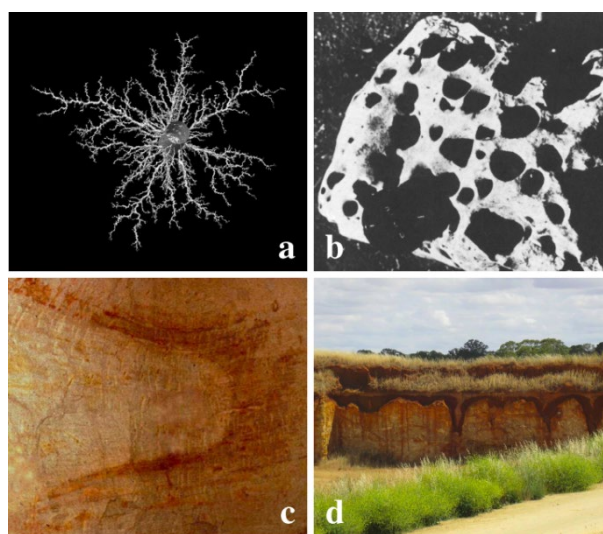


Postdoctoral Researcher position at the University of Warsaw

Reactive Flow in Porous Media

We are looking for a highly creative and motivated postdoctoral fellow to work in the project involving numerical simulations of interplay between flow, transport and chemical reactions in porous media in the context of carbon mineralization. Carbon mineralization plays a crucial role in addressing climate change by converting CO₂ into stable minerals, enabling sustainable carbon capture. The process involves two stages: firstly, water saturated with CO₂ dissolves silicate minerals, and then CO₂ reacts with the released cations to form secondary carbonate mineral deposits. However, a common challenge arises when the main flow paths become obstructed by precipitate, leading to the spontaneous halt of the reaction. In this project, our aim is to explore strategies for overcoming these limitations. We hypothesize that by harnessing the inherent couplings between flow and reaction within such a system, we can effectively direct the reaction to ensure the continuous formation of new flow paths. By doing so, we anticipate achieving a uniform distribution of the secondary carbonate minerals throughout the medium. Through an investigation of the interplay between flow dynamics and the dissolution-precipitation reaction, we seek to uncover the mechanisms governing the formation, shape, and lifetime of structures that spontaneously emerge. Understanding these underlying principles will provide insights into optimizing the efficiency of the carbon mineralization process.



Examples of patterns produced by the dissolution-precipitation 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).

The basic tool used in the project will be a dynamic-topology pore-network model of chemically transforming porous medium. The medium will be modeled as a system of interconnected pipes with the diameter of each segment changing as the result of the chemical reactions. Moreover, the topology of the network will be allowed to change dynamically during the simulation: as the diameters of the eroding pores become comparable with the interpore distances, the pores will be joined together thus changing the interconnections within the network. With this model, we will investigate different growth regimes in an evolving porous medium, allowing for both erosion and precipitation of the minerals. We will incorporate nucleation events, and consider different models of reactive area evolution, including passivation processes on mineral surfaces. We seek candidates with expertise in one or more of the following areas: numerical modeling of reactive transport in porous and fractured media, fluid dynamics, physical processes in geology, geochemical self-organization or applied mathematics. A strong background in continuum mechanics and programming, and fluent English are also necessary.

The position start date is flexible. The salary is 9000 PLN gross (~2100 EUR) per month, which is competitive for the cost of living in Warsaw. The contract includes health coverage for Poland and EU. The post holder will have access to travel funds for international meetings/conferences. Inquiries and applications should be sent by email to Piotr Szymczak (Piotr.Szymczak@fuw.edu.pl). Applications should include a detailed CV, a cover letter with a short statement of research interests and motivation and two names of potential referees. Complete applications should be received before Feb 22, 2025 for full consideration. Later applications will also be accepted until the suitable candidate is identified.