Optical thermometry to assess the impact of structural heterogeneities on coupled flow and heat transport in permeable media

Arwa Rashed*[1], Maria Klepikova*[1], Gauthier Rousseau[2], Francesco Gomez[1], Benoît Fond[3], and Yves Meheust[1]

[1]Observatoire des Sciences de l'Univers de Rennes – Université de Rennes – France
[2]Vienna University of Technology – Autriche
[3]ONERA – The Office national d'études et de recherches aérospatiales – France

Résumé

A novel application of phosphor themometry is proposed aiming to evaluate local thermal nonequilibrium effects on heat transport in heterogenous porous and fractured media. This experimental approach overcomes technical challenges as current experimental techniques, based on point (sensor) temperature measurements, do not allow capturing the interplay between temperature gradients and 3D flow topologies. A major technological challenge addressed in this project is the design and development of new experimental methodologies to perform dynamical pore scale optical measurements of temperature.It offers the possibility of presenting high resolution optical monitoring of the time-evolving temperature field. Fluid thermometry uses solid phosphor particles seeded into the flow as a tracer and probes their temperature-dependent luminescence properties using light sources and cameras. The fluid temperature is then obtained from the luminescence emission of the particles through a calibration, with a precision better than 0.3∘C.

Mots-Clés: heat transport, groundwater flow, geological heterogeneities, optical thermometry

*Intervenant