Funded PhD position

Spatio-temporal framework of the tectonic evolution of the Vosges Massif and its impact on fossil and active hydrothermal systems

Supervisors Gaétan Milesi et Yves Géraud

Context and Objectives: The Vosges Massif, located at the boundary between the Paris Basin and the Rhine Graben, exhibits a complex network of inherited and reactivated faults. These structures not only control the topography but also act as pathways for fluid circulation, promoting metallic mineralization (Pb, Zn, Ag, etc.) and the development of both fossil and active hydrothermal systems. Understanding the spatio-temporal evolution of these faults is essential to: (i) reconstruct the thermal and morphological history of the massif, (ii) characterize past and present fluid flows, and (iii) assess geothermal potential and possible reservoir formations. These results will also help constrain the geometry of basement structures in the eastern Paris Basin and the Rhine Graben.

This PhD topic addresses both fundamental (geodynamics and tectonics) and applied (geothermal energy, subsurface storage) issues. It is part of the regional framework of the PEPR Rhine Graben program and the REISOL Chair (Reinvesting the subsurface for the energy transition). The project relies on a multidisciplinary, multi-scale approach structured around three main research axes:

Axis I –Tectonic and Low-Temperature Thermochronological Analysis

- (U-Th)/He dating on apatite and zircon (30–200°C) to identify the different crustal blocks composing the Vosges Massif.
- Thermal history modeling to reconstruct temperature-time paths and distinguish the different phases of regional fault activity.

Axis II –Field Structural, Mineralogical, and Petrophysical Study

- Structural characterization and sampling of fault networks in the field.
- Petrographic and mineralogical analyses to determine fault formation and reactivation conditions, and to identify paleo-fluids that circulated through them.
- Investigation of the petrophysical properties of fault zones and their influence on fluid circulation.

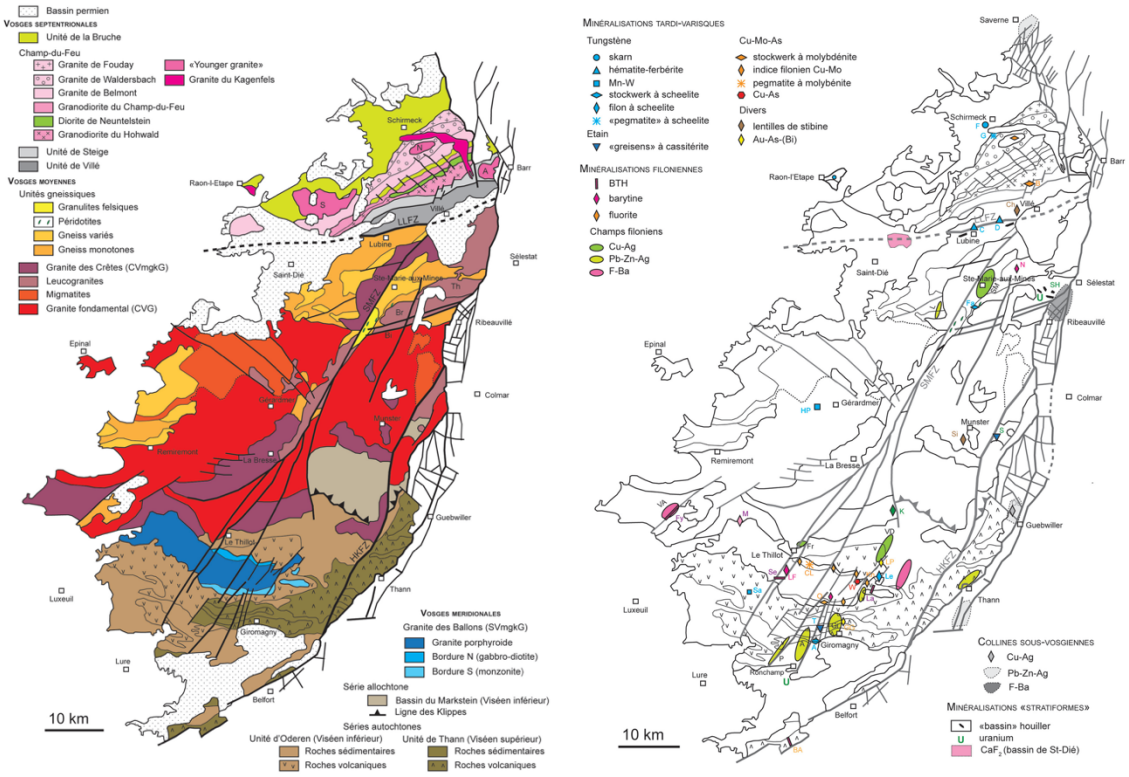
Axis III – Regional Integration

- Correlation of local data with regional geophysical datasets.
- Reconstruction of the evolution of faulted reservoirs and identification of potential reservoirs for geothermal applications or subsurface storage.
- Reconstruction of the geodynamic framework of massif evolution in relation to adjacent sedimentary basins.

The selected candidate will join the “Reservoir Geology for Primary Energy Resources and Storage” (GRéSTOCK) team at the GeoRessources laboratory (UMR 7359), University of Lorraine, in collaboration with local and national experts.

We are seeking a highly motivated candidate with an MSc (or equivalent) in geosciences, geophysics, or engineering, with an interest in fluid circulation dynamics within fractured reservoirs. A background in structural geology, geochronology, petrography, and/or mineralogy would be an advantage.

Application: Interested candidates should submit a cover letter, CV, one reference letter (from a program director or internship supervisor), and Master’s grades to: gaetan.milesi@univ-lorraine.fr and yves.geraud@univ-lorraine.fr before May 31, 2026. An online application must also be submitted via ADUM.



Appendix 1: Geological maps of the Vosges Massif (after Marignac, 2021). Left: Geological map of the Vosges Massif, modified after Elsass et al. (2008), Skrzypek et al. (2014), and Tabaud et al. (2014). The Sub-Vosgian fault network is after von Eller et al. (1972). LLFZ: Lubine–Lalaye Fault Zone, HKFZ: Hunsrück–Kohlschlag Fault Zone, SMFZ: Sainte-Marie-aux-Mines Fault Zone. Granitic bodies: A: Andlau Granite, Bi: Bilstein Granite, Br: Brézouard Granite, N: Natzwiller Granite, S: Senones Granite, Th: Thannenkirch Granite. Right: Distribution of the main metallic ore deposits within the Vosges Massif.

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Marignac C., 2021. Les gisements métalliques des Vosges et leurs relations avec l’histoire régionale : un aperçu bibliographique. Géologue N°210, 35-45.

Skrzypek E., Schulmann K., Tabaud A.-S. et Edel J.-B., 2014. Palaeozoic evolution of the Variscan Vosges Mountains. Geological Society, London, Special Publications, 405, 45-75.

Tabaud A.-S., Janousek V., Skrzypek E., ... et Paquette J.-L., 2014. Chronology, petrogenesis and heat sources for successive Carboniferous magmatic events in the Southern-Central Variscan Vosges Mts (NE France). Geological Society, London, Special Publication 405, 197-223.

von Eller J.-P., Fluck P., Hameurt J.et Ruhland M.,1972. Présentation d’une carte structurale du socle vosgien. Sciences Géologiques, Bulletin,25,3-20.