A European Fault Database as a stepping stone towards improved subsurface evaluation of hazards and resources

EGU2021-16232 Display D1607

Serge Van Gessel[1], Rob van Ede[1], Hans Doornenbal[1], Johan ten Veen[1], Esther Hintersberger[2], GeoERA-HIKE[3] Project Team

HIKE

Hazard and Impact Knowledge for Europe

EU Fault Database

Methods and Cases

Knowledge base

www.geoera.eu

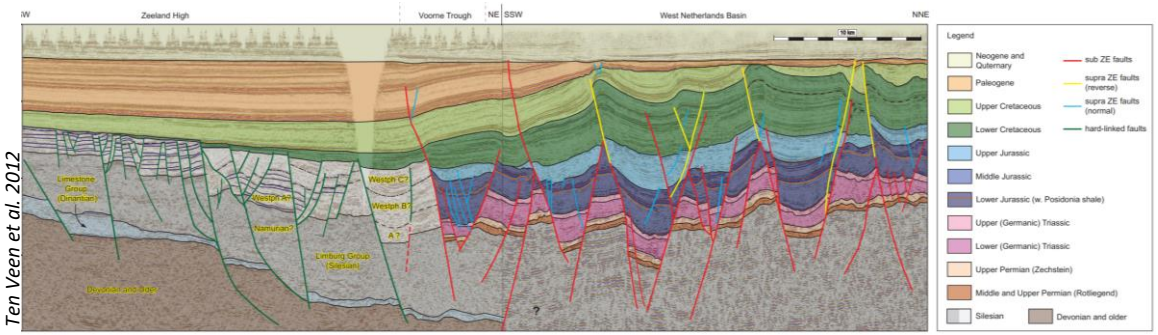
Author affiliations

1) TNO, Netherlands Organisation for applied scientific research; 2) GBA, Geological Survey of Austria; 3) see list https://geoera.eu/projects/hike10/

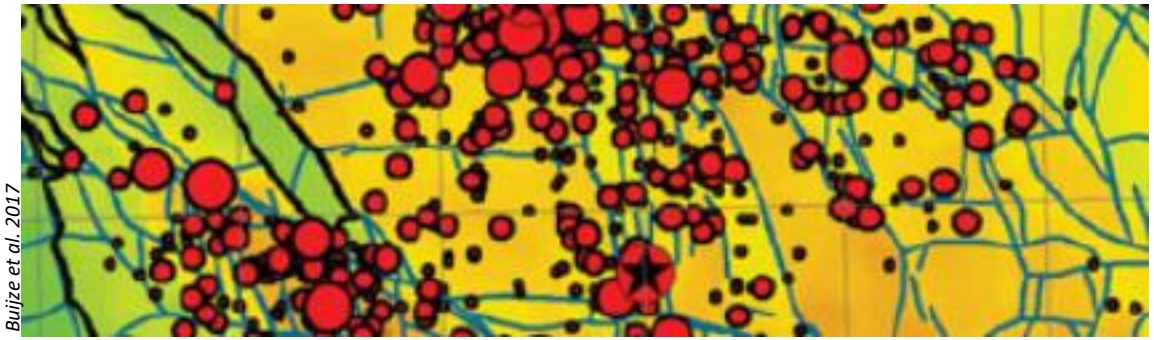
GeoERA-HIKE project partners

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731166

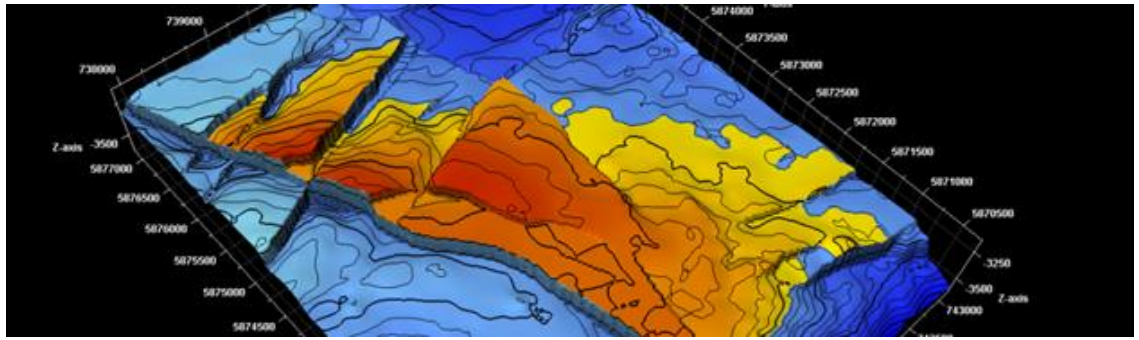
European Fault Database - Rationale



Ten Veen et al. 2012



Buijze et al. 2017



Geological & geophysical relevance

- Defining 3D structural framework
- Tectonic boundary classification
- Basin modelling and reconstruction
- Facies distribution
- Rock mechanical characteristics

Societal relevance (safety)

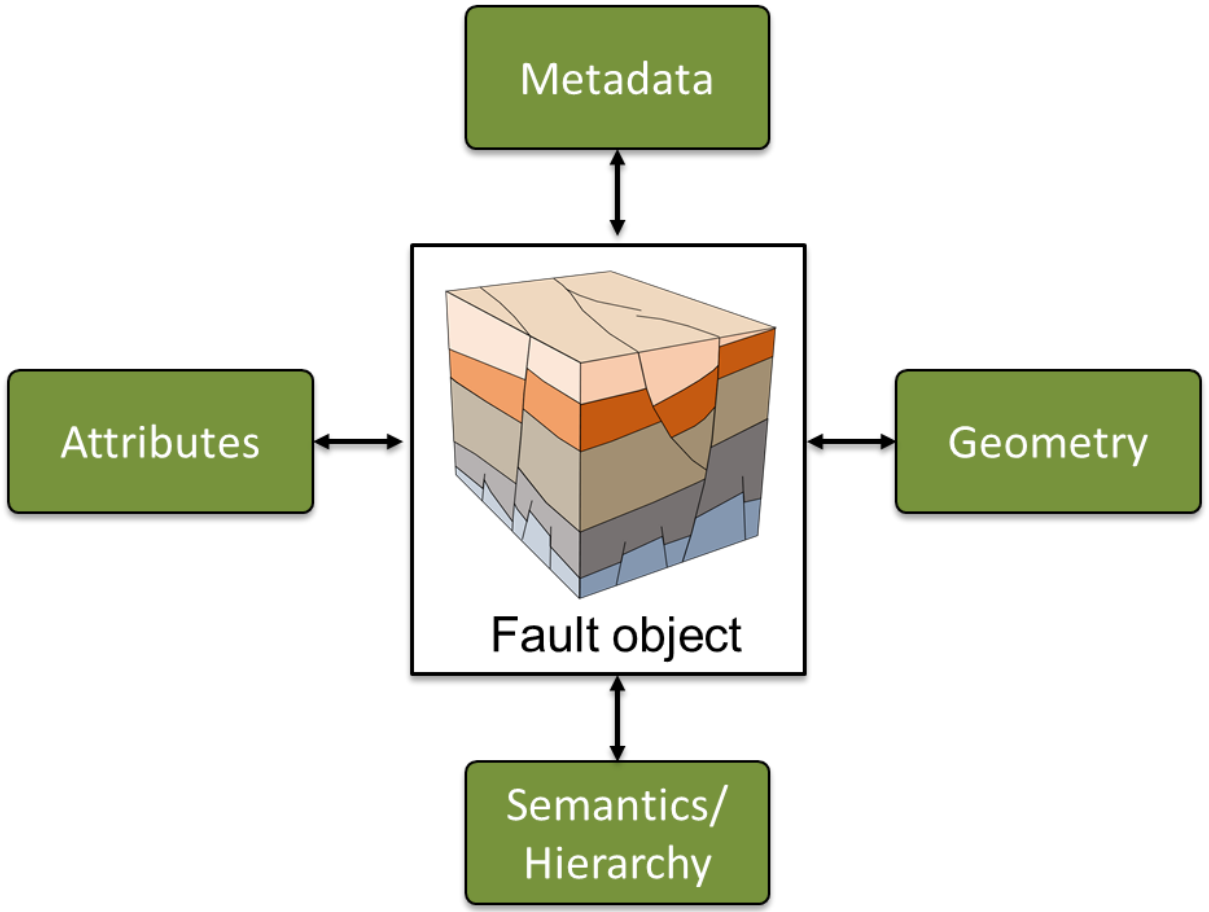
- Natural and induced seismicity
- Leakage and migration
- Ground motion and subsidence

Economic and environmental relevance

- Reservoir definition (hydrocarbons, storage)
- Reservoir performance (productivity and recovery)
- Hydrothermal resources
- Groundwater flow
- Raw minerals assemblages

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731166

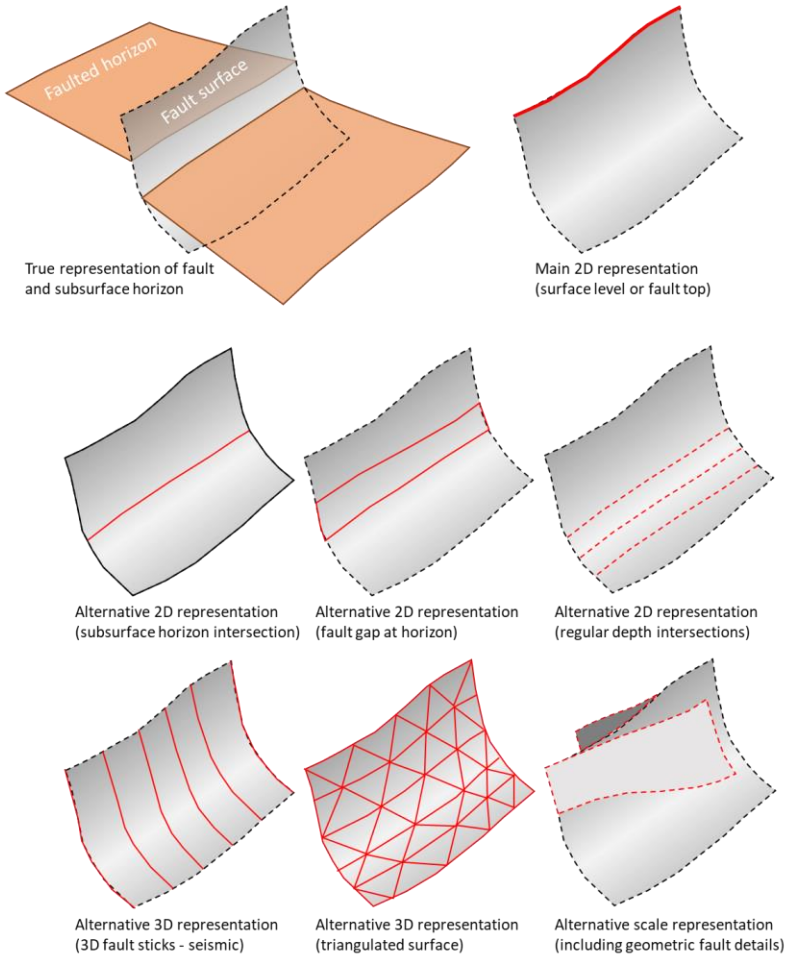
HIKE: A novel European Fault Database



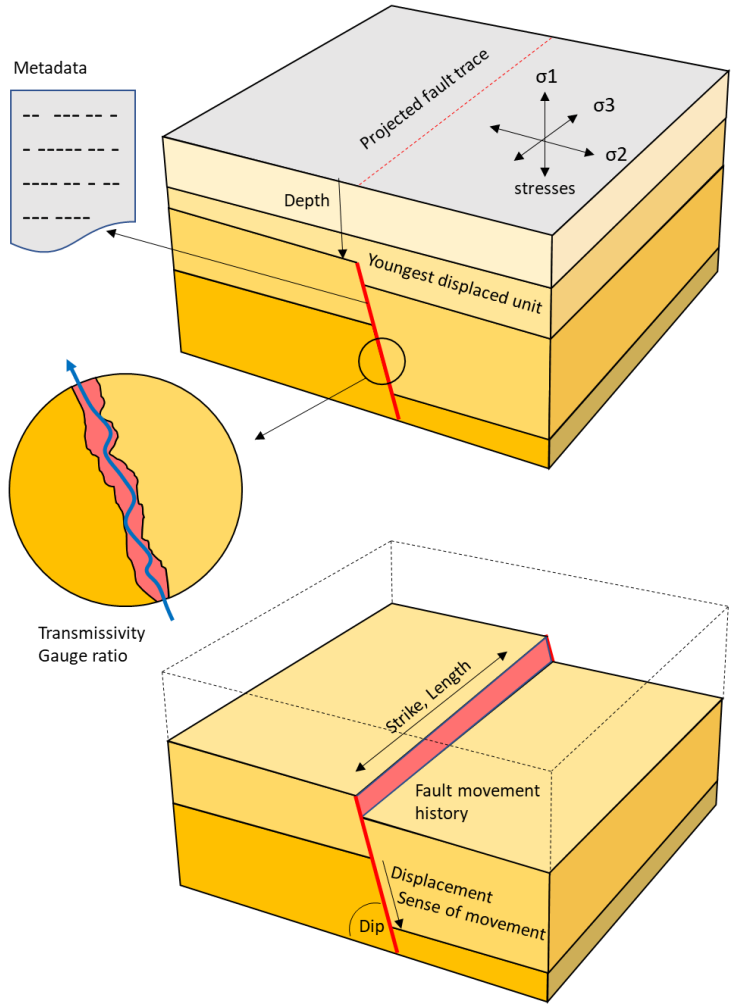
- Inclusion of all types of faults (including passive/capable)
- Surface level representation and stratigraphic intersections
- Uniform fault data architecture with a broad set of attributes
- Novel tectonic boundary classification for interpretation and correlation
- Compilation and standardization of public fault data available at partner surveys in one platform
- Existing (upgraded) fault data and many previously unpublished faults
- Link to external fault databases
- Demonstration of use R&I case studies

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731166

Fault geometries and attributes



Different 2D and 3D fault representations



- Identification, classification and meta-data parameters
- Geological and stratigraphic parameters
- Geometry-related parameters
- Physical characterization parameters
- Geohistory

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731166

Semantic concept: Classification framework

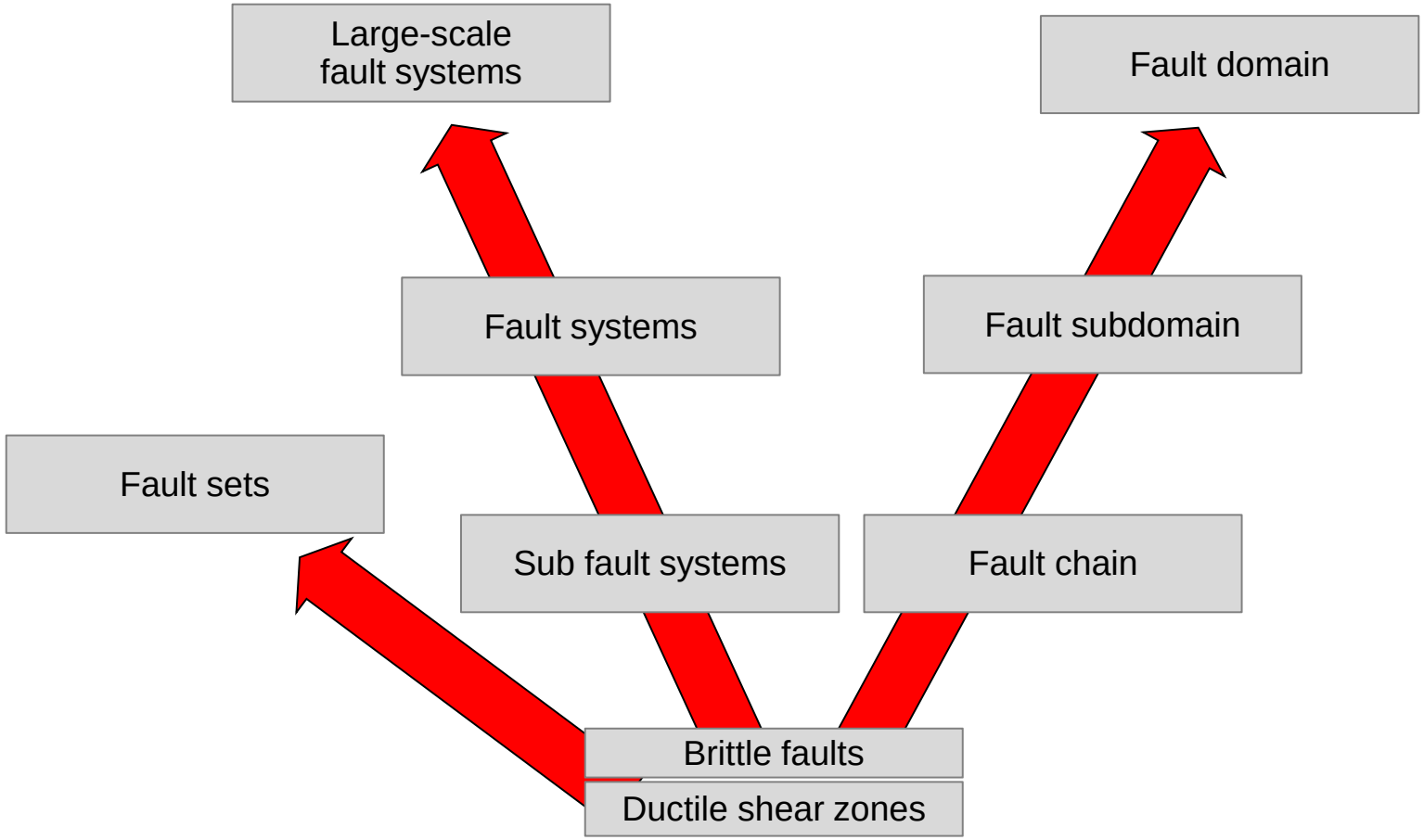
Generic hierarchical tectonic boundary concepts (cf. stratigraphic definitions for Groups, Formations, Members, Layers)

Regional definition of tectonic boundaries

- Interpretation framework
- Fault relevance for major structuration and local features
- Fault-fault relations
- (cross-border) correlation

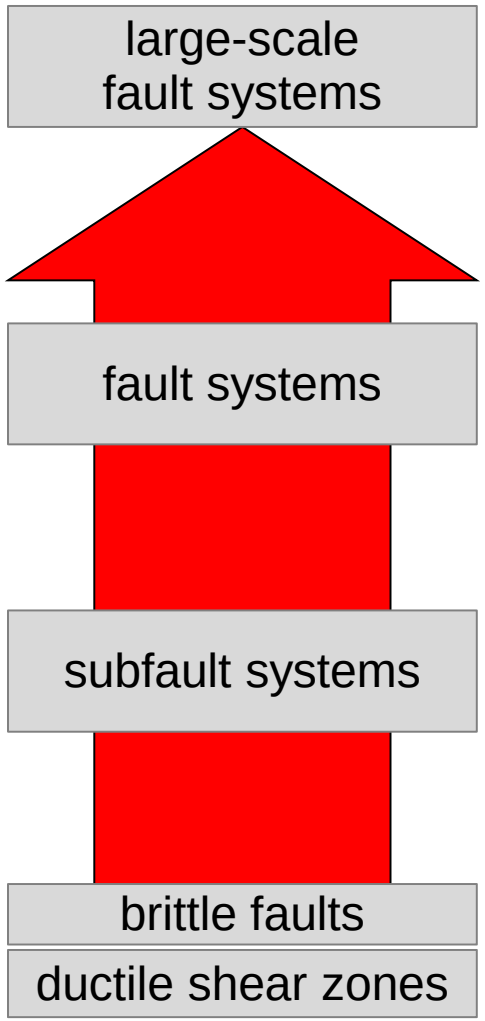
Named faults, citations

Links to external fault databases



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731166

Semantic concept: example definition in Austrian fault database



Kouřim-Blanice-Kaplice-Rodl LFS

Kouřim-Blanice FS

① Kouřim SFS

② Blanice-Graben SFS

Rodl-Kaplice FS

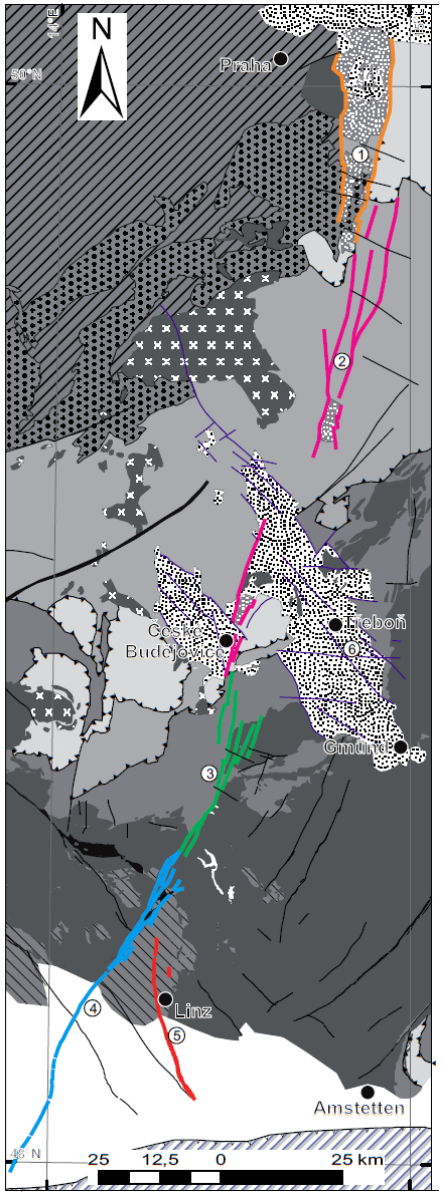
③ Kaplice SFS

④ Rodl SFS

⑤ Haselgraben SFS

Jáchymov FS

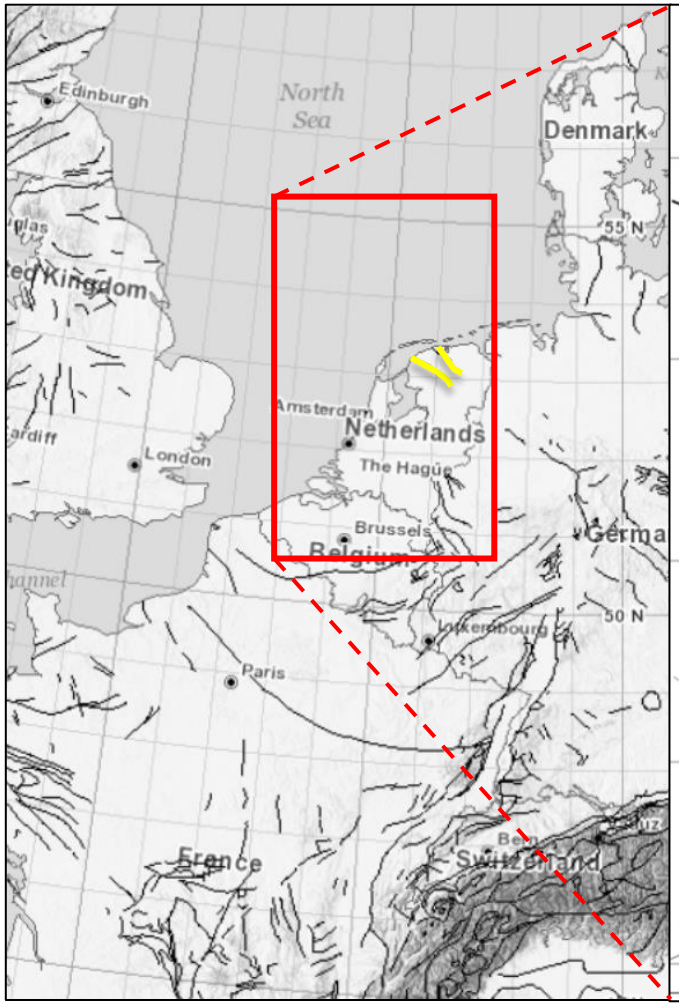
⑥ Třeboň and Budějovice SFS



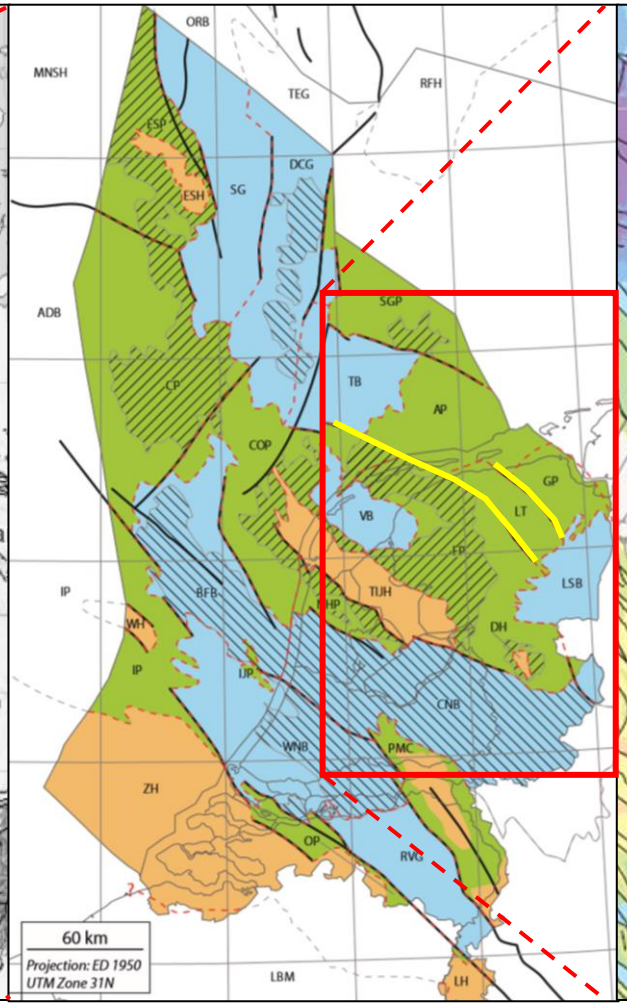
Hintersberger et al., 2017

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731166

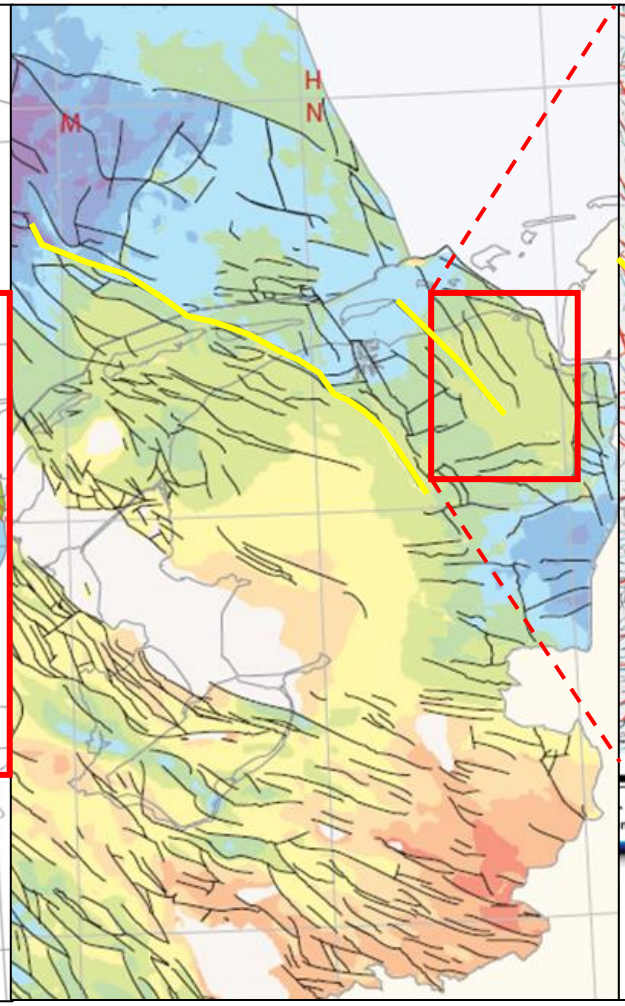
Semantic concept: example definition in Dutch fault database



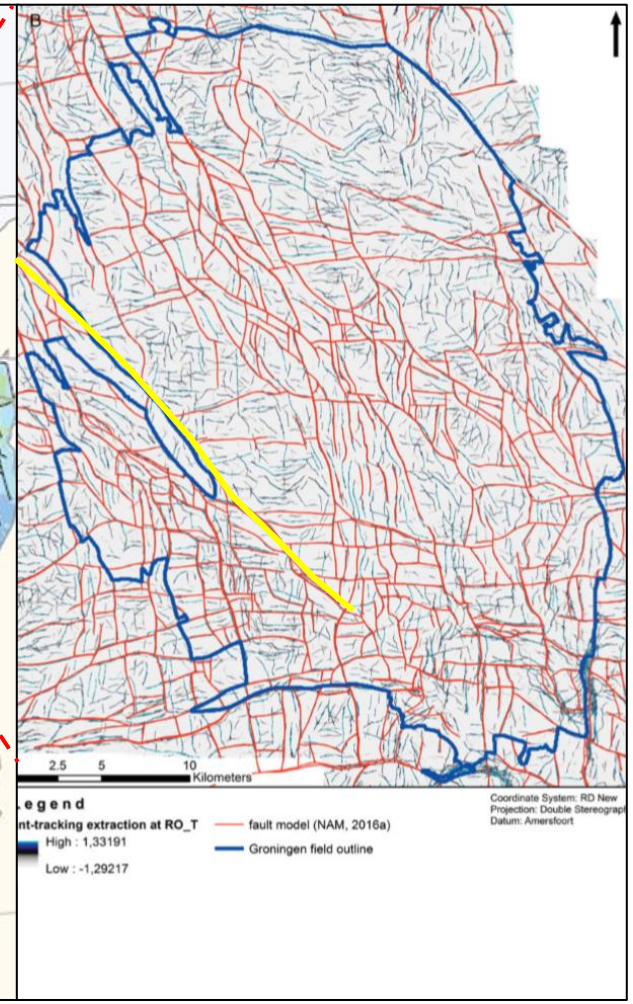
OneGeology EU surface level fault map (IGME5000)



Netherlands structural elements and boundary faults (Kombrink et al. 2012)



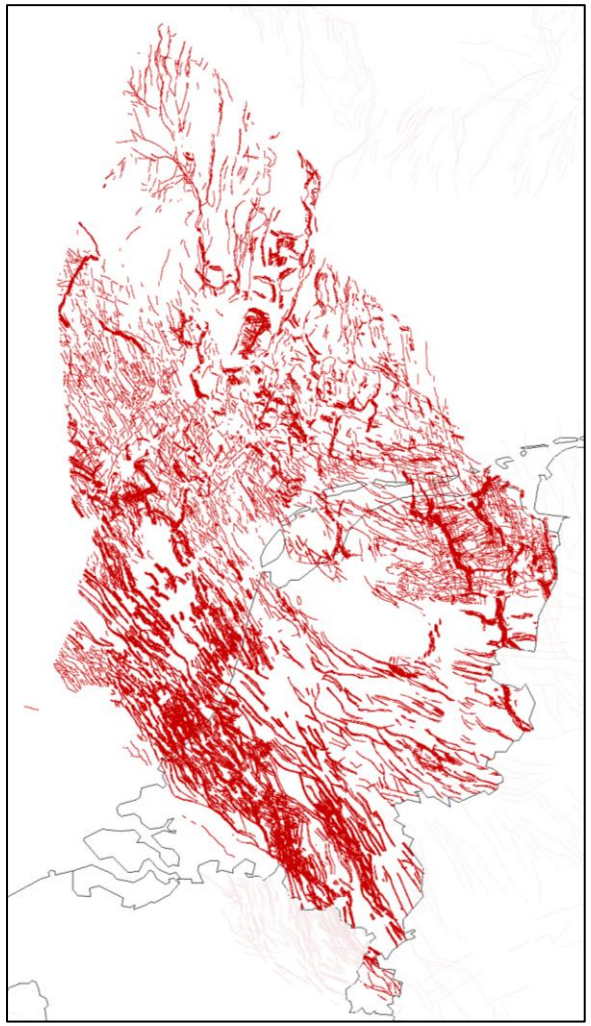
Netherlands on- and offshore fault mapping, base Permian level (Duin et al. 2006)



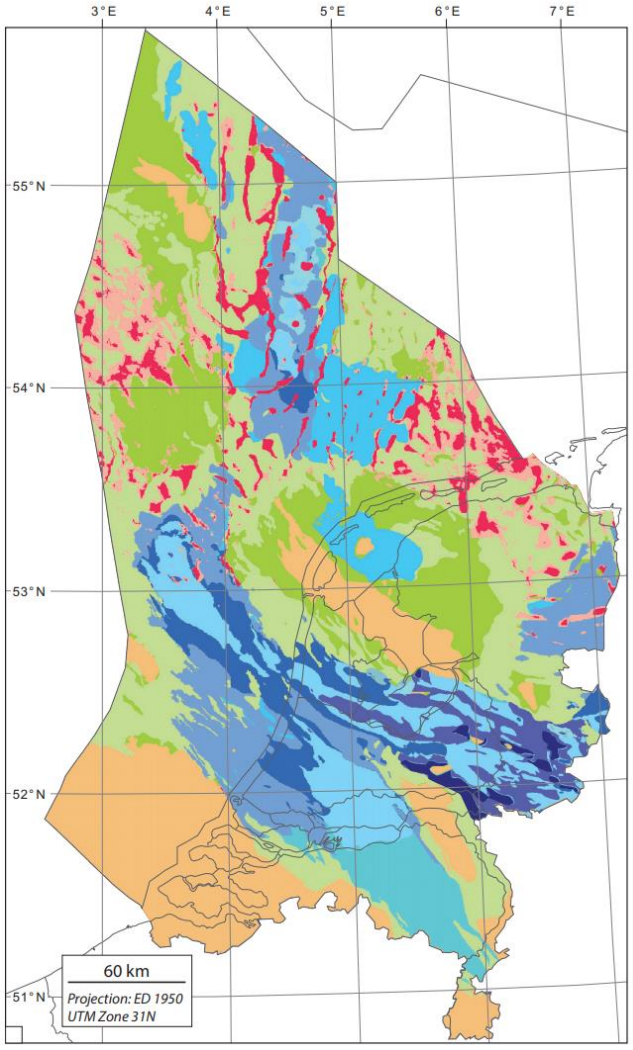
Detailed fault mapping in the Groningen gas field (Kortekaas et al. 2018). Induced seismicity assessment

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731166

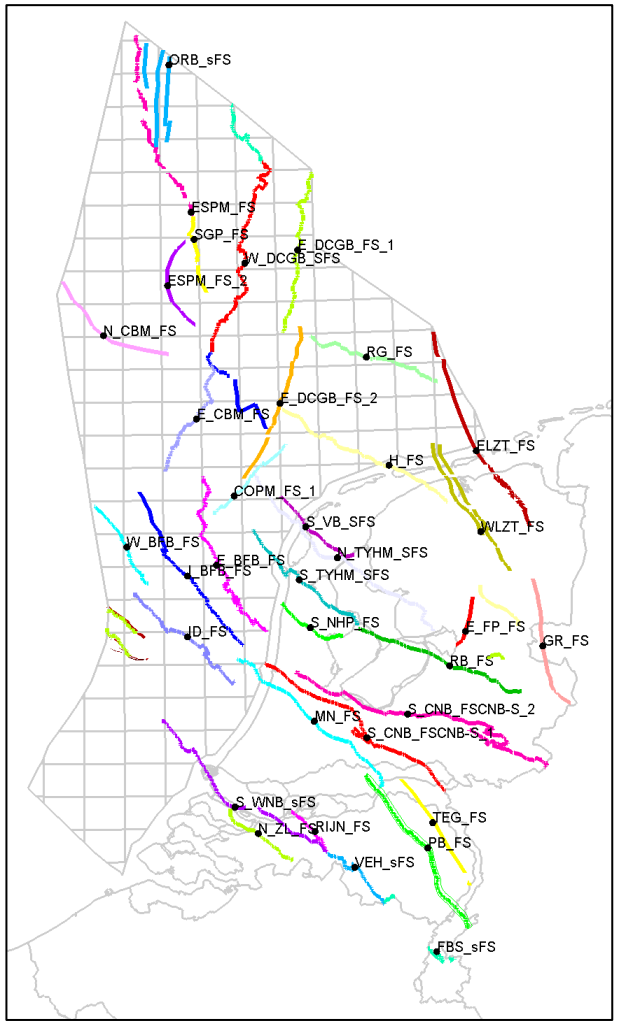
Semantic concept: example definition in Dutch fault database



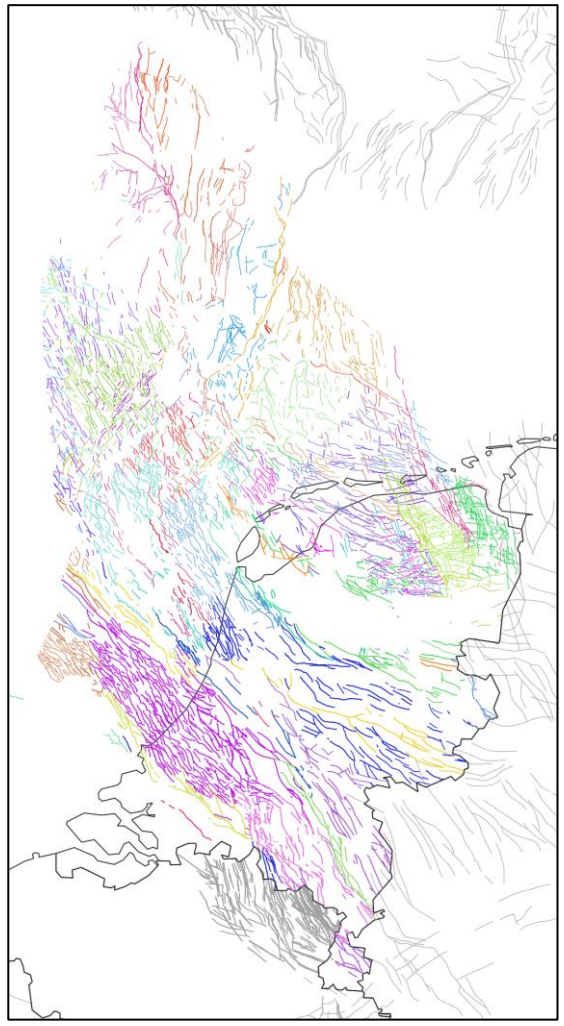
Undifferentiated faults



Major tectonostratigraphic sequences



Large scale Fault systems and fault domains

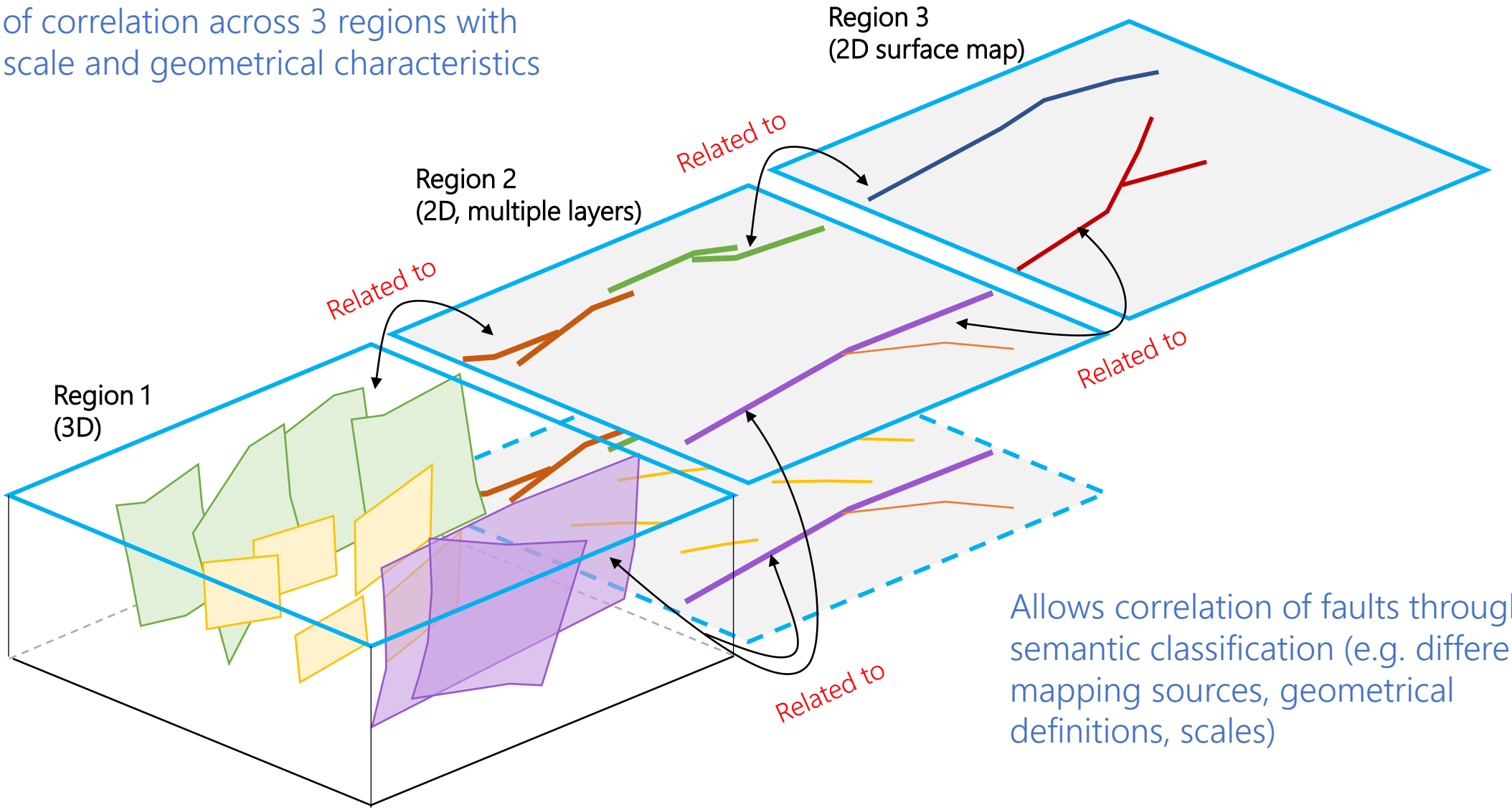


Netherlands Tectonic Boundary Classification (draft status)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731166

Semantic concept: regional correlation

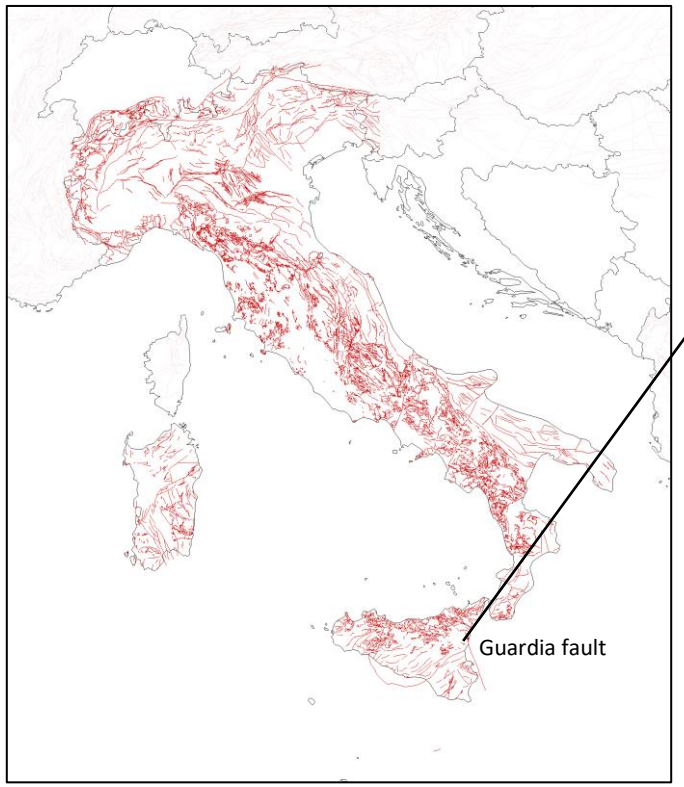
Example of correlation across 3 regions with different scale and geometrical characteristics



Allows correlation of faults through the semantic classification (e.g. different mapping sources, geometrical definitions, scales)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731166

Links to external databases



Italian faults in HIKE

Italian tectonic boundary classification

Guardia fault

URI https://data.geoscience.earth/ncl/geoera/hike/faults/4742

Guardia fault en

Notation: IT-6064

— ISPRA (2020): *ITHACA - CATALOGO DELLE FAGLIE CAPACI, Il geomapviewer è stato realizzato da ISPRA – SERVIZIO GEOLOGICO D'ITALIA su piattaforma ESRI, utilizza sistema di riferimento geografico WGS84 UTM fuso 33*

Concept relations

broader Etna volcano Domain (24)

read more ..

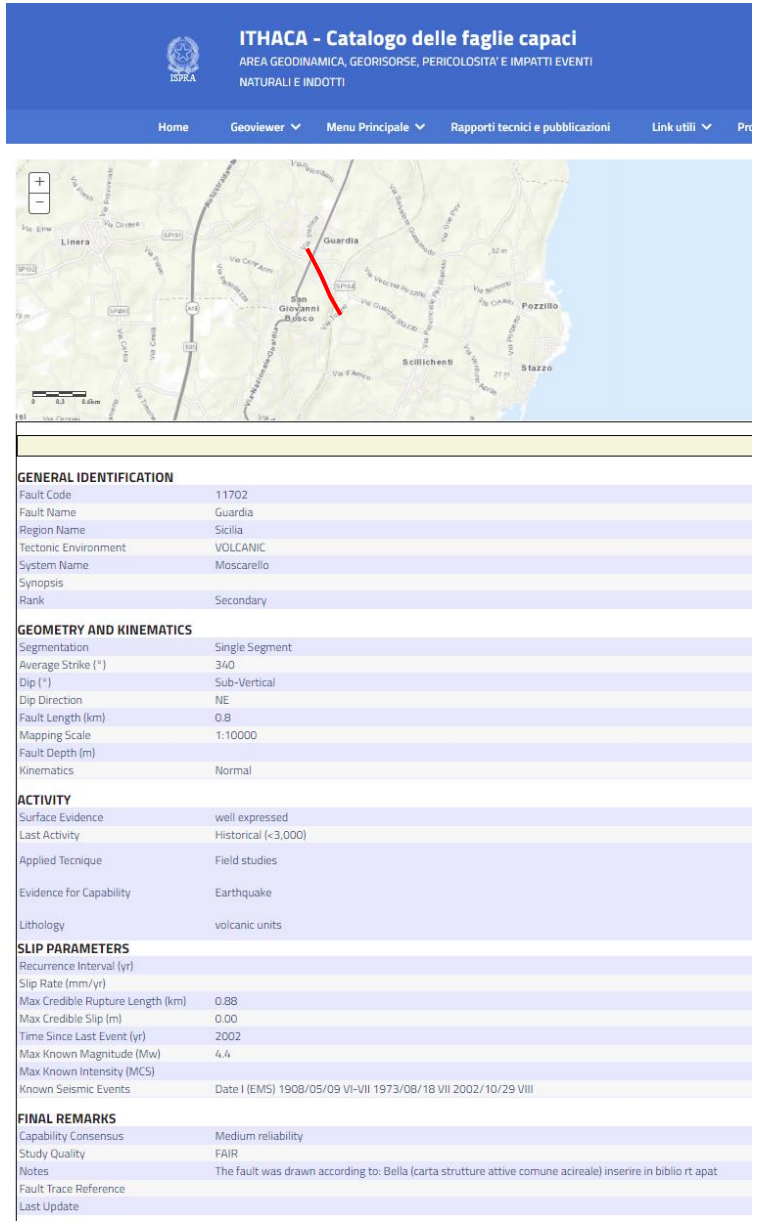
Tectonic Boundaries (1 .. 50)

.. here should be a short, 3-line text - describing the relevant scheme and allow the user to get started with the topic via the listed top concepts ....

(Austrian) Nussdorf Fault, 1: Central part of the North Alpine Molasse Basin and northward adjoining areas, 2: Bavarian Scarpland domain (N and NW Bavaria), 3: Bohemian Massif domain, ADB Supra-salt Fault Domain, ADB sub-salt NNE-SSW Fault Set, ADB sub-salt NNW-SSE Fault Set, ADB sub-salt WNW-ESE Fault Set, ADB sub-salt WSW-ENE Fault Set, Aachen Fault, Abensberg-Rottenburg Fault, Abrã Fault, Abteiland Diagonal Faults, Abusina-Sandharlanden Fault, Acciano fault, Achalm-Halfgraben, Achering Fault, Acireale fault, Adelsried-Aichach Subfault, Ademoço Fault, Aderklaa-Bockfliess Fault, Aderklaa-Bockfliess Subfault System, Adriatic plate passive continental margin Domain, Adriatic-Apulian Foreland Thrust System, Aguesse Fault, Aguesses-Asse Fault, Aham-Stockham Fault, Ahlum Fault Zone, Ahorntal-Anticline Fault, Ahrntal Shear Zone, Aicha-Halser Nebenpfahl, Aidenbach-Griesbach Step Fault, Ajuda Fault, Akmene Fault, Albaching-Rechtmehring Fault, Albstadt Shear Zone, Albufeira Fault, Alcoutim Fault, Alegrete Fault, Aletshausen-Langenneufnach Fault, Alfândega da Fé-Almendra Fault, Algibre Fault System, Allertal Fault Zone, Alling-Lochhausen Fault, Almargem do Bispo Fault, Almargem do Bispo Fault System, Almertsham Fault, Alsleben-Gröbziger Fault Zone, Altenbuch Fault, Altenbuch-Oberpöring Subfault ...

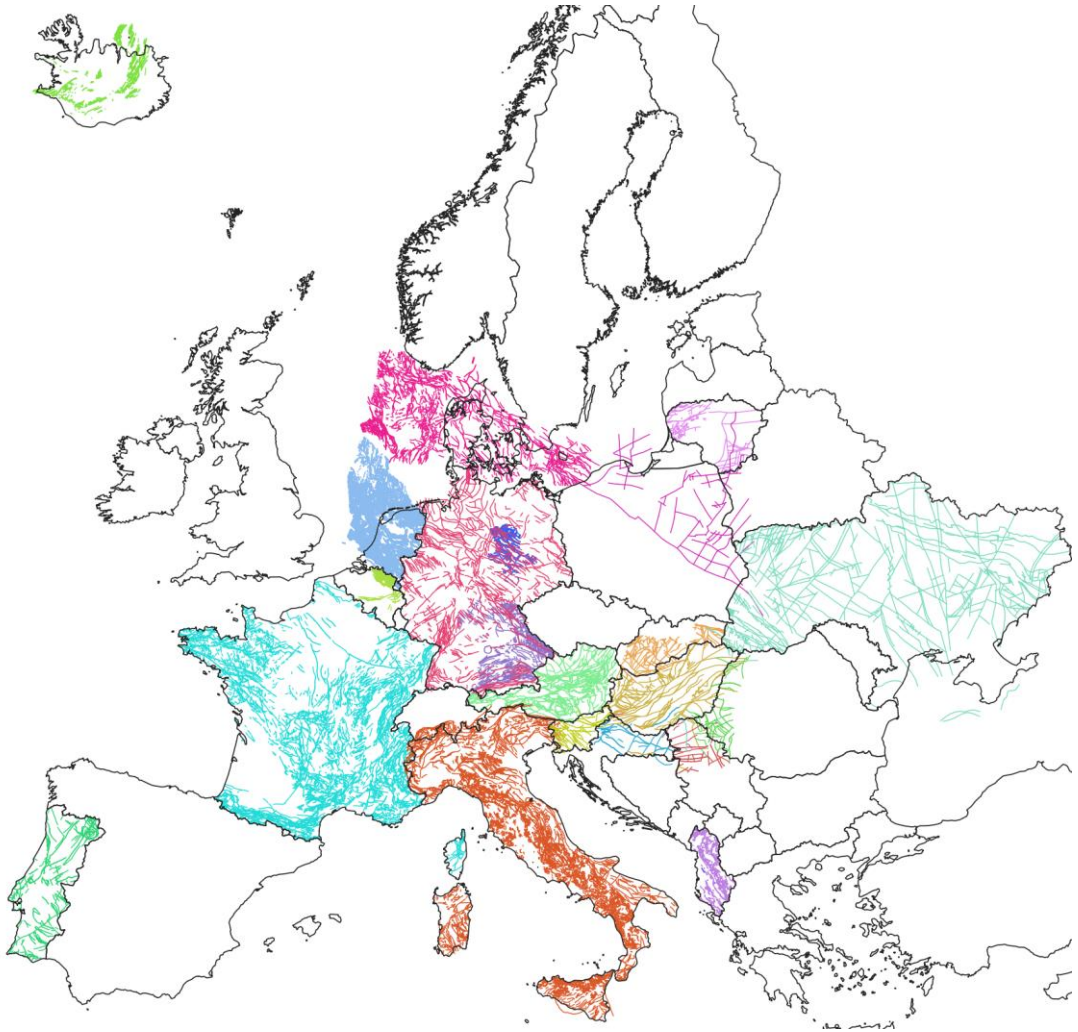
view this page in different styles like cosmo, lumen, simplex, yeti, minty, materia, united, or sandstone

Direct link to ITHACA fault database (*http://sgi2.isprambiente.it/ithacaweb/*)



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731166

HIKE Fault data collection (being finalized & prepared for dissemination)



Overview of fault data collection in HIKE (draft status per 01-04-2021) including GeoConnect3d – Pannonian Basin Area

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731166

References:

Slide 2: Image from: Ten Veen, J., Van Gessel, S., & Den Dulk, M. (2012). Thin- and thick-skinned salt tectonics in the Netherlands; a quantitative approach. Netherlands Journal of Geosciences - Geologie En Mijnbouw, 91(4), 447-464. doi:10.1017/S0016774600000330

Slide 2: Image from: Buijze, L., Van den Bogert, P., Wassing, B., Orlic, B., & Ten Veen, J. (2017). Fault reactivation mechanisms and dynamic rupture modelling of depletion-induced seismic events in a Rotliegend gas reservoir. Netherlands Journal of Geosciences, 96(5), S131-S148. doi:10.1017/njg.2017.27

Slide 5 & 6: E. Hintersberger, C. Iglseder, R. Schuster and B. Huet, 2017. The new database “Tectonic Boundaries” at the Geological Survey of Austria. Jahrbuch der Geologischen Bundesanstalt 157(1-4):195-207

Slide 7-a Snapshot of the ONE-Geology surface fault map (IGME-5000) (http://www.europe-geology.eu/onshore-geology/geological-map/onegeologyeurope/)

Slide 7-b: H. Kombrink, J.C. Doornenbal, E.J.T. Duin, M. den Dulk, S.F. van Gessel, J.H. ten Veen & N. Witmans, 2012: New insights into the geological structure of the Netherlands; results of a detailed mapping project. Netherlands Journal of Geosciences — Geologie en Mijnbouw | 91 – 4 | 419 - 446 | 2012

Slide 7-c: E.J.T. Duin, J.C. Doornenbal, R.H.B. Rijkers, J.W. Verbeek & Th.E. Wong, 2006. Subsurface structure of the Netherlands – results of recent onshore and offshore mapping. Netherlands Journal of Geosciences — Geologie en Mijnbouw | 85 – 4 | 245 - 276 | 2006

Slide 7-d: M. Kortekaas & B. Jaarsma, 2018. Improved definition of faults in the Groningen field using seismic attributes. Netherlands Journal of Geosciences — Geologie en Mijnbouw |96 – 5 | s71–s85 | 2017

Slide 8: Kombrink, H., Doornenbal, J., Duin, E., Den Dulk, M., Ten Veen, J., & Witmans, N. (2012). New insights into the geological structure of the Netherlands; results of a detailed mapping project. Netherlands Journal of Geosciences - Geologie En Mijnbouw, 91(4), 419-446. doi:10.1017/S0016774600000329

Slide 10: ITHACA fault database (http://sgi2.isprambiente.it/ithacaweb/)

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 731166

Thank you for your attention

HIKE
Hazard and Impact Knowledge for Europe

EU Fault Database

Methods and Cases

Knowledge base

www.geoera.eu

Author affiliations

1) TNO, Netherlands Organisation for applied scientific research; 2) GBA, Geological Survey of Austria; 3) see list https://geoera.eu/projects/hike10/

GeoERA-HIKE project partners

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731166