

3D Printing in Geoscience and Engineering: Emerging Technology in Education, Research, and Communication



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**Abstract:**

This workshop provides an overview of different 3D printing techniques that use both rock-like materials (e.g., sand, gypsum, clay) and polymers (e.g., plastics, resins). While these cost-effective methods are shaping the future of manufacturing, 3D printing geological media requires profound understanding of capabilities and limitations of each technique and the material properties used. The workshop includes several modules on how to digitally design and 3D print models for use in geomechanics, reservoir rock analysis, geomorphology, petroleum geology/geophysics, and rock physics. 3D printing of near-identical rock proxies provides an approach to conduct repeatable laboratory experiments without destroying natural rock samples. The workshop also discusses case studies where 3D-printed porous models are used to investigate fundamental research questions in the areas of deformation and fluid flow in reservoir sandstones and carbonate rocks. In addition, 3D-printed models are compared to their digital equivalents to investigate geomechanical and transport properties (e.g., porosity, pore sizes, grain sizes, fracture apertures, connectivity of pore and fracture networks, wettability, stiffness).

Participants will learn how to deploy 3D-printed models to improve technical communication to diverse audiences (e.g., students, geoscientists, engineers, managers, community stakeholders). Participants will gain experience with TouchTerrain app that allows 3D-printable terrain models to be generated. The integration of digital data with 3D-printed surface and subsurface features supports communication for both societal and technical objectives. The course will provide insights on future implementation of 3D printing in geoscience, including reduced costs of

3D printers, open-source software, and free access to digital model repositories.

**Biography**

Dr. Sergey Ishutov is currently a postdoctoral fellow with Reservoir Geomechanics Research Group at the University of Alberta. He earned a PhD in geology at Iowa State University, with a specialization in 3D printing geological models. He has received MSc in geology from California State University Long Beach and BSc in petroleum geology from the University of Aberdeen in Scotland. Dr. Ishutov received multiple awards and research grants from American Association of Petroleum Geologists, Geological Society of America, and the Society for Petroleum Engineers as well as industry grants for research in 3D printing porous media. Having a work experience with ExxonMobil, Aramco, Shell, and Oxy, Dr. Ishutov is one of the world pioneers in integrating 3D printing for reproduction of porous rock models and publishing this research in geoscience journals.

**Speaker Publications:**

“Comparison of Flow and Transport Experiments on 3D Printed Micromodels with Direct Numerical Simulations”

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