Institut des Sciences de la Terre d'Orléans
ISTO
UMR 7327

UNIVERSITE D'ORLEANS

Géosciences pour une Terre durable
brgm

Ph.D. Thesis – Doctoral School Energie Matériaux Sciences de la Terre et de l'Univers

GEOLOGICAL KNOWLEDGE FRAMEWORK AND STRUCTURAL INTERPRETATION PROCESS FOR BUILDING 3D ARCHITECTURES OF SUB-SURFACE

Context and objectives

Three-dimensional representations of sub-surface architectures are key for exploring georessources and quantitatively addressing geoscientific questions (e.g., about tectonics, magmatism). The description of such architectures encompasses a **geometrical description of structural objects** in a modelled area (e.g., stratigraphic layers, faults, folds) and their **spatial and time relationships.**

This doctoral project will explore an **alternative paradigm for modelling** 3D geological architectures of subsurface with an improved formalism of concepts and uncertainties (Fig. 1). This project aims at (1) improving **the numerical formalisation of knowledge and hypotheses** embedded in the subsurface representation and (2) improving the characterization of **structural uncertainties**.

This project will mainly address **epistemic uncertainties**, which partly result from the ambiguity and sparsity of available data. Ambiguity is generally compensated by manually introducing expert **interpretive information** (e.g., as interpretive cross-sections).

The student in charge of this project will develop an innovative approach that implements the **cognitive interpretation process** applied by geologists. Its formalisation will rely on:

- examples gathered in a **corpus of natural and simulated objects**,
- a formal description of geological concepts gathered in an **ontology of structures**, and
- on an **automated interpretation method** based on **spatiotemporal descriptors**.

This new paradigm approaches geomodelling as an **automated interpretation process** based on **artificial intelligence** instead of a **direct data interpolation**. The proposed method will improve the integration of heterogeneous data, scale management, and exploration of epistemic uncertainties, while clarifying the structural concepts embedded in explored architectures.

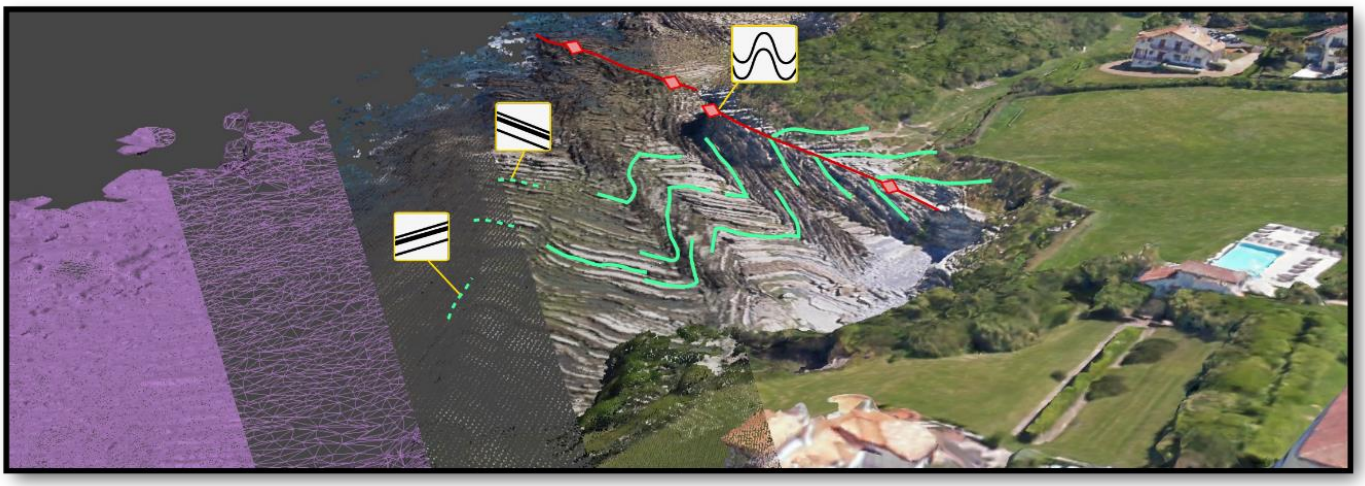


Figure 1: Illustration of the proposed automated interpretation process in terms of structural concepts, here with the example of a numerical representation of a natural outcrop..

Profile and skills required

We are seeking a student within a **Master degree** formation with components of either or both **structural geosciences** and **numerical sciences**. Candidates should be either:

- in a **math or computer science** formation, with skills in data sciences and a taste for geosciences or natural objects; or
- in a **geosciences or geophysics** formation with a taste for numerical approaches.

To be successful in this application and project you'll need:

- **programming skills**: strong skills are not compulsory but at least first experiences in using and developing codes would be required, particularly in geometry, data sciences, or geosciences; favored language: python, c++
- a taste for discovering, understanding, and improving new tools, numerical or not
- a sound understanding of **structural geology concepts** and/or a deep motivation for learning this new topic
- a great capacity for **abstraction and analysis**, which will be essential for understanding, formalising, and explicitly defining geological objects and interpretation methods.
- as always, **enthusiasm**, **team skills**, and **good reading/writing skills** are absolutely necessary.

Conditions and organisation

Period: Oct. 2021 – Sept.2024 **Duration:** 3 years
Funding: co-funding between BRGM and Orléans University (Ministerial grant)
Localisation: Orléans, Centre-Val-de-Loire, France
Laboratory: Institut des Sciences de la Terre d'Orléans (ISTO – UMR 7327)
Supervision teams:

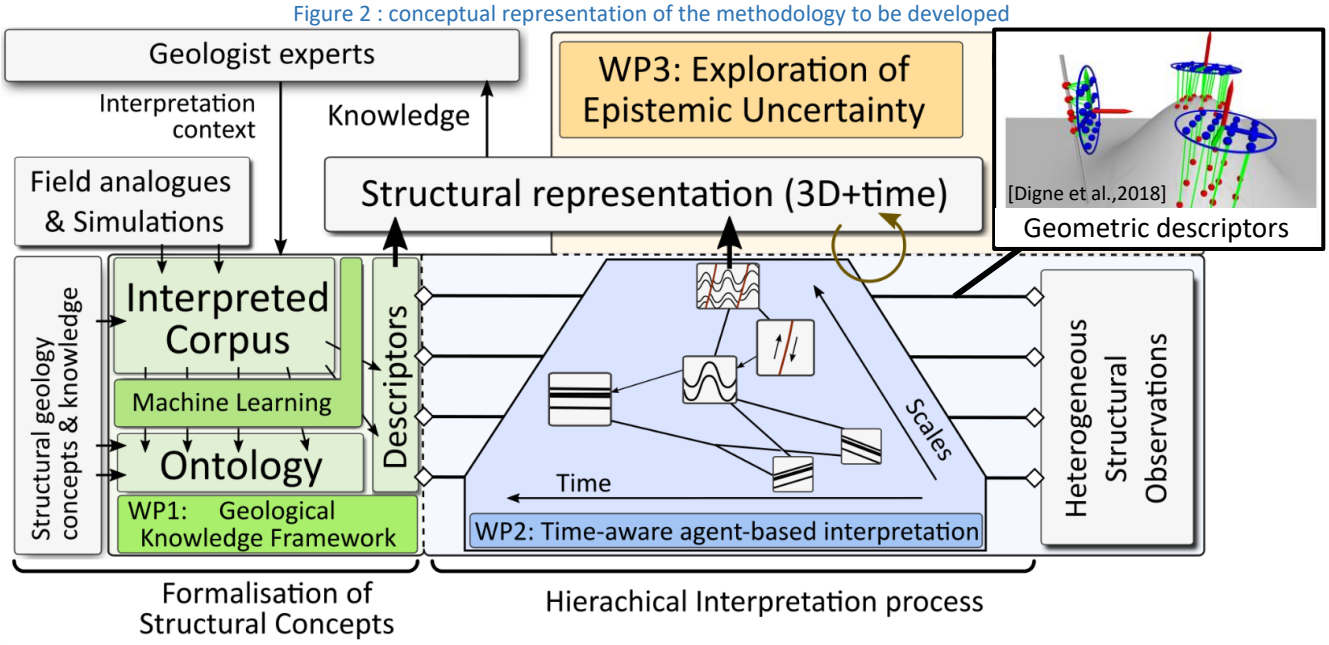
- Dr. Gautier Laurent : Associate Professor – ISTO [gautier.laurent@univ-orleans.fr]
- Dr. Christelle Loiselet : Agent BRGM [c.loiselet@brgm.fr]
- Dr. Yannick Branquet : Associate Professor – ISTO [yannick.branquet@univ-orleans.fr]

Collaborations: directly with BRGM, located just next to ISTO
International collaborations: integration within the Loop project (https://loop3d.org)

Application: send your curriculum and application letter by email
Application deadline: 19/04/2021

➢ Click to apply

Figure 2 : conceptual representation of the methodology to be developed



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