

The Petroleum and Renewable
Energy Company Ltd



Shale Gas Potential of Selected Countries in Europe, North Africa and the Near East

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Shale Gas Potential of Selected Countries In North Africa, and the Near East



1. Introduction
2. Critical Factors for a Successful Shale Gas Play
3. Shale Gas Potential in North Africa and the Near East
4. A Country Perspective - Jordan
5. Potential Shale Gas Resources
6. Summary and Conclusions



1. Introduction

Introduction

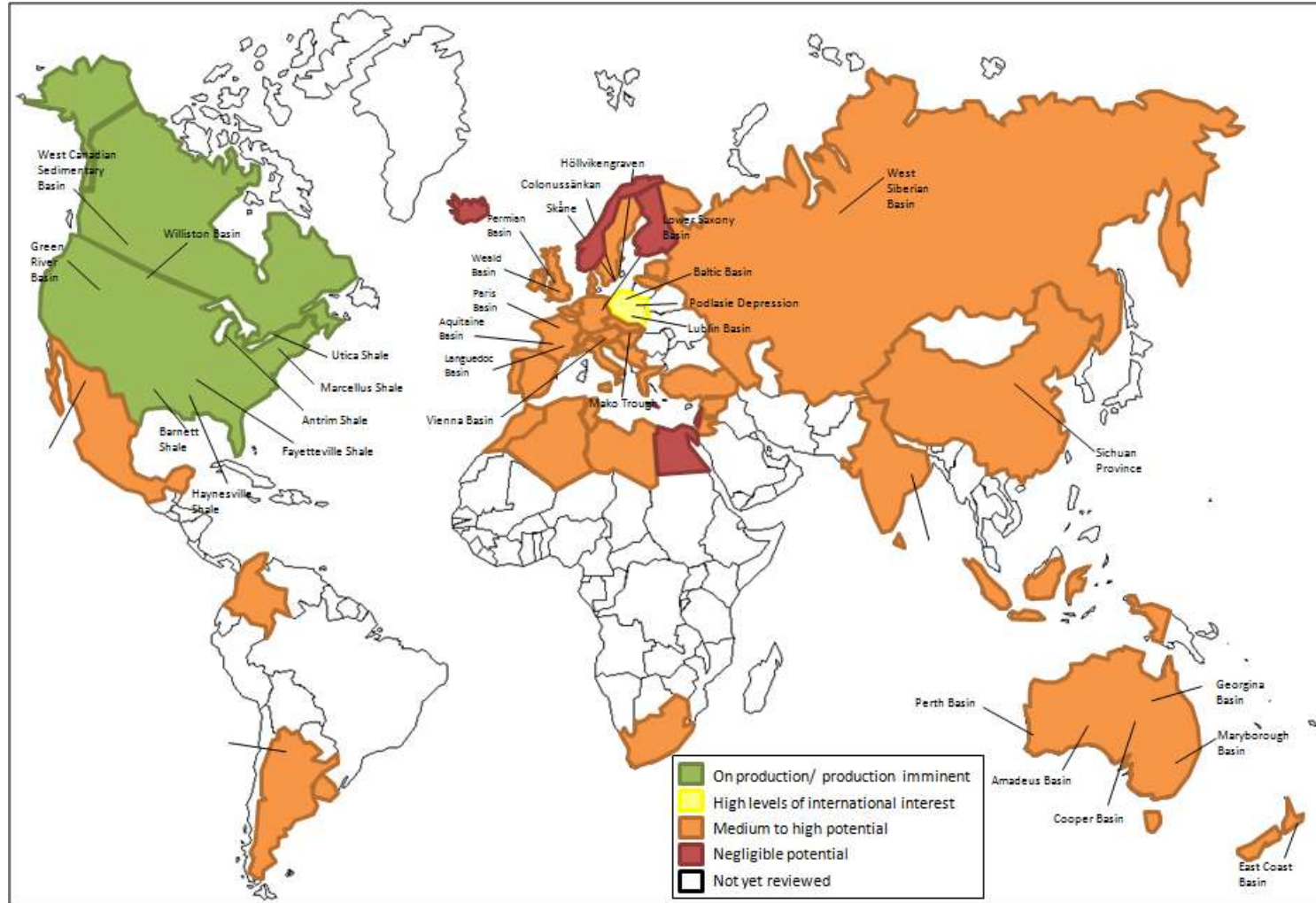


- Production from North America only at present time
- Interest in shale gas has extended to a large number of countries around the world:



Introduction

Areas of Interest





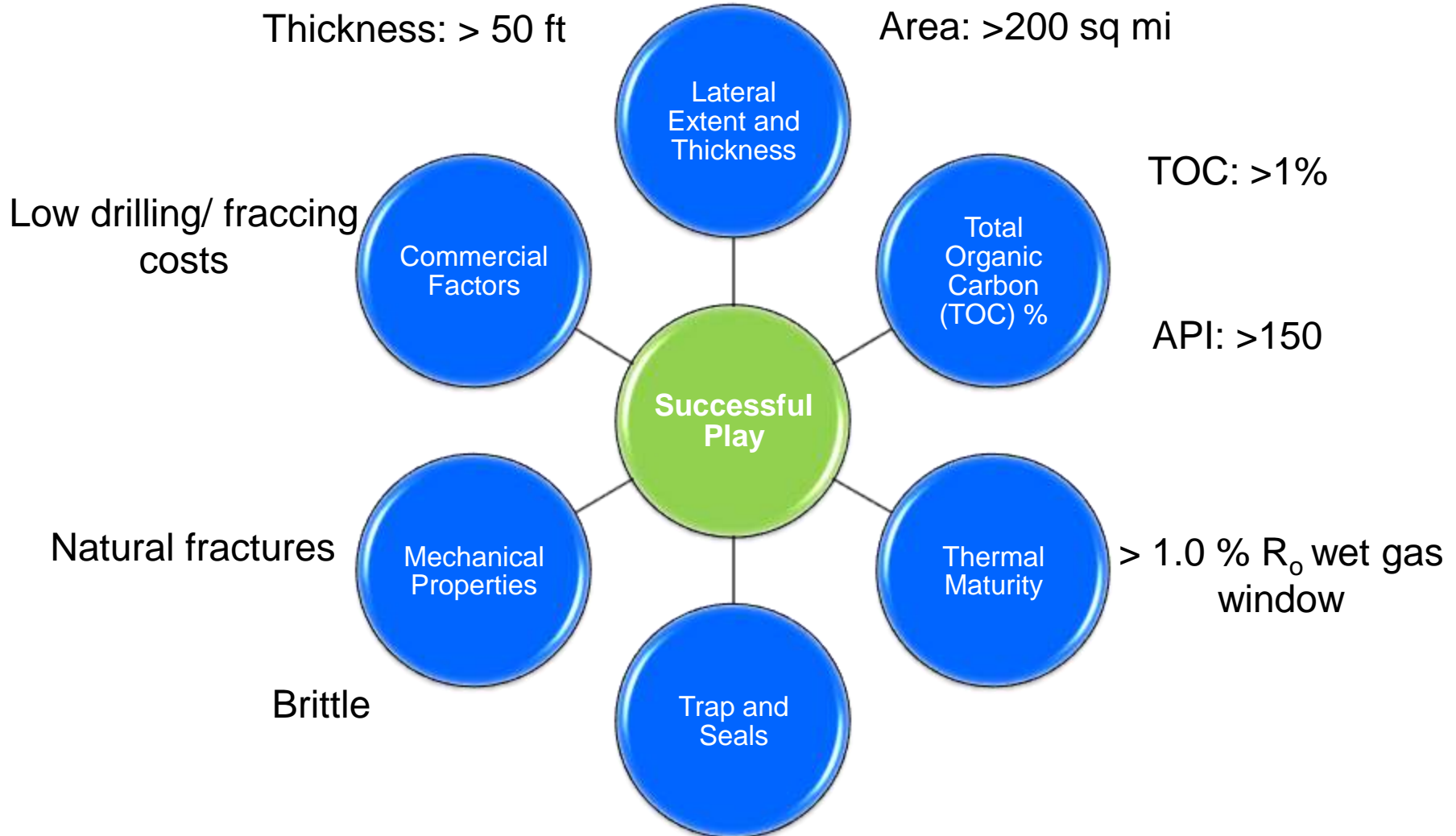
- Petrenel are studying potential in Europe, North Africa and Near East:
 - Critical success factors
 - Identify prospective basins/ shales
 - Quantify resource potential
 - Screen and rank opportunities
- Progress and interim results



2. Critical Success Factors

Successful Shale Gas Plays

Critical Success Factors





3. Regional Perspective

Regional Perspective

Shales of Interest in North Africa



Age Ma	Shale Age		Location	Shale Gas Potential?	Comment
66	Cenozoic	Paleogene	Libya, Tunisia	No	Offshore and immature
146	Mesozoic	Cretaceous	Libya, Egypt, Morocco	Unlikely	Likely to be oil prone
199		Jurassic	Egypt, Morocco USA	Unlikely	Likely to be oil prone
299		Permo-Triassic	Libya	Negligible	
359	Palaeozoic	Carboniferous	Morocco, USA	Possibly	
416		Devonian	Algeria, Libya, USA	Yes (local)	
444		Silurian	Morocco, Algeria, Tunisia, Libya, Jordan, Saudi Arabia, Syria, Iraq,	Yes (Regional)	Widespread, organic rich, and with suitable burial history.
488		Ordovician	Jordan, Algeria, USA	Yes (local)	

Regional Perspective

Shales of Interest in North Africa



Shale Age	Gas In-place						Gas Recovery		
	Extent	Thick	TOC	Mature	ϕ	Press	k	Frac.	Depth
Paleogene	●	●	?	●	?	●	?	●	●
Cretaceous	●	●	●	●	?	●	?	●	●
Jurassic	●	●	●	●	?	●	?	?	●
Permo-Triassic	●	?		●	?	●	?	?	●
Carboniferous	?	?	●	●	?	●	?	?	●
Devonian	●	●	●	●	?	●	?	?	●
Silurian	●	●	●	●	●	●	●	?	●
Ordovician	●	●	●	●	●	●	?	?	●

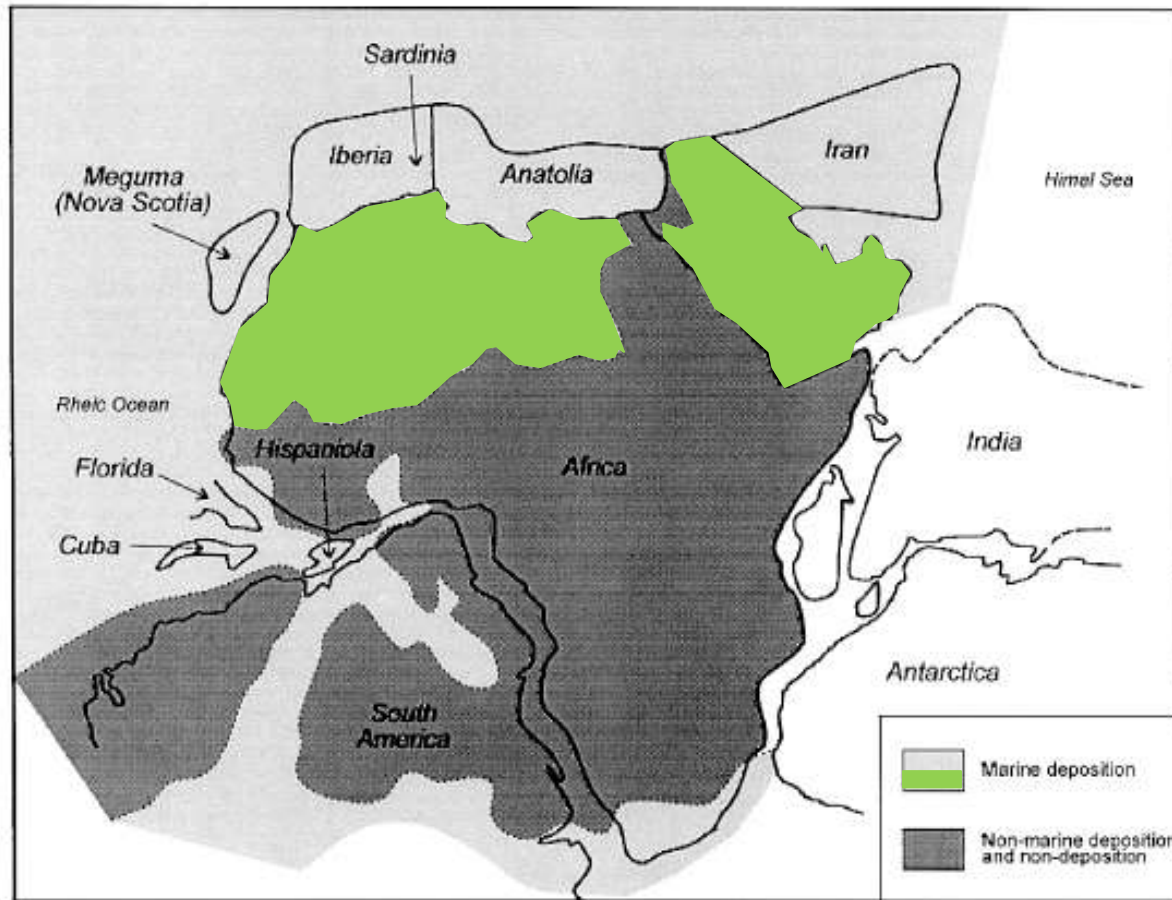
● Probable

● Possible

● Unlikely

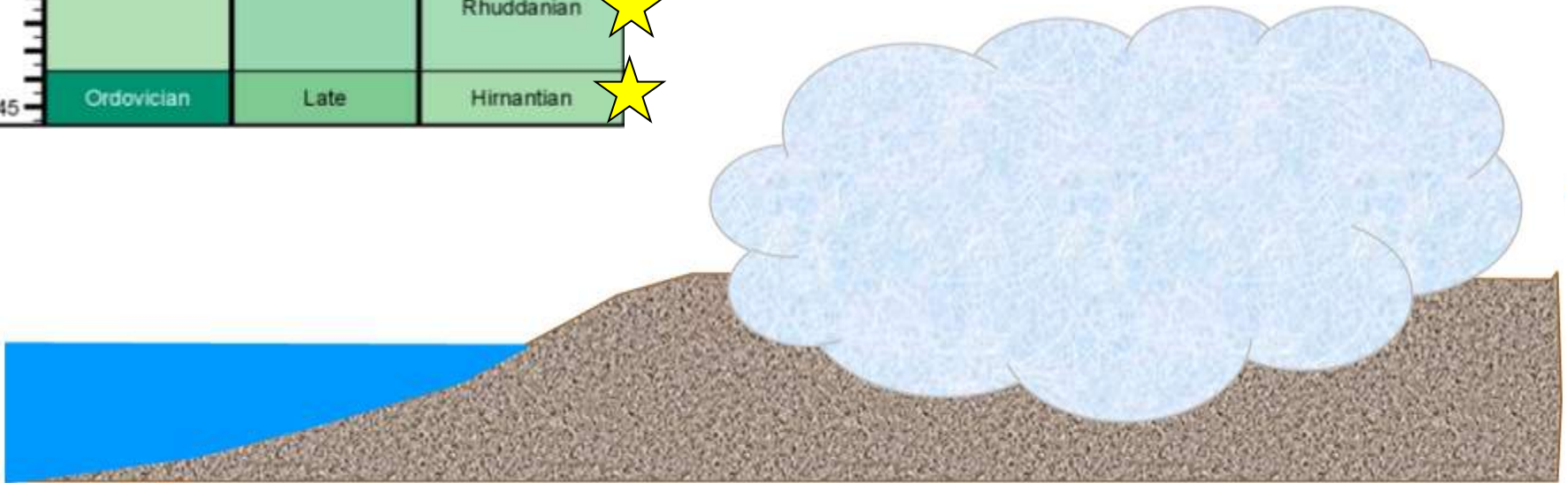
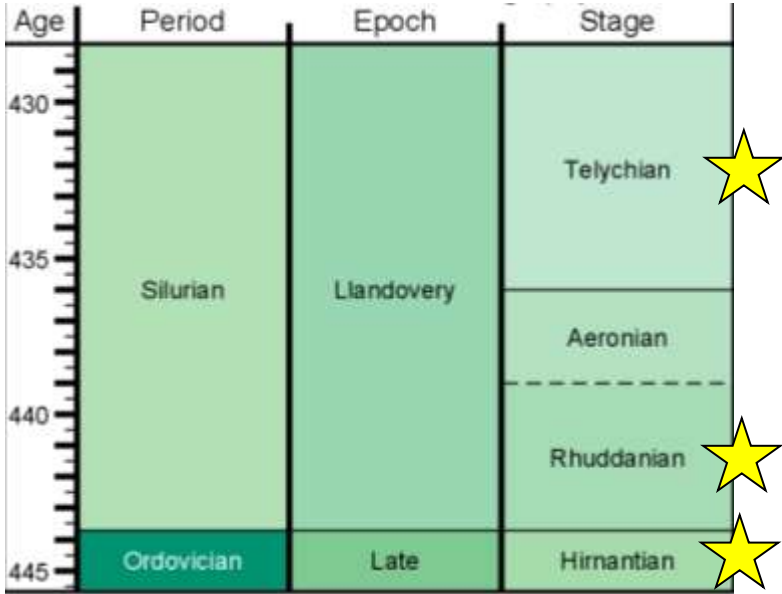
? Unknown

Silurian Hot Shales

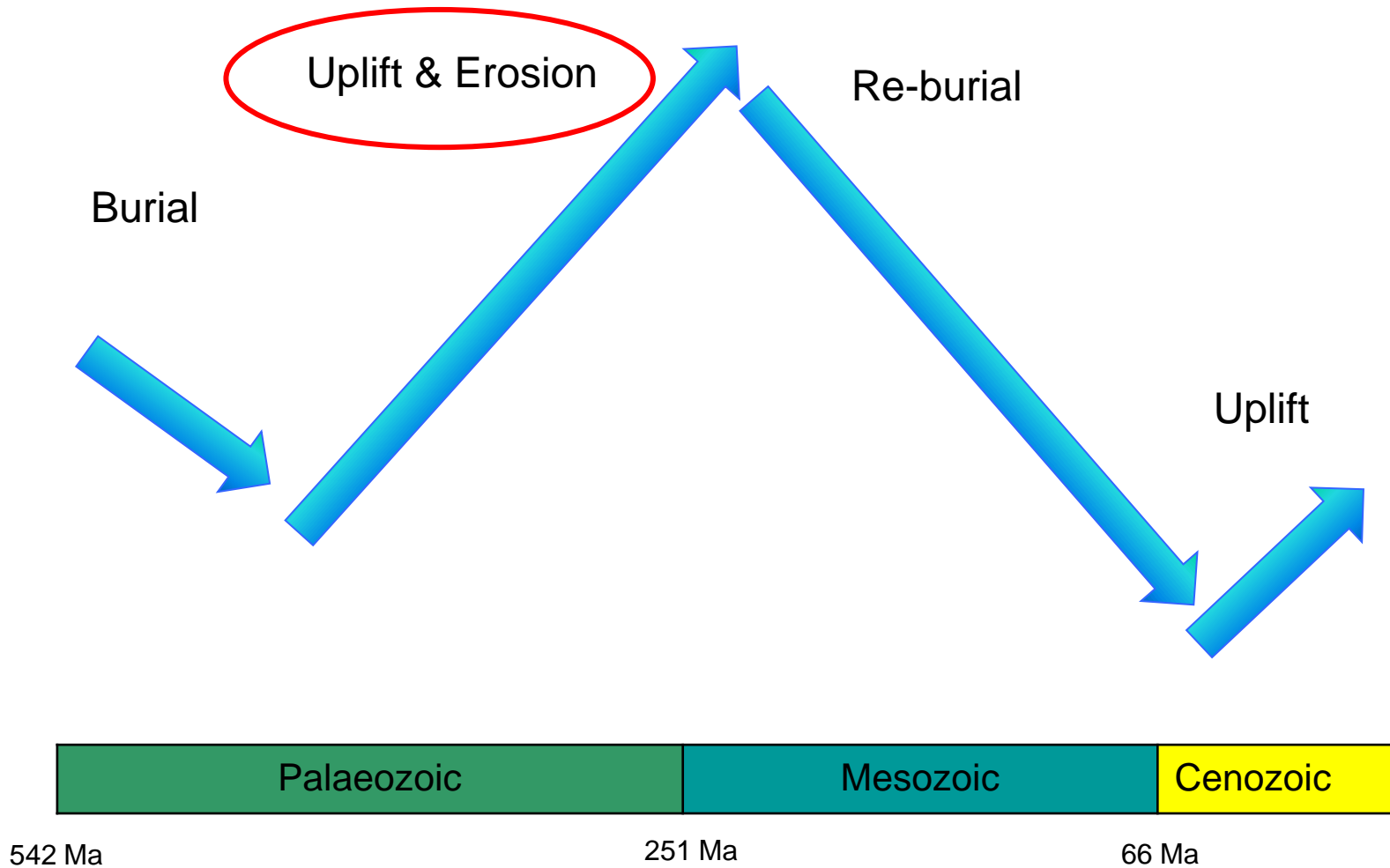


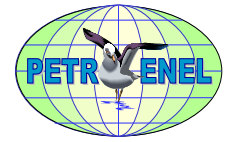
After Lüning et al., 2005

Silurian Hot Shales Deposition



Silurian Hot Shales Burial History

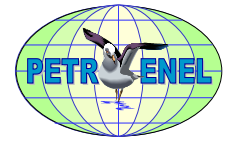




4. A Country Perspective - Jordan

Country Perspective

Why Jordan?

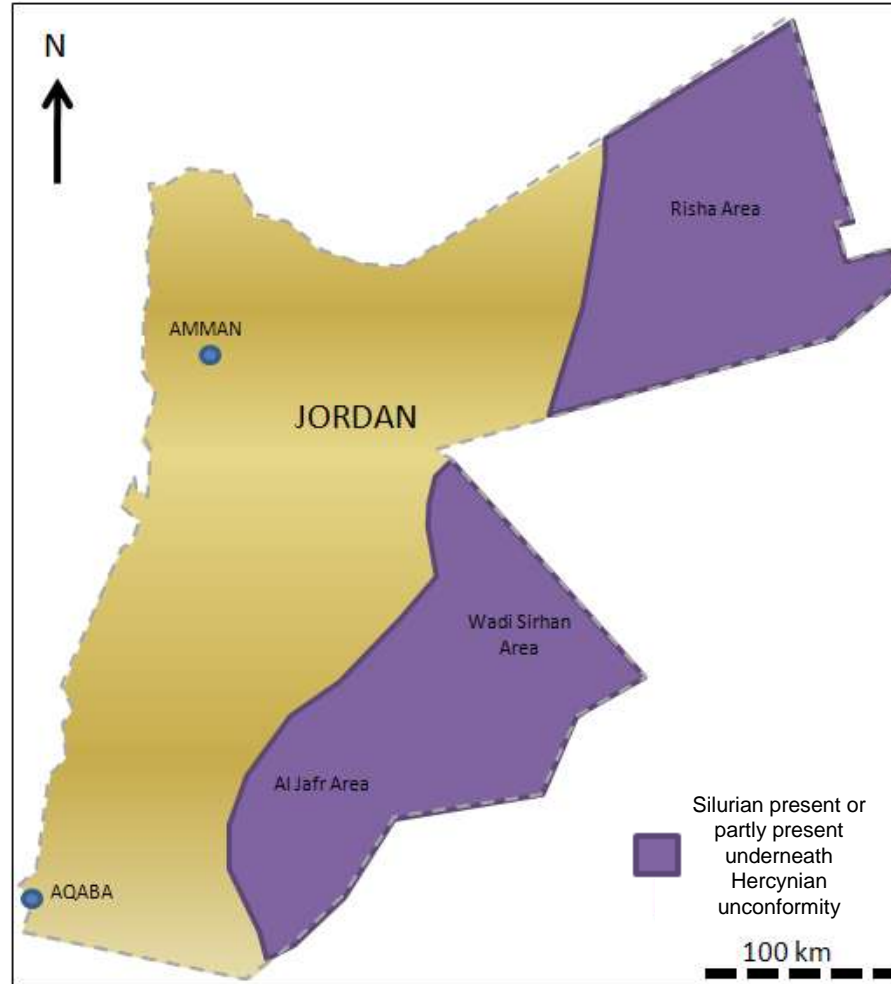


Limited hydrocarbon resources

Imports from Saudi Arabia, Egypt and Iraq

Encouraging fiscal terms

A good combination of Technical and Commercial factors



Silurian shale horizon – Mudawwara shales

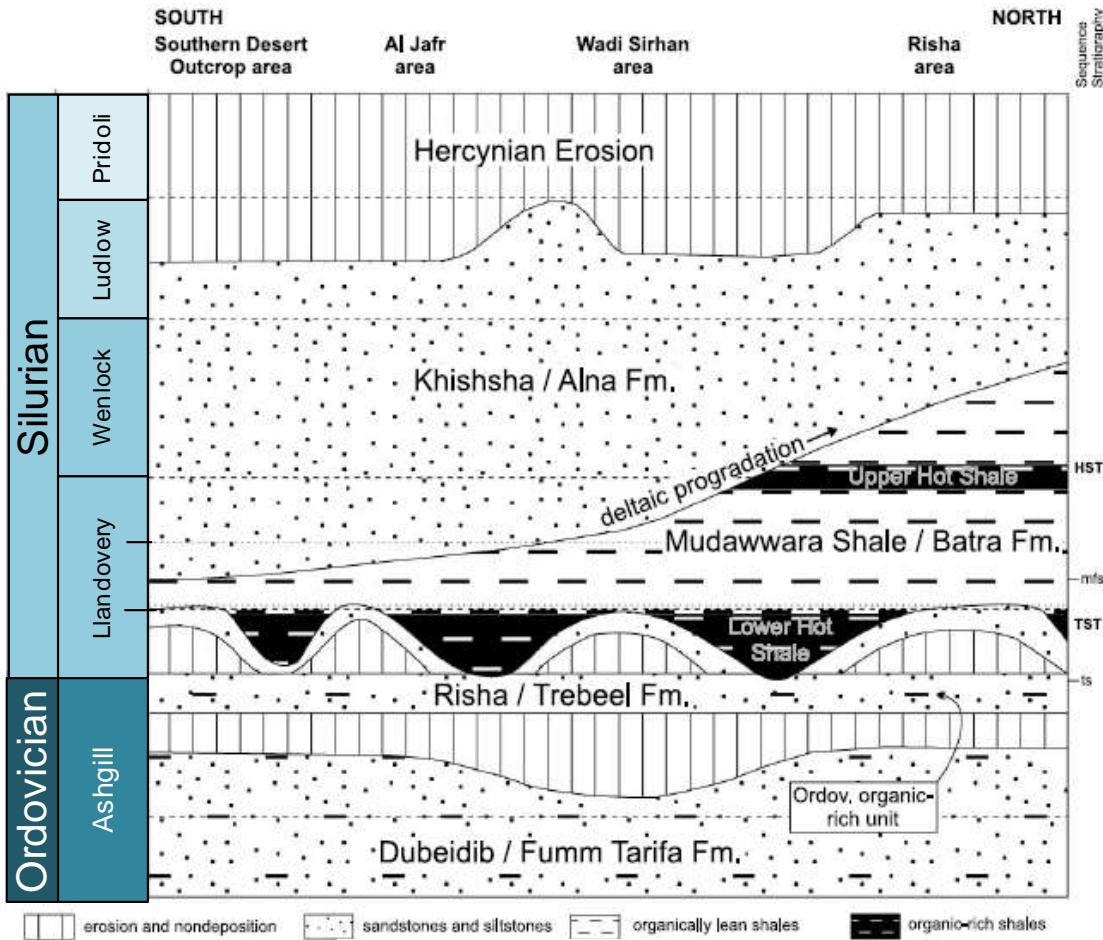
Thickest west of the Risha area

Potentially more than one hot shale horizon

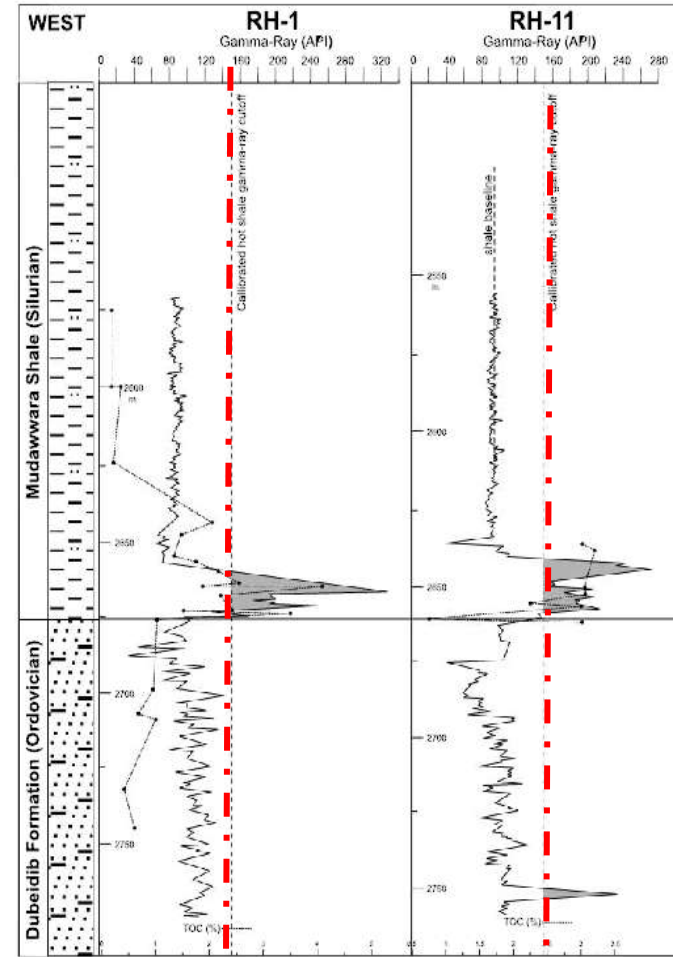
Upside of gas in grey shales

Country Perspective

Why Jordan?



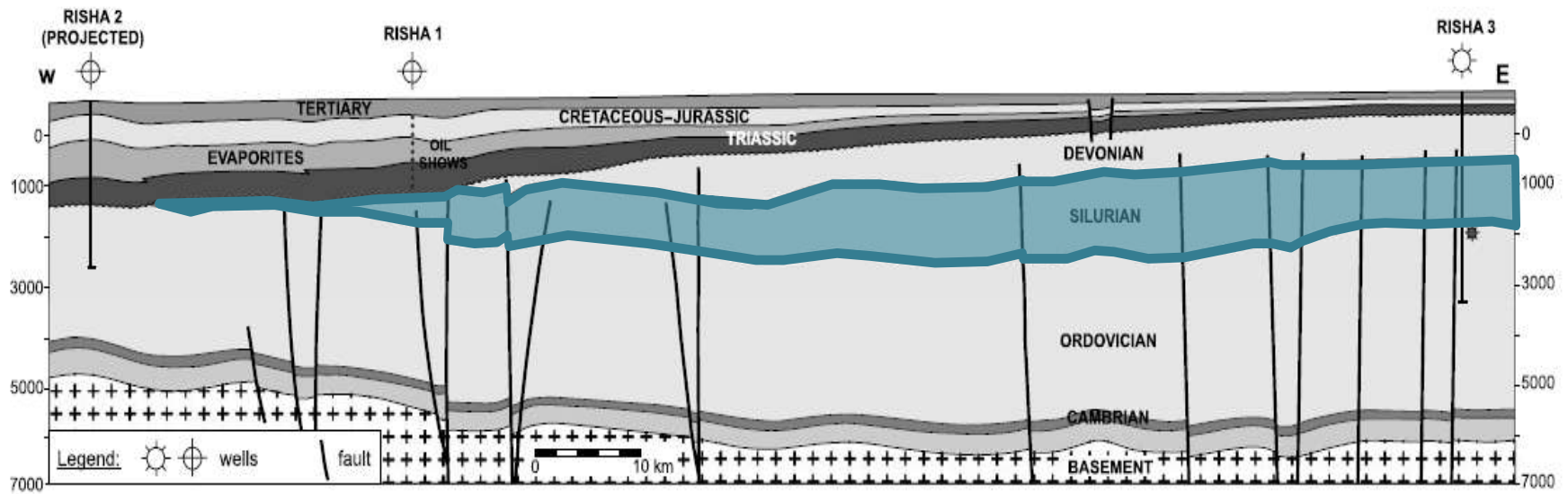
After Lüning et al., 2005



After Lüning et al., 2005

Country Perspective

Why Jordan?



After Lüning et al., 2005



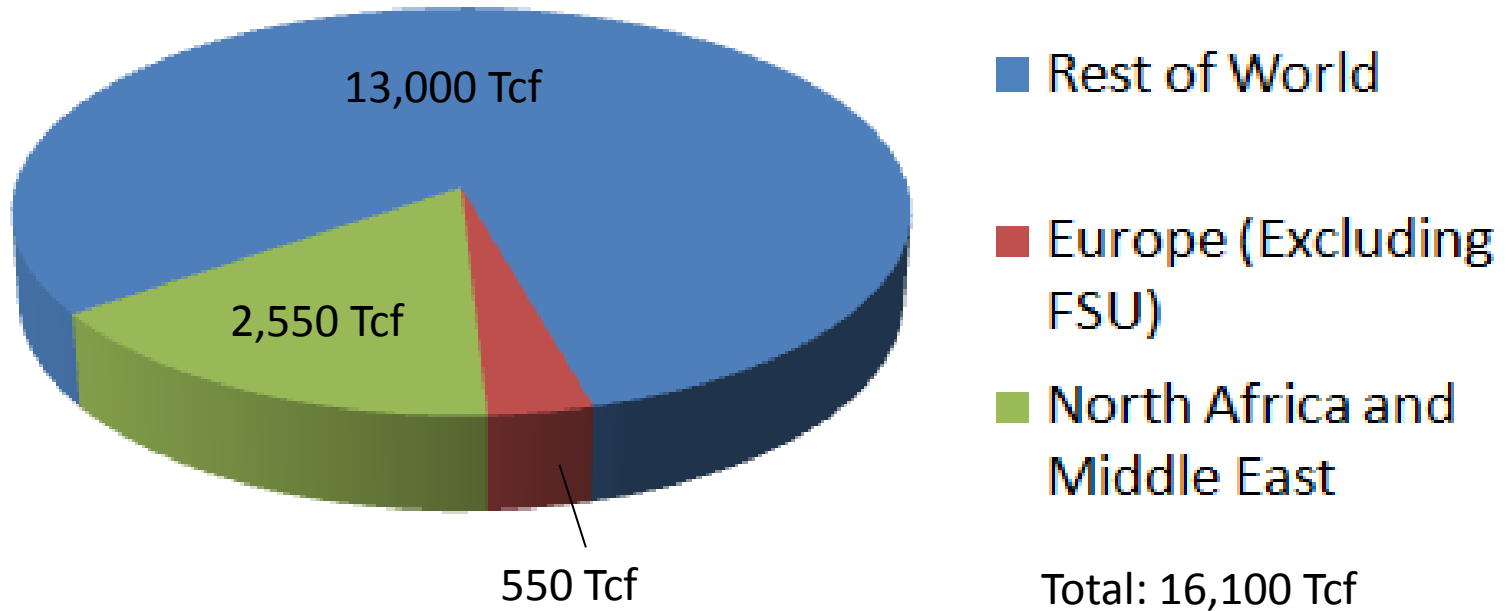
5. Potential Shale Gas Resources

Regional Shale Gas Potential

Previous Resource Estimates

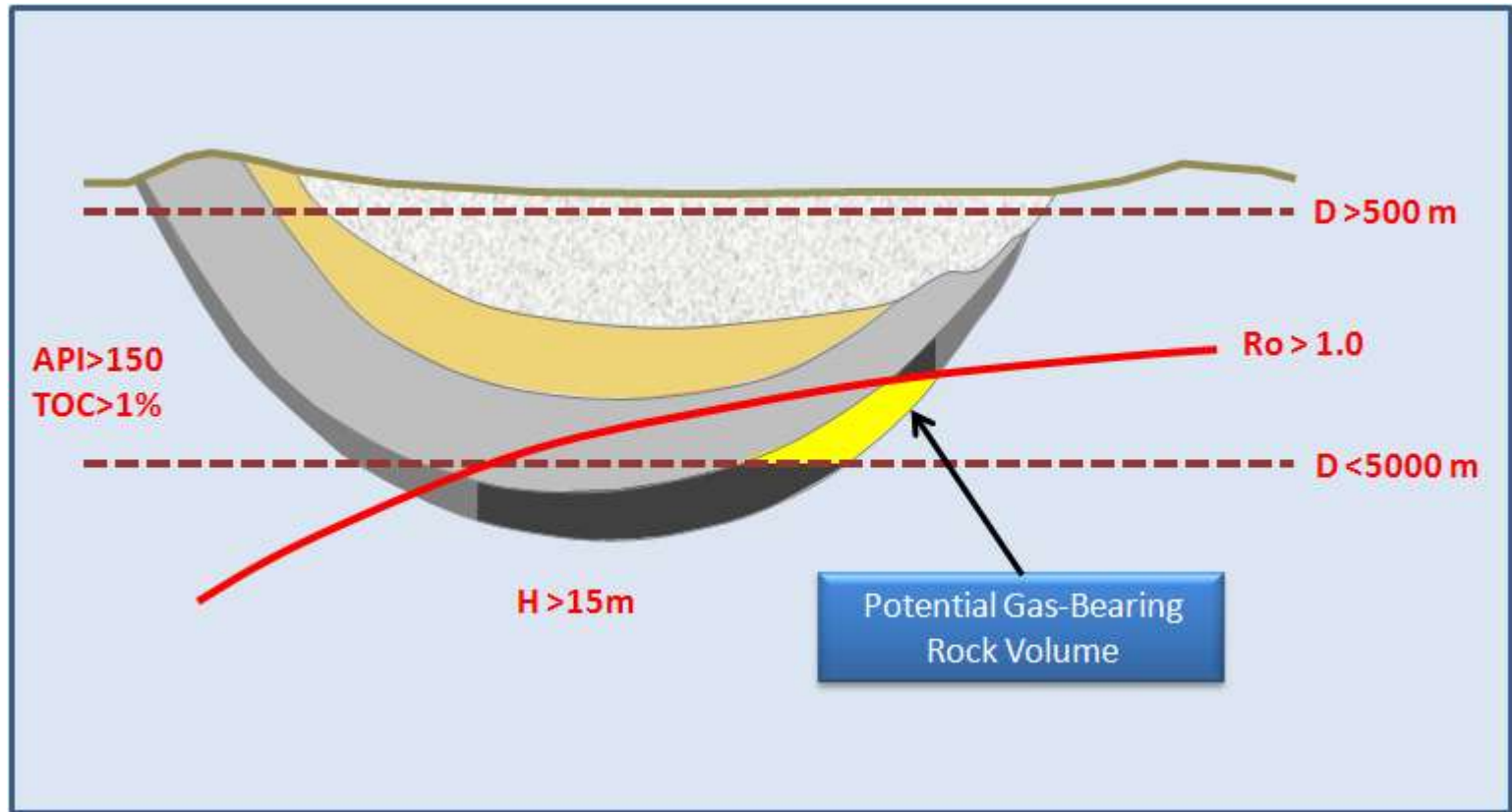


Shale Gas Resource Potential (Rogner, 1997)



Regional Shale Gas Potential

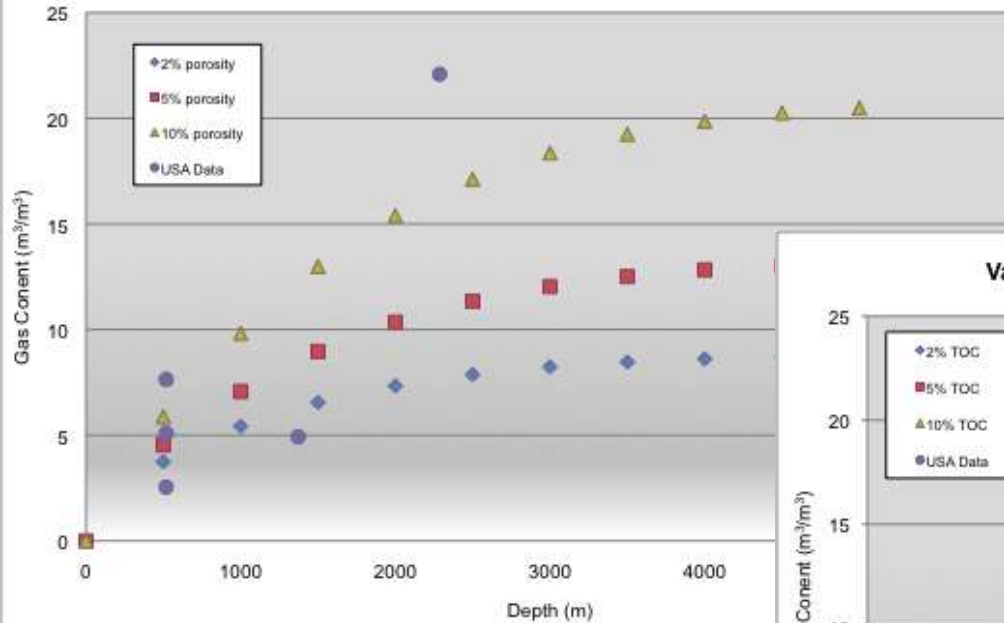
Method of Resource Calculation



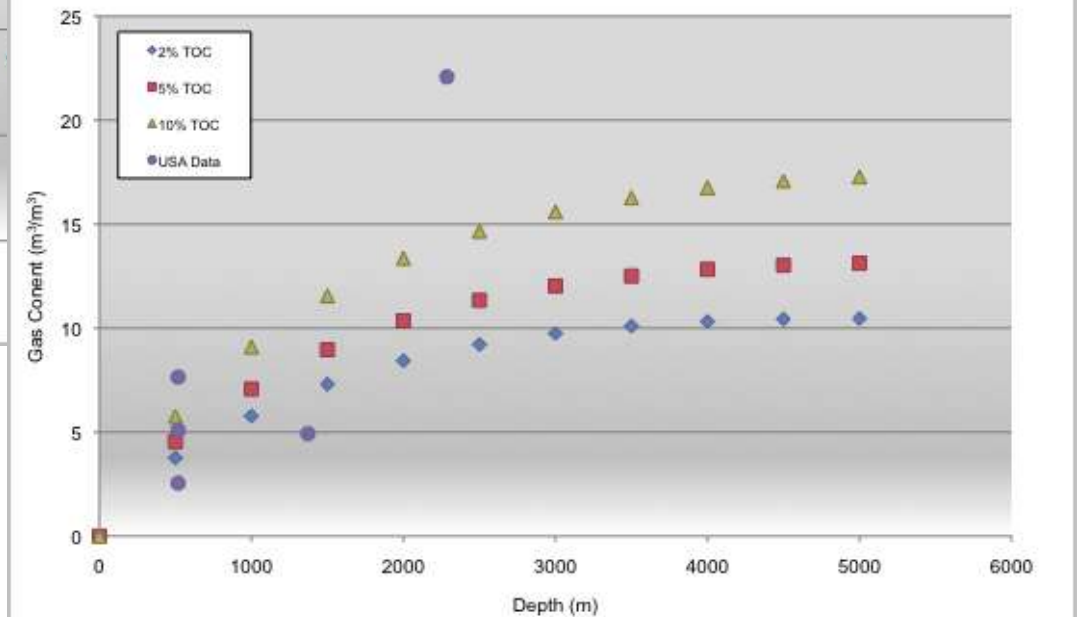
Regional Shale Gas Potential Resource Calculation – Gas Content



Variation in Shale Gas Content with Depth and Porosity

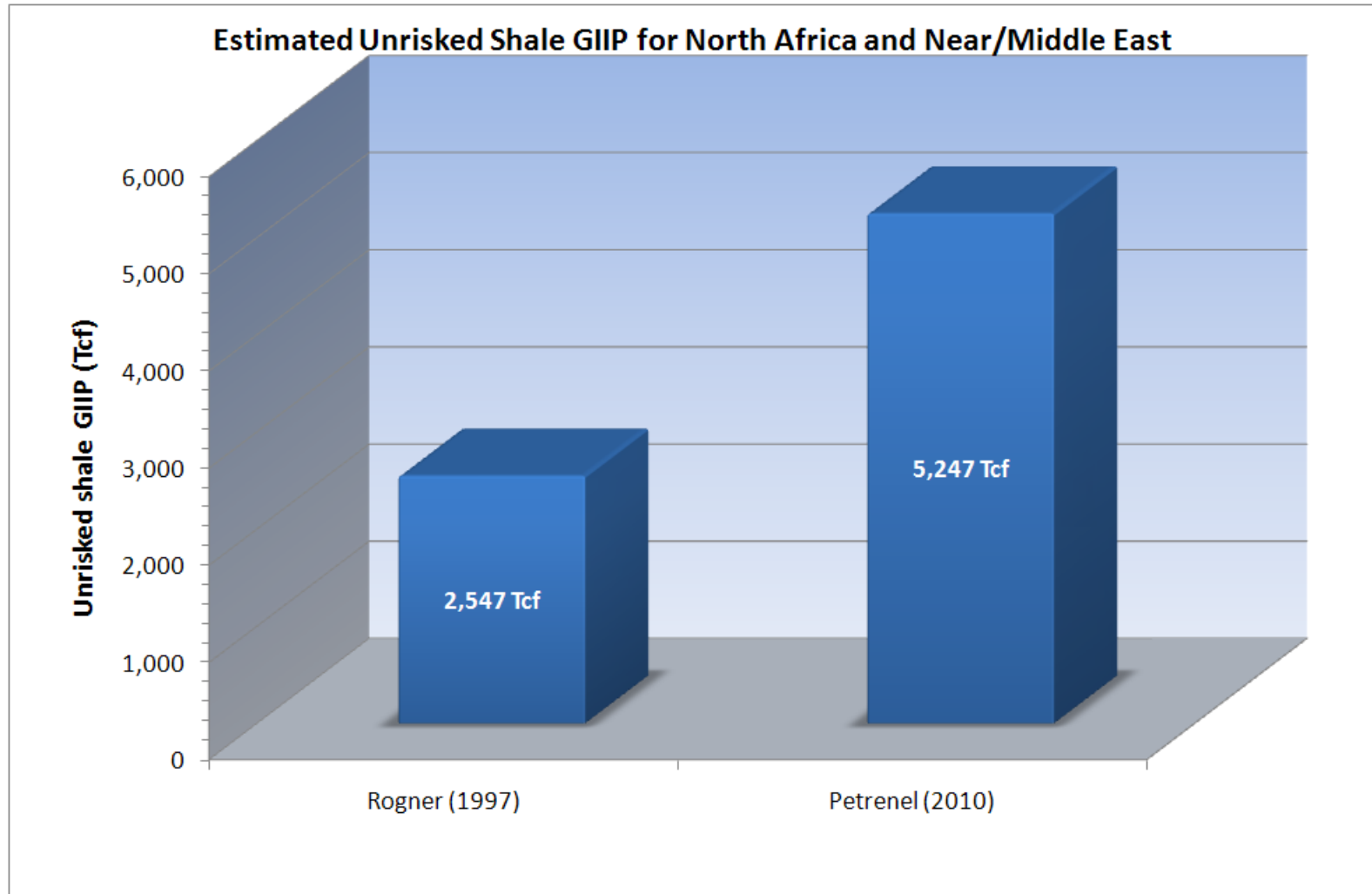


Variation in Shale Gas Content with Depth and TOC



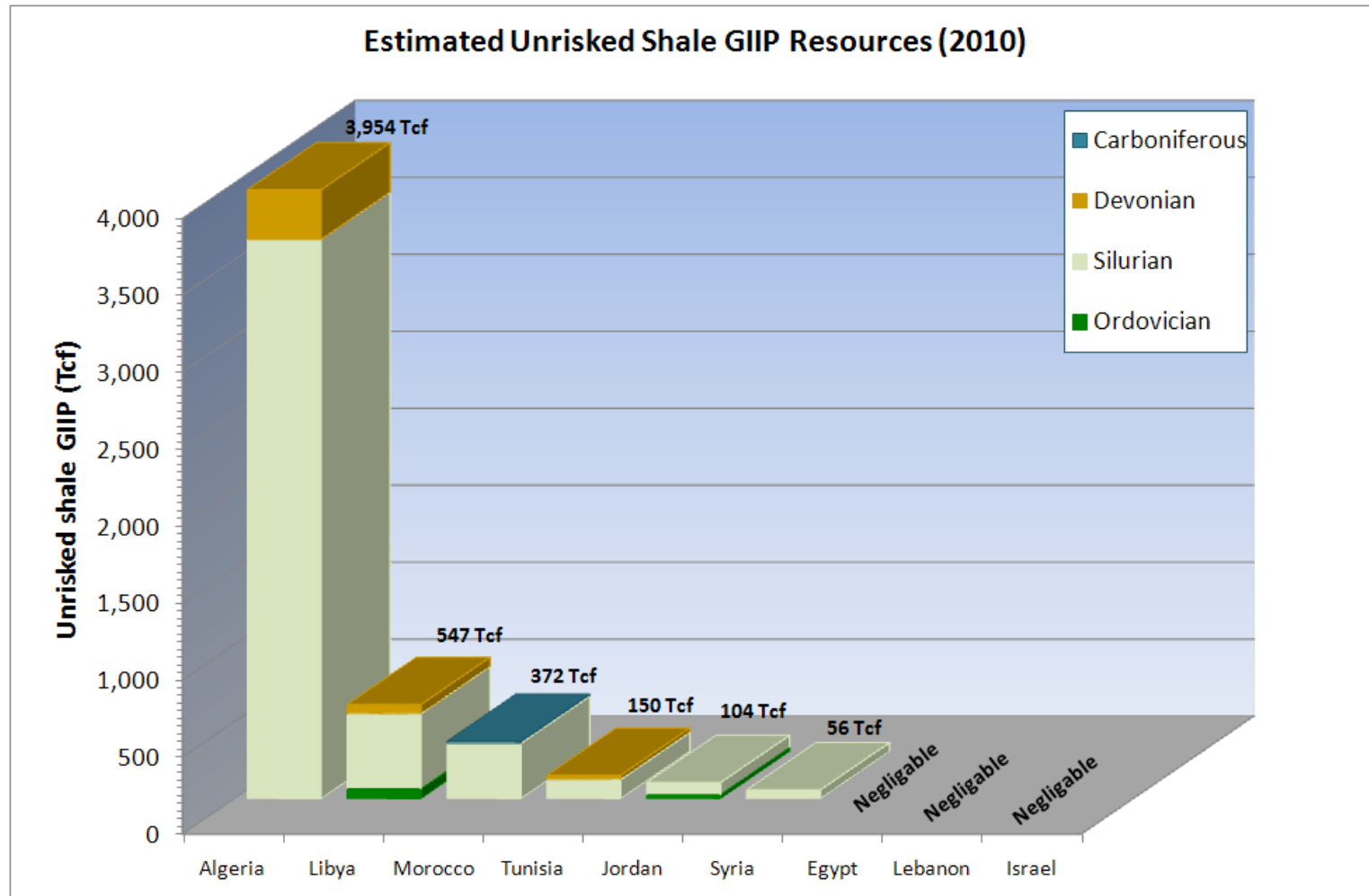
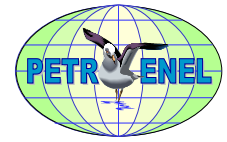
Resource Potential in the Region

Petrenel Resource Estimates



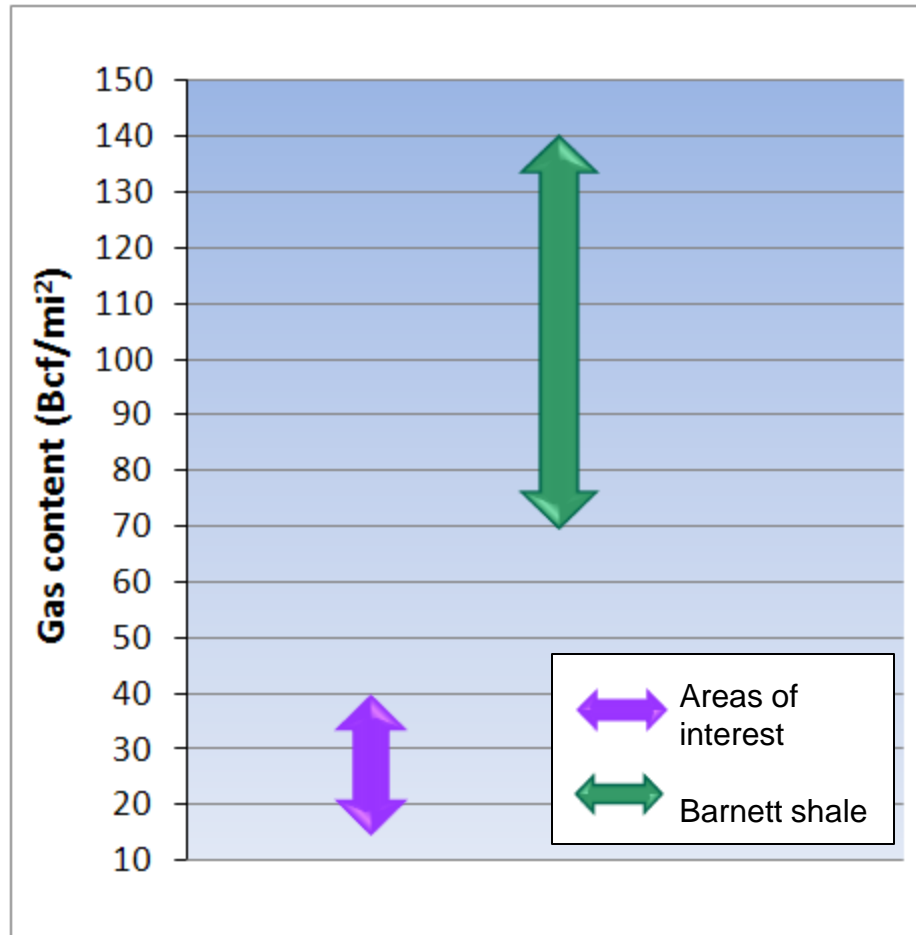
Resource Potential in the Region

Petrenel Resource Estimates



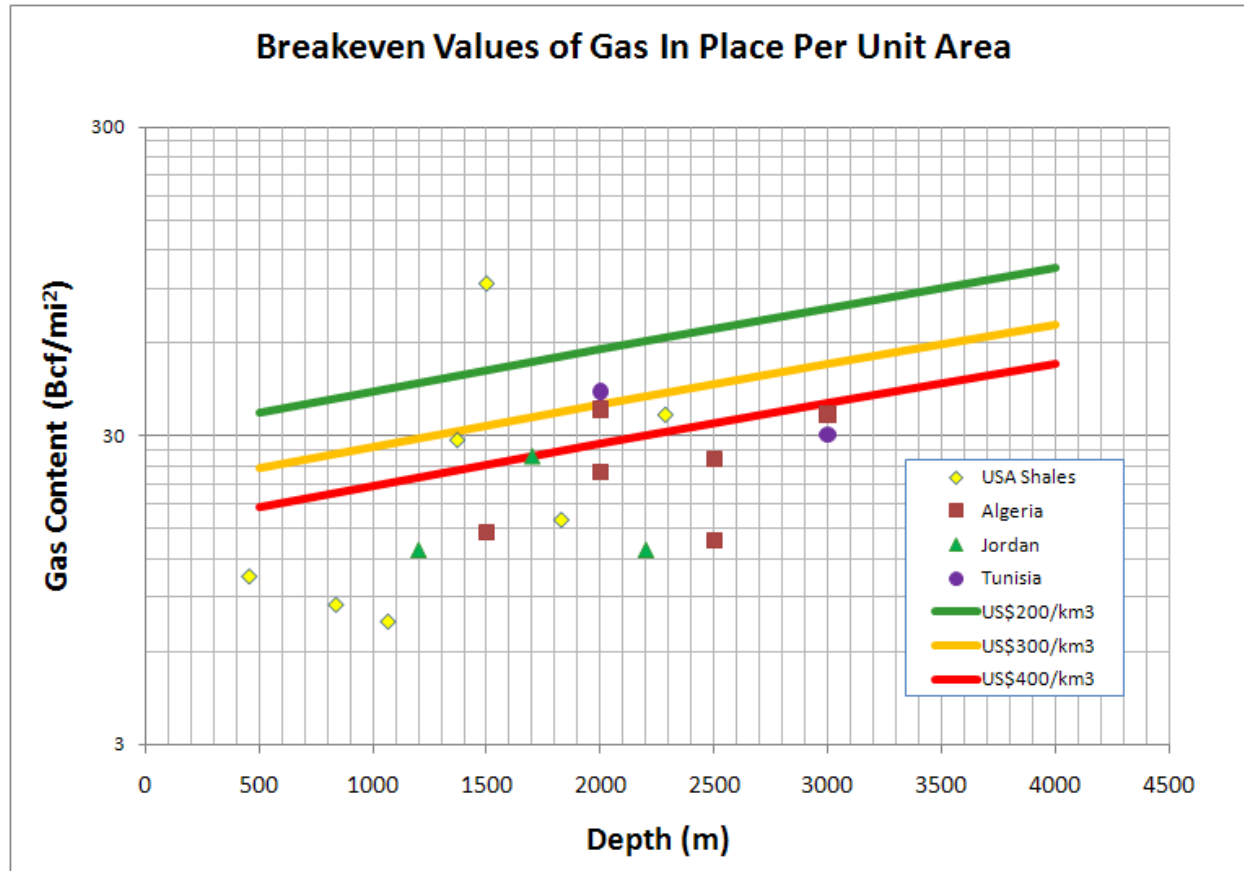
Regional Shale Gas Potential

Gas Concentrations



Urengoy 122 bcf/mi²
Leman 155 bcf/mi²

Regional Shale Gas Potential Breakeven Values



6. Summary & Conclusions

Summary & Conclusions



- Considerable shale gas potential in the Region
- Palaeozoic (Silurian) most promising target but Carboniferous, Devonian and Ordovician may be locally prospective.
- Estimated un-risked GIIP 5,250 Tcf (c.f. Rogner's 2,547 Tcf).
- Gas content 15 to 40 Bcf/ mi² (c.f. Barnett shale 70 to 140 Bcf/mi²)
- >30 Bcf/mi² required for commercial success.
- Illizi Basin (Algeria), Ghadames Basin (Tunisia, Algeria, Western Libya) and Jordan (West Risha) most prospective.
- Un-risked recovery in these most promising areas is estimated to be 285 Tcf.
- Morocco and Western Algeria have significant potential but also carry higher risk.

Questions?