# Modelling the plumbing system of sedimentary basins: towards quantification of transfers at large scale

Claude Gout*[1], Marie-Christine Cacas-Stentz[2], Adriana Lemgruber Traby[2], and Nathalie Collard[2]

[1]Universite de Pau et des Pays de L'Adour, E2S UPPA, TotalEnergies, CNRS, LFCR, Pau, France – Université de Pau et des Pays de l'Adour. E2S UPPA, TotalEnergies S.E. – France

[2]IFP Energies nouvelles – IFP Energies Nouvelles, IFP Energies Nouvelles – France

**Résumé**

The dynamics of sedimentary basins is a complex combination of synchronous generally non-linear processes. In these natural systems, fluids migration and associated transfers play a fundamental role, even more so as they represent resources that are or may become essential for human societies. One way of assessing the potential of sedimentary basins is to model their behaviour numerically.

Basin models have been developed since the 1990s for the needs of the oil industry, with the initial aim of assessing the thermal history, i.e. the maturation and expulsion of hydrocarbons from source rocks with variable kinetics and initial composition. These models are used for hydrocarbon prospect assessment in a wide range of sedimentary basins. They have evolved with the integration of the simulation of compaction mechanisms and fluid migration by Darcean single-phase or multi-phase flows. Still with an operational objective in mind, one of these models has been extended to simulate the transport of thermal energy and chemical elements in fluids, thereby helping to assess the geothermal and large scale storage potential of a basin.

The explicit representation of faults and unconformities, as well as the calculation of seal or reservoir formation fracturing as a function of fluid pressures, enables the plumbing system to be represented on a basin scale. In this network of drains, single- or multiphase fluids carrying compounds can interact with the rocks, according to the principles of reactive transport. Some of these simulations are being experimented using AI techniques. In these digital experiments, elements tracking could be a true added value for basin's dynamics understanding.

In all cases, such a coupled model, combining conductive and advective thermal physics, mechanics (particularly of porous media), hydraulics of multiphase fluids in porous media, chemistry of reactive transport and even biology impact on basin's fluids, representing geological processes in the subsurface on a large scale, makes it possible to quantify mass and energy transfers. These results can be useful both in economic applications for first-order assessment of the resources of a sedimentary basin and in the scientific field for defining the boundary conditions of more specialised models.

*Intervenant

**Mots-Clés:** sedimentary basin, basin model, THMC, coupling, fluids, mass transfer