

Shale Gas and Shale Oil:

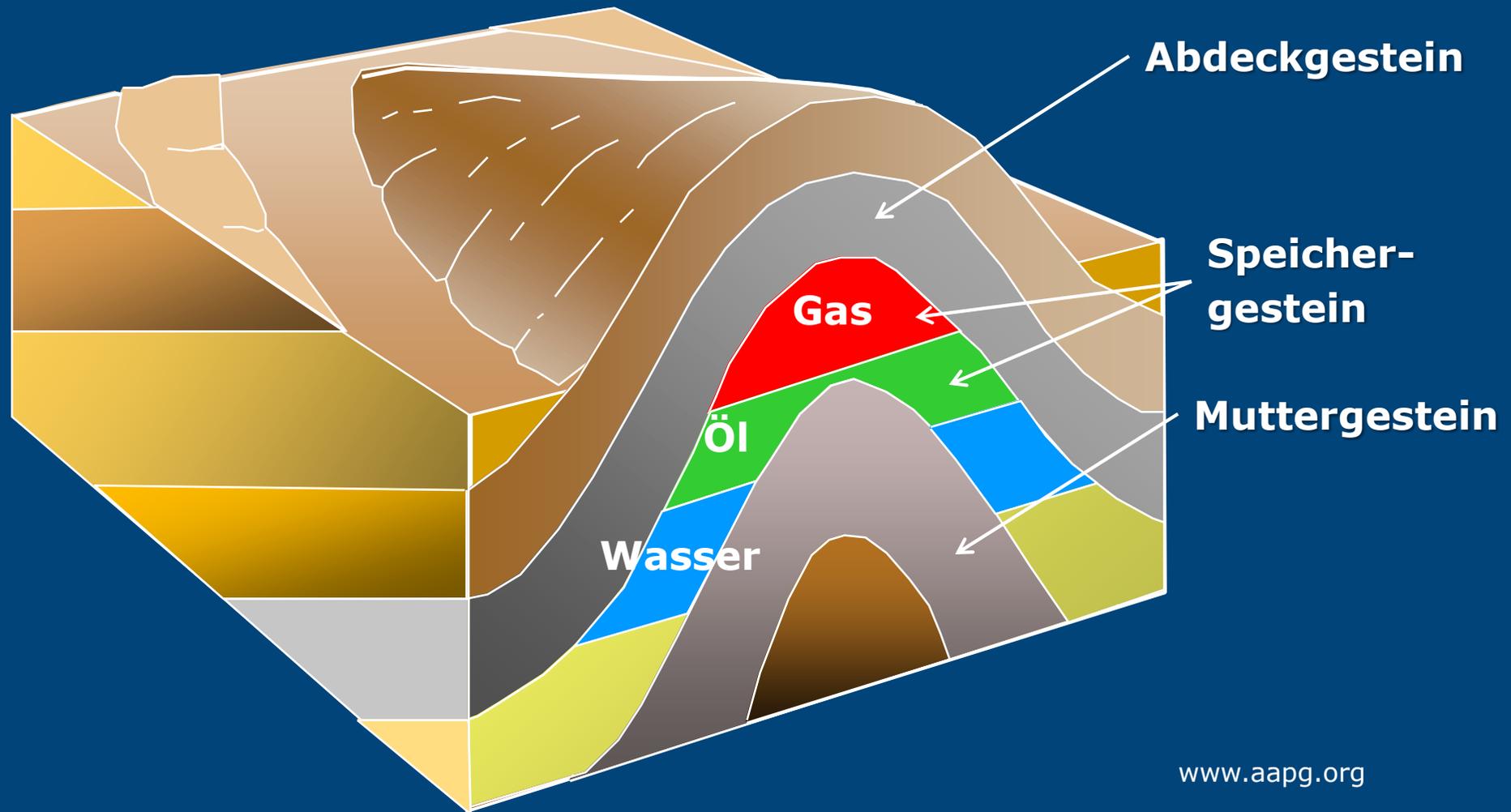
Geologische Grundlagen zu

- *Bildung*
- *Vorkommen*
- *Produktion*

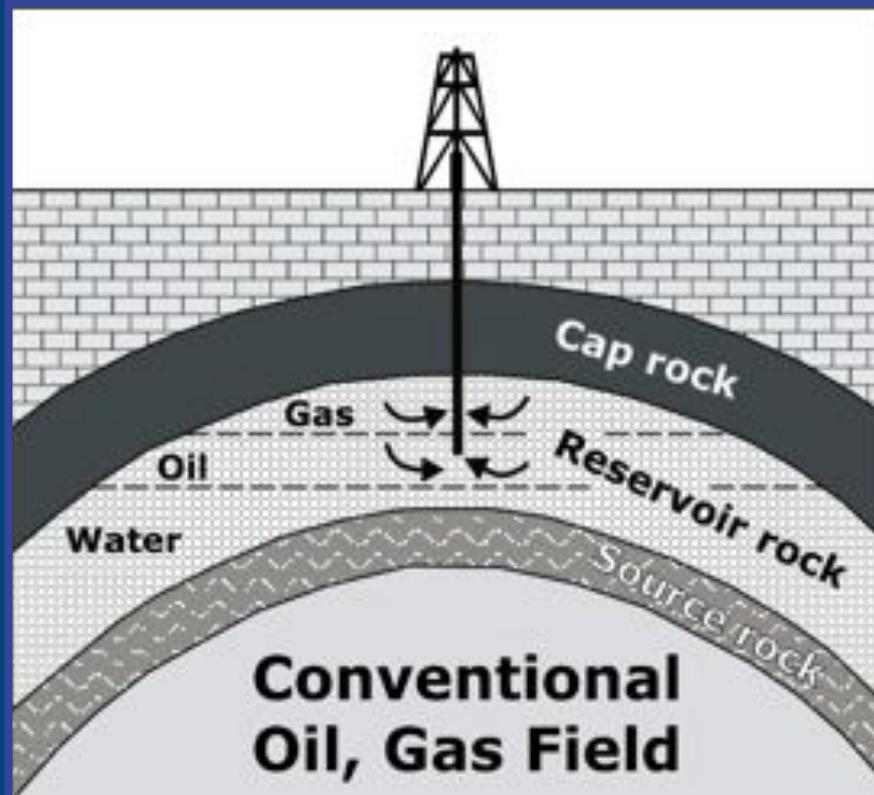
Hans-Martin Schulz



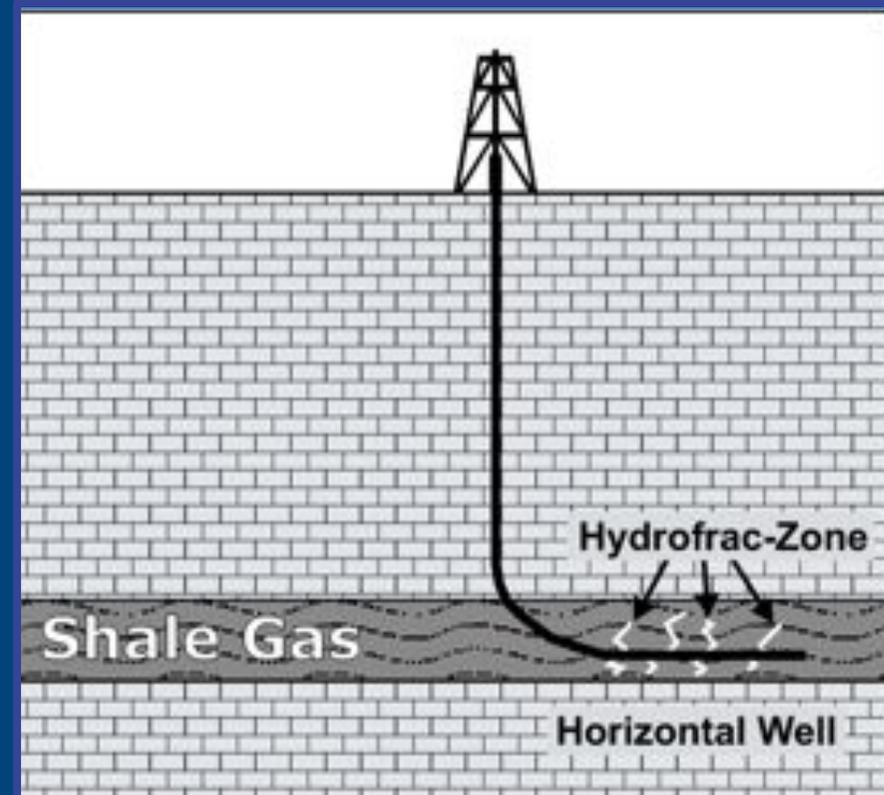
Eine konventionelle Erdöl-/Erdgaslagerstätte



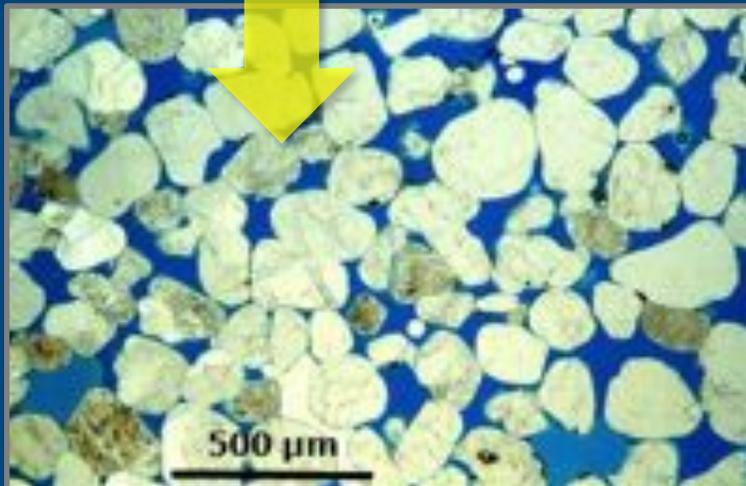
Das konventionelle



Das **un**konventionelle



Das konventionelle



Das unkonventionelle



Mögliche Akkumulationsstruktur

- Ein Oberflächenanalog -



Steinbruch in Ührde, südwestlich von Osterode, Niedersachsen

KW-Muttergestein für Erdöl und Erdgas



Was ist ein Gas Shale ?

Er ist alles zusammen:



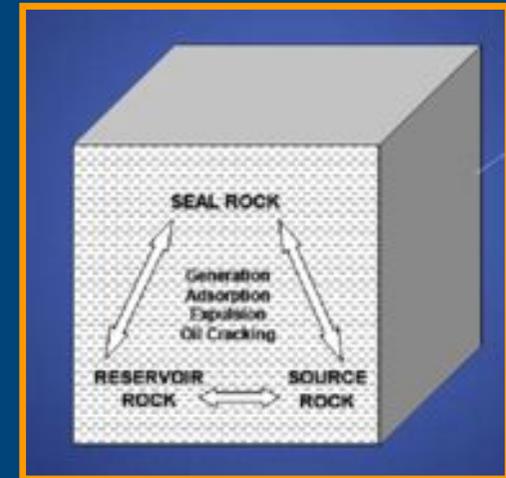
10 cm

LOMPOC Quarry Sample
Monterey Formation, CA

- die Gasquelle
- der Speicher
- die Abdeckung

und immer:

- reich an organischem Kohlenstoff



! Ein Gas Shale ist ein eigenständiges KW-System !

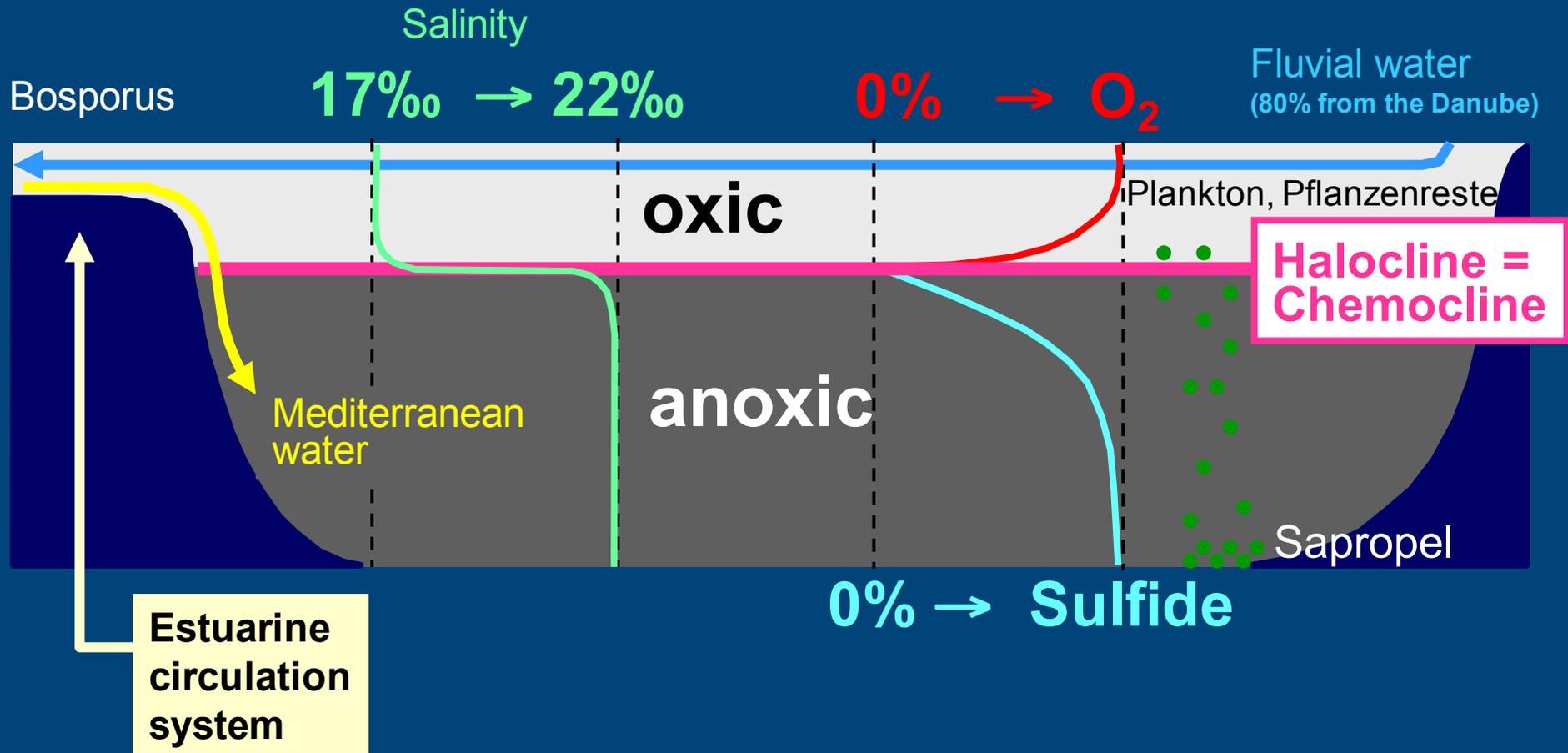
A satellite image of the Black Sea, showing the sea's dark blue waters and the surrounding landmasses in shades of green and brown. The text "Black Sea" is overlaid in white. The sea is surrounded by land, with the Bosphorus Strait visible at the bottom left. The text "Black Sea" is centered in the middle of the sea.

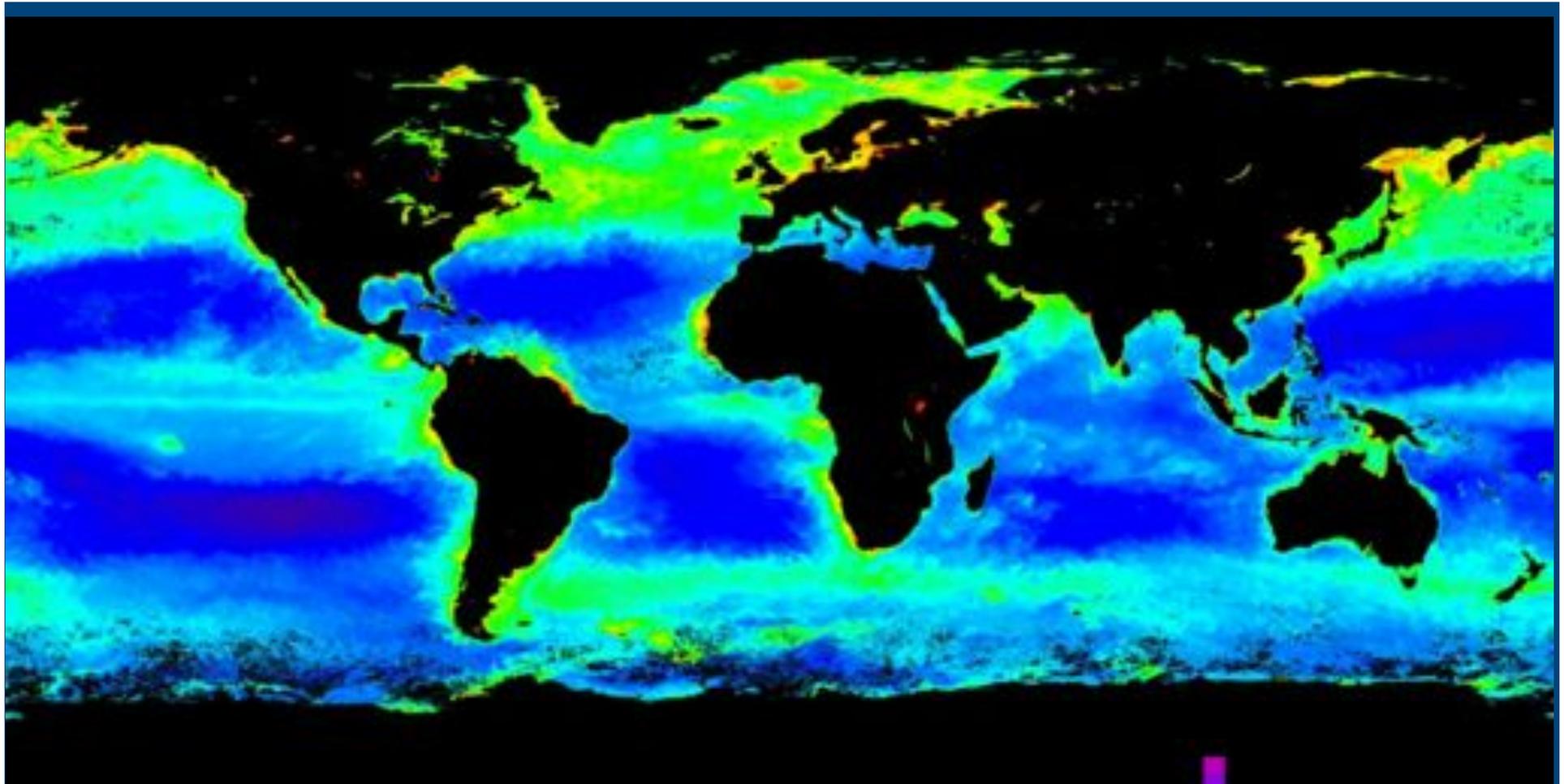
Black Sea

Processes in the Black Sea

SW

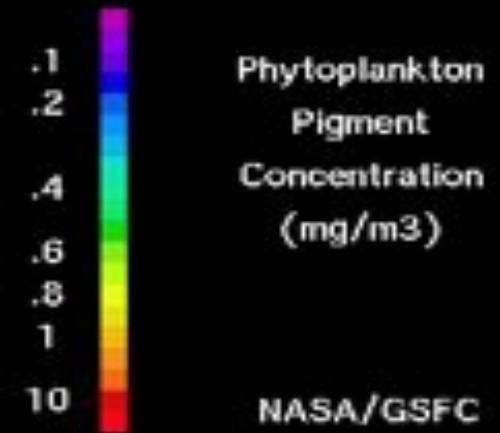
NE





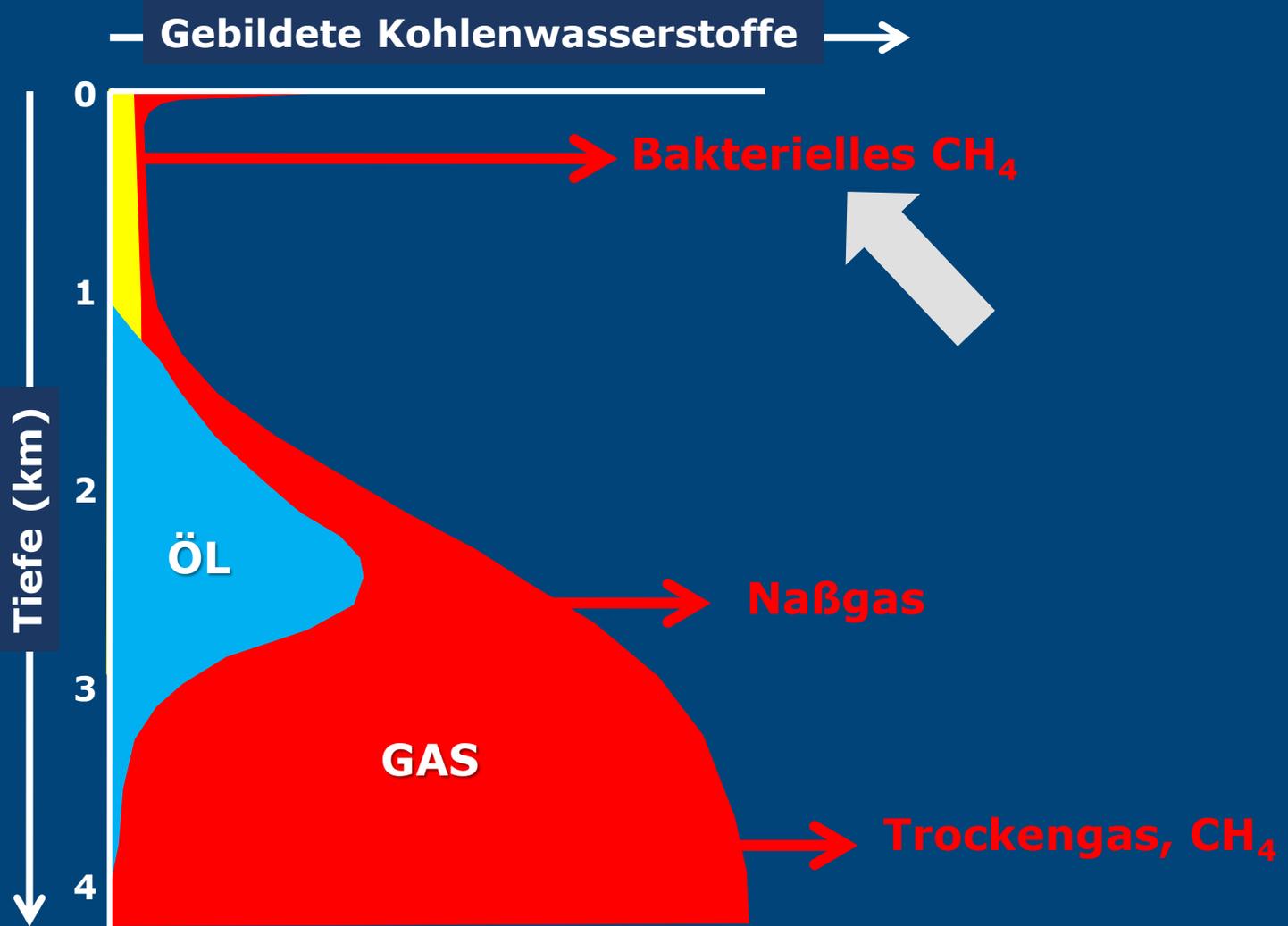
Phytoplankton photosynthesize using specialized color pigments called chlorophyll

→ “Ocean Color” maps are another way to identify areas of upwelling.



Öl- und Gasbildung

Metag.	Trocken- gas	Katagenesis	Diagenesis
		Naß- gas	Ölzone
			Unreif



Well Wickensen/ Hils half-graben
Lower part of Posidonia Shale section

pyrite

secondary
calcite

primary
calcite

pyrite

1 μm

Arbeitsabstand = 10.5 mm
Vergrößerung = 4.61 K X

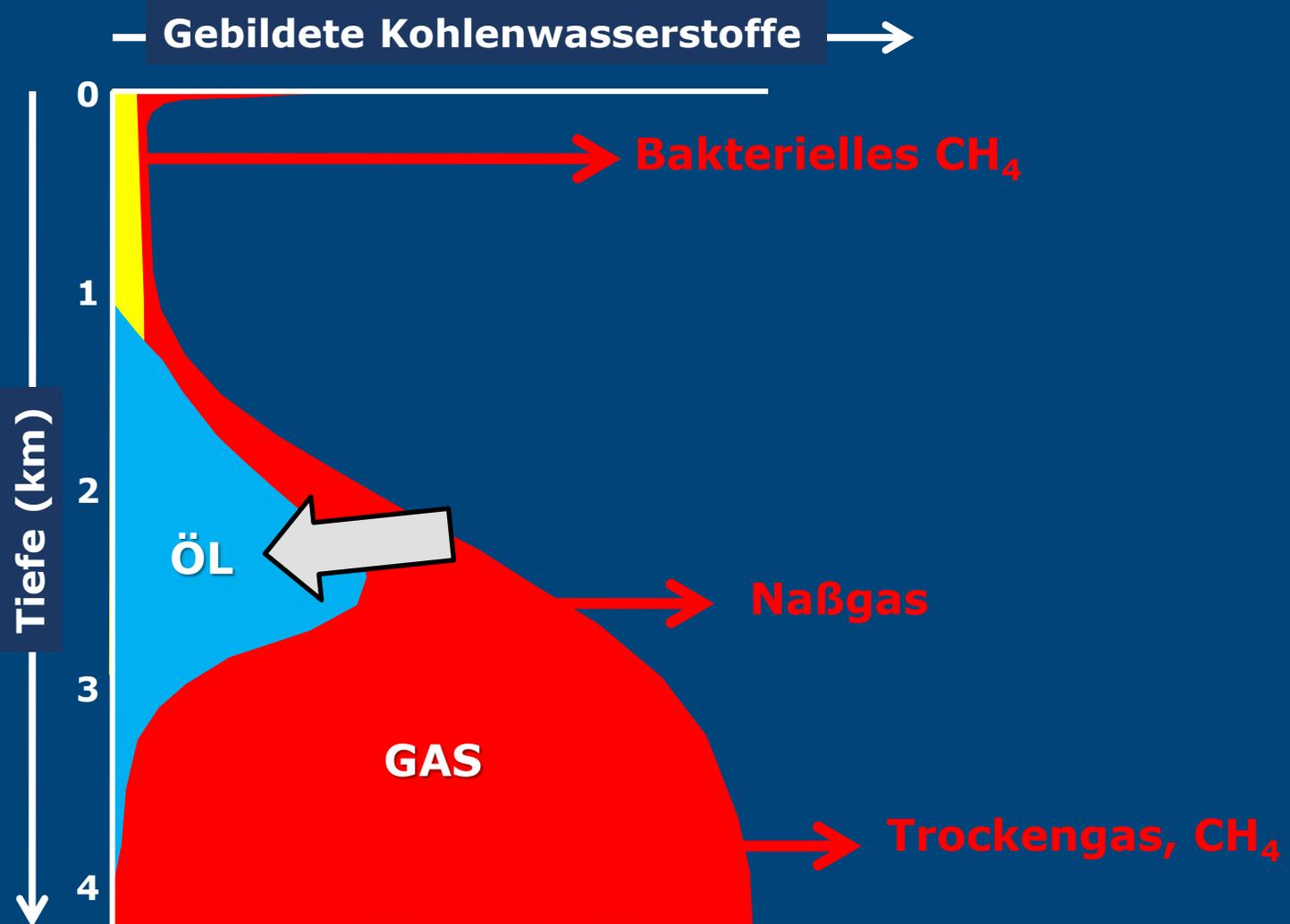
Hochsp. = 20.00 kV
Blendengröße = 120.0 μm

Signal A = SE2
Hochstrom = Ein

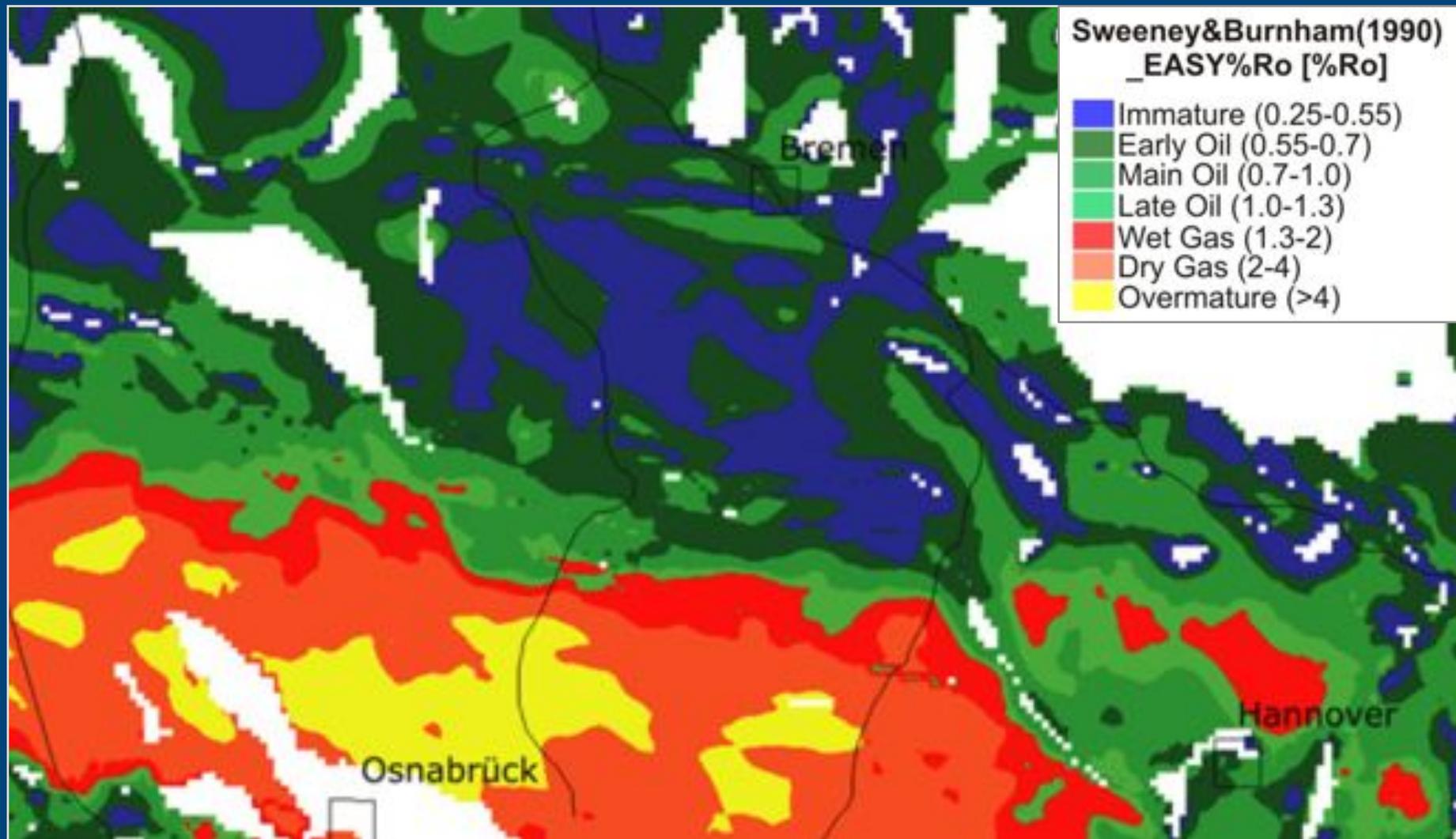
Helligkeit = 49.1 %
Kontrast = 28.6 %

Öl- und Gasbildung

Metag.	Trocken- gas	Katagenesis	Diagenesis
		Naß- gas	Ölzone
			Unreif



Thermische Reife des Toarcium



Bruns et al. (2013): Petroleum system evolution in the inverted Lower Saxony Basin, northwest Germany: a 3D basin modeling study. *Geofluids* 13, 246-271.

Petroleum Expulsion Efficiency

Hils half-graben

Haddessen – 1.45 %Rr

PEE: VERY HIGH

Harderode – 0.88 %Rr

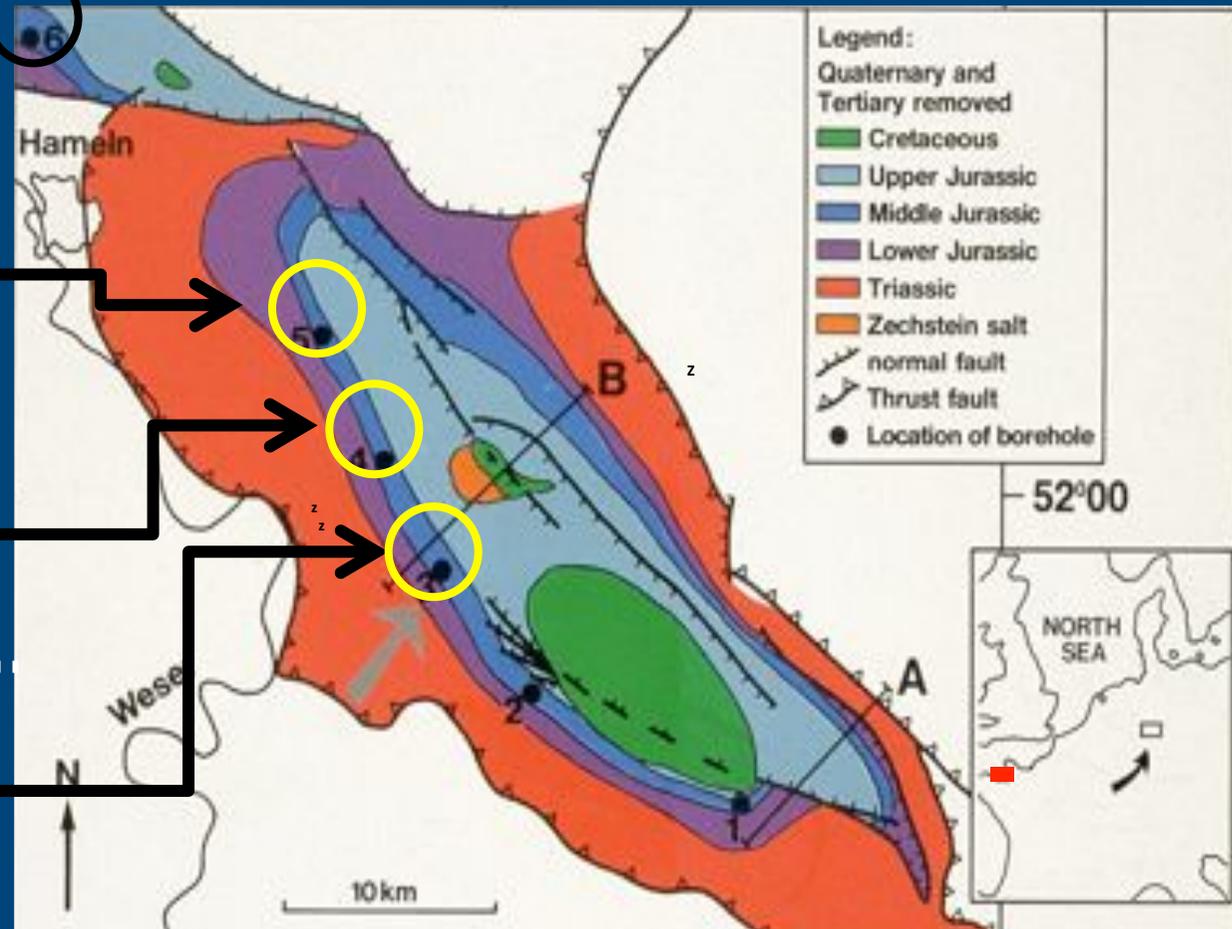
PEE: VERY HIGH

Dohnsen – 0.73 %Rr

PEE: HIGH

Dielmissen – 0.68 %Rr

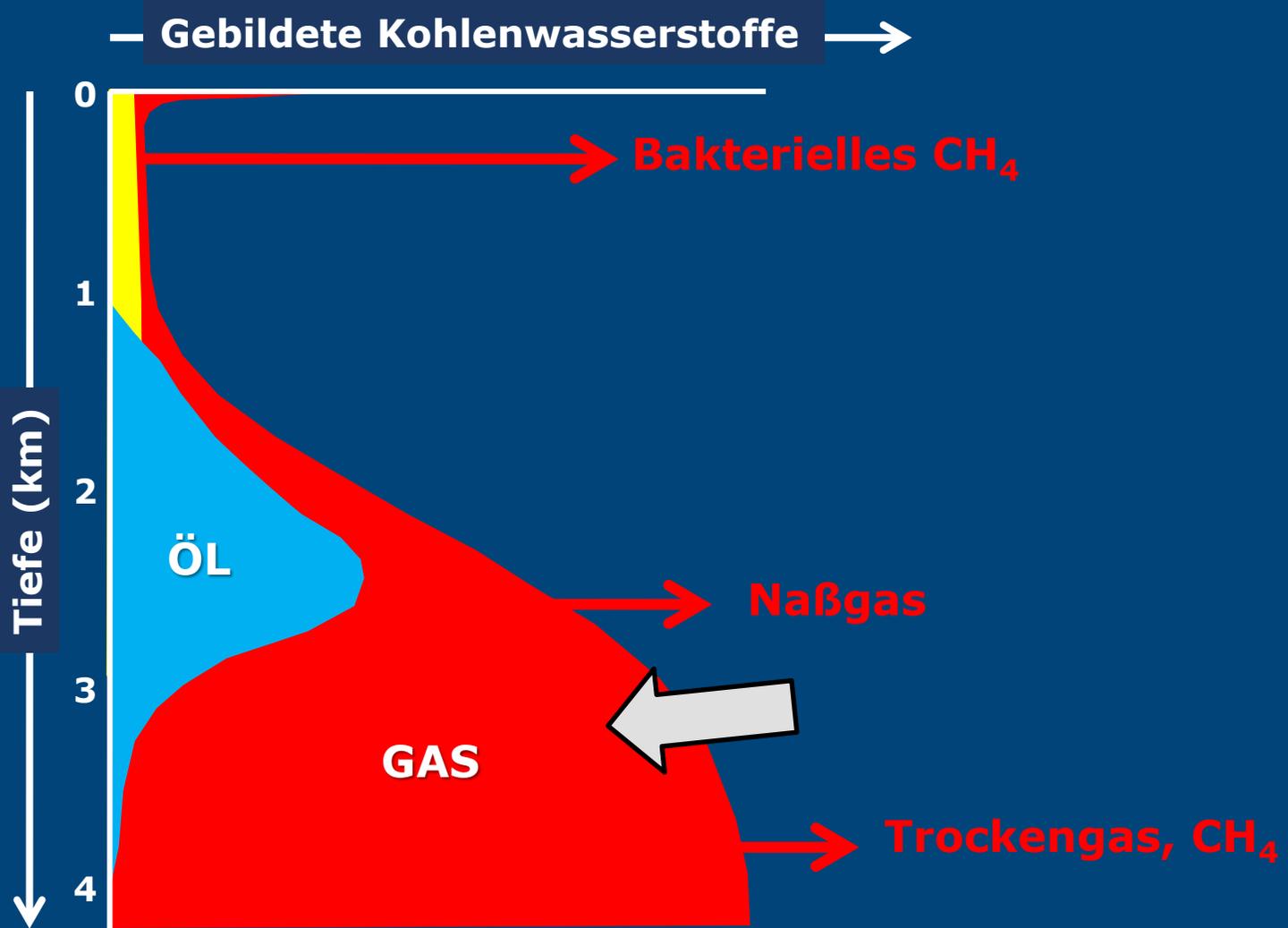
PEE: LOW



(Mann, 1991)

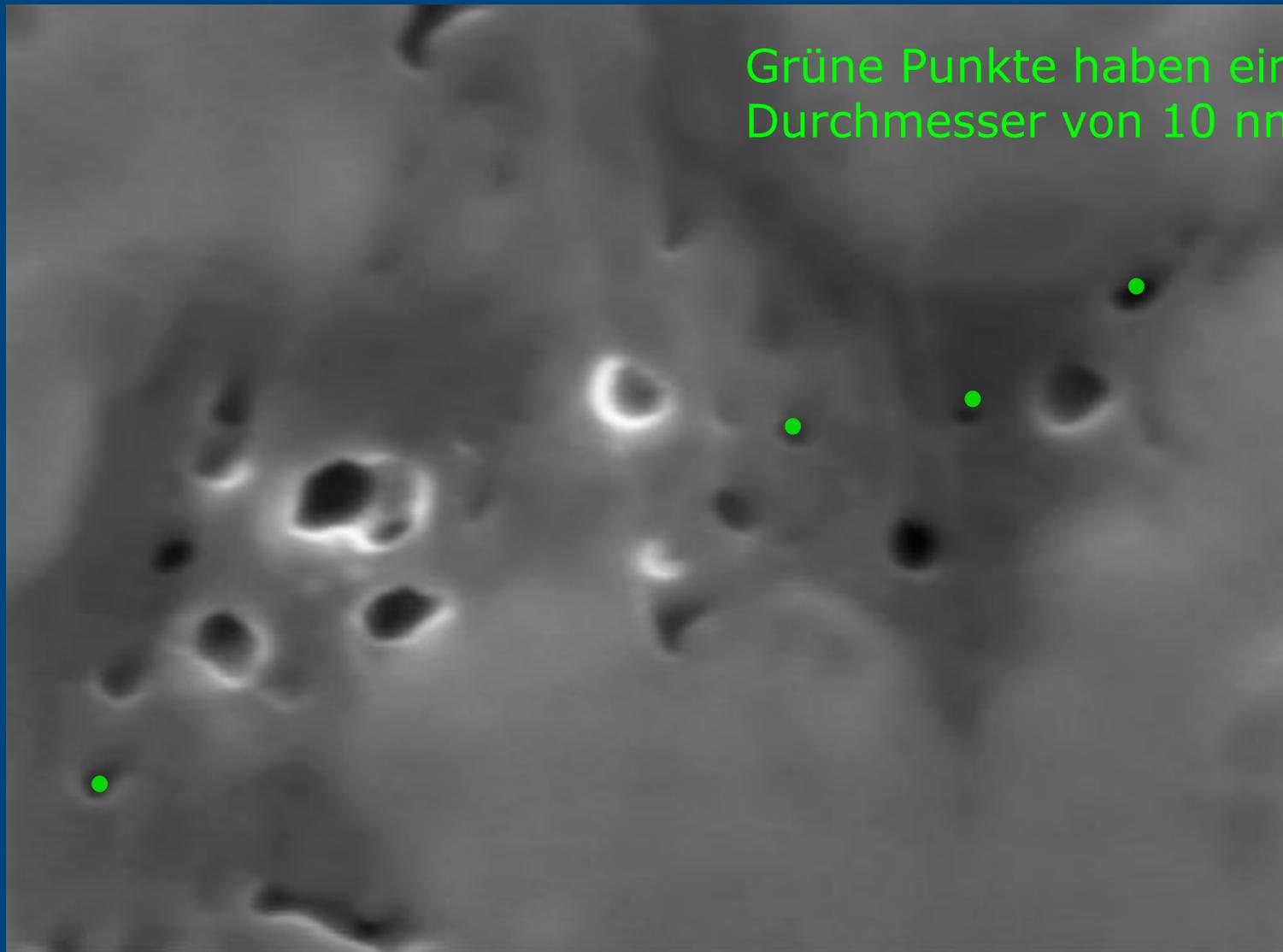
Öl- und Gasbildung

Metag.	Trocken- gas	Katagenesis	Diagenesis
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			Unreif



Nanoporen im Barnett Shale

Grüne Punkte haben einen Durchmesser von 10 nm



100nm

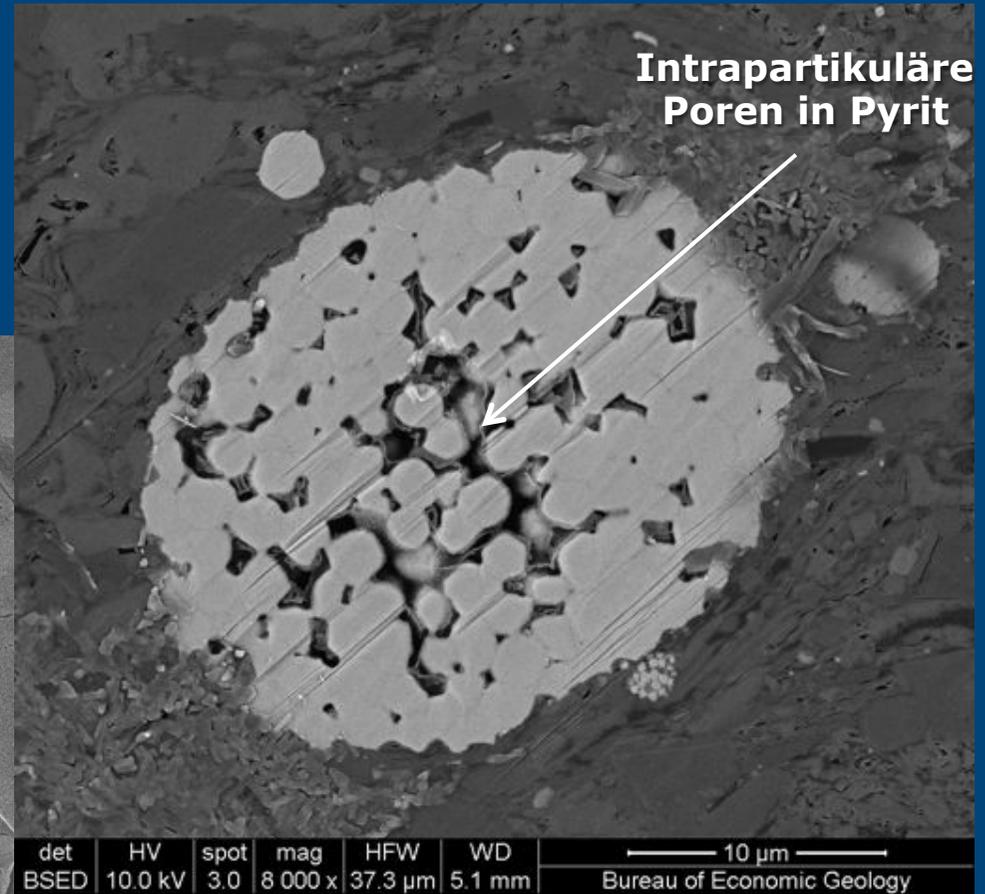
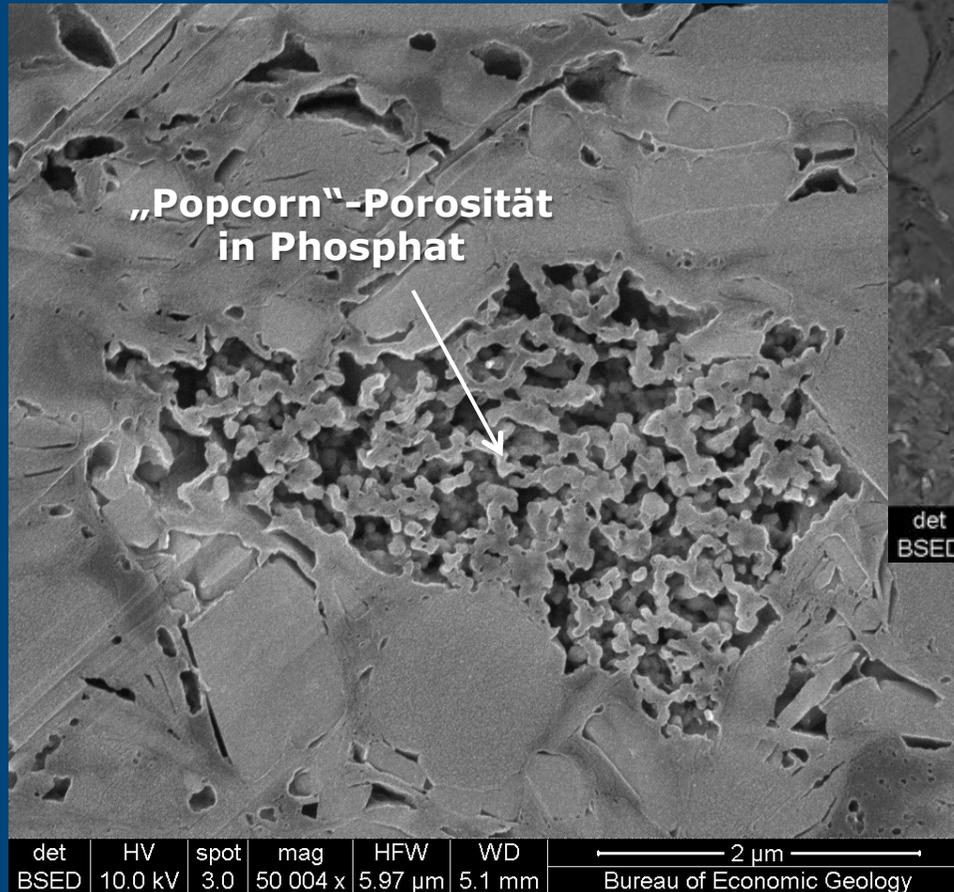


EHT = 4.00 kV
WD = 5 mm

Signal A = InLens
Mag = 150.00 K X

Reed and Loucks, 2007

FIB-REM-Aufnahme des unterjurassischen Posidonienschiefers (Thermische Reife: 1.5% Ro)

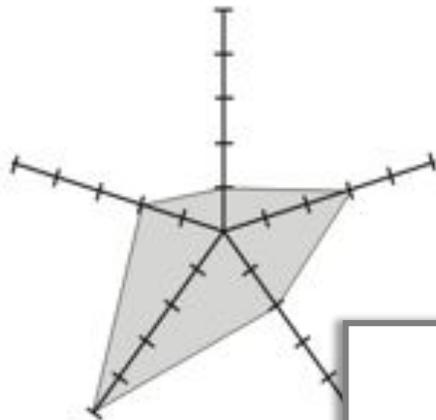


U. Hammes



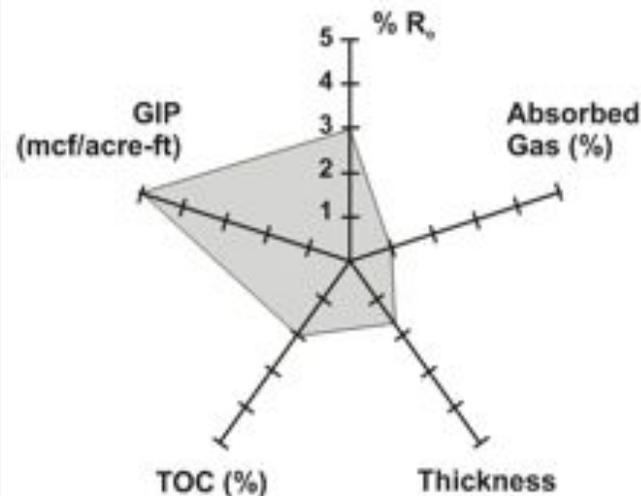
Shale Gas-Systeme sind unterschiedlich !

Antrim Shale



- **Biogenes Gas**
- **Hoher Wasserzufluß/Bohrung**
- **RF (%OGIP) ~ 20 - 60**

Barnett Shale



- **Thermisches Gas**
- **Kein Wasserzufluß/Bohrung**
- **RF (%OGIP) ~ 5-20**

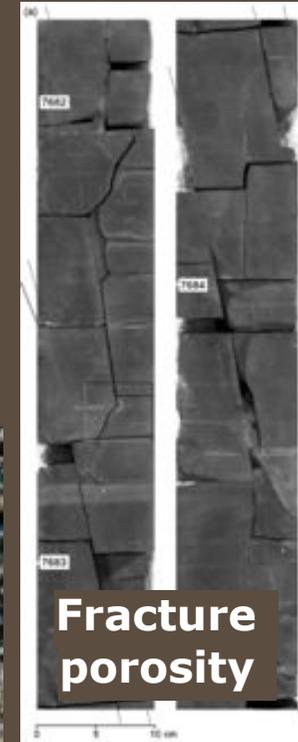
Methan in Gas Shales tritt auf ...



**ad-
sorbiert**

**+ gelöst im
Porenwasser**

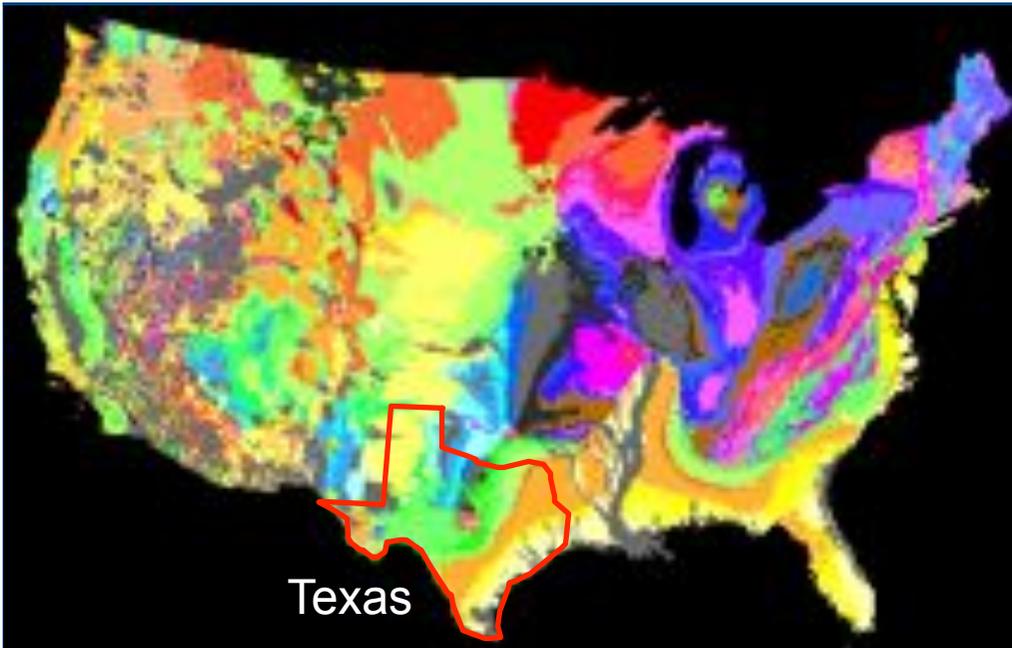
**als
freies
Gas**



- Gas in Brüchen wird sofort freigesetzt
- Adsorbiertes Gas wird durch Druckerniedrigung freigesetzt

For scale

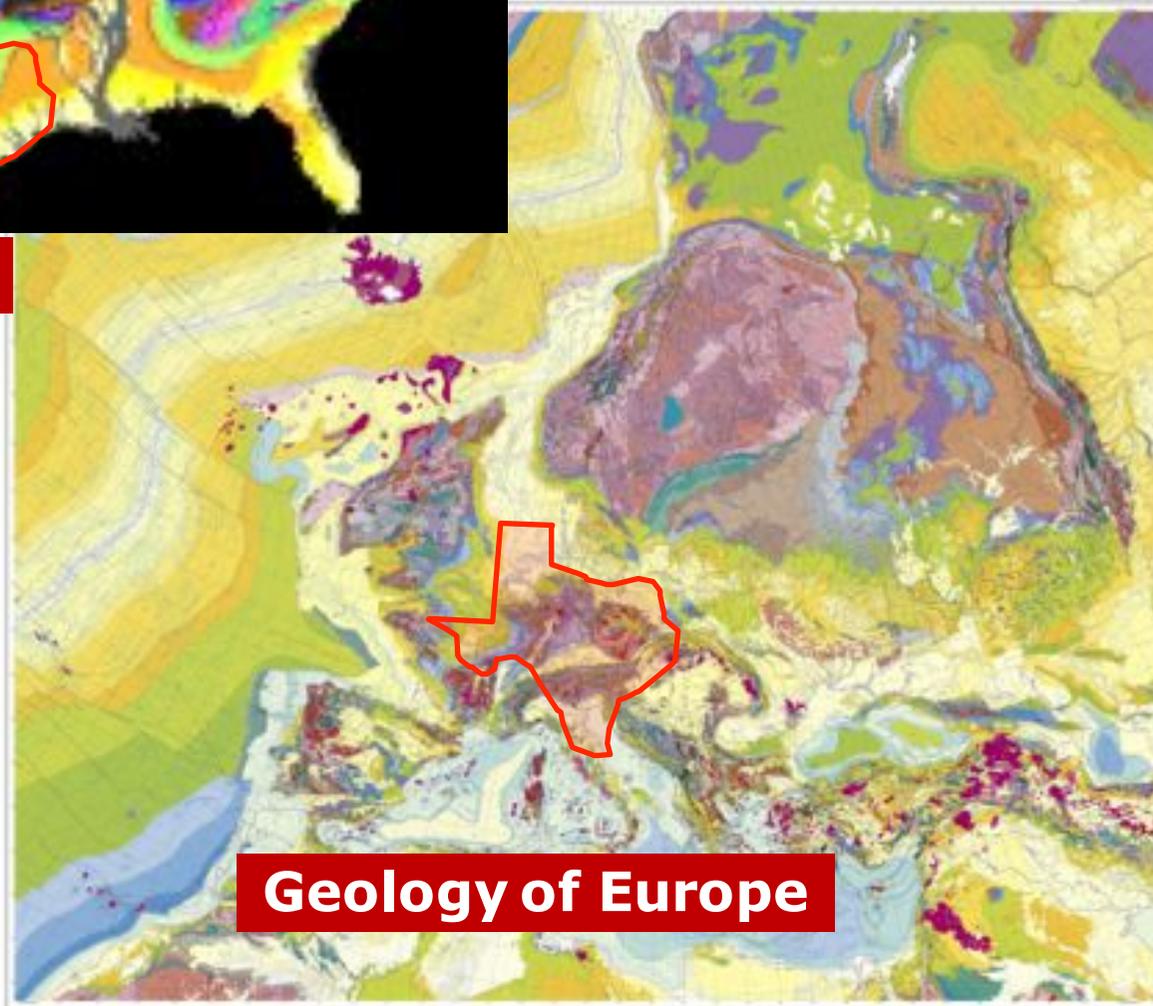
2500 km



Texas

US Geology

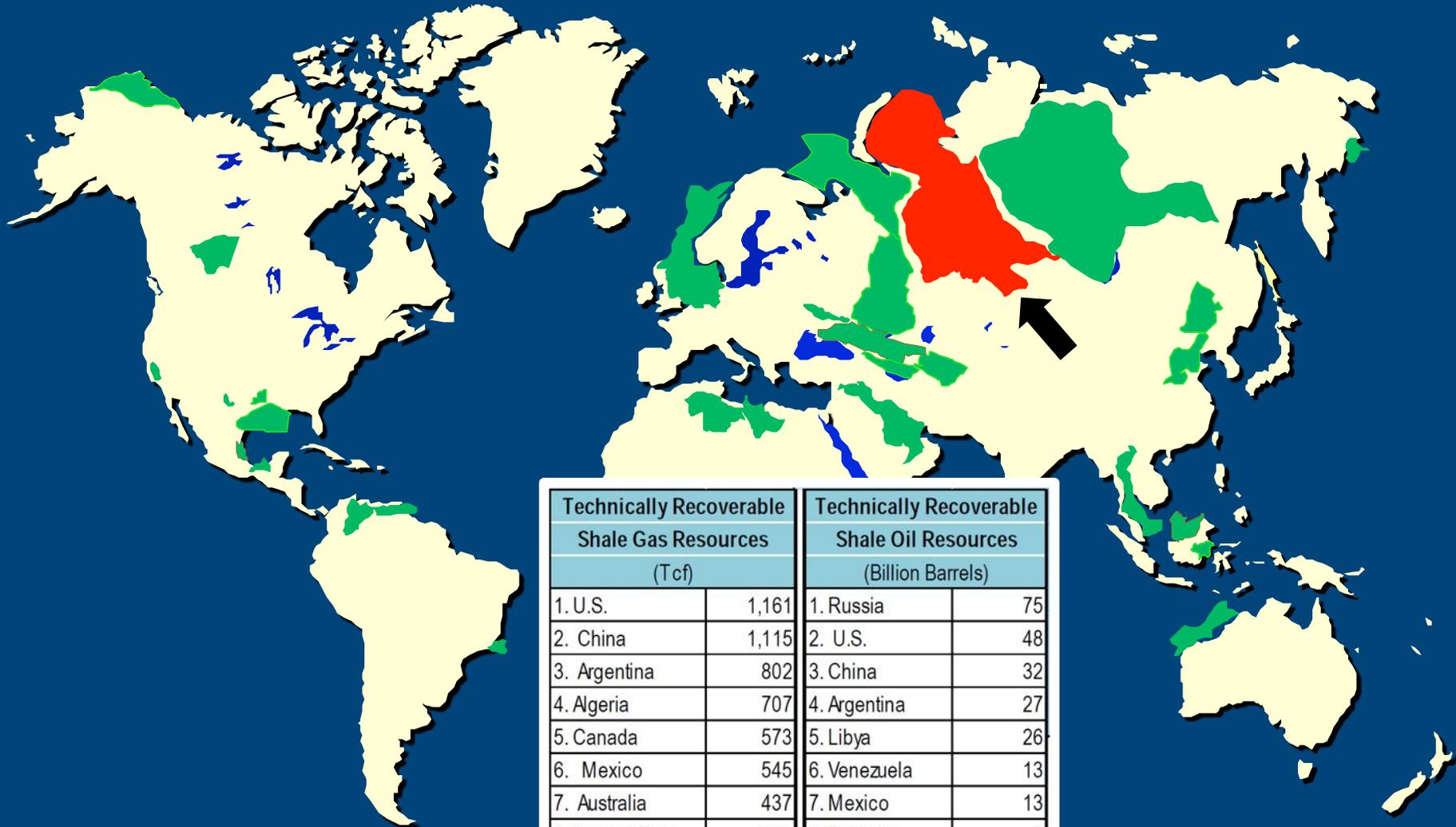
Geological Map of Europe and Adjacent Areas - IGME 5000



Geology of Europe



Selected oil and gas bearing sedimentary basins



Technically Recoverable Shale Gas Resources (Tcf)		Technically Recoverable Shale Oil Resources (Billion Barrels)	
1. U.S.	1,161	1. Russia	75
2. China	1,115	2. U.S.	48
3. Argentina	802	3. China	32
4. Algeria	707	4. Argentina	27
5. Canada	573	5. Libya	26
6. Mexico	545	6. Venezuela	13
7. Australia	437	7. Mexico	13
8. South Africa	390	8. Pakistan	9
9. Russia	285	9. Canada	9
10. Brazil	245	10. Indonesia	8
11. Others	1,535	11. Others	75
TOTAL	7,795	TOTAL	335

EIA (2013)

(AAPG)