Study shows how permafrost releases methane in the warming Arctic

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Researchers from Skoltech have designed and conducted experiments measuring gas permeability under various conditions for ice-containing sediments mimicking permafrost. Their results can be useful both in

modeling and testing techniques for gas production from Arctic reservoirs and in tracing methane emission in high latitudes. The paper was published in the journal *Energy & Fuels*.

Permafrost, even though it sounds very stable and permanent, is actually quite diverse: Depending on the composition of the frozen ground, pressure, temperature and so on, it can have varying properties, which are extremely important if you want to build something on permafrost, such as an oil and gas field. Permafrost is also very gassy: It may contain a lot of natural gas in the form of hydrates, and its permeability is an important parameter both for research and for many activities in the Arctic.

"Gas permeability affects migration and accumulation of natural gas in this frozen ground as well as atmospheric emissions. Knowledge of filtration properties of permafrost containing gas hydrates is also absolutely necessary for estimates of the possibility of extracting gas from hydrates," says Evgeny Chuvilin, Leading Research Scientist at Skoltech and a coauthor of the paper.

Chuvilin and his colleagues decided to handle the poorly studied issue of gas permeability variations in ice- and hydrate-saturated sand samples during freezing and thawing and as gas hydrates form and dissociate. For that, the team had to design and build an experimental setup that would allow them to test various samples mimicking permafrost under various pressure and temperature conditions as well as clay content.

"The data we got can be used in testing methods of gas extraction in permafrost areas, including from hydrates, and in mapping areas with high permeability in permafrost for methane emissions studies in the Arctic," Chuvilin says.

Their study also showed a high probability of increasing permeability

coupled with dissociation of gas hydrates in permafrost—a likely scenario given the current warming trend in the Arctic. "We don't necessarily have to wait for a complete thawing of permafrost—even a slight shift of temperature is enough to trigger dissociation. And increased gas permeability that will follow will create conditions for methane emissions into the atmosphere, causing a variety of environmental and technological impacts," Chuvilin notes.

More information: Evgeny Chuvilin et al, Gas Permeability of Sandy Sediments: Effects of Phase Changes in Pore Ice and Gas Hydrates, *Energy & Fuels* (2021). DOI: 10.1021/acs.energyfuels.1c00366

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