

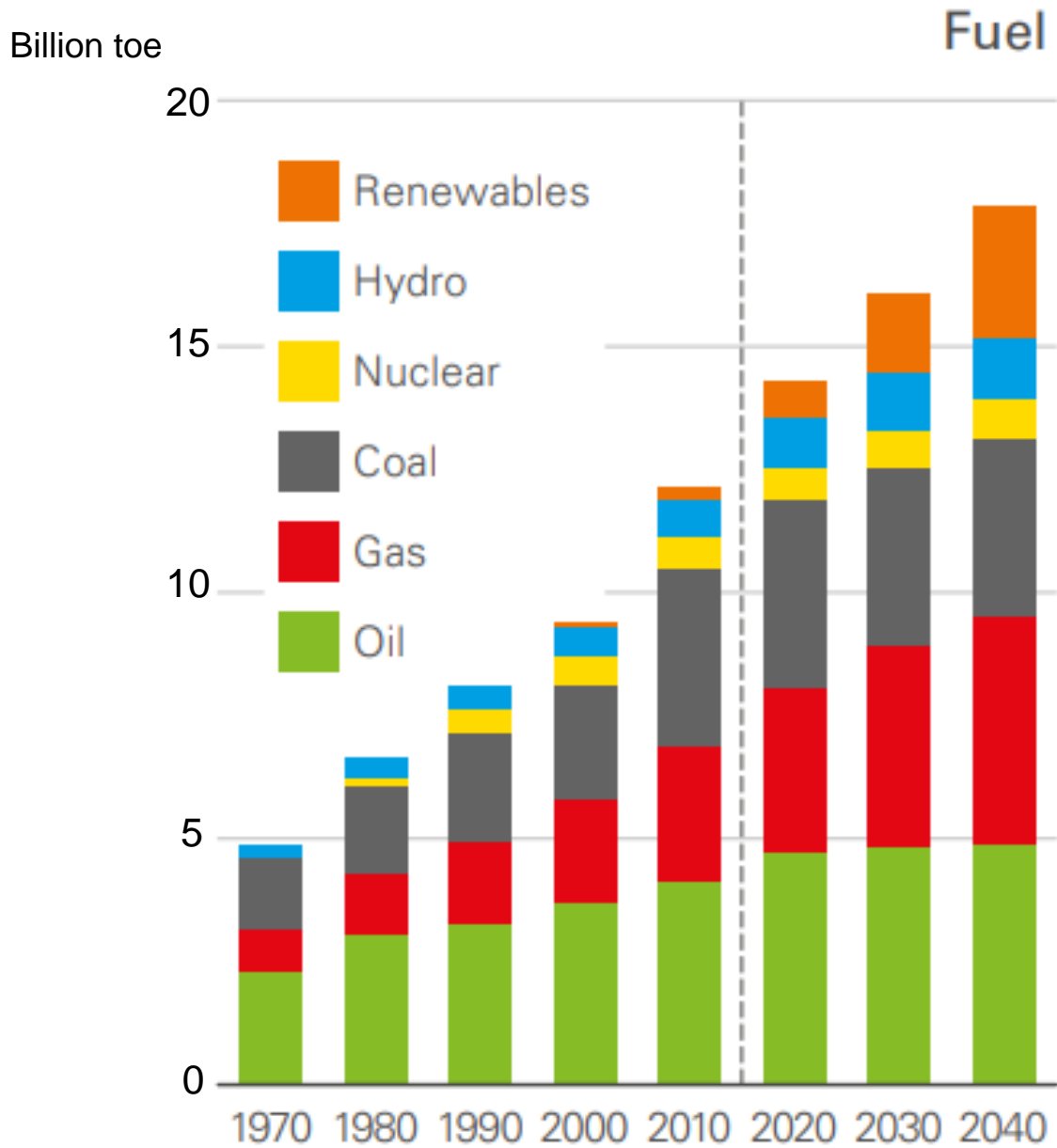
GSA0463-Geologia do Petróleo

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Andre Marconato

Instituto de Geociências

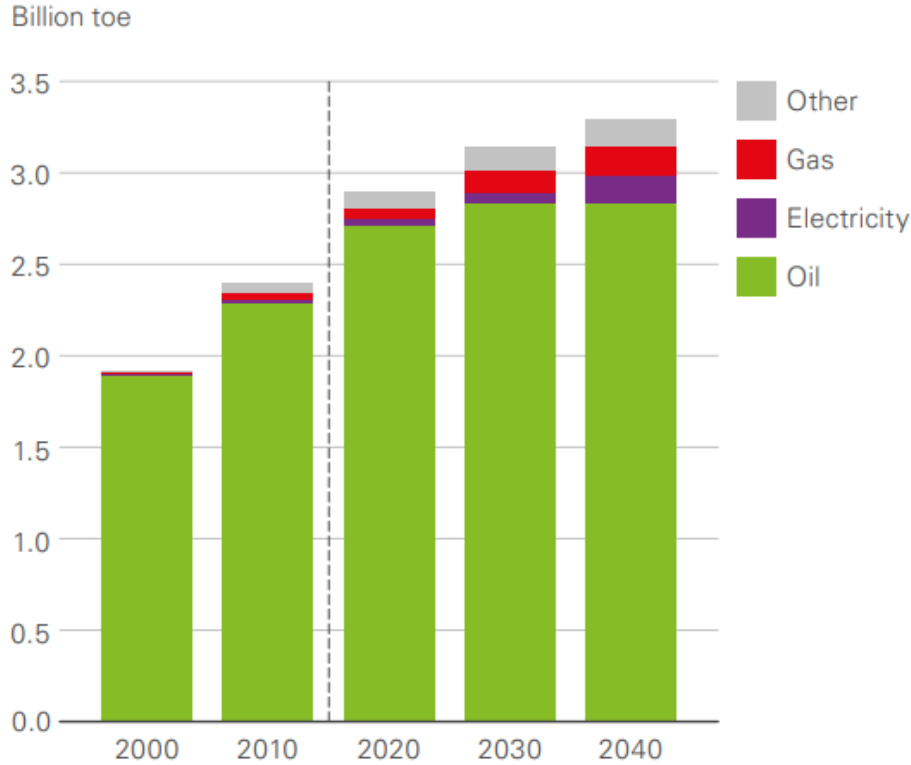
Introdução

Visão geral (“Outlook”) – Demanda por recurso



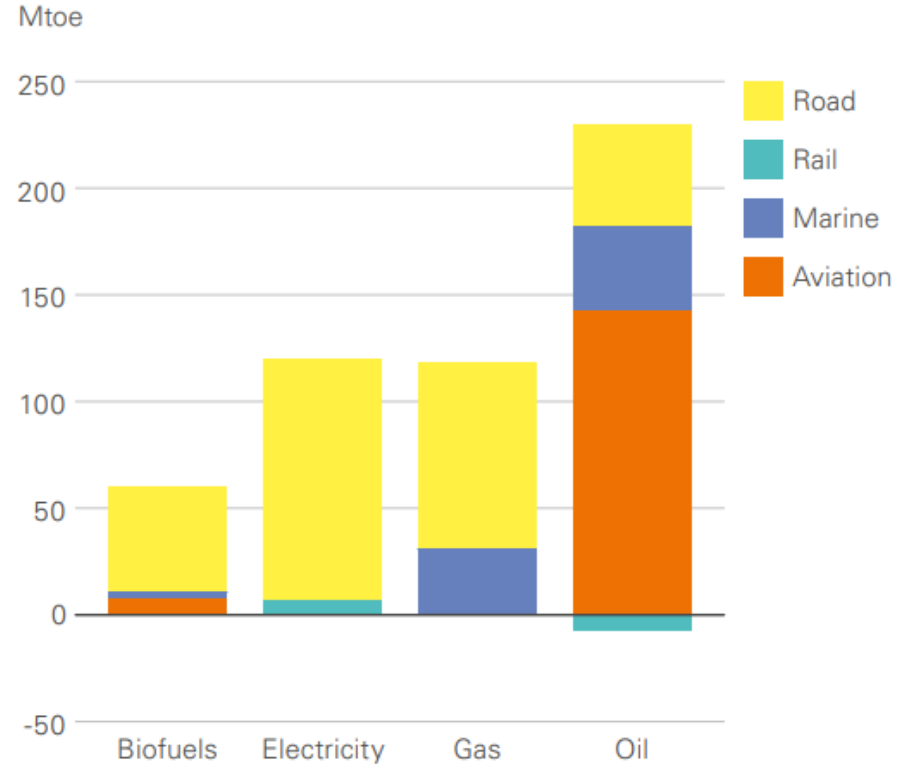
Petróleo e gás natural no setor de transportes

Final energy consumption in transport: Consumption by fuel



Other includes biofuels, coal and hydrogen

Final energy consumption in transport: Growth by fuel and mode, 2017-2040



BP (2019)



Produção de petróleo em Baku (Azerbaijão)



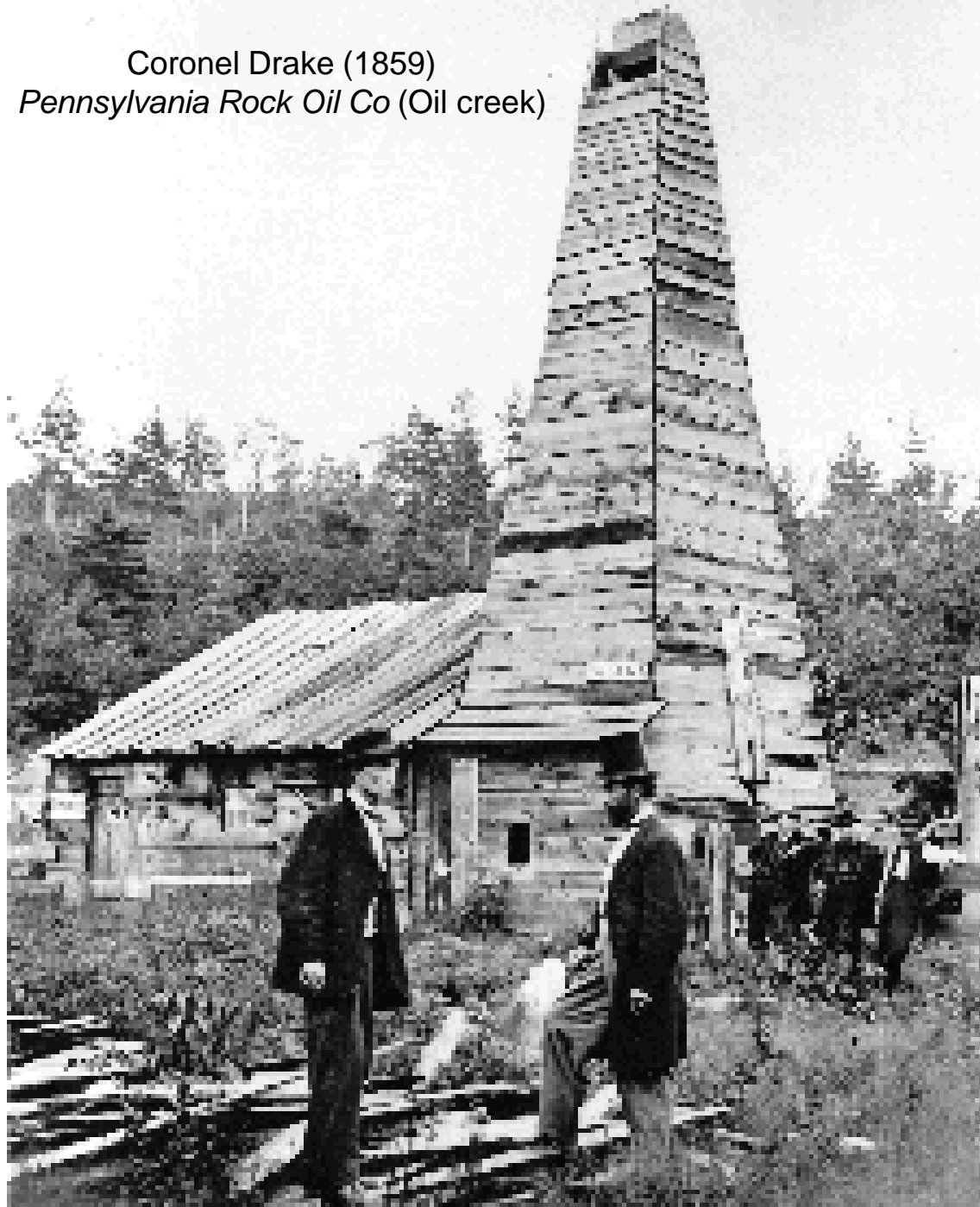
Baku – Báltico via Volga



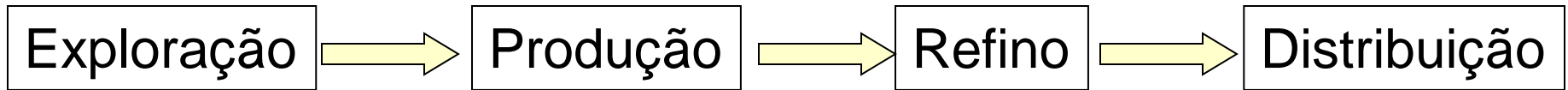
Navio tanque "Zoroaster" (Branobel)



Coronel Drake (1859)
Pennsylvania Rock Oil Co (Oil creek)



Indústria do petróleo

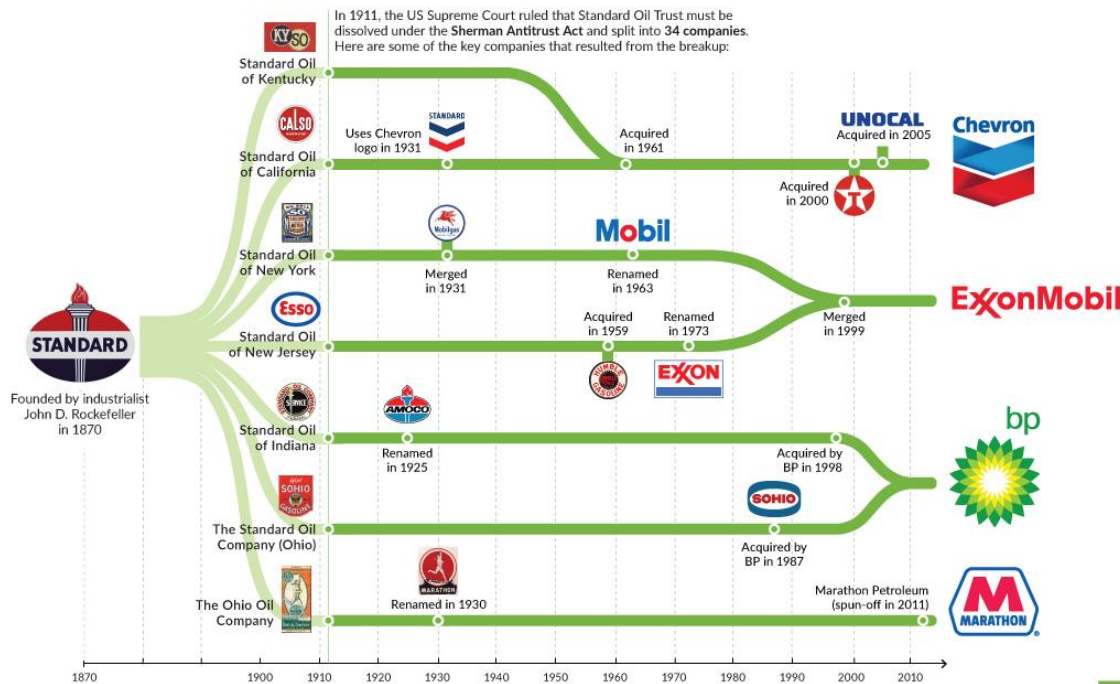


Geologia do Petróleo

Chart of the Week

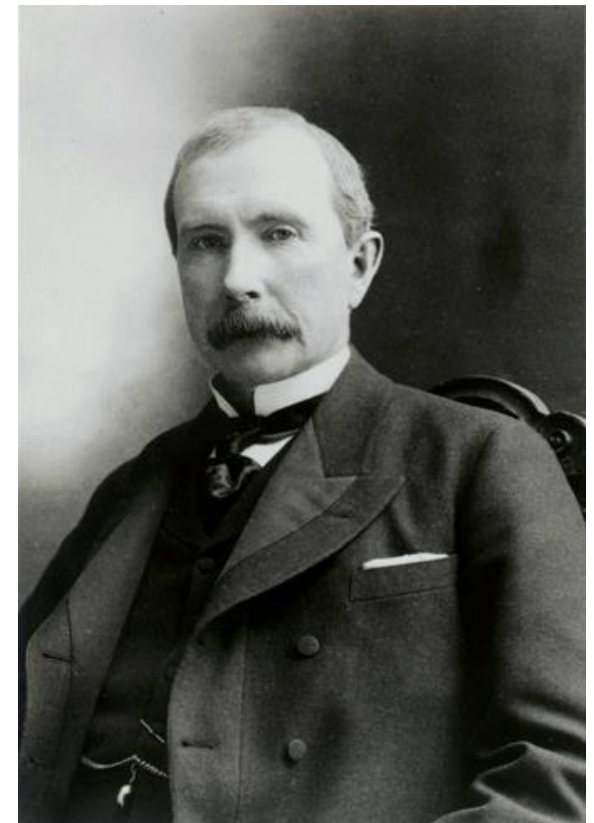
THE EVOLUTION OF STANDARD OIL

Following the remnants of John D. Rockefeller's oil juggernaut



SOURCE: Wikipedia

visualcapitalist.com





<https://www.youtube.com/watch?v=AxQEZIDws7Y>



DANIEL DAY-LEWIS

Directed by Paul Thomas Anderson

There Will Be Blood

CASTING BY ANNE VASTIC
COSTUME DESIGNER: JAMES HAMILTON
EDITED BY: BOB D'AMICO

PRODUCTION DESIGNER: BOB D'AMICO

EXECUTIVE PRODUCERS: JAMES HAMILTON, BOB D'AMICO

PRODUCED BY: BOB D'AMICO, JAMES HAMILTON, BOB D'AMICO

WRITTEN BY: PAUL THOMAS ANDERSON
DIRECTED BY: PAUL THOMAS ANDERSON

CASTING BY: ANNE VASTIC
COSTUME DESIGNER: JAMES HAMILTON

HERITAGE

AMERICAN

PRODUCTION

THEATRE

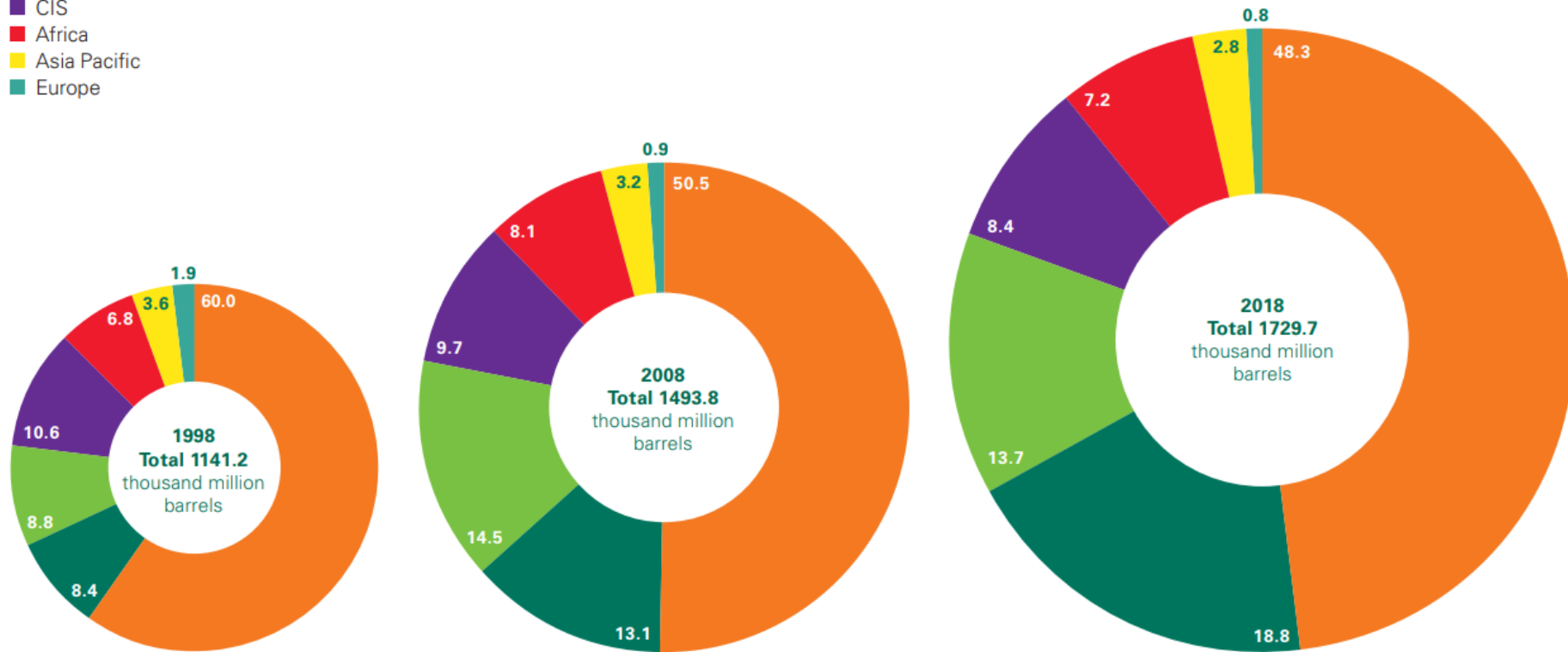
THEATRE

Reservas mundiais de petróleo

Distribution of proved reserves in 1998, 2008 and 2018

Percentage

- Middle East
- S. & Cent. America
- North America
- CIS
- Africa
- Asia Pacific
- Europe

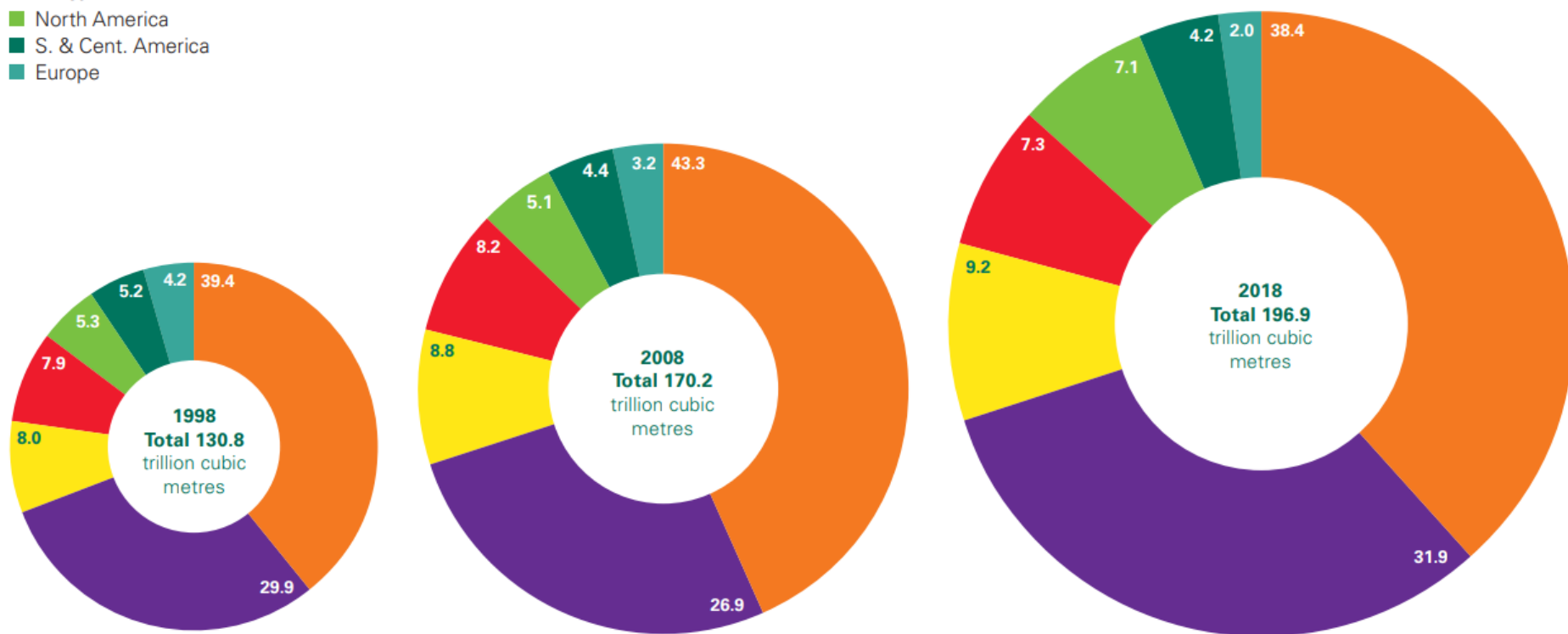


Reservas mundiais de gás natural

Distribution of proved reserves in 1998, 2008 and 2018

Percentage

- Middle East
- CIS
- Asia Pacific
- Africa
- North America
- S. & Cent. America
- Europe



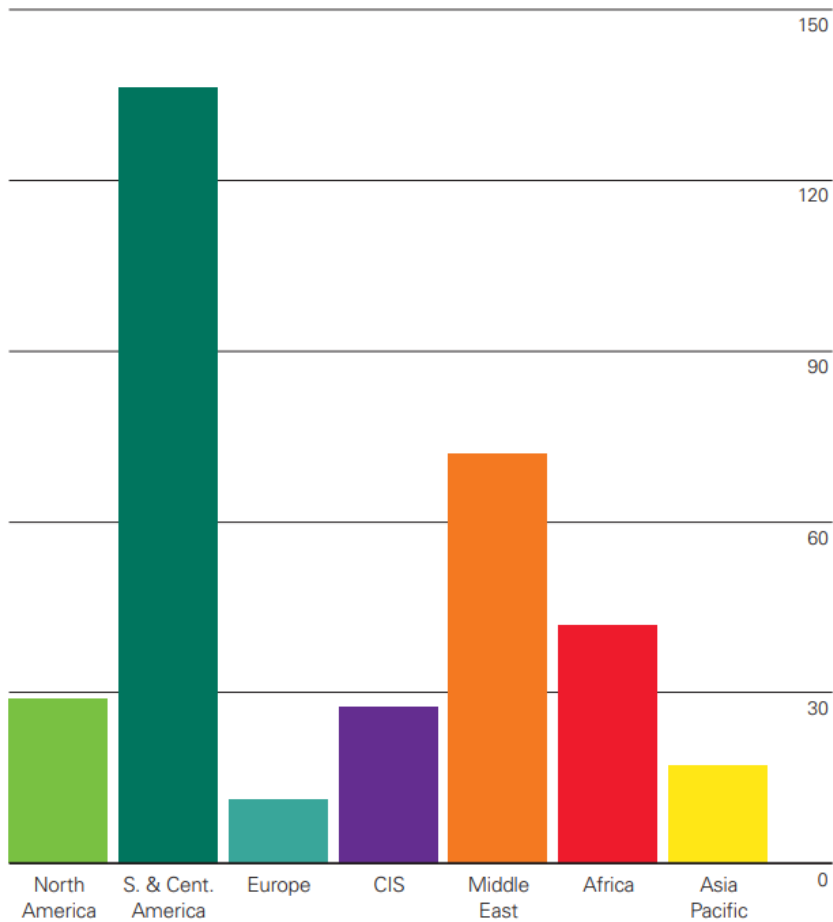
Reservas/Produção

Petróleo

Reserves-to-production (R/P) ratios

Years

2018 by region

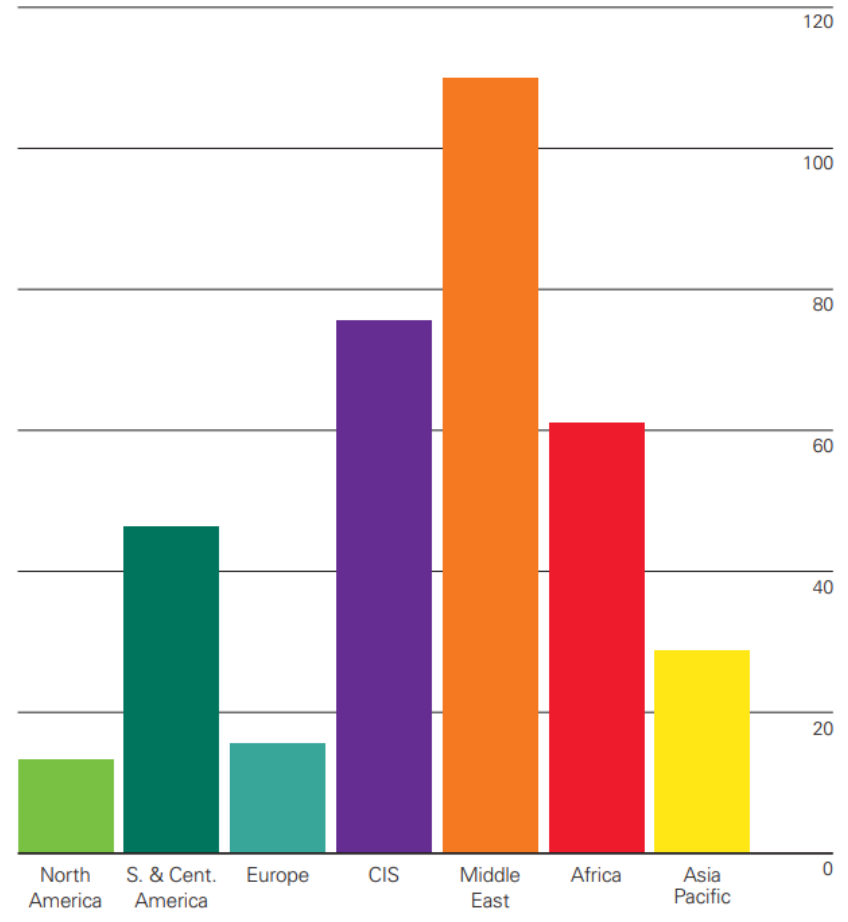


Gás

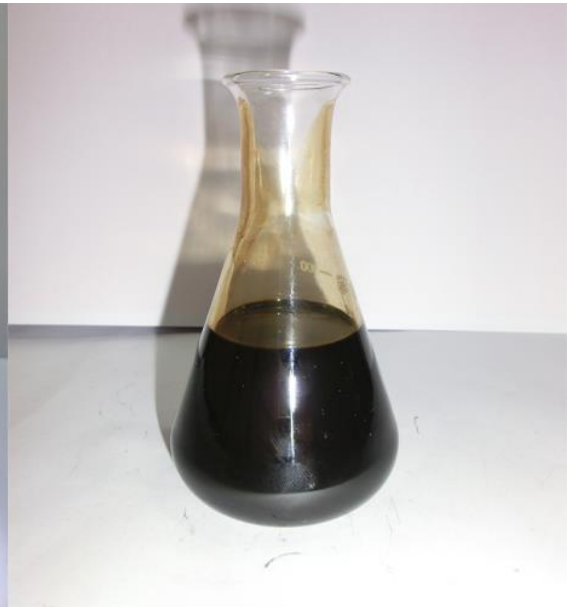
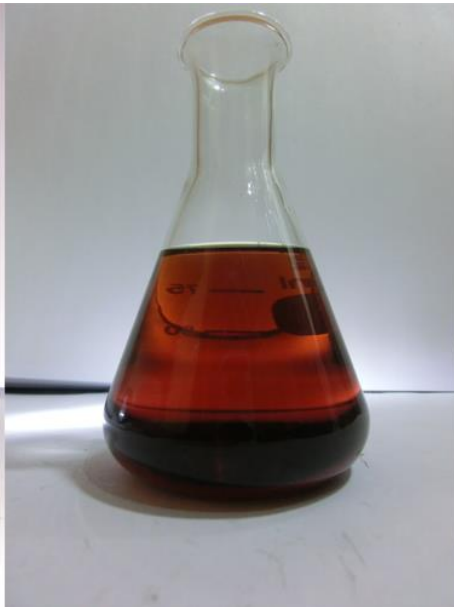
Reserves-to-production (R/P) ratios

Years

2018 by region





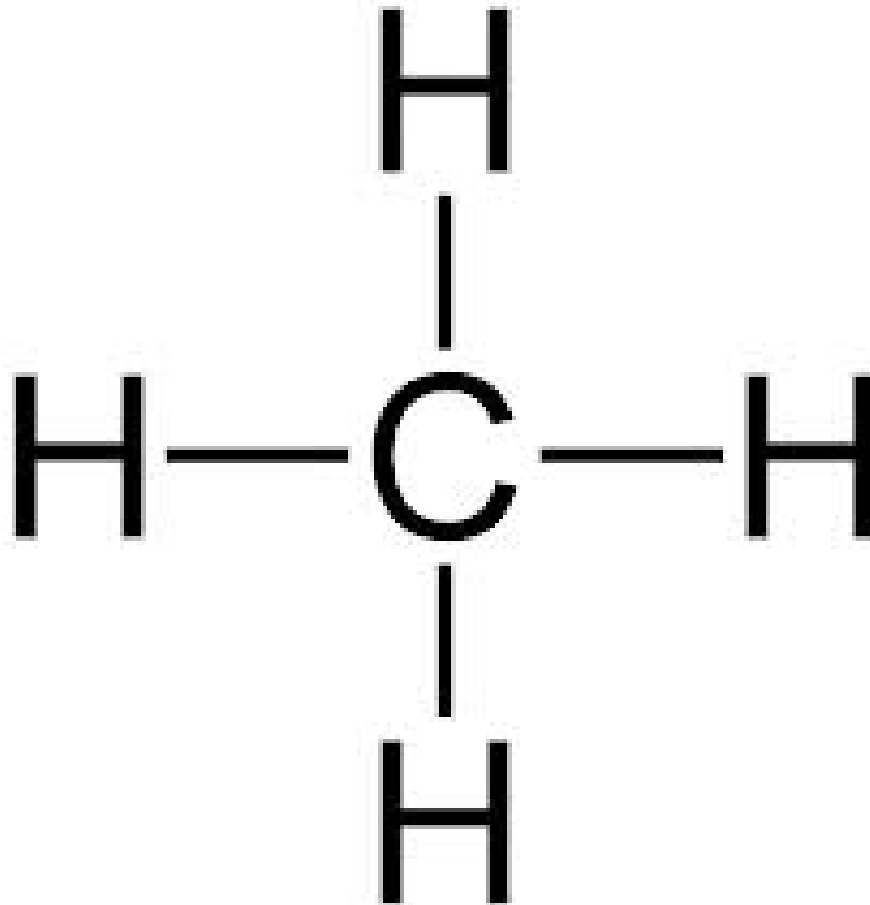


Clases de hidrocarbonetos

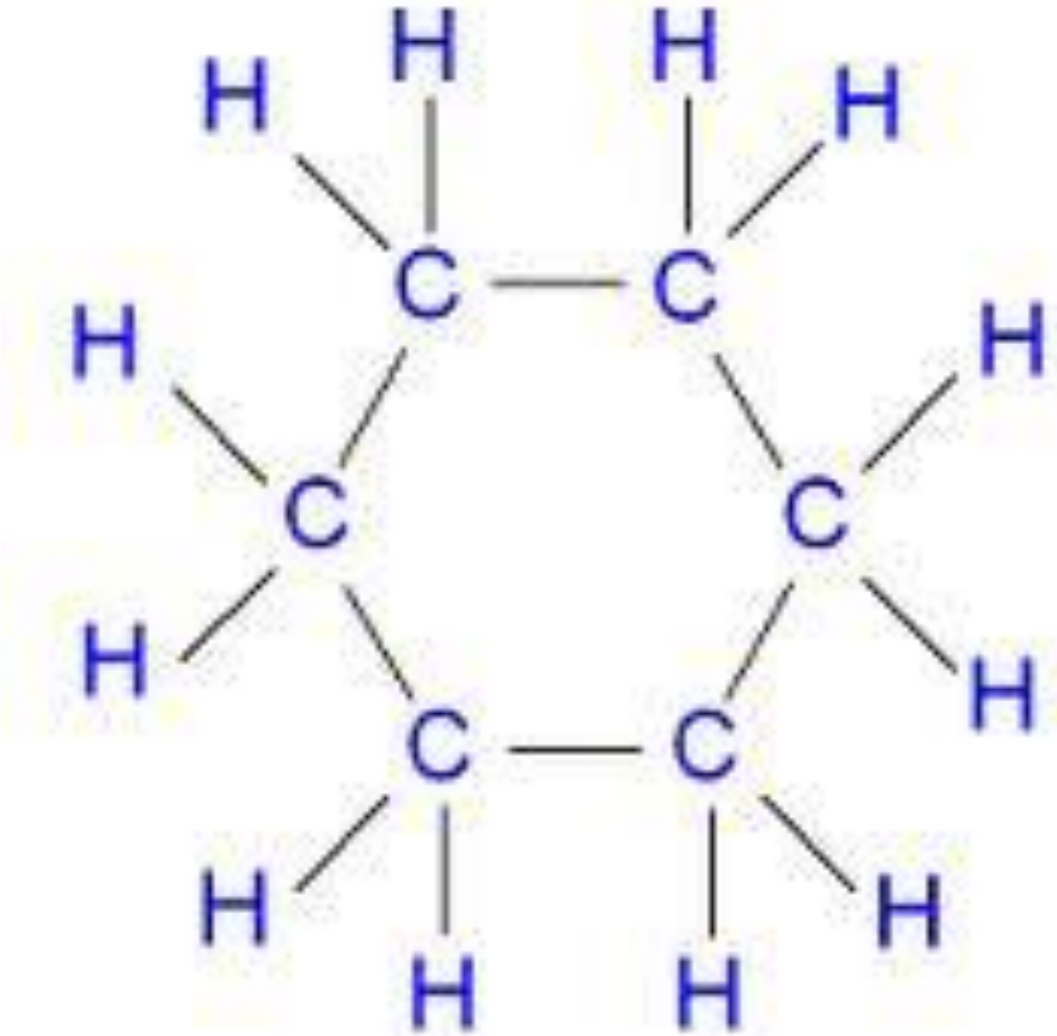
- Parafinas (alcanos)
- Parafinas cíclicas (naftenos)
- Aromáticos

Parafinas (alcanos)

Ex. Metano

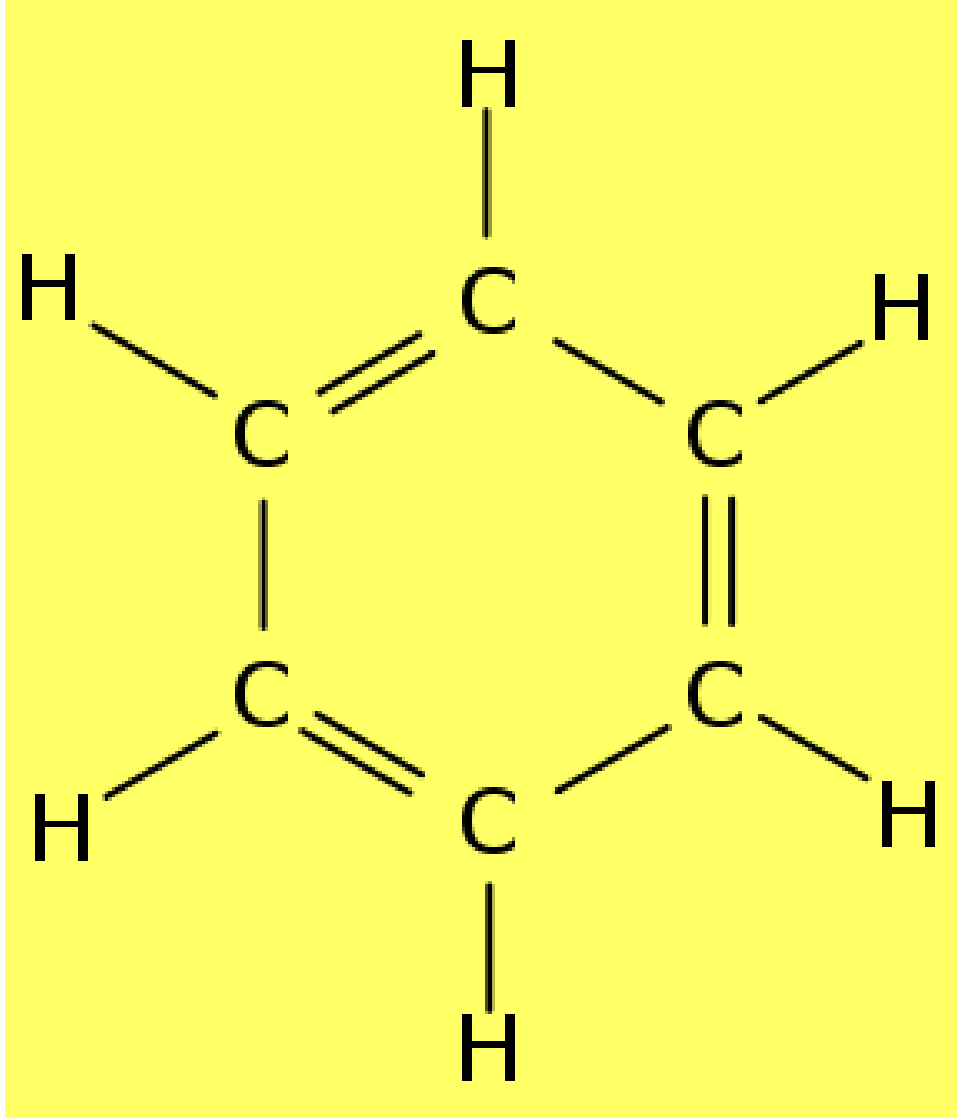


Parafinas cíclicas (naftenos)



Ex. Ciclohexano

Aromáticos



Ex. Benzeno

Óleo vs. gás

Estado físico dos HCs nas CNTP

- $< C5 =$ Gasoso
- $C5 - C15 =$ líquido
- $> C15 =$ líquido viscoso a sólido

Principais derivados do petróleo

- Gasolina: C5-C10
- Querosene: C11-C13
- Óleo diesel: C14-C18
- Óleo lubrificante: C20-C40
- Resinas, asfalto e graxas: >C40

Óleo pesado (API = 10-22)

Óleo leve (API > 31)



Viscosidade diminui
Grau API aumenta

$$API = \frac{141.5}{\rho} - 131.5$$

Classificação por peso específico

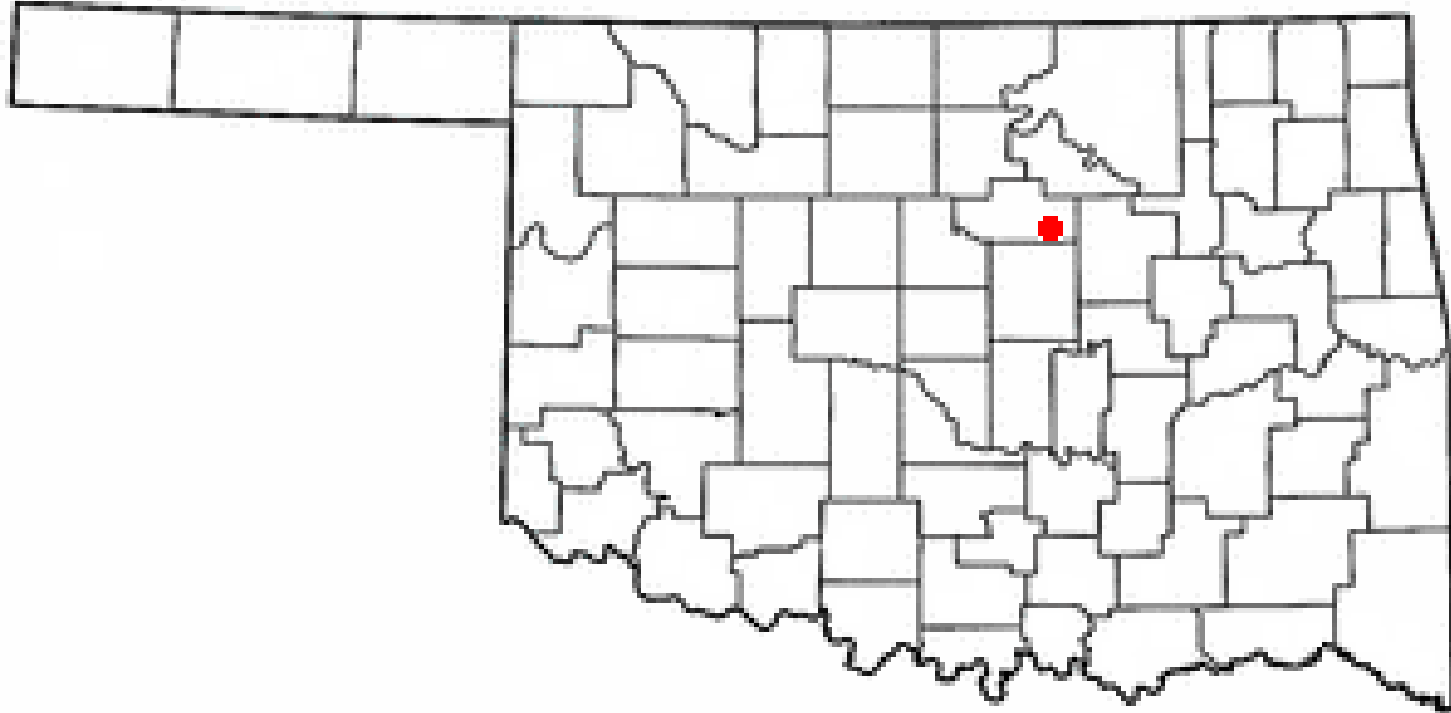
Graus API	Classe de densidade do óleo
> 31.1	Leve
22.3 a 31.1	Média
10 a 22.3	Pesada
< 10	Extra pesada

Hunt (1995)

$$API = \frac{141.5}{\rho} - 131.5$$

ρ =peso específico a 15.6°C

West Texas Intermediate (WTI): óleo leve (39,6 API), doce (0,24% S), distribuído em Cushing (Oklahoma, EUA).



US\$66,85/bbl (19/03/2023)

Brent blend: mistura de 15 tipos de óleos da bacia do Mar do Norte, óleo leve (38,06 API), doce (0,37% S), distribuído em Sullon Voe (Ilhas Shetland, Escócia).

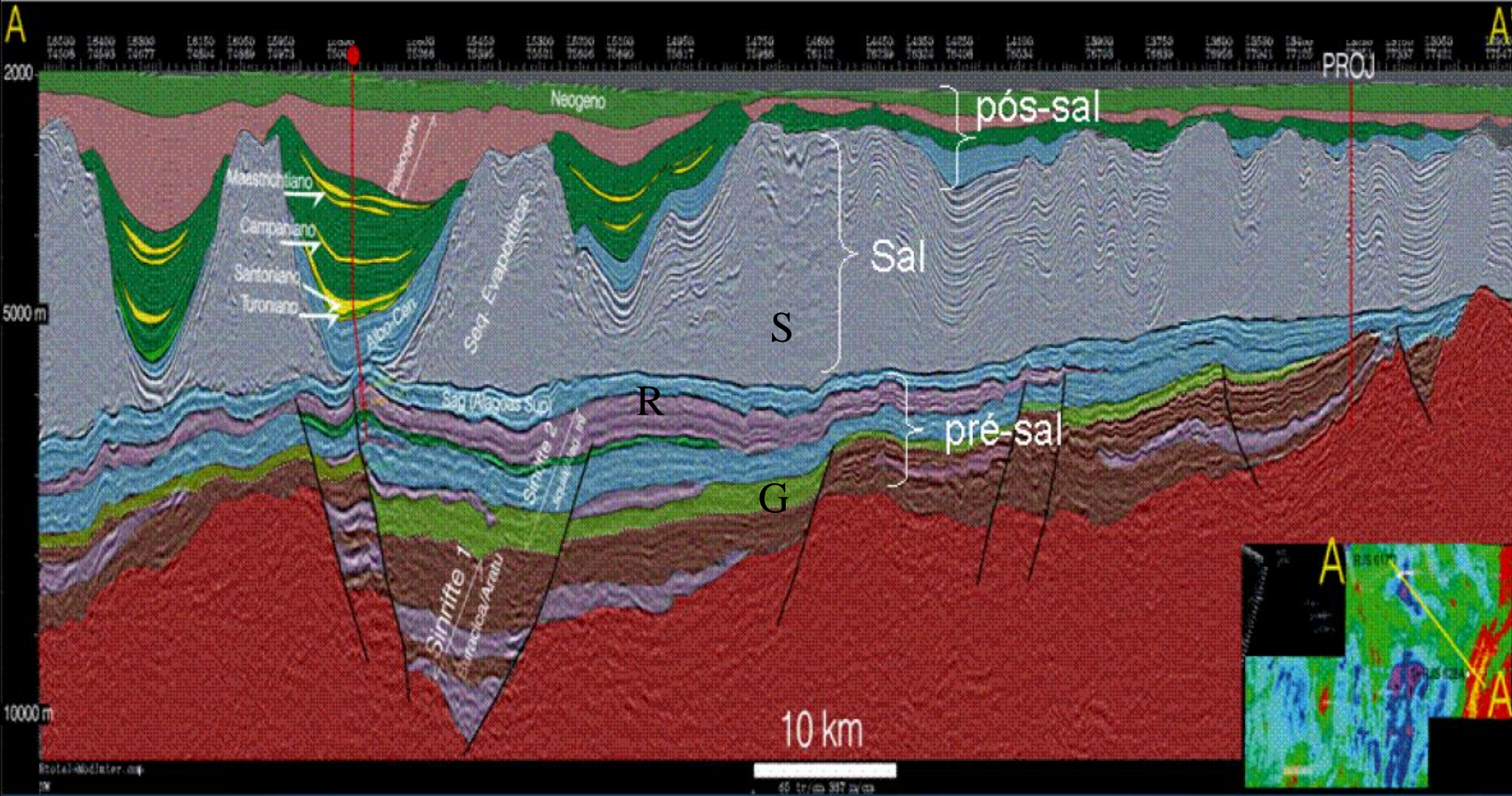
US\$72,99/bbl (19/03/2023)



Como são formadas as reservas de petróleo e gás natural?

Sistema petrolífero

Sistemas Petrolíferos



Rocha geradora

> 1% carbono orgânico



Folhelho (Fm. Kimmeridge - West, 2010)

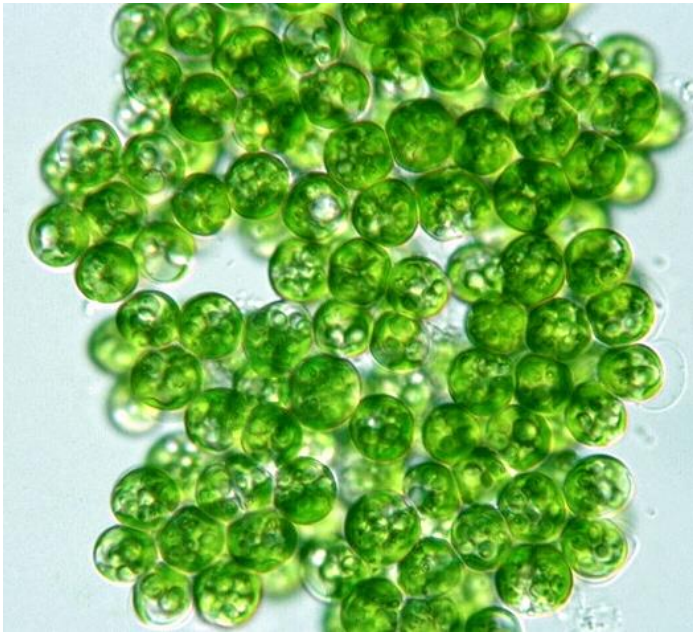
Matéria orgânica



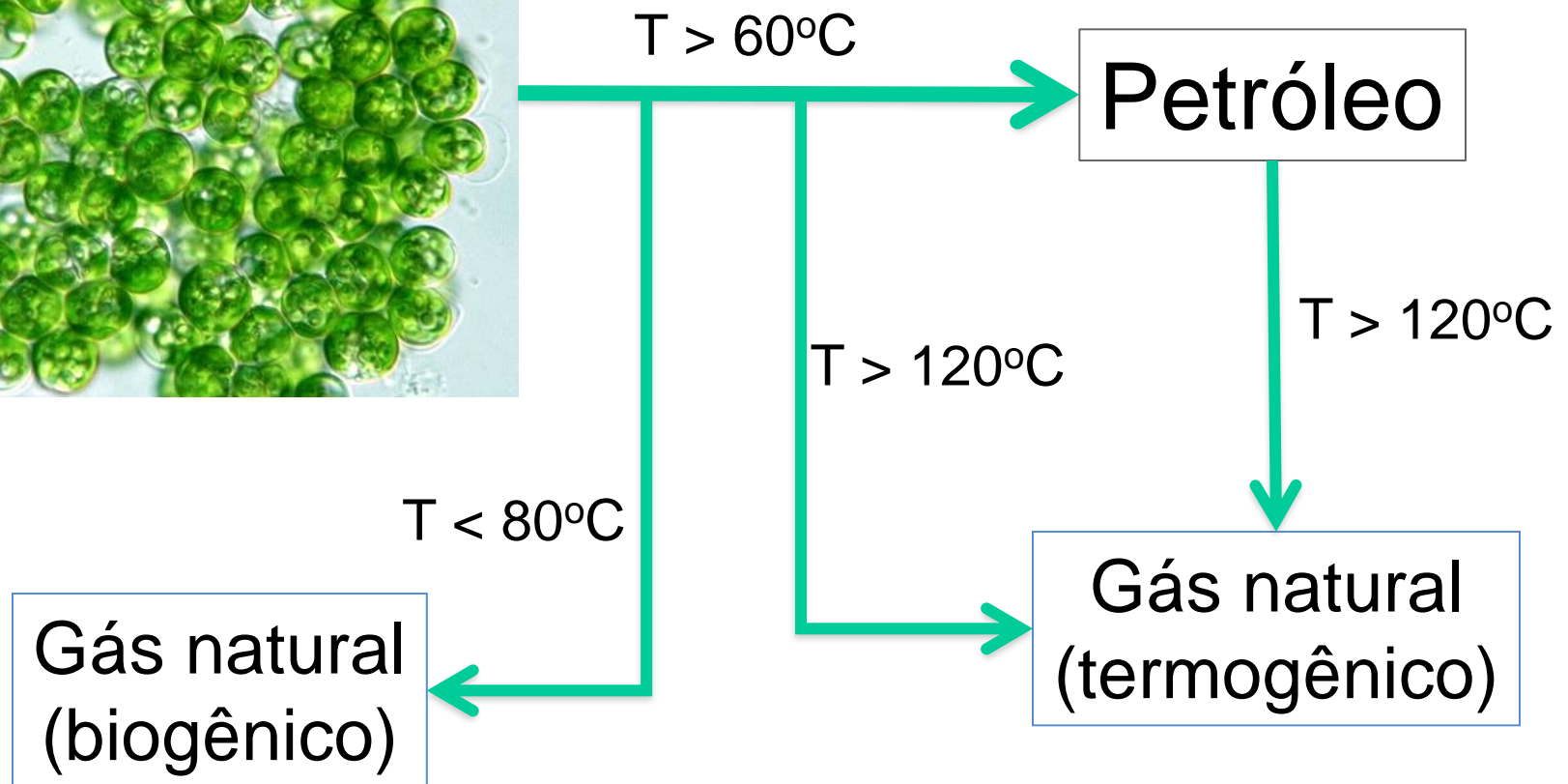
Botryococcus sp (Y. Tsukii, 2004)

Geração de hidrocarbonetos

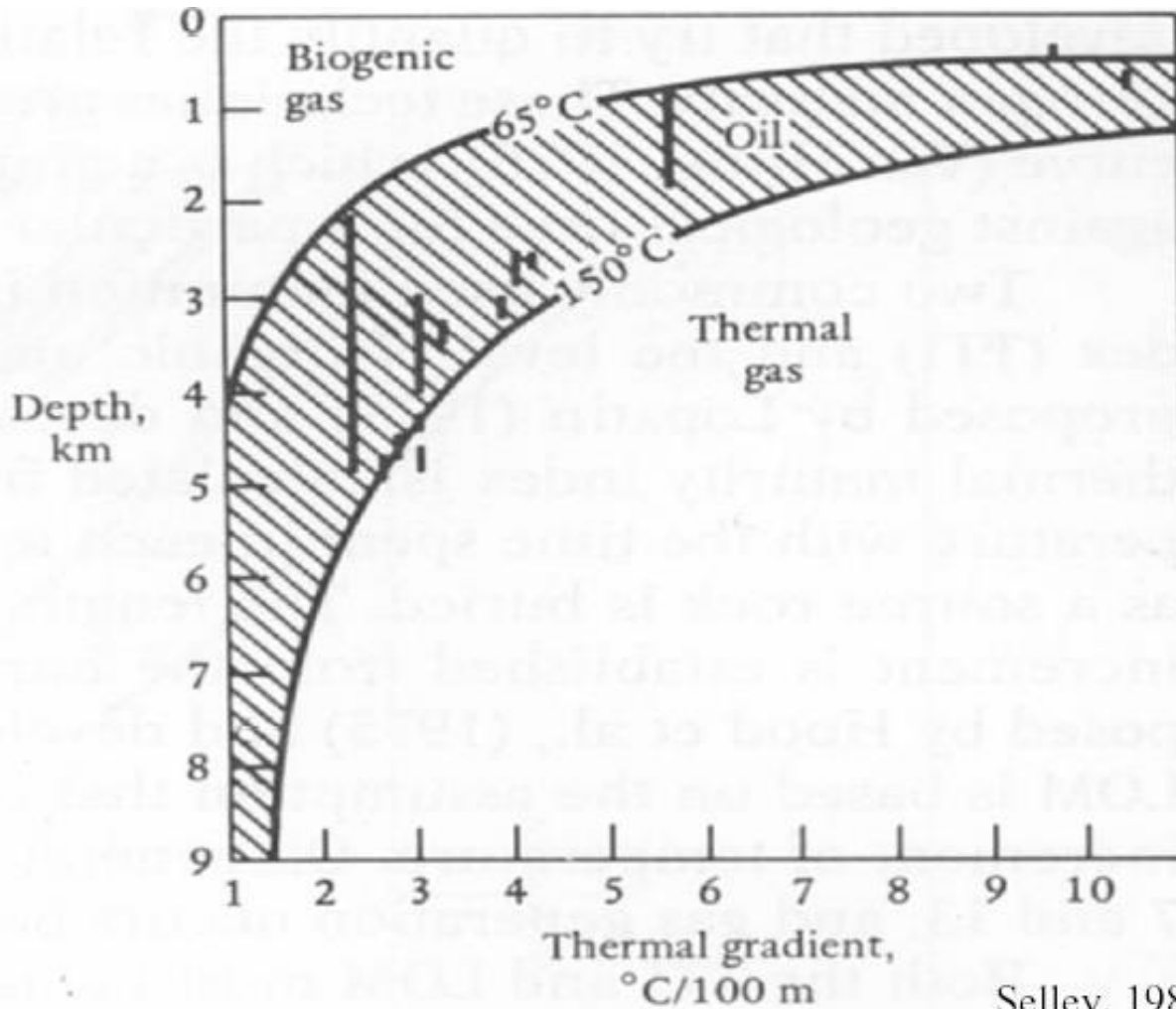
Matéria orgânica (algas)



30°C/km – Profundidade?



Geração



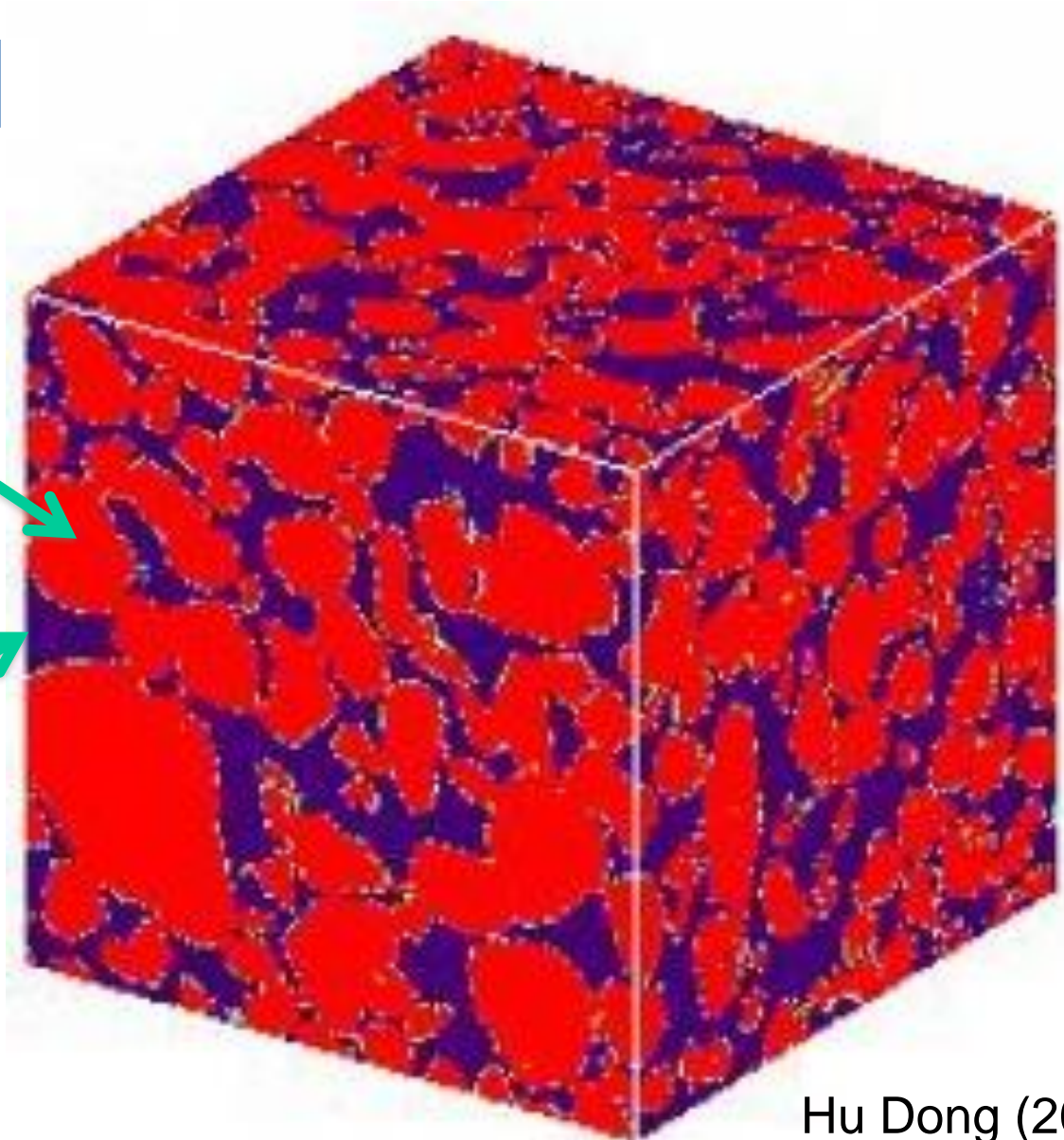
Selley, 1985

Rocha reservatório

Porosidade: 5-30%

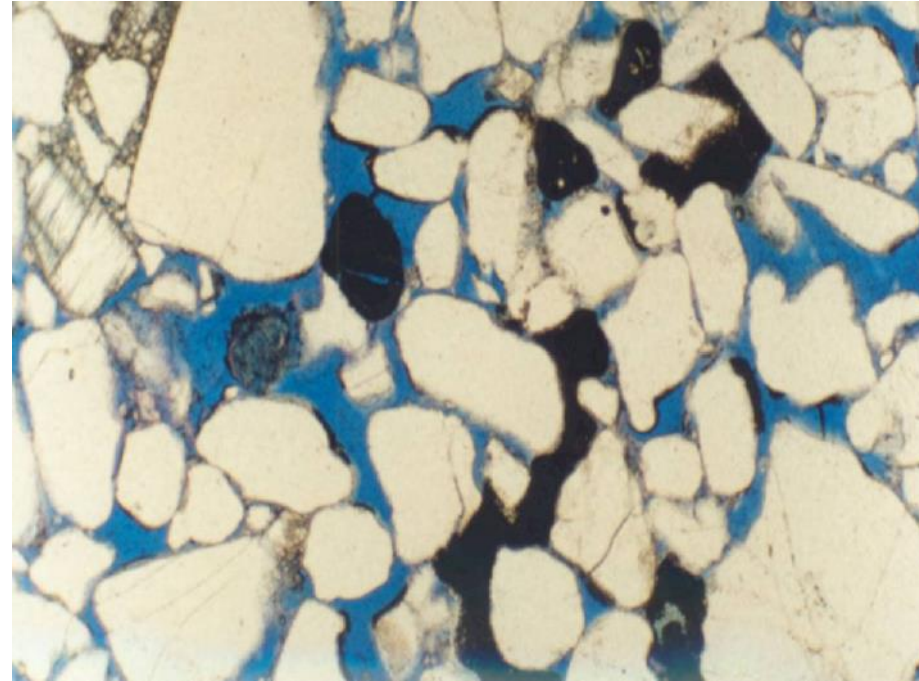
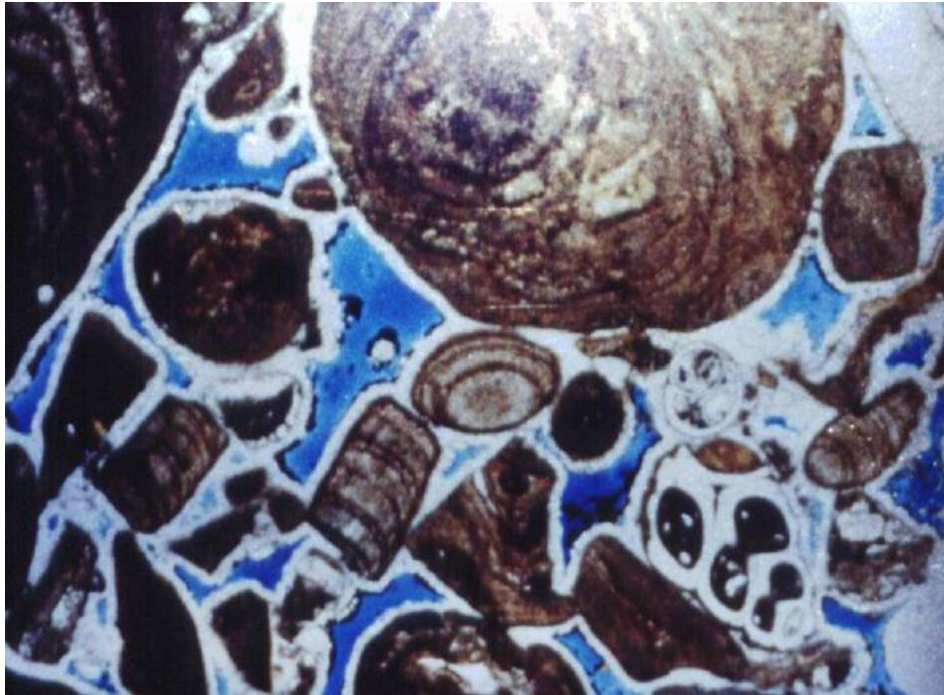
Grãos (minerais)

Poros
(petróleo, gás,
água)



Hu Dong (2007)

Rocha reservatório

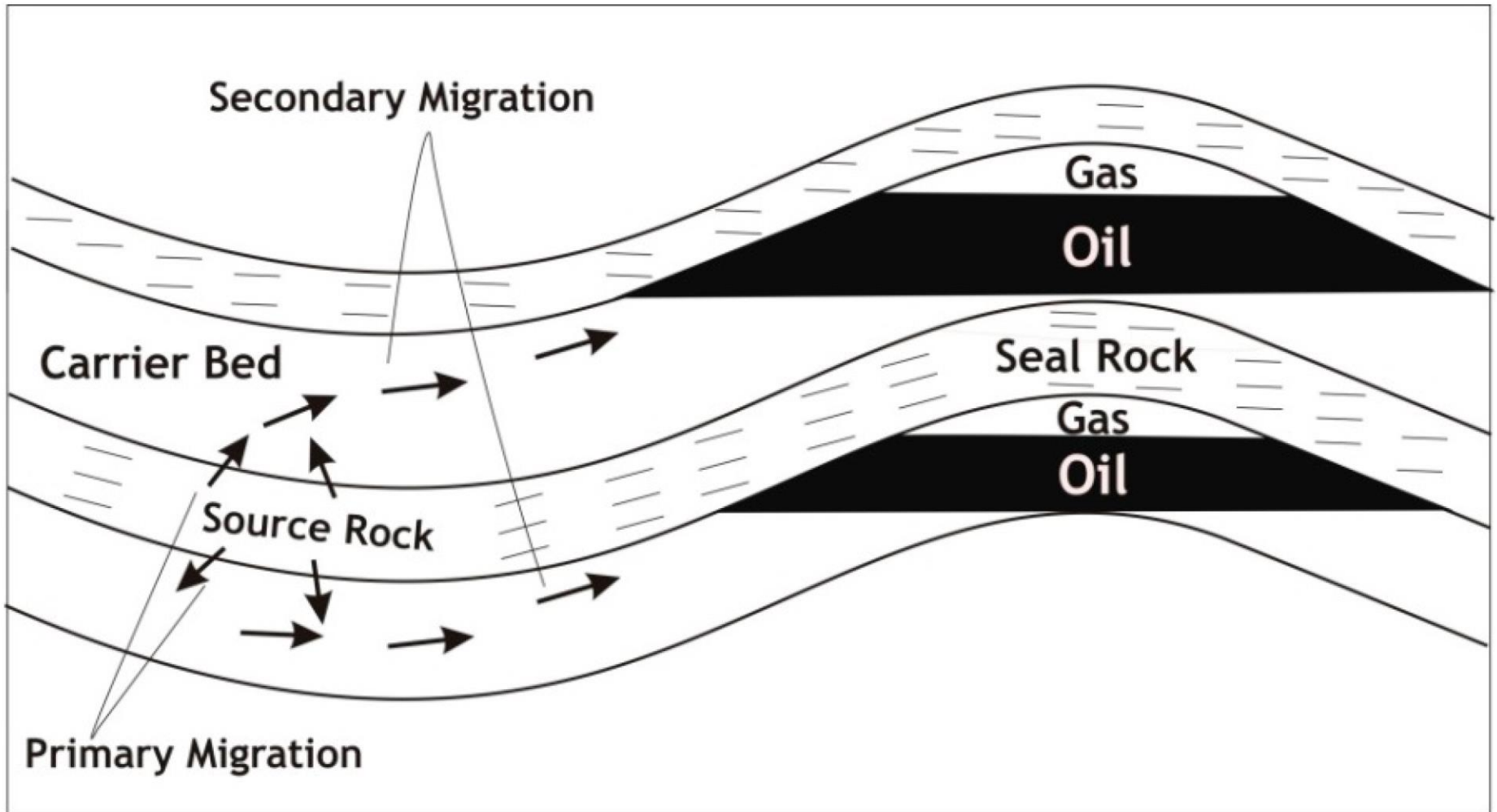


Calcário microbial (Reservatório Aptiano, Bacia de Santos)



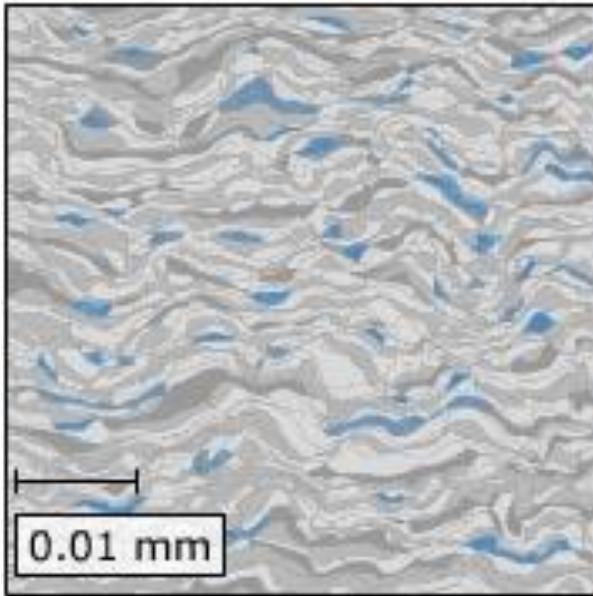
2,0 cm

Migração

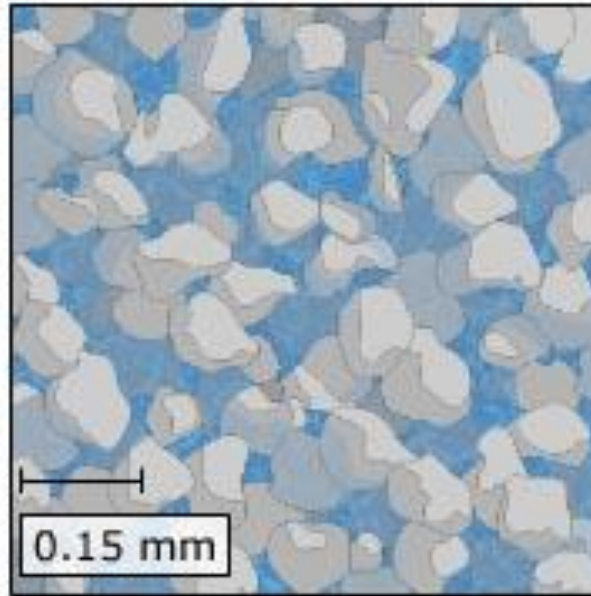


Rocha selante

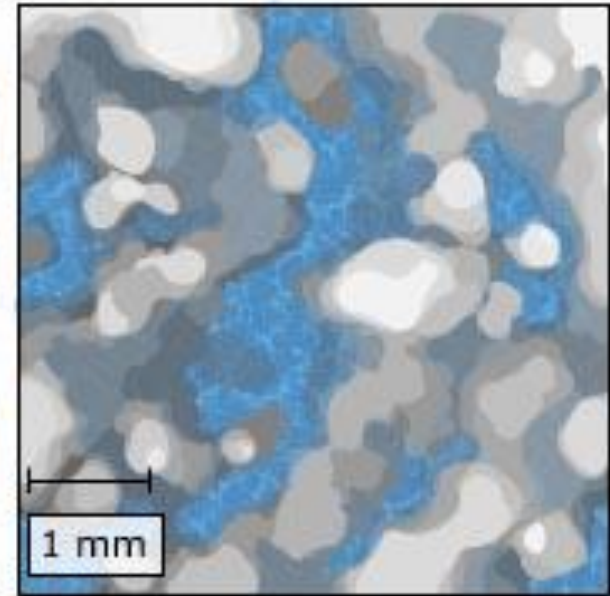
Folhelho



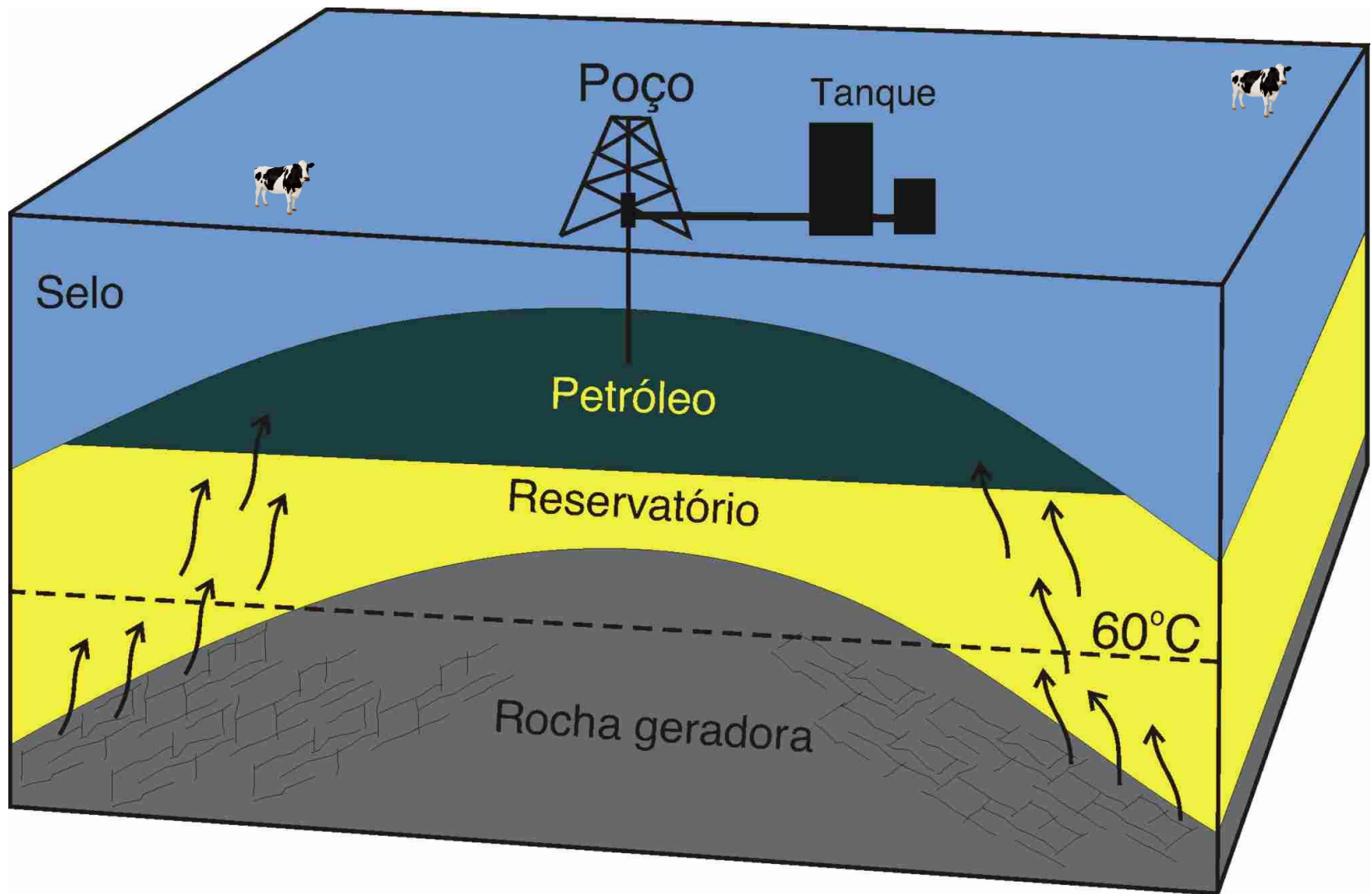
Arenito



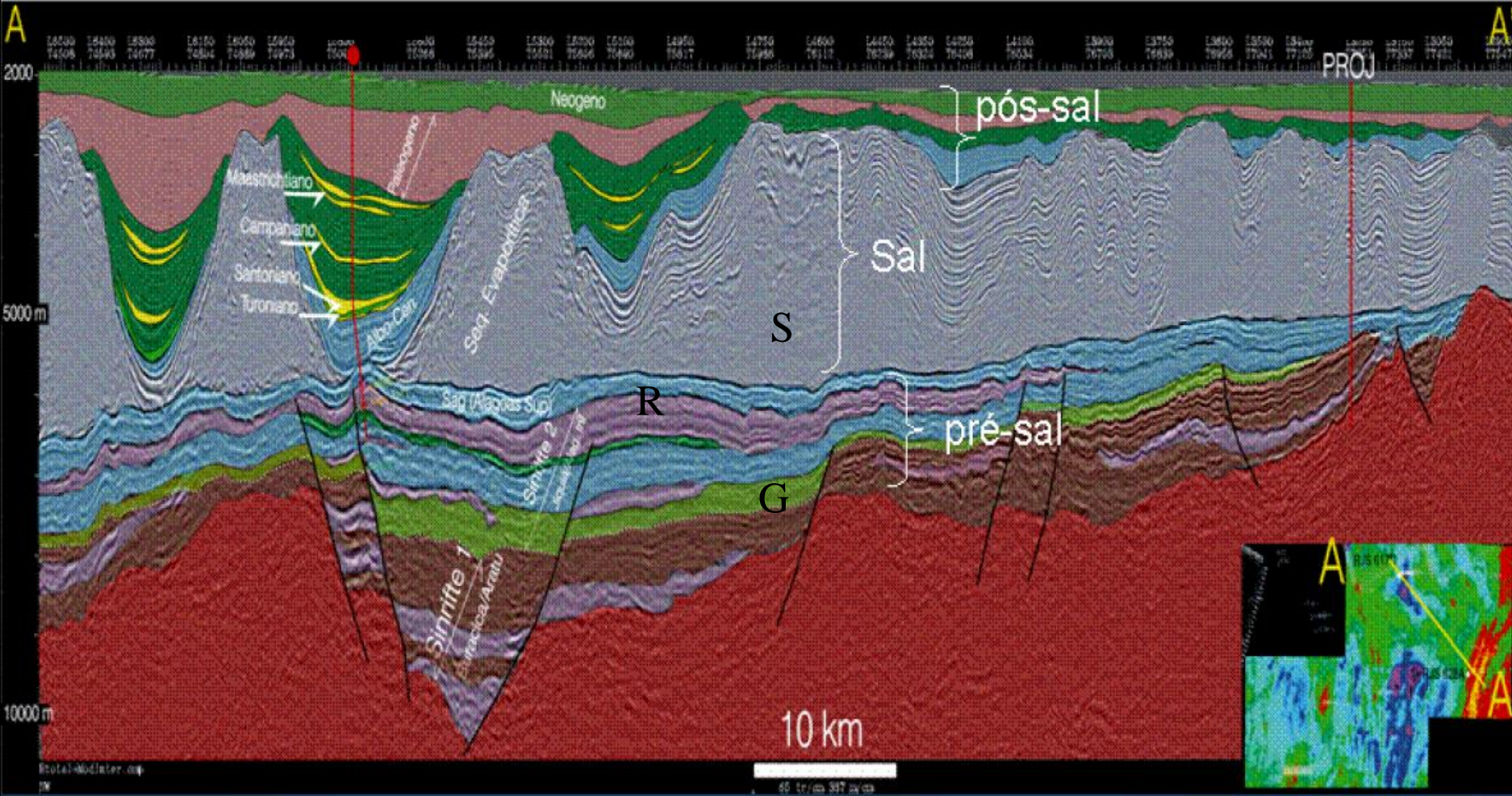
Calcário



Armadilha



Sistemas Petrolíferos



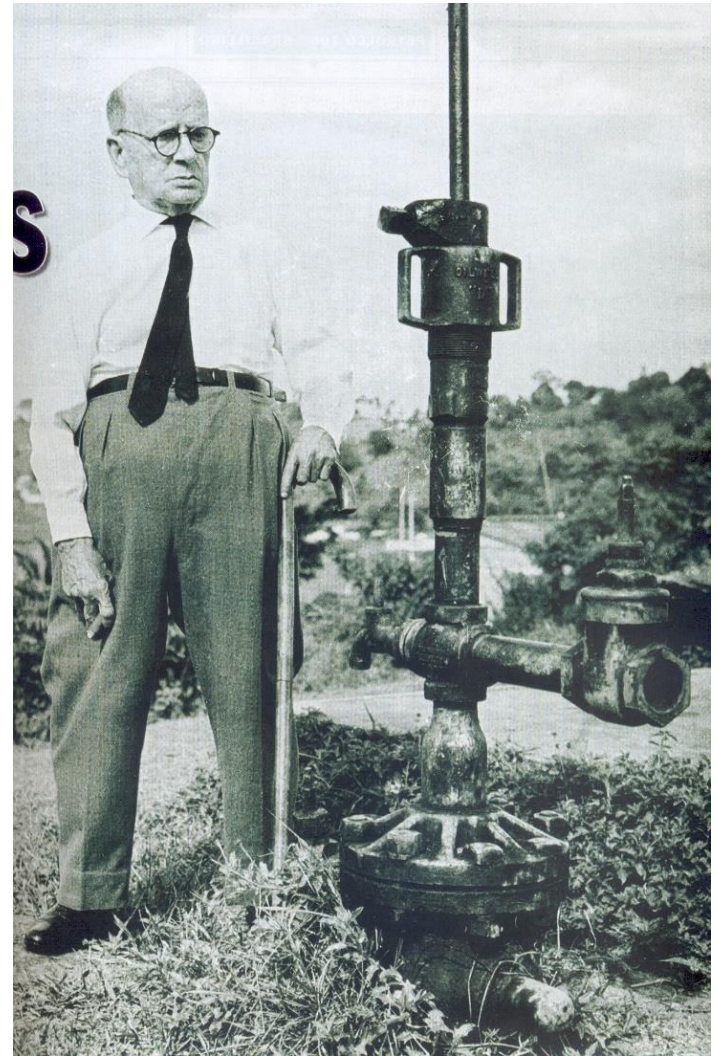
Elementos e processos do sistema petrolífero

- Elementos
 - Rocha geradora
 - Rocha reservatório
 - Rocha selante
 - Rochas de sobrecarga
 - Armadilhas
- Processos
 - Geração
 - Migração
 - Sincronia

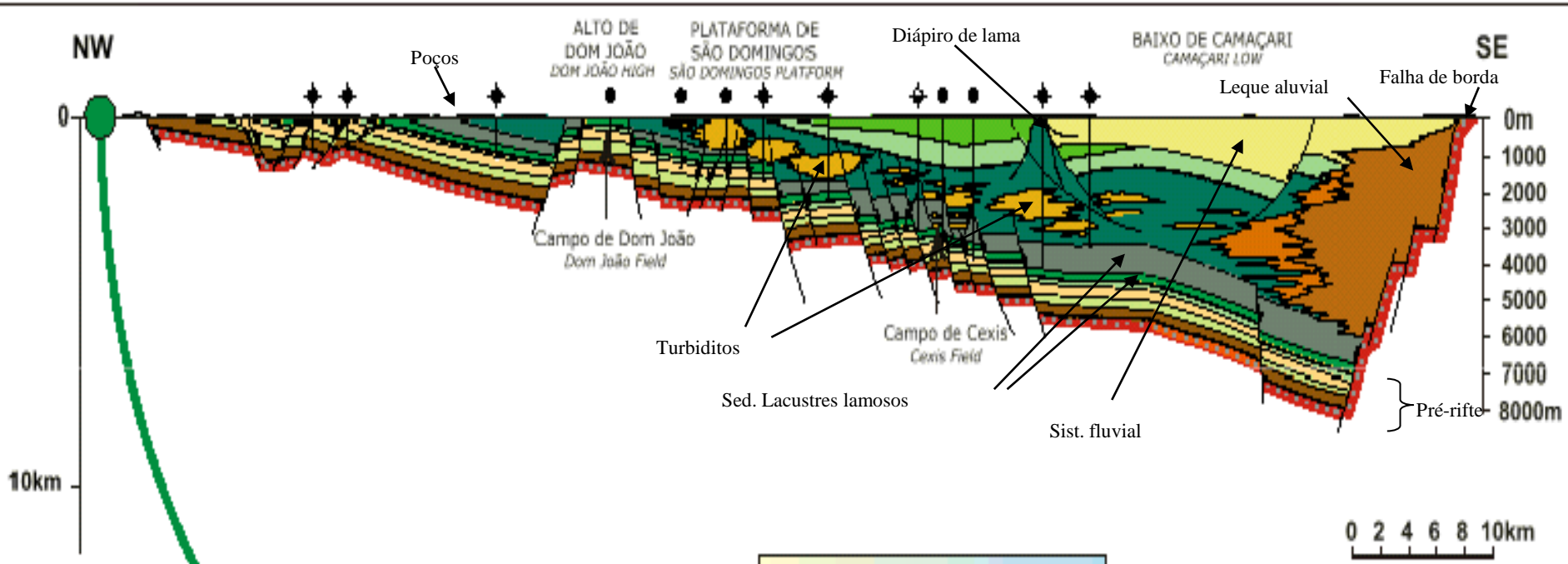
Bacia do Recôncavo



1939 – Manuel Inácio Bastos e Oscar Cordeiro perfuram poços em Lobato (BA)



1941 – Início da produção de petróleo no campo de Candeias (bacia do Recôncavo, Bahia)



- Fm. São Sebastião
- Fm. Salvador
- Fm. Pojuca
- Fm. Taquipe
- Mb. Pitanga
- Fm. Maracangalha
- Fm. Candeias - Mb. Gomo
- Fm. Candeias - Mb. Tauá
- Fm. Água Grande
- Fm. Itaparica
- Fm. Sergi
- Fm. Aliança
- Fm. Afligidos
- Embasamento



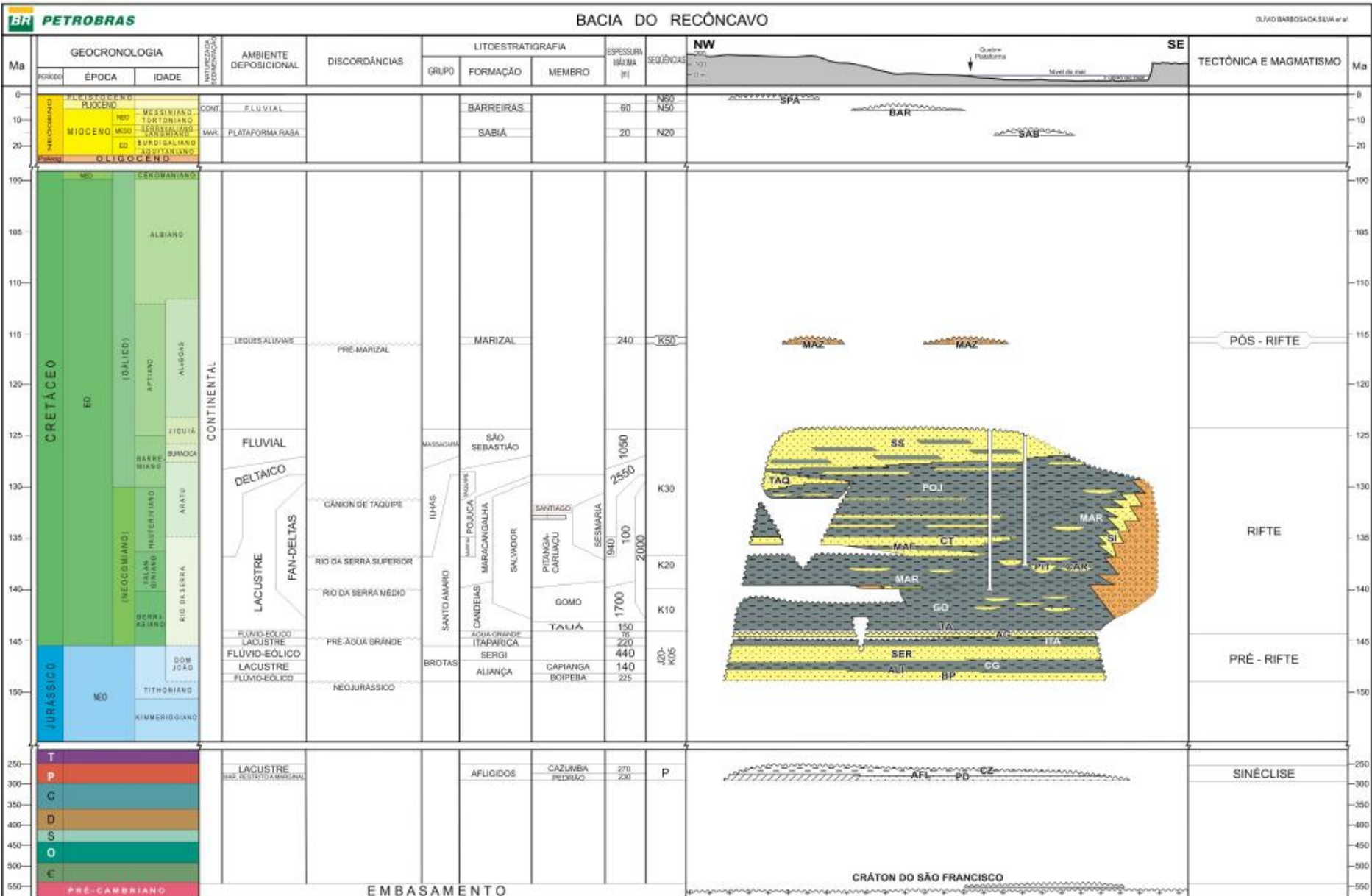
Arenitos da Fm. Sergi

$\emptyset=10-25\%$

$K=20-1200\text{ mD}$



Magnavita (2005)



Sumário

- Petróleo, condensado e gás natural
- Qualidade do petróleo (API e %S)
- Sistema petrolífero: elementos e processos