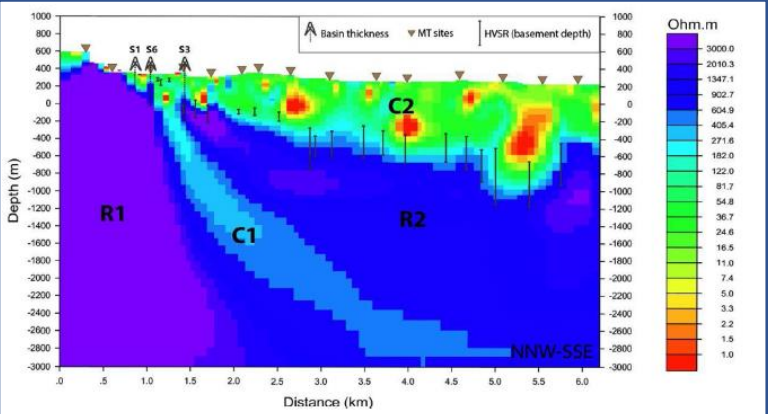


Multiscale fracture analysis of the Vallès fault zone in La Garriga-Samalus geothermal system (NE Spain)

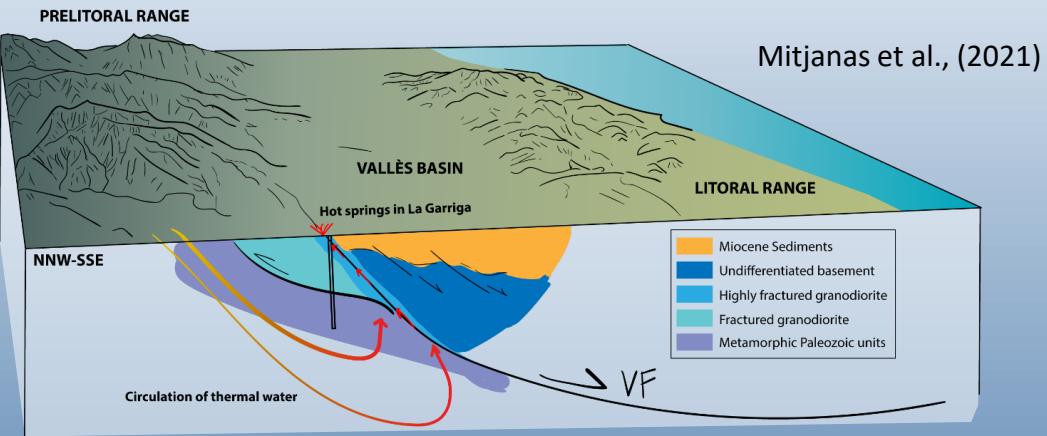
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PREVIOUS DATA



GEOLOGY
GEPHYSICS
HYDROLOGY
TEMPERATURE

CONCEPTUAL MODEL

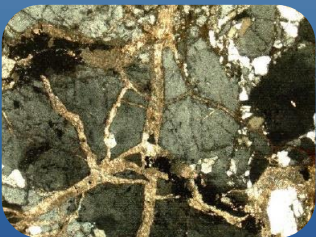
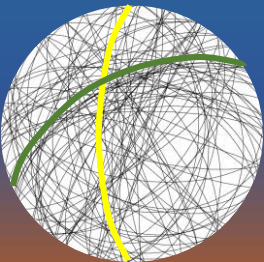
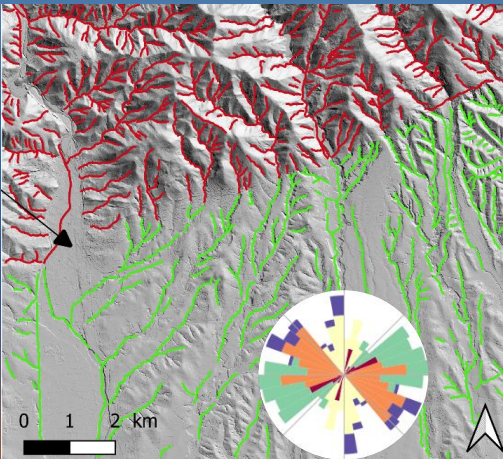


FRACTURES STUDY

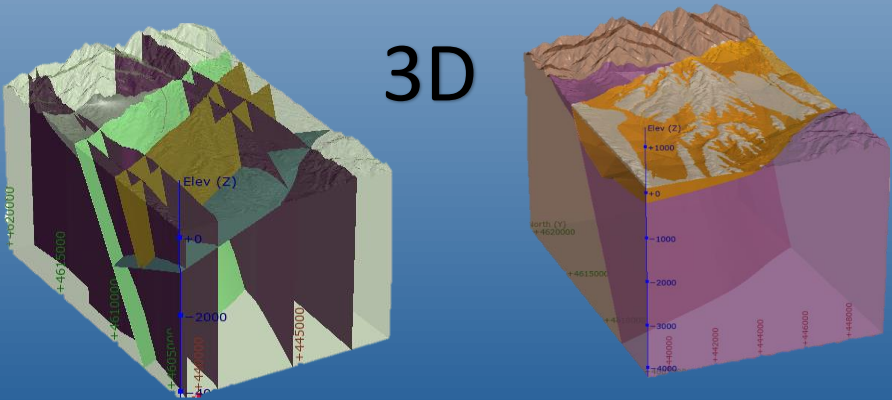
Macro-

Meso-

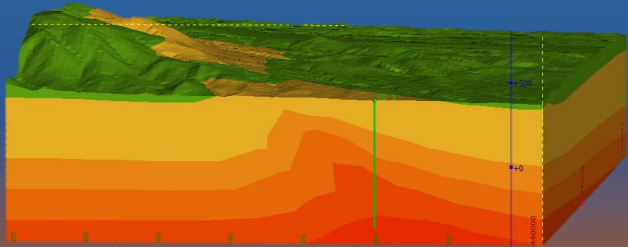
Micro-



3D



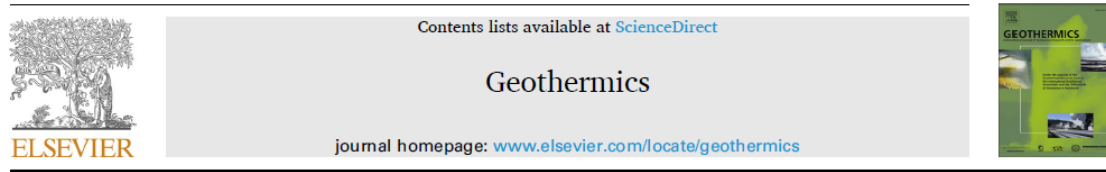
leapfrog



70°C

We strongly recommend to have a look to our last paper in order to understand the role of geophysics in the exploration of La Garriga-Samalús geothermal system

Geothermics 93 (2021) 102067



Integrated seismic ambient noise, magnetotellurics and gravity data for the 2D interpretation of the Vallès basin structure in the geothermal system of La Garriga-Samalús (NE Spain)

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<https://doi.org/10.1016/j.geothermics.2021.102067>

<https://www.sciencedirect.com/science/article/pii/S0375650521000274>

ABSTRACT

The integration of geophysical methods, together with the previous information of the Vallès basin area, has resulted in the creation of a new conceptual model that explains La Garriga-Samalús geothermal system. The integration of complementary geophysical methods seems to be a good option for the preliminary stages of a geothermal system exploration, especially in urban areas.

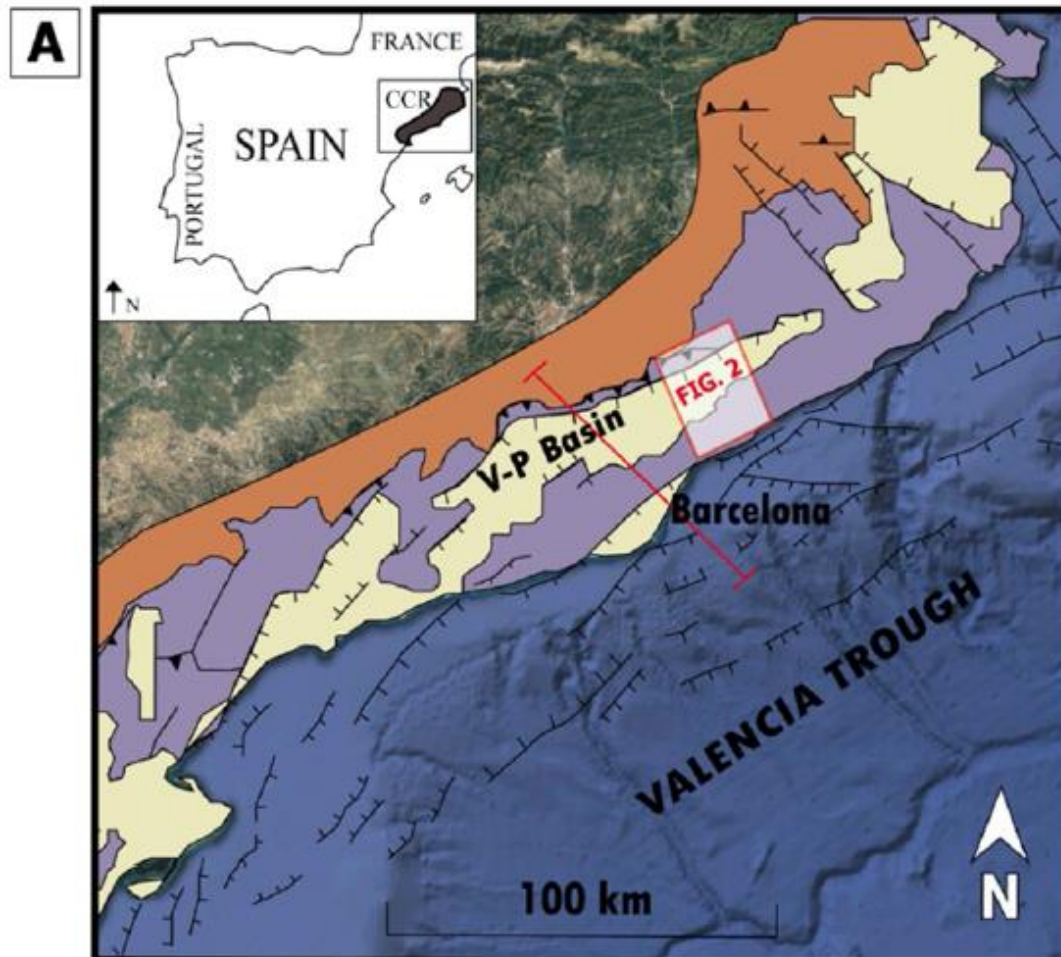
An integrated seismic ambient noise, magnetotellurics, and gravity methods were used to determine the geological units and structures which control the La Garriga-Samalús geothermal system. The 2D resistivity and density models have allowed the identification of the four main units which regulate the geothermal system: the Miocene basin, the Prelitoral Range unit, the Vallès Fault Zone, and the Paleozoic basement. The interpretation of our models set the Vallès Fault Zone, which is characterized by an anomalous low resistivity and low density, as the main path for the hot fluids. Moreover, the geophysical characterization established a new geometry for the Miocene basin. The Miocene basin presents a stepwise morphology, with the minor thickness towards the fault and an increasing thickness towards the center of the basin. This geometry seems to be related to synthetic normal faults.

These results have evidenced that, although, in some geothermal systems, the warm water may create an insufficient physical contrast; the appropriate use of some techniques can still be useful for the exploration of medium and low-temperature geothermal systems.

Multiscale fracture analysis of the Vallès fault zone in La Garriga-Samalús geothermal system (NE Spain)

Gemma Mitjanas, Gemma Alías, David García-Martínez, Pilar Queralt, and Juanjo Ledo

REGIONAL SETTING



CATALAN COASTAL RANGES: The study area is located in the limit between the Pre-coastal Range (PR) and the Vallès basin (VB). In this area, a highly fractured granodiorite (PR) limits the Miocene basin (VB) by the **Vallès normal fault**.

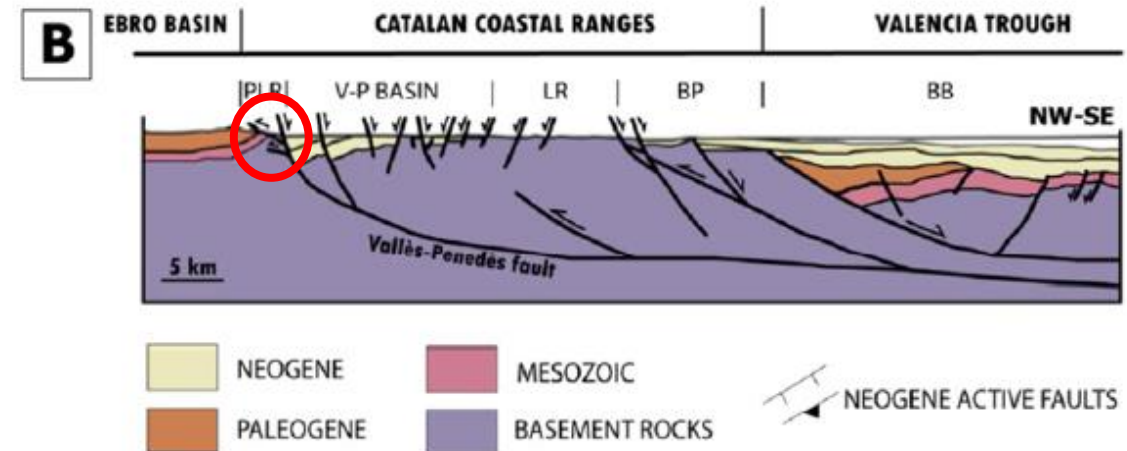
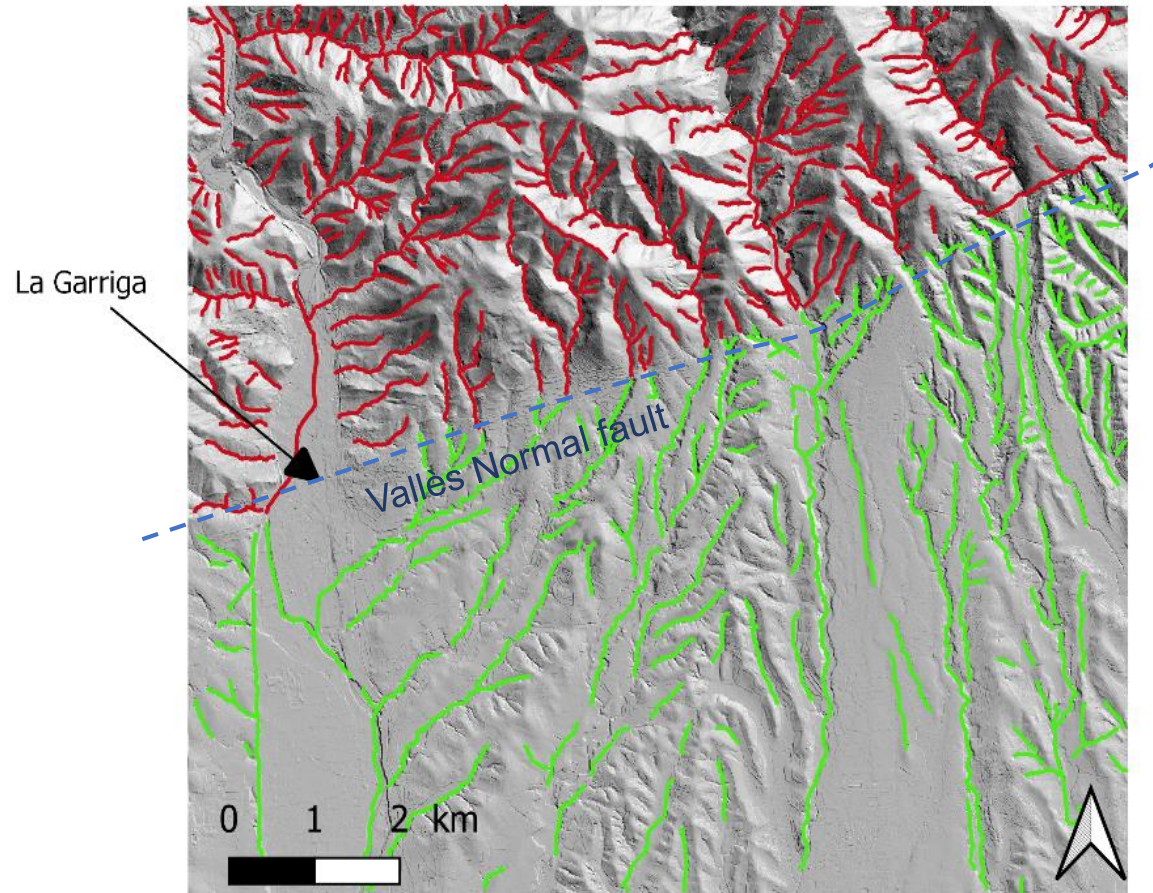


Fig. 1. A) Structural map of the Valencia trough, showing the Catalan-Valencian domain (modified from [Martí et al., 1992](#)). The red line indicates the location of the cross-section (B). The red square localizes the study area (see [Fig. 2](#)). B) Cross section of the Catalan Coastal Ranges and the Valencia trough (modified from [Santanach et al., 2011](#)). (V-P: Vallès-Penedès; PLR: Prelitoral range; LR: Litoral range; BP: Barcelona Plain; BB: Barcelona Basin).

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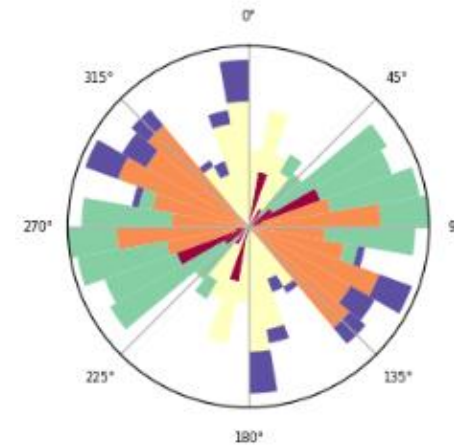
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FRACTURES STUDY



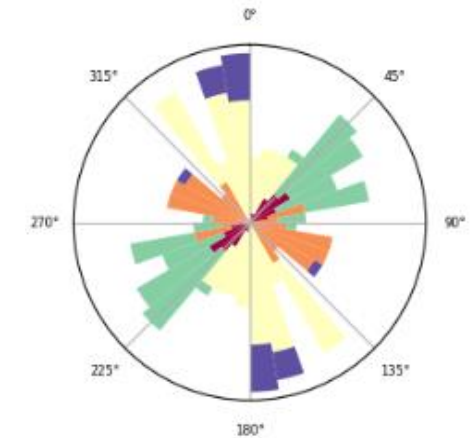
BASEMENT LINEATIONS

Rose Diagram



BASIN LINEATIONS

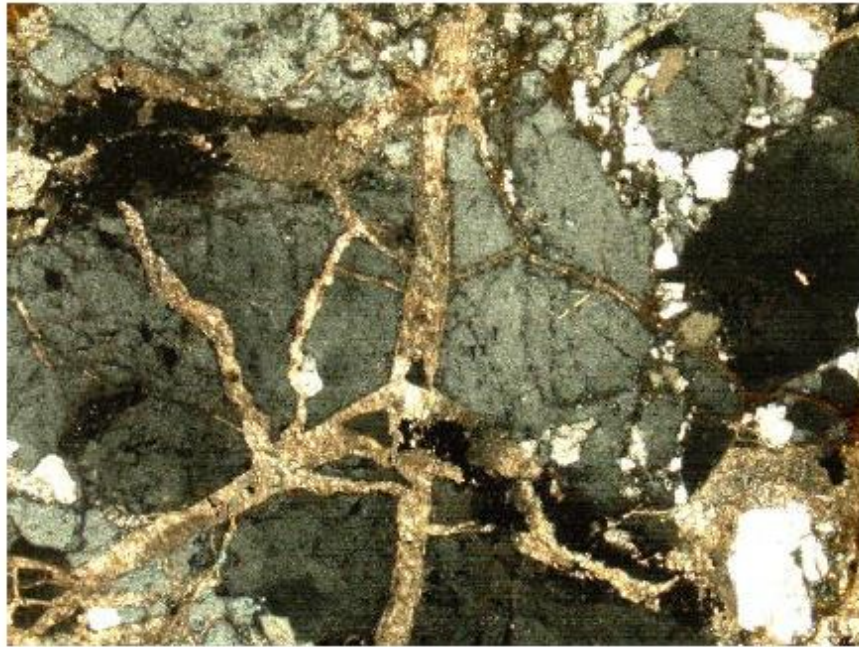
Rose Diagram



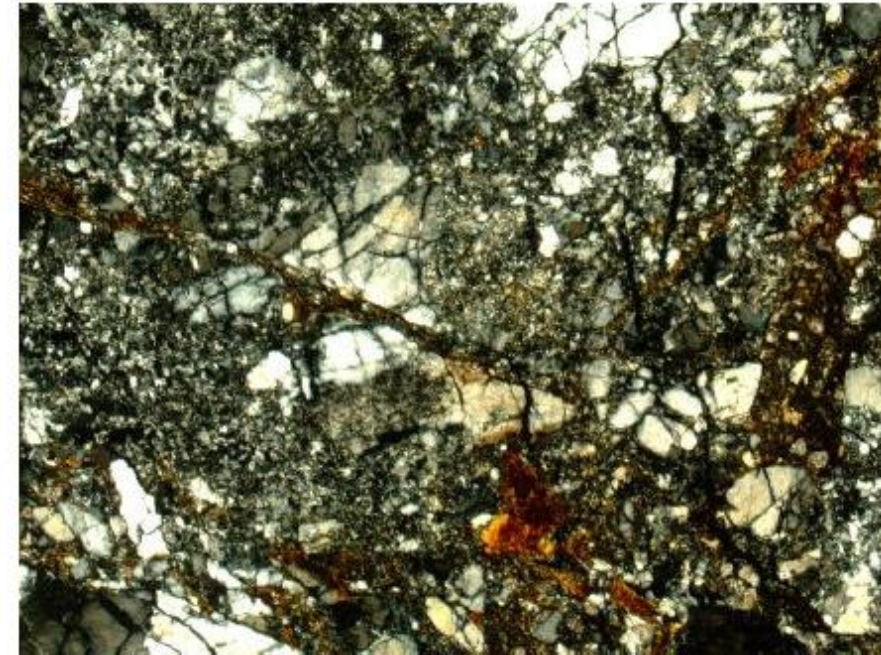
The lineations and fractures analysis have allowed the identification of three major orientations (N-S, NE-SW, NW-SE).

FRACTURES STUDY

The study of thin sections has allowed the characterization of the damage zone and the fault core associated to the Vallès normal fault.



Fractured granodiorite from the damage zone
- Crumbled rock, **permeable**-



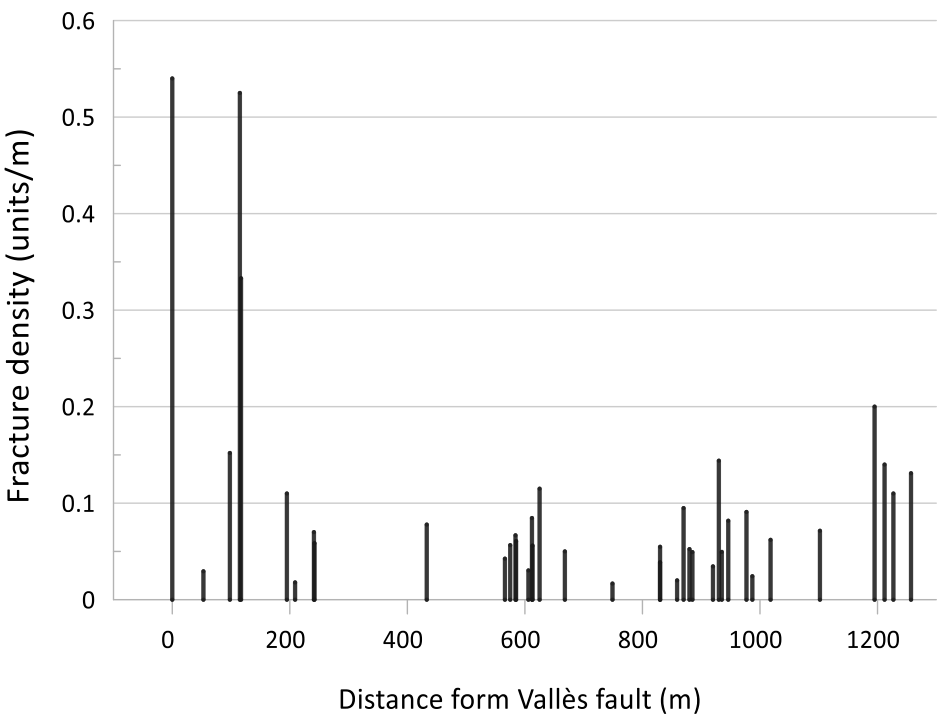
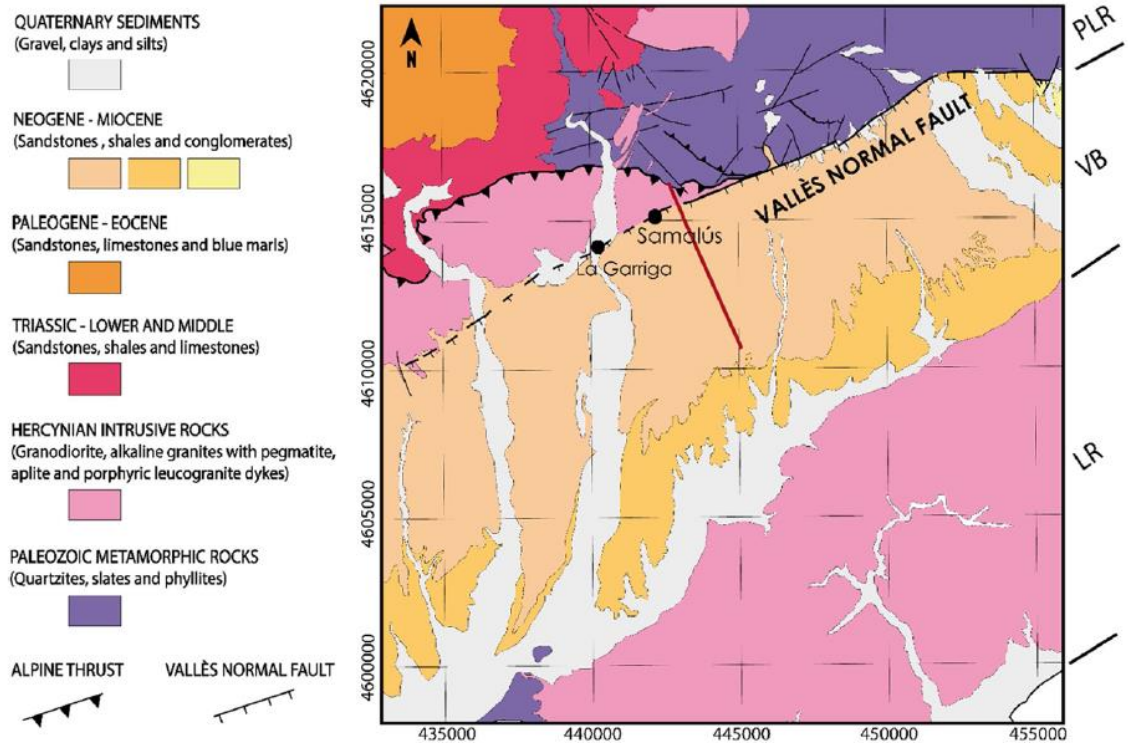
Protocataclasite from the fault core
- Compact rock, **impermeable** -

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FRACTURE DENSITY

After the analysis of 50 outcrops around La Garriga and Samalús towns, we can observe how the density of fractures increase towards the Vallès normal fault but also towards the northern Alpine thrust.

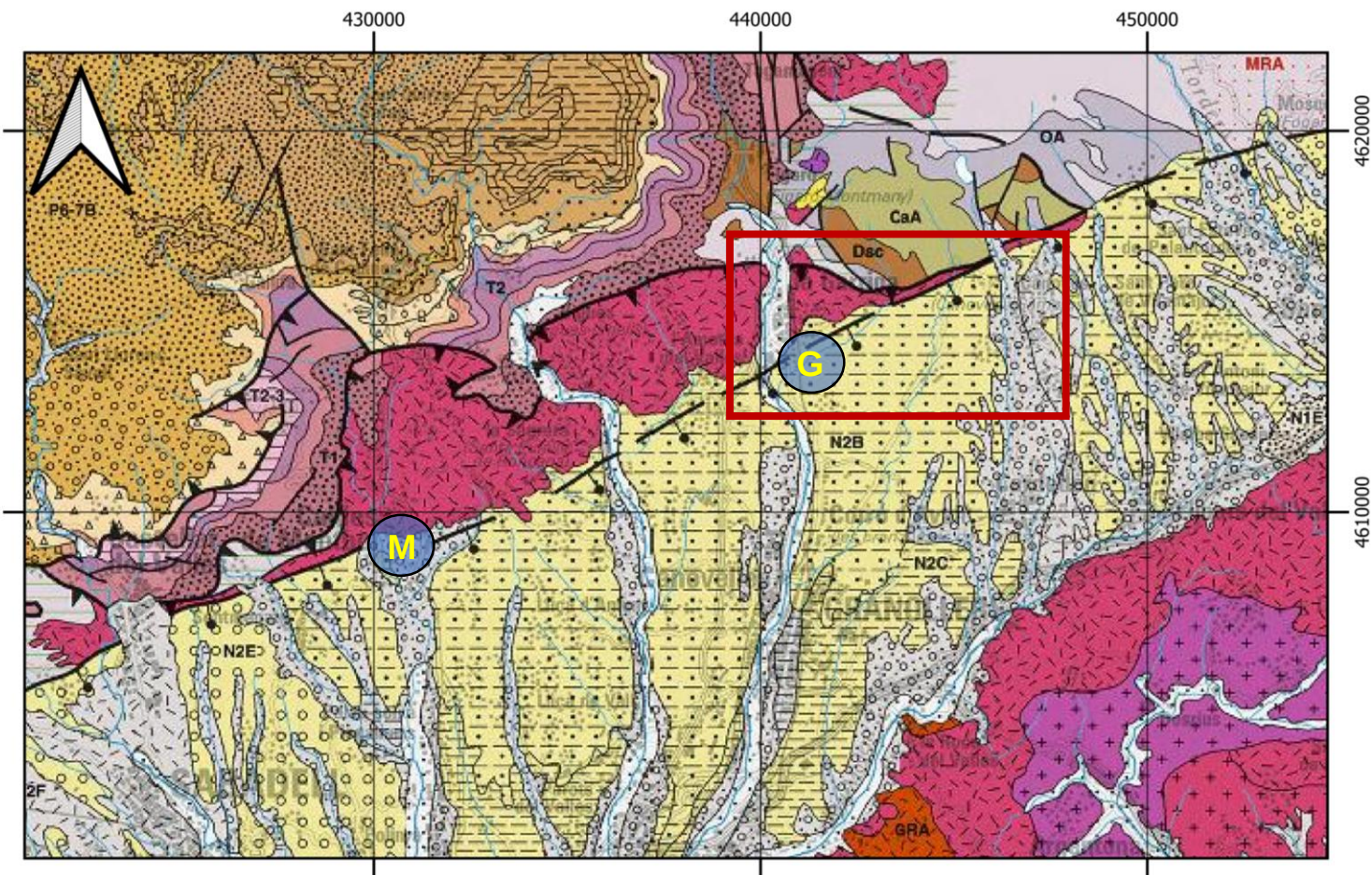


Mitjanas et al., 2021

Multiscale fracture analysis of the Vallès fault zone in La Garriga-Samalús geothermal system (NE Spain)

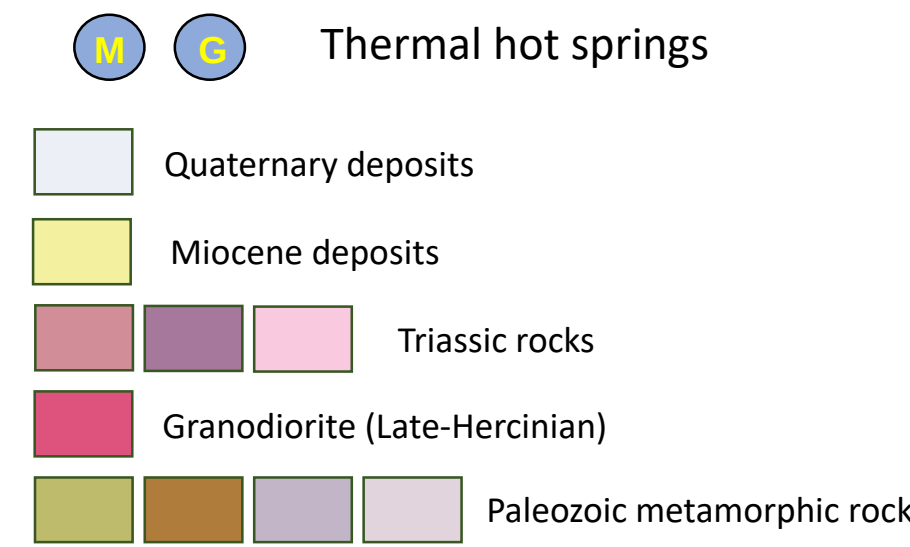
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LOCATION OF THERMAL HOT SPRINGS



Modified from ICGC, 2002 – Geologic map 1:250.000

The fragile behavior of the granodioritic unit as well as the presence of some major faults, seem to be the key point for the development of the geothermal system as well as for the manifestation of hot springs in determined sites.

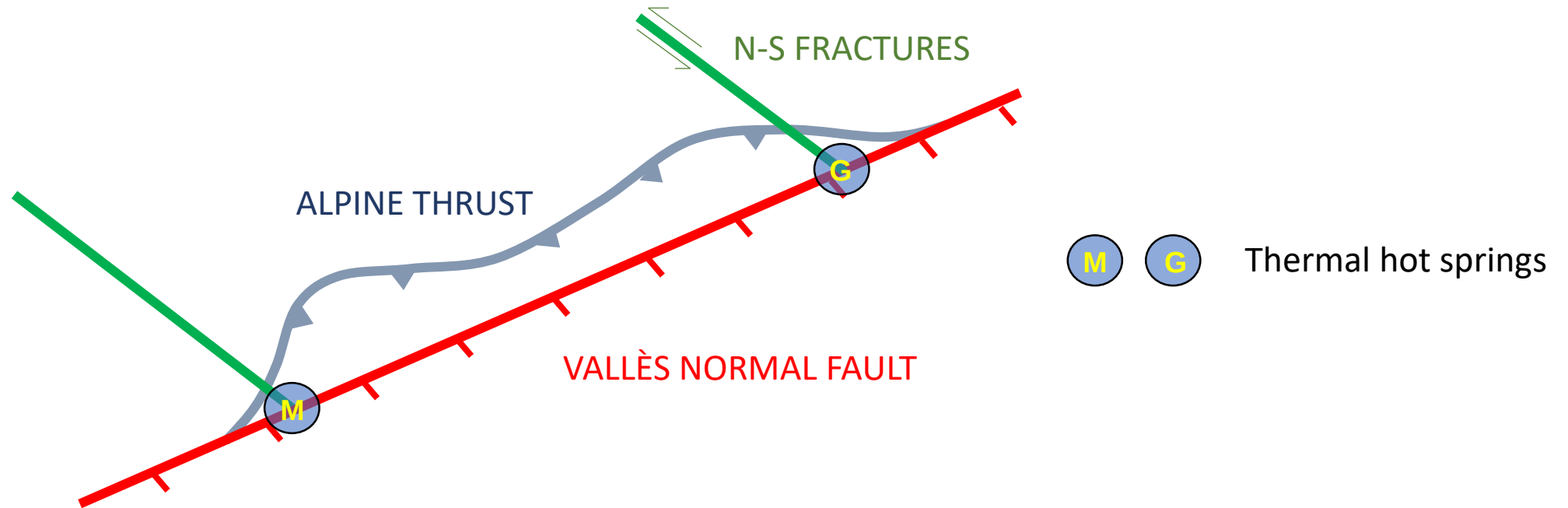


** se original map for detailed legend

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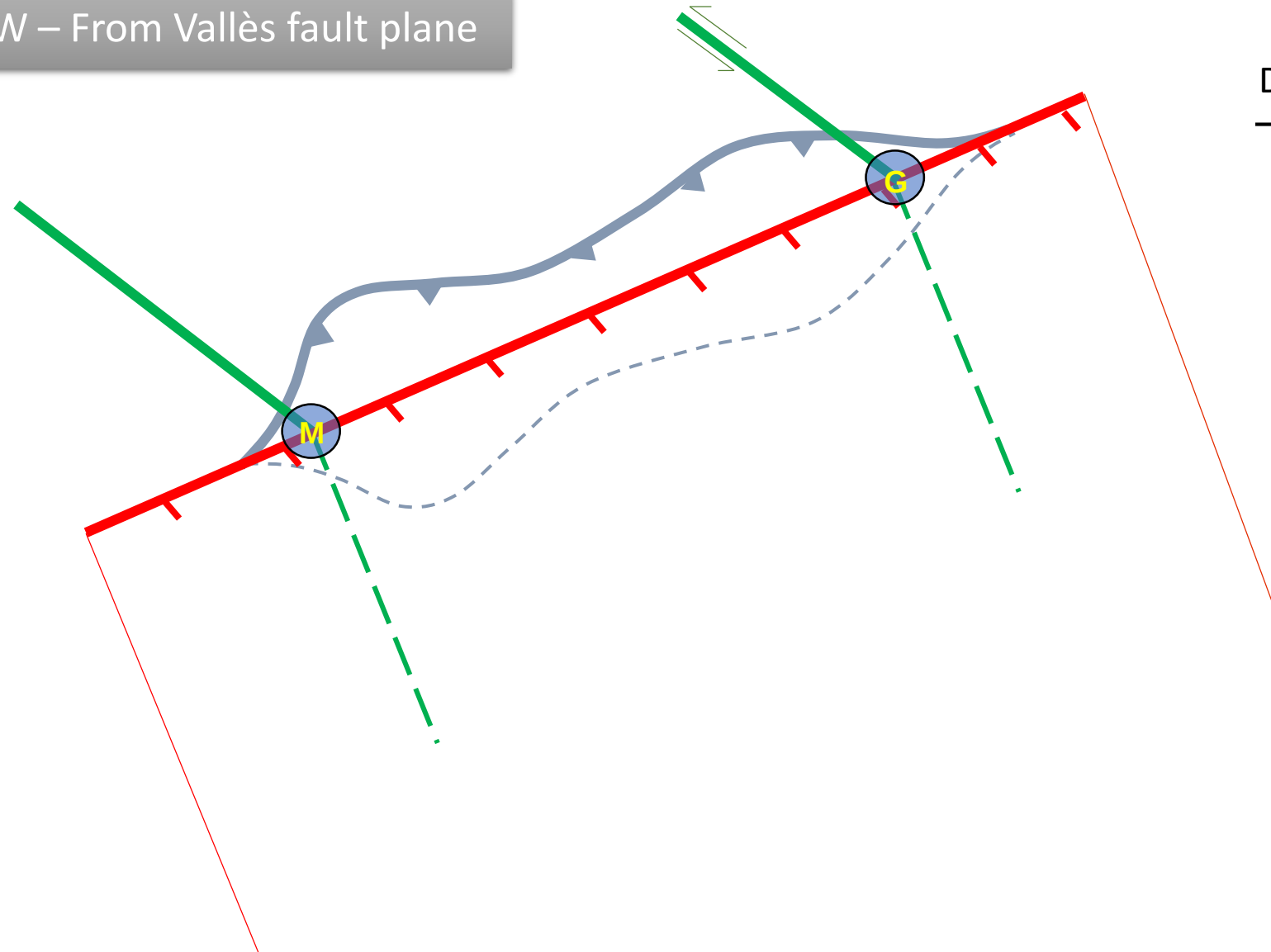
SIMPLIFIED MAP VIEW



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3D VIEW – From Vallès fault plane



Dashed lines are fault intersections

M

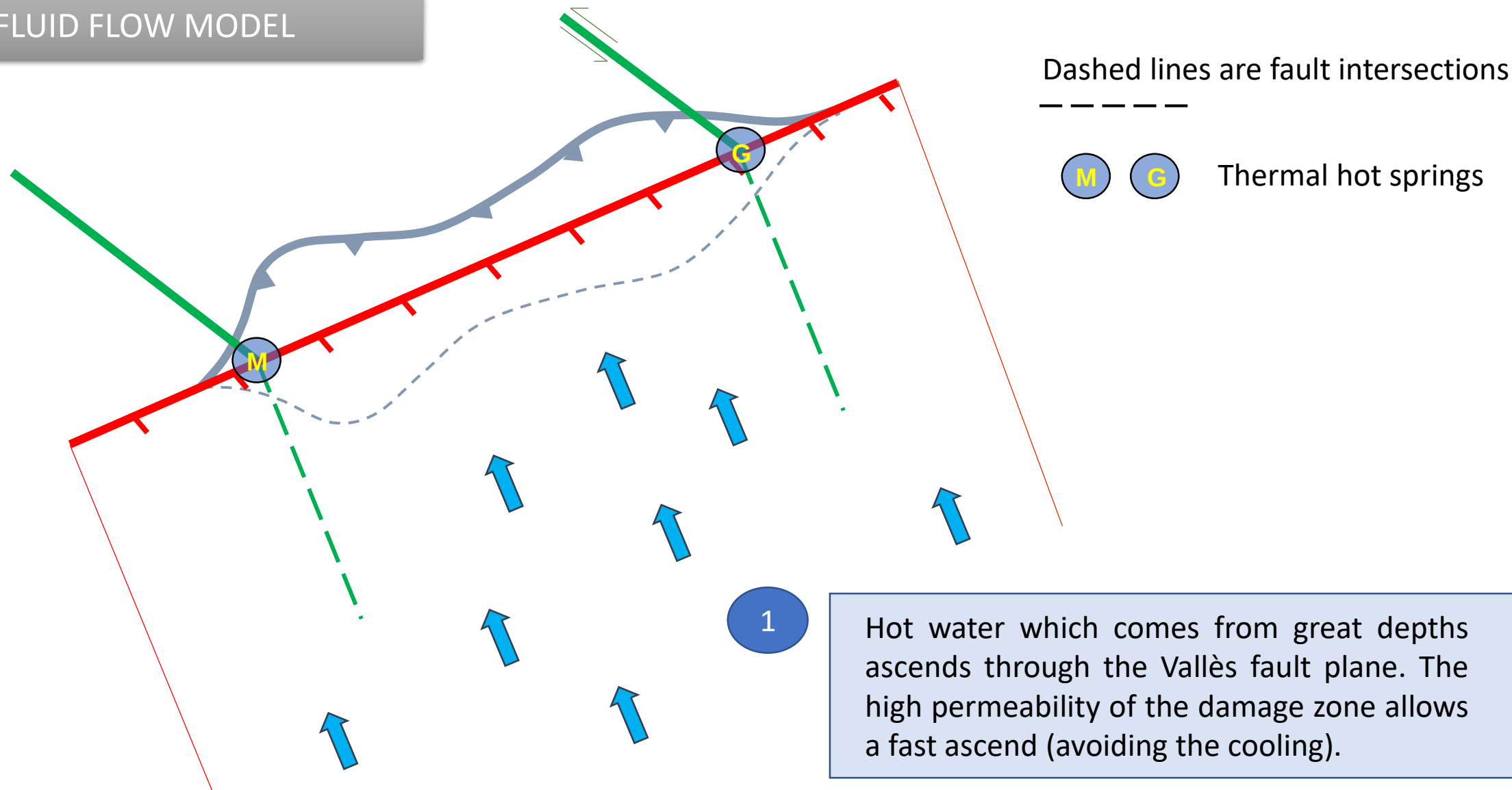
G

Thermal hot springs

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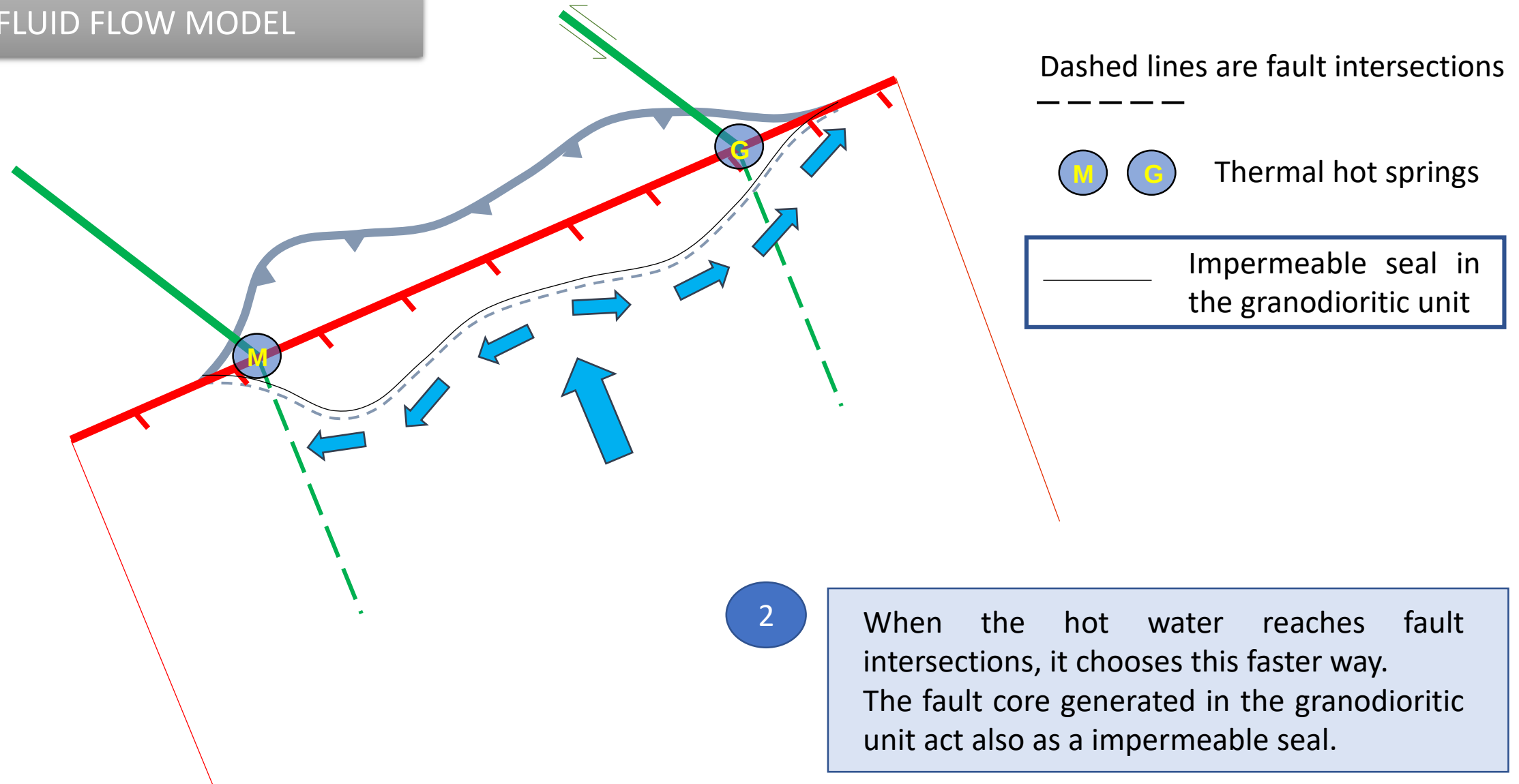
FLUID FLOW MODEL



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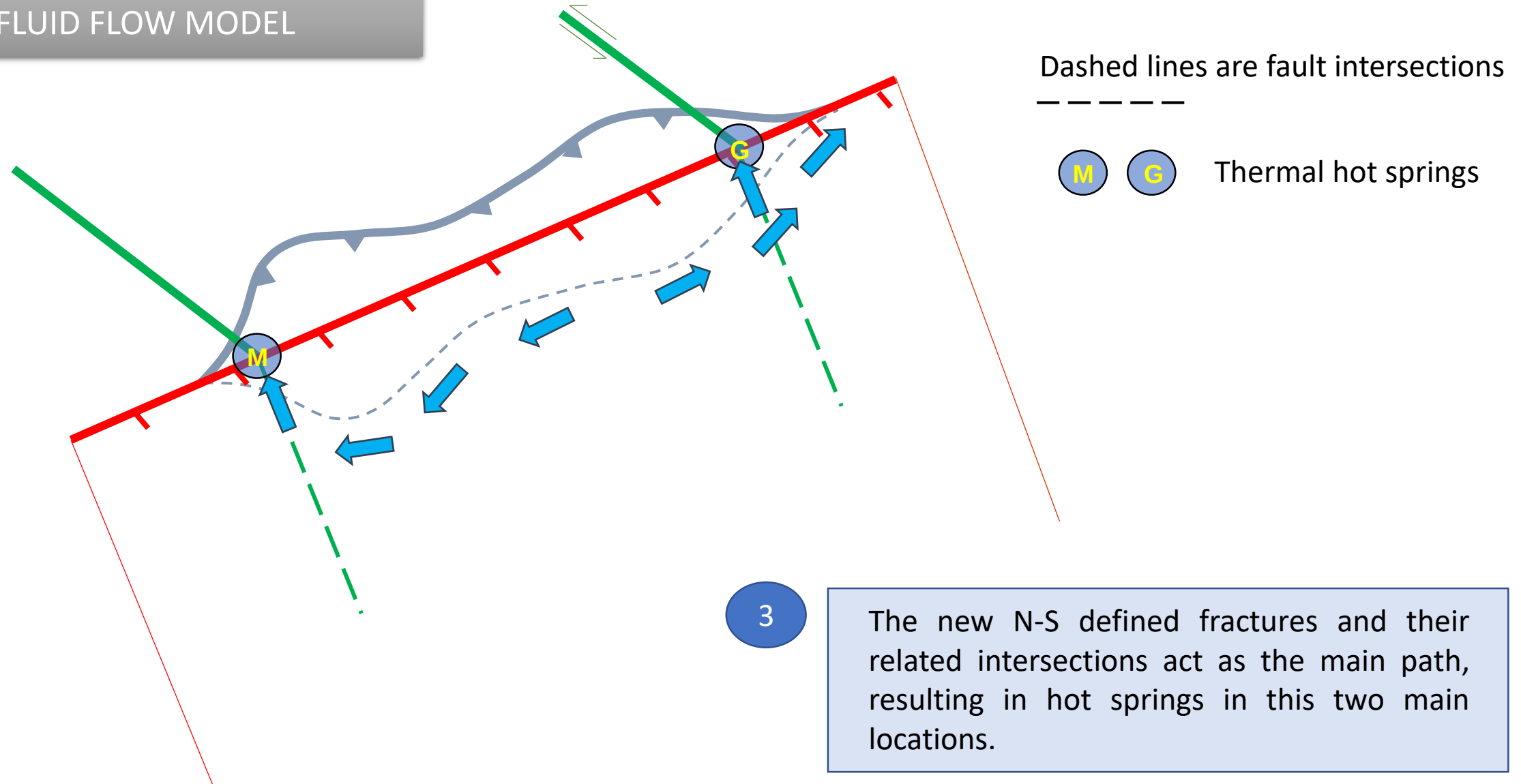
FLUID FLOW MODEL



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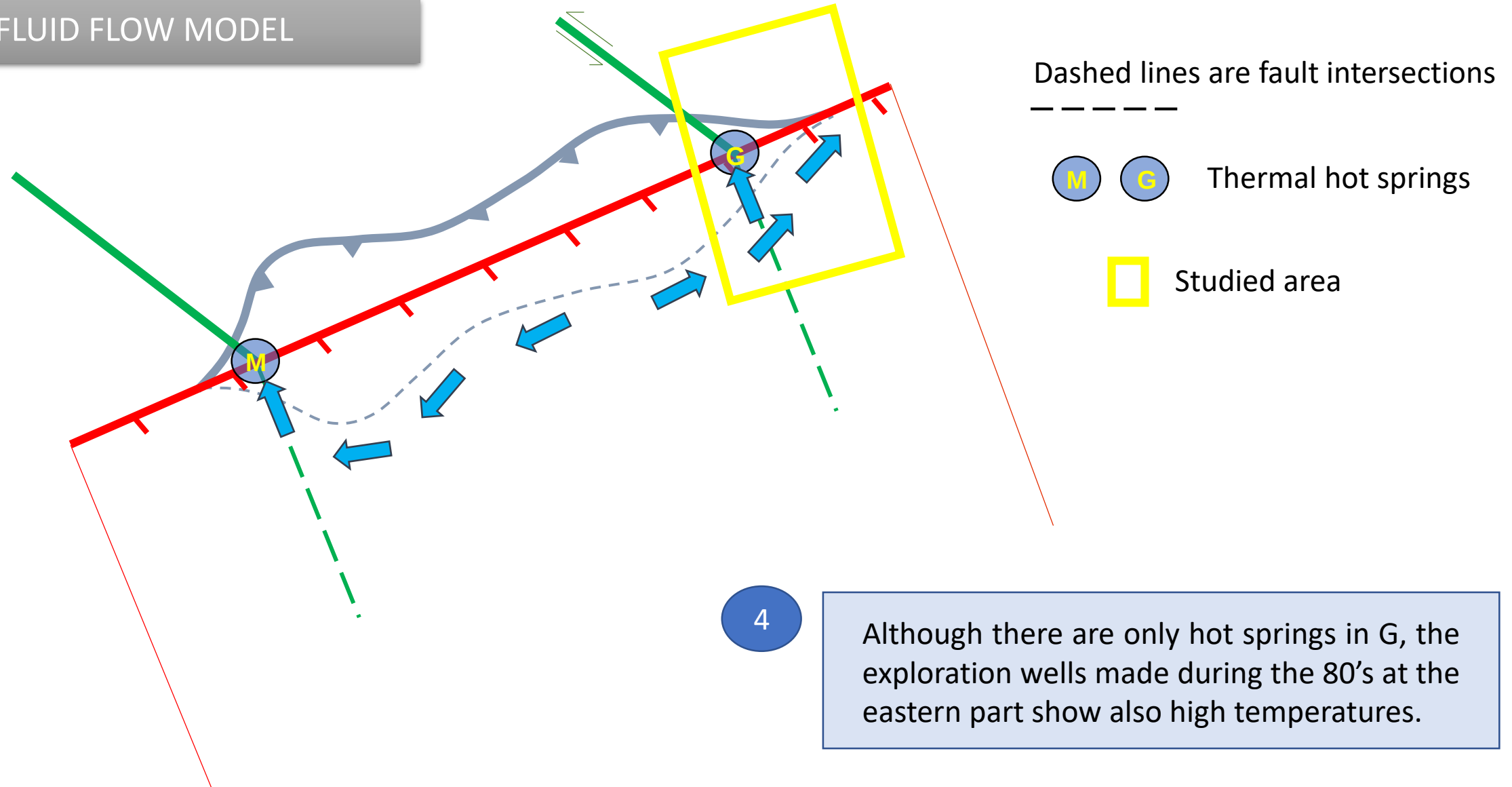
FLUID FLOW MODEL



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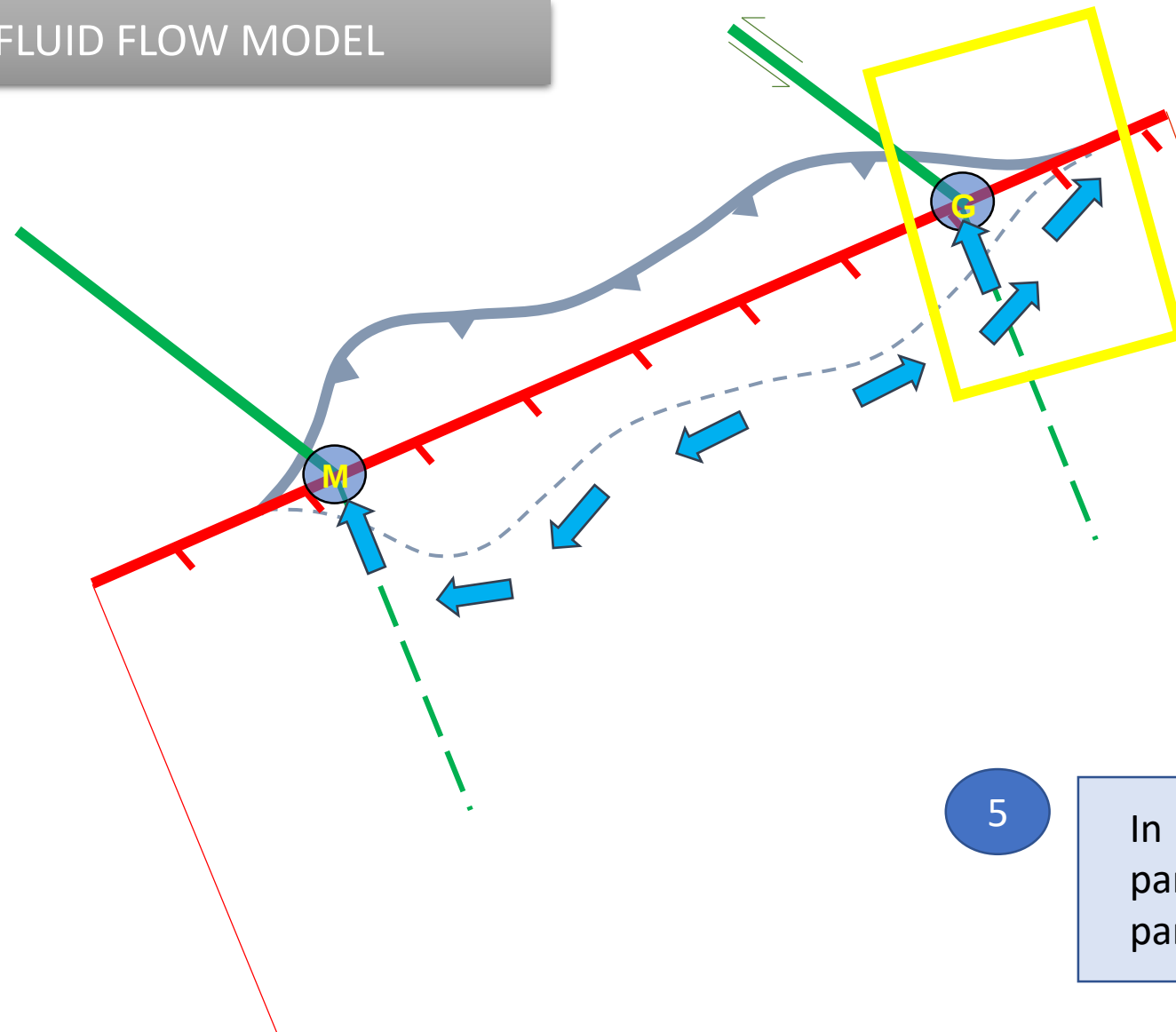
FLUID FLOW MODEL



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FLUID FLOW MODEL



Dashed lines are fault intersections

(M) (G) Thermal hot springs

Studied area

5

In this study we only included the eastern part of that system. Even that, the western part seems to have the same behavior.