Postdoctoral position on the high performance simulation of geothermal systems
ANR CHARMS: quantitative Reservoir ModelS for Complex Hydrothermal Systems

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Geothermal energy is a carbon-free steady energy source with low environmental impact. In countries with a favorable geological context, high temperature geothermal energy can make a significant contribution to power production. On the French territory, it is already an attractive option in volcanic islands context compared to importing fossil fuel. Today, about 5 percents of yearly electricity consumption of Guadeloupe already comes from geothermal energy and it is essential for achieving energetic and environmental targets, according to which the overseas territories should produce 50 percents of their electricity consumption from renewable resources by 2020 and achieve their energy autonomy in 2030. As for other parts of the world, the geothermal development potential of the Caribbean islands is high and several industrial projects are in preparation or already underway, in French overseas territories (Guadeloupe, Martinique) as well as in nearby islands (Dominica, Montserrat).

Numerical modeling has become essential in all phases of geothermal operations. It is used in the exploration phases to assess the geothermal potential, validate conceptual hypothesis and help well siting. Field development and resource management need quantitative estimation to prevent resource exhaustion and achieve its sustainable exploitation (production/injection scenarios). Finally numerical modeling is also helpful in studying exploitation related industrial risks such as the interaction with shallow water levels (drinking water resources, hydrothermal vents or eruption).

The code ComPASS `http://www.anr-charms.org/page/compass-code` is an open source

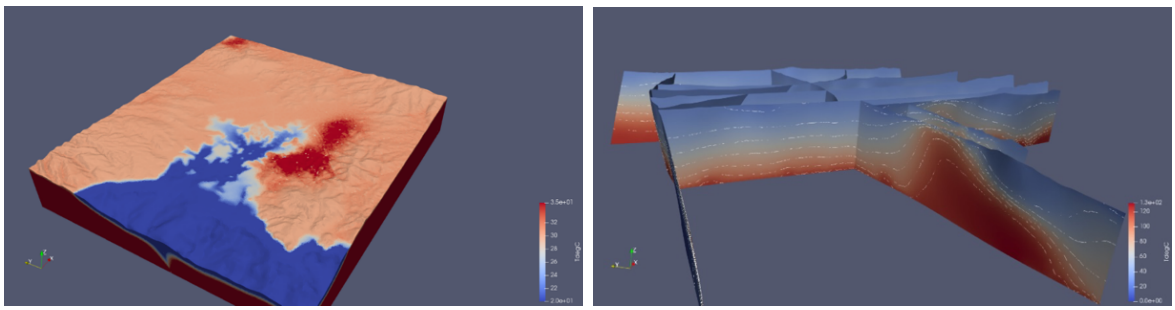

Figure 1: Simulation of the Baie du Lamentin hydrothermal system using ComPASS.

parallel code initiated in 2012 and co-developed by LJAD-Inria and BRGM (Bureau de Recherches Géologiques et Minières - French Geological Survey) since 2015. It is devoted to the simulation of multiphase non-isothermal Darcy flows and includes complex network of fractures/faults represented as interfaces of co-dimension one coupled to the surrounding matrix. The discretization is based on vertex and cell unknowns and is adapted to polyhedral meshes and heterogeneous media. The ComPASS code is co-developed since 2017 by the partners of the ANR CHARMS project including BGRM, LJAD-Inria, Storengy, la Maison de la Simulation and the Jacques Louis Lions laboratory. The main objective of the CHARMS project is to develop a new generation simulator for geothermal systems focusing on fluids and accounting for complex fault networks and wells.

We offer a two years research position to join the ANR CHARMS project and the ComPASS code development team. Different research topics in connection with the CHARMS project are proposed during this two years possibly depending on the candidate profile. They can involve typically the following topics.

- The simulation of the interaction of the subsurface with the atmosphere as an advanced boundary condition accounting for convective mass and energy transfer, liquid evaporation, rainfall and liquid outflow.
- The simulation of advanced well models represented as a set of edges of the mesh defining an oriented tree. The well model will take into account energy, mass and momemtum conservation equations in the well coupled with the reservoir porous media flow and transport model.
- Positivity preserving scheme for the transient energy conservation equation.
- Application to the Bouillante geothermal field in Guadeloupe in collaboration with BRGM and other geothermal fields yet to be defined in collaboration with Storengy.

Profile: applicants should have a PhD in scientific computing/applied mathematics and be familiar with scientific programming, numerical methods for PDEs and software engineering tools.

Location: the postdoctoral position will be held in the J.A. Dieudonné department of Mathematics (LJAD) at the University Nice Sophia Antipolis (UNS) in collaboration with Roland Masson, Konstantin Brenner from Inria/LJAD and Simon Lopez from BRGM. The postdoc will be member of both LJAD and of the INRIA team Coffee (Complex Flows For Environment and Energy, `http://www.inria.fr/equipes/coffee`).

Starting date: the position is for two years and should start between may 2018 and december 2018.

How to apply: send applications with CV, letter of motivation, and references, to roland.masson@unice.fr.

Key words: high performance computing, finite volume schemes, non-isothermal liquid gas Darcy flows, geothermal systems.

References

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