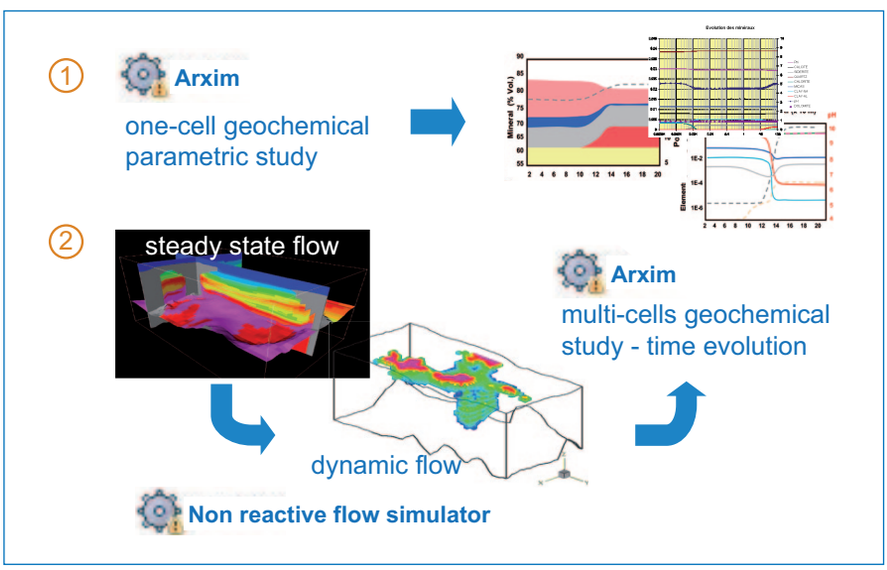
BriDGES

A Joint Industry Project

An integrated modeling platform for the management of geological CO_2 storage in aquifers

Objectives

Performing effective CO_2 storage modeling studies requires the capacity to manage data from a variety of different sources (laboratory, software, in situ measurements), multi-scale and multi-physics modeling and high-performance post-treatment.
The objective of the Joint Industry Project BriDGES* is to deliver an integrated CO_2 platform dedicated to the study of CO_2 storage in aquifers with a strong focus on multiphase flows that have a significant impact on solute transport and chemical reactivity.
This development draws on IFP Energies nouvelles' extensive expertise in the field of geosciences and the numerical simulation of complex processes, including thermo-hydro-mechanical-geochemical coupling.



BriDGES Workflows.

Technical program

The goal of the project is to construct a first version of the BriDGES CO_2 platform. This will require the development of a user-friendly interface on OpenFlow[1], a multiphase flow simulator based on Arcane[2] components and the plugging of an existing Open source software named Arxim[3].

Each task will enable the development of a ready-to-use version based on a dedicated workflow for CO_2 storage studies in aquifers:

- hydro-geological baseline: computation of a hydro-thermal steady state flow on a basin scale before CO_2 injection. This first task aims to reproduce the hydrodynamics, i.e. the basin pressure and temperature distribution constrained by outcrop water flow, the density effects due to salinity gradients and the thermal contribution of the external formations to the system.
The novelty of this type of modeling lies in the integration

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of advanced boundary conditions. The interface will provide a synthetic computation report and 2D/3D visualization of the main cell variables, such as pressure, temperature and salinity;

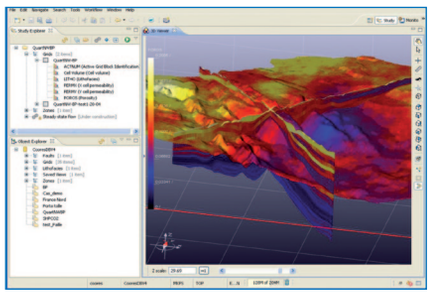
- CO_2 injection and migration: physical and numerical extensions of the simulator to compute CO_2 injection and migration in the aquifer, on a basin scale, as well as interactions with upper aquifers. A salinity model based on 2 or 3 ions will be incorporated to more effectively take into account water mixing. The selection of PVT and KrPc laws will be discussed with the sponsors. The OpenFlow interface will be extended to manage the new dynamic data;
- a quick-look approach to geochemical analysis: pre- and post-geochemical processing will be integrated. The geochemical module Arxim will be plugged into OpenFlow and the following 2 workflows will be developed:
  - a geochemical parametric study aimed at evaluating the influence of pressure, temperature and/or mineral composition on the fluid-rock system;
  - a study of the evolution of fluid-rock systems using a multi-0D geochemical approach. At the end of non-reactive flow simulation, Arxim will be executed on each grid cell of the mesh.

This quick-look method will provide an initial evaluation of rock reactivity as a function of the evolution in water composition during injection.
The results will be directly generated in a report.

Project organization and deliverables

The program will be completed over a 3-year period. The main deliverable of the BriDGES project will be a comprehensive and efficient prototype software with a user-friendly graphic interface. Intermediate deliverables will be provided at the end of each year during an annual meeting. They will include, for each task:

- a presentation of the research methodology and ongoing progress results;
- a presentation of the validation studies performed on synthetic and/or real field cases provided by the BriDGES sponsors;
- an executable copy of the prototype software (initial then updated versions);
- a user manual and tutorial for the software prototype.



User-friendly interface.

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* **Bri**ne **D**isplacement and **G**as injection **E**ffect**S**

1. OpenFlow™ is the new generation geosciences platform developed by IFPEN which includes database and workflow management.
2. Arcane is a parallel 2D/3D simulator development platform developed by CEA-DAM since 2000 and co-developed by IFPEN and CEA since 2006.
3. Arxim is a geochemical software co-developed by EMSE and IFPEN since 2006. The aim of the Arxim project is to develop modules for multiphase equilibrium/reaction calculations (fluid, mineral, gas, etc.).

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