

Universidade de São Paulo  
Instituto de Geociências

# Rochas geradoras

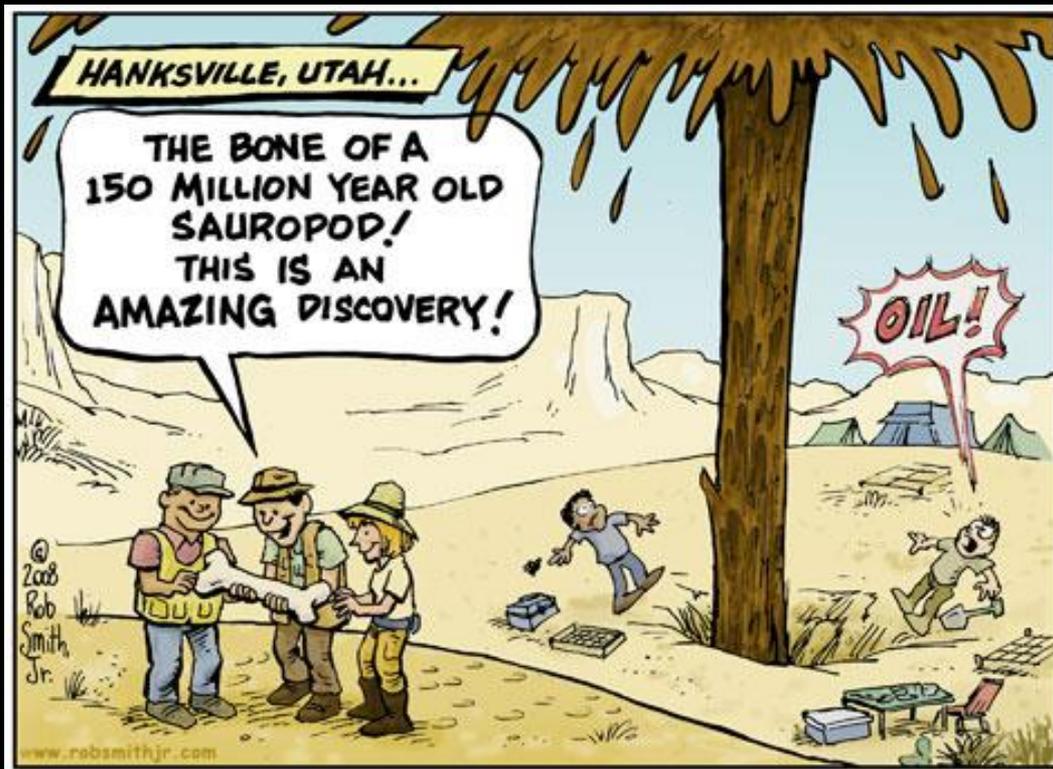
GSA0463-Geologia do Petróleo

**Folhelho negro (pelito rico em matéria orgânica, COT >1%)**



**M.O. nos sedimentos = produção - degradação**

# Qual a origem da matéria orgânica geradora de petróleo?



THE CARBON CYCLE

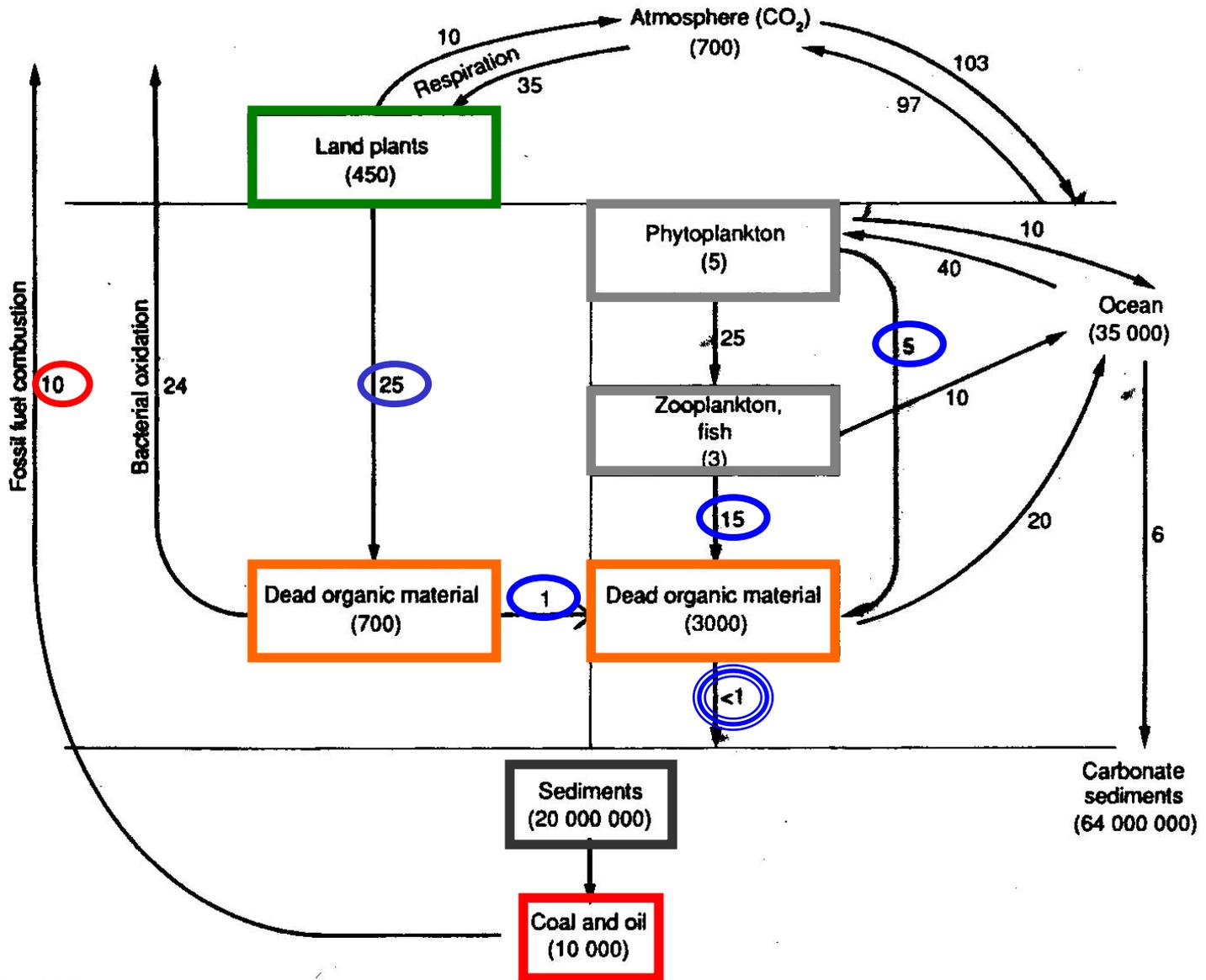
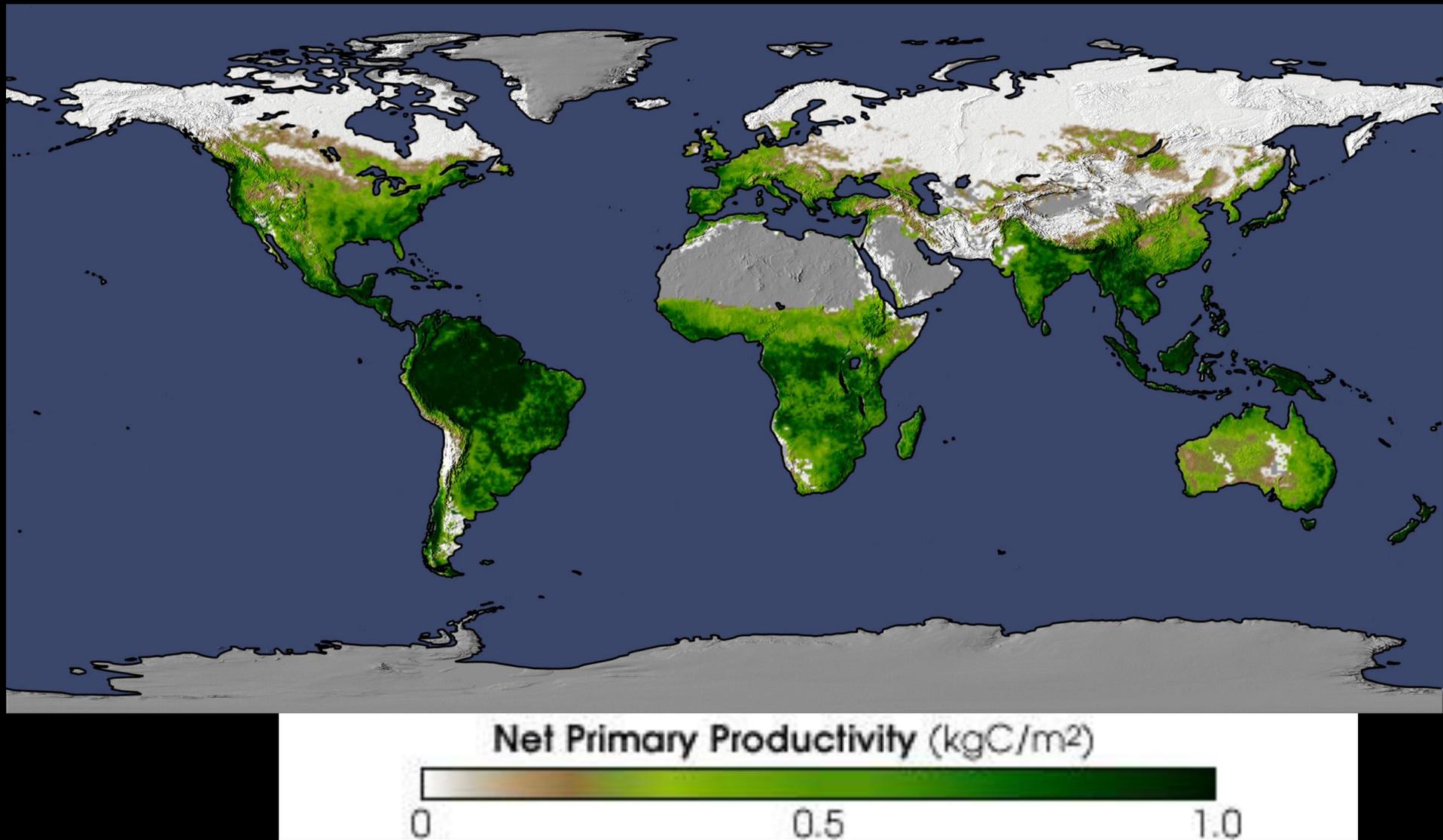
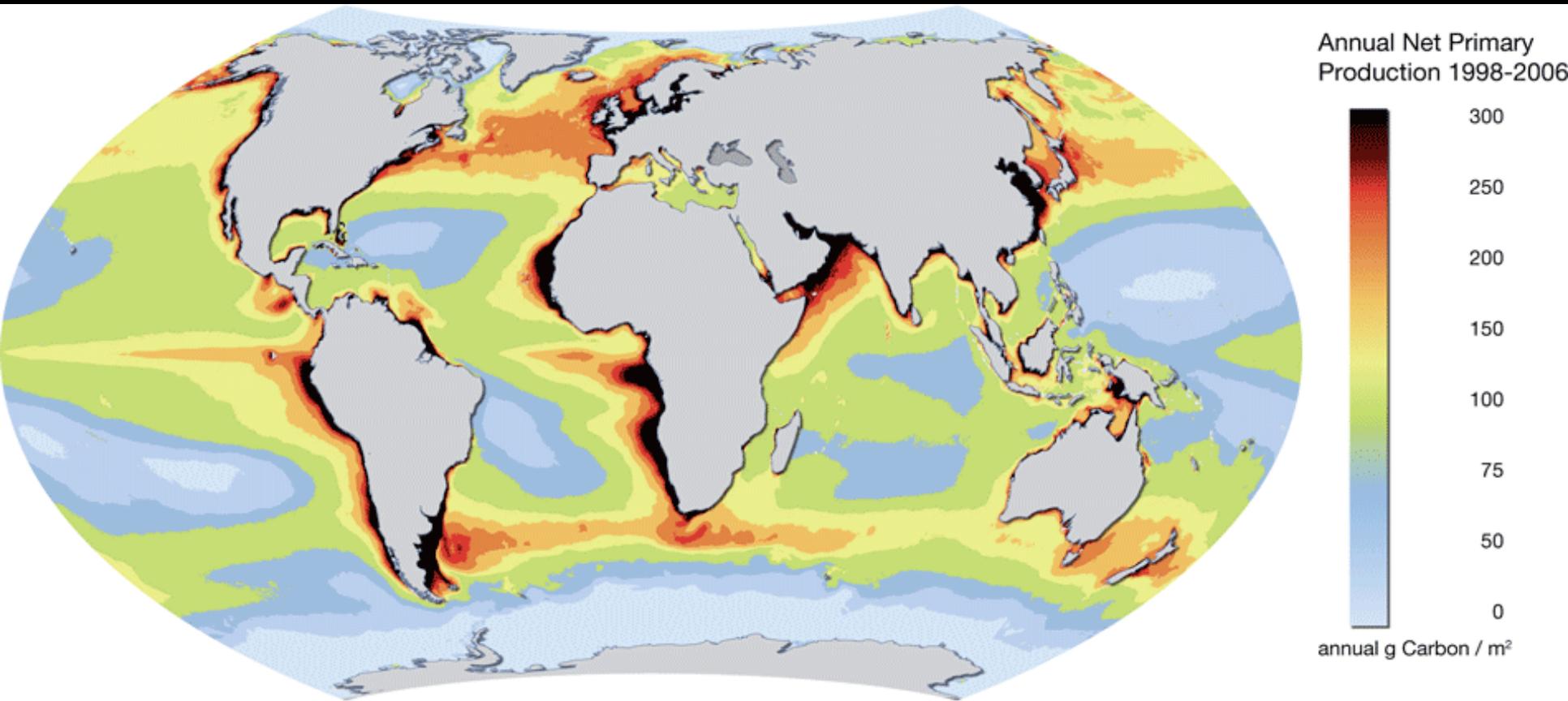


Fig. 20.1 The main elements of the carbon cycle. Numbers represent quantities in billions of metric tons. Numbers

# Produtividade orgânica terrestre



# Produtividade orgânica nos oceanos atuais



Source: Oregon State University 2007

# Composição química dos compostos orgânicos

	C	H	S	N	O
Carboidratos	44	6	-	-	50
Lignina+	63	5	0,1	0,3	31,6
Proteínas	53	7	1	17	22
Lipídios+	76	12	-	-	12
Petróleo*	85	13	1	0,5	0,5

+ Resistentes à degradação

% em peso. Hunt (1995)

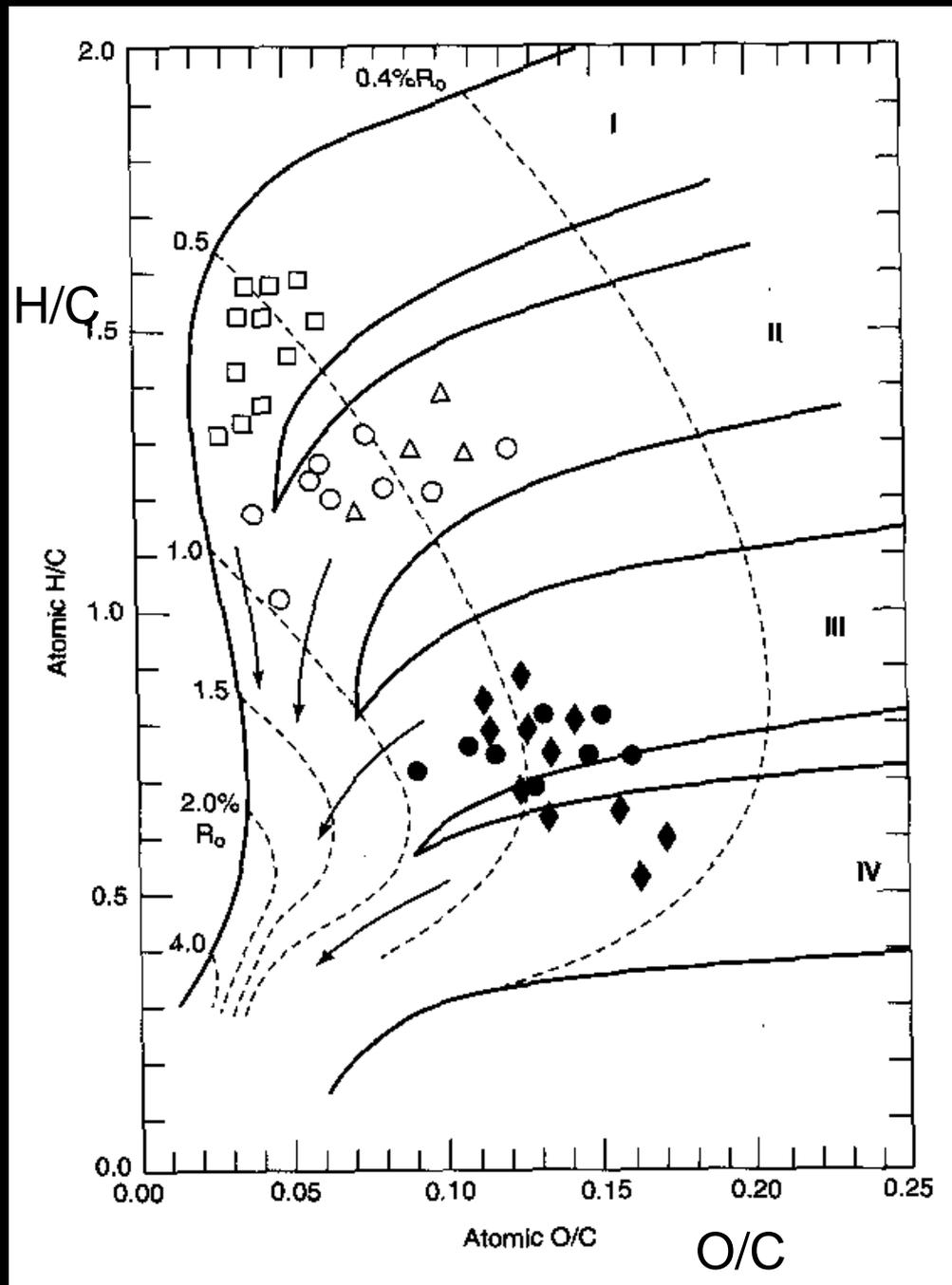
-Plantas terrestres são relativamente ricas em lignina

-Plâncton é relativamente rico em lipídios

# O que é querogênio (*kerogen*) ?

- *Querogênio: matéria orgânica disseminada nas rochas sedimentares. Apresenta elevado peso molecular e é insolúvel em solventes orgânicos (Hunt, 1995).*

# Diagrama de Van Krevelen



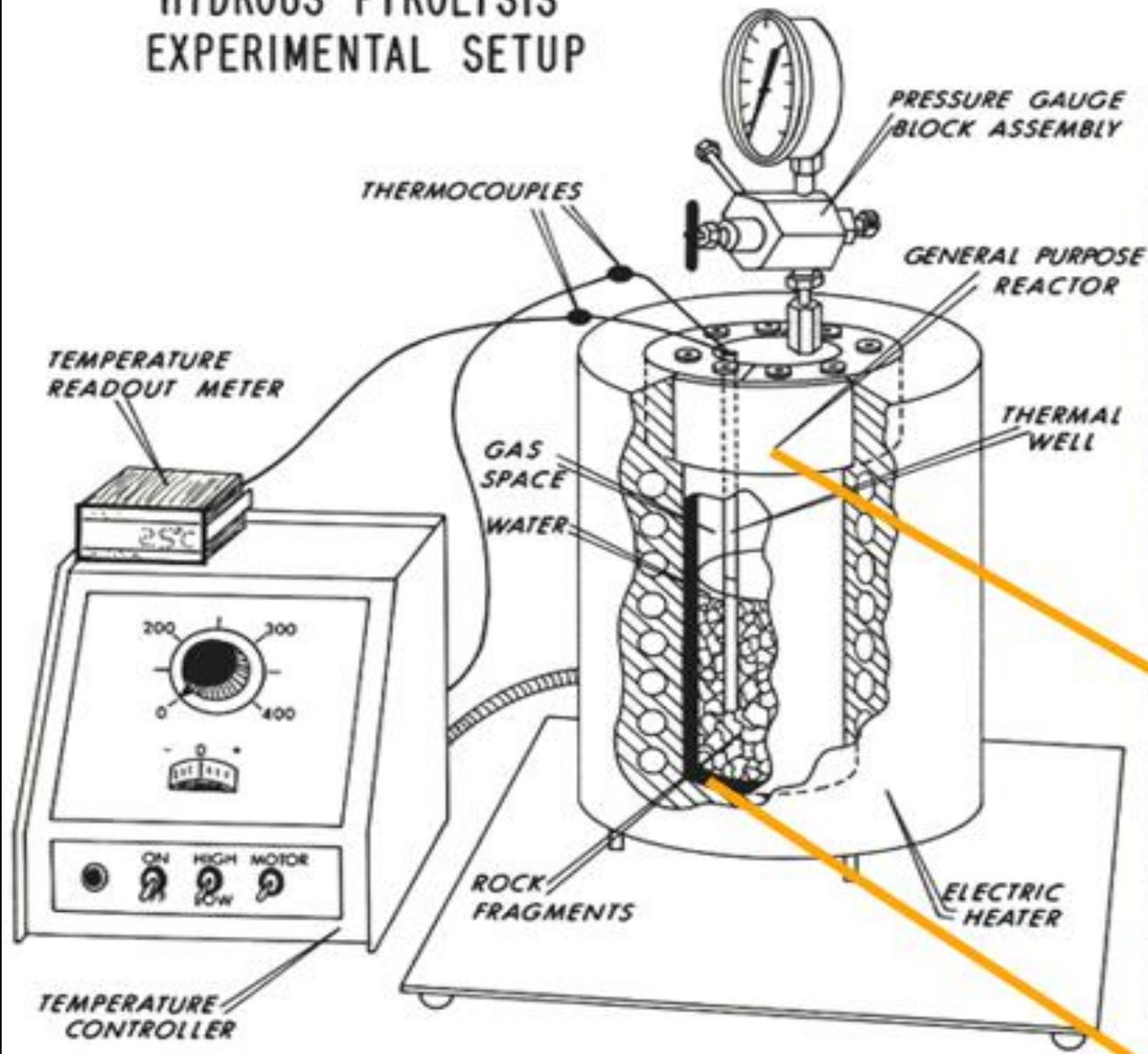
# Querogênio

- Tipo I – Matéria orgânica lacustre
- Tipo II – Matéria orgânica marinha
- Tipo III – Matéria orgânica de plantas terrestres
- Tipo IV – Matéria orgânica oxidada

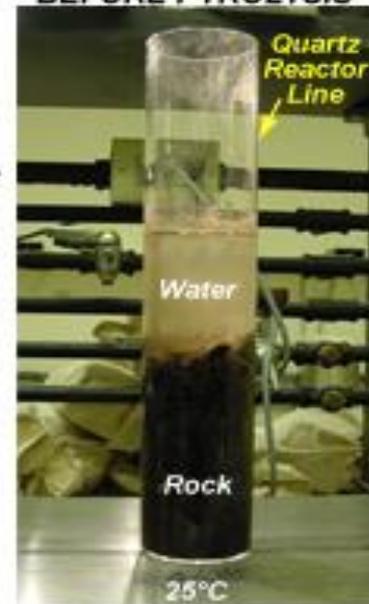
# Tipos de querogênio

Querogênio	H/C	O/C	Origem
Tipo I	1,5 a 1,8	<0,1	Lacustre
Tipo II	1,0 a 1,3	<0,15	Marinha
Tipo III	<1.0	0,2 a 0,3	Plantas terrestres
Tipo IV	<0,5		I,II ou III oxidada

# HYDROUS PYROLYSIS EXPERIMENTAL SETUP



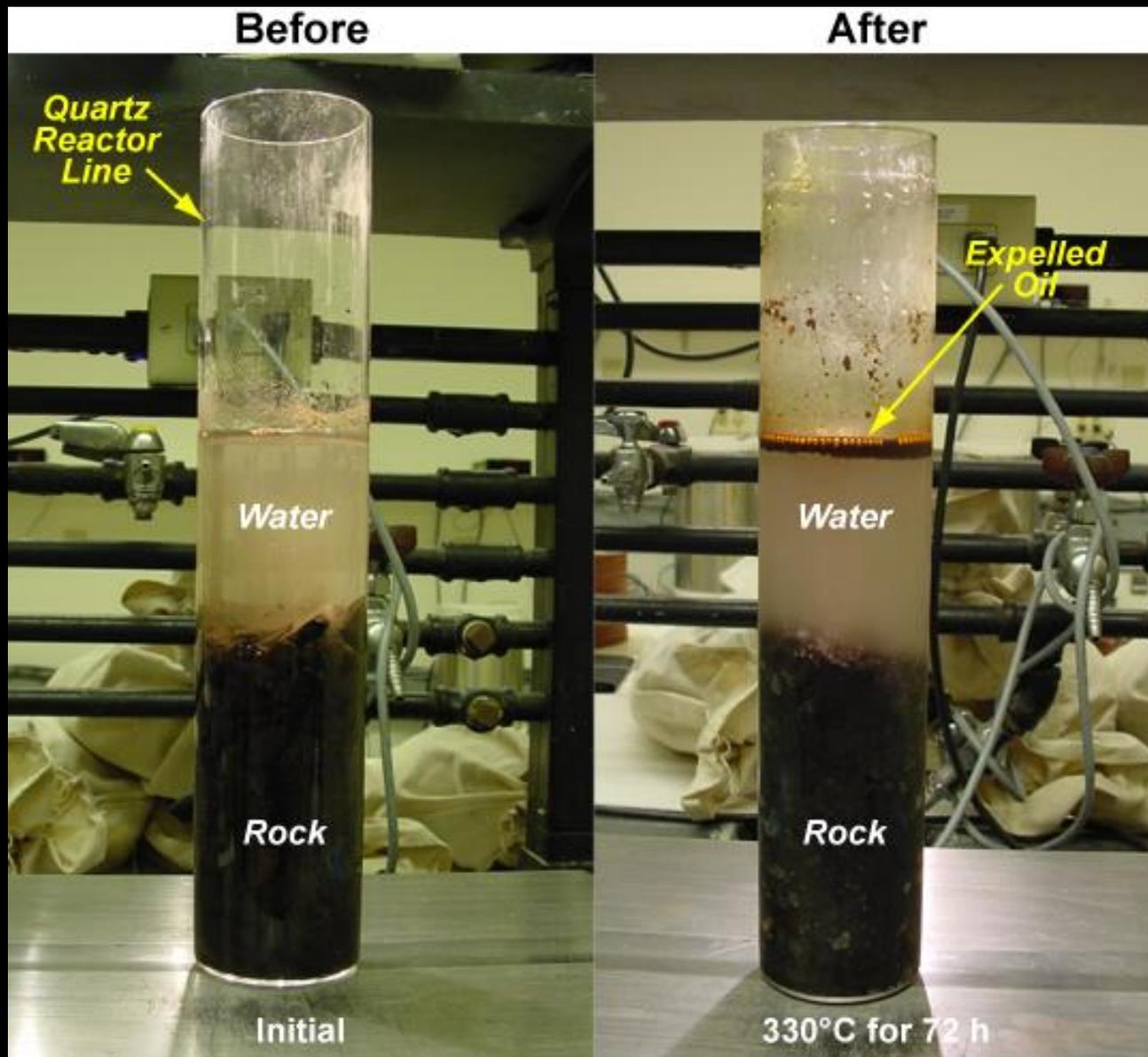
**QUARTZ LINER  
REMOVED FROM  
BEFORE PYROLYSIS**



**AFTER PYROLYSIS**

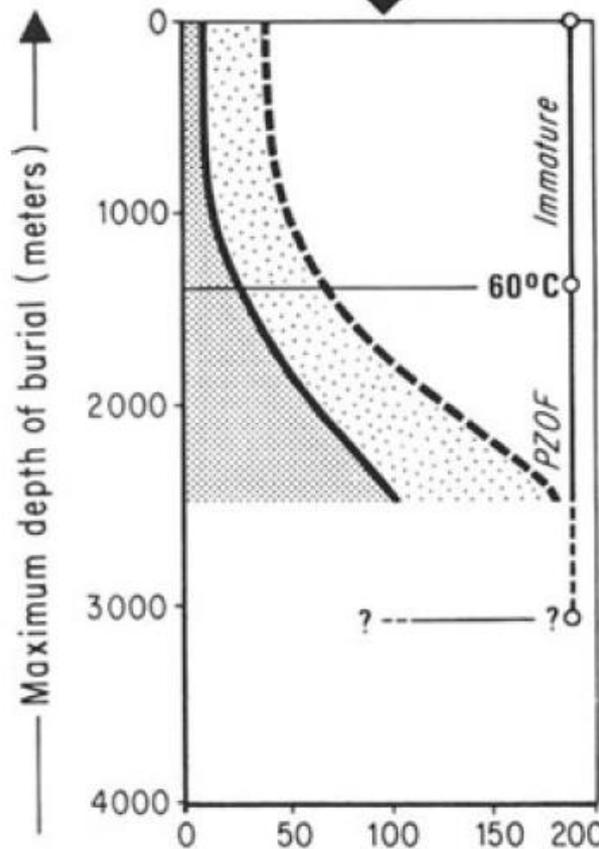


# Geração de hidrocarbonetos



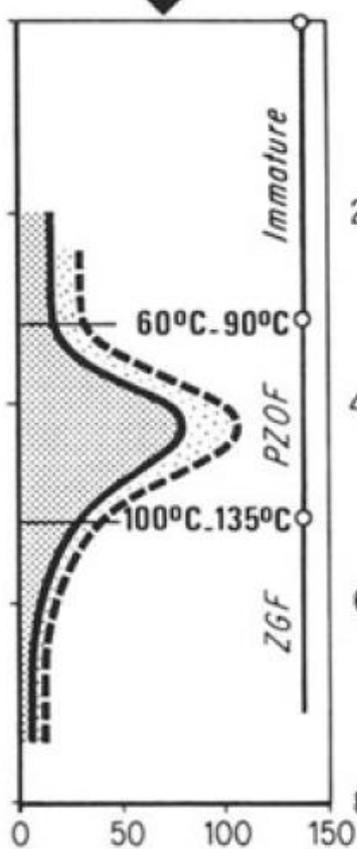
Paris Basin  
L.Toarcian

Kerogen type II



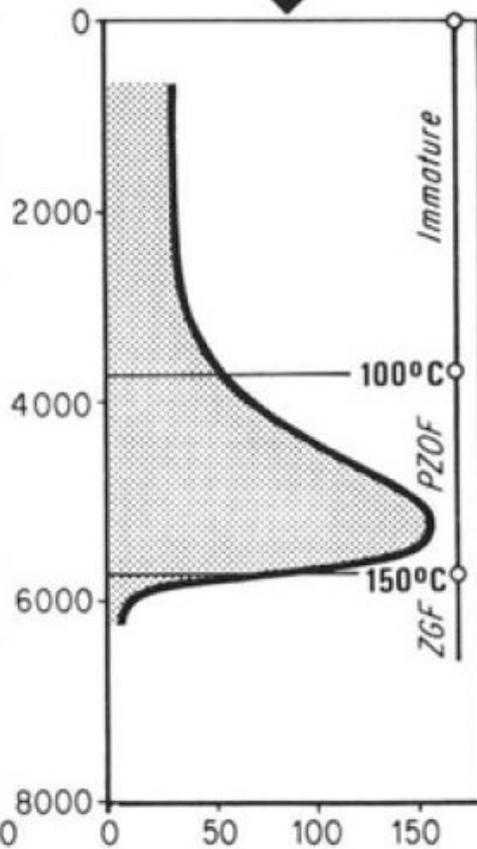
Douala Basin  
U.Cretaceous

Kerogen type III



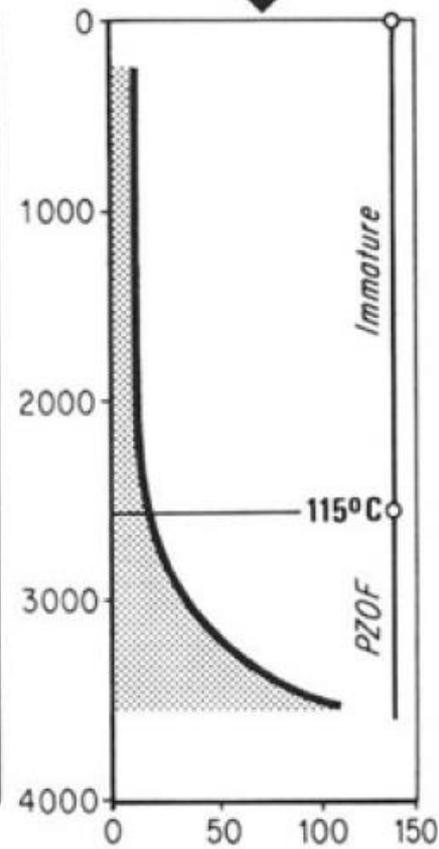
Uinta Basin  
Eocene

Kerogen type I



Los Angeles Basin  
Mio-Pliocene

( Philippi, 1965 )



▨ C15+ hydrocarbons  
▨ non hydrocarbons (resins + asphaltenes)

# Energia de ativação (Ea)

<i>Kerogens</i>			<i>Standard samples</i>			
<i>Type</i>	<i>Reaction rate</i>	<i>Source</i>	<i>E (kJ/mol)</i>	<i>A (1/m.y.)</i>	<i>S<sub>org</sub> (wt%)</i>	<i>Atomic S/C</i>
IA	Fast	Green R., CO <sup>a</sup>	194	$1.01 \times 10^{25}$	2.2	0.011
IB	Medium	Green R., UT <sup>b</sup>	219	$8.87 \times 10^{26}$	1.3	0.007
IC	Slow	Green R., WY <sup>c</sup>	269	$7.48 \times 10^{30}$	1.4	0.007
IIA (II-S)	Fast	Monterey <sup>d</sup>	143.5	$7.017 \times 10^{20}$	11	0.055
IIB (II-S)	Medium-fast	Phosphoria <sup>e</sup>	178.7	$4.223 \times 10^{23}$	9	0.045
IIC	Medium	Alum <sup>f</sup>	201.3	$1.546 \times 10^{25}$	7.4	0.036
IID	Slow	Woodford <sup>g</sup>	218.3	$5.656 \times 10^{26}$	5.4	0.024
III	Medium	Tent Island, Canada <sup>g</sup>	230	$3.98 \times 10^{27}$		

Sources: <sup>a</sup>Yang and Sohn 1984, <sup>b</sup>Sweeney et al. 1987, <sup>c</sup>Miknis and Turner 1988, <sup>d</sup>Lewan 1989, <sup>e</sup>Lewan 1985, <sup>f</sup>Lewan and Buchardt 1989, <sup>g</sup>Issler and Snowdon 1990.

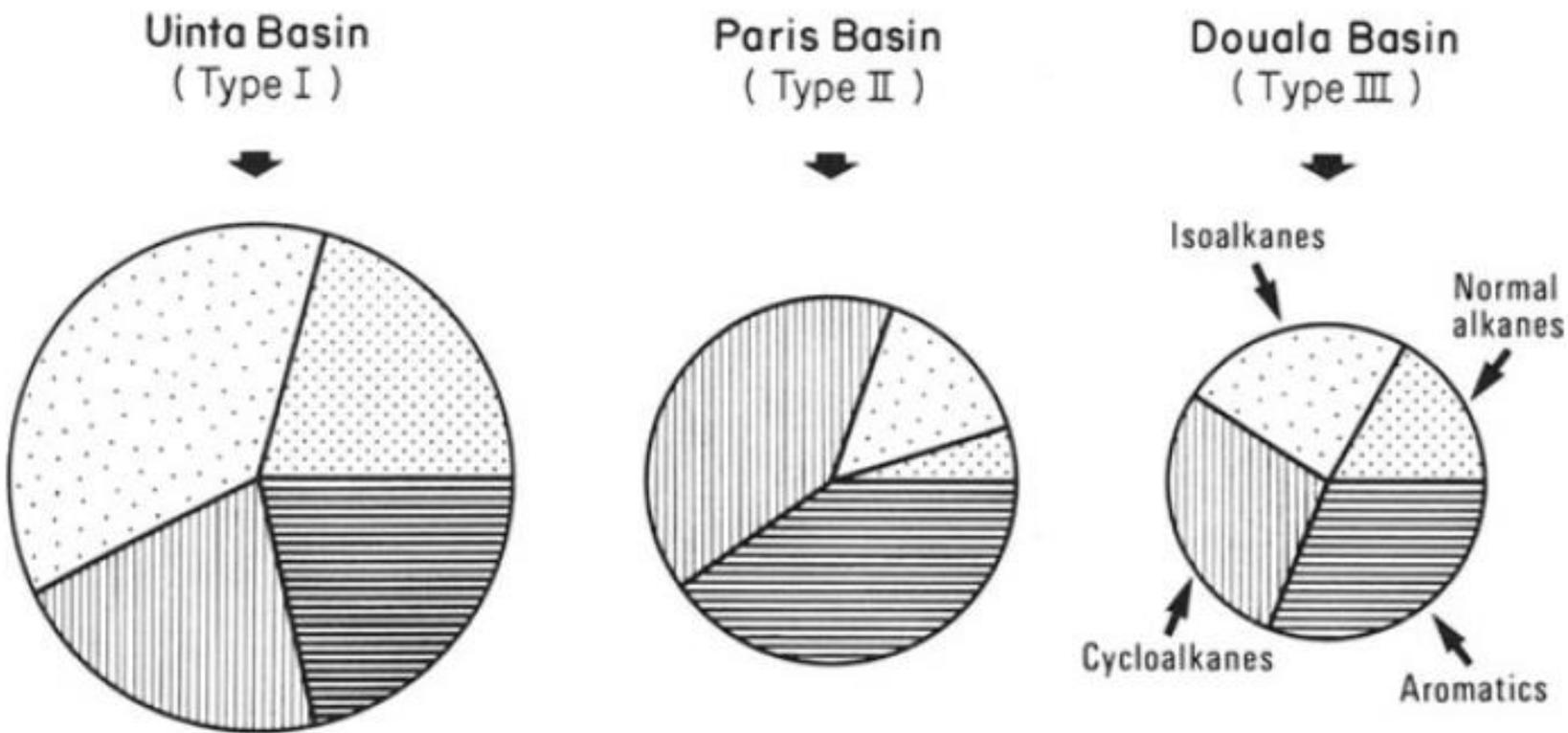
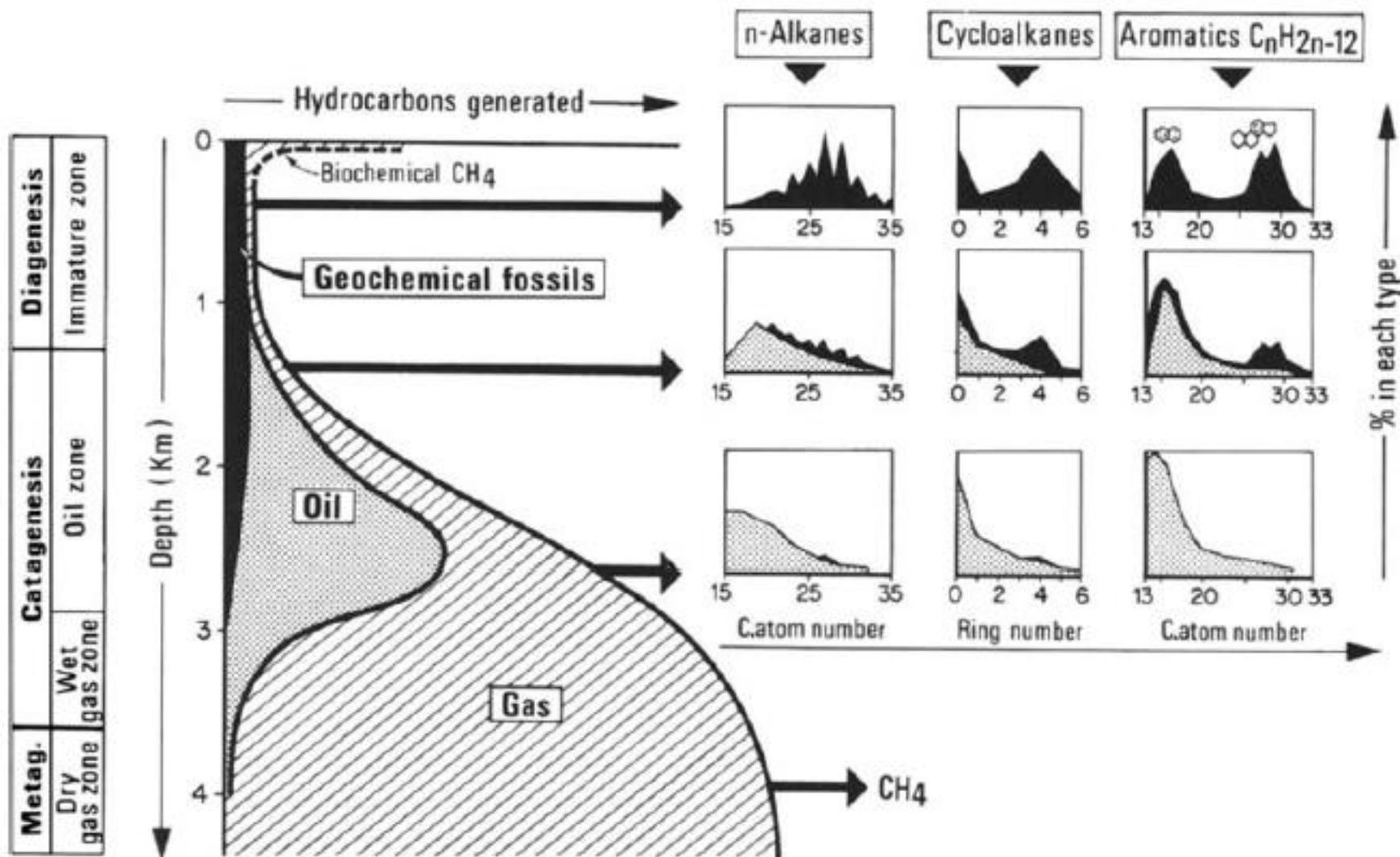


Fig. II.5.15. Compositions of hydrocarbons generated from the three main types of kerogen at the depth of maximum oil formation. Areas are proportional to the respective amount of each hydrocarbon class per g organic carbon

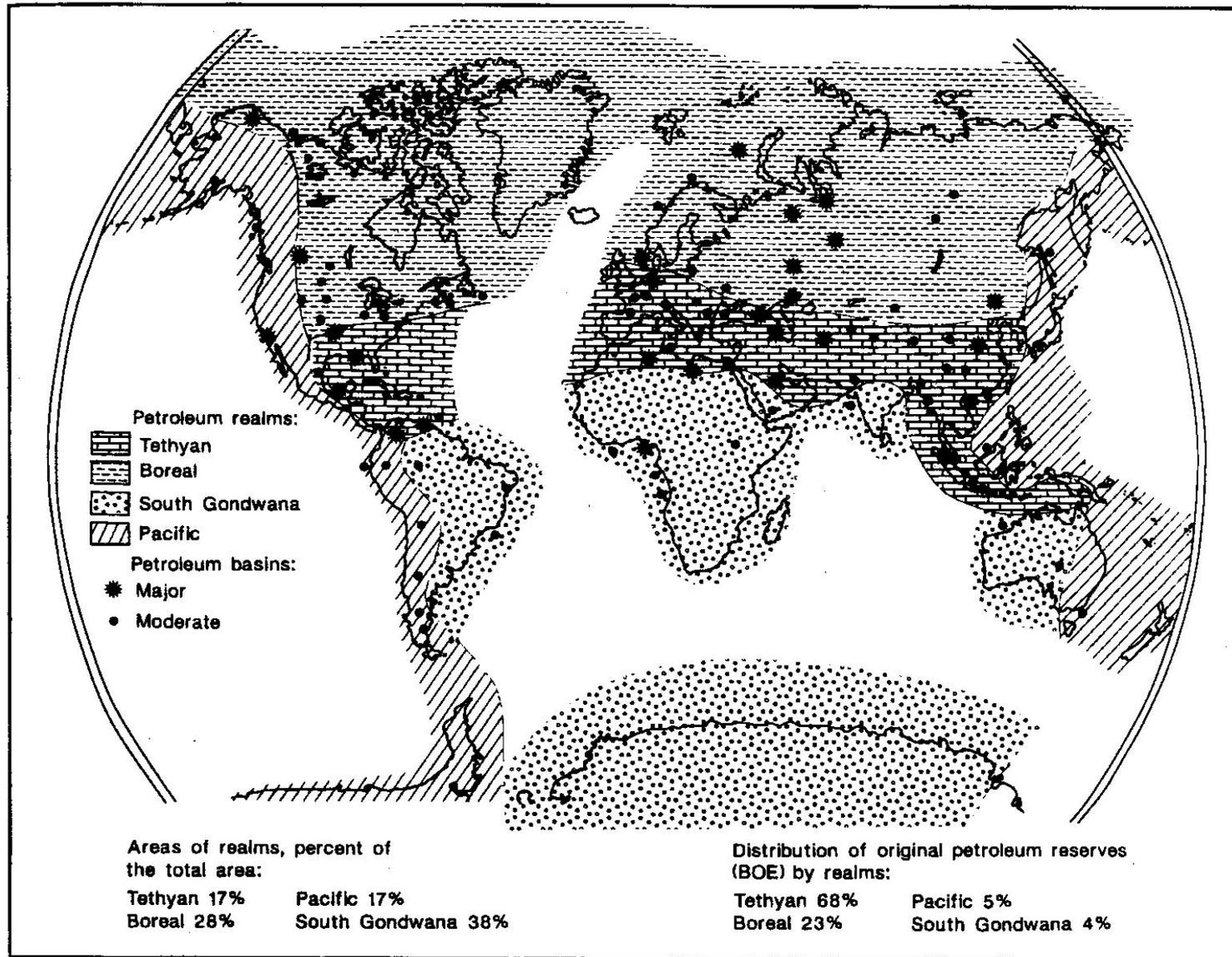
# Geração de hidrocarbonetos em bacias sedimentares



# Sumário

- Tipos de querogênio
- Fatores que controlam a transformação do querogênio em hidrocarbonetos
- Zonas de geração de hidrocarbonetos

# Distribuição geográfica das rochas geradoras efetivas



# Oceano Tethys



MAP KEY	Ancient landmass	Modern landmass	Ice caps & glaciers	Subduction zone (▼ direction of subduction)	Sea floor spreading ridge

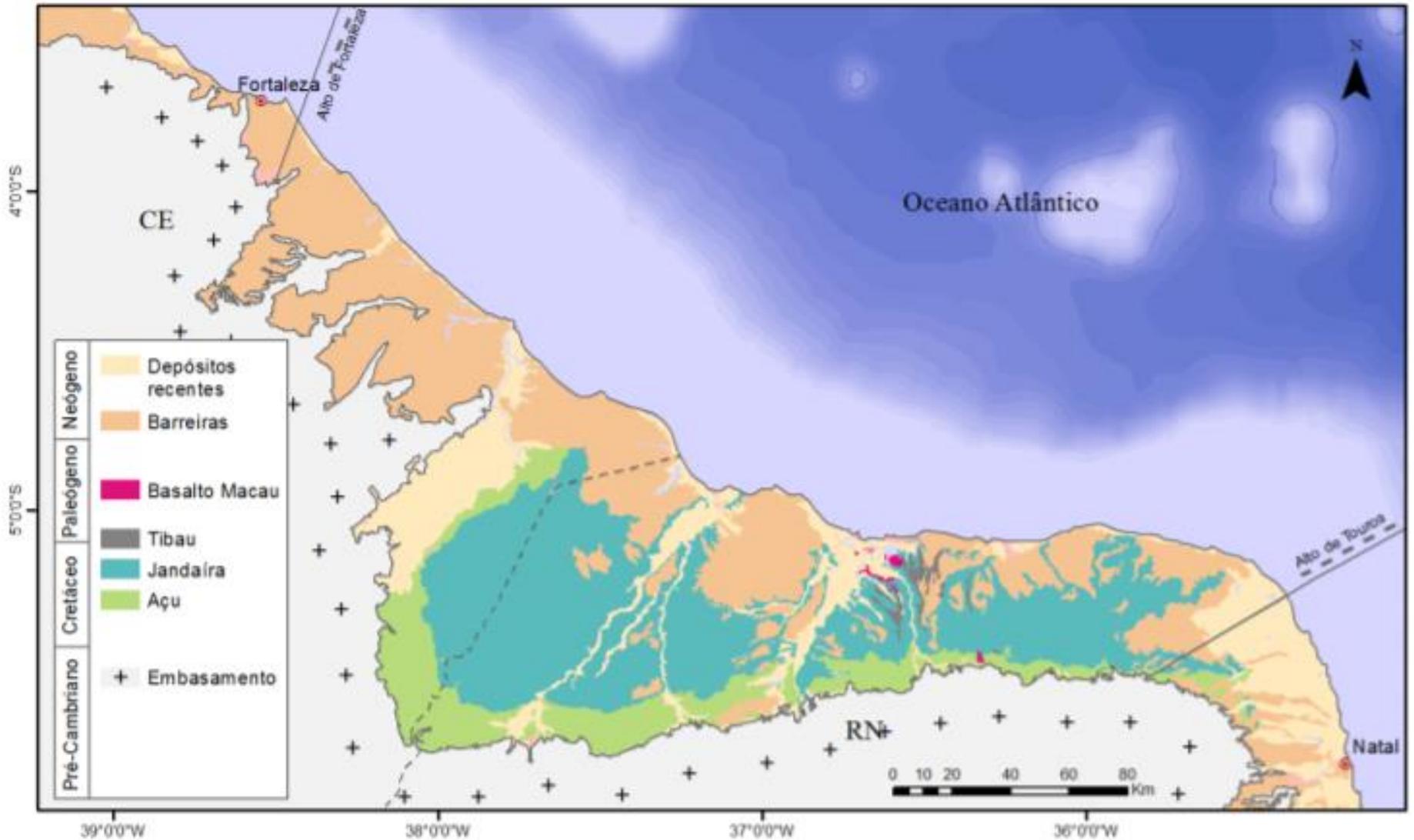
Late Cretaceous 94 Ma

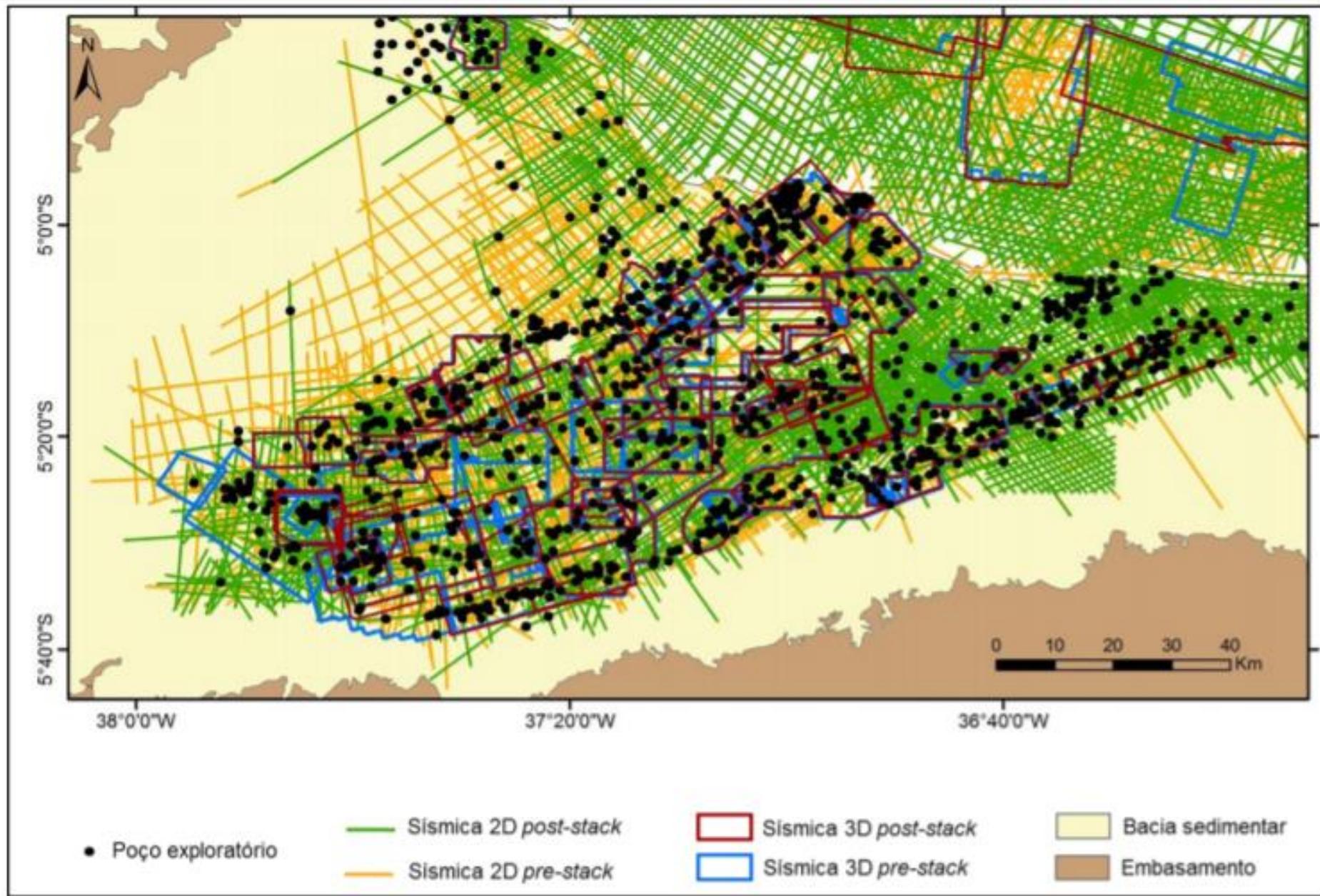


Ancient Landmasses   
Modern Landmasses   
Subduction Zone (triangles point in the direction of subduction) 

Paleomap Project (Scotese, 2003)

# Bacia Potiguar





# Bacia Potiguar - Sistema petrolífero Pendência-Açu

