



**UNCONVENTIONAL RESERVOIR ENGINEERING PROJECT**  
COLORADO SCHOOL OF MINES



## Research Summary

# EXPERIMENTAL STUDY OF HYDROCARBON FILTRATION

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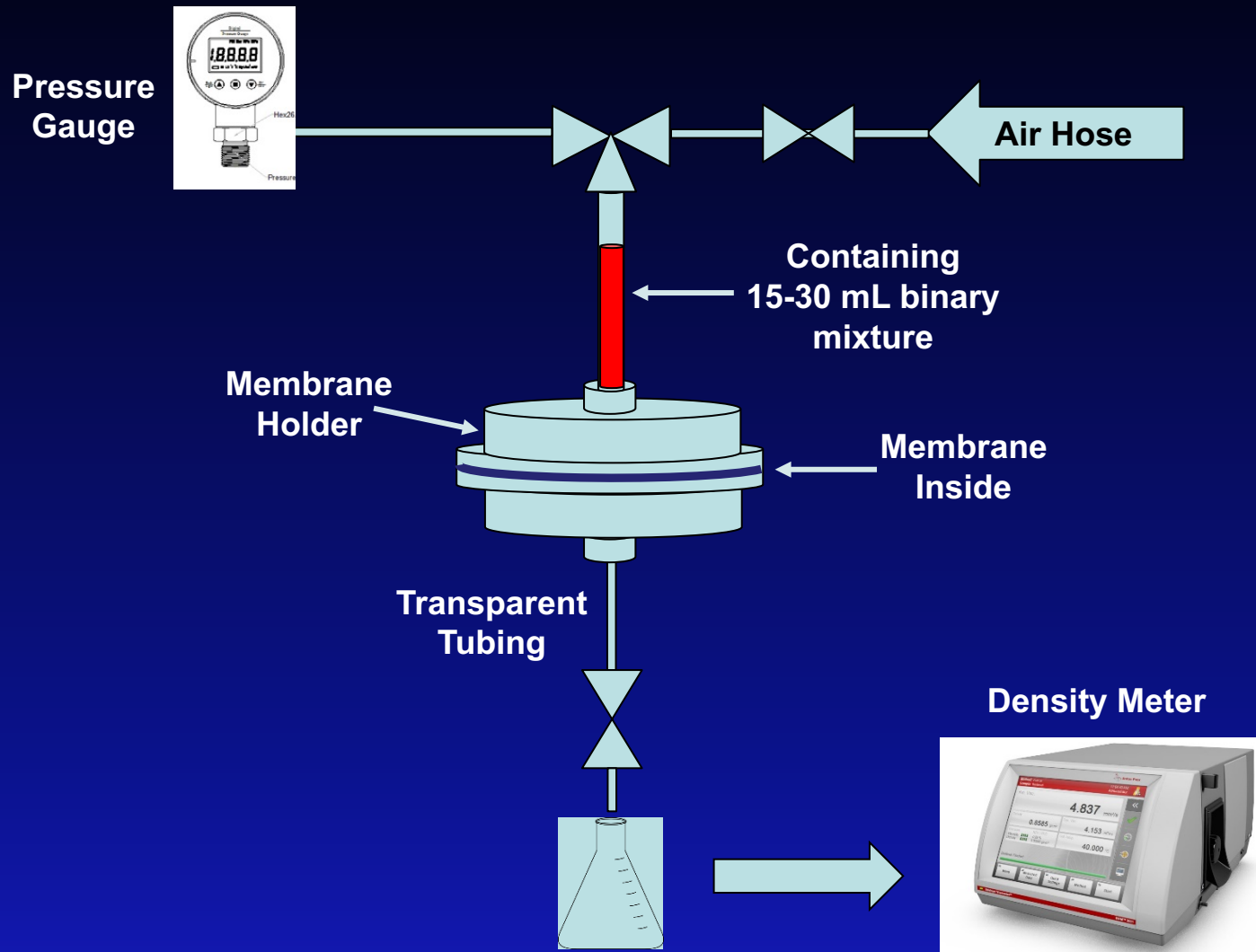
Advisory Board Meeting, May 5, 2017, Golden, Colorado

# Background

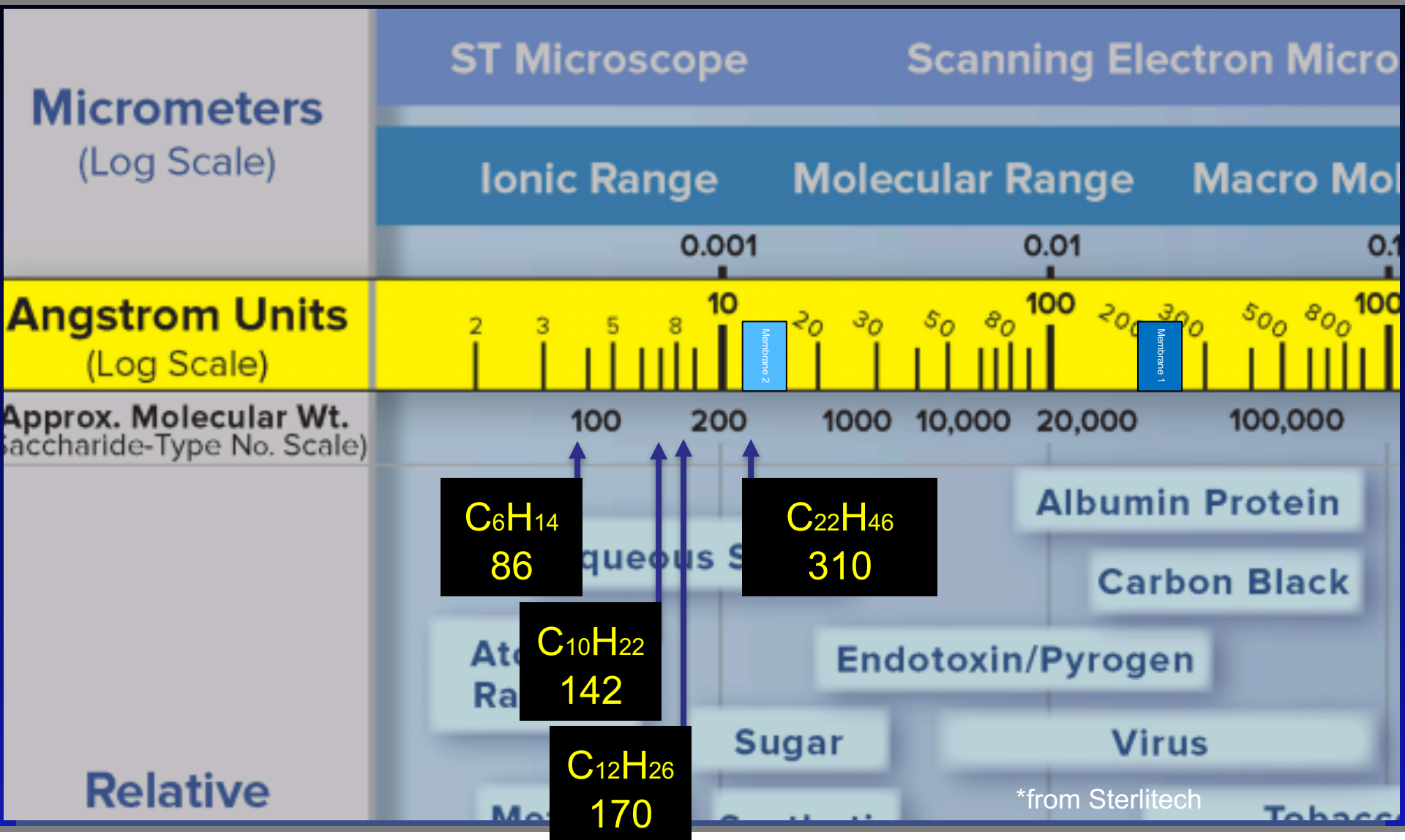
- Motivation
  - Compositional differences have been observed between hydrocarbons produced on surface and hydrocarbons in the reservoir
  - The micron to nanometer scale of shale pore size leads us to suspect the filtration of hydrocarbon by shale rock during the production
- Strategy
  - Verify filtration effect through shale 'core flood' (Z.Zhu)
  - Study filtration mechanism through artificial membrane
    - Simplified and controlled experimental parameters



# Schematic of Experimental Set-Up



# Filtration Spectrum



# Experimental Results

Membrane Properties					Experimental Condition and Results						
Pore Size	Material	Max Temp (C)	Max Pressure (psi)	Liquid Entry Pressure (psi)	Mixture (Alkane)	Operating Temp (C)	Operating Pressure (psi)	Density (g/mL)		Density Difference	
								Influent	Effluent	Absolute	Percentage
0.02 micron	PEEK	180	N/A	43	nC6/nC10	@RT	~75	0.69045	0.69231	0.00186	0.2694%
0.02 micron	PEEK	180	N/A	43	nC6/nC10	@RT	~75	0.69413	0.69446	0.00033	0.0475%
0.02 micron	PEEK	180	N/A	43	nC6/nC12	@RT	~50	0.70410	0.70554	0.00144	0.2045%
280 Dalton (1.4 nm)	PURAMEM	50	290-870	N/A	nC6/nC22	@50 C	~75	0.69844	0.70338	0.00494	0.7073%
280 Dalton (1.4 nm)	PURAMEM	50	290-870	N/A	nC6/nC12	@RT	~45	0.70218	0.70574	0.00357	0.5077%

- No filtration was achieved:
  - Instead, density of mixture increases after flowing through membrane
  - Cause: evaporation of light component (C6)



# Investigation of Potential Issues and Solutions

- Pore expansion/deformation due to pressure
  - **Plan:** compare the before/after-test image of membrane with ESEM/FESEM
  - **Plan:** stack membranes to strengthen pore structure
  - **Plan:** control and measure upstream/downstream pressure precisely with pump and proper gauges
    - Low pressure and slow flow rate
- Density measurement is not sufficiently precise to distinguish the mixture difference
  - **Plan:** use Gas Chromatography (GC)
- Membrane pore size is different than reported
  - **Plan:** characterize pore size distribution through absorption (collaboration with another research group)



Thank You!

Questions and Suggestions?