Permeability analysis of influencing factors of tight reservoir cores with high pressure

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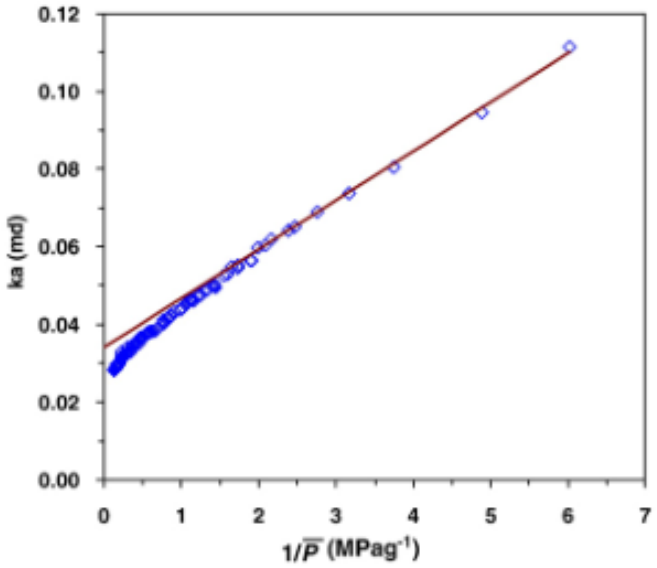
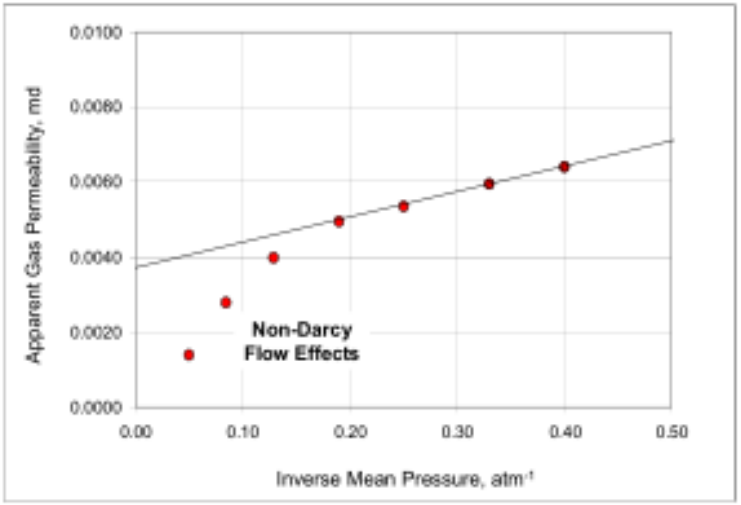
Introduction

Steady-state permeability measurement methods and gas slippage theory are well-known approaches to determine tight-core permeability.

Previous studies showed deviations in lower back pressure (0.1–7 MPa)

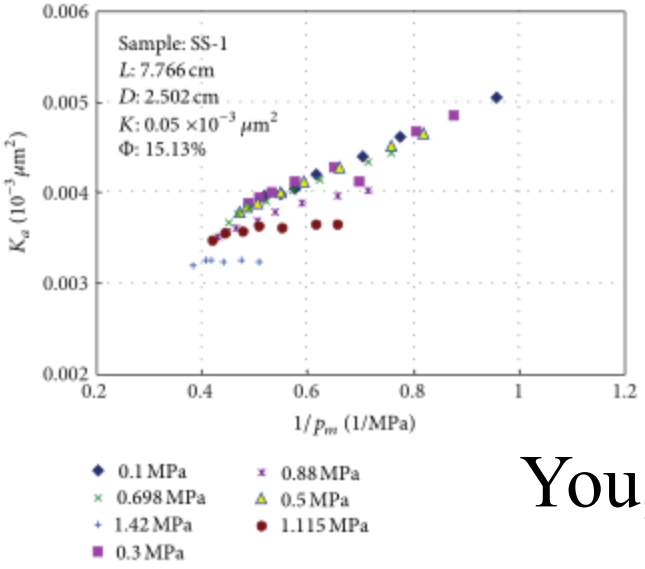


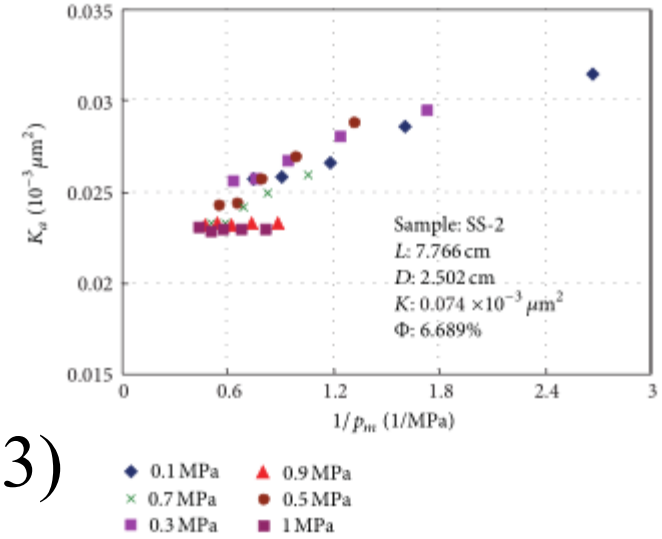
S. Li, (2009)



Rushing, J.A(2004)

Introduction





You, L.J(2013)

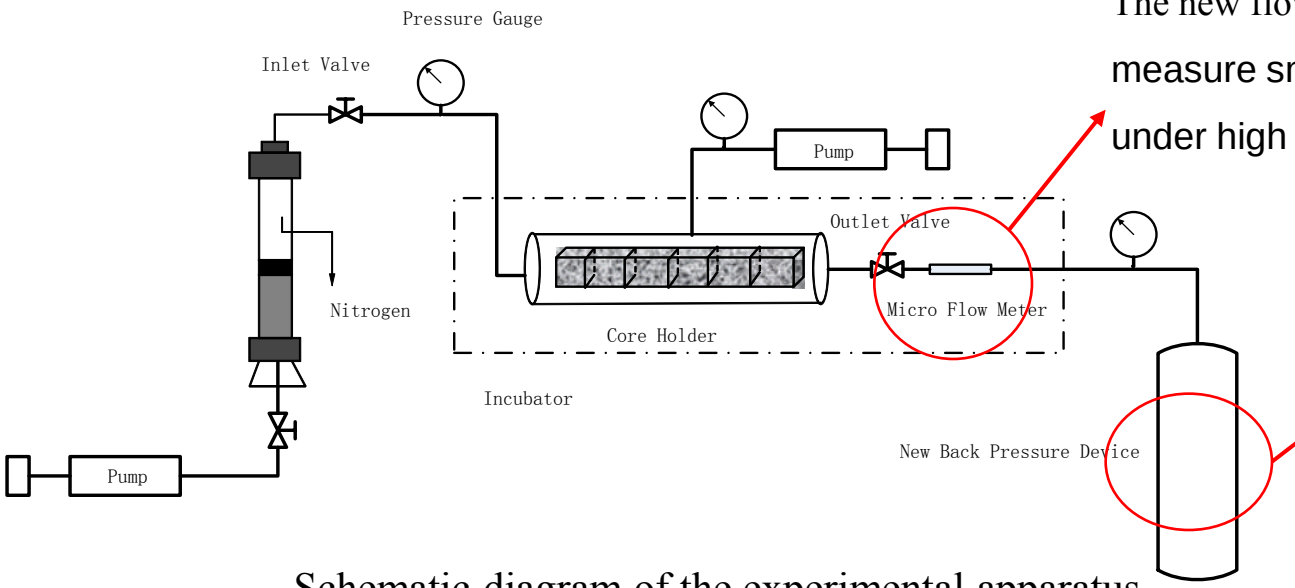
Larger back pressure is restricted by back pressure regulator (BPR).

Two defects

measuring the extremely low gas flow rate

outlet pressure fluctuations

Experimental setup



The new flow meter has been patented.

measure small flows (100 nl/min to 0.3 ml/min)

under high pressure (0 MPag to 50 MPag)

The new back pressure device employs a vessel cavity instead of BPR

Schematic diagram of the experimental apparatus

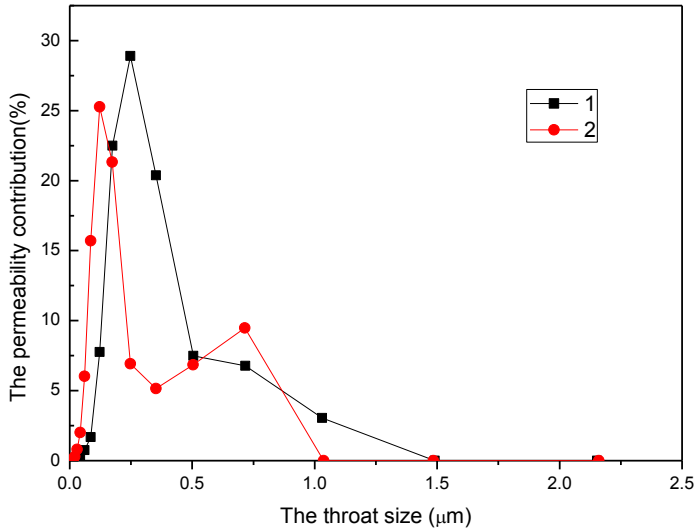
Uncertainties of experimental setup

No	Equipment	Range	Error (%)
1	Pressure gauge	0-1MPa	0.25
		0-6MPa	0.25
		0-25MPa	0.25
		0-60MPa	0.4
2	New flow meter	0.05826ml	0.14
		4.7159ml	0.012
		87ml	0.002
3	incubator	60℃	0.0017
4	Electronic Stopwatch	0-99999s	0.0001

Core samples

The base data of experiment core

Core number	Inner diameter (cm)	Length (cm)	Porosity (%)
1	2.5	6.16	9.85
2	2.52	6.98	7.9



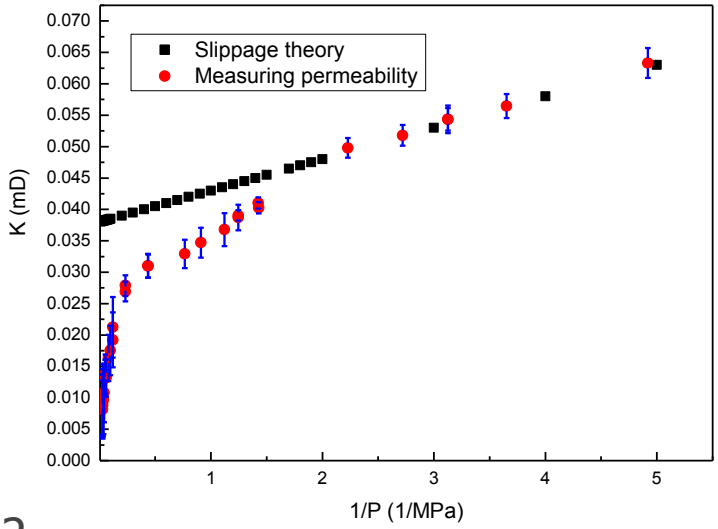
Two natural sandstone cores were collected from Shaanxi Province.

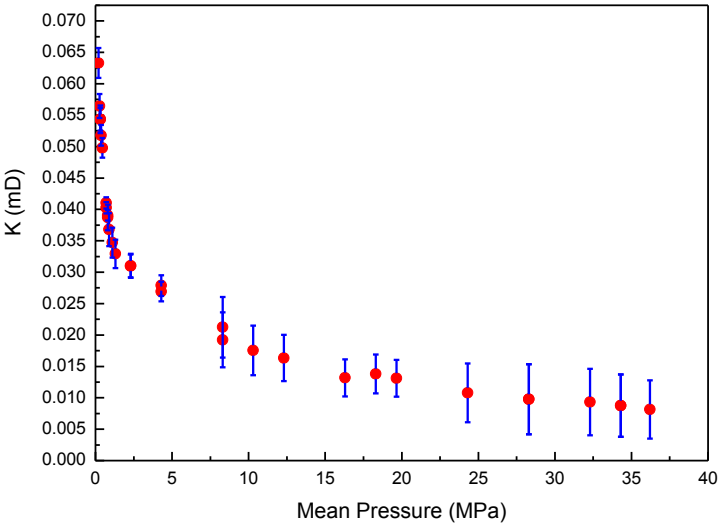
the main seepage channel is unusually concentrated and small. It is 247 nm and 122 nm.

Relationships between throat size and permeability contribution

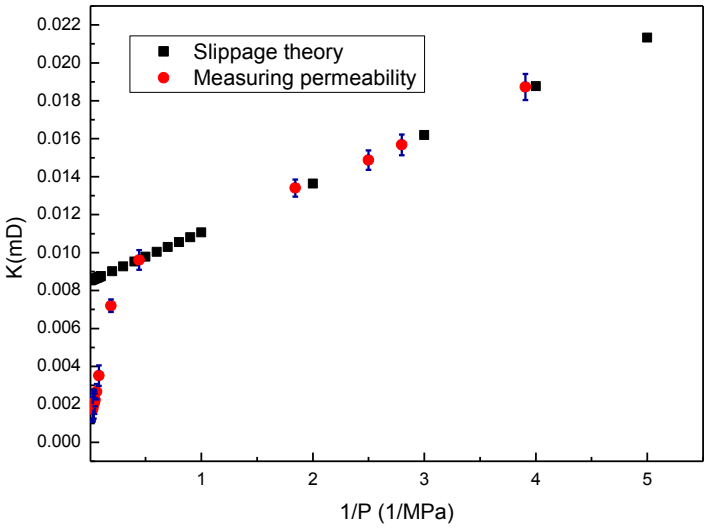
Influence of back pressure on permeability

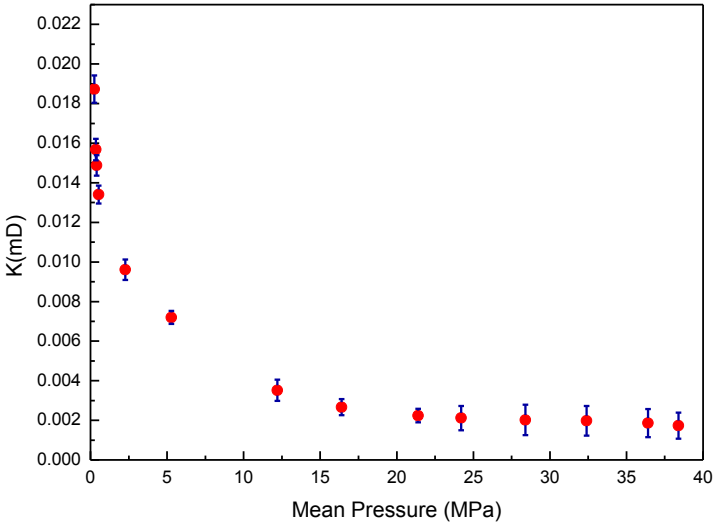
Sample 1





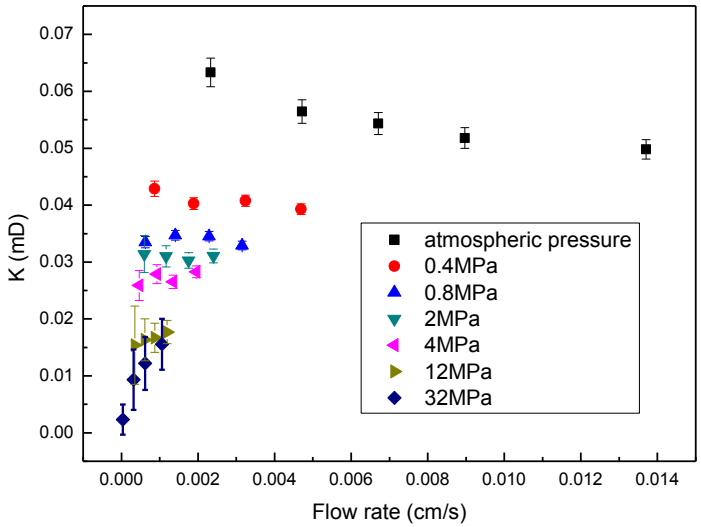
Sample 2





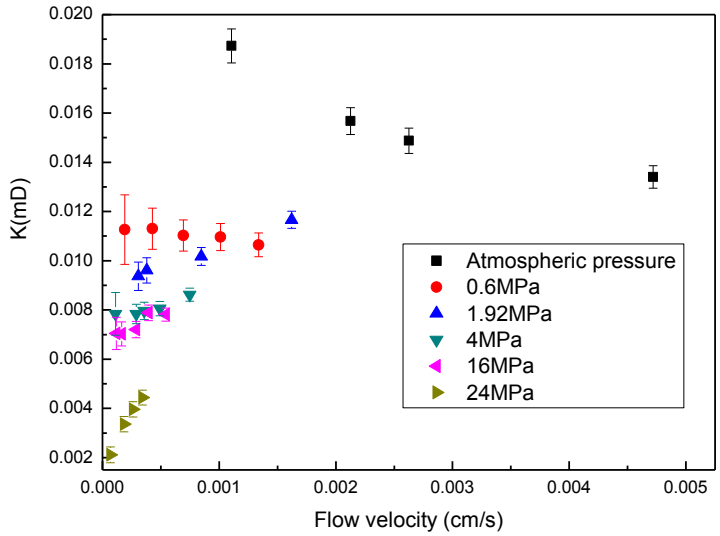
Influence of flow velocity on permeability

Sample 1



Gas slippage effect decreases and disappears as back pressure increases

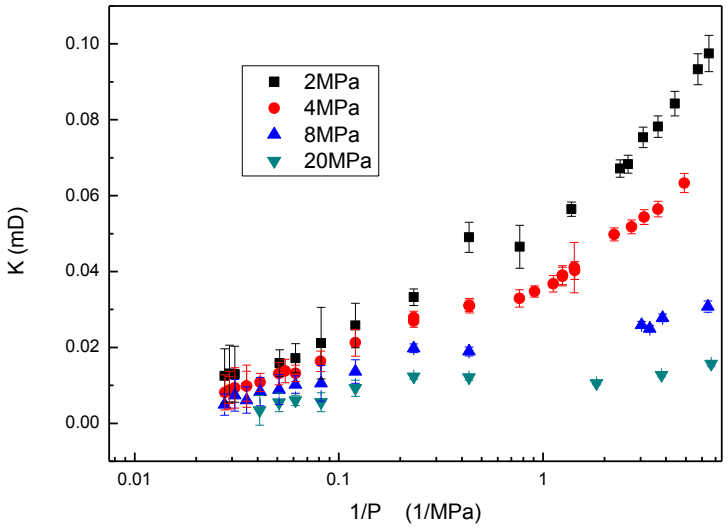
Sample 2

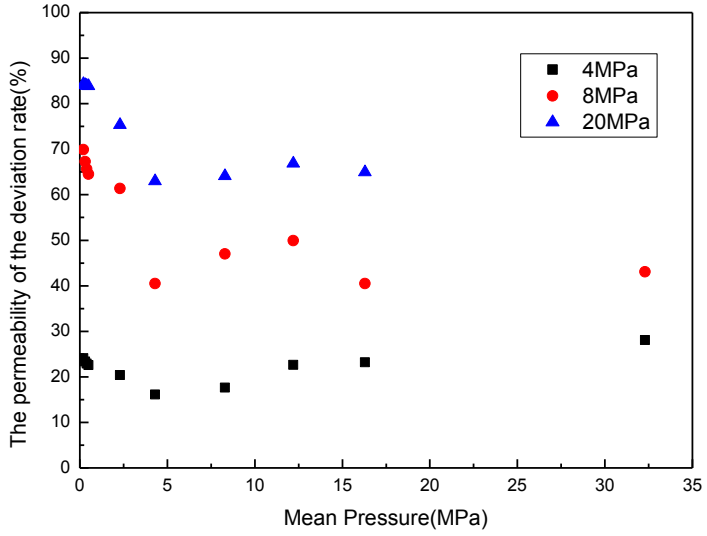


Influence of flow velocity on permeability becomes obvious when back pressure rises.

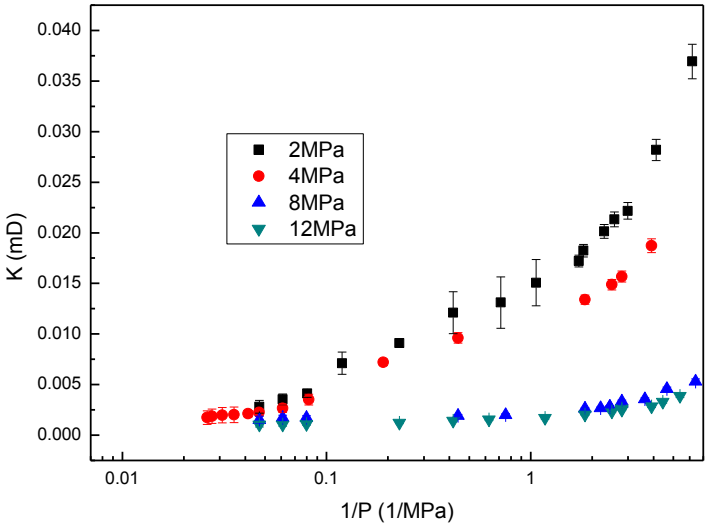
Influence of effective stress on permeability

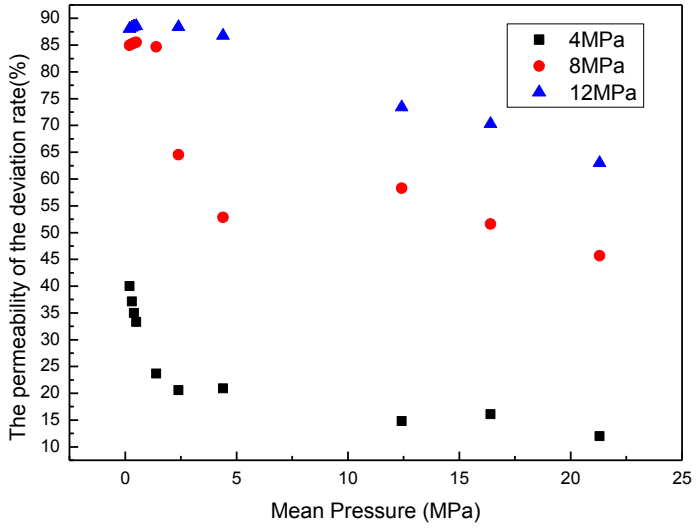
Sample 1





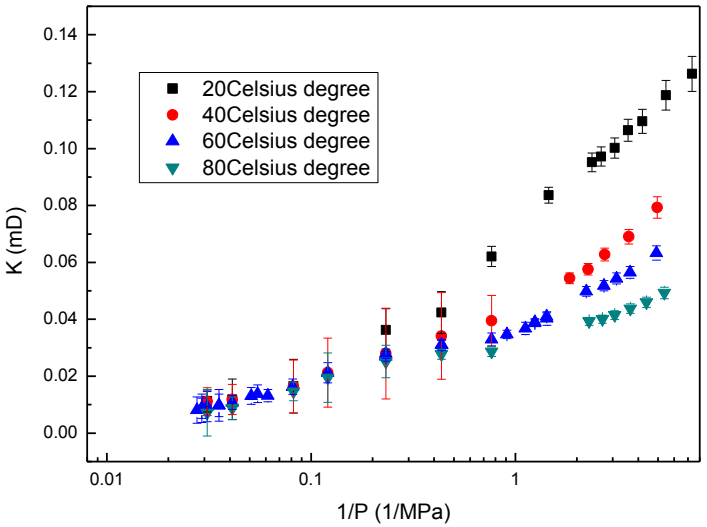
Sample 2





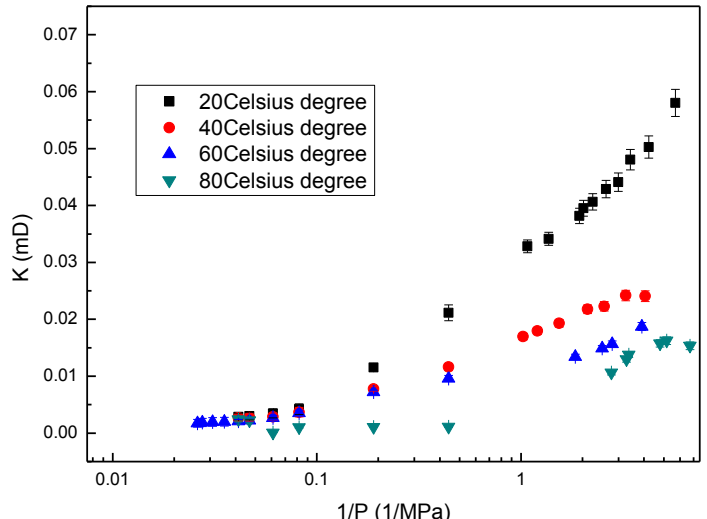
Influence of temperature on permeability

Sample 1



In low back pressure, effective stress and temperature significantly affect permeability

Sample 2



as back pressure increases, effective stress and temperature exert less influence on permeability

Thank you !