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"Gas: Sustaining Future Global Growth"

Gaseous helium storage in salt caverns: influence of physical properties

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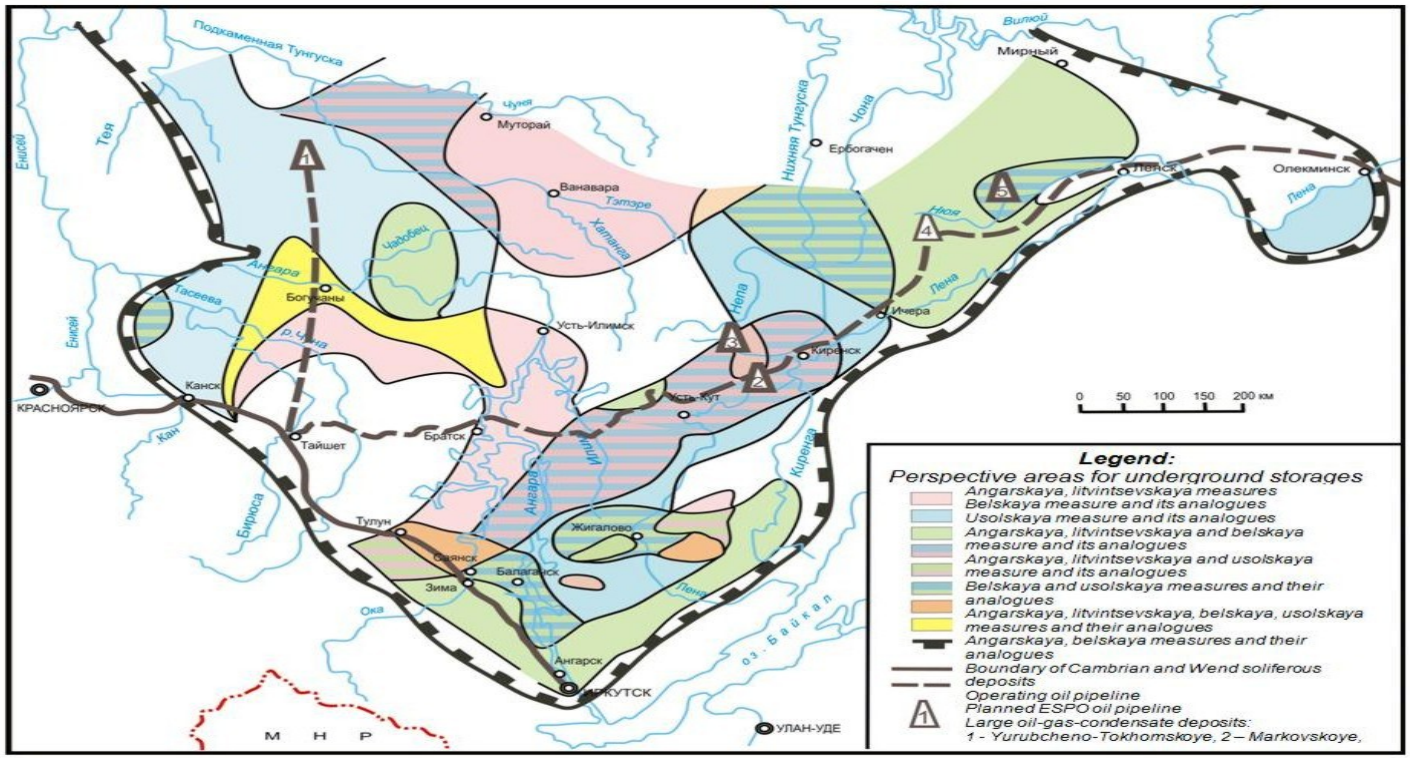
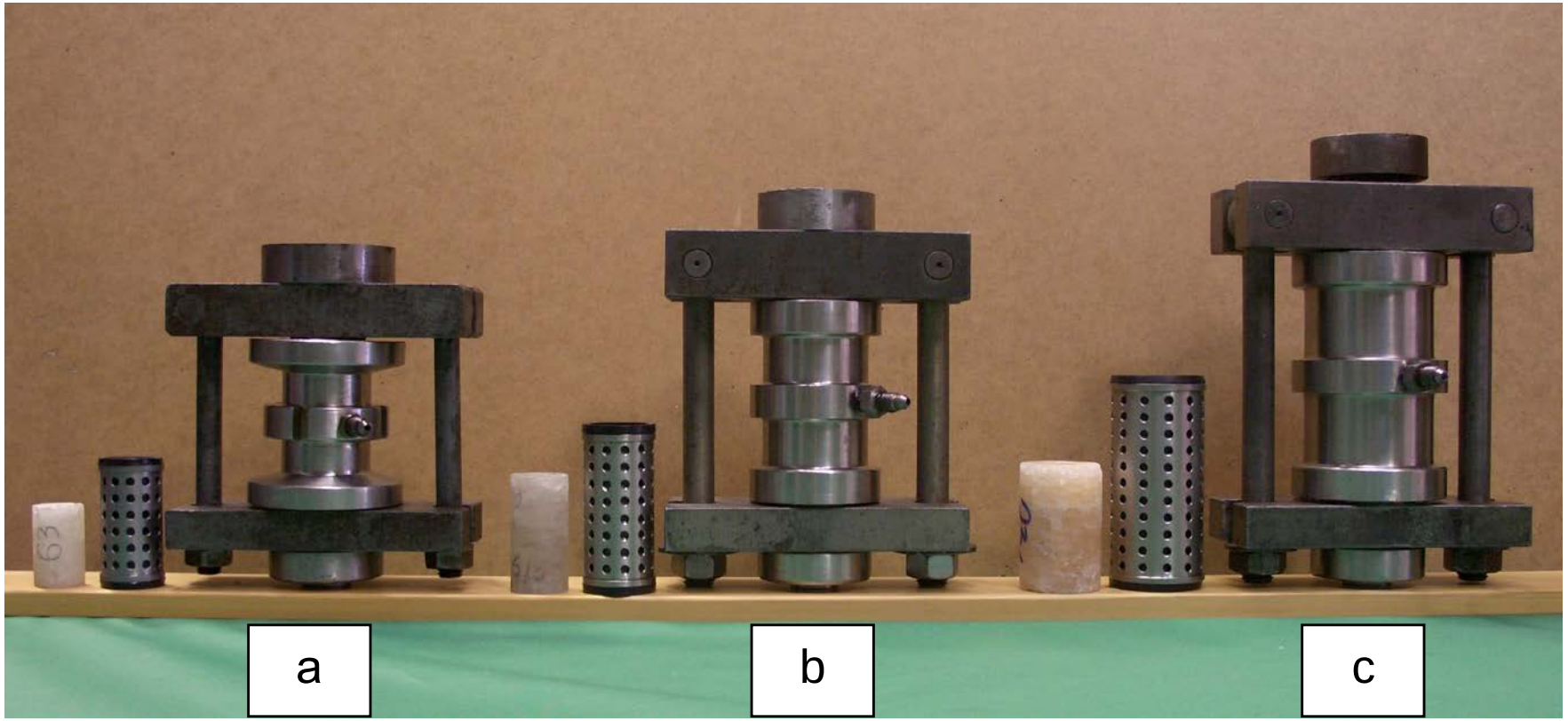
Introduction

There is an intention to develop four large gas-condensate fields in Eastern Siberia in the upcoming decades. The ultimate reserves of these fields with high concentration of helium 0.25-0.58% exceed 4 trn. m³. The helium reserves outrange 5 bln. m³.



Map of East Siberian salt basin in terms of the conditions of underground helium storage formation in rock salt

Studies of rock salt and backfill helium and nitrogen permeability



Studies of rock salt sample gas permeability have been held according to standard screen rock permeability testing procedure using the unit equipped with core holders of three standard sizes

The findings demonstrate that helium permeability values are slightly higher than those of nitrogen permeability in almost all the cases except for the samples which were not exposed to helium or nitrogen filtration.

Helium diffusion in rock salt

Helium diffusion in water and NaCl water solutions was studied via computer simulation in a wide range of concentrations, pressure and temperature. Approximation of obtained diffusion coefficients as a function of concentration and pressure gives the following formula for the coefficients of helium diffusion in NaCL water solutions:

$$D = D_0 (1 – 0.01138P)(1 – 0.1808s + 0.028s^2 – 0.0018s^3) ,$$

where P is pressure in MPa, s – molal concentration.

Helium diffusion coefficient – temperature relationship is described by the following equation:

$$D = D (T)(1 – 0.01138P)(1 – 0.1808s + 0.028s^2 – 0.0018s^3),$$

where D(T) is the coefficient of helium diffusion in water as the function of temperature.

Helium diffusion in rock salt

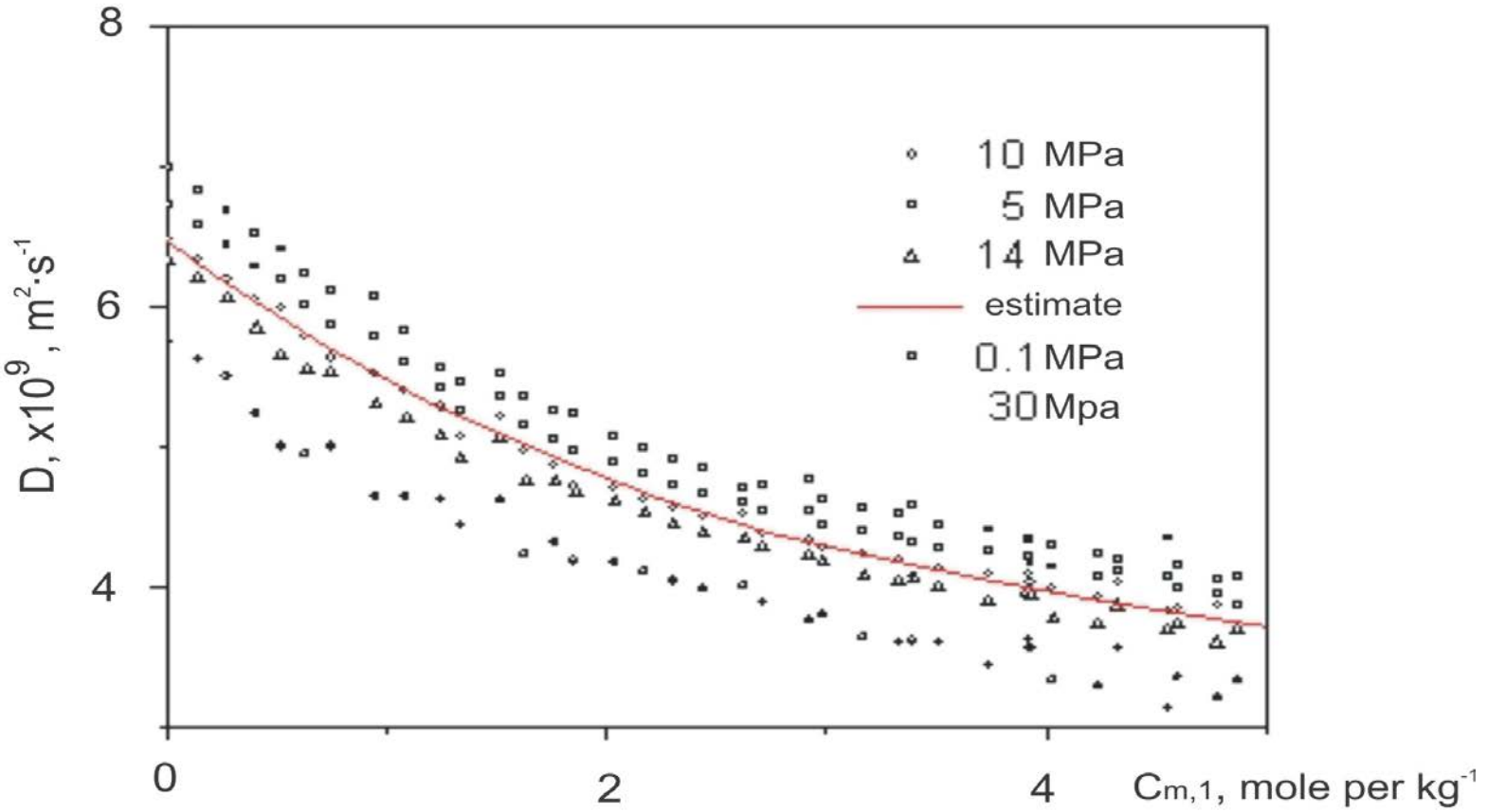


Figure shows diffusion coefficient at a temperature of 300 K and a pressure from 0.1 to 30 MPa.

Conclusions

The research results demonstrate that rock salt is a reliable screen for long-term storage of helium in salt caverns, actually without losses. The gained numerical characteristics of helium migration behaviour could be used in the process of practical calculations when dealing with underground helium storage issue.

Thank you for your attention!