1 PhD & 1 Post-doctoral research positions in experimental flow and reactive transport inside porous river beds

University of Rennes, France

Context The hyporheic zone is a sharp and puzzling interface connecting surface water (rivers) to the groundwater (aquifers)[1,2,3,4]. Sharp, because its small thickness (a few meters) and also because strong biogeochemical gradients[5] develop in this layer, in response to mixing between surface and subsurface water. Puzzling, because of its key, yet debated, role in biogeochemical processes at the catchment scale, notably on the degradation of contaminants such as arsenic[6] and nitrates[7] , or the generation of greenhouse gases such as nitrous oxide[8]. A better understanding of the mixing and reaction processes occurring in the hyporheic zone is thus critical to address these key environmental issues. Our research group, based in Rennes (France), has developed new experimental techniques based on laser-induced fluorescence that allow quantifying concentration gradients and chemical reactions in porous media rendered transparent by optical index matching (Figure 1). The objective of this project is to take advantage of these original techniques to explore mixing and reaction in the hyporheic zone.

Objectives The first objective of the project is to develop an experimental setup[9] to monitor hyporheic fluxes under controlled surface and groundwater flow conditions, notably via the index-matching technique. The second objective is to map the spatio-temporal distribution of conservative and reactive exchanges inside the sediment bed as a function of the roughness and permeability of the interface to evidence the main mechanisms for hyporheic mixing and compare them to field observations. This objective will be achieved via dissolved fluorescent probes that can be visualized with laser induced fluorescence.

Research team The PhD and the postdoctoral fellows will integrate the Geosciences Rennes laboratory (CNRS), which gathers 160 scientists of various background: physics, fluid mechanics, geophysics, geochemistry and geomorphology. The laboratory is located in a dynamical campus in the middle of an historical town, Rennes, at 1h25 of Paris. It is a leading European laboratory in this field, currently hosting 3 European Research Council (ERC) fellows and coordinating 3 Innovative Training Networks (ITN). The applicant will have access to a fully equipped laboratory for flow, transport and reaction in porous media, developed within the ERC ReactiveFronts (PI Tanguy Le Borgne). They will benefit from the support of a dedicated engineer for experimental development. The project is part of a 4 years research project called SUCHY, funded by the French National Science Agency and starting in 2020. The fellows will work in close collaboration with 2 senior researchers (Joris Heyman and Tanguy Le Borgne). They will have the opportunity to interact with 4 post-doc researchers and 4 PhD students. The project offer possible collaborations with Australian and Austrian colleges. If desired, they may also take part in under-graduate teaching in the university.

Required skills The applicant should have obtained a PhD degree (or a Master degree) in Geosciences, Fluid Mechanics, Physics after 2015. Strong experimental skills with fluids are required, with additional knowledge in data and image processing. Theoretical skills in flow and transport and river processes and knowledge of scientific programming are desirable.

To apply Send a CV and a cover letter demonstrating your interest with the thesis subject, and your carrier objectives to Joris Heyman : joris.heyman@univ-rennes1.fr and Tanguy Le Borgne tanguy.le-borgne@univ-rennes1.fr.

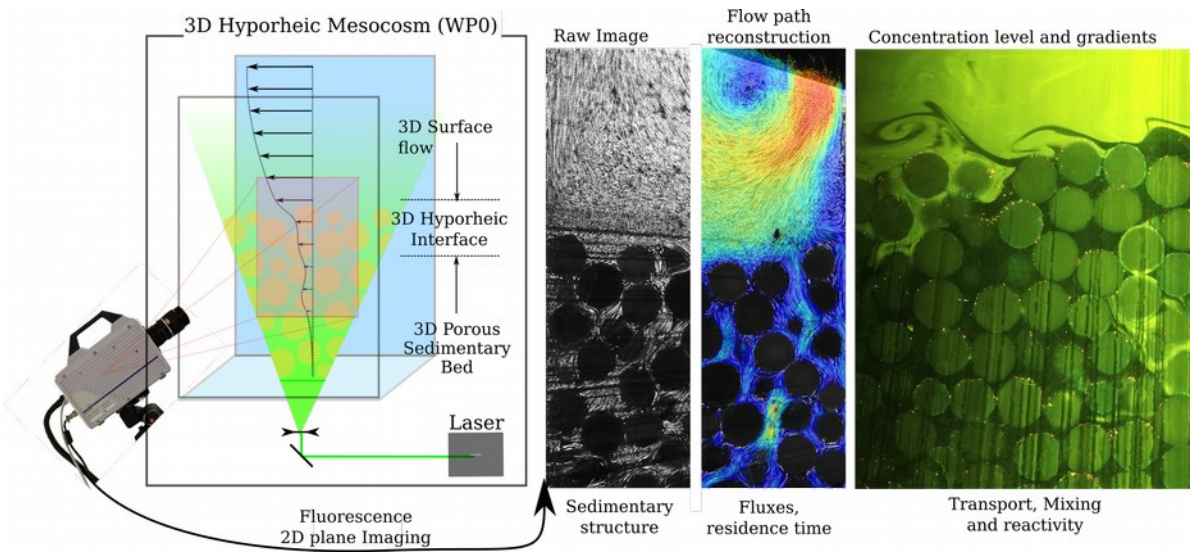

Figure 1: Experimental Methodology of the SUCHY project

1. Boano et al. (2014) Rev. Geophys. 52, http://doi.org/10.1002/2012RG000417.
2. Cardenas (2015) Water Resour. Res. 51, http://doi.org/10.1002/2015WR017028.
3. Brunner et al. (2017) Rev. Geophys. 55, http://doi.org/10.1002/2017RG000556.
4. Hester et al. (2017) Water Resour. Res. 53, http://doi.org/10.1002/2016WR020005.
5. O'Connor et al. (2008) Water Resour. Res. 44, http://doi.org/10.1029/2008WR007160.
6. Datta et al. (2009) Proc. Nat. Acad. Sc. 106, http://doi.org/10.1073/pnas.0908168106.
7. Duncan et al. (2015) Water Resour. Res. 51, http://doi.org/10.1002/2015WR016937.
8. Marzadri et al. (2017) Proc. Nat. Acad. Sc. 114, http://doi.org/10.1073/pnas.1617454114.
9. Chandler et al. (2016) Water resources research 52, http://doi.org/10.1002/2015WR0182