InterPore2018 New Orleans

Monday, 14 May 2018 - Thursday, 17 May 2018

New Orleans

Minisymposia and General Sessions

General Sessions
GS 1: Fundamental theories of porous media
Co-organizers: *Steffen Berg, Michel Quintard, Hadi Hajibeygi*

GS 2: Computational challenges in porous media simulation
Co-organizers: *Inga Berre, Sorin Pop, Jun Yao*

GS 3: Experimental achievements
Co-organizers: *Al Cunningham, Linda Abriola, Phil Vardon*

GS 4: Porous media applications (renamed)
Co-organizers: *Michael A. Celia, Anozie Ebigbo, Henk Jonkers*

Full list of accepted Symposias is listed below and available as PDF.

GS 1: Fundamental theories of porous media

Organizers
Steffen Berg
Michel Quintard
Hadi Hajibeygi

MS 1.01: Multi-scale Particulates Transport through Porous Media Saturated with Multi-Phase Fluids

Organizer
Bin Yuan, Coven Energy Technology Research Insititue
Co-Organizers
Kai Wang, Coven Energy Technology Research Insititue
Wendong Wang, China University of Petroleum (East China)
Abstract

Particulate flow in reactive porous media occurs in many disciplines, including geochemistry and chemical engineering, and enhanced oil recovery in petroleum industry. e.g., injection of seawater for water flooding filtrate invasion into reservoirs during well drilling, cold water injection into geothermal reservoirs microbial enhanced oil recovery (MEOR), alkaline flooding (AF), low salinity waterflooding (LSWF), and other secondary and tertiary recovery cases. Nanofluids that contains nanoparticles can exhibit lots of unique electrical, magnetic, and chemical properties, i.e., higher adsorption tendency, finely tuned structures and good candidates applied for some particular purposes.
Particle transport in porous media is controlled by pore-scale physics. Particles transport is affected by the shape of the particles and their surface properties, the structure of the porous medium, the chemistry of the suspending fluid, the flow velocity field in the pore space, and a variety of interaction forces between the particle and the medium. The previous studies are mainly limited to single-phase carrier fluids and sized particles in the same scale. The dynamics of multi-scale particles (i.e., nanoparticles and fine particles) transport in the presence of multiphase carrier fluids are still ongoing with limited understandings.

Determining the fate of multi-scale particles traveling in multi-phase fluids (oil, gas, water or chemicals) requires an extensive knowledge of particle transport behavior in porous media. The objective of this Minisymposia is to collect the cutting-edge research progresses focusing the behaviors of multi-scale particles flowing through porous media saturated with multi-phase reactive or non-reactive fluids.
References

Provided URLs
http://www.covenergy.com/
http://www.covenergy.com/
http://www.upc.edu.cn

MS 1.02: Fractal Theory and its Applications to Flow and Transport Properties of Porous Media

Organizer
Boming Yu, Huazhong University of Science and Technology
Co-Organizers
Muhammad Sahimi, University of Southern California
Abstract

Porous media widely exist in nature and have applications in many science and engineering fields, such as oil/gas reservoirs, groundwater aquifers, geophysics and geology, materials science, food science and engineering, chemical engineering, civil and environmental engineering, nuclear engineering, etc. Since microstructures in porous media are extremely complicated, flow and transport processes in them, such as heat and mass transfer, single- and multiphase flows, conduction, electromagnetic and acoustic wave transports are usually studied by numerical simulations and experimental measurements. They cannot, however, be analytically studied based on Euclid geometry. Fortunately, the microstructures of many porous media have been shown to have the fractal characteristic, which make deriving analytical solutions of transport properties of porous media realizable.
We invite researchers to contribute original research papers that explore the solutions of flow and transport processes in fractal porous media. The topics of this minisymposium include, but are not limited to:
1. Fractal geometry theory for porous media;
2. Fractal characterization of pores and fractures;
3. Fractal reconstruction of porous media;
4. Models and predictions of transport properties, including permeability, conductivity, electromagnetic and acoustic wave transport;
5. Fractal analysis of coupling of fluid and solid;
6. Percolation theory and its applications in pores and fractures;
7. Others topics on transport phenomena in porous media by fractal geometry theory.
References

Provided URLs
http://blog.sciencenet.cn/?398451
http://pressroom.usc.edu/muhammad-sahimi/

MS 1.03: Grand Challenges in Porous Media

Organizer
Hassan Mahani, Shell Global Solutions International B.V.
Co-Organizers
Lilit Yeghiazarian, University of Cincinnati
Abstract

The scientific community in academia and industry deals with many research topics and questions in natural and engineered systems that have been around for decades but have not yet been fully resolved. Such problems are abundant in the theory or modeling of porous media, as well as experimental techniques. There are also emerging challenges due to energy transition and increasing concerns about global warming, all of which have prominent impact on our day-to-day life and welfare of societies at large.
Thanks to the multi-disciplinary platform that InterPore provides, we feel that there is a great opportunity to identify and solve grand challenges encountered in various fields of porous media research. It is possible that, as the motto of InterPore "Similar solutions for diverse applications" implies, many grand challenges may have common solutions. Finding these solutions would require community effort.
Thus, the aim of this mini-symposium is to provide a platform for researchers based in academia and industry to highlight top-priority, grand challenges that are key to solve for further advancement or even revolution in specific applications of porous media.
Furthermore, the presenters will have an opportunity to propose a Grand Challenge for the community to solve. This can take form of a society-wide competition, a student competition, or a follow up mini-symposium at subsequent InterPore meeting(s). The organizers will be happy to work with you on logistics of such events.
You are kindly invited to present Grand Challenges in all areas of porous media science and technology.
References

Grand Challenges areas, but not limited to:
• Soils and Aquifers
• Hydrocarbon Reservoirs
• Biological systems such as Tissues and Plants
• Electricity such as Fuel Cells and Batteries
• Concrete, Textiles and Composite Materials

Provided URLs
https://scholar.google.nl/citations?hl=nl&user=RPukXfYAAAAJ&view_op=list_works&sortby=pubdate
http://homepages.uc.edu/~yeghialt

MS 1.04: Upscaling of mixing, dispersion and reaction processes from pore to continuum scale

Organizer
Marco Dentz, IDAEA-CSIC
Co-Organizers
Branko Bijeljic, Imperial College

Abstract

An in-depth understanding of solute mixing and reactive transport is key in engineered and natural porous media with applications ranging from the design of porous reactors to diffusion in human tissue to geothermal heat production. Spatial heterogeneity in pore and Darcy scale medium and flow properties leads to scale effects in system parameters (e.g., hydraulic conductivity, dispersion coefficients, chemical rate constants) and emerging large scale processes (e.g., anomalous diffusion, memory reactions, mechanical mixing) due to the interaction of small scale processes, segregation and mass transfer across heterogeneity-induced interfaces. Recent advances in experimental and theoretical approaches have shed new light into the pore and Darcy-scale mechanisms that govern these processes and their large scale quantification.
This session addresses a diverse group of researchers investigating Eulerian and Lagrangian flow properties, solute and particle transport, and mixing and reaction phenomena under spatial heterogeneity in fluids at rest and under single, multiphase and variable density flows on the pore and Darcy scales. It aims to bring together experimental observations from the lab to the field scale with theory and numerical simulations to advance our understanding of heterogeneity-induced mixing, transport and chemical reaction dynamics over a large range of spatial and temporal scales.

References

Provided URLs
https://mhetscale.wordpress.com

MS 1.05: Drying of porous media from pore to macro scale

Organizer
Rui Wu, Shanghai Jiao Tong University
Co-Organizers
Abdolreza Kharaghani, Otto von Guericke University
Marc Prat, IMFT
Abstract

Drying of porous media is of great interest not only for the scientific research but also for the industrial applications. Pertinent examples include recovery of volatile hydrocarbons from underground oil reservoirs, remediation of contaminated soils by vapor extraction, and water management of proton exchange membrane fuel cells, just to name a few. Drying of porous media includes vapor transport, thermal transfer, liquid flow, solute transfer, and menisci movement, etc. Understanding these transport processes at the pore scale is essential to uncover the macro scale phenomena occurring during drying of porous media.

Thanks to recent advances in computational and imaging techniques, pore scale modeling (e.g. pore network model) and experiments (e.g. micromodel experiment, micro-CT, NMR) on drying of porous media have gained much attention. This mini symposium is dedicated to bring together scientists to discuss the recent achievements in drying of porous media at different scales as well as the linkage between different scales.

References

MS 1.06: Upscaling of mass transfer in fractured porous media

Organizer
Morteza Dejam, University of Wyoming
Co-Organizers
Hassan Hassanzadeh, University of Calgary

Abstract

Significant portion of the world's water and energy resources are stored in fractured rocks. Modeling and experimentation of mass transfer through fractured porous media have received considerable attention over the previous decades.
Fractured rocks consist of matrix blocks of various sizes and network of fractures. Mass transfer in such fractured media is most often a coupled problem because of the porous nature of the matrix blocks leading to an interaction between the two media. The fracture-matrix interaction, multi-phase flow features, and other fracture and matrix characteristics such as roughness and variable matrix block size distribution make fractured rocks as complex systems, which pose important research challenges.
Mass transfer processes in fractured rocks find different applications in diverse branches of science and engineering, including contaminant transport in underground water resources, enhanced recovery from hydrocarbon reservoirs, geological storage of CO2 in deep saline aquifers, and geothermal reservoirs.
This minisymposium invites experts from universities, research organizations, and industries to discuss the challenges and opportunities we are facing in modeling and experimentations of mass transfer in fractured rocks. This minisymposium addresses experimental and theoretical studies with focuses on:
• Dispersion in fractured porous media;
• Upsaling of advective-diffusive mass transport processes in fractured rocks;
• Multi-phase flow aspects of mass transfer during gas/solvent injection in tight and shale oil reservoirs;
• Gas-oil mass transfer and diffusion during enhanced oil recovery (EOR) in fractured reservoirs;
• Fracture-matrix interaction due to mass exchange in double-porosity systems;
• Contaminant transport in fractured rocks;
• Fractured geothermal reservoirs.

References

Provided URLs
https://www.uwyo.edu/petroleum/faculty-staff/dejam/
https://schulich.ucalgary.ca/profiles/hassan-hassanzadeh

MS 1.07: Advances in solubility trapping of CO2 in geological formations

Organizer
Hamid Emami, Pennsylvania State University
Co-Organizers

Hassan Hassanzadeh, University of Calgary
Abstract

Securing significant volumes of CO_2 in deep saline aquifers can be achieved through occurrence of natural processes such as solubility (dissolution), residual, and mineral trapping that lead to permanent trapping of CO_2. One of the fundamental effect of CO_2 dissolution in brines is the slight increase in the aqueous-phase density on top of formations underneath the buoyant free-phase CO_2 plume. This dissolution process brings the system to a gravitationally unstable state, resulting in a naturally induced convective dissolution. Such a convective mixing increases the rate of dissolution of CO_2 in brines, reducing the volume of buoyant free-phase CO_2 and therefore decreases the timescale over which leakage is possible. CO_2 dissolution can be also enhanced using nano- and reactive materials, steer large-scale migration of the free-phase CO_2, in-situ/ex-situ dissolution schemes, which ultimately increase the security of storage. This minisymposia addresses experimental and theoretical studies with focuses on:
• CO_2 dissolution in presence of natural flow and dispersion;
• Dissolution trapping of CO_2 in heterogeneous aquifers;
• Convective mixing of impure CO_2 in saline aquifers;
• CO_2 dissolution in naturally fractured aquifers;
• CO_2 dissolution in geothermal reservoirs;
• Pore-scale dissolution of supercritical CO_2 in brine;
• Reaction induced convective dissolution;
• Use of nano-materials to accelerate convective dissolution;
• Upscaling of reactive-advective-diffusive CO_2 transport processes;
• Interplay of geochemical and multiphase flow processes in solubility trapping;
• Accelerated CO_2 dissolution through engineering and in-situ/ex-situ schemes;
• Experimental studies of convective dissolution using analogue fluids.
References

Provided URLs
http://www.eme.psu.edu/faculty/emami-meybodi
http://people.ucalgary.ca/~hhassanz/

MS 1.08: Non-linear flows in porous media: impact of inertia and non-linear rheologies on pore scale processes and applications

Organizer
Michel Quintard, Institut de Mécanique des Fluides de Toulouse
Co-Organizers
Yves Méheust, Géosciences Rennes
Yohan Davit, Institut de Mécanique des Fluides de Toulouse
Vittorio Di Federico, Università di Bologna
Abstract

Non-linear effects in momentum equations arise from either inertial effectsor non-Newtonian rheology. Inertia terms are important for flows in highly permeable media such as fractured rocks, canopies, urban canyons, wells, chemical reactors. Non-Newtonian rheologies are encountered in industrial applications such as gel permeation chromatography, filtration of polymer solutions,

cement injection in soils, glue penetration in porous substrates, injection molding of composite; subsurface applications such as polymer slugs or remediation of polluted aquifers and enhanced oil recovery using foams, clay-based muds for well drilling, and solid particles suspensions for soil remediation and fracking; biological processes such as blood flow in vascular networks.
Flow non-linearity and geometrical multi-scale complexity render the development of micro- and macro-scale models extremely challenging. Understanding pore-scale flows and relationships between the various scales requires advanced simulations (molecular, meso-scale approaches, effective boundary conditions such as slip conditions for polymer flows, continuum approaches) performed in realistic structures. Advances in the field further require development of experiments at various scales along with novel visualization and imaging techniques. Finally, interpretation of pore/fracture scale results in terms of macro-scale models and effective properties challenges all upscaling techniques.
We welcome contributions addressing the impact of non-linearities on single- or multiphase flow and solute transport, based on theoretical/numerical/experimental studies and over a broad range of scales and applications. Topics may include rheological studies, flow characterization and modeling for realistic rheologies, estimation of effective properties, industrial applications, including gel permeation chromatography, polymer filtration, material processing; large-scale subsurface applications such as aquifer/soil/vadose zone remediation, EOR, fracking.
References

Provided URLs
http://mquintard.free.fr/#jobinfo

MS 1.09: front & interface dynamics and up scaling transport properties in porous media

Organizer
Benoit Noetinger, IFPEN
Co-Organizers
Marco Dentz, IDAEA
Insa Neuweiler, Leibnitz Universitat Hannover
Abstract

Up scaling procedures in heterogeneous porous media are especially difficult when fronts corresponding to sharp variations of a transported quantity propagate inside the porous medium. These fronts can correspond to multiphase flows, reactive flows, phase transition fronts etc… and involve a rather complex and strong coupling between non-linearities, hydrodynamic instabilities and the underlying disorder of the porous medium. Such phenomena can lead to the emergence of self-organized behaviors.
The session will focus on state of the art results, new experimental and theoretical approaches or simulation methods

References

Neuweiler, I., Attinger, S., Kinzelbach W., King, P.R. (2003): Large scale mixing for immiscible displacement in heterogeneous porous media., Transport in Porous Media 51, 287-314.
Dentz, M. & Tartakovsky, D.M. Transp Porous Med (2009) 79: 15. https://doi.org/10.1007/s11242-008-9268-y
Nœtinger, B., Artus, V., & Ricard, L. (2004). Dynamics of the water–oil front for two-phase, immiscible flow in heterogeneous porous media. 2–isotropic media. Transport in porous media,

56(3), 305-328.

MS 1.10: Visualizing and understanding multiphase flow through microfluidic and micromodel devices

Organizer
Peixi Zhu, University of Texas at Austin
Co-Organizers
Ke Xu, University of Texas at Austin
Matthew Balhoff, University of Texas at Austin
Abstract

Understanding the fluid mechanism at the pore scale is important for controlling the flow process in porous media in many multiphase flow applications, including oil recovery or remediation improvement, water purification, efficient energy conversion in fuel cells, targeted drug delivery, etc. Pore scale transport phenomena can be very different from bulk fluid, especially when there is more than one phase, due to the presence of flow, confined space and tortuous geometry. As a traditional approach, macroscopic output quantities, such as effluent concentration, pressure drop across the porous media or oil/water ratio are measured and interpreted to gain insight to the microscopic phenomena in the pores.

Microfluidics allow micron-scale visualization of fluid flow and provides visual evidence to transport phenomena at the pore level. Microfluidic devices with various pore geometries, including discrete pores or pore network (micromodels) can be fabricated, and the surface wettability can be tailored to represent realistic porous media for a specific application. To gain further insight to the fluid mechanism, measurements of various fluid properties can also be obtained by incorporating sensors or image analysis methods onto the devices. Microfluidic technology has helped to discover unknown fluid mechanisms associated with capillary pressure, rheology, chemistry, colloidal science, etc., that are found in porous media of many multiphase flow applications.

In this minisymposium, we call for papers that focus on applying micromodels or microfluidic devices to study multiphase flow, with strong applications or implications towards practical process of flow in porous media.

References

Provided URLs
http://pge.utexas.edu
http://pge.utexas.edu
http://pge.utexas.edu/facultystaff/profiles/balhoff

MS 1.11: Conservative and Reactive Transport of Charged Species in Permeable and Impermeable Porous Media

Organizer
Massimo Rolle, Technical University of Denmark
Co-Organizers

Valentina Prigiobbe, Stevens Institute of Technology
Marc Hesse, The University of Texas at Austin

Abstract

The understanding of fluid flow, transport processes and reactions is crucial to describe the movement of solutes and particles in porous media. For charged species an important role is played by electrostatic interactions that can occur both within the pore water, as well as between the transported species and the surface of the solid matrix. Although a number of contributions have addressed charged effects in porous media, many aspects remain to be explored. These include the coupling with fluid flow, with other transport processes, with chemical reactions, as well as the effects of heterogeneity and different geochemical conditions.
This session focuses on the recent developments in the investigation of transport of charged species in porous media. We invite submissions based on theoretical, experimental and modeling approaches aiming at elucidating transport and electrostatic interactions both in permeable and impermeable porous media. We welcome contributions from various fields of geosciences and engineering in which the study of the fundamentals of charged species transport is performed at different scales and is motivated by applications in groundwater contamination, long-term waste disposal and confinement, remediation of subsurface environments, and water treatment.

References

Provided URLs
http://www.dtu.dk/english/service/phonebook/person?id=96242&tab=1
https://web.stevens.edu/facultyprofile/?id=2070
https://www.jsg.utexas.edu/hesse/marc-hesse/

MS 1.12: Fluids in Nanoporous Media

Organizer
Gennady Gor, New Jersey Institute of Technology
Co-Organizers
Patrick Huber, Hamburg University of Technology
Abstract

Many porous media have characteristic pore sizes in the nanometer range. These media include natural materials (clays, coal, and shale), concrete, as well as synthetic materials used for separation, purification, and energy storage. In most natural or technological processes the pores in these materials contain fluids: water in clays and concrete, hydrocarbons in coal and shale, etc. In nanopore-confined fluid, tight spatial confinement and solid-fluid interactions may significantly alter the fluid' s physical properties, causing, for example, the molecular structuring of the fluid, shifts of the freezing or evaporation points and the appearance of the disjoining pressure. These pore-scale effects necessarily lead to a change in the parameters of continuum models for fluid transport in nanoporous media and poromechanics; moreover, they also often require introducing new physics in the governing equations. The objective of this minisymposium is to provide a forum for the discussion of all possible aspects of fluid phases confined in nanoporous materials: fundamental and applied, theoretical and experimental.

References

Provided URLs

http://porousmaterials.net
http://huberlab.wp.tuhh.de

MS 1.13: Solutions to inverse and often ill-posed problem in flow and transport in porous media

Organizer
Jyoti Phirani, Indian Institute of Technology Delhi
Co-Organizers
Umang Agarwal, Shell Technology Center Bangalore, India
Abstract

The characterization of porous media for future predictions is relevant for many naturally existing porous media inaccessible for visual inspection, for example geological sediments and biological tissues. In geological porous media like oil reservoirs, geothermal reservoirs and groundwater aquifers, the response at the wells are used to characterize the sediments for flow behavior, be it well test analysis, tracer tests or use of historical production data. In biological tissue the flow of blood in the capillaries is measured by tracer tests. These inverse problems of porous media characterization for flow are generally ill-posed, however a unique solution is sought for accurate predictions and prognosis. This mini-symposium will address the solution strategies of these inverse and ill-posed problems in flow and transport in porous media. The relevant questions include finding solid and fluid properties, fluid volumes, and flow behavior in porous media using tracers; using historical data to gather information about the porous media; and using specific tests like well test in geological porous media for characterization.
References

MS 1.14: Transport in nanoporous materials. Theory and molecular dynamics simulations

Organizer
Signe Kjelstrup, Norwegian University of Science and Technology
Co-Organizers
Bjørn Hafskjold, Norwegian University of Science and Technology, NTNU
Dick Bedaux, Norwegian University of Science and Technology, NTNU
Guillaume Galliero, Université de Pau et des Pays de l' Adour, France
Abstract

This topic addresses a combination of theory (non-equilibrium thermodynamics) and simulations (non-equilibrium molecular dynamics) as applied to nanoporous materials. Of particular interest is the use of simulations to make theoretical progress, and to help understand mechanisms that are effective at the molecular level. Lecturers will be chosen that can elucidate these issues from different perspectives.
References

Provided URLs

http://porelab.no/
http://www.ntnu.no/ansatte/bjorn.hafskjold
http://porelab.no/
https://www.researchgate.net/profile/Guillaume_Galliero

MS 1.15: Soft porous materials

Organizer
Benoit Coasne, CNRS/University Grenoble Alpes
Co-Organizers
Noushine Shahidzadeh, Universiteit Van Amsterdam
Jan Carmeliet, ETH Zurich
Abstract

Soft porous matter is an important field in materials science and engineering with materials like compliant porous solids, foams, intrinsically porous polymers, organic membranes, gels and natural materials such as wood, bamboo, plants, linen, clays, coal, etc. In common, these materials often show a nanoporous structure with a large surface area combined with a compliant skeleton, leading to strong coupling between adsorption and thermo-hygro-mechanical behavior. This coupling clearly manifests itself in a complex adsorption-induced deformation that is often irreversible. The origin of this coupling is often found at the lower pore scales where fluid-solid interactions like hydrogen bonds may play an important role. Such interactions may be studied experimentally or by modelling at different scales, using atomistic simulation or poro-mechanical approaches in a multiscale framework. This workshop will provide a platform for discussion on experimental, theoretical and modeling approaches, with the aim to address fundamental and applied aspects of nanoporous materials including the underlying microscopic mechanism of this exotic adsorption-induced deformation behavior.
References

Provided URLs
https://www-liphy.ujf-grenoble.fr/Benoit-Coasne-webpage
http://www.uva.nl/en/profile/s/h/n.shahidzadeh/n.shahidzadeh.html
http://www.carmeliet.ethz.ch/about-us/people/person-detail.html?persid=155983

MS 1.16: Heterogeneity, uncertainty, and multiple scales in groundwater problems

Organizer
Graciela del Socorro Herrera, Universidad Nacional Autónoma de México
Co-Organizers
Eric Morales-Casique, Universidad Nacional Autónoma de México
Abel Felipe Hernández, Instituto Nacional de Electricidad y Energías Limpias
Abstract

How to deal with heterogeneity in groundwater problems has been the focus of intense research over several decades. The most common way to address this issue is through the stochastic approach, which has been coupled lately with data assimilation methods to consider all available

data as well as to reduce uncertainty in model parameters and results. Stochastic prediction of groundwater flow and transport provide us additionally with a measure of uncertainty. Another characteristic that groundwater flow and transport often exhibit is behavior at multiple scales. To explicitly include and mathematically treat the multiscale aspects of groundwater, it is important to incorporate suitable techniques or methods. The aim of this session is to provide an opportunity for researchers to communicate and exchange results in these topics

References

Provided URLs

http://www.geofisica.unam.mx/recnat/pages.php?listado=visualizar&persona=ghz

http://www.geologia.unam.mx/comunidad-igl/morales-cacique-e

MS 1.17: Flow of Non-Newtonian and Complex Fluids Through Porous Media

Organizer

Soheil Saraji, University of Wyoming

Co-Organizers

Maysam Mousaviraad, University of Wyoming

Abstract

Non-Newtonian and complex fluids comprise a wide range of substances such as gels, concentrated emulsions, dispersions, surfactant solutions, foams, blood, and polymers. The flow of these fluids in porous media is relevant to many industries including hygiene products, pharmaceuticals, and oil and gas industry. However, there is a significant lack of understanding in the fundamental physics of non-Newtonian flow through porous media, particularly concerning the link between the microscale physics and the apparent macroscale behavior. This mini-symposium will focus on recent advances in theoretical, experimental, and computational aspects of single- and multi-phase flow in porous media involving non-Newtonian and complex fluids. This includes experimental studies on the effects of fluid rheology, interfacial rheology, elasticity, inertia, wall-slip and other non-linear phenomenon in porous media, as well as application of new experimental techniques such as SANS, SAXS, micro-CT, MRI, confocal microscopy, micro-PIV, etc. Also, studies on recent improvements of modeling techniques to simulate non-linear flow in porous media at the macro- and pore-scales are encouraged, especially for multi-phase flows. Of particular interest are coupled computational approaches such as coupling high and low fidelity solvers for multi-physics processes, Eulerian-Lagrangian methods for particle dynamics/filtration, and fluid-structure interaction models for deformation of solid skeletons including imaging-based computations. Lastly, the current status and the outlook on collaborative experimental and computational research will be emphasized, including simulation-based experimental condition design, experiment-based computational model development, and validation experiments with uncertainty analysis for computational verification and validation studies.

References

Provided URLs

https://www.uwyo.edu/petroleum/faculty-staff/saraji/

https://www.uwyo.edu/mechanical/faculty-staff/maysam-mousaviraad/index.html

MS 1.18: Pore scale formulations and upscaling of reactive transport problems in porous media

Organizer
Carina Bringedal, Hasselt University
Co-Organizers
Jyoti Phirani, Indian Institute of Technology
Kundan Kumar, University of Bergen
Abstract

Reactive transport through porous media is relevant for geothermal energy and storage, CO2-sequestration, enhanced oil recovery and groundwater contamination. Heterogeneous chemical reactions are able to deform the porous medium structure, causing the porosity and permeability to alter, and hence affecting the flow through the medium. Reactive transport problems are generally difficult to model due to this two-way flow coupling. Understanding the physical processes at pore scale is essential to capture relevant mechanisms, while being able to upscale the model, through e.g. homogenization, is needed for efficient numerical implementation. This minisymposium will address mathematical topics related to pore scale descriptions of reactive transport problems. Relevant questions include applicability and convergence of the upscaling procedure, and properties of upscaled formulations.
References

MS 1.19: Interface driven processes in porous media

Organizer
Kilian Weishaupt, University of Stuttgart
Co-Organizers
Iryna Rybak, University of Stuttgart
Rainer Helmig, University of Stuttgart
Abstract

Interfaces in porous media appear on different scales and influence the effective behaviour of the system. These include the interfaces between two different porous media, interfaces between
porous media and free fluids, fluid-fluid and fluid-solid interfaces in porous media, etc. Modelling such systems is a challenge due to the complexity of interface driven processes that are
coupled, non-linear and evolving on various spatial and temporal scales. The majority of existing modelling concepts and numerical
solution algorithms consider idealized cases and oversimplified interface conditions. However, physically consistent descriptions of
the interfaces supported by laboratory experiments and pore-scale numerical simulations as well as robust and efficient numerical
solution strategies for coupled macro-scale models are needed to adequately simulate flow and transport in porous media.

This minisymposium is aimed to bring together researchers working on
the development of new modelling concepts, advanced computational
algorithms and dedicated laboratory experiments to study flow and
transport processes in porous media with interfaces and to discuss

current achievements and foreseeable work over the coming years.
References

MS 1.20: Porous media evolving mechanism, theory and its applications in energy engineering

Organizer
Yangsheng Zhao, Taiyuan University of Technology
Co-Organizers
Dong Yang, Taiyuan University of Technology
Abstract

In energy engineering such as shale gas, geothermal energy, coalbed methane, oil shal et al., the most important thing is to improve the porosity or permeability of the rock underground, which means to make the initial tight non-permeable rock gradually evolving into high porosity and high permeablity rock. All these evolving process always involved complex coupling of multi-physical fields. The evolution of such process could be by artificial methods, such as hydraulic fracturing to enhance oil & gas the recovery ratio and exploitation rate, chemical grouting to prevent leakage, and chemical solution leaching in underground uranium ore mining, or by natural evolution as weathering of rock, damage and rupture of geological structures, or even more by the □III□Natural–artificial evolution as the combination of the two others mentioned before. All these process is important to the success of these energy engineering. The theory of such project involves description of the pore morphology and its connectioned, and governingcontrol equation related tofor seepage mass and heat transfer, heat transfer in porous media, and the description of describing tthe evolution process, the numerical simulation of such evolving process and so on. The Application of this subject may concerned with geothermal energydevelopment, nuclear waste disposal, mechanism and development of oil and gas, enhanced coal bed methane, and earthquake prediction, et al..
References

MS 1.21: Hydraulics and mechanics of unsaturated porous media: current state of knowledge and practice

Organizer
Ehsan Nikooee, Shiraz University
Co-Organizers
Nasser Khalili, UNSW
Majid Hassanizadeh, Utrecht University
Jacques Huyghe, University of Limerick
Ehsan Nikooee, Shiraz University
Abstract

Simulating hydraulics and mechanics of unsaturated porous materials is a question of great interest in many disciplines from petroleum engineering, soil science, geotechnical engineering, to food processing, and building physics. The stress measure of a porous medium containing different fluids is a function of volume fraction of phases and their interfaces. The volume fraction of different phases and interfaces is a function of porous structure of a porous material which itself deforms and varies from one state to another [1-3].

Therefore, detailed knowledge on how porous structure changes under various environmental loads (inclusive of chemical interactions, mechanical loading, …) is a key to better formulate various coupled processes at macroscale.

Furthermore, determination of capillary pressure (fluid pressure differences), fluid phase saturation and specific interfacial area is a question of major practical importance to model various phenomena occurring in multiphase porous materials [4-12]. Evaporation in natural and industrial porous material, dissolution of contaminations in ground water, rainfall induced landslide present a few examples of such phenomena. Several multiscale analytical and numerical models have been proposed to date to portray porous structure and capture the processes occurring therein.

Hereby, we invite unsaturated porous media researchers to contribute to this mini-symposium by presenting their research works describing the challenges pertinent to model unsaturated porous materials, recent advances, experimental and numerical tools and techniques (from imaging techniques to traditional soil water retention measurements such as hanging column). We would like to discuss current challenges and opportunities, and envision future perspectives with your valuable contributions.

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MS 1.22: Non-Newtonian Flow and Transport Over Porous Surfaces

Organizer
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Co-Organizers
Nina Shapley, Rutgers University
Kashif Nawaz, Oak Ridge National Lab
Abstract

Flow of particle-laden liquids (often characterized as non-Newtonian fluids) has substantial applications in a wide range of industries including biomedical fields, food, and pharmaceutics to name a few. In addition, coupling of free-fluid flow, heat and mass transport over porous surfaces is very prominent both in nature and industry; thus, it has attracted significant attention from various fields of study. For instance, flows over and through endothelial glycocalyx of blood vessels, coral reefs and submerged vegetation canopies, crop canopies, and carbon nanotubes (CNTs) [1-8]. Since the process can be significantly different from the flow of pure fluids over smooth surfaces, the topic requires attention due to the novelty of the phenomenon. Understanding the coupled flows of complex fluids over porous surfaces will significantly advance our knowledge of how flow and mass transport occurs over porous media.

The aim of this mini-symposium is to bring together industrial, academic, and National Laboratory researchers working in various fields of the fluid flow over permeable surfaces, the fluid-porous interface, and the related transport phenomena in order to provide a platform for discussing current and future research topics in this area. In particular, we are inviting research topics related to the flow and transport of particle-laden liquids and/or non-Newtonian fluids over the porous surfaces and associated applications. We seek experimental analysis using techniques such as Particle Image Velocimetry (PIV) and other experimental methods, theoretical approaches, and numerical studies at both pore and continuum scales.

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MS 1.23: Challenges in porous media characterization and modelling of multiphase flow with capillarity

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Jianchao Cai, China University of Geosciences (Wuhan)
Yingfang Zhou, University of Aberdeen
Harpreet Singh, National Energy Technology Laboratory

Abstract

Porous media characterization and multiphase flow with capillarity are relevant to the multi-discipline society of porous media research, such as hydrocarbon extraction, geosciences, environmental issue, hydrology, biology and so on. And thus the relevant stakeholders of this events are petroleum industry, subsurface water service companies, the air and water pollution authorities and service companies, environmental authority and service company and bio-material society. Reliable Porous media characterization of multiphase flow functions are important to model in many applications of interest, including studies of residual water or oil in hydrocarbon reservoirs and long-term storage of supercritical CO2 in geological formations.

In this minisymposium, we aim to address the challenges that related to porous media characterization and multiphase flow. The presentations on, but not limited to, the flowing topics are all welcome: such as porous media reconstruction and complex flow, oil and gas flow in unconventional formations, multi-Field coupling and multiphase flow, pore scale modelling and upscaling, new technologies and methods in porous media research, cross discipline in porous media research.

References

MS 1.24: Pore structure characterization and micro-scale effect on fluid flow in unconventional reservoir

Organizer
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Jingsheng Ma, Heriot-Watt University
Jun Li, King Fahd University of Petroleum and Minerals

Abstract

The development of shale oil/gas will be one significant way to increase energy production. However, shale oil/gas reservoirs have the characteristics of complex and tight pore structure, in which the porosity and permeability are very low, and the fluid flow is non-linear and has Klinkenberg slippage effect in shale gas. So, it's difficult to study the pore-scale flows of shale oil/gas using traditional lab experiments. To address the above issues, the multi-component and multi-scale digital cores will be constructed based on CT scan, focused ion beam scanning electron microscopes (FIB-SEM) and superposition and coupling algorithm. The pore network model will be extracted to reflect realistic 3D topologies, the emphasis of which is to identify micro fracture. Then, the pore structure of shale oil/gas reservoir can be studied. Effect of micro scale on shale oil flow can be explored via Lattice-Boltzmann method and directly solving N-S equation method based on digital core and pore network model. Other kinetic methods (e.g., DSBGK method and DVM) can be used to study the shale gas flows based on the digital rock geometries. Experiments of nitrogen adsorption, pressure decay, intrusive mercury and displacement for shale samples can also be implemented to complement the numerical study. These researches will uncover the characteristics of pore structure and the mechanism of pore-scale flow in shale reservoirs, which will provide theoretical foundation for the development of shale oil/gas reservoir.

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MS 1.25: Upscaling Porous Materials with Strong Solid-Fluid Interactions

Organizer
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Co-Organizers
Marcio Murad, Laboratorio Nacional de Computacao Cientifica

Abstract

Porous materials involving intermolecular, electro-chemical or physico-chemical interactions at the pore-level have strong solid-fluid interactions. These interactions are prevalent in media such as expansive soils, food stuff, coalbed methane, shale gas reservoirs, batteries, paper and biomaterials. The solid-fluid interactions are a consequence of several features such as nano-sized pores, charged solid surfaces, solute adsorption resulting in swelling, and other multi-physical interactions. The coupling between charges, electric fields, deformation, and hydration in single and multiphase flow create challenges in developing and implementing appropriate multiscale models capable of capturing in an accurate fashion the effective-medium behavior. Here we discuss challenges associated with strong solid-fluid interactions such as unknown or poorly understood physics and chemistry at the microscale, complex features arising in the up-scaling process along with numerical and experimental issues.

References

Provided URLs
http://math.wsu.edu/faculty/lschreyer/
http://www.lncc.br/~murad/

MS 1.26: Fundamentals and applications of foam in permeable media

Organizer
Valentina Prigiobbe, Stevens Institute of Technology
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Martin Ferno, University of Bergen
Anthony Kovscek, Stanford University
Abstract

In the recent years, the study of foam stability and transport in permeable media has gained renewed attention from the scientific community across various fields of engineering and sciences. In particular, the recent synergy in the use of surfactants, polymers and/or particulates (colloids and nanoparticles) has opened new application frontiers in shale gas resources and contaminated site remediation. Smart combinations of foam agents has improved foam stability and increased apparent foam viscosity at high internal gas phase volumetric fraction.

Significant progress has been made in previous decades to understand the fundamental processes of foam generation and destruction, as well as the mathematical description of foam transport in porous media. However, underlying physical mechanisms of foam transport through permeable media at the relevant conditions for the new and emerging applications are not yet well understood.

This session focuses on the recent developments in the study of transport of foam in permeable media and welcomes experimental and theoretical contributions from the engineering and sciences that improve our understanding of the complex behavior of foam at different scales, i.e., from microfluidics to field applications.

References

MS 1.27: Pore Scale Processes and Upscaling of Flow and (Reactive) Transport in Porous Media

Organizer
Tom Bultreys, Imperial College London
Co-Organizers
Amir Raoof, Utrecht University
Veerle Cnudde, Ghent University
Stefanie Van Offenwert, Ghent University
Abstract

In this mini-symposium, we invite contributions that integrate experiments and numerical modeling

in the quantification and upscaling of (single phase and multi-phase) flow and (reactive) transport processes in porous media from the pore to the core (laboratory)-scale. This is aimed to result in effective macro-scale parameters which may be used in continuum scale models, by characterizing flow and reactive transport behaviour based on processes taking place at the pore scale.
The processes which affect fluid flow and reactive transport in porous media span a wide range of spatial and temporal scales (from molecular adsorption and interfacial jump at a front to geologic dispersion at regional scales). At different scales, different physics may dominate, and thus shape the aggregated behaviour of the transport process which emerge at the (typically large) application scale. To resolve processes at dominant scales and advance the science required for upscaling pore scale phenomena to operational scales, we need to combine theoretical and numerical models (e.g. CFD and pore network models) with advanced observational and experimental (e.g. micromodel, column and X-ray micro-CT) approaches.
We invite contributions on topics including (but not limited to): multi-scale computational and experimental studies of multiphase flow, reactive solute transport, pore scale visualization of dynamic processes, virus and colloid adsorption and transport, biofilm growth, dissolution and precipitation reactions, as well as contact line and interface movement.

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MS 1.28: Coupled chemo-mechanical processes in fractured and nano-porous media

Organizer
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Albert Valocchi, University of Illinois at Urbana-Champaign
Abstract

Over the past decade materials containing fractures and nano-pores (e.g., shales, carbonate rocks, nano-composites) have become increasingly important for emerging subsurface activities such as unconventional gas and oil resources, geologic storage of CO2, geothermal energy recovery, and nuclear waste disposal. These activities typically involve injecting and/or extracting fluids, perturbing stress conditions, and treating highly concentrated or supercritical phase fluids. As a result, coupled chemo-mechanical processes involving flow and reactive transport at a range of pressure and temperature can lead to complex behaviors that change pore topology (e.g., precipitation, dissolution, compaction, and fracturing) and geophysical properties (e.g., permeability, elastic/plastic properties) across spatial and temporal scales. This is especially true for nano-porous materials because of their enormous physical and chemical heterogeneity across scales and high surface to volume ratio. Accurate prediction of coupled chemo-mechanical processes also requires realistic representation of pore structure, topology, and composition/mineralogy. Multiscale and multiphysics analysis of coupled processes in fractured and nano-porous media with broad compositional range and physical and chemical heterogeneity will enhance a fundamental understanding of poromechanical and flow responses of these media. This session invites laboratory experiments, the state of the art imaging and numerical simulations, and field studies focusing on the characterization of fractured and nano-porous materials, and coupled

chemo-mechanical processes and their impact on poromechanical and flow responses during fluid-solid interactions.
References

MS 1.29: Macroscopic modelling of interfacial transport phenomena in porous media

Organizer
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J. Alberto Ochoa-Tapia, Universidad Autonoma
Didier Lasseux, I2M Bordeaux
Abstract

Macroscopic modeling of reactive or bio-reactive transport phenomena in porous media or at a fluid-porous interface is very challenging due to numerous industrial or environmental applications : pyrolysis of biomass, bone growth, biofilms development, solidification of multi-components mixture. The challenges concern the structural evolution of the porous media with time, the description of the interfacial growth velocity, the macroscopic representation of transport phenomena at the fluid-fluid, fluid-porous or fluid-solid interfaces, including local slip conditions and inertial effect. Numerical solution of macroscopic conservation equations coupled with solution of the associated closure problem should allow the description of the time evolution of the effective transport properties. These challenging points represent the main objective of the present mini-symposium.
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MS 1.30: Water movement in porous media under microgravity

Organizer
Kosuke Noborio, Meiji University
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Masaru Mizoguchi, The University of Tokyo
Abstract

Long-term space mission needs to provide enough carbohydrate to astronauts during their mission. Previous research indicated that water was hindered to infiltrate into porous media. This was against our current knowledge based on Richards' equation. Since microgravity affects the contact angle between water and solid, metric potential may become smaller at the same volumetric water content. It is still challenging for us to understand how water moves in porous media under microgravity. We would like to propose a minisymposium addressing recent research results and future work.
References

Provided URLs
http://www.meiji.ac.jp/cip/english/
http://www.u-tokyo.ac.jp/en/index.html

MS 1.31: Theoretical and computational descriptions of hysteresis in multiphase flow in porous media

Organizer
Abdullah Cihan, Lawrence Berkeley National Laboratory
Co-Organizers
Robin Zhao , Massachusetts Institute of Technology
Abstract

This mini-symposium focuses on hysteresis in multiphase flow in porous media, which has important implications in subsurface technologies (e.g., geologic carbon storage, exploitation of conventional and unconventional oil and gas reservoirs, geothermal energy, underground nuclear waste storage, and protection of groundwater aquifers) and chemical and biological sciences (e.g., microfluidics, fluid transport in plants). Advanced modeling approaches supported by experimental data can help further our understanding of the impact of hysteresis, leading to more effective strategies in solving existing subsurface energy and environmental challenges.
The main focus areas of this mini-symposium involve advanced modeling approaches that incorporate physical and chemical mechanisms of hysteretic fluid flow at both the microscopic and the macroscopic scale. Possible applications include but not limited to gravity and capillary dominated redistribution of CO2 in post-injection geological carbon storage, flow in hydraulically fractured reservoirs, and gravity-driven fingering in unsaturated soil.
The topics covered in the symposium are expected to include recent trends and new developments in mathematical modeling of hysteresis, theory of multiphase flow, upscaling, and multiscale modeling approaches that have demonstrated applicability. We aim to bring scientists and engineers in various fields to present their latest findings and to promote collaborations.

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https://eesa.lbl.gov/profiles/abdullah-cihan/
http://www.robinzhao.com/about

MS 1.32: Sorption, Phase Behavior, and Fluid Transport in Fractured Black Shales

Organizer
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Co-Organizers
Zhehui Jin, University of Alberta
Qinjun Kang, Los Alamos National Laboratory
Abstract

Black shale formations are complex porous media, because a large fraction of the fluids-in-place reside in pores with diameters that are comparable to the size of the molecules themselves. In conventional reservoirs, once the porosity is known so is the total fluid volume. In nano-porous shale, however, fluid-rock interactions cannot be neglected. Surface adsorption results in heterogeneous density profiles within small pores and even the pressure is not clearly defined. The amount of adsorption depends on the pore sizes and their specific surface areas as well as mineral composition, with clay and organic minerals contributing most adsorption sites. Surface wetting is important because water and light hydrocarbons compete for adsorption sites. Dissolution of, e.g., methane into the organic solid matter can also be significant.
In addition to estimates of fluids-in-place, the transport mechanisms in shale are also poorly understood. Knudsen diffusion, Klinkenberg slippage, dusty gas models, and Hagen-Poiseuille flow have all been used to describe transport in nano-porous media but challenges remain in fully establishing the driving force when densities are heterogeneous, pressures ill-defined, and velocity profiles under debate. Natural and induced fractures pose additional challenges, as does phase behavior under nano-scale confinement, exhibiting, e.g., shifts in critical points.
We solicit submissions related to recent experimental, theoretical, and numerical advanced made in describing sorption, anomalous phase behavior and fluid transport in shale from the nano-meter to the reservoir scale.

References

Provided URLs
http://u.osu.edu/moortgat

MS 1.33: Physico-Chemical Fluid Dynamics of Enhanced Oil Recovery

Organizer
Mikhail Panfilov, Université de Lorraine
Co-Organizers
Igor Bogdanov, laboratoire CHLOE, Université de Pau
Igor Bondino, Total
Abstract

The mini-symposium addresses the fundamental aspects of miscible, chemical and microbiological EOR techniques. They are all based on the general model of multi-component two-phase or three-phase flow in porous media. The partial miscibility of the species in the phases and the phase transitions are possible. A particular component is a bacterial population, which can initiate chemical reactions between other species. The impact of compositional effects and the effects of population dynamics on the pore-scale and the macroscale behavior of the system is the objective of the mini-symposium. New physical mechanisms, new mathematical models and solutions, new effects discovered experimentally or theoretically form the basis of the expected presentations.
References

GS 2: Computational challenges in porous media simulation

Organizers
Inga Berre
Sorin Pop
Jun Yao

MS 2.01: Pore-Scale Modeling and Experiments on Multiphase Flow in Porous Media

Organizer
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Co-Organizers
Bo Guo, Stanford University
Chaozhong Qin, Eindhoven University of Technology
Philip Kunz, University of Stuttgart
Abstract

Pore-scale flow physics and chemical reactions in porous media play a critical role in the macroscopic processes of interest in a broad range of applications, including hydrocarbon production, geological carbon storage, groundwater contamination, and many other industrial applications, e.g., fuel cells, batteries, and inkjet printing. Modeling and experiments at the pore-scale give better understanding of the pore-scale phenomena, and provide quantitative information for macroscale models. Thanks to recent advances in computational and imaging techniques, direct simulation of multiphase flow in porous media has gained much attention. This minisymposium is dedicated to bring together scientists who investigate pore-scale multiphase flow in porous media to discuss recent achievements in research and industry.

We seek novel contributions that highlight recent advances in but not limited to direct simulations, pore-network modeling, microfluidic experiments, and non-invasive visualizations of reacting and non-reacting multiphase flow in porous media. Comparisons of modeling with analytical solutions and/or experiments are encouraged. We also particularly invite modeling studies on wetting behavior, multiphase treatment as well as reacting multiphysics systems with no restrictions on numerical methods.
References

MS 2.02: Modeling and simulation of subsurface flow at various scales

Organizer
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Co-Organizers
Jun Yao, China University of Petroleum (East China)
Abstract

Modeling of flow and transport in subsurface porous media is an essential component of many scientific and engineering applications, with increased interests in recent years. Application areas vary widely, and include groundwater contamination, carbon sequestration, petroleum exploration and recovery, and many others. Traditional modeling approaches focusing on Darcy' s scale simulation has obtained great successes. However, new challenges, especially the challenges from unconventional oil and gas reservoirs, demand the understanding of porous media flow at smaller scales from the pore scale to the molecular scale. In addition, accurate mathematical and numerical simulation remains a challenging topic from many aspects of physical modeling, numerical analysis and scientific computation. We invite speakers to present their original research work as well as review talk describing the recent advances in mathematical modeling, computer simulation, numerical analysis, and other computational aspects of flow and transport phenomena in subsurface porous media at various scales. Potential topics include, but are not limited to: 1) advanced numerical methods for the simulation of subsurface flow and transport; 2) new methods including LBM and Pore-network are also encouraged. Spatial discretization schemes based on advanced schemes that preserve local mass conservation (such as mixed finite element methods and discontinuous Galerkin methods) are of particular interest; 3) modeling and simulation of multi-phase flow in subsurface porous media at pore scale and molecular scale; 4) computational thermodynamics of fluids, especially hydrocarbon and other oil reservoir fluids, and its interaction with flow and transport.
References

MS 2.03: Challenges in flow and transport simulations in poro-fractured media: numerical methods and modeling

Organizer
Stefano Berrone, Politecnico di Torino, Italy
Co-Organizers
Jeffrey Hyman, Los Alamos National Laboratory, USA
Sandra Pieraccini, Politecnico di Torino, Italy
Abstract

Subsurface flow and transport simulations in poro-fractured media must address many inherent challenges ranging from the fracture network geometrical complexity, which makes the mesh generation process an issue; the complex physical phenomena involved, which require a suitable modeling; the intrinsically large scale nature of applicative problems, calling for the development of very efficient numerical methods with a special attention to HPC aspects; the large uncertainty in the parameters describing the geometry and the hydro-geological properties of the problem, requiring special approaches for uncertainty quantification analysis, which on its own calls for a large amount of simulations, making robustness a further issue.
Discrete Fracture Network (DFN) and Discrete Fracture Matrix (DFM) models allow for an explicit representation of the interconnected fractures network that are the primary pathways for flow and transport. The detailed description of the network allows DFN to model a wider range of transport phenomena than traditional continuum methods. However, the inclusion of detailed geometry poses several additional challenging numerical issues. Furthermore, in several contexts, reliable simulations may require a coupling between the several phenomena affecting the dynamic of poro-fractured media.
The main focus of the mini-symposium will be on recent advances in numerical methods and modeling techniques for addressing these issues.

References

MS 2.04: Transport phenomena in solvent-aided thermal recovery of heavy oil and bitumen

Organizer
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Mohsen Zirrahi, University of Calgary

Abstract

Thermal recovery methods have been applied in the past decades to produce highly viscous bitumen from oil sand reservoirs. Thermal recovery involves steam generation and injection to subsurface oil sand reservoirs to mobilize and drain bitumen toward a production well. However, efficient application of thermal energy has been a challenge and has been more pronounced lately due to low oil prices. These methods are energy intensive, require treatment of large volumes of water, and emit excessive carbon dioxide. Addition of solvents to steam has shown promise in reducing energy intensity and environmental impacts of thermal methods.
Steam/Solvent co-injection processes involves complex transport phenomena in porous media. Non-isothermal, multi-component and multiphase flow of diluted bitumen/water/steam pose important research challenges. Better understanding of the coupled processes during solvent-aided thermal recovery provides a prospect to reduce energy intensity and negative environmental impacts of bitumen production.
This mini-symposium invites experts from universities, research organizations, and industries to discuss the challenges and opportunities we are facing in design, modeling and experimentations of solvent-aided thermal recovery methods. This minisymposia addresses experimental and theoretical studies with focuses on:
• Transport phenomena during thermal and solvent-aided recovery processes;
• Diffusion of solvents in bitumen;
• Solvent and steam condensation in porous media;
• Foamy oil flow in heavy oil and bitumen reservoirs;
• Emulsion formation in solvent-aided recovery methods;
• Asphaltene precipitation in solvent-aided processes;
• Reactive flow and transport during thermal and solvent-aided thermal processes;
• Surface and interfacial properties in bitumen and heavy oil recovery methods;

References

Provided URLs
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MS 2.05: Modeling and Controlling of Viscous Fingering in Miscible and Immiscible Displacements in Subsurface Porous Media

Organizer
Qingwang Yuan, University of Regina (will be in Stanford University from December 1, 2017)
Co-Organizers
Jinjie Wang, China University of Geosciences
Abstract

Single and multiphase flows and transport in subsurface porous media are widely encountered in the environment-energy nexus such as underground water contamination, CO2 sequestration, oil and gas enhanced oil recovery, and geothermal recovery. The flow instabilities, or the so-called viscous fingering (VF), are commonly observed under unfavorable viscosity contrast of displacing and displaced fluids. Establishing proper theoretical models and accurate simulation of VF in porous media are essential for the understanding of the instability mechanisms. Moreover, the control of VF in displacement processes, either enhancement or mitigation, is significantly important for the contaminant transport, CO2-brine drainage, and oil, gas and geothermal energy recovery efficiency. This proposed mini-symposium offers researchers an opportunity to present their latest results and to exchange research ideas. In this session, we invite researchers to present their recent advances on theoretical and physical modeling of VF in subsurface porous media. The topics of interest include, but not exclusively: 1). The control of VF in porous media and Hele-Shaw cell encountered in environmental and energy sectors; 2). Interfacial propagation and miscible displacements in porous media with and without heat transfer, reaction, phase change, inertia and heterogeneity; and 3). Fundamental investigations on instability mechanisms, experimental studies, accurate numerical modeling of temporal development of VF, and highly efficient computational techniques.
References

MS 2.06: New Trends in Image Processing: From Discrete Tomography over Machine Learning to in-situ Contact Angle Measurement

Organizer
Steffen Berg, Shell Global Solutions International B.V.
Co-Organizers
Nishank Saxena, Shell International Exploration and Production Inc.
Ryan Armstrong, University of New South Wales
Peyman Mostaghimi, University of New South Wales
Andreas Wiegmann, Math2Market GmbH
Frieder Enzmann, Johannes Gutenberg University Mainz
Abstract

While image processing as such is an established field which as such does not necessarily warrant a minisymposium. However there are new trends both on the processing of raw data and the post-processing of segmented data to extract specific properties like contact angle which deserve a minisymposium to exchange experience and identify promising solutions.. This minisymposium addresses some of the new trends and the following specific topics are proposed:

- Segmentation during tomographic reconstruction reconstruction [1]
- Filtering and correction of artifacts before reconstruction, or before segmentation
- Novel segmentation methods [2]
- assisted clustering with spatial correlations [4]

- machine learning and artificial intelligence methods [3,4,5]
- property calculation in post-processing
- curvature / capillary pressure and contact angle (direct, morphological methods)
- Minkowski functionals [6]
- impact of image artifacts and sub-voxel features on resulting properties
- in porous media related to earth sciences, membranes and fabrics, fuel cells, batteries, biological applications and more.

References

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[4] Khan et al., Multi-phase classification by a least-squares support vector machine approach in tomography images of geological samples, Solid Earth 7, 481-492, 2016.
[5] Andrew et al. Pore-scale contact angle measurements at reservoir conditions using X-ray microtomography, Adv. Water Resour 68, 24-31, 2014.
[6] Herring at al. Effect of fluid topology on residual nonwetting phase trapping: Implications for geologic CO2 sequestration, Adv. Water Resour., 62(Part A), 47–58, 2013.

MS 2.07: Prediction of the thermal conductivity of porous materials

Organizer
Hans Janssen, KU Leuven, Building Physics Section
Co-Organizers
Dominique Baillis, INSA Lyon, LaMCoS laboratory
Prabal Talukdar, Indian Institute of Technology Delhi, Department of Mechanical Engineering
Benoit Nait-Ali, Université de Limoges, ENSIL-ENSCI
Abstract

The thermal conductivity of porous materials is a crucial parameter in many industrial and scientific environments. Illustratively, this property controls the insulating value of building and construction materials, the heat exchange efficiency of metallic and ceramic foams, and the effectiveness of drying and sintering processes. Knowledge of and insight in this parameter is hence very important for many industrial and scientific applications.
In the past, the thermal conductivity of the involved porous materials was most often determined experimentally, which limits the spectrum of materials and variations that can be swiftly characterized. In more recent years hence, research is focusing on the prediction of the thermal conductivity of porous materials, via analytical and numerical methods. Analytical methods make use of heat transport solutions for simplified (unit) structures while numerical approaches model the heat transfer mechanisms in a discretised pore-scale model of the material. Several international research groups are at present working on this theme, each though based on their respective focal materials and applications. There is though much common ground in all these research activities, and this minisymposium ‘Prediction of the thermal conductivity of porous materials’ aims at exploiting and enhancing these potential synergies. Given the number of organisers backing this minisymposium, a significant number of abstracts is expected, illustrating the value and weight of

this research topic within the porous materials world.

References

Provided URLs
http://web.iitd.ac.in/~prabal/#home

MS 2.08: Recent Advances in Multiscale Methods and Uncertainty Quantification

Organizer
Felipe pereira, Mathematical Sciences Department, The University of Texas at Dallas, Richardson, TX, USA
Co-Organizers
Eduardo Abreu, Department of Applied Mathematics, Institute of Mathematics, Statistics and Scientific Computing, University of Campinas, Campinas, Sao Paulo, Brazil.
Arunasalam Rahunanthan , Department of Mathematics and Computer Science, Central State University, Wilberforce, Ohio, USA
Fabricio Sousa, Department of Applied Mathematics and Statistics, Institute of Mathematics and Computer Sciences, University of Sao Paulo, Sao Carlos, Sao Paulo, Brazil

Abstract

We are concerned with fast and accurate multiscale numerical methods for the simulation of multiphase porous media flows and effective methods for the characterization of heterogeneous reservoirs.

For porous media flows we propose to examine the accuracy of multiscale mixed methods, the development of informed spaces for the construction of multiscale basis functions, their parallel implementation in multi-core systems and how distinct methods compare with each other. Also of interest to this mini-symposium is the comparison of such computational methods with related finite volume procedures. We are interested in contributions aiming at applications at the field, Darcy and pore scales.

For porous media flows at the field scale we intend to discuss recent progress in the development of effective Markov chain Monte Carlo (McMC) methods for reservoir characterization. We are interested in effective McMC procedures as well as related procedures for uncertainty quantification.

The organizers of this mini-symposium welcome contributions both on the integration of existing multiscale methods and methodologies for uncertainty quantification as well as on recent research describing progress in individual research areas involved in this proposal.

References

Provided URLs
http://www.utdallas.edu/math/832/felipe-pereira/

MS 2.09: Fluid flows and transport processes in the porous media affected by heterogeneities [auto created title]

Organizer
Jun Yao, China University of Petroleum (East China)
Co-Organizers
Qingfu Zhang, China University of Petroleum (East China)
Zhaoqin Huang, China University of Petroleum (East China)

Abstract

Fluid flows and transport processes in the porous media are affected by heterogeneities in a wide range of scales [1]. It is a challenging problem to resolve numerically all of the scales in flow numerical simulation. The multiscale methods are designed to efficiently capture the fine-scale heterogeneous influence without resolving all the fine scale features. These methods are, therefore, applicable for multiscale problems and become a hot issue these years. The development of multiscale numerical methods for the solution of partial differential equations with heterogeneous coefficients across scales has received increasing attention over the years [2]. We also made several contributions to the extension of multiscale methods during the past few years: (1) We study the two-phase porous flow in strong heterogeneous reservoirs [3]; (2) We developed an accurate and efficient multiscale numerical scheme for two-phase flow in fractured reservoirs and extend it to fractured-vuggy reservoirs [4-5]; (3) A multiscale mimetic method was developed for the simulation of multiphase flow in fractured media in the context of an embedded discrete fracture model [6]; (4) We develop a hybrid multiscale algorithm for coupled geomechanics and flow simulation; (5) Recently, we propose a near-linear complexity multigrid method with multiresolution decomposition for solving flow problems in fractured porous media. Lots of researchers have made great contributions to the application of multiscale methods towards flow simulation. This proposal is to gather scientific frontier in this field and provide a platform for focused discussions.

References

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MS 2.10: Advanced finite-volume methods for flow and transport in porous media

Organizer
Matteo Cusini, Delft University of Technology
Co-Organizers
Martin Schneider, University of Stuttgart
Hadi Hajibeygi, Delft University of Technology
Rainer Helmig, University of Stuttgart
Abstract

The accurate description of multiphase flow processes is essential for a variety of engineering applications involving porous media (e.g., technical, biological and environmental applications).
Numerical simulations of such processes demand for resolving several challenges due to the scales at which the processes are resolved, the complex fluid and media physics, and their chemical interactions. These processes often involve high contrasts in space (resolution gap between that of the parameters description and the scale of the process) and time scales (slow processes coexisting with fast ones) and coupled unknowns of different natures (local and global). Consequently, the need for accurate and efficient numerical simulations motivates the development of advanced simulation methods.
Finite-volume-based schemes have been widely employed for the simulations of flow and transport processes and have greatly evolved over the past years both at non-linear and linear levels. This mini-symposium strives to review recent advancements in control-volume based methods. These include advanced discretisations, non-linear finite-volume schemes and innovative strategies to represent the coupled processes at different scales (namely, multiscale and model reduction techniques). The aim of the mini-symposium is to favour synergies and fruitful discussions between the researchers of this active field.
References

MS 2.11: Advances in coupled flow and geomechanical processes in fractured porous media

Organizer
Christine Maier, Heriot Watt University
Co-Organizers
Inga Berre, University of Bergen
Florian Doster, Heriot Watt University
Sebastian Geiger, Heriot Watt University
Abstract

Coupling flow dynamics with geomechanical processes in fractured porous media is of high importance in various areas such as geothermal energy extraction, production of carbonates from naturally fractured or hydraulically enhanced reservoirs, caprock integrity during gas injection or induced seismicity through wastewater injection. The in-situ stresses are affecting the permeability and therefore the flow behaviour in the fractures as well as the matrix porous media while the fluid propagation is alternating the effective stresses causing potential failure of the material but also closure or opening of the preexisting fractures and faults. This mini-symposium provides a platform for presenting advancements in numerical and physical models for coupling fluid flow and geomechanics in fractured porous media. Submissions of contributions that help to close the gap between application needs and fundamental research are especially welcomed.
References

MS 2.12: High order schemes for simulation of flow and transport in porous media

Organizer
Todd Arbogast, University of Texas at Austin
Co-Organizers
Abstract

Fluid phase behavior, chemical reactions, buoyancy, and formation heterogeneity can induce complex behaviour in the solution to the equations governing flow and transport in porous media. Steep gradients that are nearly shocks can form in the saturation and/or concentrations of chemical components within the fluid, and highly channelized flow can be characteristic of some geologic formations. High order accurate numerical schemes can be used to approximate the flow field and to capture the saturations/concentrations near steep gradients, allowing accurate simulation of complex flow and transport in porous media. This mini symposium will bring together researchers working on various numerical schemes designed to give relatively high-order accurate approximation of flow and transport. Work on finite volume and finite element methods, including WENO, discontinuous Galerkin, and enhanced Galerkin schemes, will be considered.

References

Provided URLs
https://www.ma.utexas.edu/users/arbogast/

MS 2.13: Advances in numerical modelling of multiphase flow and transport in fractured porous media

Organizer
Konstantin Brenner, Univercity Nice Sophia Antipolis
Co-Organizers
Abstract

The numerical modelling of multiphase flow and transport in fractured porous media remains a challenge.The fracture networks occur at different scales of natural porous media. Acting as the drains or the barriers they alter dramatically the large scale hydraulic properties of the porous media. Having a paramount effect on flow and transport process, the fracture networks possess a complex and highly uncertain geometries, which urges for the accurate, efficient and robust simulation tools.

This mini-symposium aims to bring together researchers working on developing of new mathematical models,
numerical schemes, and efficient linear and nonlinear solvers dedicated to numerical simulations of

multiphase
flow and transport in fractured in porous media to discuss recent advances on this topic.

References

MS 2.14: Numerical methods for processes in fractured media

Organizer
Géraldine Pichot, Inria
Co-Organizers
Alessio Fumagalli, University of Bergen
Elyes Ahmed, University of Bergen
Abstract

In many energy and environmental applications (oil reservoirs, geothermal energy production, nuclear waste storage, CO2 storage, groundwater resources, …), fractures play a major role as their characteristics (notably their permeability and aperture) may be orders of magnitude different from those of the surrounding rock matrix. This affects deeply the different physical (mechanical, hydraulic and thermal) and/or chemical phenomena involved. Moreover, their great variety in size (from a few centimeter to kilometers) and their organization in networks require dedicated efficient and robust numerical methods. The objective of this mini-symposium is to have an overview of recent numerical methods to handle fractures in underground processes.
References

Provided URLs
https://www.irisa.fr/sage/geraldine/
http://www.uib.no/en/persons/Alessio.Fumagalli
http://www.uib.no/en/persons/Elyes.Ahmed

MS 2.15: Modelling and Simulation of Porous Media: From Microstructure to Functionality

Organizer
Sarah Staub, Fraunhofer ITWM
Co-Organizers
Andreas Wiegmann, Math2Market
Abstract

Modelling and Simulation of Porous Media: From Microstructure to Functionality

Porous media, as e.g. nonwovens, paper or foams, are essential in many applications in a wide field. Examples for these applications are filters, hygiene products, card boards as well as thermal and acoustic insulation materials among many others. The functionality of these products is highly connected to the microstructure of the utilized porous media.
This minisymposium focuses on the modeling and simulation of the resolved microstructure and its

relationship to the functionality of the porous medium. Possible topics are

• Deformation of porous media
• Permeability and flow
• Thermal conductivity and acoustic properties
• Coupled problems as e.g. fluid structure interaction

The aim of the minisymposium is the exchange of researchers from different fields to gain experience for the structure-property relationship of porous media. The understanding of this relationship is indispensable for the digitalized design and optimization of the regarded structures.
The minisymposium is not limited to contributions connected to modeling and simulation. Experimental contributions as well as contributions connected to image analysis and microstructure generation are very welcome as these topics are of great importance for the validation of the methods and the generation of input data.

References

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https://www.itwm.fraunhofer.de/en/departments/sms/staff/sarah-staub.html
https://www.math2market.com/

MS 2.16: Frontiers in understanding of gas migration processes in porous media

Organizer
Radek Fučík, Czech Technical University in Prague
Co-Organizers
Michael Plampin, US Geological Survey
Jiří Mikyška, Czech Technical University in Prague
Andres Clarens, University of Virginia
Michal Sněhota, Czech Technical University in Prague
Abstract

The goal of the minisymposium is to provide a broad overview of conceptual, experimental, and computational challenges that arise in the understanding of physical and chemical processes that are in play during gas flow in porous media. Thorough knowledge of these processes is essential in many different engineering or environmental protection applications such as CO2 sequestration, toxic vapor intrusion risk assessment, hydrocarbon gas extraction or storage, thermal energy storage, evaporation from plants, gas generation during nuclear waste storage, or vadose zone hydrology. This minisymposium offers researchers an opportunity to present their recent results and discuss ideas. In particular, these research topics are welcome:
a) thermodynamics of mixtures
b) compositional flow in porous media
c) phase transitions involving gas
d) multiscale experiments and simulations
e) porous medium-free flow coupling
f) non-isothermal modeling of gas mixtures
g) flow of bubbles in porous medium
h) processes in capillary fringes
i) multiphase flow in clay-rich media

j) gas phase imaging in porous media
h) thermo-hydro-mechanical coupling
and others.
References

Provided URLs
http://mmg.fjfi.cvut.cz/~fucik
https://www.usgs.gov/staff-profiles/michael-r-plampin
http://kmlinux.fjfi.cvut.cz/~mikysjir

MS 2.17: Digital imaging of multi-scale porous materials, and image-based simulation and upscaling of flow properties

Organizer
Arash Aghaei, Thermo Fisher Scientific
Co-Organizers
Arsalan Zolfaghari, University of Kansas
Abstract

Digital imaging techniques such as X-ray Computed Tomography and Scanning Electron Microscopy are used to image and characterize two- and three-dimensional features in porous materials. These images are often used in combination with numerical models to simulate physical phenomena such as fluid flow. An inherent limitation of these models, at any given scale, is their resolution. This limitation becomes more evident when the sample of interest demonstrates multiple scales of features such as in carbonate rocks and tight sands. Characterizing samples at multiple scales, using various image modalities and resolutions, and building multi-scale models are being proposed as a solution to overcome this limitation. In addition, challenges exist in linking different scales that are prevalent in the area of single and multiphase flow in porous media. Such scale-related challenges primarily arise because of the different scales existing between field applications and their corresponding physics at pore levels. To be specific, typical pore sizes and their corresponding pore fluid occupancies range from nanometer to several hundred micrometers. From the application point of view however, typical reservoir scales are in the ranges of miles. The existence of such broad scales of interest could also bring other parameters into play, such as time and volumetric flow rates. These are additional key parameters, specifically, if mass or heat transfer controls the process of interest such as in CO2 EOR. We encourage the submission of manuscripts addressing challenges associated with characterizing multi-scale porous materials, especially those containing imagery and experimental data or field scale results.
References

Direct pore-to-core up-scaling of displacement processes: Dynamic pore network modeling and experimentation
A Aghaei, M Piri - Journal of hydrology, 2015
Pore-scale network modeling of three-phase flow based on thermodynamically consistent threshold capillary pressures. I. Cusp formation and collapse
A Zolfaghari, M Piri - Transport in Porous Media, 2017
The effect of deformation on two-phase flow through proppant-packed fractured shale samples: A micro-scale experimental investigation

M Arshadi, A Zolfaghari, M Piri, GA Al-Muntasheri… - Advances in Water Resources, 2017
Provided URLs
https://www.linkedin.com/in/aaghaei
https://www.linkedin.com/in/arsalan-zolfaghari

MS 2.19: Advances in Observation and Modeling of Coupled Flow and Deformation in Fractured Rock

Organizer
Harihar Rajaram, University of Colorado, Boulder
Co-Organizers
Satish Karra, Los Alamos National Laboratory
Abstract

High-pressure injection of fluids into fractured rock masses is relevant in the context of enhanced geothermal systems, hydraulic fracturing, induced seismicity resulting from deep well wastewater disposal, and geologic carbon sequestration. Although poroelastic modeling of coupled flow and deformation is well established, the additional challenge posed by fractured rock is that fractures are significantly more permeable and compliant than the rock matrix, and will thus strongly control the overall hydro-mechanical behavior. Fractures deform considerably under high fluid pressures, leading to alterations in their aperture/permeability, which in turn influences the evolution of the pressure field. The mechanical behavior of fractures is highly nonlinear, and their normal and shear stiffness both depend on pressure and stress. Modeling these feedbacks and addressing the additional complexity of shear slip events and fracture propagation are crucial to simulation of coupled flow and deformation in fractured rock. Advances in computational technology and algorithms have facilitated the development of simulators that can represent these coupled hydromechanical processes realistically. Several of these simulators explicitly resolve discrete fractures and their nonlinear evolving behavior. Simultaneously, there has been a rapid growth of in-situ monitoring technologies that provide high-resolution measurements of fracturing, multi-dimensional deformation, and tilt. Such high-resolution observations are invaluable for constraining models and understanding the important factors controlling hydro-mechanical behavior. We invite contributions reporting field or modeling studies of coupled fluid flow and deformation in fractured rock.
References

Provided URLs
http://www.colorado.edu/ceae/harihar-rajaram

MS 2.20: Mathematical, physical and computational aspects of chemical enhanced oil recovery

Organizer
Prabir Daripa, Texas A&M University
Co-Organizers
Abstract

Displacement processes during chemical enhanced oil recovery involve multi-component

multi-phase fluid flow in heterogeneous porous formations. Chemical components used in such oil recovery processes not only change the properties of the host fluids but also interact with the formations changing their properties. Thus chemistry and non-Newtonian fluid dynamics play a big role in chemical enhanced oil recovery. Understanding and accurate modeling of these effects in the presence of multi-scale nature of the properties of rock formations pose a significant challenge and requires research in a host of areas including, but not limited to, fundamental fluid dynamics of Newtonian, non-Newtonian and visco-elastic fluid flows in porous media, modeling by an appropriate complex system of PDEs and studies of these associated PDEs, appropriate numerical methods for accurate solutions of these equations that bridge static and dynamic scales across wide range of underlying physical and chemical phenomena, fast and accurate numerical methods and algorithms, quantification of uncertainty involved in predictions using these methods and so on. In this mini-symposium, speakers will address some of these issues.

References

Provided URLs

http://www.math.tamu.edu/~daripa

MS 2.21: Advances in the numerical modelling of multiphase flow and transport in highly heterogeneous porous media

Organizer

Francois Hamon, Lawrence Berkeley National Lab

Co-Organizers

Bradley Mallison, Chevron

Hamdi Tchelepi, Stanford University

Abstract

The numerical simulation of multiphase flow and transport at the Darcy scale is essential for a wide range of applications, including CO2 sequestration in geological formations, oil recovery in fractured media, and geothermal energy production. High heterogeneity creates specific numerical challenges that must be addressed to obtain reliable flow simulations without undermining computational efficiency. Overcoming these challenges is key to more accurately capture the complex dynamics involved in fundamental multiphase flow mechanisms including, but not limited to, counter-current capillary imbibition, non-wetting phase trapping, and capillary hysteresis. This session focuses on contributions presenting recent computational advances tackling the issues arising in the presence of high heterogeneity and fractures through the construction of new modelling approaches or the design of discretization schemes and solution algorithms. We also encourage contributions exploring the numerical coupling between heterogeneous capillary effects and other processes acting on multiphase systems such as geomechanics, thermodynamics, and geochemistry.

References

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* Nilsen, H. M., Lie, K.-A., Andersen, O., “Fully implicit simulation of vertical-equilibrium models with hysteresis and capillary fringe”, CompGeo, 2016

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* Van Duijn, C. J., Cao, X., Pop, I. S., “Two-phase flow in porous media: dynamic capillarity and heterogeneous media”, TiPM, 2016

* Hamon, F. P., Mallison, B. T., Tchelepi, H. A., “Hybrid Upwinding for two-phase flow in heterogeneous porous media with buoyancy and capillarity”, accepted in CMAME, 2017

MS 2.22: Advances in decision making and risk assessment approaches for geologic CO2 storage and fossil energy extraction applications

Organizer
Rajesh Pawar, Los Alamos National Laboratort
Co-Organizers
Daniel Tartakovsky, Stanford University
Abstract

Predictions of long-term behavior of complex systems are being increasingly used in informing the decision making process and risk assessments of various subsurface applications including, geologic CO2 storage and fossil energy extraction. The performance of subsurface systems and reservoirs strongly depends on fully coupled thermo-hydro-mechanical-chemical processes that can take place at multiple length scales (nano-meters to kilo-meters) and temporal scales (seconds to centuries). The geology of subsurface can be very complex, including presence of discontinuities such as faults and fractures. Additionally, the predictions and decisions need to take into consideration effect of uncertainties in the knowledge and parameters. In recent years significant progress has been made in improving the understanding of coupled processes taking place in geologic CO2 storage sites as well as conventional and unconventional fossil energy reservoirs through advanced experimental and analytical techniques. Similarly, the field of numerical modeling has advanced through development of advanced simulation approaches, novel numerical algorithms and applications of machine-learning and data-driven approaches. This mini-symposium provides a forum for researchers to exchange ideas on advancing the state-of-the-art of approaches to predict long-term behavior in order to effectively manage subsurface fossil energy extraction and storage sites. We welcome contributions on innovative laboratory experimental approaches, advanced simulation approaches, novel numerical algorithms including applications of machine-learning and data-driven approaches.
References

MS 2.23: Network Models

Organizer
Alex Hansen, NTNU
Co-Organizers
Abstract

Network models have lately ended up in the shadow of models that resolve the flow at the pore scale. However, network models and pore scale models address very different questions. It is the aim of this mini symposium to highlight these differences and to probe the state of the art of network models.
References

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[2] S. Sinha et al. Transp. Porous Media, 119, 77 (2017).

Provided URLs
http://www.porelab.no

MS 2.25: Hierarchical Flow Modelling in Biological Systems

Organizer
Ingeborg Gåseby Gjerde, University of Bergen
Co-Organizers
Cécile Daversin-Catty, Simula Research Laboratory
Marie Elisabeth Rognes, Simula Research Laboratory
Jan Martin Nordbotten, University of Bergen
Abstract

The modelling of biological systems frequently gives rise to multiscale problems, in space, time and structure. This is due to the diverse scales on which physical and chemical processes such as flow and transport can take place. If these scales cannot be fully resolved, one option is to simplify the model by viewing it as a system of PDEs defined on domains of heterogenous dimensions.

An example of this can be found in modelling of the brain, where the vascular network plays a key role in the flow of fluids and solute transport [1, 2]. As the arteries have negligible radii compared to their length, it is natural to view them as 1D transport lines embedded in a 3D porous medium. Similarly, membranes and other (semi-)permeable barriers may be considered as 2D surfaces in what ultimately becomes a mixed-dimensional model.

In particular, we therefore consider porous media which may consist of PDEs defined on an n-dimensional domain, coupled together with n-d dimensional PDEs (e.g., n = 3, d = 0, 1, 2). This type of system exists in several other applications, including fracture and well-models in geosciences, reinforced materials, electromagnetic modelling, etc [3]. This minisymposium invites participants to present their works on applications involving such hierarchical modelling, or on computational approaches for solving these type of problems.

References

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Preconditioners for saddle point systems with trace constraints coupling 2d and 1d domains. SIAM J. Sci. Comput. 38 (2016), no. 6, B962–B987.

[3]: Boon, W. M., Nordbotten, J. M., Vatne, J. E., Mixed-dimensional partial differential equations. Preprint: http://arxiv.org/abs/1710.00556

MS 2.26: Modeling, simulation and validation of filtration problems

Organizer
Galina Printsypar, University of Oxford
Co-Organizers
Oleg Iliev, Fraunhofer Institute for Industrial Mathematics, ITWM
Gareth Morris, Dyson Ltd.
Abstract

A lot of research has been dedicated to studying the vital process of air, water, and other fluids filtration. Specifically, the mathematical modeling is becoming an essential tool in advancing the knowledge and improving the technologies of the contaminant separation strategies. Computer simulations are used a common tool in daily work of engineers designing filters or planning operation regimes of filtration devices. Validation in comparison with experiments is an important component of establishing models and algorithms. The proposed minisymposium aims to bring together researchers and engineers working on the mathematical modeling, numerical simulations, and experimental validation in the area of porous media flows with application to filtration problems. The applications include but are not limited to filtration of contaminants from air, oil, water, etc. using non-woven, ceramic, and other filter media, forward and reverse osmosis, purification of water using functionalized membranes, and other membrane technologies.
References

Provided URLs
https://www.maths.ox.ac.uk/people/galina.printsypar
https://www.itwm.fraunhofer.de/de/abteilungen/sms/mitarbeiter/oleg-iliev.html

GS 3: Experimental achievements

Organizers
Al Cunningham
Linda Abriola
Phil Vardon

MS 3.01: Application of NMR Methods to Porous Media:

Organizer
Andreas Pohlmeier, Research Center Jülich, Germany
Co-Organizers

Christoph Arns, University of New South Wales, Sydney, Australia
Matthias Appel, Shell Oil Company, Houston, Texas, USA

Abstract

Nuclear Magnetic Resonance (NMR) has become one of the most powerful non-invasive methods for characterizing the dynamics of liquids in natural and technical porous media from the pore- to the decimeter scale. Characteristic is its great versatility with respect to target quantities like fluid content, relaxation properties, diffusion coefficients, or velocities. These different NMR methods, either integral or as MRI, are applied for the characterization of structures and dynamic processes in diverse scientific and commercial fields like natural resources exploration, geosciences, mechanical engineering, food analysis, and biosciences. Increasingly, the link between theory and experiments is strengthened by numerical simulations which vice versa stimulate new experimental approaches. Therefore, this mini-symposium intends to join scientists from academia and industry who are interested in further development and application of NMR and MRI in natural and artificial porous media.

References

MS 3.02: Fluid Interactions with Thin, Fibrous Porous Media

Organizer
Nicolae Tomozeiu, Océ-Technologies B.V.
Co-Organizers
Andrew Baker, Kimberly-Clark Corporation
Hamed Aslannejad, Utrecht University

Abstract

This mini-symposium is aiming to overview the current status of experimental achievements and theoretical modeling in the fields of thin, fibrous porous media (TFPM), and their interactions with fluids: vapor and liquids (with and without particles). This topic is of current interest and of great relevance for the paper industry, printing technologies, personal care products, packaging, fuel cells, geotextiles, etc. Theories, experimental methods for exploring the physico–chemical interactions, as well as computational simulations to describe the fluid transport on and into TFPM are addressed in this mini-symposium.
Simple or complex (mixtures of liquids and small particles) fluids in contact with TFPMs are subject to spreading, absorption, diffusion and capillary suction processes, while the TFPM may deform due to swelling processes. Understanding of the physico-chemical processes involved in these interactions is needed. The need for improvement of measurement techniques such as: electro- and optical-spectroscopy, three dimensional imaging, and advanced gravimetric techniques as well as more powerful computational models is driven by the increasing diversity and complexity of the small droplets / thin-layered and nano-scaled materials used in industrial applications.

Topics:
- Thin Fibrous Porous Media (TFPM): properties and characterization;
- Liquid absorption /diffusion in TFPMs;
- Surface modification of fibers and implications on liquid transport through / into TFPMs;
- Fiber mechanics considering the swelling level and implications into fluid transport properties;
- From process modeling to the real industrial applications of TFPMs;
- Hydro-expansion and dimensional stability of TFPMs in presence of moisture;

- Complex structures formed with TFPMs;

References

Provided URLs
https://www.oce.com
http://www.kimberly-clark.com
http://www.geo.uu.nl

MS 3.03: Transient transport phenomena in porous media (imbibition, drying, particle transport, etc): recent physical insights gained from internal measurements

Organizer
Philippe COUSSOT, Univ. Paris-Est
Co-Organizers
Leo PEL, Tech. Univ. Eindhoven

Abstract

Processes involving complex transport phenomena in porous media, such as drying, imbibition, colloid transport, are ubiquitous in industrial and environment. They have so far often been considered essentially at a macroscopic scale. Various techniques (MRI, Neutron scattering, X-Ray Microtomography, etc) now offer direct internal imaging on the liquid or particle distribution, transfer dynamics, local arrangements, 1D concentration distribution, etc, which provide rich information that may be used for detailed comparison with modelling, or for deeper physical analysis. This mini-symposium aims at gathering contributions providing such information, which may or have been used for further physical understanding of these processes.

References

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MS 3.04: Micro and nano fluidic approaches for studying flow, transport and crystallization processes in porous media

Organizer
Noushine Shahidzadeh, University of Amsterdam -Institute of Physics
Co-Organizers
Hannelore Derluyn, CNRS/TOTAL/Univ Pau & Pays Adour, Laboratoire des fluides complexes et

leurs reservoirs-IPRA
Daniel Broseta, CNRS/TOTAL/Univ Pau & Pays Adour, Laboratoire des fluides complexes et leurs reservoirs-IPRA
Joaquin Jimenez-Martinez, EAWAG, Swiss Federal Institute of Aquatic Science and Technology and Civil Engineering dept., ETH-Zurich
Abstract

The aim of this mini symposium is to provide a forum of discussion on significant and original experimental work related to pore-scale phenomena at the micro- and nano-scale of interest to a wide range of applications such as oil and gas production, soil mechanics and materials science. Since the kinetics of fluid flow, solute and colloidal transport, and precipitation and crystals growth (e.g. salt or gas hydrates) show a strong scale-dependence, microscale approaches are needed to study liquid and solid transport and crystallization in small volumes for a better understanding of the dynamics of these processes at the pore-scale level. The mini-symposium will summarize the state of the art and new research directions by gathering specialists in the different relevant fields of porous media involved in research through miniaturization.
References

Provided URLs
https://iop.fnwi.uva.nl/scm/

MS 3.05: Advanced methods for micromodel fabrication and diagnostics within

Organizer
Dimitris Nikitopoulos, Louisiana State University, Mechanical and Industrial Engineering Department
Co-Organizers
Daniel Park, Louisiana State University, Mechanical and Industrial Engineering Department
Abstract

Micromodels are essentially “Labs-on-a-Chip” for pore-scale diagnostics and measurements of various flows related to oil & gas reservoirs, including multi-phase flows, and the mobility of particles. The scope of this session will be on micromodel design and fabrication methods, the development of diagnostics for measurements in micro-models, the reporting or results from such measurements, and the improving of the understanding of the associated physics including those of moving interfaces and the interaction between particles and micromodel walls. Of particular interest are pore-scale flow characteristics (single and multi-phase), micro/nano-particle velocity, concentration and deposition rate distributions, the motion of fluid-fluid interfaces, and the transport characteristics of application chemicals.
References

Provided URLs
https://lsu.edu/eng/mie/people/faculty/nikitopoulos.php
https://lsu.edu/

MS 3.06: Microfluidics and Micromodels in Porous Media Research

Organizer
Farzan Kazemifar, California State University Sacramento
Co-Organizers
Yaofa Li, University of Notre Dame

Abstract

Microfluidics has contributed greatly to the physical, chemical, biological and materials research in the past three decades. Particularly, the microfluidics-based microsystems, called micromodels have been a powerful tool in porous media research, used extensively to investigate a wide variety of problems. The applicability of different visualization techniques afforded by the optical access in micromodels has been one of the primary causes for their popularity and extensive use in laboratory studies. Advances in imaging technology have made it possible to study flow and transport phenomena in 2D (Armstrong and Berg, 2013, Kazemifar et al., 2015), 2.5D (Xu et al., 2017), and 3D (Datta et al., 2014, Holzner et al., 2015) porous micromodels. With advanced designing and microfabrication techniques, the micromodels have also been made extremely versatile to achieve a wide range of experimental conditions (temperature, pressure, geometry, wettability, etc.) (Morais et al., 2016, Li et al., 2017, Zhao et al., 2016). Moreover, recent rapid advances in imaging technology with high temporal and spatial resolutions offer even more possibilities for visualization of the dynamic phenomena. A minisymposium within the InterPore conference will provide a unique opportunity for an open discussion between the research experts in different imaging techniques in porous micromodels.

In this minisymposium we seek contributions from researchers using 2D and 3D porous micromodels focusing on applications, such as trapping mechanisms, drainage and imbibition processes, dissolution and dispersion. Leading experts will have the opportunity to discuss modern methods and achievements, and define problems to be addressed with advanced imaging techniques.

References

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MS 3.07: Magnetic Resonance in Porous Media: From structure to transport

Organizer
Joseph Seymour, Montana State University
Co-Organizers

Sarah Codd, Montana State University
Abstract

This session will cover the breadth of magnetic resonance (MR) applications in porous media. Characterization of pore structure and transport processes in porous media ranging from geological to industrial to biological systems will be presented.
References

Provided URLs
http://www.montana.edu/mrm/
http://www.montana.edu/mrm/

MS 3.08: From microns to meters: Heterogeneity across laboratory scales

Organizer
Luca Trevisan, Karlsruhe Institute of Technology
Co-Organizers
Ronny Pini, Imperial College
Abstract

The complexity of natural environments is manifested through the variability in both structural and chemical properties of the porous medium, which in turn leads to variations in key petrophysical, transport and multiphase flow parameters. While most physical processes operate at the pore-scale, heterogeneity appears across the continuum of length scales, with the effects of small-scale (mm-cm) heterogeneities often propagating over much larger observational scales (tens to hundreds of meters). The ability to parameterize transport and flow properties at a scale where flow is described by continuum-scale physics and where their spatial variability is taken into account remains a major challenge for researchers. Laboratory studies provide a unique opportunity to make direct observations of flow processes in porous media. Hereby, the advent of imaging technology is providing an unprecedented level of observational detail on porous structures and processes from several meters down to the scale of a single pore throat. Most significantly, the use of non-invasive imagery is providing the required information to evaluate computational upscaling methods across a wide spectrum of relevant scales that characterize the subsurface. The aim of this mini-symposium is to explore advances from experimental and computational studies aimed at quantifying the impact of heterogeneities in the structure and chemistry of porous media on their transport and flow processes across laboratory scales (from microns to meters). Contributions are invited on various topics dealing with fluid flow in the subsurface, thus including but not limited to: geological carbon sequestration, enhanced oil recovery, geothermal energy and groundwater hydrology.
References

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MS 3.09: Pore-scale processes and Properties of Geomaterials and Rocks: Engineered by Human, Inspired by Nature?

Organizer
Tiziana Vanorio, Stanford University
Co-Organizers
Gianluca Cusatis, Northwestern University
Abstract

The development and degradation of the physical and mechanical properties of Earth materials spurred considerable research interests across the centuries as well as across disciplines. Whether the goal is to understand energy dissipation and release through strained rock formations, monitor dynamic microbial induced alterations in subsurface environments, or hold together artifacts ranging from 2,000-year-old monuments, modern skyscrapers and highways, to planetary shelters exposed to chemically harsh conditions, we must understand how the physical and mechanical properties of geomaterials develop and/or degrade as well as how they might respond to bio-chemo-mechanical processes. Almost as water controls biological systems, fluids profoundly influence porous Earth materials not only as physical modifiers of pore pressure but also as agents of chemical mass transfer and reactions. This coupling requires experimentation.
This mini-symposium provides a unique opportunity to leverage knowledge and create connections across Earth processes and properties of geomaterials. We encourage submissions on novel and innovative experimental approaches that might emerge in the future to overcome technical issues as well as quasi real-time imaging to gain better knowledge of pore scale processes in rocks, cement, and fibrous materials. The final objective is bring together students, scholars and practitioners across the geoscience and engineering disciplines to leverage cross-functional knowledge on bio-reactive flow in porous media not only to study how it influences subsurface processes but also to hone it down further so as to bring together natural and engineering solutions for more sustainable materials.

References

MS 3.10: From deformable porous media to frictional fluids

Organizer
Fredrik Kvalheim Eriksen, Porous Media Laboratory
Co-Organizers
Guillaume Dumazer, Porous Media Laboratory
Marcel Moura, Porous Media Laboratory
Abstract

The introduction of Coulomb friction into multiphase porous media flows leads to an array of exotic behaviors which are still not fully understood. They can be observed for example in flows in a deformable porous network, in which the matrix responds dynamically to the imposed flow conditions. Furthermore, if the porous medium is a flowing structure, dissipation mechanisms from viscosity and friction come into play and it makes sense to consider so-called frictional fluids. This perspective opens up new avenues of investigation in porous media research relevant for natural or

engineered systems. The fracturing of a porous matrix, or the displacement of an interface across a dense suspension of grains offer nice examples of intellectually and aesthetically fascinating patterns. The theoretical basis describing the interaction between fluids and the porous matrix is not mature yet, and such an understanding is crucial to many geophysical processes and industrial applications. This mini-symposium offers the opportunity to foster the interest and nurture the community' s curiosity about recent results on multiphase flows in deformable porous media. Our focus includes (but is not restricted to) contributions from experimental, theoretical and numerical efforts to understand the basic mechanisms behind pattern formation, transport properties and optimization problems in deformable porous media and frictional fluids. With this mini-symposium we aim to gather leading research results in the field and together develop novel techniques and approaches to understand the problem.
References

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http://folk.uio.no/mnmoura/

MS 3.11: fundamental aspects of geological storage of CO2

Organizer
Auli Niemi, Uppsala University
Co-Organizers
Mike Celia, Princeton Universty
Jan Nordbotten, University of Bergen
Rafid al-Khoury , Delft Unversity of Technology
Abstract

Geological storage of CO2 is widely considered a key technology, capable of significantly reducing the amount of CO2 released into the atmosphere, thereby reducing the negative impacts of such releases on global climate. Around the world, projects are already in operation, while others are being initiated. Successful implementation of CCS will, however, require a deep understanding of the relevant multi-phase flow, transport and trapping processes of the CO2/brine system, and the related coupled thermo-hydro-mechanical-chemical (THMC) processes.

This minisymposium invites all contributions addressing recent developments concerning fundamental process understanding of CO2 transport and trapping, their modeling and quantification over the range of scales relevant to geological storage of CO2. Results from theoretical and modeling studies as well as from experiments in the field and in the laboratory are envisaged to provide important insights.
Examples of important challenges include quantification and modeling of residual and dissolution trapping, linking of model and experimental results over the range of scales from pore and core scales to laboratory, field experiment and actual storage site scales, addressing the challenge of large scale modeling of the storage sites, addressing the coupled THMC processes and addressing the effects of geological heterogeneity and associated prediction uncertainty.

References

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MS 3.12: Physical and geochemical pathways for nano/micro-porous multiphase saline systems

Organizer
M. Azaroual, BRGM (French Geological Survey), Orléans, France,
Co-Organizers
N. Spycher, LBNL, Berkeley, USA
M. Steiger, University of Hamburg, Germany
L. Mercury, University of Orléans, France
AbstractSaline waters are often associated to the multiphasic hydrosystems of soils and sub-surface media (i.e., oil and gas reservoirs), which are targeted for different uses (the near well bore of CO2 and others 'non-wetting' fluids, engineered tunnels for nuclear wastes storage), and/or whic h are environmental sensitive unsaturated systems (critical zone under climate change, etc.). In such geosystems, capillary processes and osmotic forces cooperate to drive specific phase transitions, possibly with geomechanical consequences, even leading to fracturing of solid matrix. The relevant scales for these processes span for nanometer to micrometer or more, implying the effects of geochemical confinement and interfaces.

The association of in situ observations (phase transitions, chemistry of the aqueous phases, mineralogical features of solids, etc.), and carefully defined thermodynamic sketches, is growingly shedding light into the geochemical reaction paths at the pore scale. The development of smart thermodynamic databases (adapted to the Pitzer model, or other models) able to capture thermodynamics of highly saline waters, allows to deconvolute finely the chemical processes at play in the fluid phases. The nano/micro-fluidic devices and various micromodels allowed deciphering key processes for identifying relevant couplings between processes at relevant time and space scales.

The maturity of these experimental and numerical tools is a prerequisite for integration and upscaling these critical and relevant physical and physical-chemical mechanisms to identify possible cooperativity (attenuation, amplification and compensation effects) between the transport properties, the thermo-kinetic reaction paths, the pore and confining pressures controlling the mass,

heat and mechanical (im)balances at the pore scale and through micro-continuum.

The aim of this mini-symposium is to gather researchers and engineers from academia and industry institutions to share results and challenges required for further advancement in these specific and emerging applications of porous media. Any papers connected to (bio)geochemistry of 'confined' brines and multiphase reactive transport are welcome to exchange on the recent achievements and future development perspectives.

GS 4: Porous media applications (renamed)

Organizers
Michael A. Celia
Anozie Ebigbo
Henk Jonkers

MS 4.01: Flow, transport and mechanical properties of granular porous media: from powders to soil

Organizer
Pejman Tahmasebi, University of Wyoming
Co-Organizers
Muhammad Sahimi, University of Southern California
Abstract

Granular media constitute a ubiquitous class of porous media. Examples range anywhere from powders, to soil and other types of unconsolidated porous media such as sandstone. Despite decades of research, modeling of granular media, particularly natural ones that have grains with irregular shapes and rough surfaces, and their properties, especially their mechanical properties and their stability, are still subjects of extensive research. The focus of this mini-symposium is on the latest developments in this active area of research. We invite papers on theoretical, experimental, and computer simulation studies of modeling of the morphology of granular media, and their flow, transport, mechanical and other important properties.
References

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Malmir, H., M. Sahimi, and M. R. R. Tabar (2016b), Packing of nonoverlapping cubic particles: Computational algorithms and microstructural characteristics, Phys. Rev. E, 94(6), 62901,

MS 4.02: Use of Packed Beds in Chemical Manufacturing – Theory, experiments, models and design innovations

Organizer
Krishnaswamy Nandakumar, Louisiana State University
Co-Organizers
Brian Hanley, Louisiana State University

Abstract

Packed beds are a special class of porous media that are engineered for use in unit operation devices in chemical manufacturing for carrying out separations and reactions. Both random and structured packings have been developed. Flow, heat and mass transfer and reaction processes have been studied in such systems. With the advent of advanced manufacturing technologies such as additive manufacturing, complex shapes with well-defined functionalities can be manufactured to achieve process intensification. This session is conceived and developed by EPIC@LSU (Enabling Process Innovation through Computation) to bring together researchers studying such systems using experimental and computation techniques to understand and design innovative process equipment using such packed structures as integral parts of separation and reaction devices. Submissions on all aspects of transport and reaction in random and structured packing in normal-g and high–g environment under all modes of operations (co-, counter- and trickle-flow modes) are invited. Computational studies that use Direct Numerical Simulations in packed beds for extracting information on local particle level heat and mass transfer coefficients and experimental studies using tomography and PIV based methods that provide high fidelity velocity and phase distributions are also welcome.

References

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https://www.lsu.edu/eng/che/people/faculty/hanley.php

MS 4.03: Applications of biochemical modification of porous media

Organizer
Leon van Paassen, Arizona State University
Co-Organizers
Robin Gerlach, Montana State University
Akiko Nakano, Kyushu University
Michael Gomez, University of Washington
Jason DeJong, University of California Davis

Abstract

Biochemical processes can affect the mechanical and hydrological properties of porous media. Formation of biominerals, biogas and biofilms influence material behavior and may be stimulated for a variety of applications in civil and environmental engineering. For example, microbially induced carbonate precipitation (MICP) has been shown to increase the strength and stiffness of unconsolidated sands or reduce the permeability and may be employed to reduce the risk of earthquake induced liquefaction, improve slope stability or control transport of contaminants. Recent investigations have shown that biogenic gas production may also be used to improve the mechanical behavior. The compressibility of the gas prevents pore pressure build-up during cyclic loading. At the same time formation of biogas, like formation of biofilms and biominerals reduces

permeability. We invite contributors to present and discuss recent advancements and discoveries, including experimental studies at various scales, but also theoretical and numerical studies aimed to improve fundamental insight on the biogeochemical conversions and their relation with hydro-mechanical properties of porous media.

Note! This session will be developed in coordination with the MS entitled “Biochemical mineral precipitation for subsurface applications”. Please review both MS descriptions to guide your submission.

References

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MS 4.04: Thermo-hydro-mechanical-chemical energy storage (THMC-ES)

Organizer
David Smeulders, Eindhoven University
Co-Organizers
Jacco Haasnoot, Crux Engineering
Frank Wuttke, Kiel University
Abstract

In order to mitigate climate changes, the question how to decarbonize the energy system while maintaining energy security is becoming more and more urgent. Achieving these goals entails the growing use of renewable energy sources. However due to the inherent intermittent nature of these resources, there is a strong mismatch between energy supply and demand, both in space and time. This requires revolutionary new concepts for green energy storage and transportation. Examples are thermochemical and adsorptive materials for heat storage, subsurface ice energy storage, compressed air storage in salt caverns, porous design material for high thermal heat storage in shallow ground and reverse electrodialysis (RED) for energy generation. In all of these application the understanding of coupled themo-hydro-mechanical and chemical processes in porous media is of paramount importantance.

In this minisymposium, the expertise from both knowledge institutes and industry is brought together for effective knowledge exchange. Interactive sessions will be organized in the form of networking, pitches, lectures and poster presentations.

Organizers: Jacco Haasnoot (CRUX Engineering BV, Netherlands), Frank Wuttke (Kiel University,

Germany), David Smeulders (Eindhoven University, Netherlands)

References

MS 4.05: Biochemical mineral precipitation for subsurface applications

Organizer
Al Cunningham, Center for Biofilm Engineering, Montana State University
Co-Organizers
Robin Gerlach, Center for Biofilm Engineering, Montana State University
Adie Phillips, Center for Biofilm Engineering, Montana Strate University
Leon van Paassen, Arizona State University

Abstract

Engineered biochemical processes which result in mineral precipitation in subsurface fractured rock and porous media are being researched extensively. For example, engineered calcite precipitation resulting from urea hydrolysis has been demonstrated to reduce porous media porosity and permeability, seal fractures, and control reactive transport processes. This minisymposium invites contributions show-casing biochemically-induced mineral precipitation focusing on contemporary subsurface issues. Specific applications of interest include, but are not limited to, improving wellbore cement integrity, fracture sealing, porous media permeability modification, and reactive transport control. We encourage both experimental and simulation modeling-based submissions which examine biochemical mineral precipitation processes and applications. Field-scale case studies are also encouraged.
Note! This session will be developed in collaboration with the MS entitled “Applications of biochemical modification of porous media”. Please review both MS descriptions to guide your submission.

References

Provided URLs
http://www.biofilm.montana.edu/
http://www.biofilm.montana.edu/
http://www.biofilm.montana.edu/

MS 4.06: Porous media flow in biological systems

Organizer
Tobias Koeppl, University of Stuttgart
Co-Organizers
Timo Koch, University of Stuttgart
Rainer Helmig, University of Stuttgart

Abstract

Mathematical models are becoming increasingly important in several application fields from

medicine and biology. In medical applications, mathematical models
provide the possibility to investigate different diseases like cancer or arteriosclerosis, non-invasively.
As a result, physiologists can obtain more insight into the healing of diseases
with less danger for a patient and reduced costs. An application from botany, is the wateruptake of plants. Using numerical devices, this process can be simulated in a short time, enabling biologists and chemists to obtain new findings in a faster way.

Considering the mentioned application areas, it turns out that important components of biological systems can
be modeled as a porous medium and that the understanding of flow and transport processes through these components is crucial to
obtain applicable results. Examples for such systems are vascularized tissue or soil surrounding a root network.

The major modeling challenges in this context are on the one hand to incorporate the multiscale structure of biological systems into the
computional model. Moreover in many cases flow processes in the porous matrix have to be coupled with
different flow models. Simulating blood perfusion of tissue by capillaries or the wateruptake by roots, flow within tissue or soil has to be coupled with flow through a network structure, which requires the derivation of reliable and robust coupling concepts.

The objective of this minisymposium is to bring together researchers from various fields of expertise dealing with
modeling of flow in biological systems. Furthermore, contributions addressing
theoretical and algorithmic aspects, are welcome.
References

MS 4.07: Simulation of saturation overshoots in gravity driven two-phase flows

Organizer
Tobias Koeppl, University of Stuttgart
Co-Organizers
Martin Schneider, University of Stuttgart
Rainer Helmig, University of Stuttgart
Abstract

Quantitative and reliable modeling of gravity driven flows is of high importance for many application areas like geological C02 and energy storage. It can be observed in experiments that gravity driven flows exhibit instabilities and saturation overshoots.

In order to reproduce these saturation
overshoots by Darcy theory for two-phase flow in porous media, an extension of the constitutive law for the capillary pressure and hysteresis models for the capillary pressure as well as the relative permeabilties have been introduced. Despite of the fact that this approach has been applied successfully, there are still
many open issues in this context.

The objective of this minisymposium is to bring together researchers from various fields of expertise

dealing with hysteresis models for two-phase flow problems in porous media. Contributions addressing both theoretical and computational aspects, are welcome.
References

MS 4.08: Life in porous media: a microbiological approach

Organizer
Gastón L Miño, LAMAE, Fac. de Ing. de Univ. Nac. de Entre Ríos, Oro Verde, Argentina
Co-Organizers
Harold Auradou, Fluides, Automatique et Systèmes Thermiques Lab, Orsay, France
Pietro de Anna, Institut des sciences de la Terre, Faculté des géosciences et de l' environnement, Lausanne, Switzerland
Abstract

During the past decades, studies examining the impact of biological microscale processes on macroscale phenomena have demonstrated the need of additional investigation to further define these interactions. Microorganisms have the ability to modify the environments in which they live. Conversely, the environment also affects these microorganisms' own behavior. The small scale transport of bacteria in aquifers or soil, together with bacterial attachment/detachment, bacterial carbonatogenesis, and biofilm growth, are processes that contribute to the blocking of fluid pathways at the porous scale (bioclogging). These transport properties also contribute to the removal and neutralization of contaminants in waste (bioremediation). The use of a porous scaffold design for tissue engineering is another example of this interaction between cells and porous media and has been demonstrated to cause tissue regeneration.
This mini-symposium aims to gather researchers from different disciplines such as physics, chemistry, biology, engineering, material science, ecology and medicine among others to present different aspects of biological microsystems present in different types of porous media. The mini-symposium is open to studies using experimental, theoretical, and numerical approaches.
References

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MS 4.09: Biofilm Processes in Porous Media

Organizer
Adrienne Phillips, Montana State University
Co-Organizers
Anozie Ebigbo, ETH Zurich
Alfred Cunningham, Montana State University
Robin Gerlach, Montana State University
Fabrice Golfier, University of Lorraine
Abstract

Biofilms are microbial communities attached to surfaces by extracellular polymeric substances. During their development, they may grow, disperse, decay, or even remain dormant. In porous media, they interact with the solid structure and the fluids. Microbial cells may be transported by fluids and may attach to surfaces. Biofilms can utilize substrates from the fluid to form complicated three-dimensional structures on the solid surfaces and in the pore space. This may lead to significant changes in flow patterns. Biofilms may also locally alter the chemical environment, creating the potential for chemical reactions with solid minerals. All of these lead to a complex interplay of biofilms processes with flow and reactive transport in porous media, which is relevant in many applications, including groundwater contamination, protection, and remediation, underground storage of fluids, and oil and gas recovery. We seek abstracts that tackle the difficult task of describing and observing biofilm processes in porous media at various scales (cellular, biofilm, pore, or Darcy scale). For this mini symposium, we welcome submissions that include modeling and/or experiments dedicated to understanding biofilms in porous media. In addition, we welcome submissions on state-of-the-art methods for imaging, measurement, and analysis of biofilms in porous media.
References

MS 4.10: Evaluation and Optimization of Non-Conservative Transport in Porous Media

Organizer
Xiaolong Yin, Colorado School of Mines
Co-Organizers
Chao Yang, Institute of Process Engineering, Chinese Academy of Sciences
Ning Wu, Colorado School of Mines
Abstract

In natural and engineered porous media, non-conservative transport is more rule than exception. Difference between inlet and outlet concentrations is the standard gauge for gain and loss; it is based on this difference that the fate of contaminants in aquifers, the performance of a porous catalytic reactor, or the efficiency of a filter is evaluated. Non-conservative transport can be attributed to a number of pore-scale mechanisms. For instance, mixing of reactive species in the pore fluid leads to homogeneous reactions; contact with solid surface may generate sorption and heterogeneous reactions; particulates such as aerosols and colloids may be geometrically strained; when multiple fluid phases are present, fluid-fluid interfaces may become movable sources and sinks. Much of this information however is lost when only the inlet and outlet concentrations of species of interest versus time are examined. We propose this mini-symposium as a forum to host studies that attempt to uncover the connections. We will focus on the following topics: 1) inverse modeling that is not solely based on inlet / outlet data but has also considered pore-scale mechanisms; 2) experiments and/or pore-scale simulations that help to link pore-scale mechanisms to the outcome of non-conservative transport; 3) engineering and/or industrial cases that have consciously utilized identified pore-scale mechanisms to promote or suppress mixing, reaction, and transport by the need.
References

Provided URLs
http://multiphase.mines.edu

MS 4.11: Multiphase flow through fractured/fractured karst carbonate reservoirs

Organizer
Zhaoqin Huang, China University of Petroleum (East China)
Co-Organizers
Jun Yao, China University of Petroleum (East China)
Abstract

Naturally fractured/fractured karst carbonate reservoirs exist throughout the world and represent significant amounts of oil and gas reserves. There has been an increasing interest in fracture flow in recent years, because of the need to characterize the co-existing of porous flow and free fluid flow through fractured/fractured karst reservoirs. However, the multi-phase flow problem demands the understanding of this coupling flow at different scales from the pore scale to the Darcy scale. In addition, accurate mathematical and numerical simulation remains a challenging topic from many aspects of physical modeling, numerical analysis and scientific computation.
The aim of this mini symposium is to bring together researchers in the aforementioned fields to highlight the current developments both in theory and methods, to exchange the latest research ideas, and to promote further collaborations in the community. Potential topics include, but are not limited to:
(1) Mathematical modeling of fractured/fractured karst carbonate reservoirs, including equivalent continuum model, double-porosity model, and discrete fracture models, especially the coupling of multiphase porous flow and free fluid flow.
(2) Advanced numerical methods for the simulation of multiphase flow and transport in fractured/fractured karst carbonate reservoirs, such as finite different method, finite volume method, finite element method and so on.
(3) Experiments of fractured/fractured karst reservoirs both at pore scale at core lab scale, and tracer testing at field scale.
(4) Multiscale modeling and simulation of multi-phase flow in fractured/fractured karst reservoirs, such as multiscale finite elements method, multiscale finite volume method and so on.
References

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http://english.upc.edu.cn/
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MS 4.13: Natural and engineered nanoparticles in porous media: experimental findings and modeling approaches

Organizer
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Co-Organizers
Thilo Hofmann, Universitat Wien
Nathalie Tufenkji, McGill University
Abstract

Transport and deposition of nanoparticles in unsaturated and saturated porous media are processes of considerable importance in many fields of science and engineering, and a thorough understanding of particle filtration processes is essential for predicting the transport and fate of nanoparticles in the subsurface environment. On the one hand, mobile subsurface nanoparticles have received considerable attention due to their potential risk for human health: natural nanoparticles can act as carrier for a wide range of harmful strongly sorbing contaminants, thus facilitating their migration in the subsurface; moreover, bacteria, viruses, and engineered nanoparticles that may be harmful can also be found in subsurface environments (1-3). On the other hand, the study of nanoparticles is also important for the development of new technologies for environmental remediation and sustainable agriculture: micro-scale understanding of the mechanisms that control the mobility of reactive nano- (and micro-) particles is of pivotal importance in the design, implementation, and performance evaluation of field applications of nanotechnology for environmental remediation and agriculture (4-5).
The mini-symposium addresses the topic under different perspectives, including both experimental and modeling approaches, bringing together scientists who investigate nanoparticle transport and fate in porous media in various disciplines to discuss recent advances.
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MS 4.14: Wicking of Liquids in Porous Materials

Organizer
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Abstract

Wicking of liquids in porous media is essentially the spontaneous imbibition of wetting liquids into dry porous media. It is one of the long-standing, but still important, applications of flows in porous media. Several fields where the wicking theory is applied include wicking of oil during combustion of lamps, wicking of incense in cylindrical wicks of plug-in type room fresheners, wicking of liquid through metallic gauge in satellites as a means to deliver fuel for combustion, wicking of liquids during coloring of textiles, wicking of liquid resin during processing of composites, wicking of liquids in wipes and personal hygiene products, etc.

This minisymposium will focus on various methodologies available for modeling the wicking flows in porous substrates. These will include the capillary models such as the Washburn equation and its variants after including the gravity and inertia effects; the sharp-front Darcy's law based models; the diffuse-front Richard's equation based models obtained from the unsaturated flow; as well as some avant-garde models such as those based on LBM or on fractals. Efficacy of various models will be tested through experimental validations. The symposium will also explore the characterization of various quantities relevant for various models such as hydraulic radius for capillary models; permeability, porosity, surface tension and contact angle for the sharp-front Darcy's law based models; relative permeability and capillary pressure for the diffuse-front Richard's equation based models; etc.

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MS 4.15: Lagrangian methods for scalar transport in porous media

Organizer
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Co-Organizers
Sanjeeva Balasuriya, University of Adelaide
Abstract

Transport of scalar quantities (e.g. heat or chemicals) by fluid flow through porous media is key to a wide range of systems including enhanced oil or heat recovery from subsurface reservoirs, carbon sequestration in underground aquifiers, thermo-chemical heat-storage reactors or dispersion of chemicals for in situ groundwater remediation or mining. These systems involve (one or more of) three basic transport problems: (i) efficient scalar dispersion and mixing (e.g. chemicals for in situ minerals mining); (ii) rapid resource extraction (e.g. geothermal energy); (iii) targeted scalar delivery and/or confinement to designated subregions (e.g. creation of reaction zones for in situ groundwater remediation). Insight into the global Lagrangian transport of the fluid that carries the scalar quantity and ways to manipulate this is crucial for adequately tackling these problems. Recent studies e.g. demonstrated that well configurations and pumping schemes designed on the basis of Lagrangian chaos enable efficient subsurface fluid distribution by chaotic advection (Trefry et al. 2012; Varghese et al. 2017). Thus generic methods and concepts from Lagrangian transport studies (Balasuriya 2016; Aref et al. 2017) offer ways to systematically address the above transport problems. However, this approach, despite its proven worth in other fields as industrial mixing and geophysical transport (Wiggins 2005; Metcalfe et al. 2012; Aref 2017), to date finds little application for scalar transport in porous media. The mini-symposium seeks to bring the Lagrangian ansatz and methodology to the attention of the porous-media community and encourage discussion and exchange on this topic.
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MS 4.16: Two-Phase Flow and Reactive Transport through Thin Porous Layers

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Ahmad Kaffel, University of Wisconsin
S.Majid Hassanizadeh, Utrecht University
Abstract

Thin porous layers are widely used to regulate flow and transport processes in industrial applications and products, such as fuel cells, hygiene products, textiles, and inkjet printing. A thin porous medium/layer is characterized by its much larger lateral dimensions than its thickness. A number of challenges lie in formulation and modeling of two-phase flow and reactive transport through thin porous layers. They include failure of the REV (representative elementary volume) concept along layer thickness, layer-layer interfacial effect, and swelling of layers. Furthermore, it is challenging to measure material properties of a thin porous layer such as capillary pressure and relative permeability. Recent advances in computation and experimental techniques have been bringing many opportunities to improve our understanding of flow and transport through thin porous layers. This minisymposium aims to bring together scientists and engineers who investigate thin porous layers to discuss recent achievements. We particularly call for contributions from the topics of water transport and heat management in hydrogen fuel cells, wetting and wicking in thin fibrous layers, and experimental measurement of material properties of thin porous media.
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MS 4.17: Transport through Soft Porous Media

Organizer
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Rungun Nathan, Penn State University Berks
Abstract

In the past decade, transport through soft porous media has attracted tremendous attention due to its broad applications in biological systems and industrial applications. An example is the critical role of the interstitial pressurization inside the porous articular cartilage for knee joints lubrication [1-6]. Another example is the transport through the porous endothelia glycocalyx layer (EGL) that covers the inner surface of our blood vessels. The EGL plays a critical role in microcirculation as a molecular sieve for plasma proteins [7], as a mechanotransducer of fluid shear stress [8], and as a highly compressible porous hydrodynamic interface in the motion of red and white cells in capillaries [9-13]. Recent studies about lift generation inside soft porous media [13-26] has led to new research thrust that employs soft porous media for lubrication.

For its very broad applications, transport through soft porous media has become a very active research area. There is a strong need for the porous media community to understand the fundamental mechanism related to the heat transfer, mass transfer and fluid flow through a soft porous media. The aim of this mini-symposium is to bring together industrial, academic, and National Laboratory researchers working in various fields, and to provide a platform for extensive discussion of the current and future research topics in this area. In particular, we are inviting research topics that examine the transport phenomena through a soft porous media using analytical, numerical or experimental approaches.

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MS 4.18: Coupling multi-physic at the pore-scale: experimental and numerical investigation

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Co-Organizers
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Cyprien Soulaine, Stanford University
Vahid J. Niasar, University of Manchester
Abstract

Coupling multi-physic at the pore-scale: experimental and numerical investigation

Pore-scale investigations of complex subsurface processes have recently attracted a lot of attention in many domains such as oil and gas production, CO2 storage and contaminant hydrology. On the one hand, pore-scale experimental techniques allow a direct visualization of the different

mechanisms involved in 2D micro-models or in 3D rocks. On the other hand, pore-scale numerical models allow the underlying physical laws to be resolved on a pore-by-pore level. Combining both experimental and numerical achievements can allow us, for the first time, to investigate complex subsurface processes (e.g. thermal energy storage, enhanced oil recovery, nuclear waste trapping…) at the relevant scale where the geochemical and hydro-mechanical nature of the rock/fluid interactions plays a crucial role.
This session will focus on pore-scale investigations that include two or more of the following mechanisms:
- Two-phase flow and transport
- Solid-fluid interaction (wettability, solid deformation, solid dissolution, …)
- Fluid-fluid interaction (miscibility, capillarity, …)
- Chemical reactions
- Electrostatic effects
- Heat transfer
- Coupling between nano- and micro-scale

Particular attention will be given to work that uses numerical modelling to match and complement experimental work.

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MS 4.19: Rock/fluid Interactions and Their Impact on Flow and Transport in Geologic Media

Organizer
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Co-Organizers
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Abstract

Rock/fluid interactions, physical or chemical, affect heat and mass transport processes in geologic media at different scales. This session invites papers on recent advances in experimental, computational modeling or imaging studies of fundamental or applied research on rock/fluid interactions at multiple scales (nano-scale to reservoir/basin-scale studies).

Areas of research can be fundamental/theoretical or application based as those applied to development of conventional and unconventional hydrocarbon resources, gas hydrates, hydrogeology, diagenesis, contaminant transport in soils and rocks, geothermal energy, CO_2 sequestration and subsurface nuclear waste storage. Topics could include mineral-fluid chemistry, reactive surface areas, rock/fluid physics (wettability, adsorption, osmosis, interfacial tension/adhesion, trapping mechanisms), computational (pore network modeling, reactive transport and basin modeling) or related.

References

MS 4.20: Porous and Multiphase Transport Processes in Biological and Biomedical Systems

Organizer
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Co-Organizers
Johannes Nitsche, University at Buffalo, The State University of New York
Abstract

Percutaneous transport of chemicals and drugs, design of implantable polymeric systems for sustained drug release, tracking the distribution of medications within tissue/body, and ion transport in intercellular gap junction pores are examples of applications where progress in biological science and technological development hinges on understanding flow and diffusion processes in porous and multiphase systems at multiple scales of description: molecular, microporous and macrocontinuum. Covering both experimental and theoretical/computational methodologies and results, this interdisciplinary Minisymposium is intended to facilitate discussion and nucleate collaboration between members of the porous media community and researchers in biological/biomedical fields. In particular: (1) providing exposure for experts in porous media to novel biotransport phenomena and biomedical applications, and (2) unifying a multitude of biological processes and biomedical mechanisms involving microstructured systems within an overarching framework and relevant methodologies used in the porous media community.

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MS 4.21: Improving food-water nexus sustainability and security through innovative hydrologic solutions and new fundamental insights

Organizer
Andrew Trautz, Colorado School of Mines
Co-Organizers
Tissa Illangasekare, Colorado School of Mines
Abstract

Food production will need to increase by over 70% by the year 2050 to meet the demands of population growth. Favorable climate conditions and the availability of land, nutrients, and water are the primary factors contributing to agricultural productivity. This problem is addressed in developed nations by expanding arable land acreage and utilizing agricultural techniques that rely extensively and intensively on mechanization, irrigation, and agrochemicals. These approaches are economically and ecologically unfeasible to the vast majority of farmers in developing countries where the majority of food is produced on smallholder or family farms that are less than 2 ha in size. Maximizing and increasing food production on small farms will require the more efficient use of

small plots of land and limited water supplies – a paradigm referred to as ecological intensification. At the present, the primary inefficiency in small plot agriculture is the evaporative losses of water to the atmosphere, or as more commonly referred, non-consumptive water use. A possible solution to increasing agricultural yields and improving water conservation involves the development of new and innovative low-cost methodologies and management schemes. Such approaches will require a foundation deeply rooted in the strong understanding of the interactions or feedbacks occurring between soils, plants and the near-surface atmospheric boundary layer. This mini symposium calls for the submission of abstracts focused on the fundamental research of heat, mass, and momentum transfer processes occurring within the soil-plant-atmosphere continuum and policies related to food-water nexus sustainability and security under adverse climate conditions.

References

MS 4.22: Evolving porous media and coupled chemical and physical processes

Organizer
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Nikolaos Prasianakis, Laboratory for Waste Management, Paul Scherrer Institut
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Abstract

Chemically reactive fluids introduced in natural and engineered porous media in numerous applications induce reactions that can alter pore structures. For example, mineral dissolution and precipitation have been observed in rock matrix under conditions that are relevant to geological carbon storage and shale gas production. The induced structural change in porous media affect in turn fluid flow, solute transport, and reactive processes. Thus, the evolution of porous media is highly dynamic, driven by the continuous feedback processes between chemical and physical processes. Mechanistic understanding of these coupling is required to build predictive models at multi-scales for addressing the evolution of various geological systems and informing optimization of the operations of subsurface energy recovery and waste storage.
In this minisymposium, we aim to initiate a discussion of recent research progress and emerging challenges in this active research area. We warmly invite submissions of experimental, theoretical and numerical studies on the following, but not limited to, topics.
1. Characterization and observation of (dynamic) pore structures.
2. Modeling of fluid flow, mixing, and transport of reactive solutes in evolving porous media.
3. Alteration and passivation of reactive surfaces.
4. Impacts of heterogeneity (e.g. pore structure, spatial distribution of minerals) on the evolution of porous media.
5. Upscaling porous media evolution to scales relevant for predictive modeling.

References

MS 4.23: Fluid flow-fracture phenomena in porous media

Organizer
Bill Carey, Los Alamos National Laboratory
Co-Organizers
Catherine Peters, Princeton University
Abstract

How do stress, reactions and matrix interactions control flow and transport processes in fractured, low-permeability materials? Enhancing these processes is key to successful hydraulic fracturing operations in unconventional oil & gas and geothermal energy applications. Limiting these processes is central to containment in CO2 sequestration and nuclear waste repositories. This symposium invites experimental and computational studies of geomechanical, geochemical and hydrologic processes that govern fracture flow and fracture-matrix interactions. Areas of interest include coupled deformation and flow, stress-permeability relations, coupled chemical reaction and flow, fracture-matrix communication, multiphase flow behavior in fractures, flow and proppants, fracture-property-transmissivity relationships, and flow and transport in fracture-networks.
References

MS 4.24: Optimization and inversion techniques

Organizer
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Abstract

With the fast advance in computing technologies, more and more sophisticated models are being developed for simulating multiscale, coupled physical, chemical, and biological processes in water resources and energy applications. Inversion techniques are needed to make these models useful, by fusing prior information and measurements in experimental design, and in model selection, calibration, and reliability evaluation. Process-level, reduced-order, and data-driven models are also widely used in optimization applications to support real-time decision making, risk assessment, and long-term planning. In this mini-symposium, we consider recent advances in the development and applications of optimization, machine learning, and inversion techniques in water resources and energy applications, with a particular focus on large-scale inversion and optimization problems that make use of the state-of-the-art parallel or Cloud computing platforms.
References

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http://www.beg.utexas.edu/people/alex-sun

MS 4.25: Transport Processes Controlling Unconventional Reservoir Production Performance

Organizer
Mehdi Zeidouni, Louisiana State University
Co-Organizers
Hossein Hejazi, University of Calgary
Roohollah (Radwin) Askari, Michigan Technical University
Abstract

This session covers advances in experimental and modeling techniques to improve our understanding of the processes controlling the production performance of unconventional reservoirs such as shale/tight formations and heavy oil deposits. Completions efficiency can significantly affect the productivity of unconventional tight/shale wells. Monitoring and interpretation techniques on determining the effectiveness of hydraulic fracturing stimulation from various sources of data (e.g. microseismic monitoring, fiber optic technology, and tracer tests) will be addressed. In addition, the session will include methodologies and approaches for characterizing unconventional reservoir rock and fluids.
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MS 4.26: Advances in Determining Hydraulic Properties of Thin Porous Media

Organizer
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Co-Organizers
Divesh Bhatt, Kimberly-Clark Corporation
S.Majid Hassanizadeh, Utrecht University
Abstract

Nowadays, thin porous media have attracted much attention because of their importance to many various industries. Hygiene products, paper, filters, fuel cells, membranes, textiles, muscular tissues, and other biological or manufacturing thin compositions widely exist in daily life. The typical characteristic of a thin porous layer is that its thickness is much smaller than its in-plane dimensions. A stack of thin porous layers creates contact interfaces, whose properties are quite different with thin layers. Furthermore, the hydraulic properties of a thin porous layer may vary along through-plane or in-plane directions. Determining the hydraulic properties is essential to understand and model fluid flow in thin porous media. The validity of classical methods in thin porous media is doubtful, because of the huge differences between thin porous media and normal porous media (e.g., soils). Recently, many experimental techniques and numerical methods (e.g., inverse modeling and pore-network modeling) have been developed specially for thin porous media. This mini-symposium aims at introducing numerical and experimental methods, and also sharing the challenges and ideas, for determining the hydraulic properties of thin porous media.
References

MS 4.27: Novel Concepts in Energy Storage

Organizer
ILENIA BATTIATO, Stanford University
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JOHN CUSHMAN, Purdue University
DANIEL TARTAKOVSKY, Stanford University
Abstract

Dramatically improved performance of energy storage devices, e.g., batteries, is a prerequisite for successful energy transition. Porous materials are a key component in most of such devices. This mini-symposium deals with innovative approaches to design of energy storage devices, including development of new porous materials.
References

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MS 4.28: New Applications and Research Insights Related to Colloids at Interfaces

Organizer
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Chongyang Shen, Department of Soil and Water Sciences, China Agricultural University, Beijing, China
Abstract

Colloids (e.g., microorganisms, nanoparticles, organic matter, and clays) at interfaces play a critical role in many industrial (e.g., wastewater treatment, filters, mining, 3D printers, and petroleum production), medical (e.g., development of antimicrobial surfaces and drug delivery) and environmental (novel remediation techniques and risks assessment of pathogens, antibiotic resistant bacteria, nanoparticles, and colloid-associated contaminants) applications. This mini-symposium seeks contributions from diverse disciplines on novel applications and research insights related to colloids in natural and engineered porous media and interfaces. Experimental, theoretical, and modeling studies from the interface to the field-scale are welcomed to stimulate cross-discipline discussions and synergistic research activities.
References

MS 4.30: Taming Leaky Wellbores - Plugging and Abandonment in Gulf of Mexico Wellbores

Organizer
Mileva Radonjic, Louisiana State University
Co-Organizers
Ipsita Gupta, Louisiana State University
Raissa Ferron, University of Texas, Austin
Andrew Bunger, University of Pittsburgh
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Abstract

For the first time in the history of Oil & Gas exploration and production, there are more wells to be plugged & abandoned (P&A), than drilled in the near future. The current practice is slow, expensive and not optimal. The new regulations require robust technology, calling for long term effectiveness of barrier materials in prevention of HC leakage.
This session seeks to contribute towards permanent plugging and abandonment of wells in the Gulf Of Mexico (GOM), focusing on:
1. Design, testing of novel barrier materials,
2. potential and applications of 3D printing in wellbore plugging and remediation
3. optimization for durability and monitoring under evolving subsurface conditions.
4. Numerical simulations of long term integrity of plugging material

The Oil and Gas industry employs cutting edge technology in drilling and completion activities in the GoM; the goal is to have GoM P&A be equally advanced. This can only be achieved through an interdisciplinary approach that involves science and engineering for the good of society and the planet.

References

Provided URLs
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