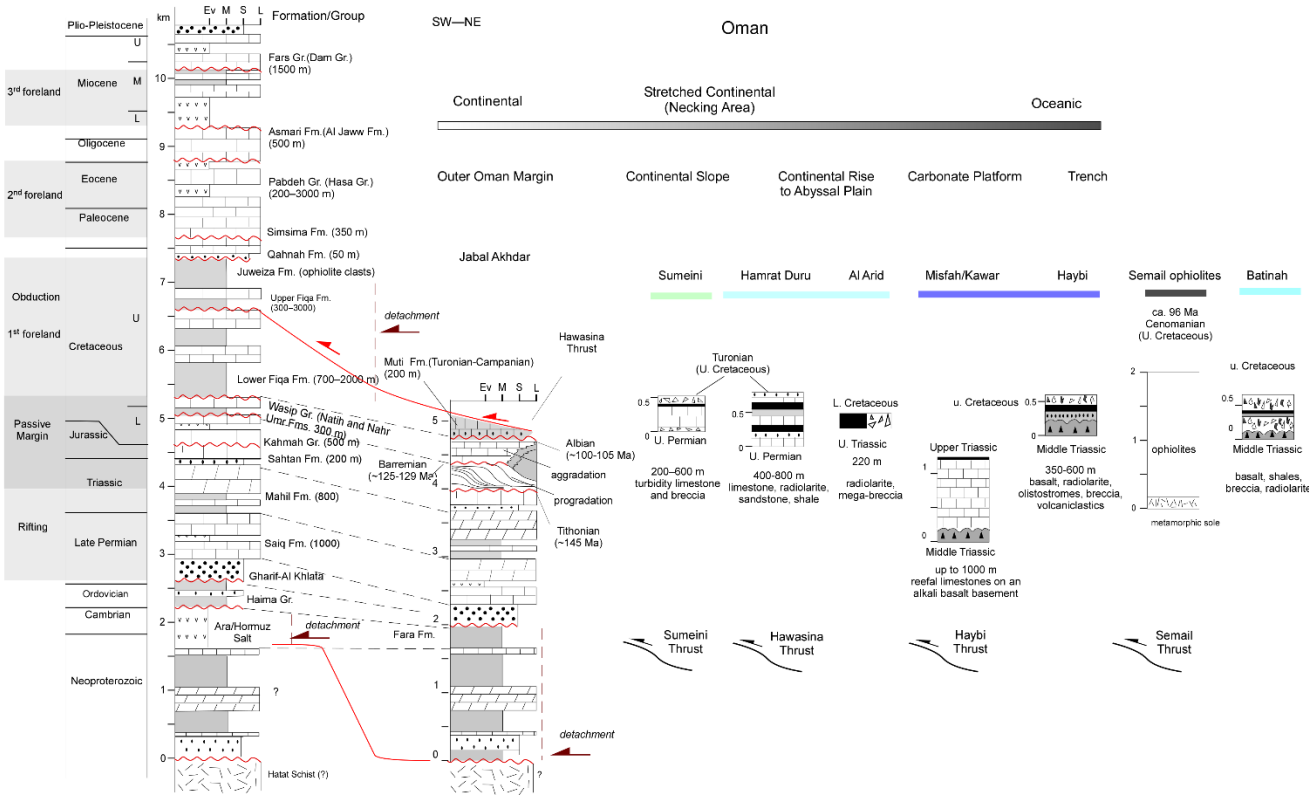
This study aims to enhance the reconstruction of structural geometries in the central part of the Oman Mountains and elucidate the tectono-sedimentary relationships of the Oman orogenic system. To achieve these objectives, we conducted a regional-scale stratigraphic correlation and constructed a 250-km-long balanced and restored geological cross-section from the internal domains to the foreland of the Oman orogen, across the Jebel Akhdar window.



Timing of deformation across the Zagros fold belt

Najafi M.*[1], Beamud E.[2], Madanipour S.[3], Lashgari A.[4], Ruh J.[5] Koshnaw R.[6], Vergés J.[1]

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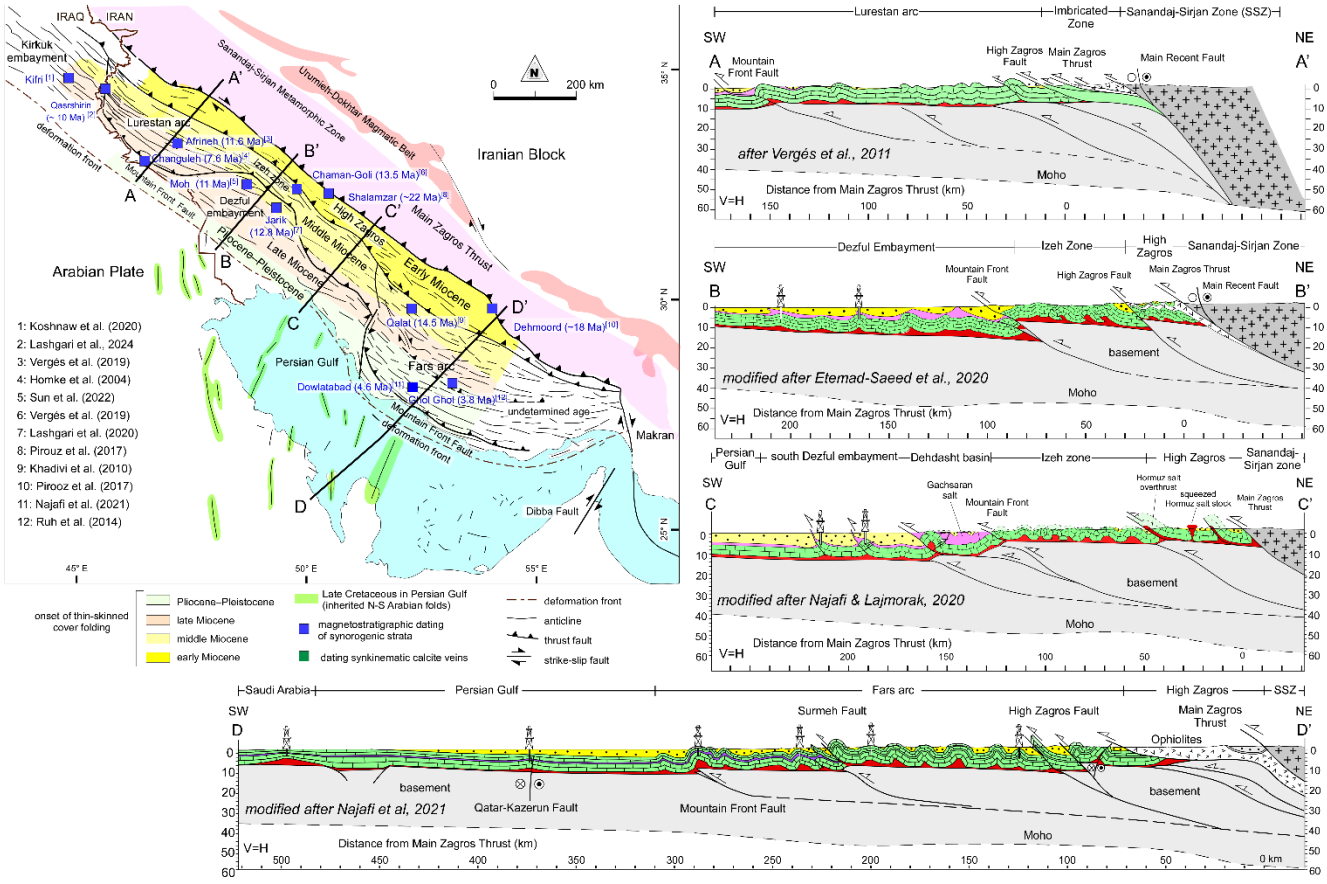
The Zagros fold belt in the Arabian-Eurasian collision zone is shaped by a combination of thin-skinned detachment folding and thick-skinned thrusting. Analysis of magnetostratigraphic ages indicates that the folding of the sedimentary cover propagated along multiple detachment levels in sequence toward the foreland since the early Miocene. However, late and out-of-sequence basement thrusting has subsequently reshaped the structural style of the region.



Rheology modification in subduction channels due to eclogite facies metasomatism (Rocky Beach Metamorphic Mélange, Port Macquarie, Australia)

Finch, M. A.[1,2], Olesch-Byrne, A.*[1,2], Chapman T.[3], Beilharz, M.[2] & Tomkins, A.T.[2]

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The rheological properties at the interface between the downgoing and overriding plate in subduction zones provide insight into how plate convergence is accommodated and the controls on seismic and aseismic slip. We determined that the pressure and temperature conditions of metasomatism dramatically change the rheology of subduction channels. The Rocky Beach Metamorphic Mélange is an example of the interplay between metasomatism-induced changes in rheology and deformation during return flow.

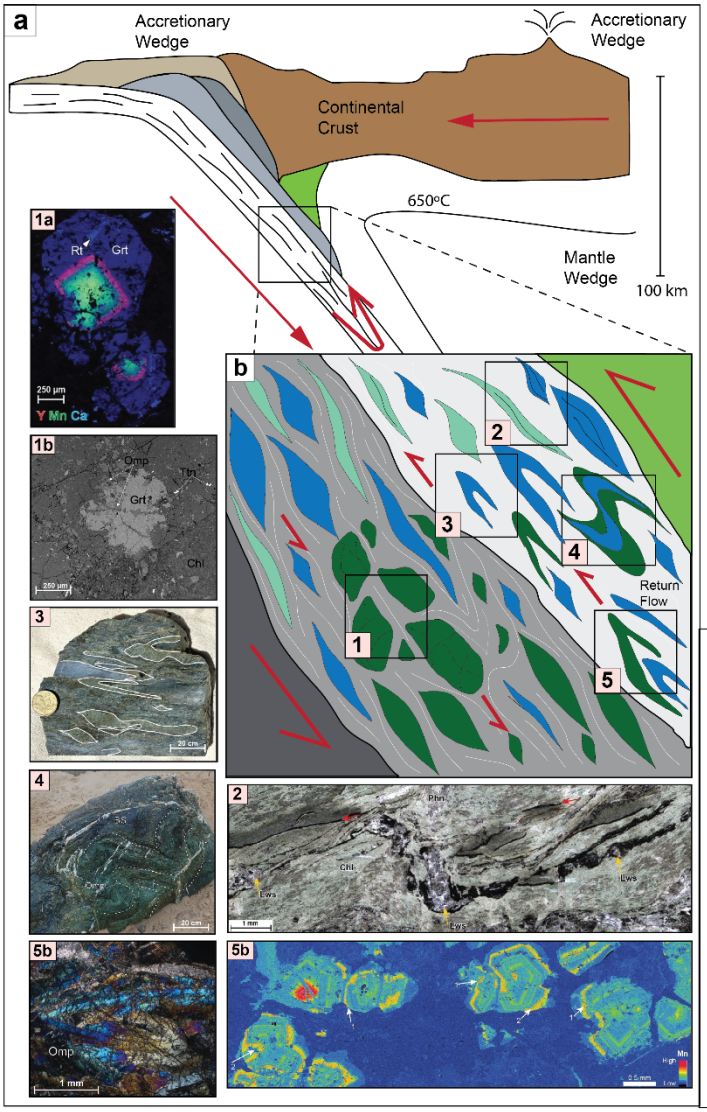

Figure: A) Schematic diagram illustrating subduction zone dynamics with a focus on the return flow mechanism within the subduction channel. B) A conceptual model that outlines the structural characteristics of the subduction mélange, highlighting the contrast between the downgoing limb and the return flow. Insets 1-5) Provide microscale to macroscale evidence of characteristic structures and mineral assemblages, demonstrating the retrograde metamorphism stages of the return flow process. Insets 1a and 1b reveal mineral compositions typical of high-pressure eclogite facies, while Insets 2-5 illustrate the evolution of structural and textural relationships, along with compositional zoning associated with the return flow.

The role of fluid migration in a mylonitic shear zone in REE ore deposit formation

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The Mary Kathleen REE ore deposit formed adjacent to a ductile shear zone, which is thought to be the ore fluid conduit. The role of the shear zone in the formation of the ore deposit was examined, including the relationship between rheology, deformation mechanisms, and ore fluid flow.

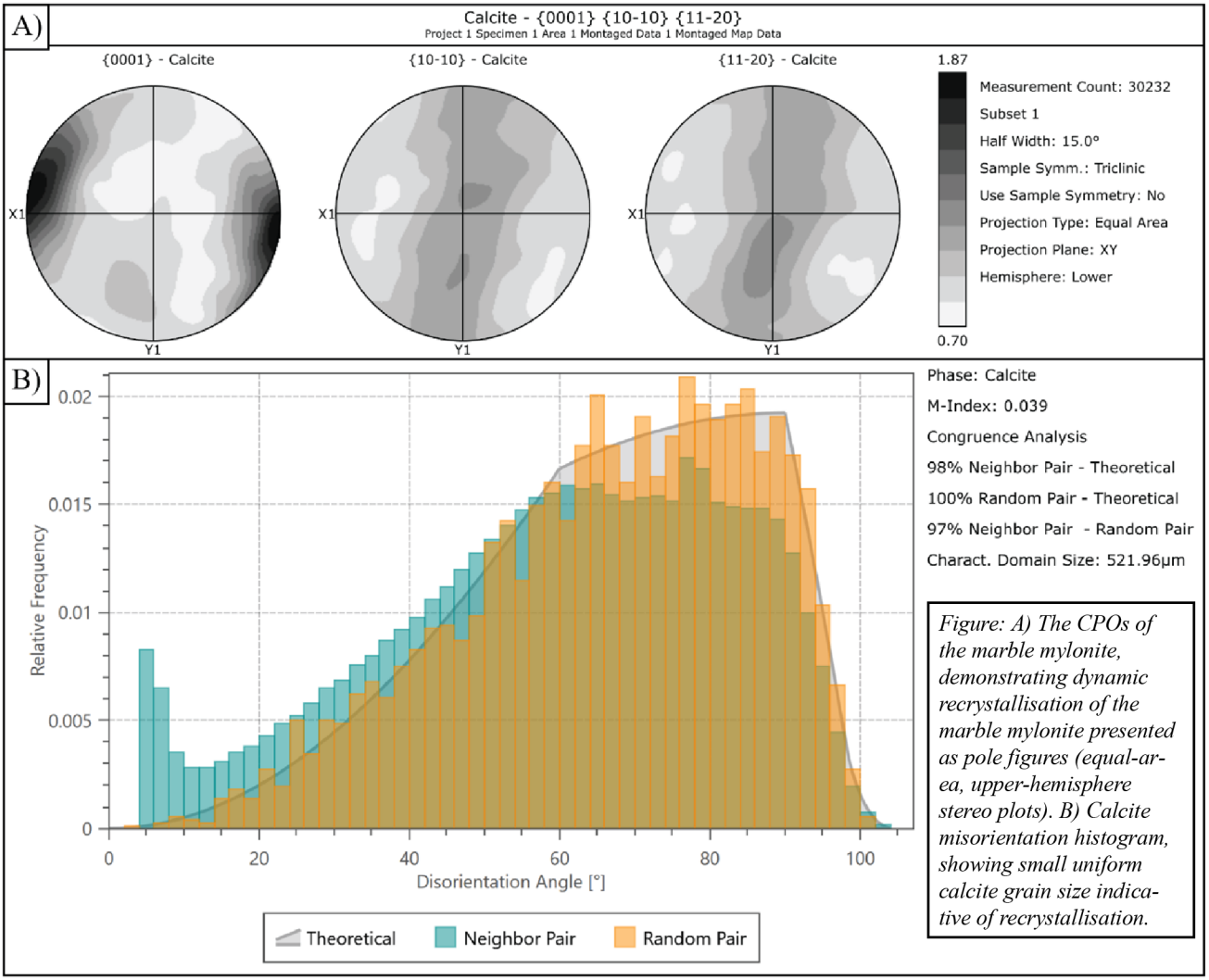

Figure: A) The CPOs of the marble mylonite, demonstrating dynamic recrystallisation of the marble mylonite presented as pole figures (equal-area, upper-hemisphere stereo plots). B) Calcite misorientation histogram, showing small uniform calcite grain size indicative of recrystallisation.

Quantitative meso- and micro-structural analysis of the meso-Alpine mylonites of the southern Calabrian Peloritani Composite Terrain: a contribution in unravelling the western Mediterranean microplates kinematics

Ortolano G.[1], Visalli R.[1]*, Fazio E.[1], Alsop G.I.[2] & Cirrincione R.[1]

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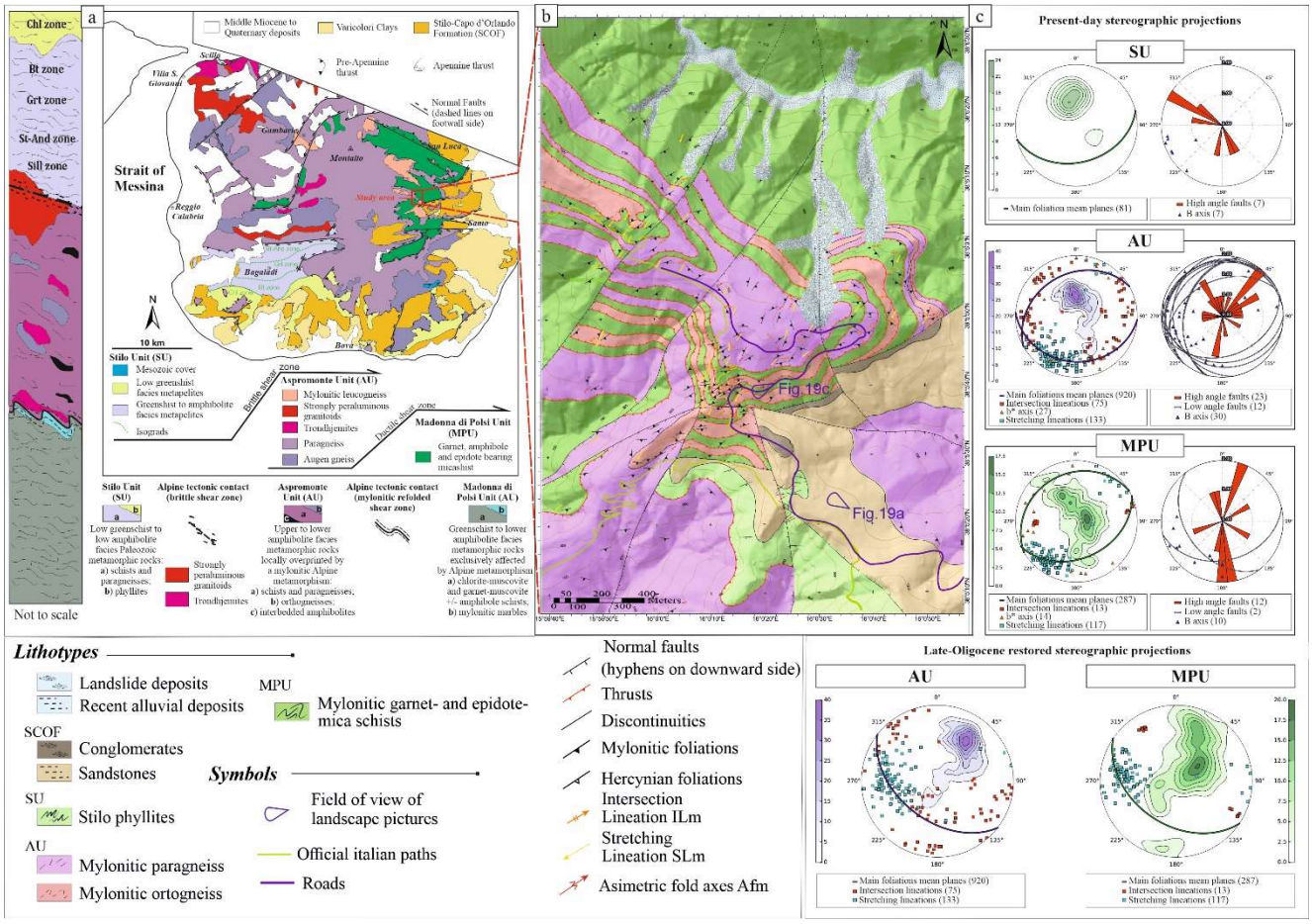
The Montalto Shear Zone (MSZ) forms mylonites in the central portion of the Aspromonte Massif that occupy an area of about 200 km2 with an apparent thickness of 900 m (Fig. a).

The Aspromonte Massif, together with the Peloritani Mountains belt in Sicily, constitutes a piece of the original continental southern European Variscan margin, which differs substantially from the rest of the Calabria Peloritani Composite Terrane (CPCT). This sector of the CPCT is, indeed, composed of a first order nappe-like structure, despite being characterized by an exclusive SE-ward nappe emplacement, consistent with a constant Africa-verging tectonic structure since the Late Eocene.

Image

(a) Geological sketch map of the Aspromonte Massif nappe-like edifice with relative tectono-stratigraphic column (after Ortolano et al., 2015 modified); b) Detailed geological-structural map of the Montalto Shear Zone tectonic evolution; c) Stereographic projections of the present-day and of the late-Oligocene restoration of the mylonitic-related structural features)



Shearing and exhumation of carbonated serpentinites on the Island of Elba subduction channel (Northern Apennines, Italy)

Papeschi S. *[1], Rizzo R.E.[2], Vannucchi P.[2], Okazaki, K.[3], & Hirose T.[4]

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[2] Department of Earth Sciences, University of Firenze, Italy
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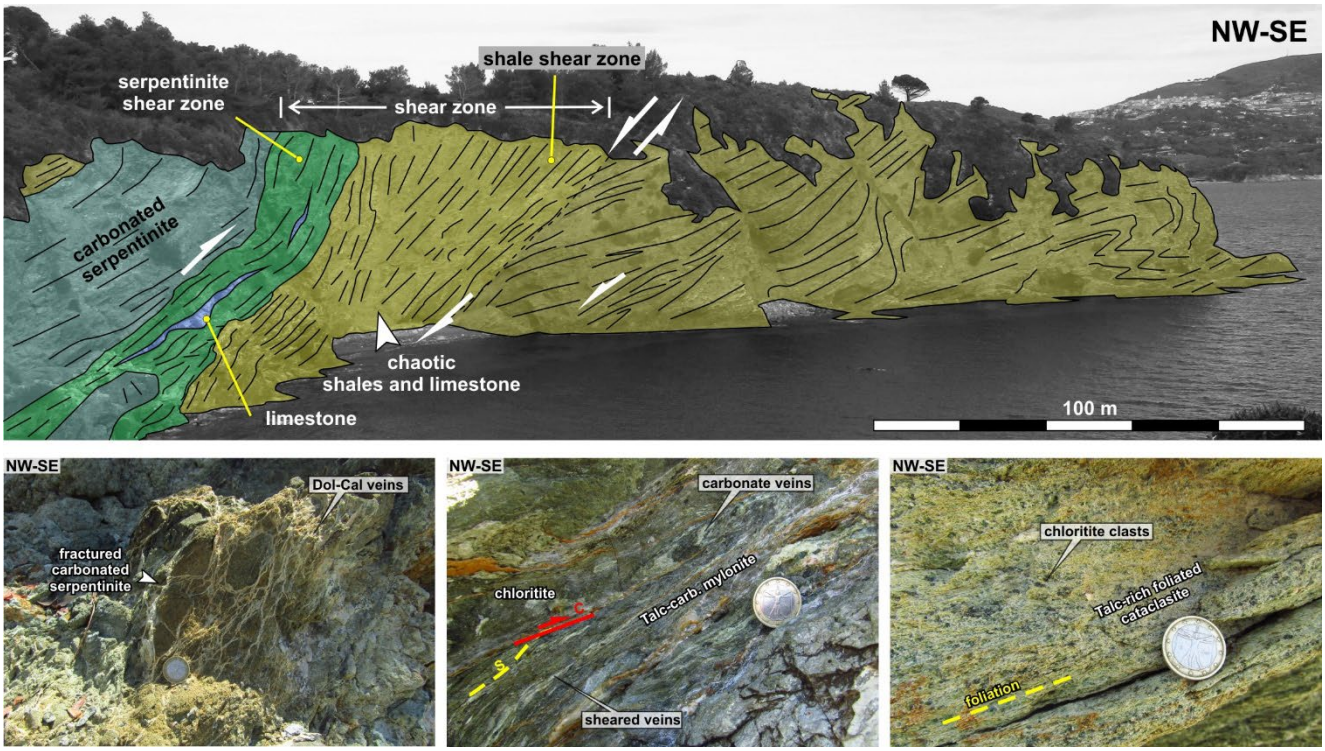
We report on an exhumed subduction complex preserved at the interface between continental and oceanic units on Elba. The complex consists of sheared and carbonated serpentinites and mélanges with blocks and tectonic slices of metasediments and metabasalts. Metamorphic constraints suggest temperatures of 260 – 320 °C range, with sediment-derived. CO_2 carbonation. This complex offers evidence of Paleogene/Cretaceous subduction in the Northern Apennines.



Geologic and metamorphic constraints on magma emplacement to validate regional seismic tomography of Tuscany (Project MIGRATE)

Papeschi S.*[1], Bonini M.[1], Lanari R.[1], Lupi, M.[2], Montanari, D.[1], & Del Ventisette C.[2]

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[2] University of Geneva, Switzerland
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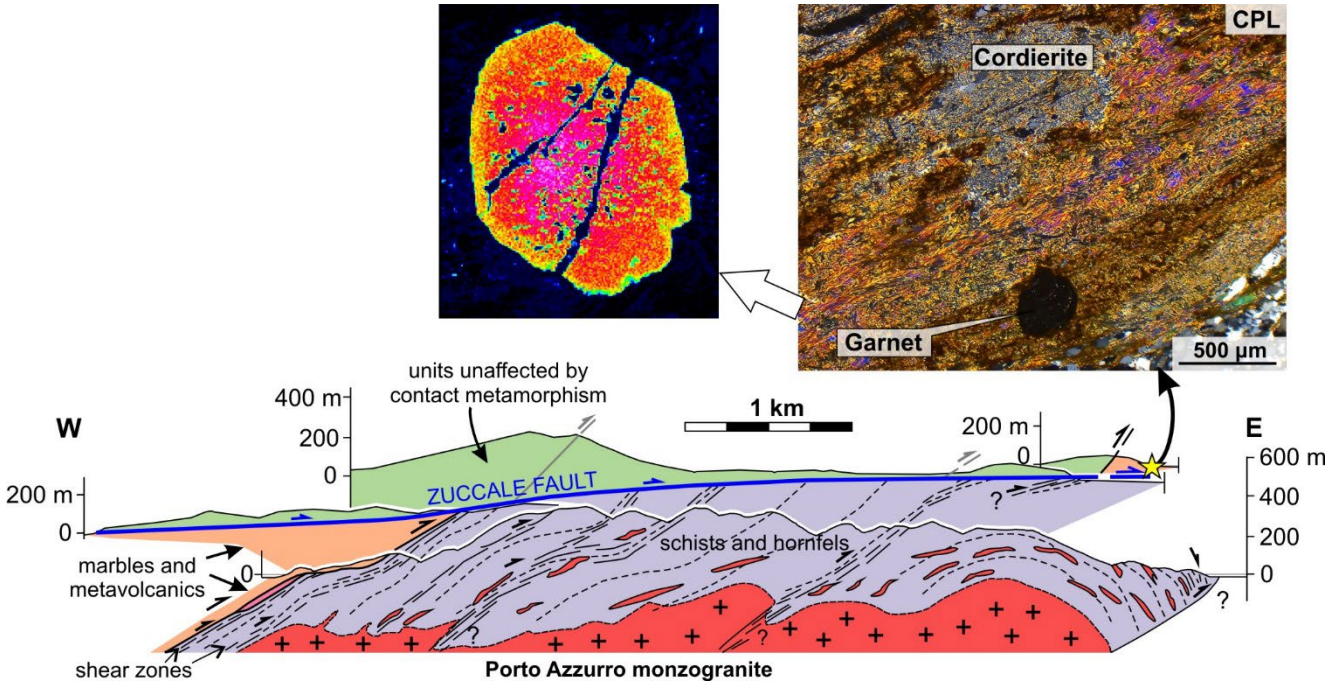
The Northern Apennines hinterland has been interpreted as a back-arc where magma emplaced in an active tectonic setting. However, the lack of constraints on the depth and setting of magma emplacement has led to contrasting tectonic, emplacement, and exhumation models. As part of project MIGRATE, funded by the SNFS, we (1) provide the first depth constraints on the Zuccale Fault and (2) document the emplacement of the Campiglia Marittima plutons in a contractional setting.



Documenting climate-induced deformation in the Himalayan orogenic belt

Parui C. *[1] & Bhattacharyya K.[2]

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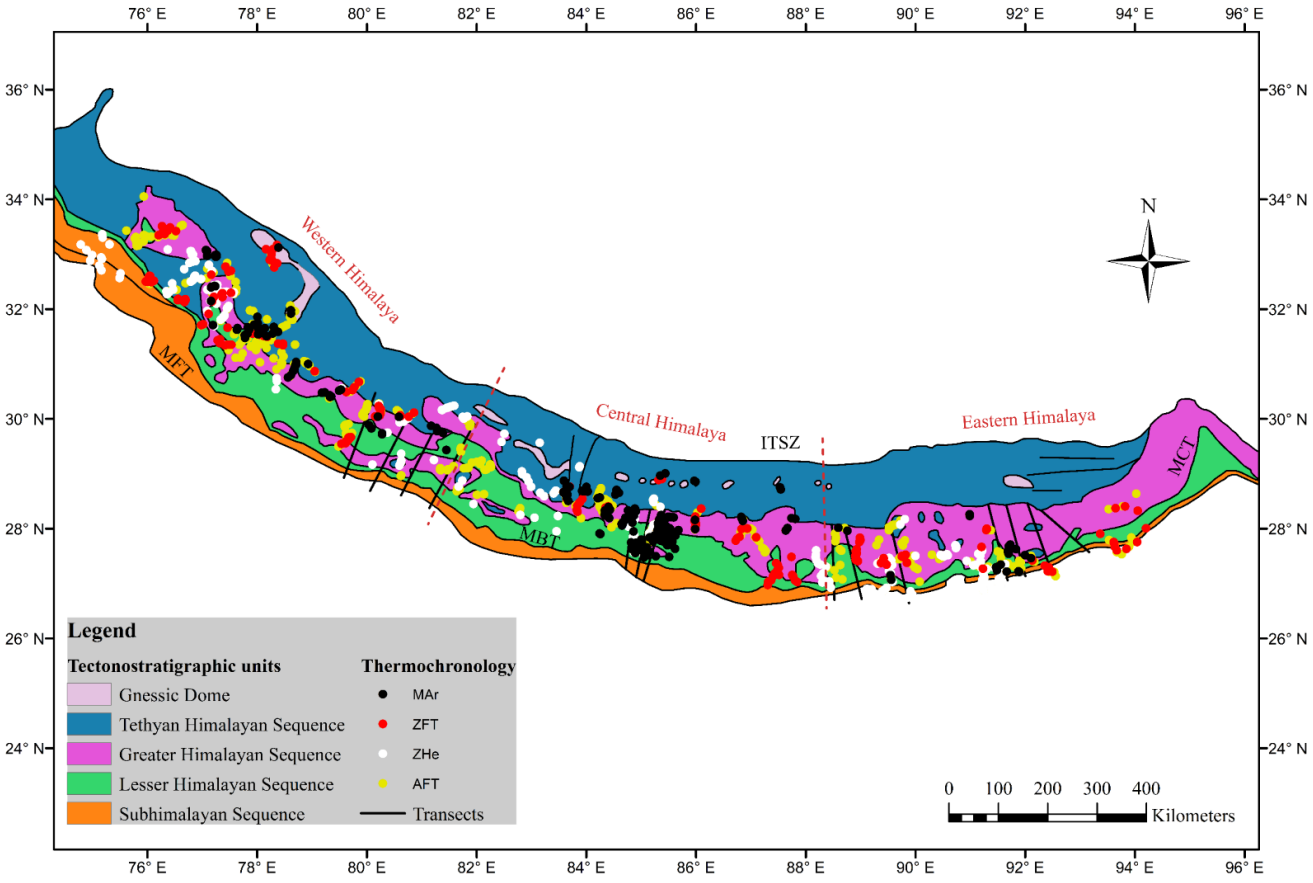
Enhanced precipitation increases erosion of orogenic wedges and destabilizes their steady state, prompting a tectonic response. The rising of the Himalaya played a pivotal role in the formation (24 Ma) and periodic intensification (15-8 and 2 Ma) of the South Asian Monsoon. Integrating published shortening rates from 16 regional transects and 1733 thermochronology datasets, we suggest that the Lesser Himalayan duplex formed as a tectonic response to the intensified South Asian Monsoon at 15 Ma.



Unraveling the structural evolution of the Yeneena basin hosting Cu deposits: Preliminary results

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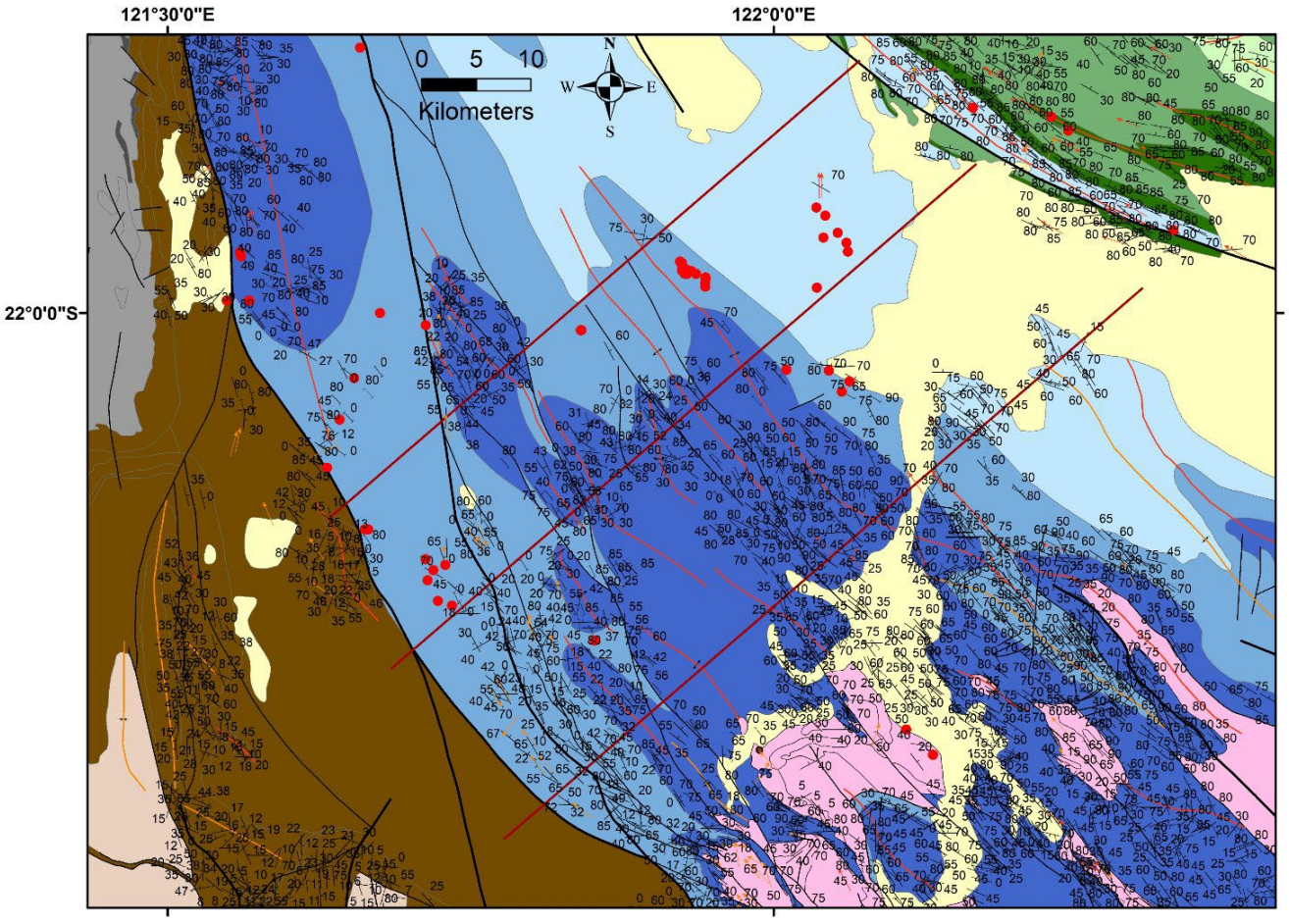
The deformed Neoproterozoic Yeneena Basin as part of the Paterson Orogen hosts the Nifty Cu deposit. Timing of mineralization and its relationships to the two post-depositional orogenic phases remains ambiguousThis study aims to bridge that knowledge gap by integrating regional geophysics, mapped surface geology, and structural analysis of oriented drill cores with the construction of a transport-parallel regional balanced cross-section to unravel the structural evolution of the basin.



From compression to extension in the Eastern Pyrenees: new insights from low-temperature thermochronology

Peris S. [1*], Griera A. [1], Gómez D. [1] & Teixell A. [1]

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To define the timing of the transition from the Alpine orogeny to the Neogene extension in the E Pyrenees, we combined low-temperature thermochronology and thermal history modelling to characterize the differential exhumation episodes between tectonic blocks. A new zircon and apatite (U-Th)/He dataset is used to describe the latest stages of landscape evolution and to define the cooling history of each tectonic block, which eventually lead to a new structural model of the region.

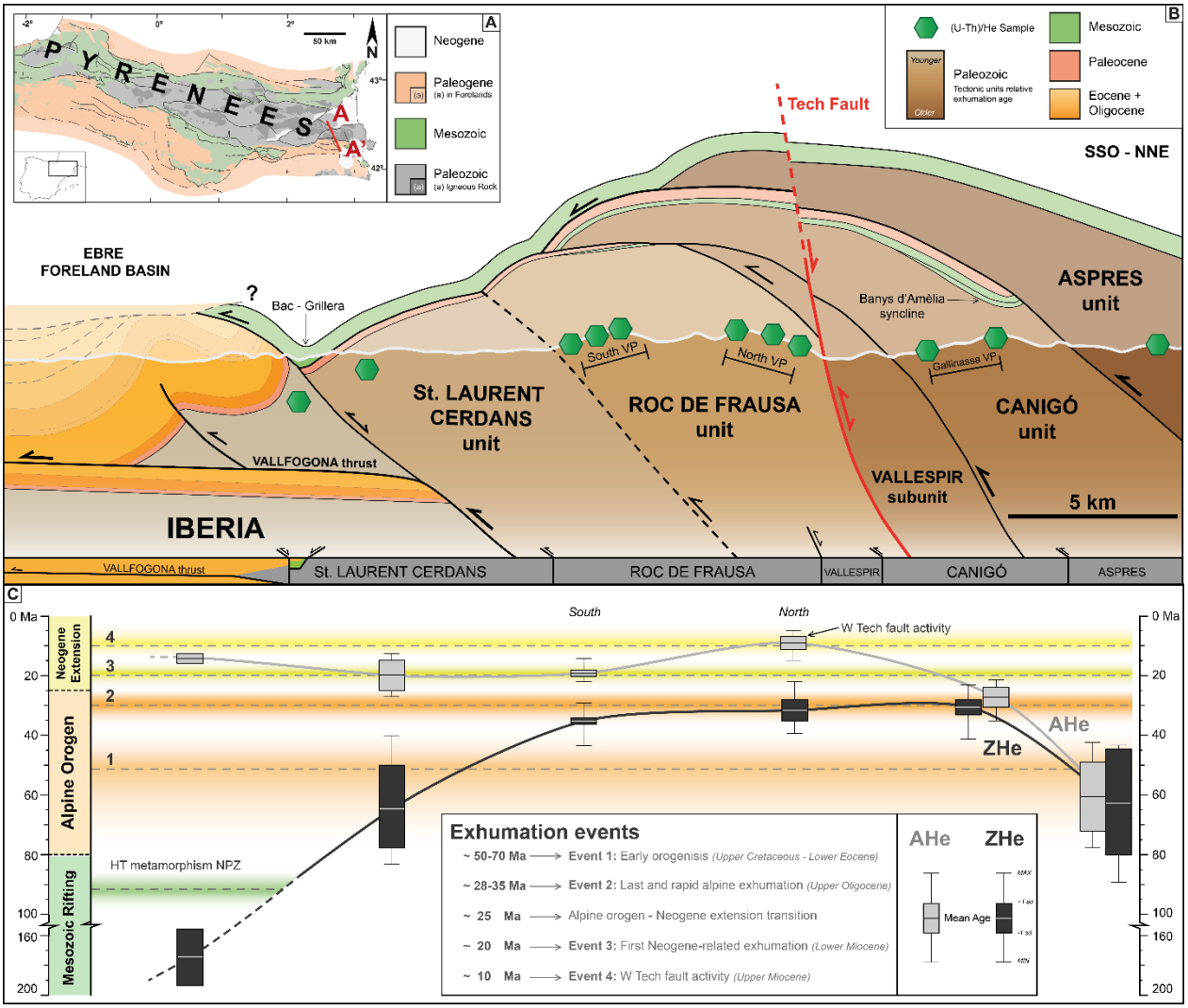

Figure 1: (A) Geologic map of the Pyrenees region with A-A' cross section location (B) Schematic A-A' cross section differentiating tectonic blocks and locating the samples from this work (C) Summary mean (U-Th)/He ages along a NNW-SSE transect (A-A'), divided by tectonic units and highlighting the main exhumation events.

Structural and metamorphic evolution of the tectonic mélanges in the Alpine Subduction Complex (Piemonte – Sesia-Lanzo Zone boundary, Western Italian Alps)

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[1] Dipartimento di Scienze della Terra "A. Desio", Università degli Studi di Milano, Italy
[2] Dipartimento di Scienze della Terra e dell'Ambiente, Università di Pavia, Italy
[3] Universitat de Barcelona, Spain
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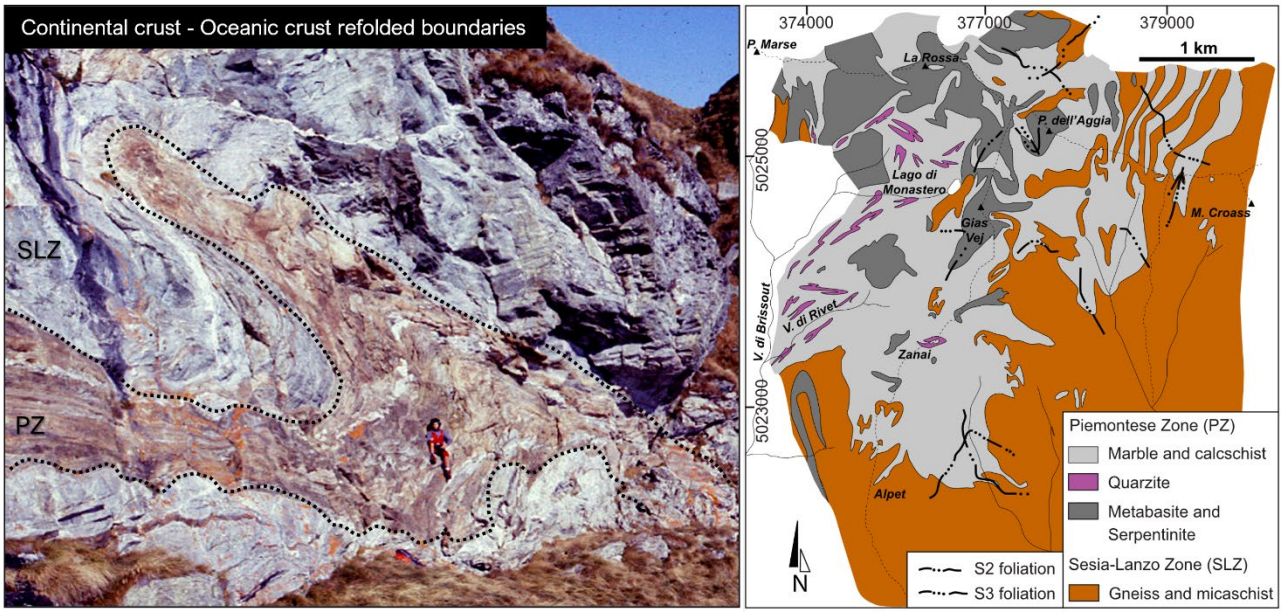
At the boundary between the Piemonte and Sesia-Lanzo zones, oceanic and continental crust rocks extend for ~ 50 km.

The metamorphic mineral assemblages marking successive foliations indicate that eclogite to blueschists facies conditions dominate different portions of this tectonic mélanges.

The origin of this rock assemblage architecture could be the result of transposition in the mantle wedge, otherwise it may represent the reworked primary series of an extensionally-thinned continental margin.



Salt-embedded basins in energy transition. Characterization of the sedimentary succession of the Estopanyà and Boix synclines (South-Central Pyrenees) as outcrop analogues for CCS and geothermal reservoirs.

Ramirez-Perez P.[*,1], Cofrade G.[1], Onetti E.[1], Cruset D.[2], Cantarero, I.[1], Sizun J.P.[3], Martín-Martín J.D.[1] & Travé A.[1]

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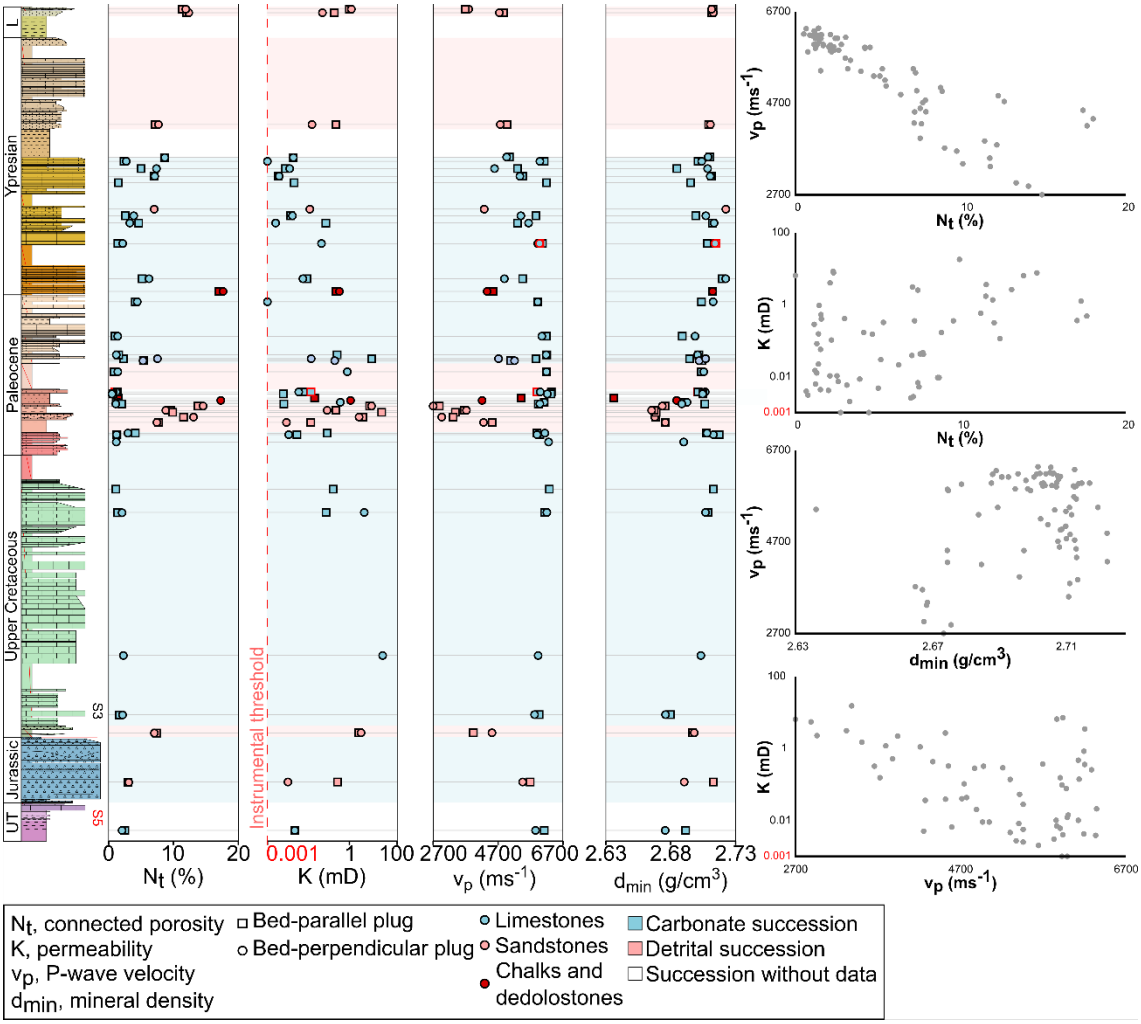
Salt-embedded basins are potential targets in energy transition, but diapirism and its diagenesis can lower reservoir quality. In this contribution, we present the petrological, petrophysical (connected porosity, permeability, and P-wave velocity), and petrothermal (thermal conductivity) characterization of the sedimentary fill of the Estopanyà and Boix synclines, to discuss their potential as outcrop analogues for CCS or geothermal reservoirs, and which factors control their reservoir properties.



Unveiling the evolution of the Giant Quartzolite Reefs in the Bundelkhand Craton of North-Central India: A tectonic conundrum

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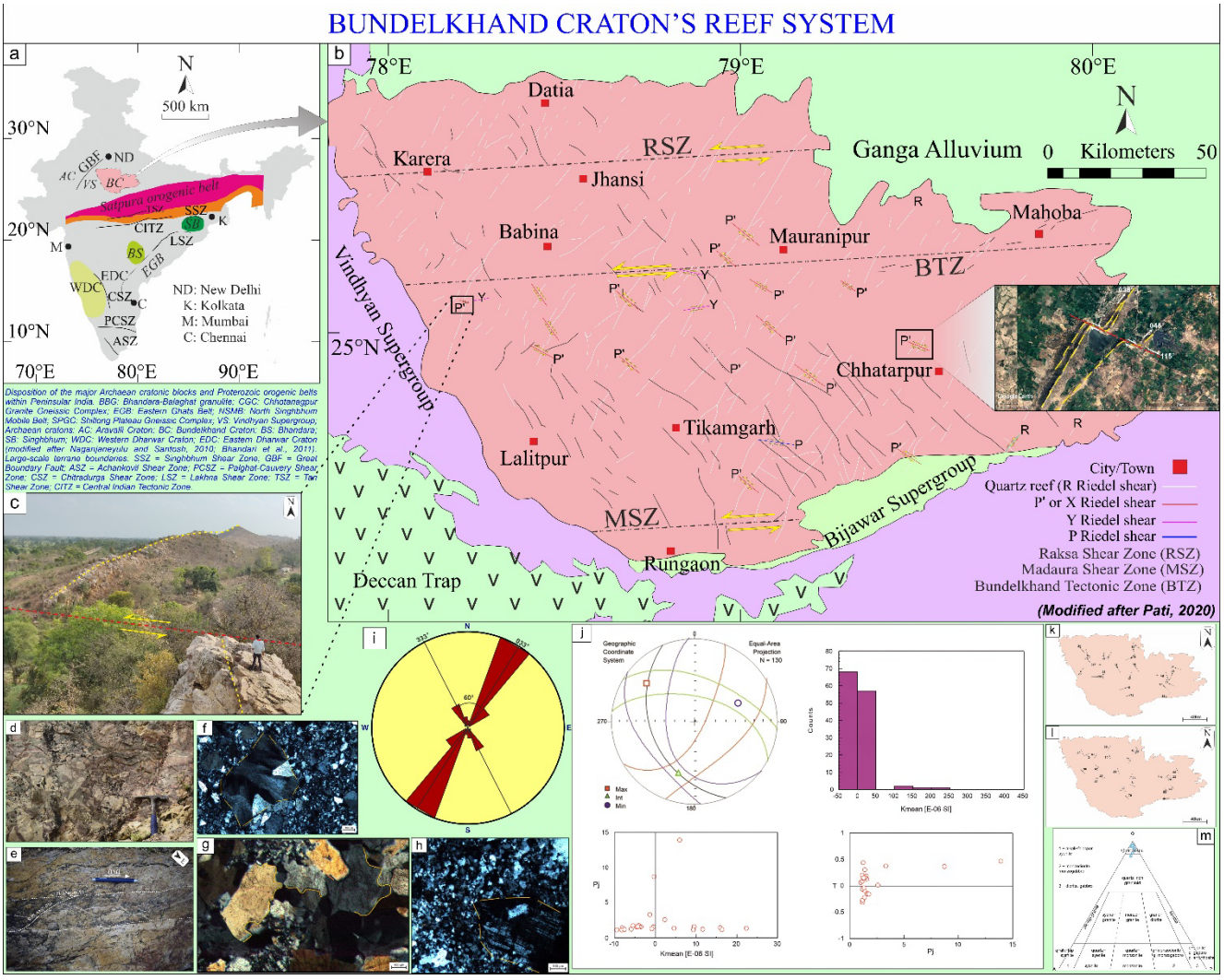
* *Corresponding email:* rptomar@bhu.ac.in/ sayandeep87.geo@bhu.ac.in

Description: Bundelkhand Craton features distinct ridge-like formations, visible in satellite/drone images, as depicted in the graphical representation of the extensive work conducted by us. It provides insights into the magnetic properties and deformation characteristics of the Quartzolite reefs, indicating the presence of brittle to ductile deformation features. Conjugate relationships and Riedel shear kinematics are highlighted, indicating their influence on the formations' evolution in the craton.



Thermo-mechanical effects of microcontinent collision on ocean-continent subduction system

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We used numerical models to simulate collision of microcontinents with different sizes located at various distances from the upper plate in a subduction system to evaluate their effects on the thermo-mechanical evolution of subduction systems. Our results reveal that the size and location of the microcontinent and convergence velocities of both plates affect the style of the subduction zone and the thermal state in the mantle wedge is affected by the presence of microcontinent.

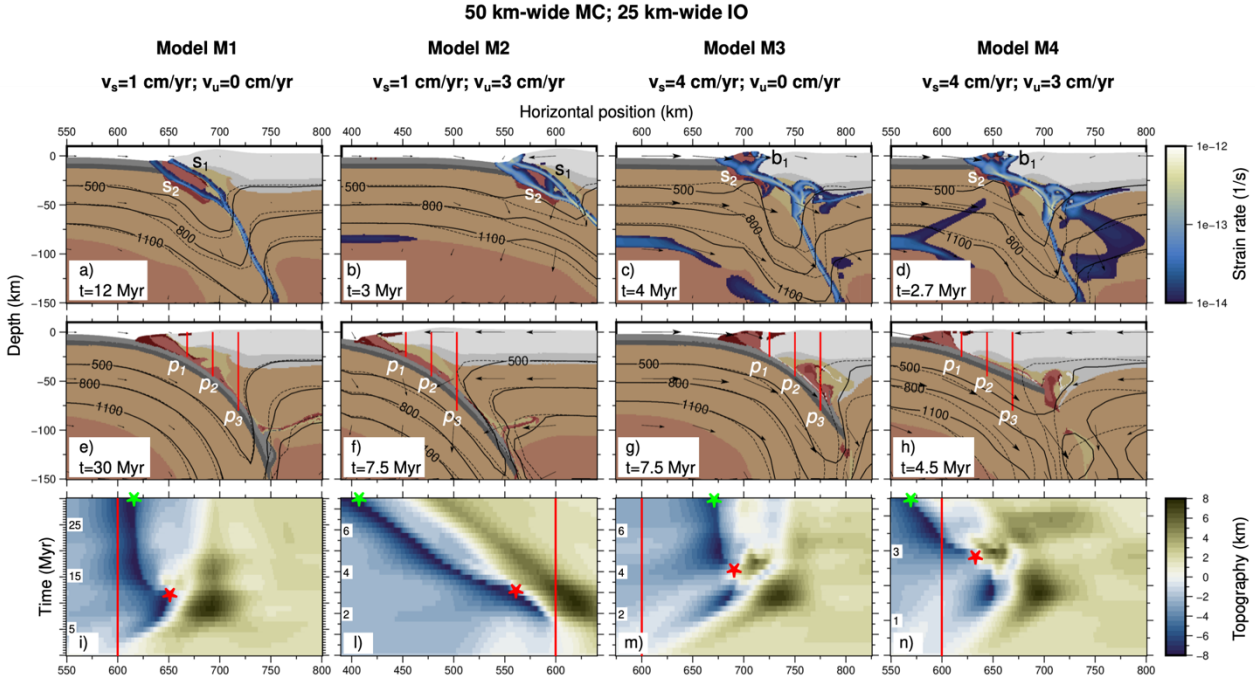

Figure - The evolution of models with a 50 km-wide microcontinent (MC) and a 25 km-wide inner ocean (IO) at two distinct stages, including velocity fields and strain rates (panels a-h), and the evolution of topography throughout the entire duration of simulations (panels i-n) are presented for different velocities of the subducting plate (v_s) and the upper plate (v_u).

U-Pb carbonate dating as a tool to unravel complex fault evolution: an example from the central Southern Alps (Italy)

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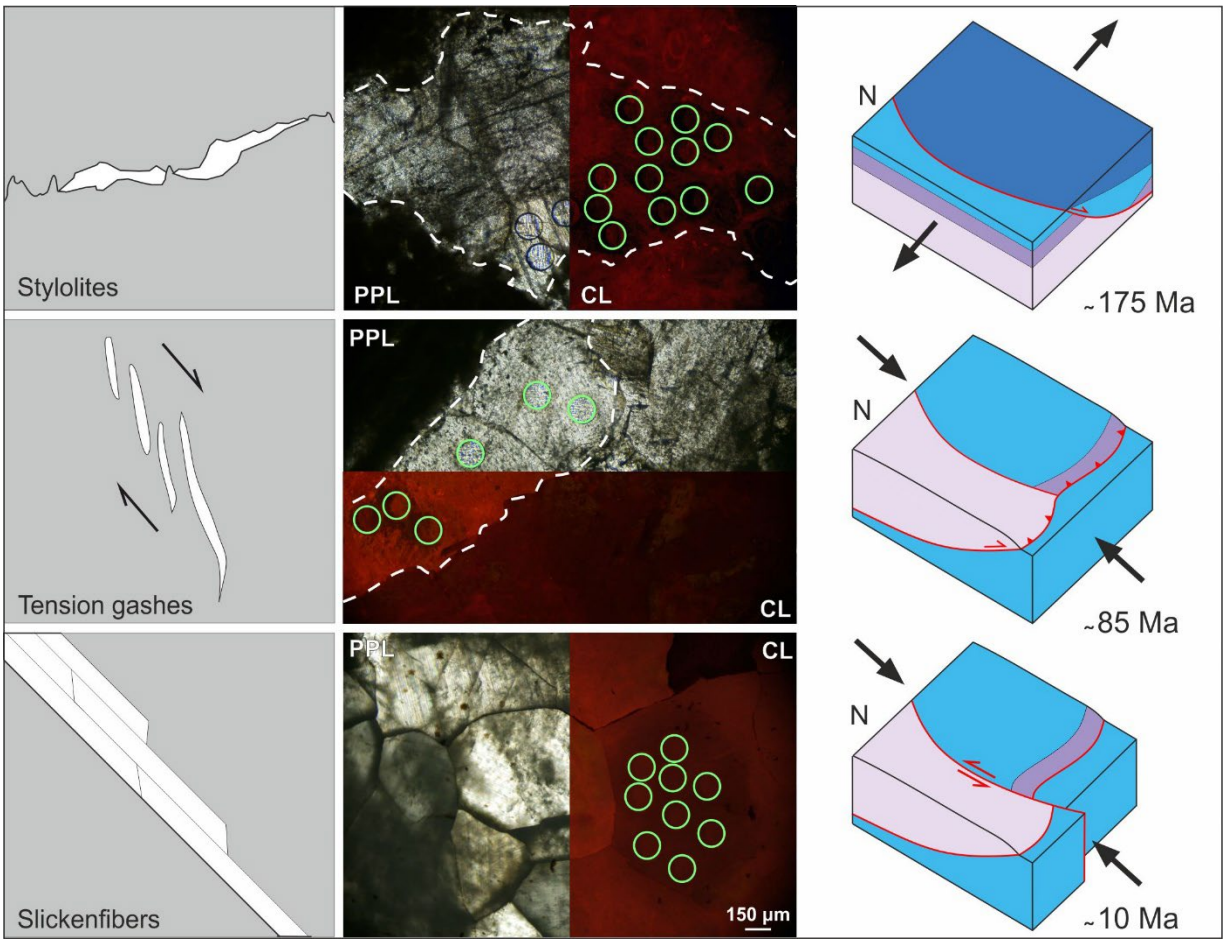
The timing of upper crustal fault zones has long been inferred based solely on indirect constraints, until the advent of *in situ* U-Pb dating of carbonates. The successful application of this method relies on careful microstructural and geochemical analyses. This approach has been applied to syn-kinematic carbonates along the Amora Fault, a growth fault of the Italian central Southern Alps that underwent a complex evolutional history since the Early Jurassic.



Structural control on the upwelling of fluids from the Val d'Agri hydrocarbon reservoir (Southern Italy)

Schirripa Spagnolo G.*[1], Beaubien S.[1], Marchesini B.[1], Bernasconi S.M.[2], Agosta F.[3], Prosser G.[3], Castorina F.[1], Aldega L.[1], Tavani S.[4,5], Bigi S.[1], Smeraglia L.[4], Novella D.[6], Ruggieri G.[7], Billi A.[3], & Carminati E.[1]

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[2] Department of Earth Sciences, ETH Zurich, Switzerland
[3] Department of Sciences, University of Basilicata, Italy
[4] Institute of Environmental Geology and Geoengineering, National Research Council, Italy
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[6] Department of Geosciences, University of Padova, Italy
[7] Institute of Geosciences and Earth Resources, National Research Council, Italy

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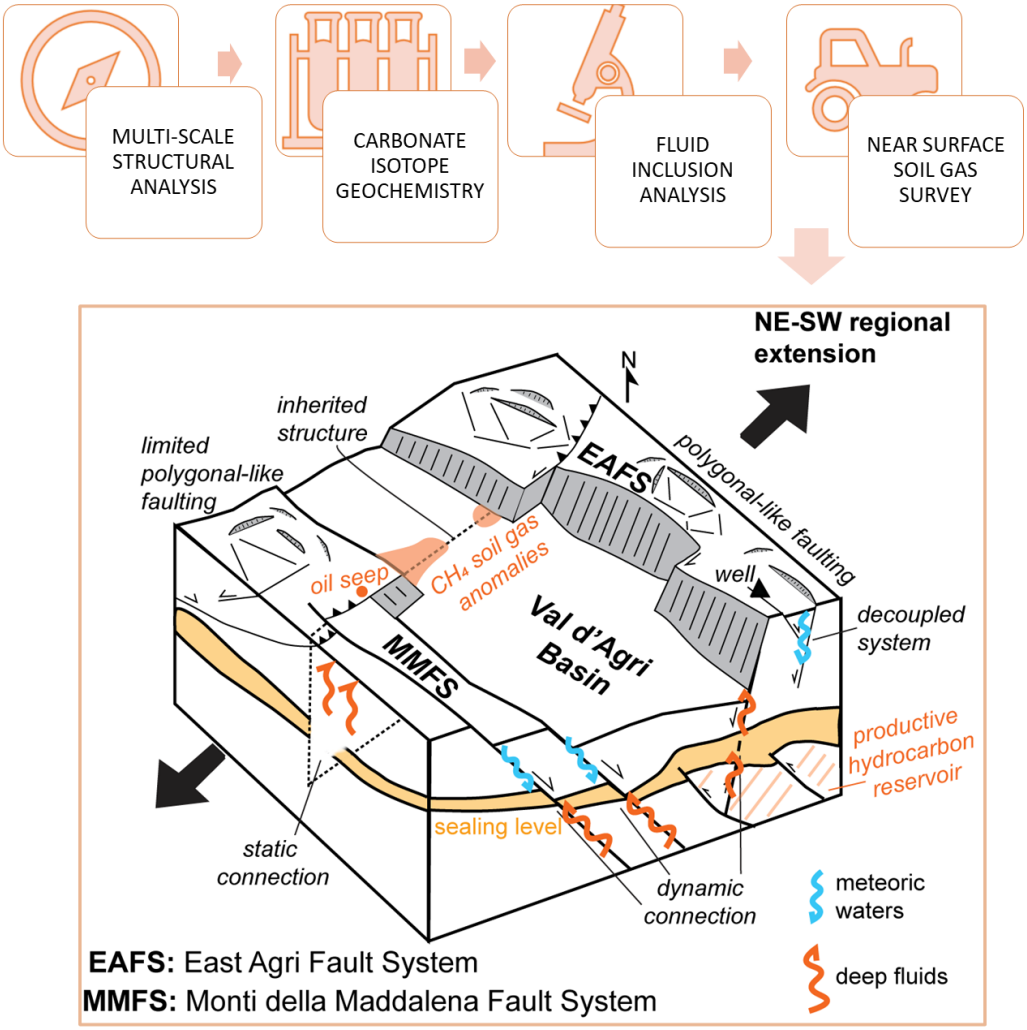
Structural control of fluid flow can occur in a static or dynamic way. We investigate this process in the hydrocarbon-rich Val d'Agri Basin, affected by both natural and oil extraction-induced seismicity. Employing a multidisciplinary approach, we reveal that structural architecture of the basin influences fluid flow from hydrocarbon reservoir to surface differently. Indeed, a decoupled system, static continuous connections, or dynamic periodic connections are recognized.



Synchrotron X-ray Backscatter Diffraction Microscopy (XBDM) and X-ray Fluorescence Microscopy (XFM) for the rapid microstructural and -chemical characterization of deformed rocks

Schrank C. E. *[1], Jones M. W. M.[2], Howard D. L.[3] Berger A.[4] & Herwegh M.[4]

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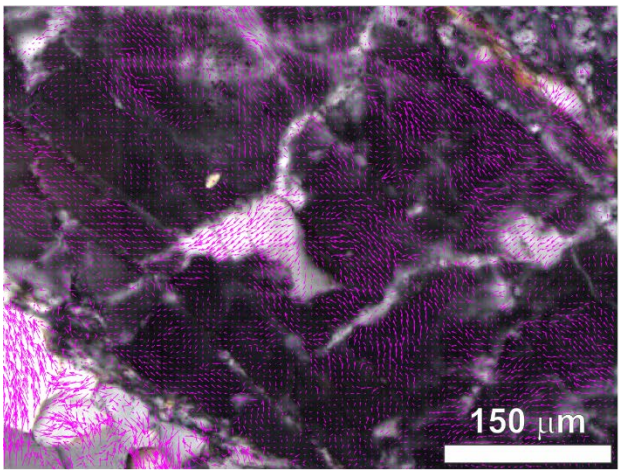
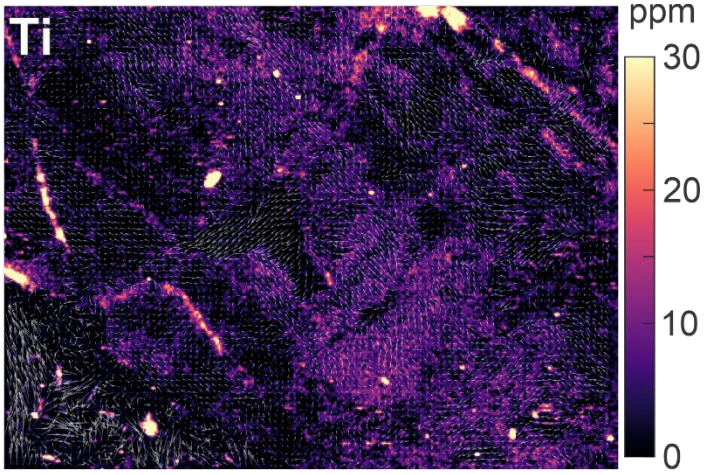
[2] School of Chemistry and Physics, Queensland University of Technology, Australia
[3] Australian Nuclear Science and Technology Organisation, Australian Synchrotron, Australia
[4] Institute of Geological Sciences, University of Bern, Switzerland

* *Corresponding email:* christoph.schrank@qut.edu.au

Mapping the structural and chemical make-up of deformed rocks in thin section constitutes a key methodology in microtectonics, geochemistry, and petrology. We present a new synchrotron method for the rapid simultaneous mapping of crystal orientation (XBDM) and trace-element composition (XFM) of entire thin sections with micron-scale resolution. As scientific example, it is shown that the Ti distribution in quartz and feldspar within a mylonite can be accurately correlated with crystal structure.



Zoom into K-spar clast in a XPL micrograph with superposed XBDM grain orientation vectors



Corresponding XFM map of Ti, again with XBDM orientation vectors.

Evidence for stress-reaction coupling during the growth of antitaxial fibrous veins from X-ray Fluorescence Microscopy

Schrank C. E. *[1], Jones M. W. M.[2], Kewish C.M.[3,4] van Riessen, G. A.[4] Phillips, N. W.[5] Hinsley, G.[6] Wolff, A.[7] & de Jonge, M.D.[3]

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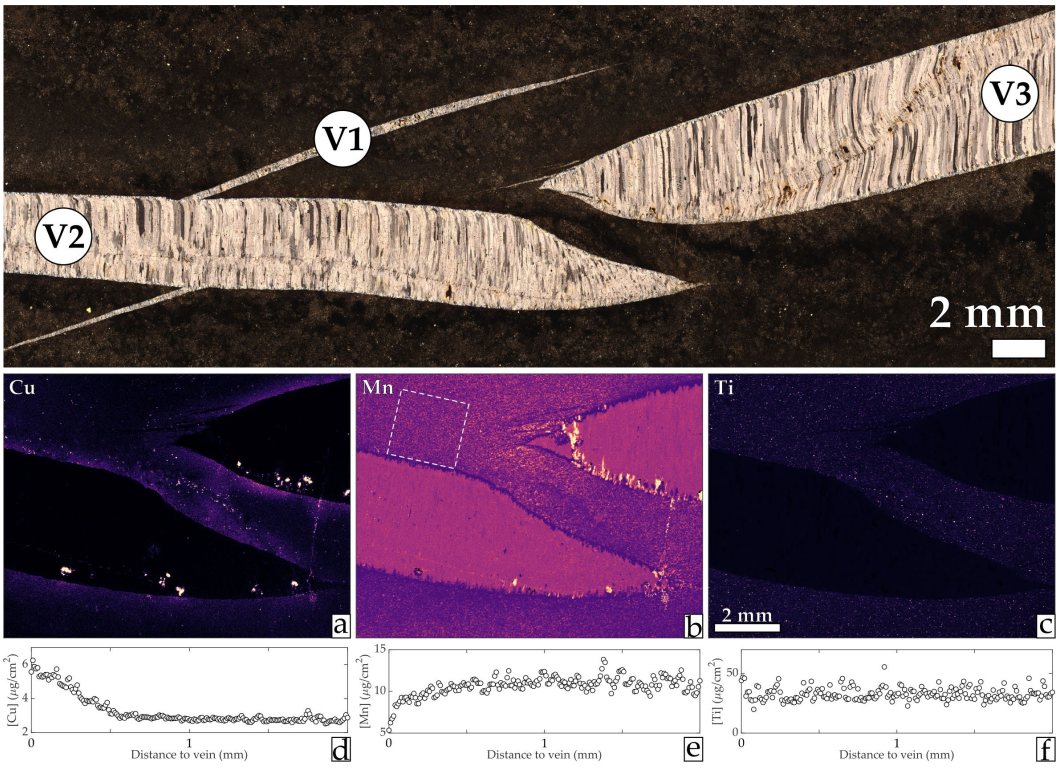
The growth mechanism of antitaxial fibrous veins remains debated. Proposed endmembers include growth via inflation due to the force of crystallization and crack-seal growth driven by tectonic stress. Microchemical maps of the tips and margins of antitaxial fibrous calcite veins from the Australian Tindelpina Shale Member provide evidence for stress-reaction coupling and enable 2D mass balances. The results suggest that tectonic stress and external fluids played a key role during vein growth.



Structure, microstructure and kinematics of the Tonalá-Escuintla shear zone in southern Mexico

Serrano-López G. *[1,2], Fitz-Díaz E.[2], & Ramos-Arias M. A.[3]

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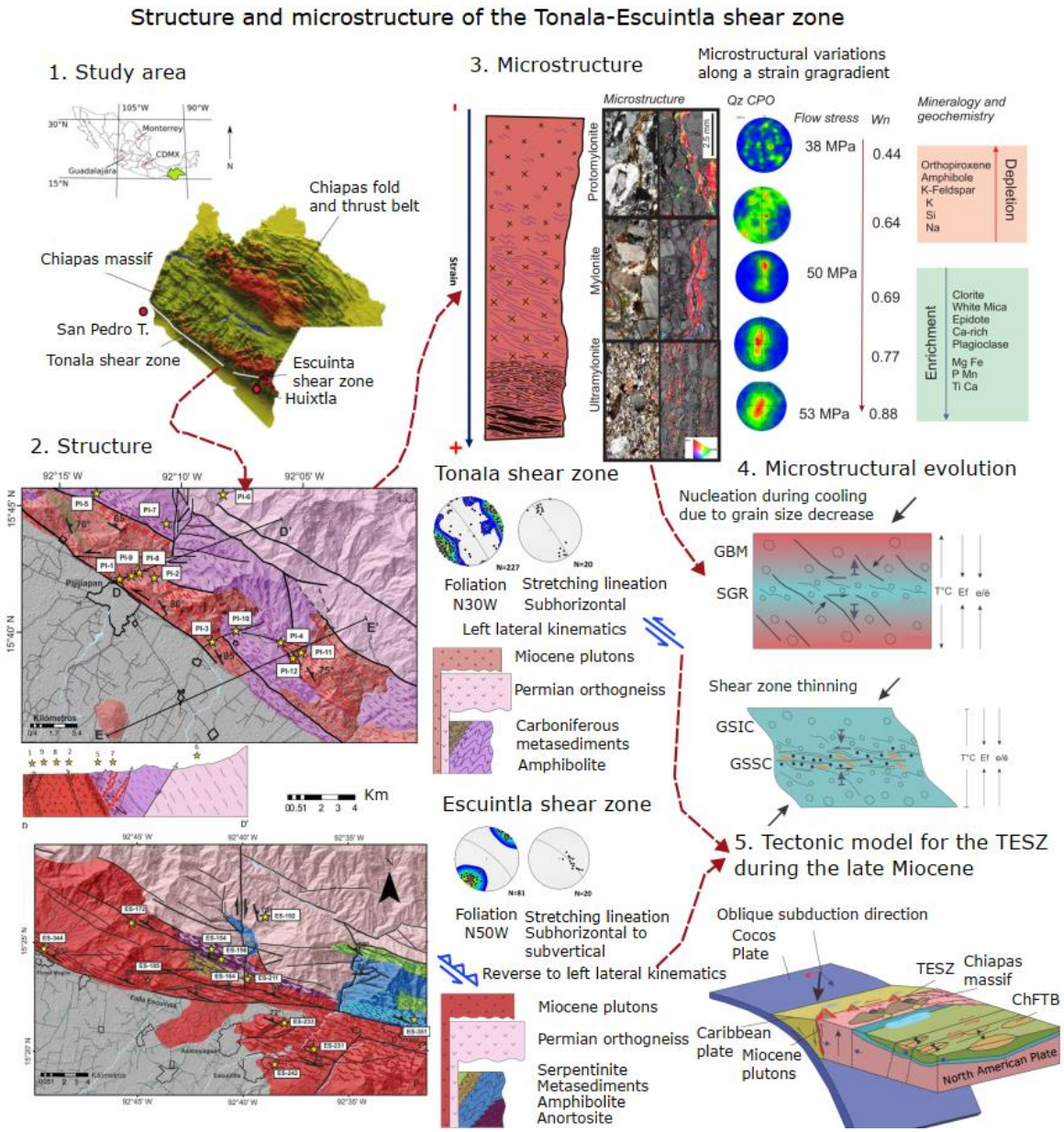
The Tonalá-Escuintla shear zone (TESZ) is a NW structure developed during the late Miocene on syntectonic arc-related plutons (2). A structural, microstructural and kinematic analysis is presented (2,3) to propose a model that accounts for the evolution of the TESZ (4). We discuss the current tectonic models proposed for the region for the late Miocene. According to our results, this structure records, in part, the oblique subduction of the Cocos plate during the Chiapanecan orogeny (5).



The interplay of transpression and metamorphic doming in the southwestern Tauern Window

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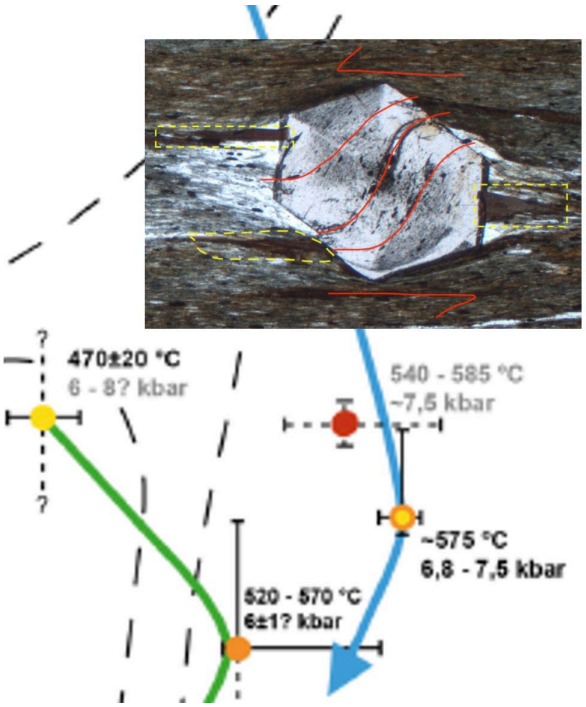
The Greiner Shear Zone that cuts through the southwestern Tauern Dome is reportedly a Miocene retrograde sinistral strike-slip fault. However, we found evidence for intermittent shearing and metamorphic heating that has been related to the Oligocene Tauern crystallization. This poses questions about the timing of collisional nappe stacking, transpression, doming and subsequent crustal shortening due to the Dolomite Indenter. Does careful mapping provide the answer?



Quantitative Tectonic Activity Assessment of Manisa Fault: A multi-dimensional approach

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[2] Munzur University, Türkiye
[3] Eskişehir Osmangazi University, Türkiye
[4] İstanbul Technical University, Türkiye
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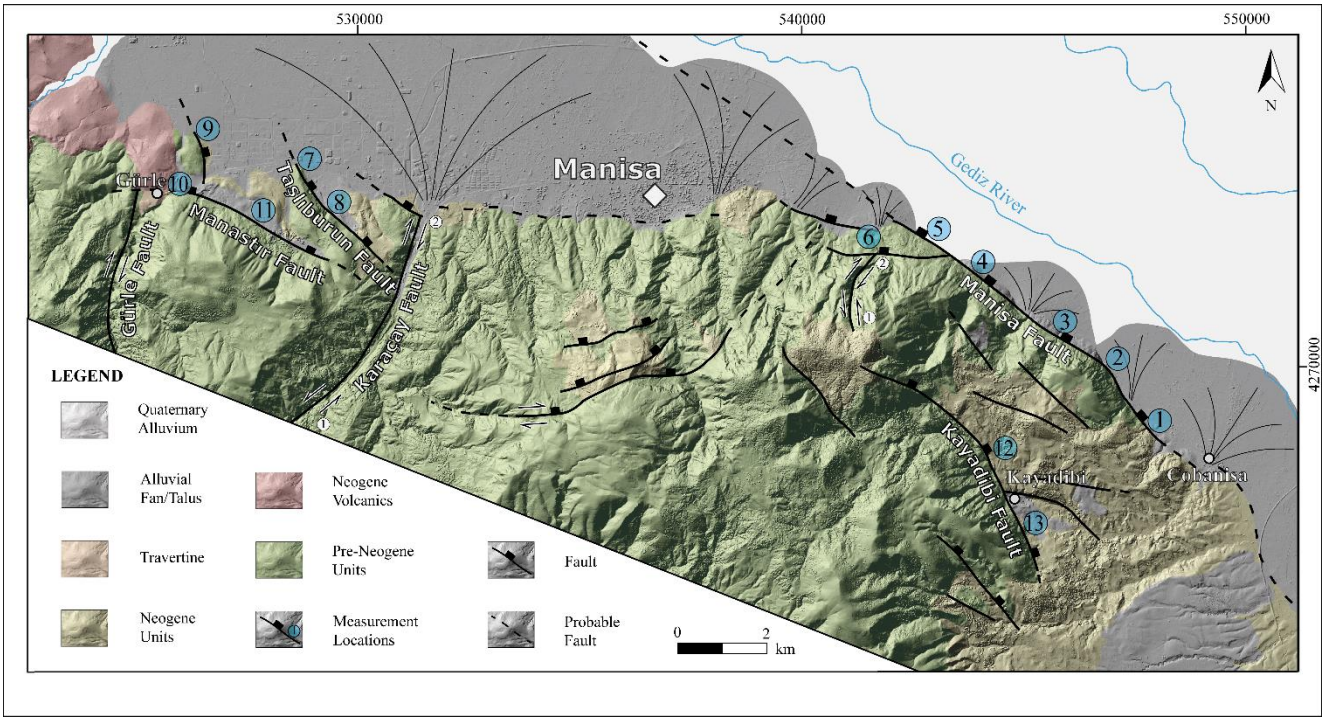
Western Anatolia's pronounced NE-SW crustal extension and its dynamic landscape, mainly shaped by faults along horst-graben boundaries, spotlight the crucial Manisa Fault at the Gediz Graben. Through advanced techniques such as kinematics, morphotectonics, paleoseismology, fault plane dating and stable isotope analysis, the study reveals the fault's significant role and influence on the graben. It demonstrates the fault's effect on the regional geodynamics across spatial and temporal conditions.



Exploring the Geothermal Potential in the Iberian Peninsula: AI-Enhanced Subsurface Analysis

Torné, M.*[1] Jiménez-Munt I.[1] Balaguera A.[1] Gómez-Rivas E.[2] Marzan I.[3] Negredo, A.M.[4] Alcalde J.[1] Jurado, M.J.[1] & Vergés, J.[1]

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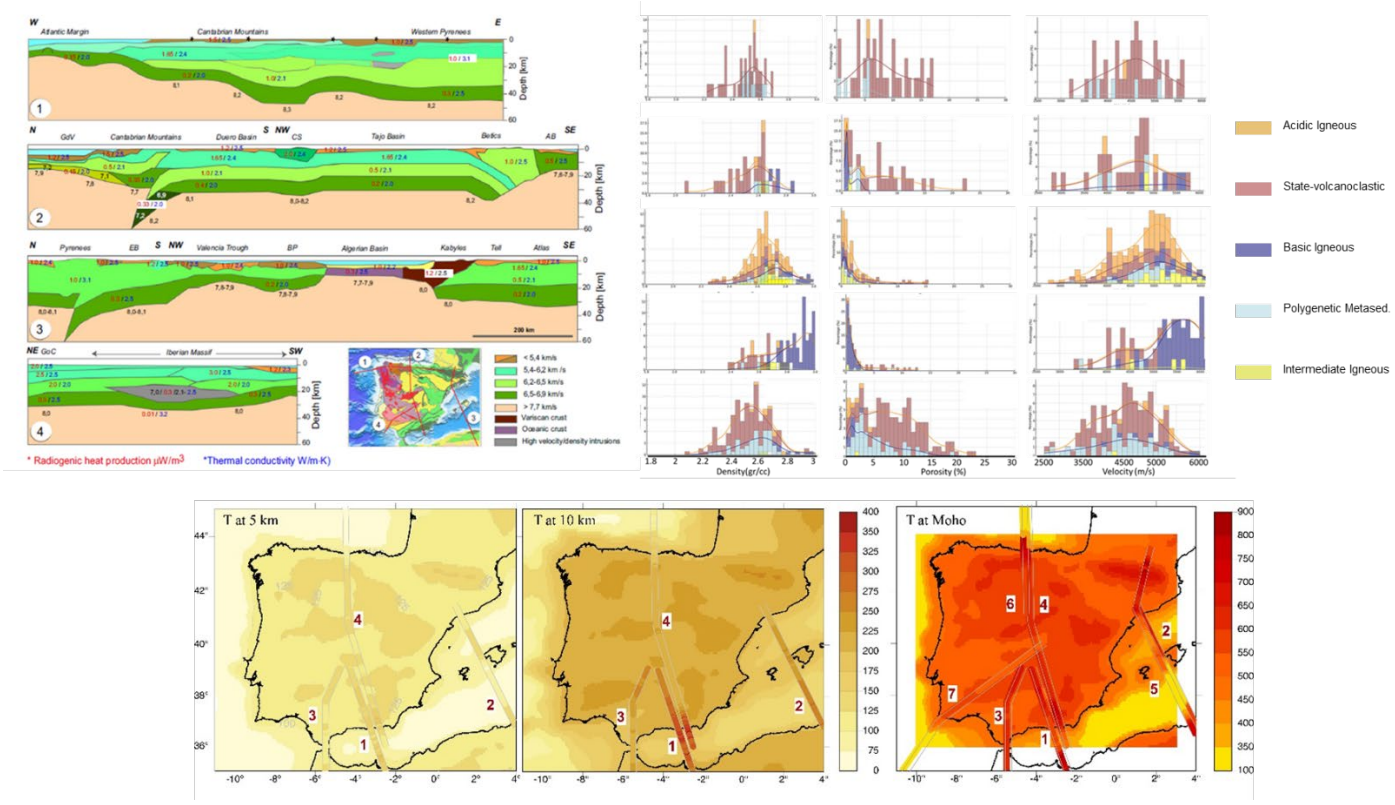
Geothermal energy, crucial for clean energy transition, demands deep understanding of temperature distribution and fluid flow in the crust. Our study unveils Iberian Peninsula's depth T distribution, indicating no lithospheric anomalies for high temperatures at shallow depths but promising potential at intermediate depths, fostering geothermal exploitation. Integrating AI for subsurface characterization enhances precision, optimizing geothermal resource utilization and advancing sustainable energy solutions.



Modified from Torne et al. (2023). Geothermal Energy, 11-3. https://doi.org/10.1186/s40517-023-00246-6

The role of evaporitic detachment levels in shaping the structure of orogenic fold belts based on field examples

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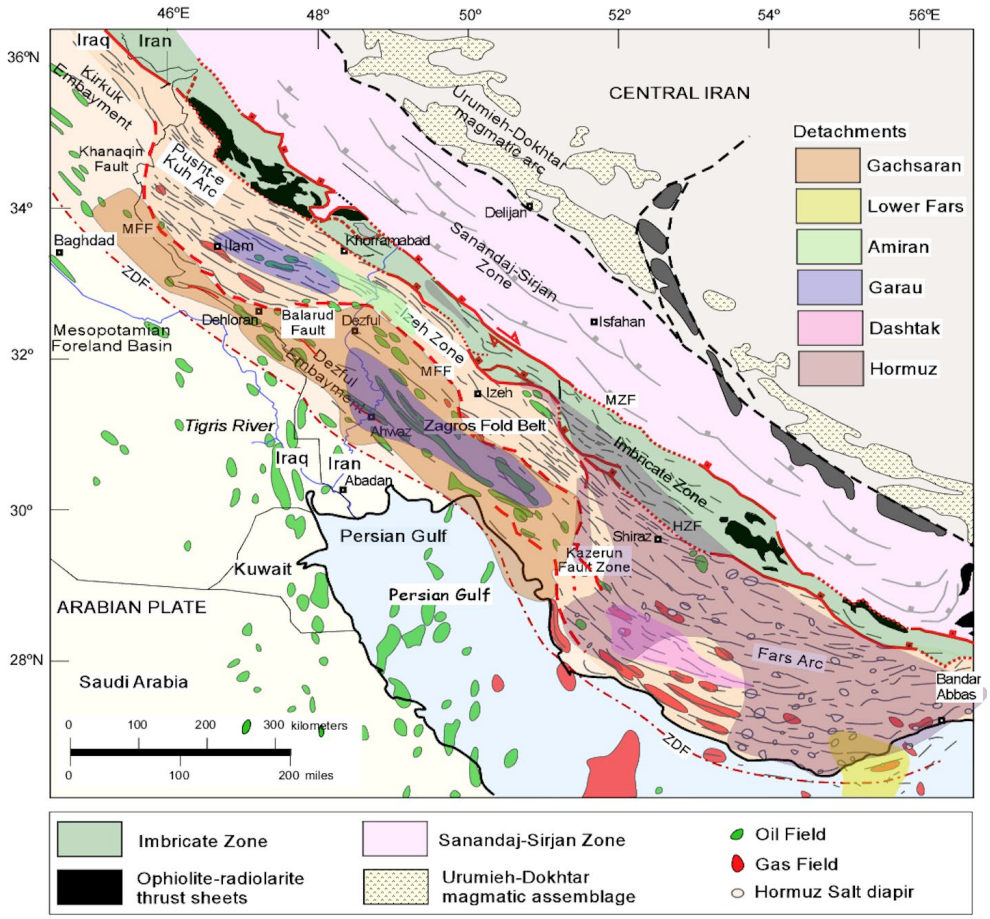
Ductile evaporitic layers embedded in sedimentary successions are key players as detachment levels in the progression of orogenic systems, as evidenced by examples from the Pyrenees, Betics, and Zagros fold belts. These evaporitic units may predate compressional events or deposit during foreland basin development. Their effectiveness as detachment levels or their involvement in the growth of diapiric structures strongly depend on their extent and thickness, but also on their interaction with multiple superimposed evaporitic layers.



Map showing the main distribution of pre-shortening and syn-foreland evaporitic layers that controlled the structural style of the Zagros fold belt (Iran) (Vergés et al., 2024).

Monazite bearing syntectonic veins: processes and timing during low-T deformation in the Mexican Orogen

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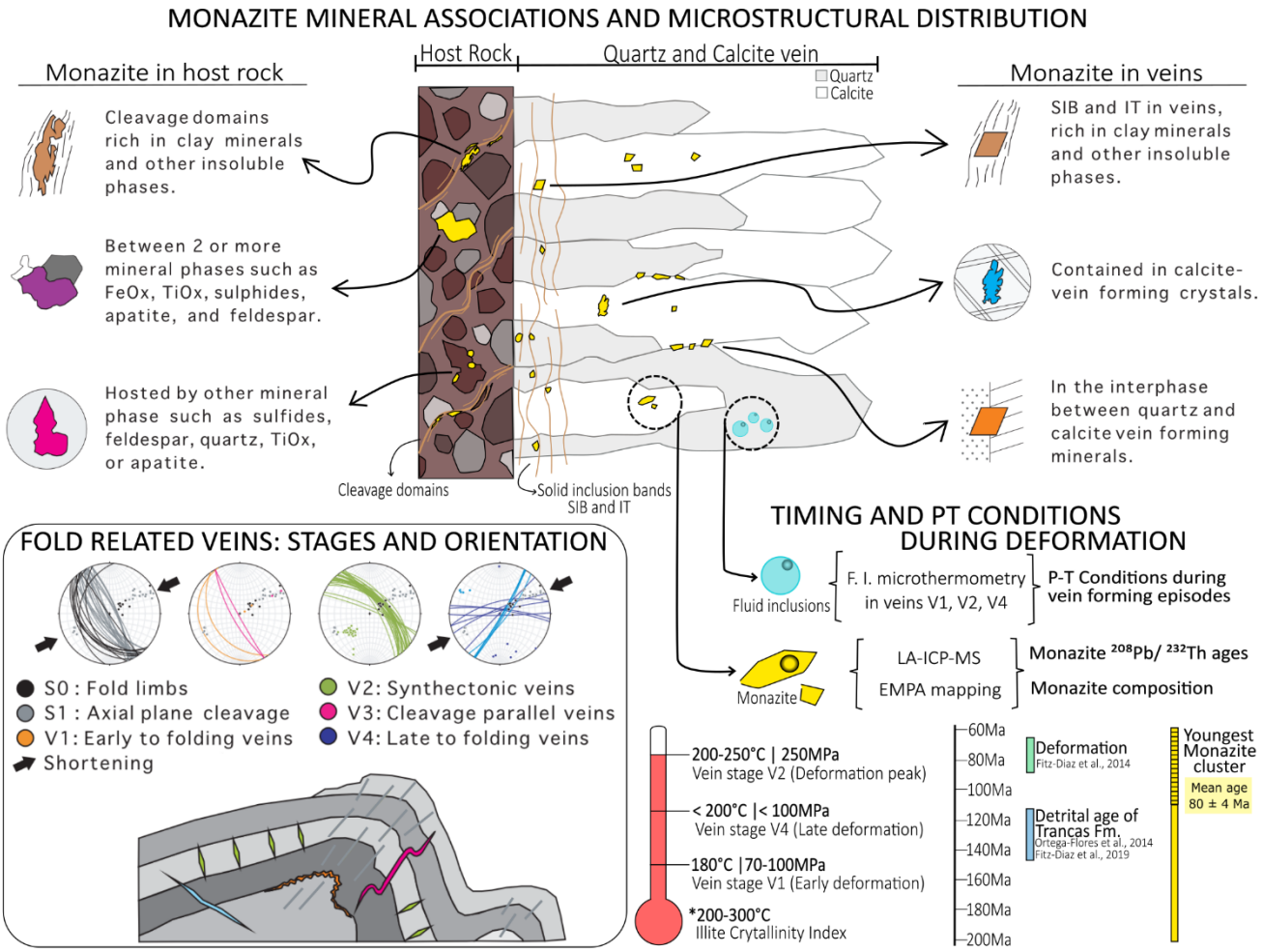
We study Monazite crystals hosted in folded volcaniclastic sandstones and syntectonic veins of the Mexican Fold-Thrust Belt. Veins formed in low grade conditions (<300°C, <250MPa) from low salinity fluids. Monazite crystals constitute multiple mineral assemblages and are commonly related to structures formed by high interaction with fluids in veins and host rock. Monazite Pb-Th ages (62-199Ma) suggest multiple crystal generations are present, where the youngest cluster is coeval to deformation.



Geothermal potential near the Alps-Apennines tectonic limit: an integrative perspective

Vidal-Reyes, M.I. *[1], Tesauro, M.[1], Amadori, C.[2] & Nader, F.[3]

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[3] IFP Energies Nouvelles

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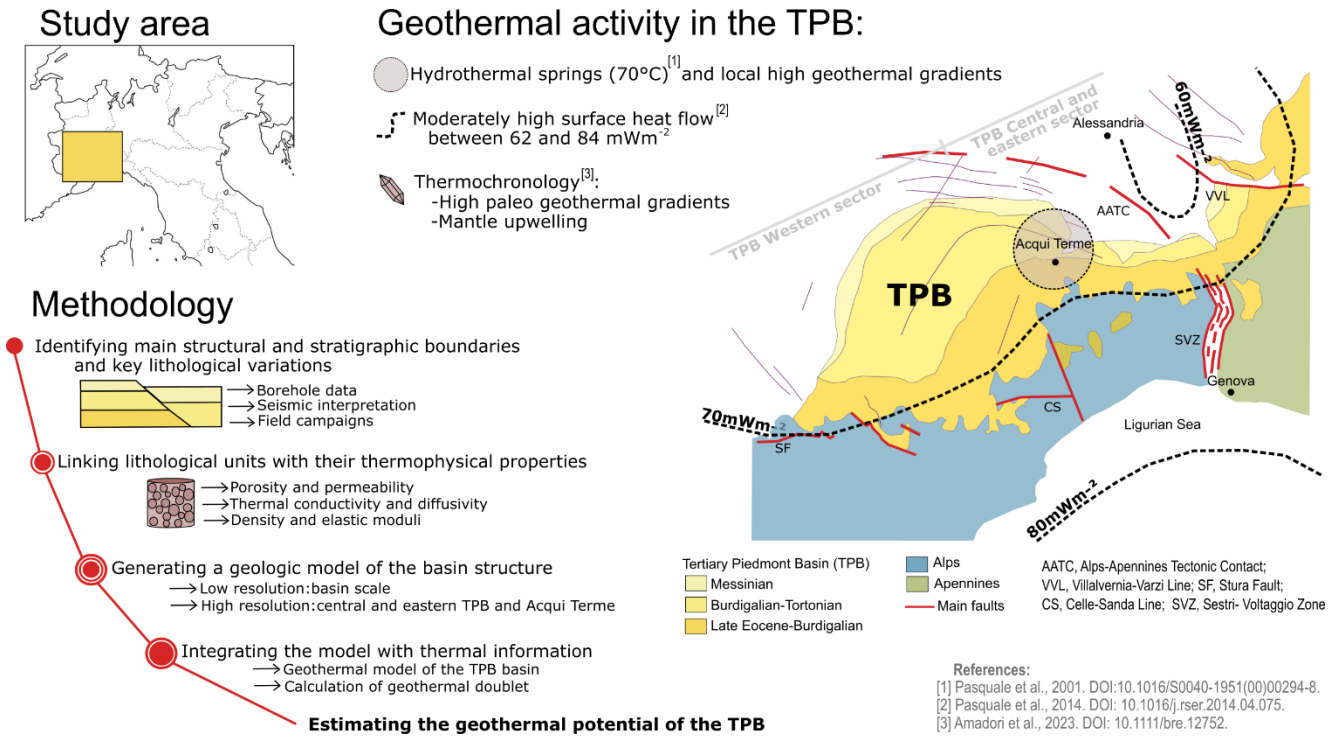
The Tertiary Piedmont Basin (TPB) accommodates up to 6 km of sediments that record the complex tectonic history of the Alps-Apennines junction. Previous studies [1-3] highlight the TPB as a region with important geothermal activity, as it has several hot springs, moderately high surface heat flux, and high geothermal gradients. In this study we aim to determine the geothermal potential of the TPB, by revealing its thermal structure and implementing a thermo-physical model of the basin.



References:
[1] Pasquale et al., 2001. DOI:10.1016/S0040-1951(00)00294-8.
[2] Pasquale et al., 2014. DOI: 10.1016/j.rser.2014.04.075.
[3] Amadori et al., 2023. DOI: 10.1111/bre.12752.

Major element and isotope diffusion through dislocation networks in deformed garnet

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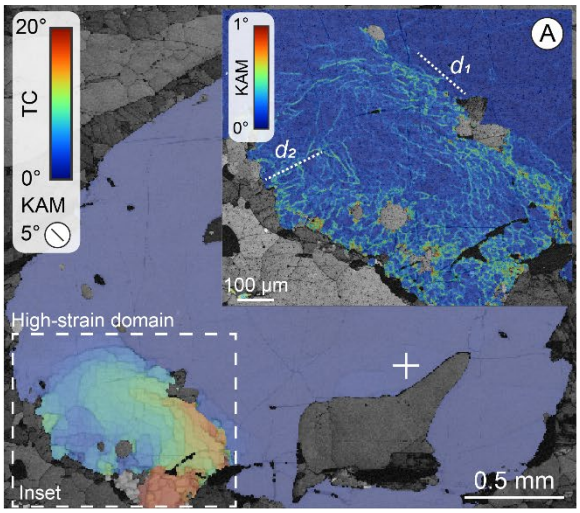
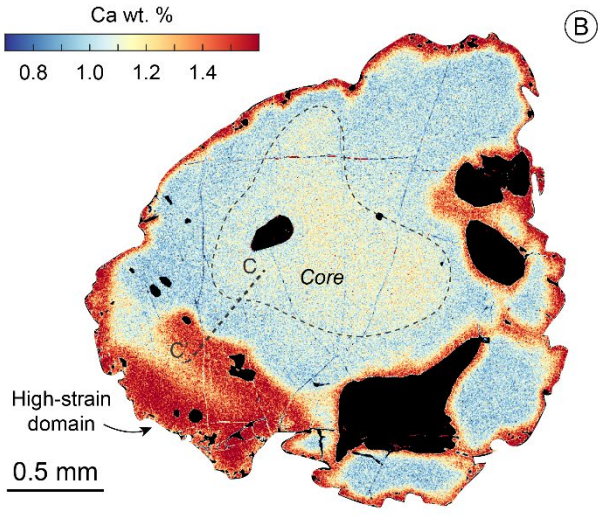
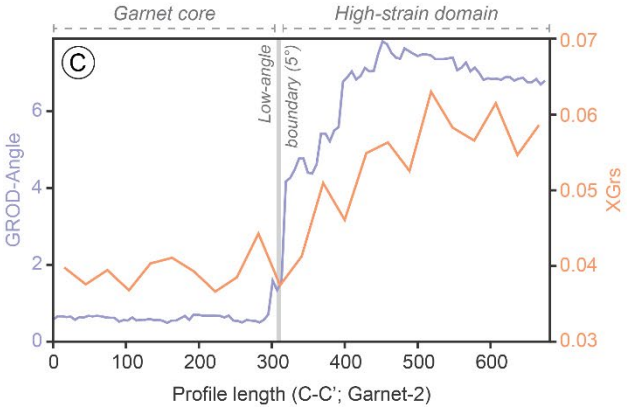
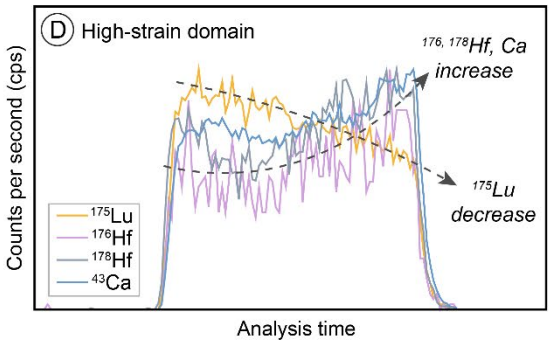
Garnet is the key mineral to constrain the conditions and timing of metamorphism, and its chemical and isotopic systems are interpreted to be unaffected by ductile deformation. Detailed microstructural (A) chemical mapping (B) show that major elements (C) and Lu–Hf isotopes (D) are mobilized when the density of dislocations exceeds the threshold required to form a dislocation network. This shows that resetting in garnet is more complex than previously assumed during high-temperature deformation.









Crustal shortening in the Eastern Southern Alps (Italy): results from the Valsugana and Belluno thrust zones

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[1] Dipartimento di Scienze Biologiche, Geologiche e Ambientali, Università degli Studi di Bologna, Italy
[2] Dipartimento di Scienze della Terra, Sapienza Università di Roma, Italy

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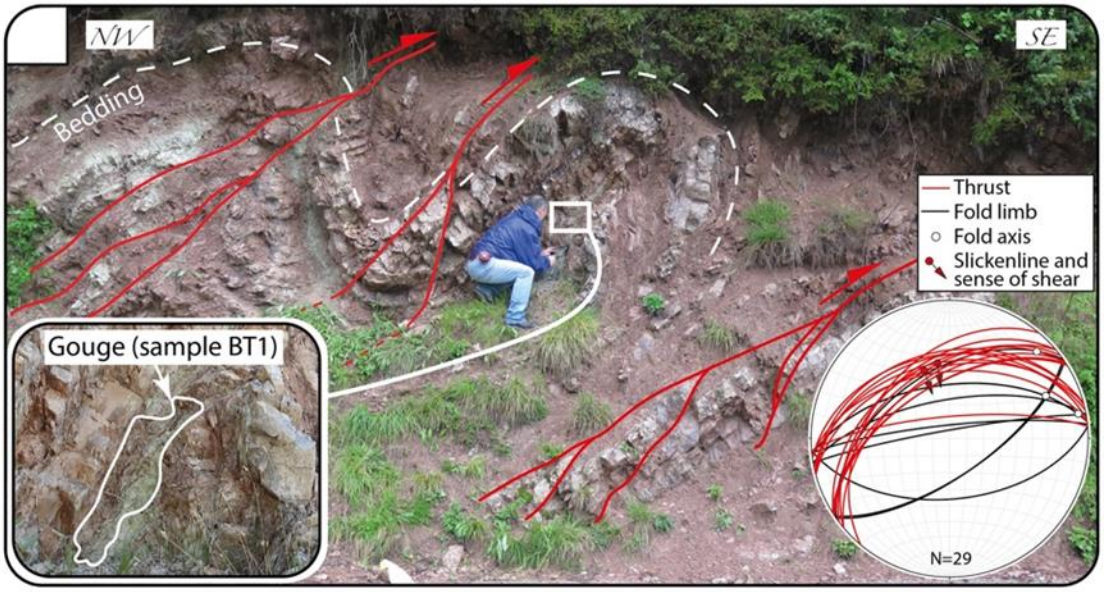
This work presents structural, microstructural, and geochronological results of selected key outcrops along a regional cross section transecting the fold-and-thrust belt of the Eastern Southern Alps (Italy). The multidisciplinary dataset provides insights into the style and regime of deformation, as well as the timing (Late Cretaceous to Late Miocene) of tectonic events responsible for the long-term crustal shortening during the development of this Alpine orogen.



SE-verging thrusts in Upper Cretaceous marly carbonate (fault gouge along thrust is shown in the insert)

Continental dynamic topography inferred from global hiatus surfaces since the Upper Jurassic

Berta Vilacís*[1], Hamish Brown[1] , Sara Carena[1] , Hans-Peter Bunge[1] , Jorge N. Hayek[1] , Ingo L. Stotz[1] & Anke M. Friedrich [1]

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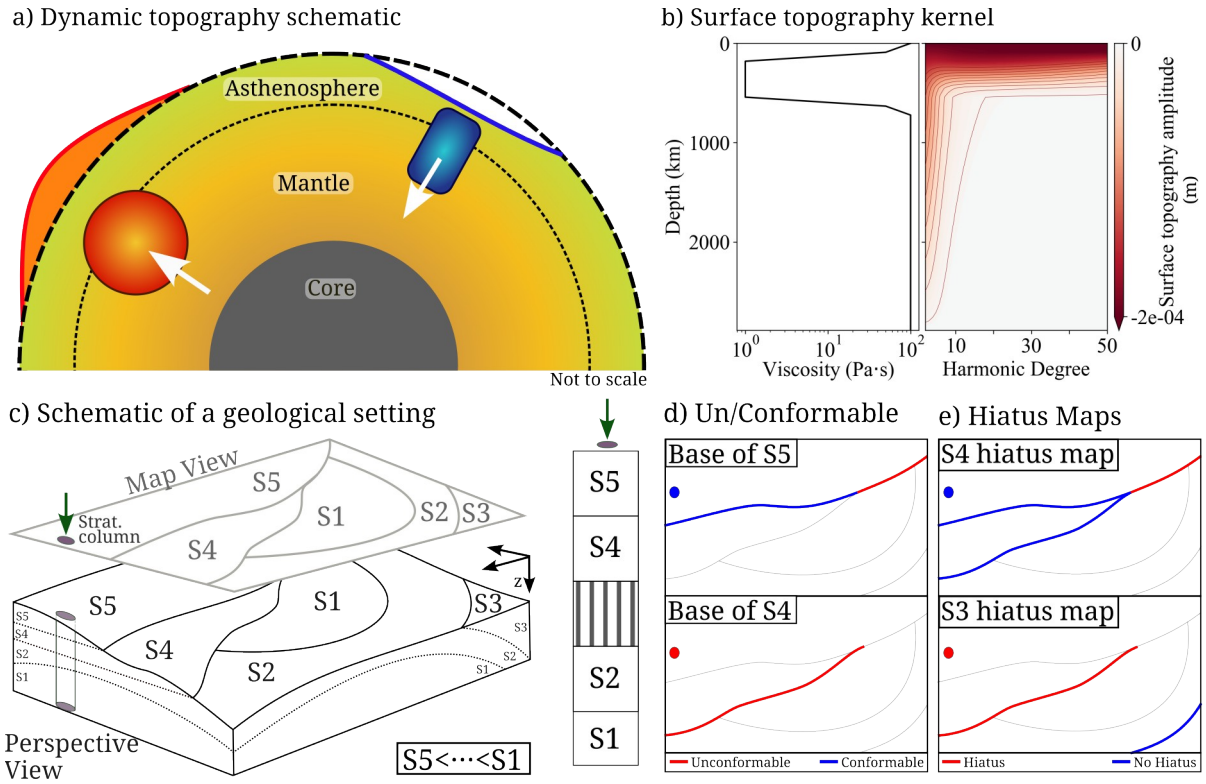
Mantle convection induces horizontal and vertical motion of the Earth's lithosphere, also known as dynamic topography. It is crucial to map this motion quantitatively from the geological record in order to provide temporal and spatial constrains on mantle flow. I will present work on continent scale stratigraphy linking it explicitly to mantle induced dynamic topography and global dynamic Earth models.



Diffusion and reaction creep in a "fluid absent" retrograde phyllonite zone.

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[1] Dept. Earth and Environmental Sci., Wesleyan University, 265 Church Street, Rm 437, Middletown, Ct. 06459

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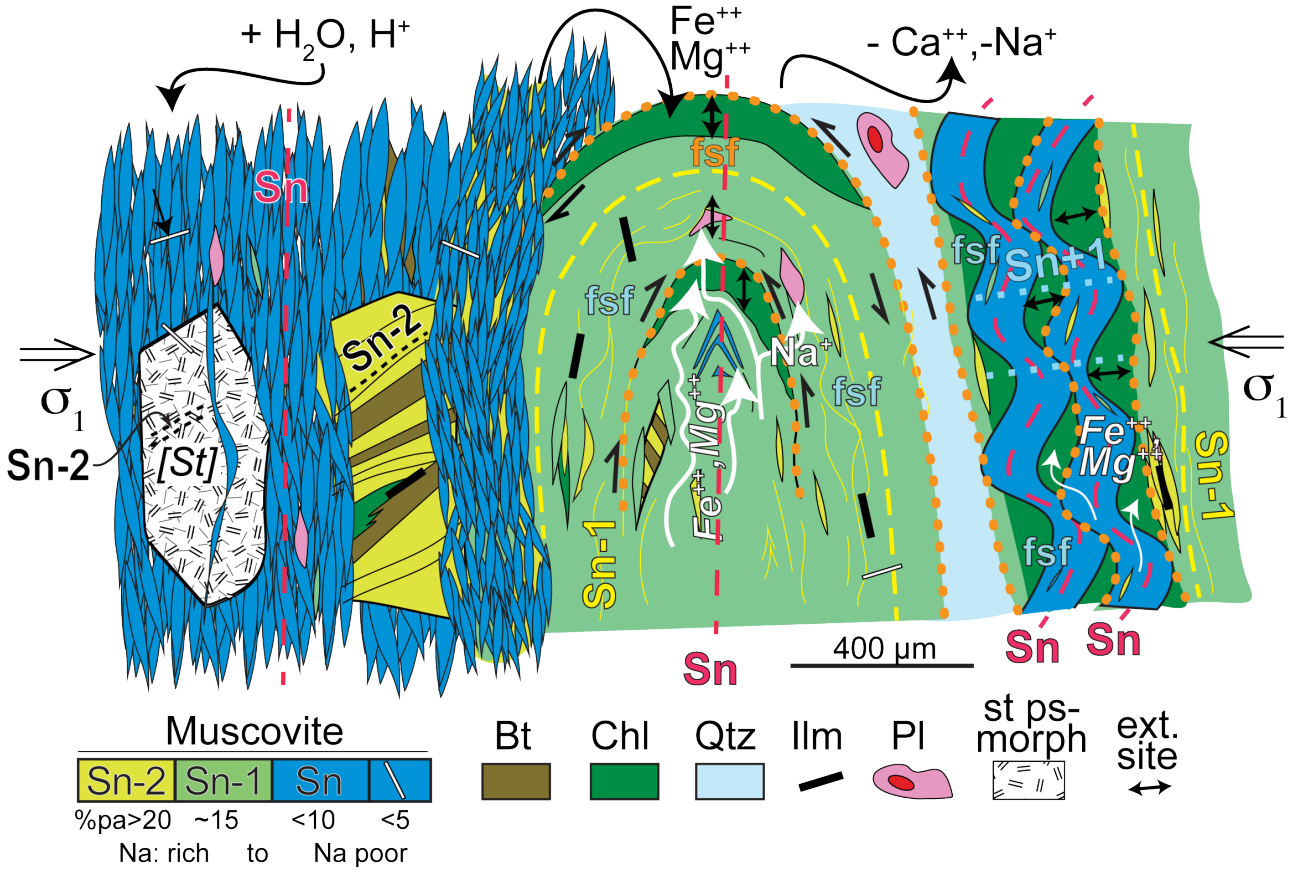
Deformation in retrograde phyllonites (CT, USA) occurred dominantly by dissolution – precipitation creep (DPC) in which Na-poor muscovite-rich foliations successively overprint Na-rich muscovite in earlier foliations. DPC was active despite the low activity of H_2O (~0.1) indicated by microtextures, a complete P-T-time path, and pseudosection modelling. We find that these pressure solution processes occurred in "fluid absent" conditions; thus, retrograde reactions do not require fluid flow.



Can tectonic-scale analogue models explain the structural complexity of the 2016 Mw 7.8 Kaikōura earthquake?

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[2] University of Melbourne, Australia

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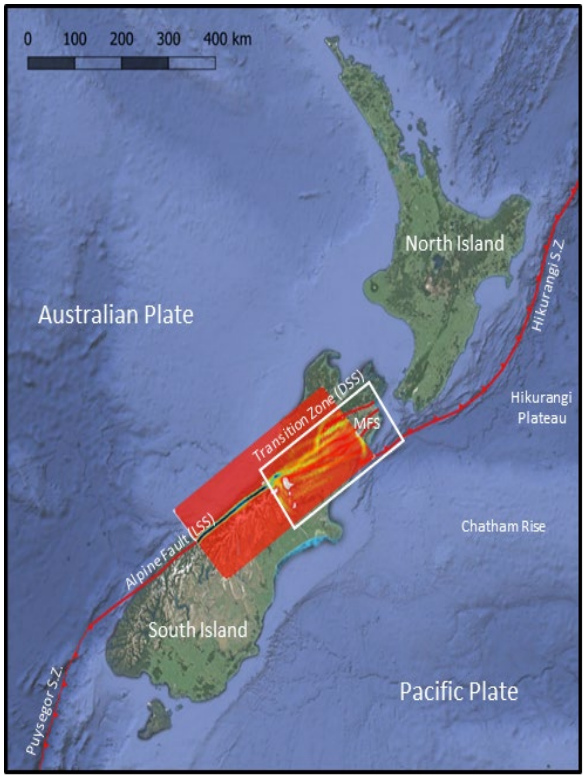
The 2016 Mw 7.8 Kaikōura earthquake is the most structurally complex earthquake on record and is associated with the ongoing development of the Marlborough Fault System (MFS), located in northeast South Island, New Zealand. Here, we present a scaled 'sandbox' model of a plate boundary transition zone, which accurately scales to the locations and ages of development of the MFS faults. Our results provide new insight into the initiation and complexity of the 2016 Kaikōura earthquake.



A baseline model for fault development across transpressive plate boundaries

Withers M. *[1], Eisermann JO.[2], Ulrich R .[2] & Cruden AR.[1]

[1] Monash University, Australia
[2] Universität Hamburg, Germany

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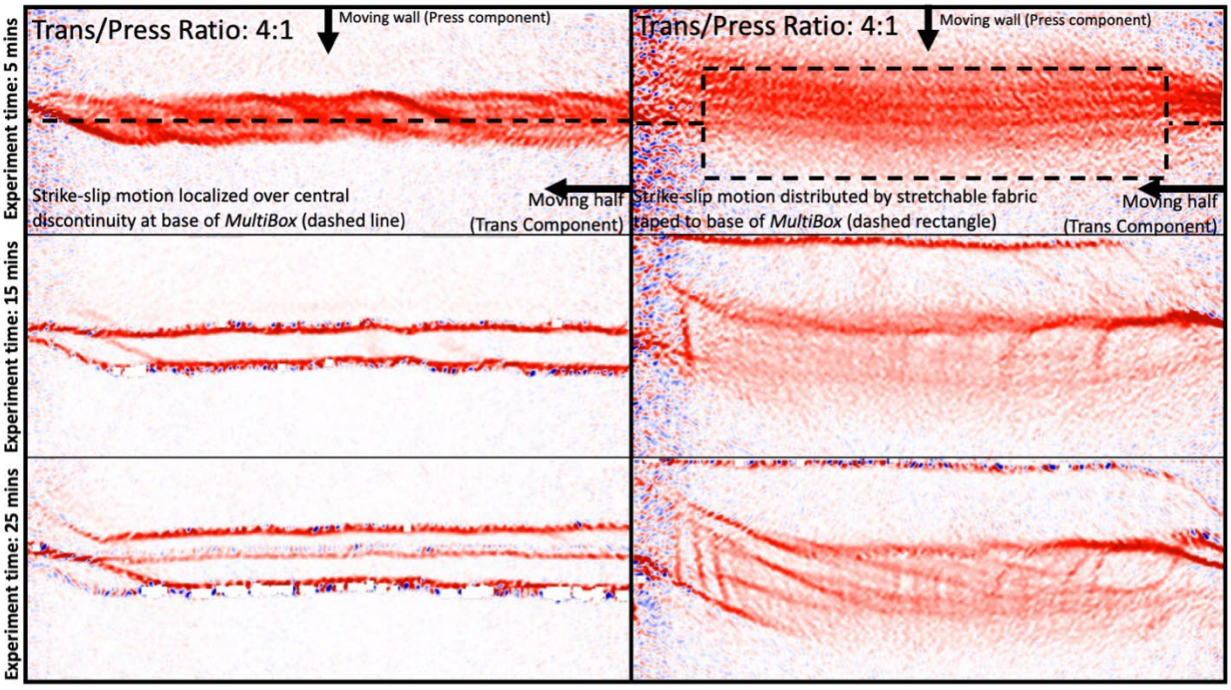
Fault networks which develop across transpressive systems can differ substantially depending on tectonic boundary conditions. We present the results of a transpressive analogue experiment series, conducted at the Universität Hamburg, using the unique *MultiBox* apparatus. We vary the trans:press ratio across 20 experiments, and use DIC shear strain maps (eg Fig. 1) to provide a baseline model of the development and distribution of faults across all possible transpressive boundary conditions.



Formation mechanism and physical simulation of segmented overlays of the depth strike-slip faults in Tarim basin

WU Kongyou*[1], HONG Mei[1]

[1]School of Geoscience, China University of Petroleum (Hua dong), China

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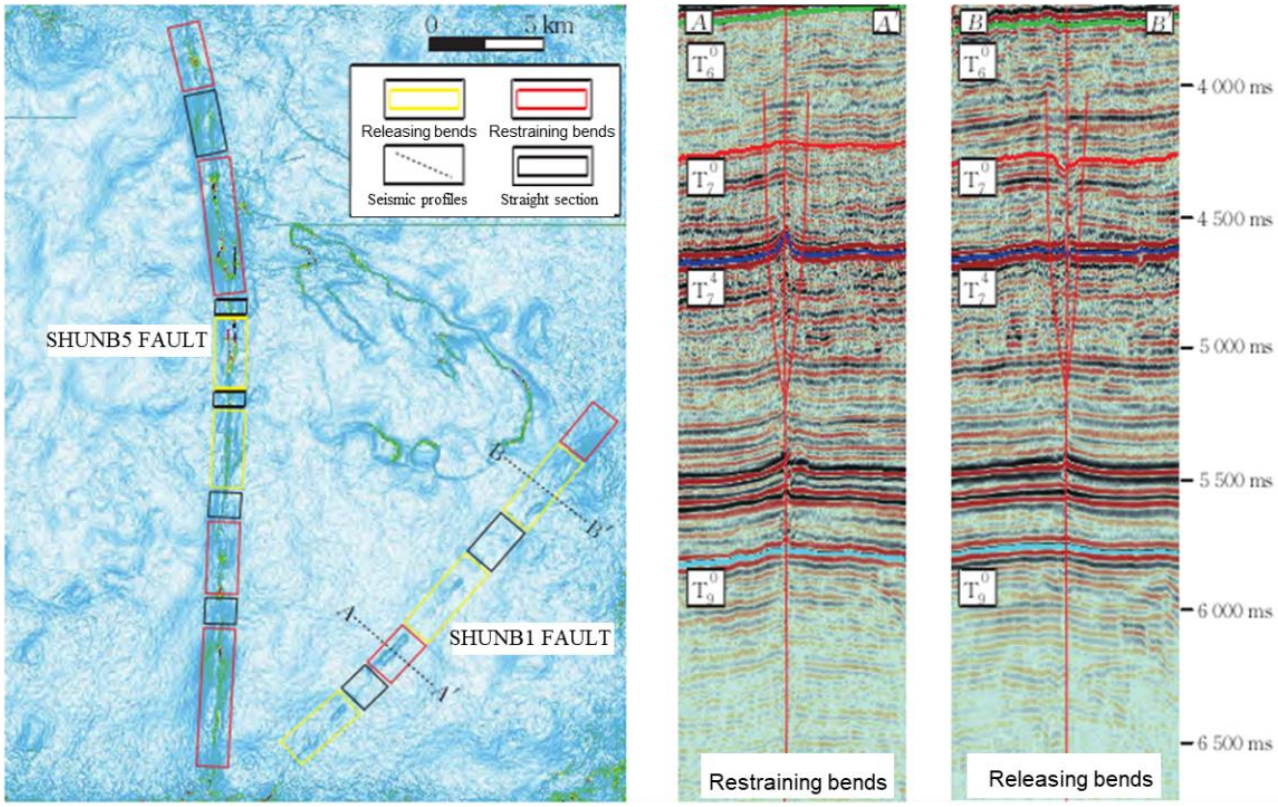

Strike-slip faults in Tarim Basin have the characteristics of segmented overlays along the strike. Its segmented overlays are usually associated with releasing bends and restraining bends. Based on structural characteristics, we conducted the simulation experiments to investigate the internal characteristics of these segmented overlays. The geometry and kinematic characteristics of basement faults are believed to be the key factors that control the development of types of segmented overlays.

Acknowledgements： This research was supported by the National Natural Science Foundation of China (No. 42272155).

Strain hardening due to calcite twin based on some interface theories

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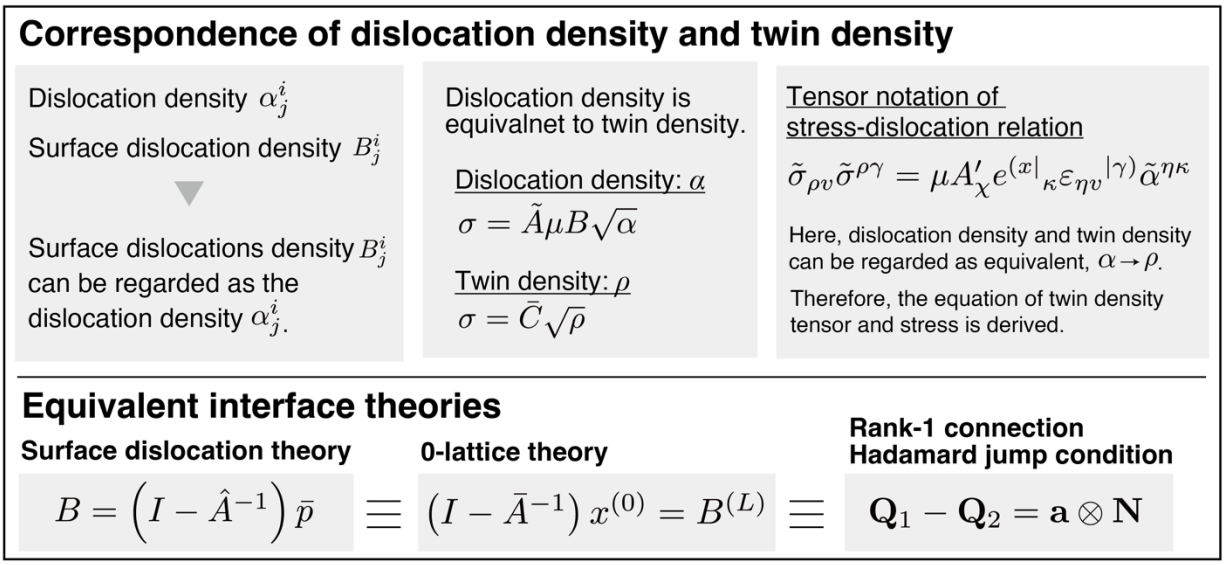
The deformation twin density of calcite increases with differential stress and has been used as a piezometer to estimate paleostress. However, its theoretical background is not well understood. In this study, the relationship between twin density and stress is derived theoretically using surface dislocation theory. The correspondence between surface dislocation theory and other interface theories is also discussed to provide a comprehensive explanation of strain hardening.



Caprock shapes salt extrusions in the Zagros Fold and Thrust Belt (Iran)

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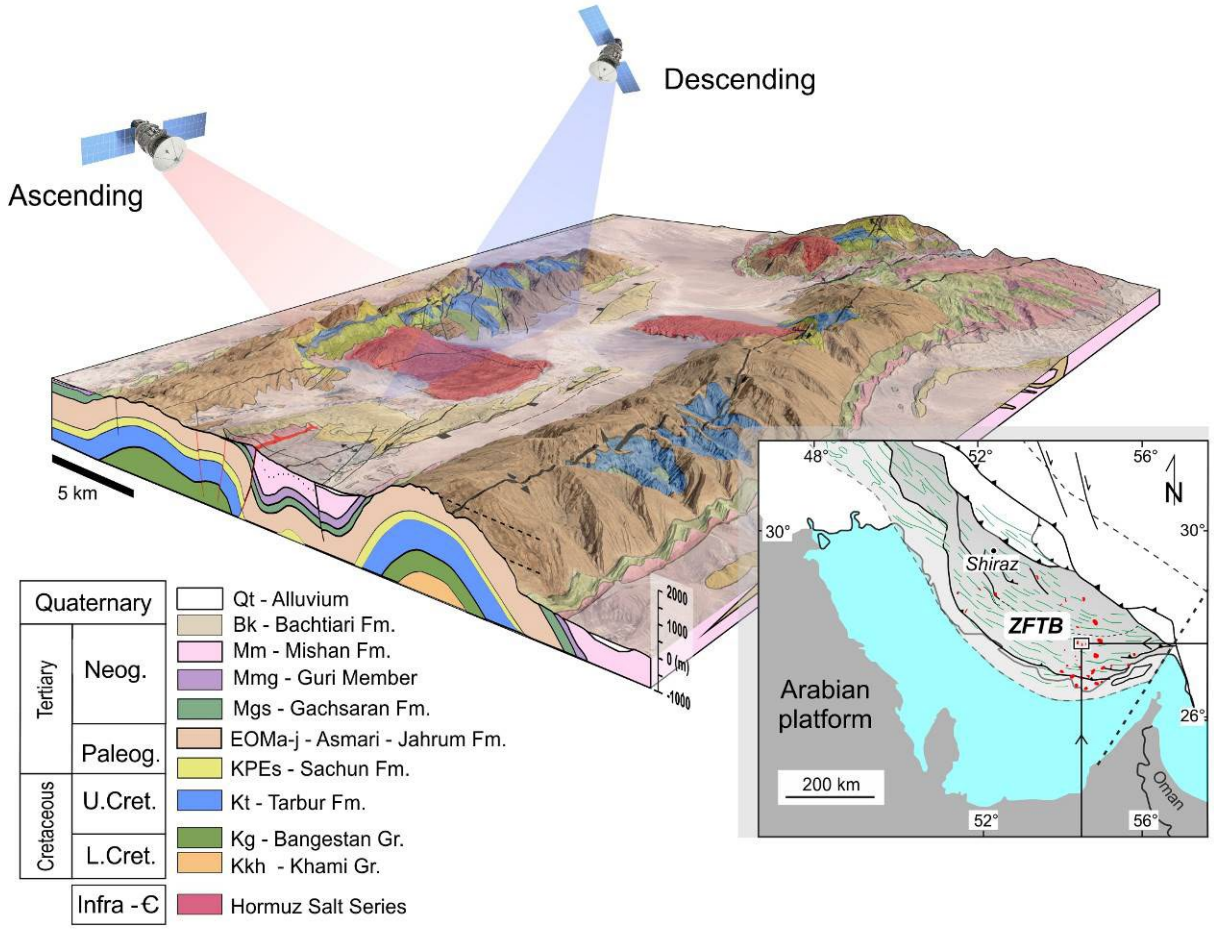
Salt glaciers of the Eocambrian Hormuz Formation in Iran are composite structures that consist of salt and salt caprock mélange. Careful analysis of geodetic signals from satellite interferometry refines our understanding of the flow dynamics of these composite structures. We postulate that the salt caprock mechanically confines the lateral spreading of salt and can enhance subsidence at the summit portions of the extrusions. We did not recognize any seasonal displacement signals.



Quartz enhances frictional strength in dolomite fault gouge

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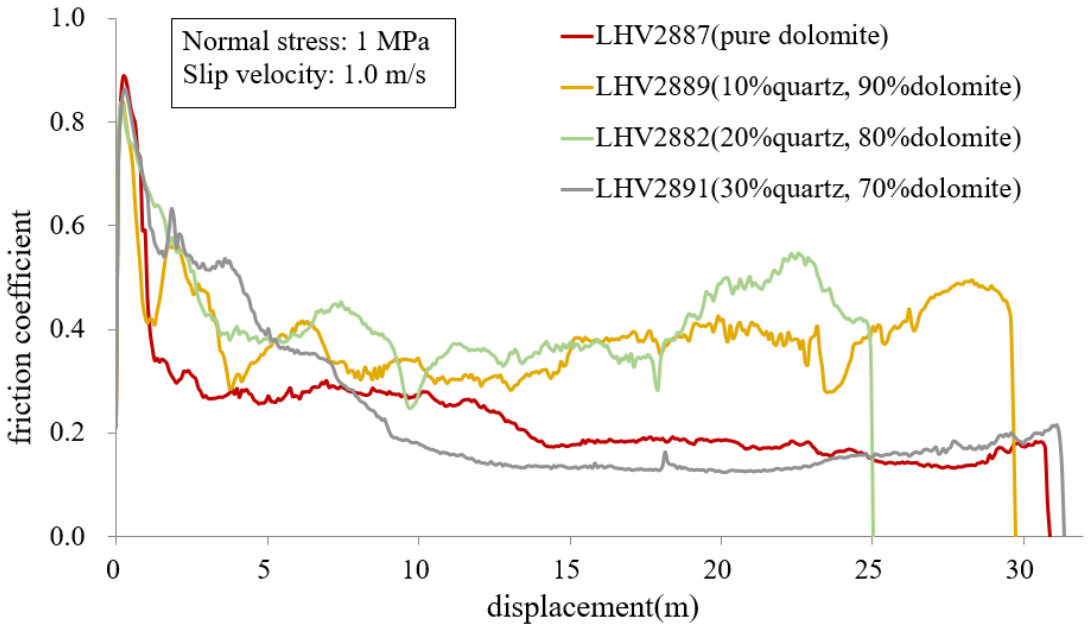
To investigate the frictional behavior of quartz in dolomite fault rock during coseismic slip, high velocity shear experiments were conducted on the quartz-bearing dolomite fault gouge and the synthetic quartz-dolomite gouges with different mass ratio. The results show that at 1.0 MPa normal stress and 1.0 m/s slip velocity, both slip weakening distance (D_w) and steady-state friction coefficient rise with the increasing quartz content. We propose that quartz enhancing the gouge's strength.



Deep mantle anomalies and their surface dynamic topographic response

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The topography is shaped by isostasy but also by dynamic topography driven by stresses caused by mantle flow. We calculated the dynamic topography along our modeled deep structure of Adria-Dacia microplates. The mantle flow generated by the slabs along the western and eastern Adria margins results in some viscous stresses transmitted to surface. We discuss them in terms of the geodynamic process of the region and the surface observations.