

## Two PhD positions at the University of Warsaw

### Reactive Flow in Porous Media

We seek two PhD students interested in research on pattern formation in dissolving porous rocks. The interdisciplinary project involves laboratory experiments and theoretical modeling of rock dissolution processes. One of the candidates should have hands-on experimental background in physics, fluid dynamics, chemical engineering or geosciences and the other a strong background in numerical modeling.

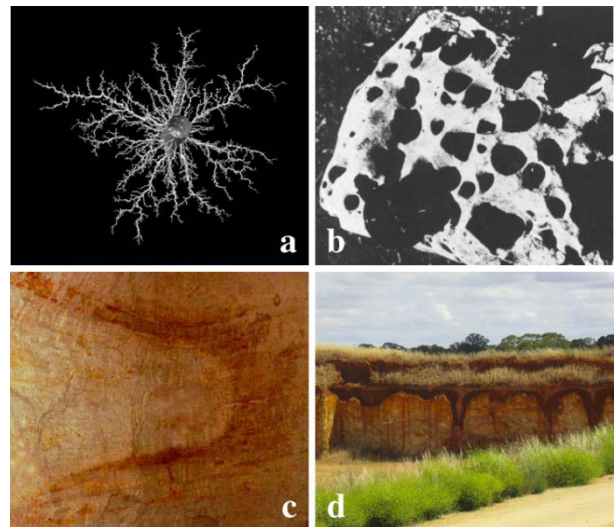
The commencement date is flexible, but not later than October 1, 2017. The monthly PhD scholarship is 3000 PLN (~700 euro, tax-free), which is competitive for the cost of living in Warsaw, plus benefits: health insurance for Poland and EU and access to funds for international travel to experimental facilities, meetings and conferences.

#### Description of the project

Strong coupling between the flow and dissolution in reactive porous media may lead to spontaneous formation of pronounced dissolution channels ("wormholes"). The shape of these channels and rate of their advancement are controlled by the flow rate, reaction rate and the porosity difference between primary and secondary mineral. However, there is no deeper understanding of the exact nature of this dependence. We will approach this problem by a combination of controlled dissolution experiments on natural rock samples and numerical modeling.

Laboratory acidization experiments will be performed on rock samples collected from karst outcrops where natural dissolution channels are present. The evolution of the micro-architecture of the pore space will be monitored before, during and after dissolution using neutron and X-ray imaging techniques. The basic modeling tool will be a multi-scale numerical model, combining three different techniques: (1) a microscopic (pore-scale) model of flow and transport in 3D pore geometries extracted from tomographic images, (2) a coarse-grained Darcy-scale model of a dissolving rock core, calibrated using the results of the pore-scale model (3) a pore-network model providing distribution of pore sizes computed from neutron and X-ray measurements. The project will be carried out under a joint supervision of Piotr Szymczak (theoretician) and Andrzej Radlinski (experimentalist).

Inquiries and applications should be sent by email to [Piotr.Szymczak@fuw.edu.pl](mailto:Piotr.Szymczak@fuw.edu.pl). Applications should include a detailed CV, cover letter with a short statement of research interests and names and addresses of two referees. Complete applications should be received before May 28, 2017, for full consideration. Late applications may also be accepted until a suitable candidate is found.



*Examples of patterns produced by the dissolution-processes in rocks: (a) wormholes (30 cm long) produced during carbonate acidization (b) holes formed by limestone dissolution (5–10 cm across) (c) a uranium roll (~1 m), and (d) terra rossa fingers (~10 m).*