Description of Funded Research Projects
1st Call for H.F.R.I. Research Projects
to support Post-Doctoral Researchers

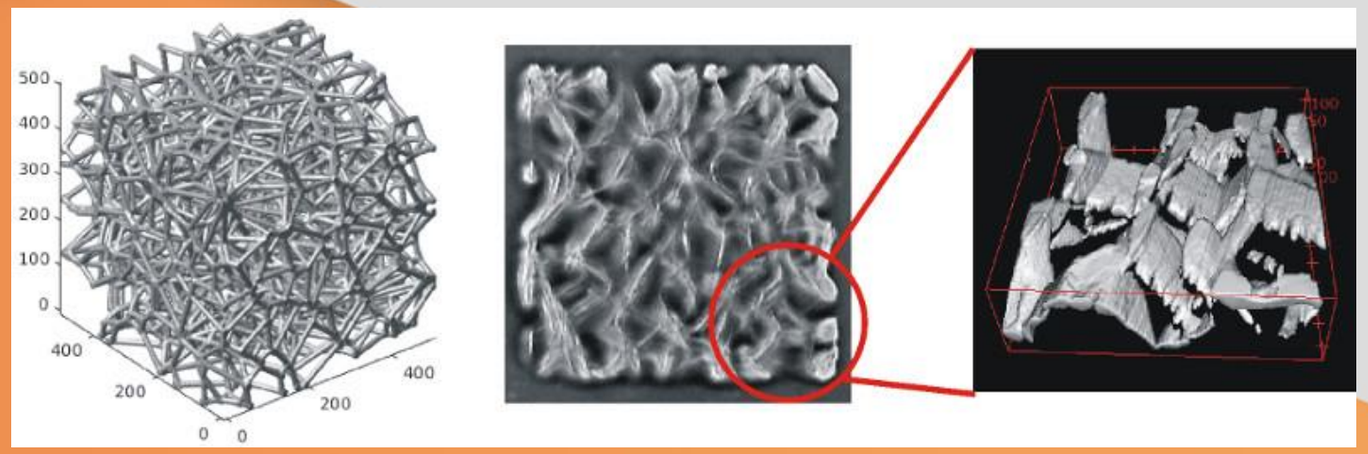
H.F.R.I.
Hellenic Foundation for
Research & Innovation

Research Project Title:

Micro-Macro scale couplings in reactive transport processes in porous materials; realistic 3D experiments towards rigorous upscaled models

Principal Investigator:

Andreas Yiotis



Popular Title:

Numerical and experimental study of multiphase flows and mass transfer in geologic porous media, based upon the combination of rigorous visualization of flow dynamics within realistic 3D structures

Scientific Field:

Products and Processes Engineering

Host Institution:

National Center for Scientific Research Demokritos (NCSRD)

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The study of transport phenomena in soils and porous materials is an active field of research in applications of significant scientific and technological interest. Such processes include flow, mass and heat transfer in traditional applications related to the exploitation of the earth's natural energy resources (e.g. Enhanced Oil Recovery and Geothermal Energy Production), but also in a series of recently identified major engineering challenges of the 21st century, such as technologies related to sustainable development and climate-change mitigation strategies (e.g. geologic carbon sequestration and the management of groundwater aquifers). These processes occur within the highly heterogeneous internal structure of soils leading to a complicated highly non-linear interplay between transport phenomena with local reaction rates at the microscale, with a profound effect on the apparent field scale dynamics. The successful design and implementation of integrated engineering solutions in subsurface applications processes in a sustainable and cost-efficient manner, requires the development of rigorous physical and numerical models for the calculation of the apparent field scale dynamics based on the physics emanating at the microscale of porous media structures. These models combined with laboratory and field-scale experiments, provide invaluable insight on microscale effects and local flow conditions on the dominant transport mechanisms that determine fluxes and apparent reaction kinetics.

The main objective of the proposed research project is to improve our physical understanding of reactive transport processes in porous media, focusing primarily on micro-macro scale couplings that arise under different flow/structural conditions. This objective will be achieved using an integrated/ multidisciplinary approach that combines state-of-the-art 3D additive manufacturing tools, microscopy visualization/imaging techniques and rigorous pore-scale numerical models. The ambition of this project is to develop for the first time 3D replicas of porous subsurface structures in order study experimentally, and then model numerically pore scale physics governing flow, mass transfer and reactive transport under typical conditions.

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The current project is expected to have a profound impact in a wide range of applications, primarily in energy-related processes, such as reservoir flows (enhanced oil recovery from fractured reservoirs) and geothermal flows (geothermal heating), but also in a series of recently identified major engineering challenges, such as technologies related to sustainable development and climate-change mitigation strategies (CO_2 sequestration application, soil remediation). The latter environmental applications have a significant critical social and environmental impact, as they are directly related to the decrease of CO_2 levels in the atmosphere and the Paris Climate Agreement long-term goal of keeping global average temperature below 2°C compared to pre-industrial levels.

To me, H.F.R.I. funding would mean...

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The funding of the research proposal 3DmicroPores, for me represents a significant acknowledgement of my research career in the particular field. It is my hope that this project will provide added-value to my research and enhance my professional maturity in the academic/research sector of Greece, but will also be very beneficial to all members in my research group who have devoted their efforts to science despite the difficult conditions in our country.

The Principal Investigator,
Andreas Yiotis

Funding

Amount: **178,780 €**

Duration: **36 months**

Foundation: **H.F.R.I.**

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Hellenic Foundation for Research & Innovation

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