

# Decoding the Shan 23 Shale

Nanoscale Fluid Dynamics and Development Potential in the Eastern Ordos Basin

Based on advanced NMR methodologies with gradient centrifugation and variable-temperature drying.

# The Macro Context: Eastern Ordos Basin



## Basin Metrics Board

**Basin Area** 370,000 km<sup>2</sup>

Typical craton basin, western North China Block

**Study Area** 4.5 × 10<sup>4</sup> km<sup>2</sup>

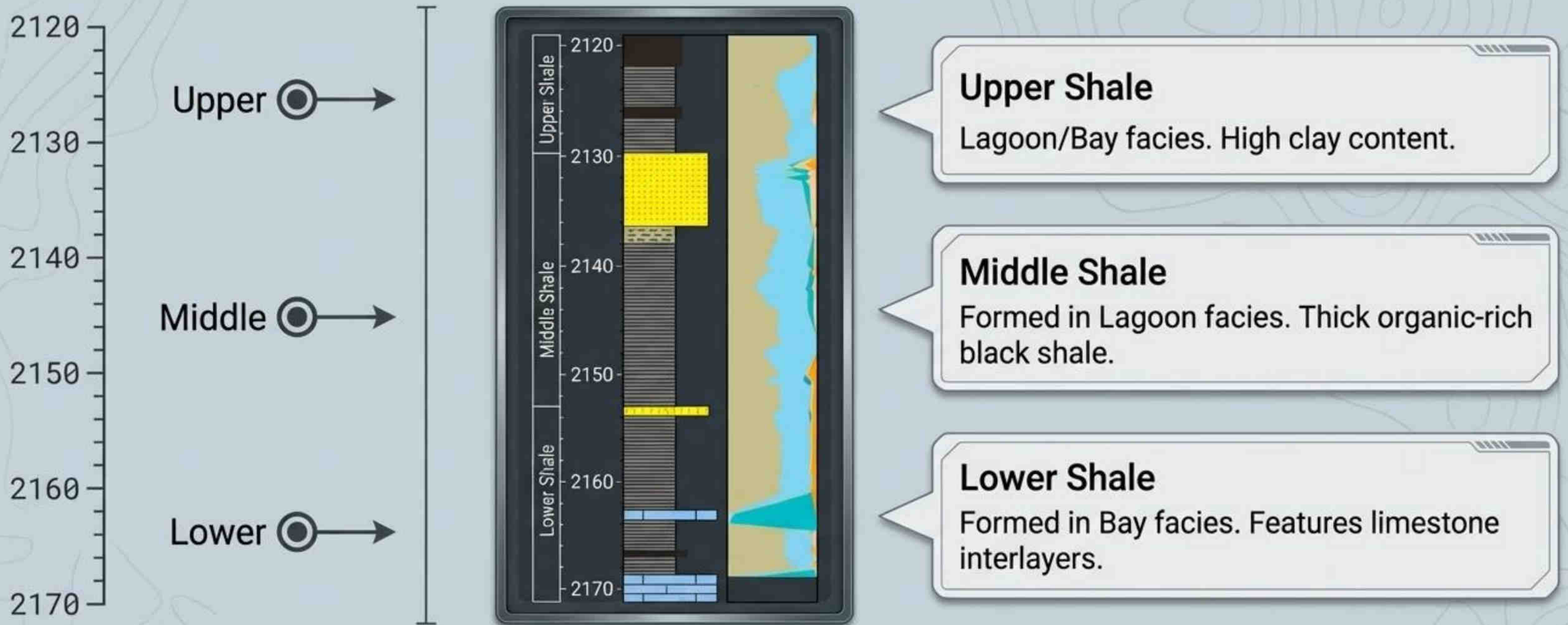
**Formation Period** Late Carboniferous to Early Permian

Transgression period forming thick organic-rich marine-continental transitional shale

**Thermal Maturity (R<sub>0</sub>)** > 2.0

Dry gas generation stage

# The Target Strata: Shan 23 Submember



While all three zones reside in the dry gas generation window, rapid sea-level changes during deposition created vastly different mineralogies and reservoir qualities.

# The Stratigraphic Diagnostic Matrix



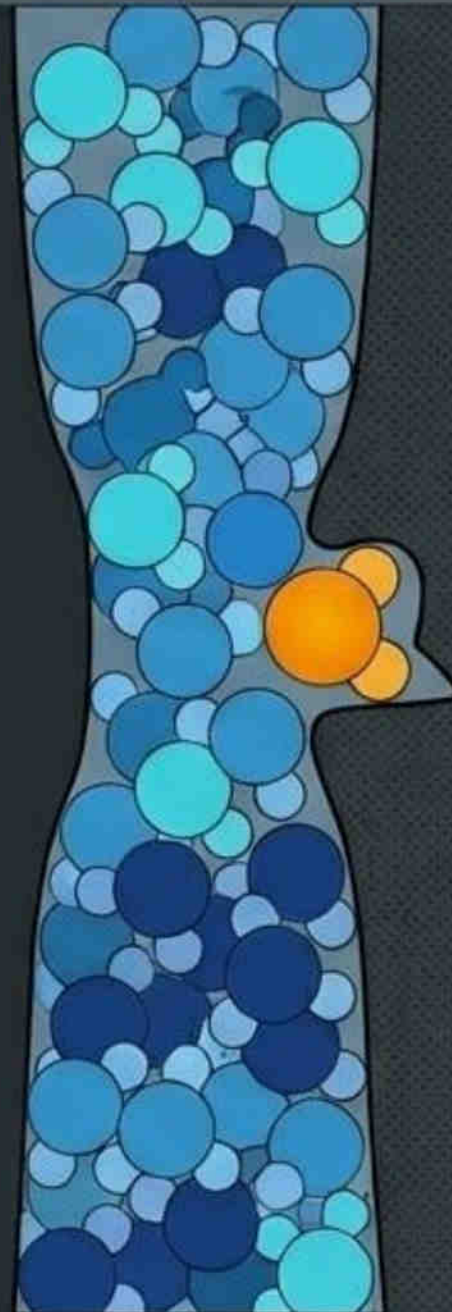
Initial rock-mechanic diagnostics isolate the Middle and Lower shales as superior targets. But total gas is only half the equation—we must evaluate fluid flow.

# The Diagnostic Challenge: Seeing the Invisible Water

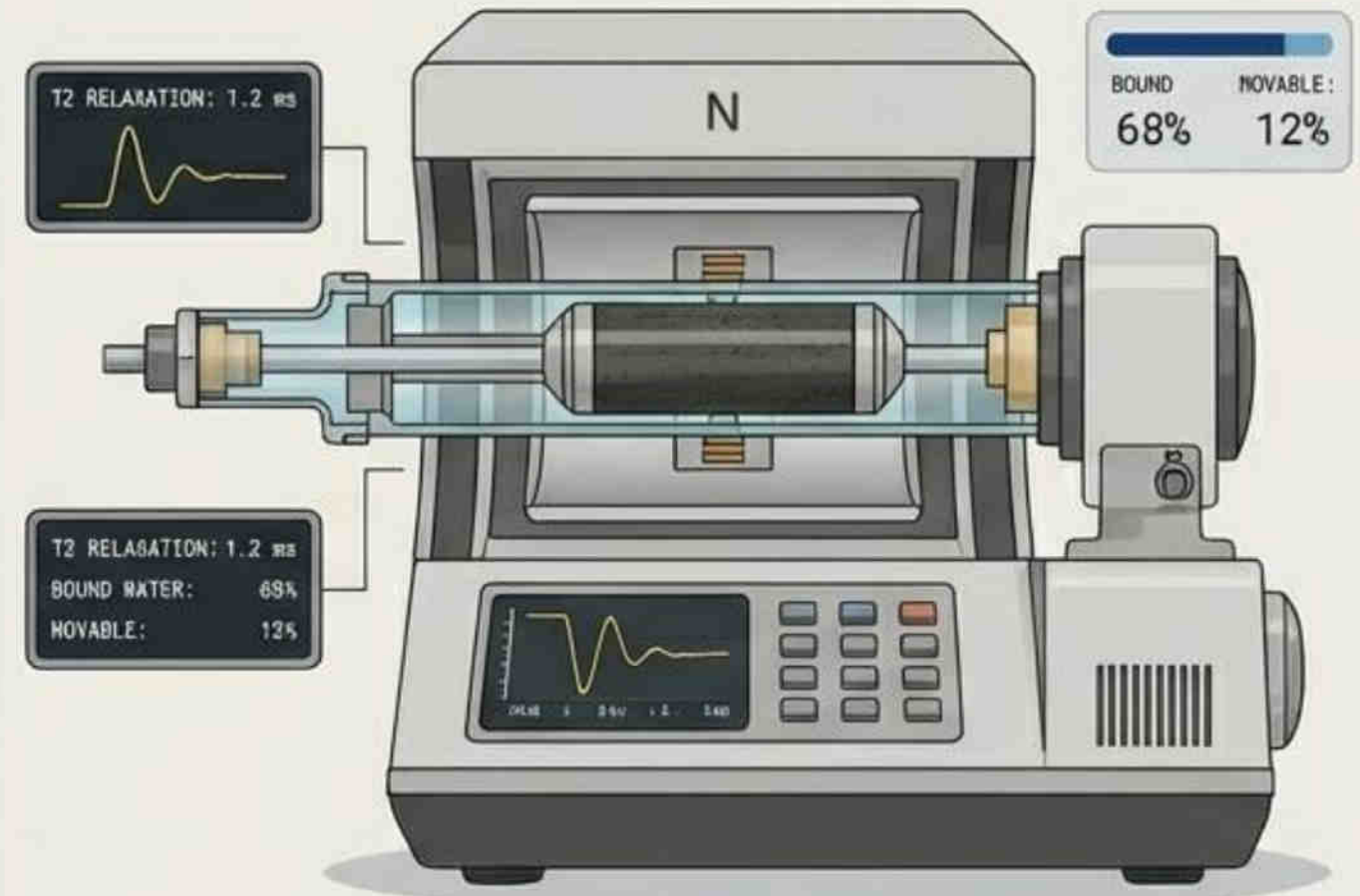
## THE PROBLEM

Marine-continental transitional shales hold massive gas reserves, but feature remarkably high reservoir water cuts.

High gas content is irrelevant if water physically blocks the nanoscale pore throats.



## THE SOLUTION

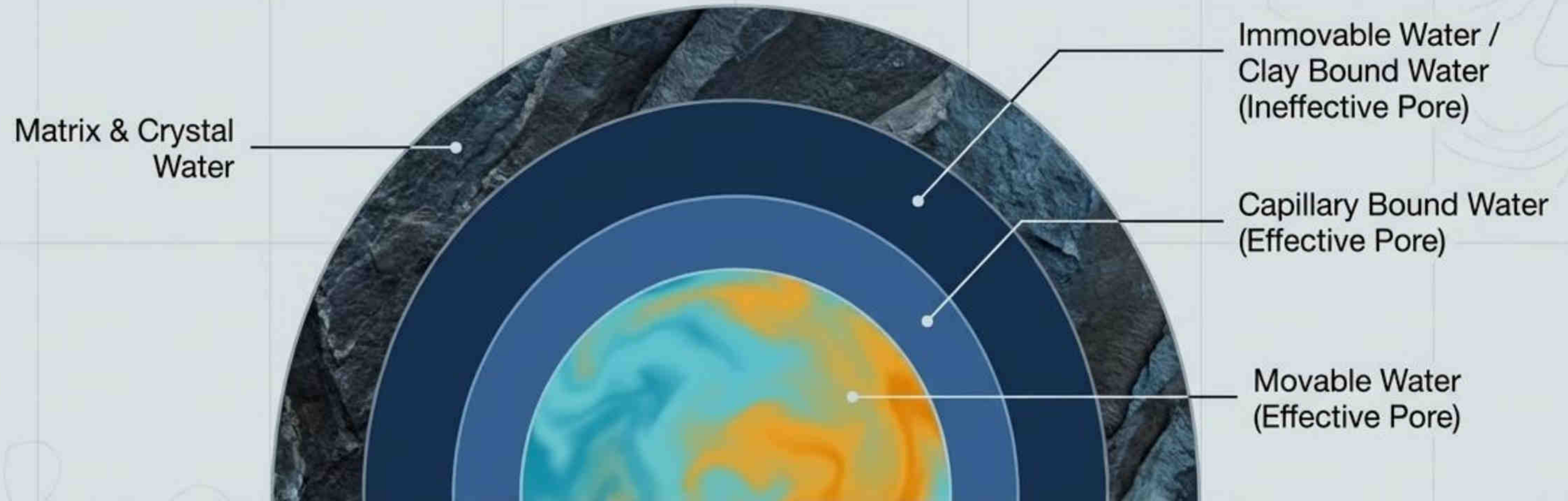


To predict actual flow capacity, we must measure exactly how water is bound within pores measuring fractions of a nanometer.

# The Methodology: NMR Fluid Extraction Timeline



# Nanoscale Anatomy of a Transitional Shale Pore



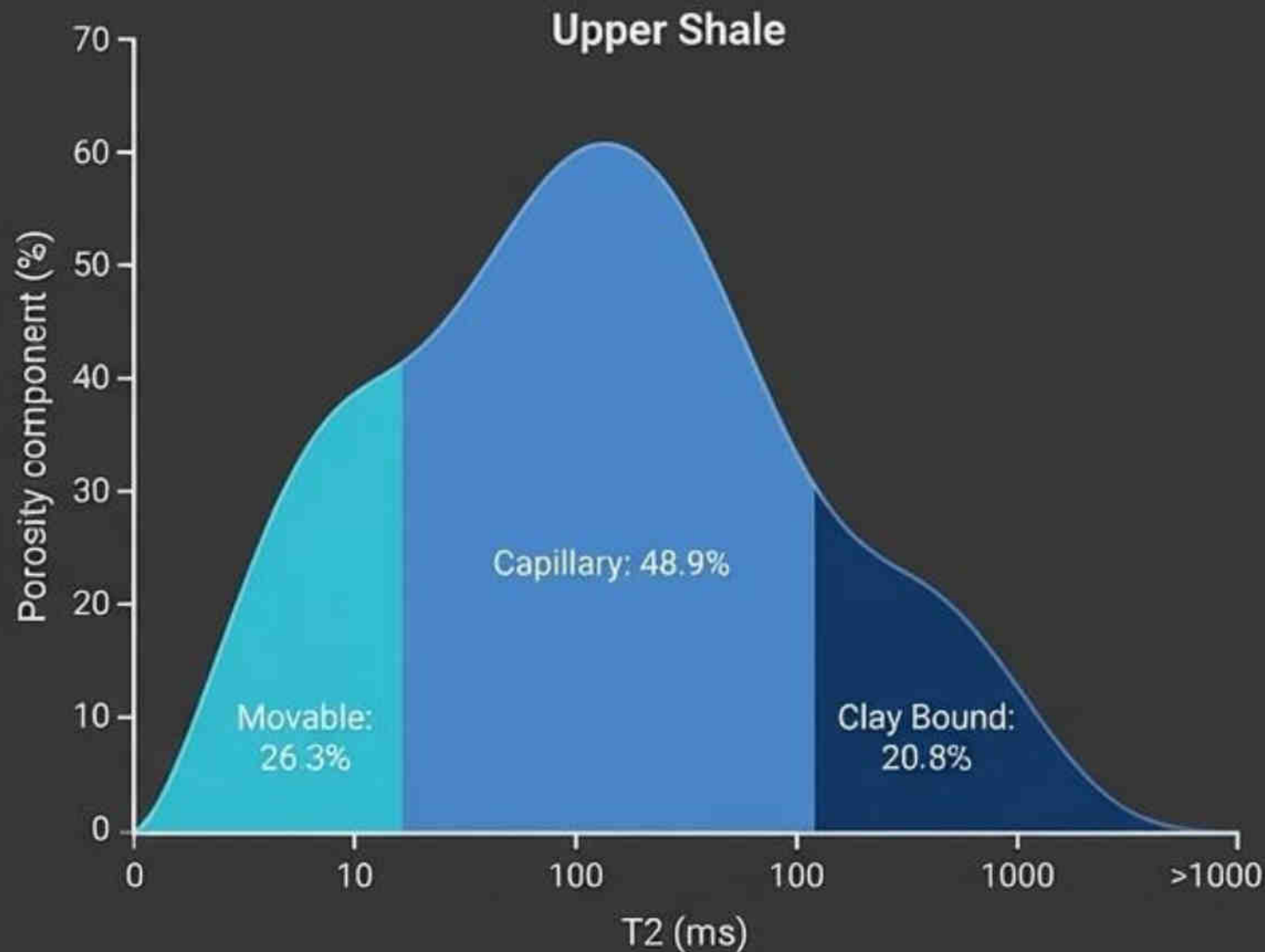
T2 Relaxation Time Cutoffs ( $T_{c1}$ ,  $T_{c2}$ ,  $T_{c3}$ ) map directly to these physical boundaries. Minimum exploitable pore size is defined by the boundary between immovable and capillary bound water.

# Fluid Dynamics: Upper Shale Profile



## Area-Fill Graph

T2 relaxation data (rom a reference material)



## Reservoir Viability

### 1 Total Movable Pores

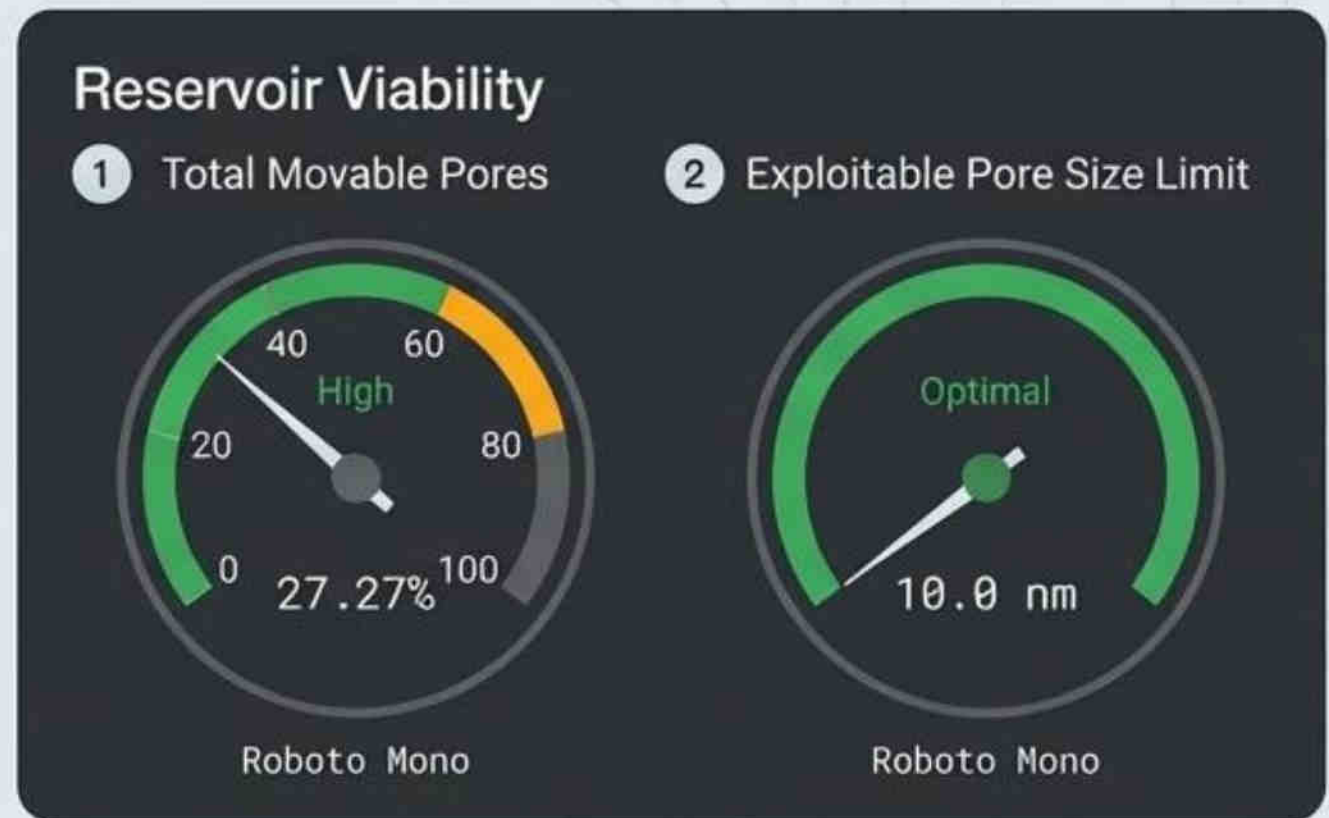
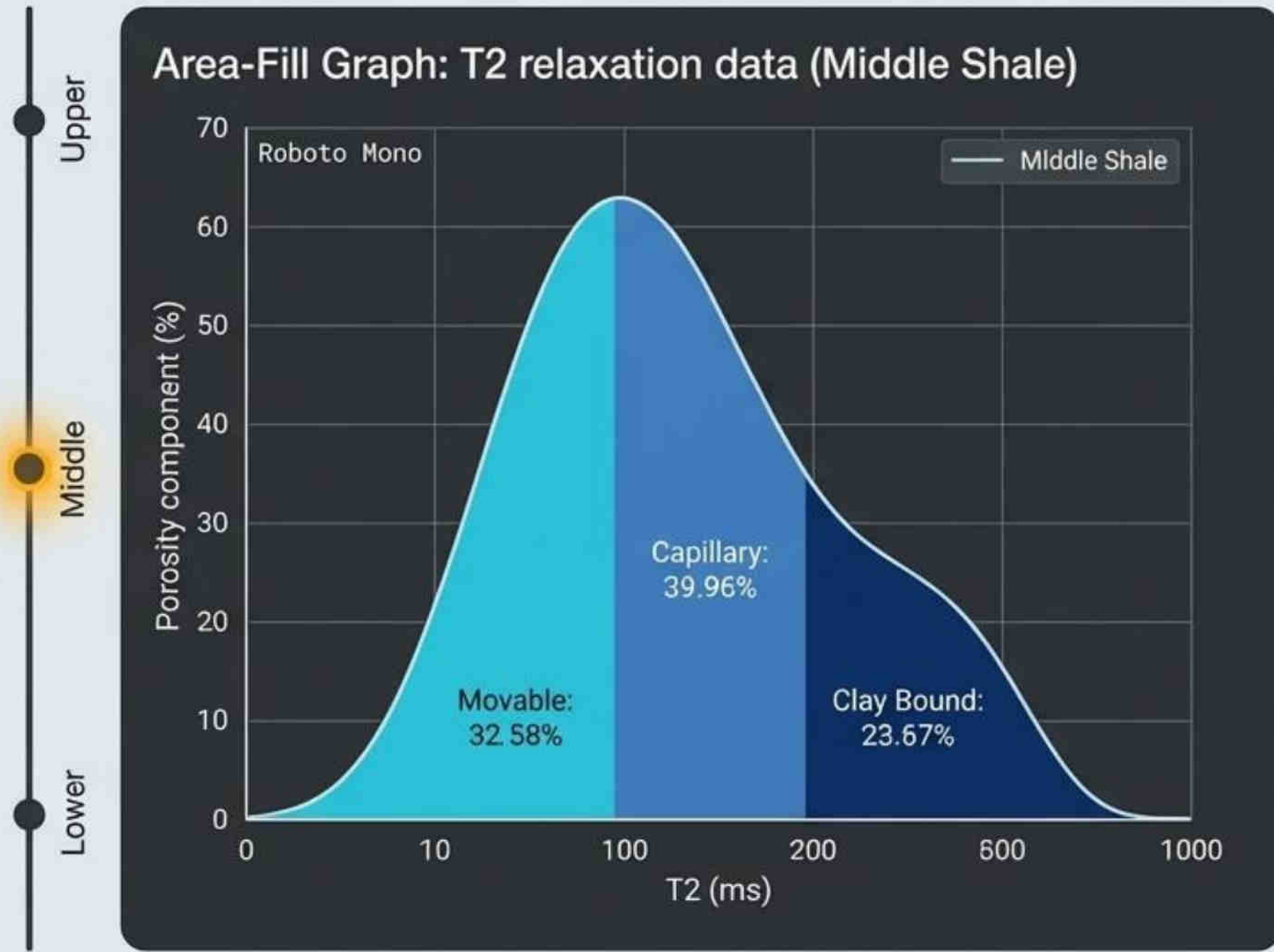


### 2 Exploitable Pore Size Limit



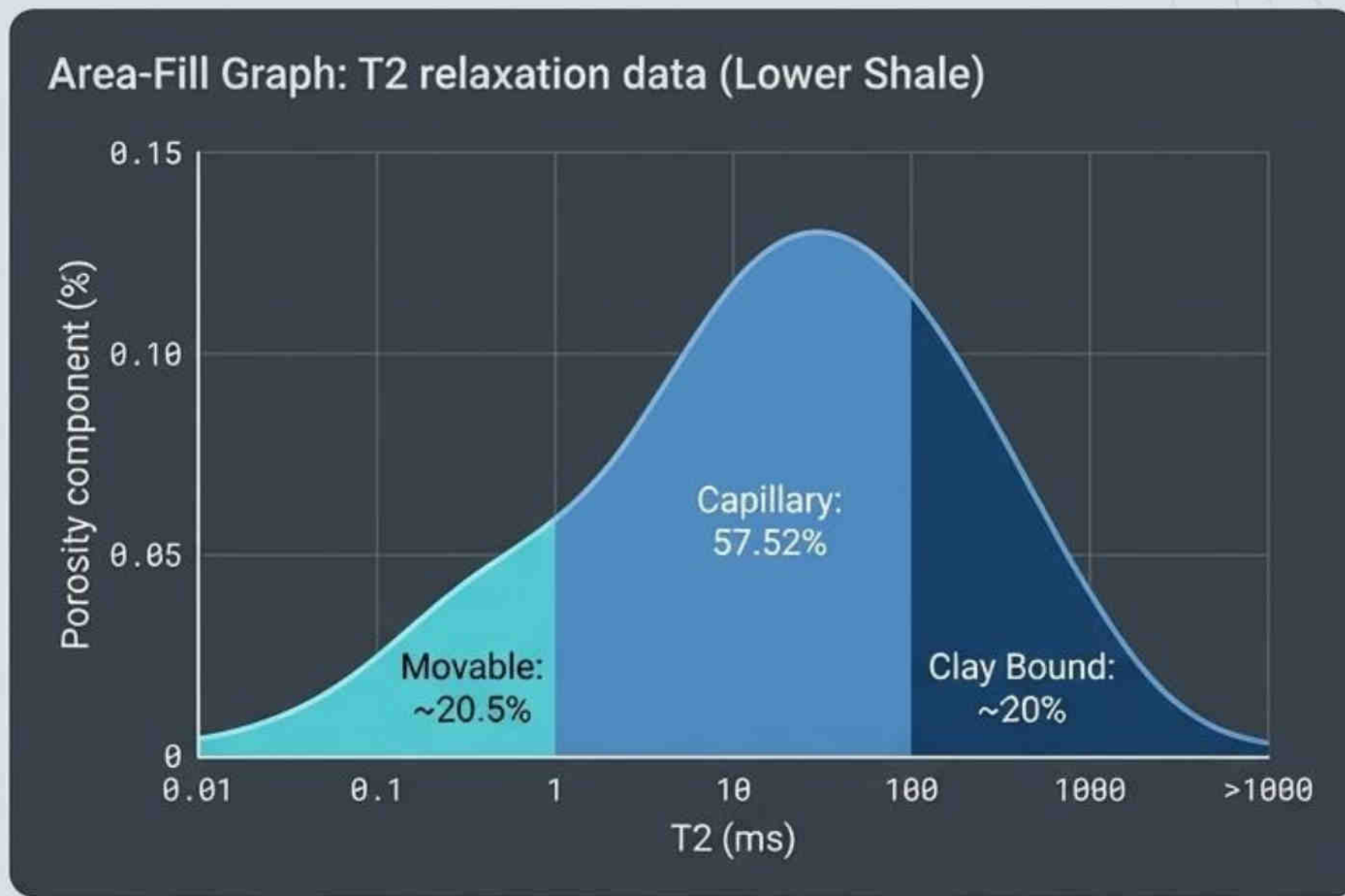
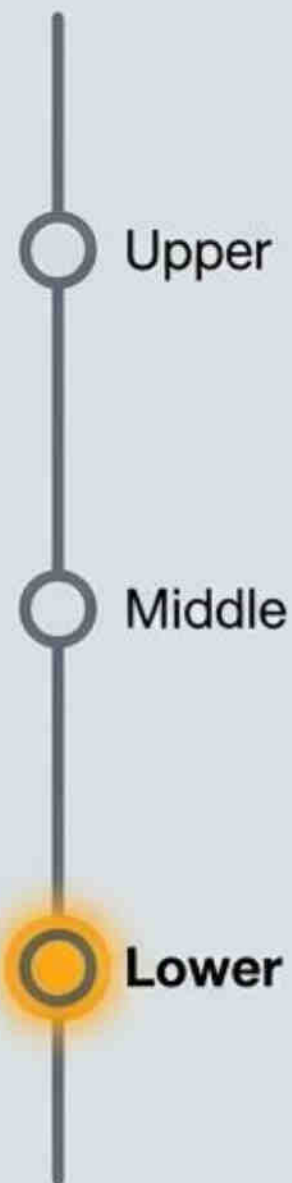
High clay content chokes the pore throats. The highest minimum pore size limit makes extraction highly difficult.

# Fluid Dynamics: Middle Shale Profile



**The optimal target.** Features the highest movable water content (32.58%) and the lowest capillary bound water, creating excellent flow capacity.

# Fluid Dynamics: Lower Shale Profile



### Reservoir Viability

High

27.35%

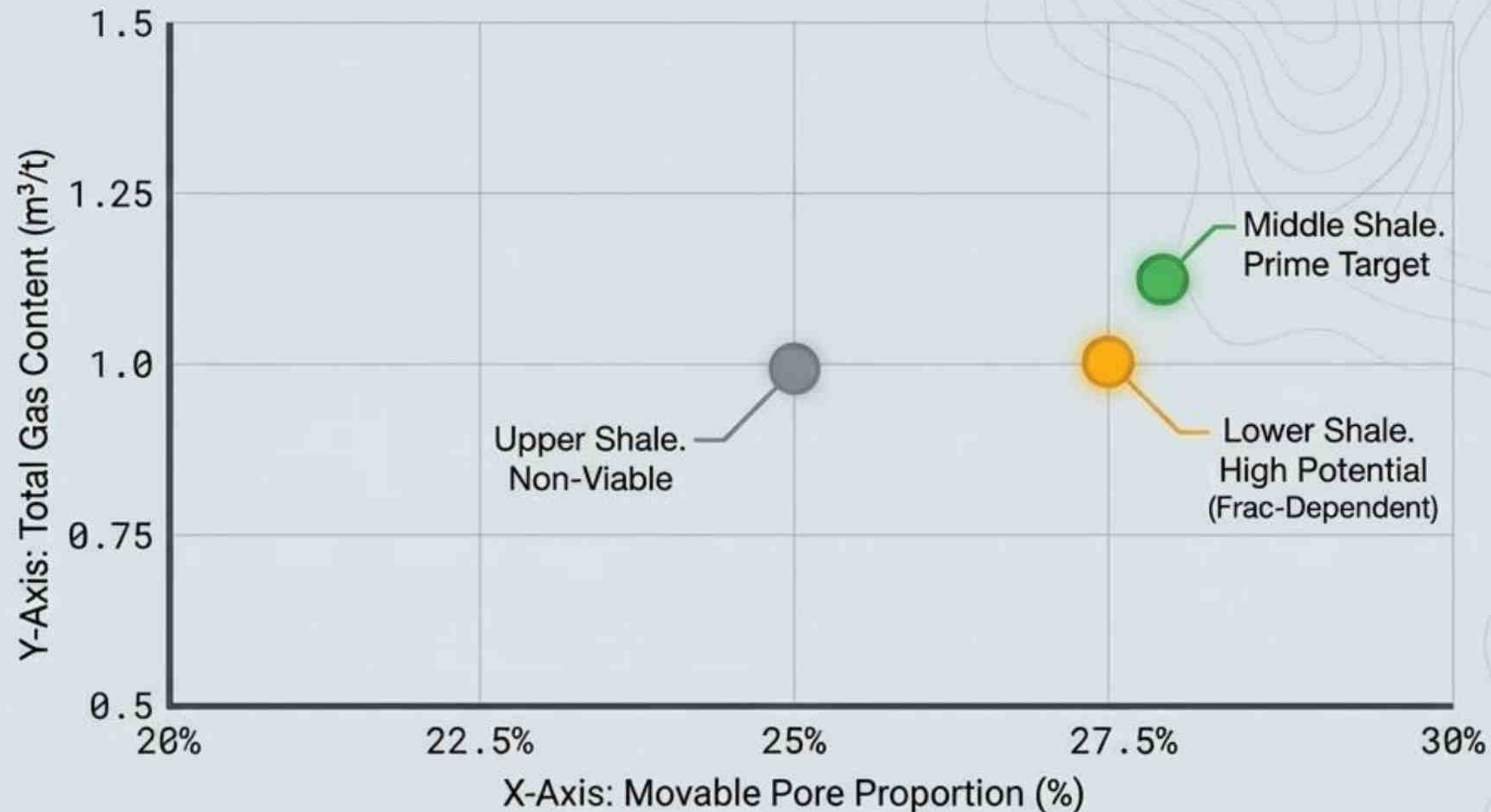
Total Movable Pores

10.0 nm

Exploitable Pore Size Limit

The paradox layer. Despite containing the highest capillary bound water (57.5%), its massive bound pore capacity and 10nm threshold yield excellent total effective porosity (78.61%).

# The Development Potential Matrix



Synthesizing gas volume with nanoscale fluid flow isolates the Middle and Lower shales as the definitive assets for associated development technology.

# Strategic Conclusions: Shan 23 Submember

## 1 The Macro Reality

All three transitional shale intervals reside in the dry gas generation window ( $R_o > 2.0$ ), but rapid facies changes mandate layer-specific extraction strategies.

## 2 The NMR Advantage

Gradient centrifugation and variable-temp drying prove that capillary bound water (39.9% – 57.5%) is the dominant fluid, dictating that advanced fracturing is required to unlock the rock.

## 3 The Target Hierarchy

<b>Avoid:</b>	Upper Shale (12.6nm threshold, choked pores).
<b>Exploit:</b>	Middle and Lower Shales. Both achieve 27% movable pore proportions and 10nm exploitable thresholds, holding 80% of their gas as lost/desorbed



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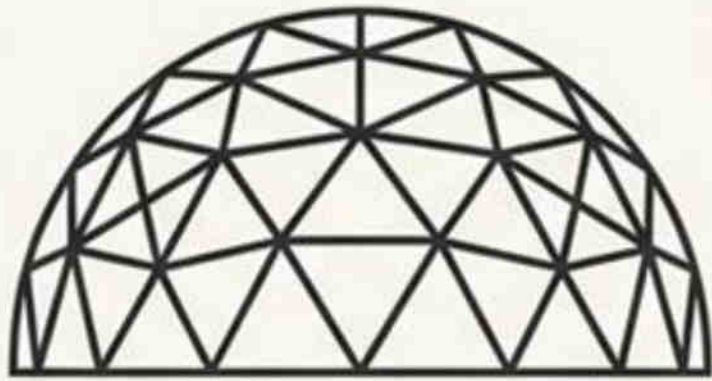
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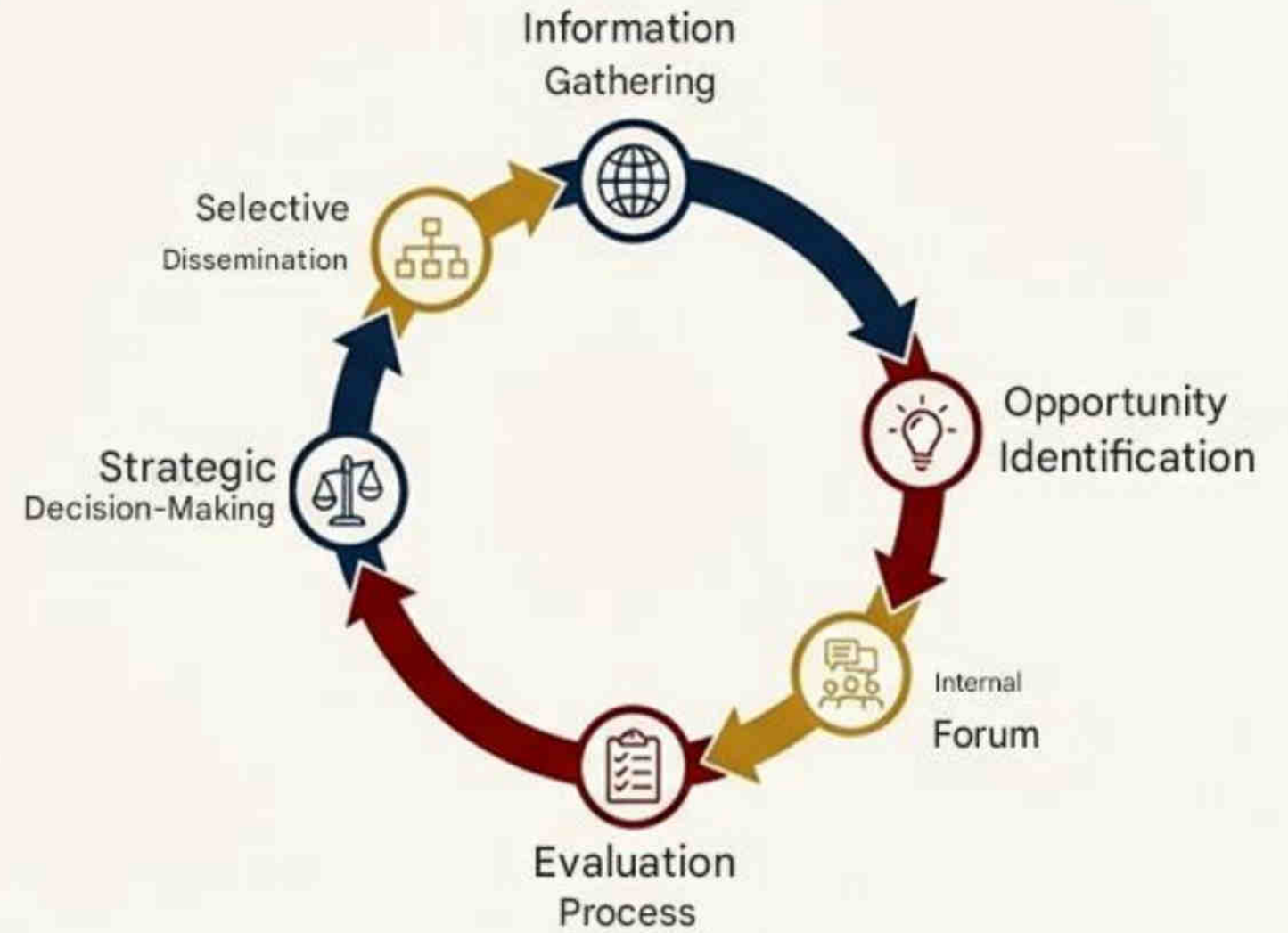
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