Early Stage Researcher position available within a Marie Curie Initial Training Network Flow in Transforming Porous Media (FLOWTRANS)

A Marie Curie Fellowship (Early Stage Researcher), concurrent with registration for a doctoral degree (Ph.D.), will be available at the Institut de Physique du Globe de Strasbourg (IPGS, http://eost.unistra.fr/recherche/ipgs/), laboratory of the CNRS / University of Strasbourg, France, as part of the above Marie Curie Integrated Training Network (ITN), in cooperation with the Universities of Universities of Glasgow, Oslo, Münster, Warsaw, Copenhagen, Grenoble and the Hebrew University of Jerusalem, together with Industrial Partners Magnitude and Offshore Resource Group-Geophysical (ORGG), as well as associate partners CSIRO, AMPHOS 21, IEI and IRIS.

The research themes of FLOWTRANS relate to the characterization and the understanding of rock deformation processes, fluid flow and chemical reaction within rocks and granular media. This has become an ever-increasing problem in Earth Sciences, Physics, and in many industrial applications, including natural hazards (earthquakes, landslides, volcanoes), CO2 geological sequestration, hydrocarbon migration, ore deposit development, and radioactive waste disposal. One of the main problems is the ***understanding of flows in transforming porous media***, where the rocks and fluid pathways evolve spatially and temporally, for example due to chemical interactions with the flow, or due to compaction of the solid matrix. The dynamic feedbacks between flow, destruction of permeability due to compaction or local precipitation, creep of the rock, and creation of permeability due to dissolution, chemical reaction or fracturing, makes understanding of such complex systems a challenge.
The specific research topic based in Strasbourg is somewhat flexible but will focus on:

Flow in chemically evolving fractures and porous media and related impact on mineralization and surrounding stresses.

Understanding how a rock evolves during flow, and how this evolution affects the flow path and the distribution of forces in the surrounding rock formations, is a challenging problem with numerous applications in the industry, to understand reservoir evolution, or in geotechnique, waste storage and water management fields. This project will study the evolution of porosity during a slowly reactive flow in porous and fractured carbonates. The evolution of stress for confined rocks associated to the reactions will be studied. The flow and diffusion advection of the reactants will be modeled using Lattice Boltzmann simulations, coupled with molecular dynamics elastic models implying a reactive component (mass exchange between the fluid and solid). This will be done for monophasic and biphasic flow (air/water). The reaction will be a common carbonate precipitation/dissolution. The electric charge transport associated to the rock/water and water/air interface will be modeled using electrokinetic theory adapted for this flow.
Experiments will also be performed to test and calibrate the models. Notably, X ray studies, imaging of the evolving structures, and measurement of the stress evolution related to these reactions, will be performed.
This research will contribute to: 1/ understand pattern formation and porosity evolution in carbonates, 2/ understand the interplay between solid elastic rock mechanics, fluid mechanics and slow reactions – which will provide the basis to understand the evolution of stress fields in rock formations associated to such reactions 3/ set up a direct modeling framework of electric potentials measured in rocks at variable saturations.

This project will imply collaborations with the other members of the network, and regular research stays involved in these secondments. These fields are important in applied research, notably for issues involving slow permeability evolution in carbonate rocks. The impact for the industry is to understand the origin of the current porosity structures in reservoirs. Monitoring fluid flow using self potential is also an operationally used method in the industry, understanding the origin of the signal in multiphasic flow is a key issue that this project intends to address.
The Marie Curie Fellow will have some basis on physically based models, and fluid mechanics. The ability to process experimental data, perform geophysical inversions and a taste for natural geological patterns and materials will be appreciated. He/she has to have some interest to be part of a collaborative group, and the ability to be a team player.

The normal eligibility requirements of Marie Curie Fellowships apply. Researchers may be any nationality but must not have resided in the country of their host organization for more than 12 months in the 3 years immediately prior to date of selection by the host institution. The applicant must also satisfy the requirements to register as a doctoral student at the University of Strasbourg, which generally involves holding an appropriate Diploma or Master degree. Marie Curie Fellowships have substantial benefits, both in salary (~30 000 EUR per year - gross) and in mobility and allowances (mobility allowance of ~700EUR per month). The duration of the Fellowship is 36 months.
Applications are welcome from students with any relevant physics, mechanics, earth science, engineering or materials science background. The applicant should have a good command of both written and spoken English. The Marie Curie Fellowship is planned to begin in June 2013, but a later start is also possible.

Prospective applicants should contact:
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