A Geologia da Terra

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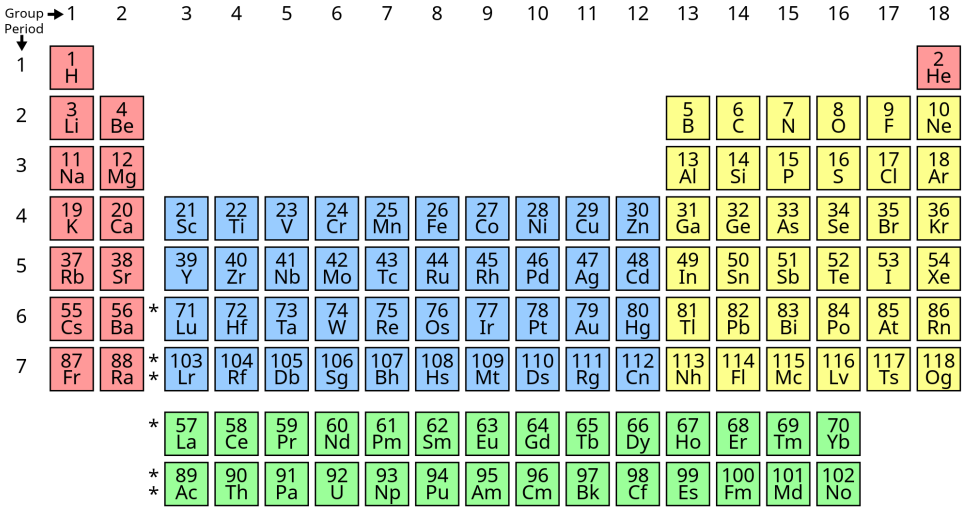
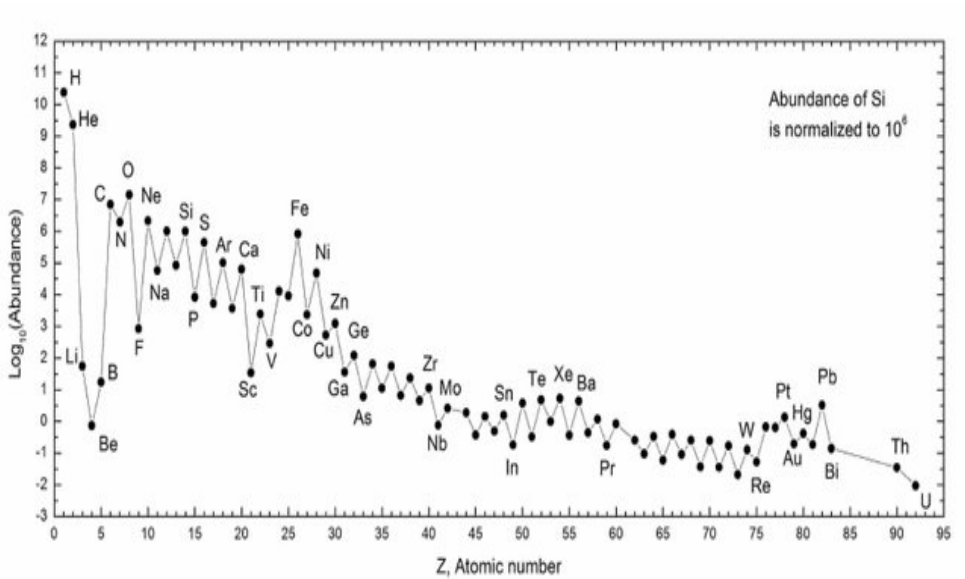
25 de Fevereiro de 2021

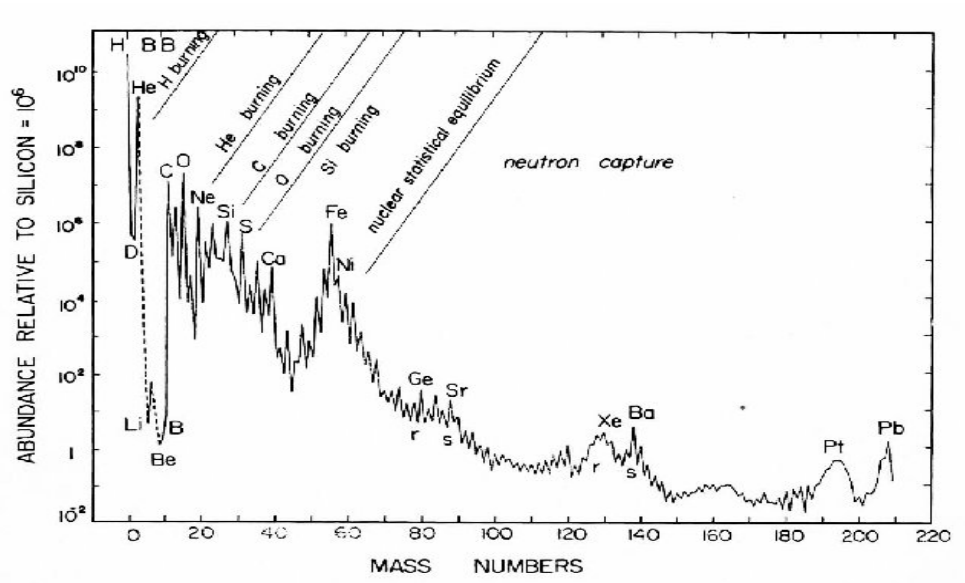
De onde vêm os planetas? Os elementos *a priori*



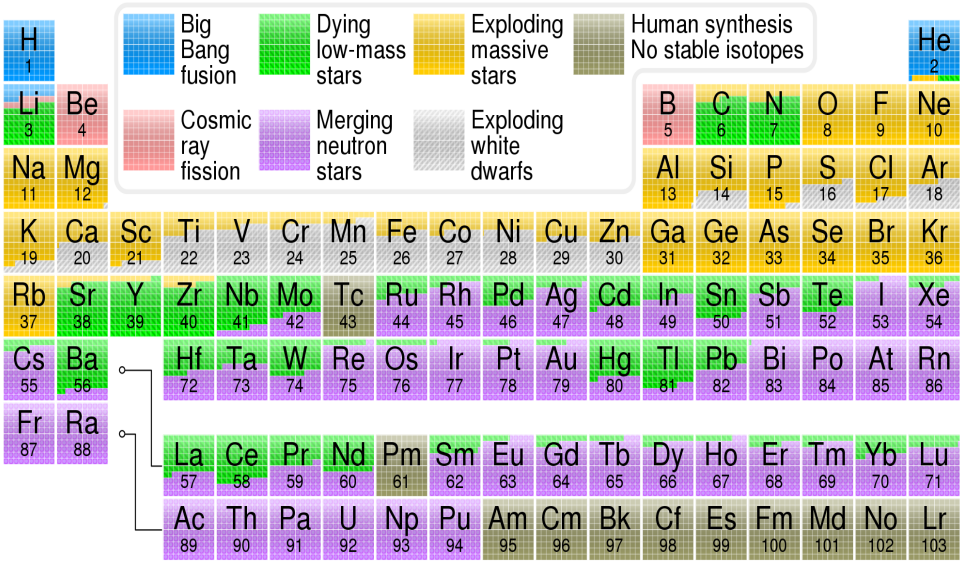
De onde vêm os planetas? Nosso Sistema Solar



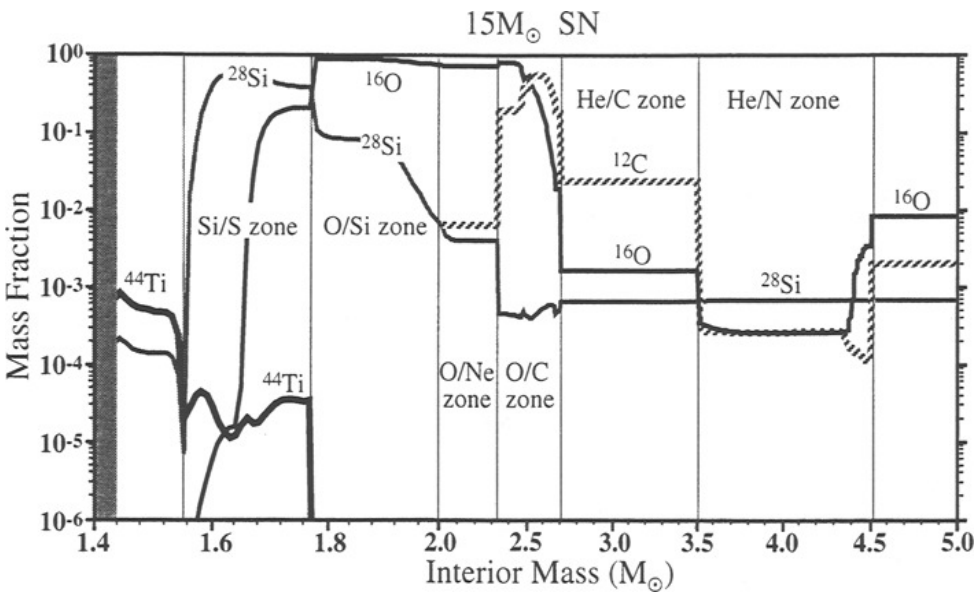
De onde vêm os planetas? Nosso Sistema Solar



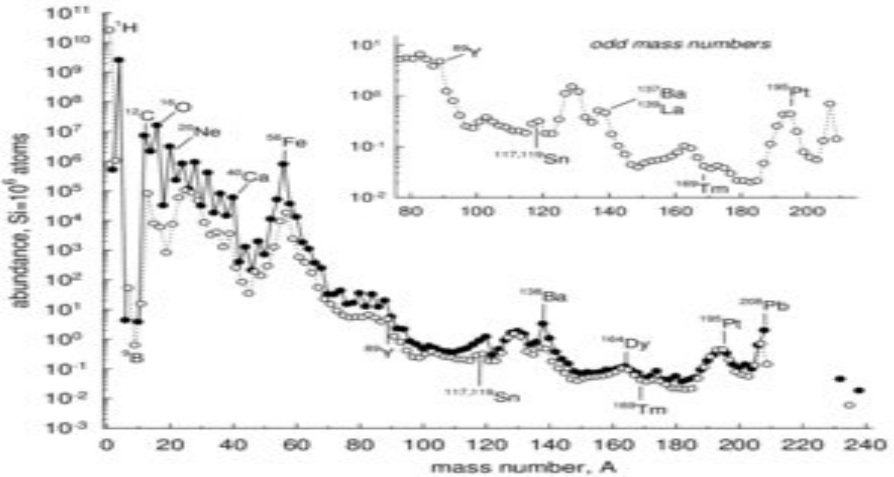
De onde vêm os planetas? Da Evolução Estelar



De onde vêm os planetas? Da Evolução Estelar



De onde vêm os planetas? Da Evolução Estelar

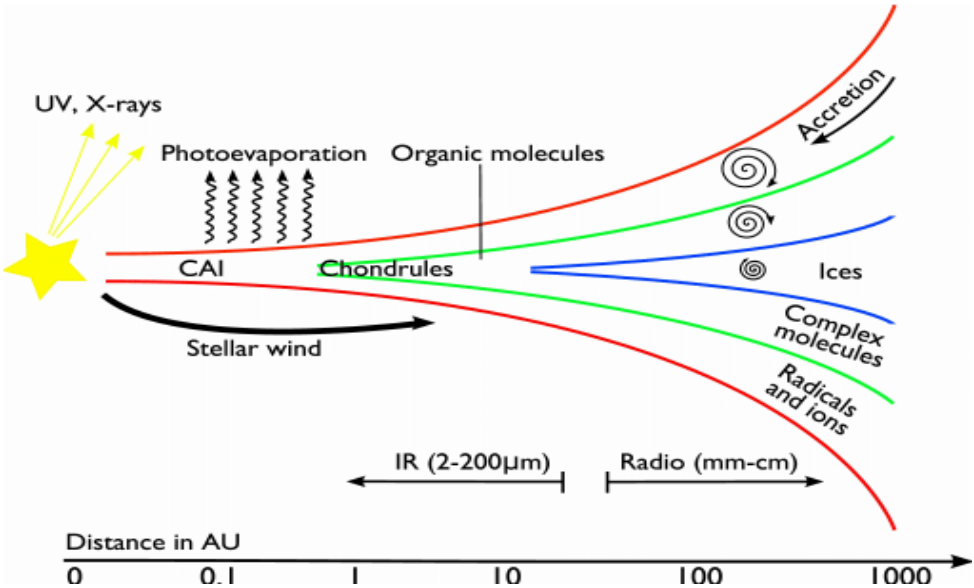


Materiais Presolares

H	25900000000
He	2510000000
C	7190000
N	2120000
O	15700000
F	804
Na	57700
Mg	1030000
Al	84600
Si	1000000
S	421000
Ca	60400
Fe	848000

Gases (primários)	H_2O, NH_3, CH_4
Gases (secundários)	CO, CO_2, NO, ...
Sólidos	diamante, C
	SiC, Si_3N_4
	Al_2O_3
	olivinas e piroxenes

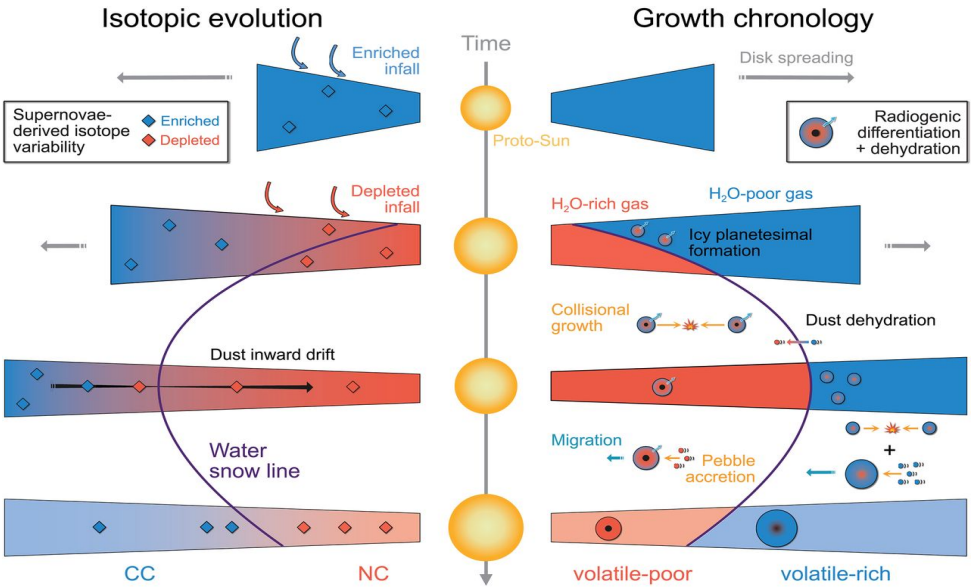
Formação do Sistema Solar



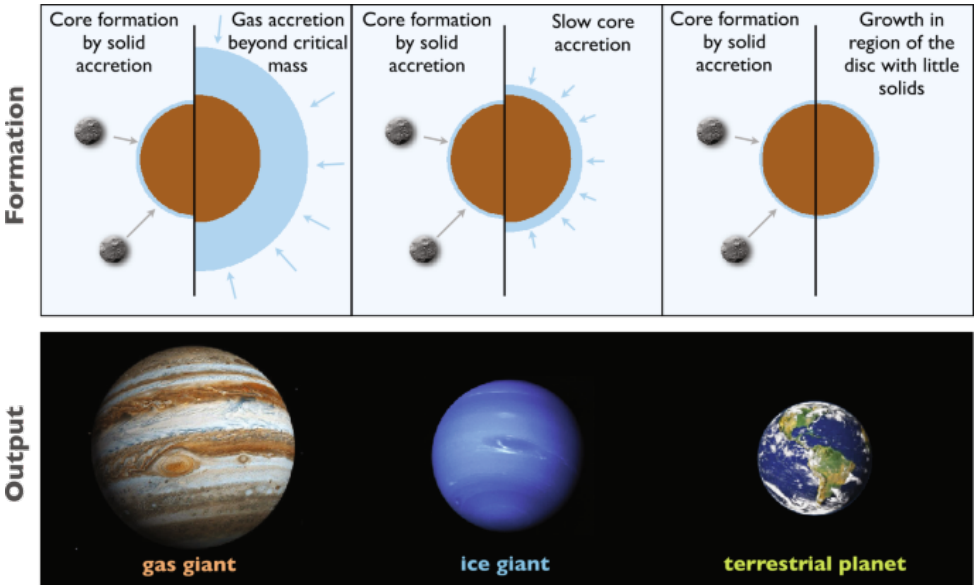
Evolução Mineralógica

$>$	4,6	Minerais de Ur: C, SiC, Si_3N_4, Al_2O_3, silicatos
$\approx$	4,56	mais haxonite
$\approx$	4,55	mais dolomita, calcita, magnesita, ...

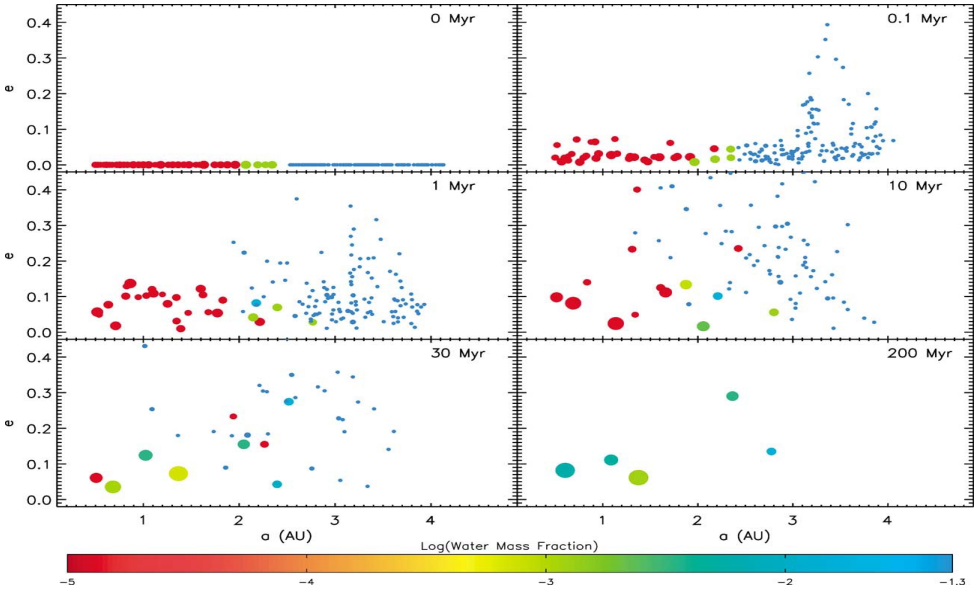
Formação de Planetas: Evolução Colisional



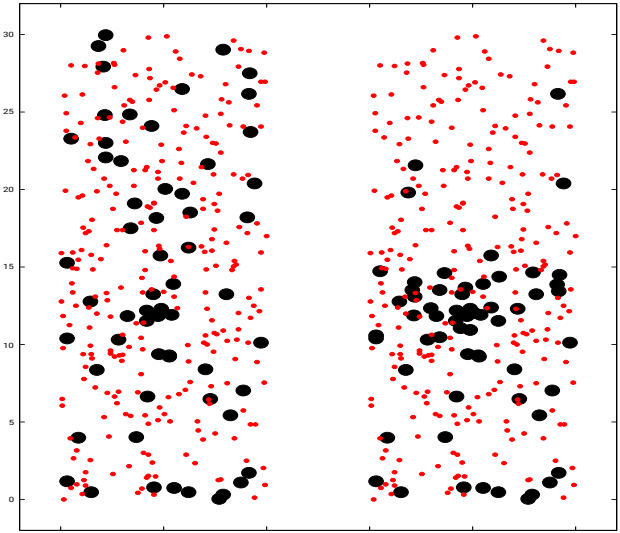
Formação do Sistema Solar



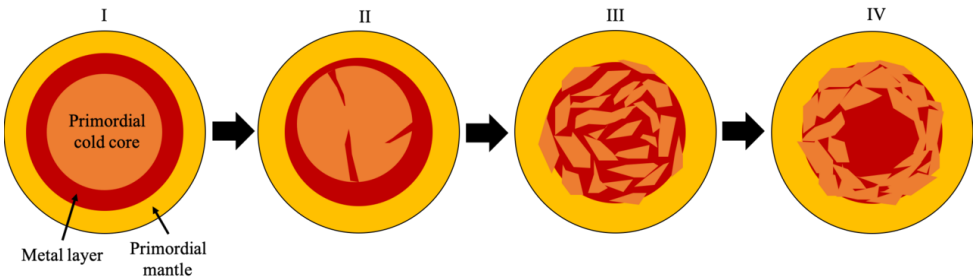
Formação de Planetas: Evolução Colisional



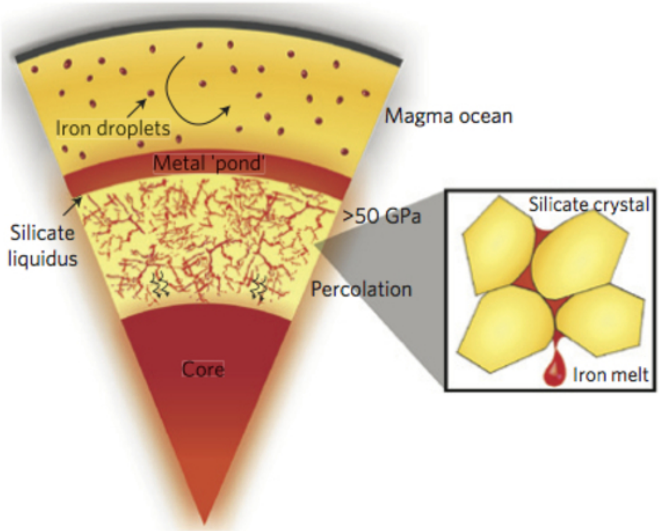
Formação de Planetas: Diferenciação Cinemática



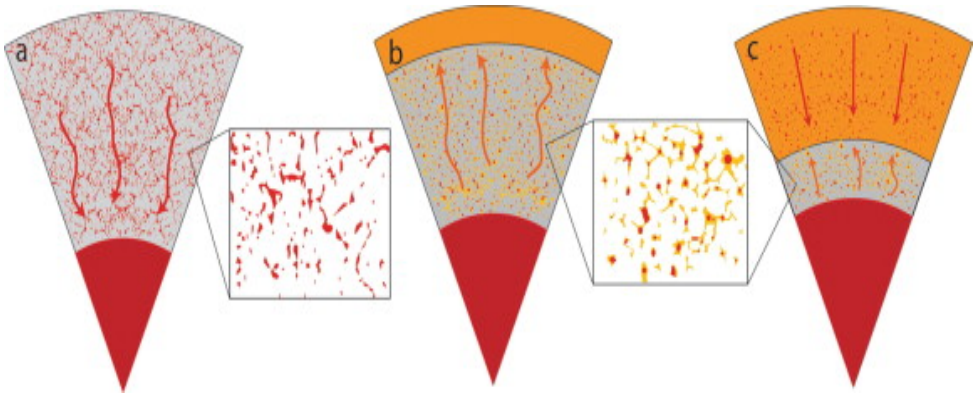
Formação do Núcleo Primitivo



Formação do Núcleo: Chuva Metálica



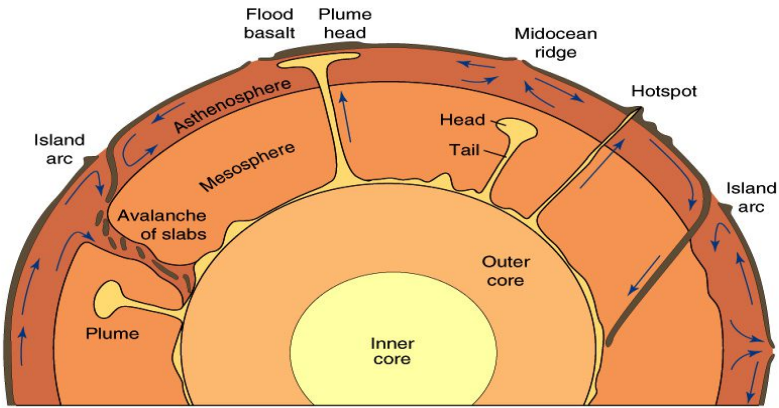
Formação do Núcleo: Chuva Metálica



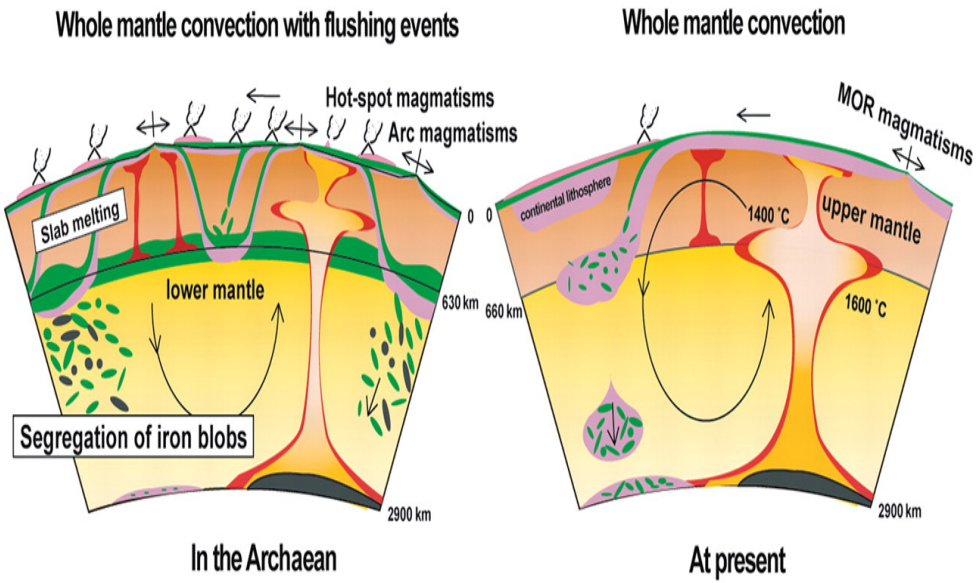
Evolução Mineralógica

$>$	4,6		Minerais de Ur: C, SiC, Si_3N_4, Al_2O_3, silicatos
$\approx$	4,56		mais haxonite
$\approx$	4,55		mais dolomita, calcita, magnesita, ...
	4,55	4,0	Evolução de rochas Igneas
	4,0	3,5	Granitização e pegmatites

Convecting materials in the Earth's mantle originate deep, near the core-mantle boundary



Tectonismo & Magmatismo



Tectonismo & Magmatismo: Outros Planetas

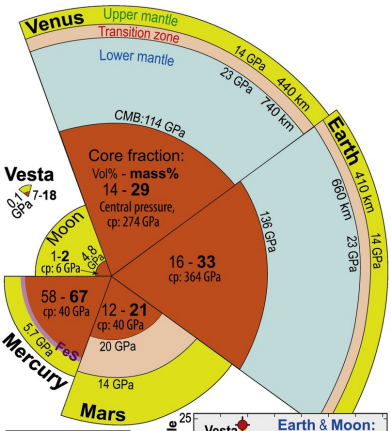


Table 2: Compositional references

Other key references

Khan et al. 2018
Steinberger et al. 2010
Russell et al. 2012
Aitta, 2012
Garcia et al. 2012
Hauck et al. 2013

Evolução Mineralógica

$>$	4,6		Minerais de Ur: C, SiC, Si_3N_4, Al_2O_3, silicatos
$\approx$	4,56		mais haxonite
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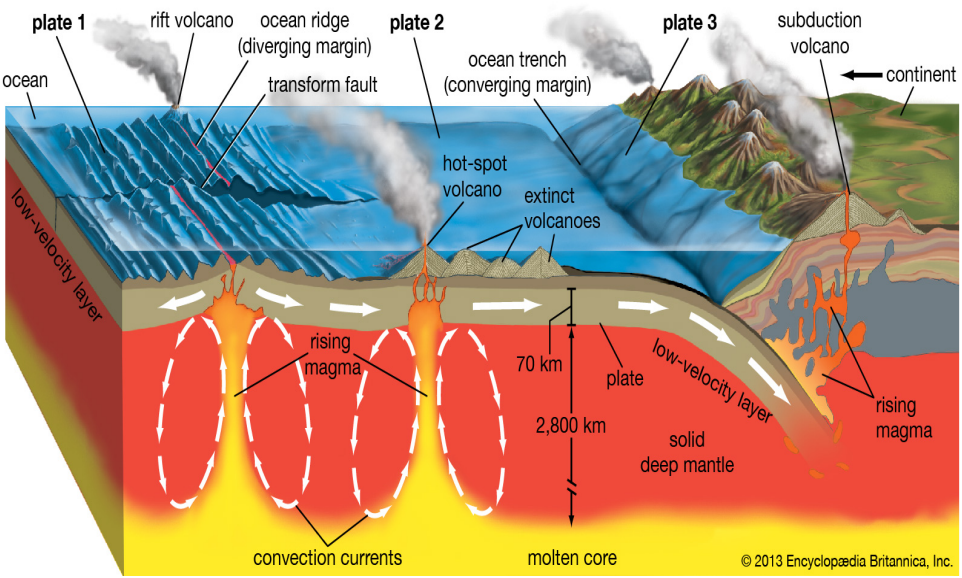
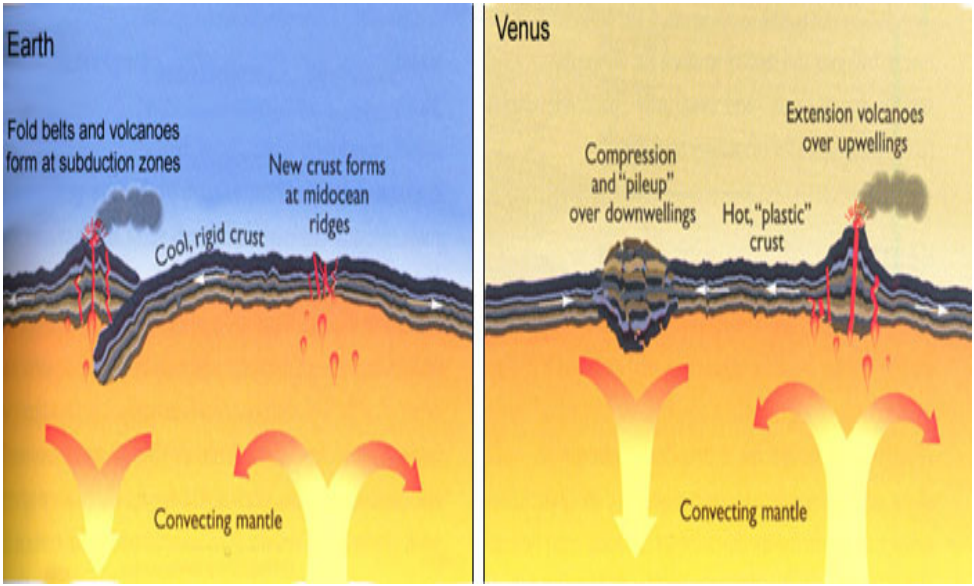
	4,55	4,0	Evolução de rochas Igneas
	4,0	3,5	Granitização e pegmatites
$>$	3,0		Placas Tectônicas: hidratos de metano

Placas Tectônicas

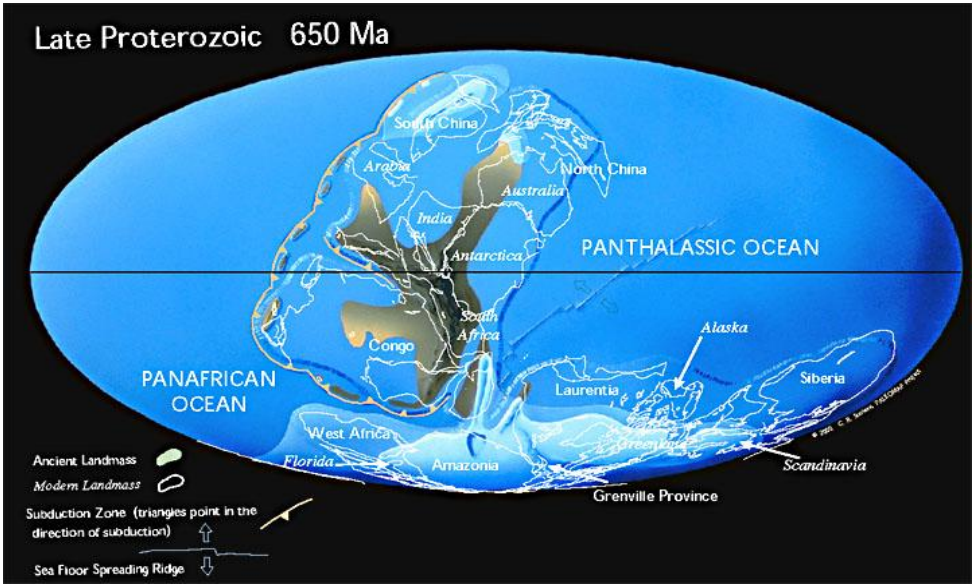
Placas Tectônicas: Subducção, Rifting



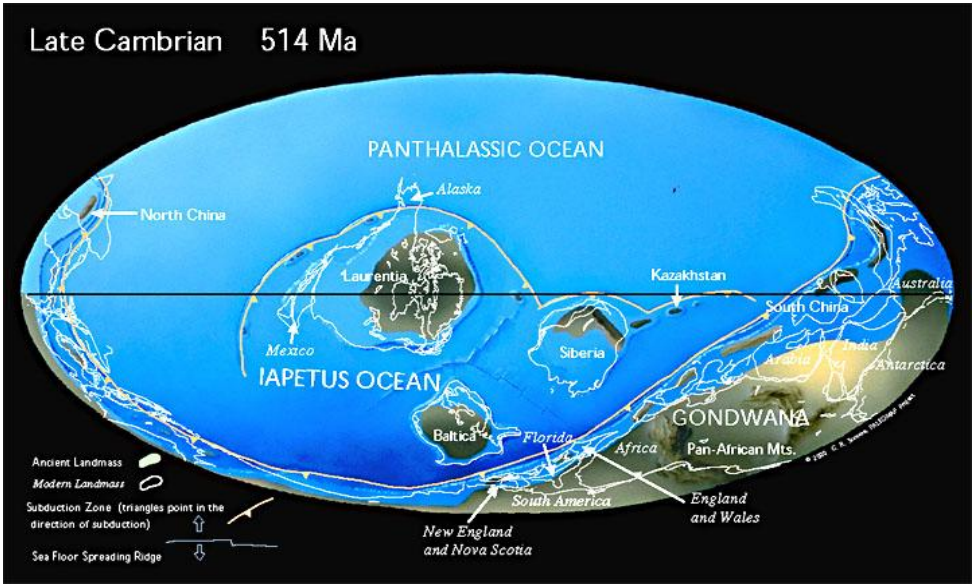
Placas Tectônicas: Terra & Vênus



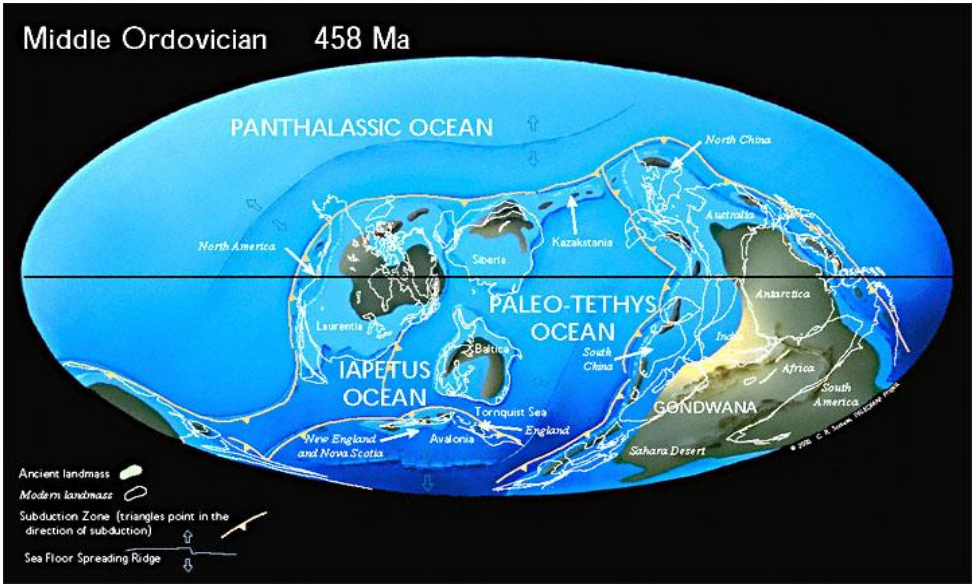
Evolução da Superfície: 650Ma



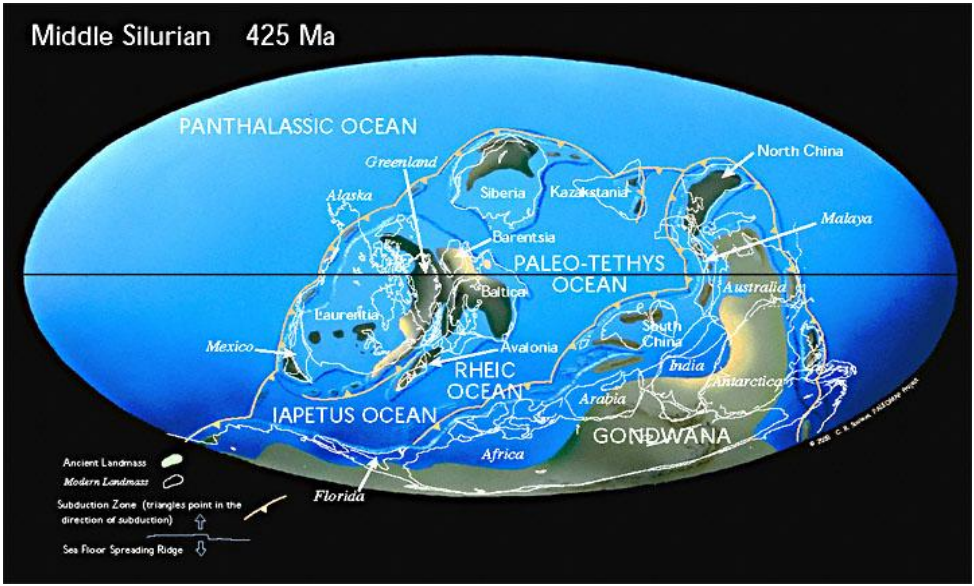
Evolução da Superfície: 514Ma



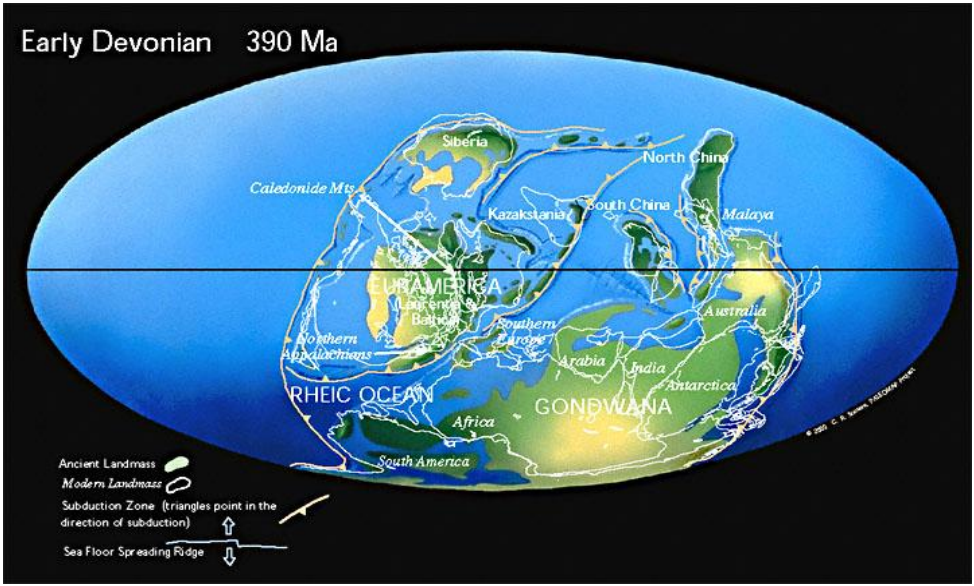
Evolução da Superfície: 458Ma



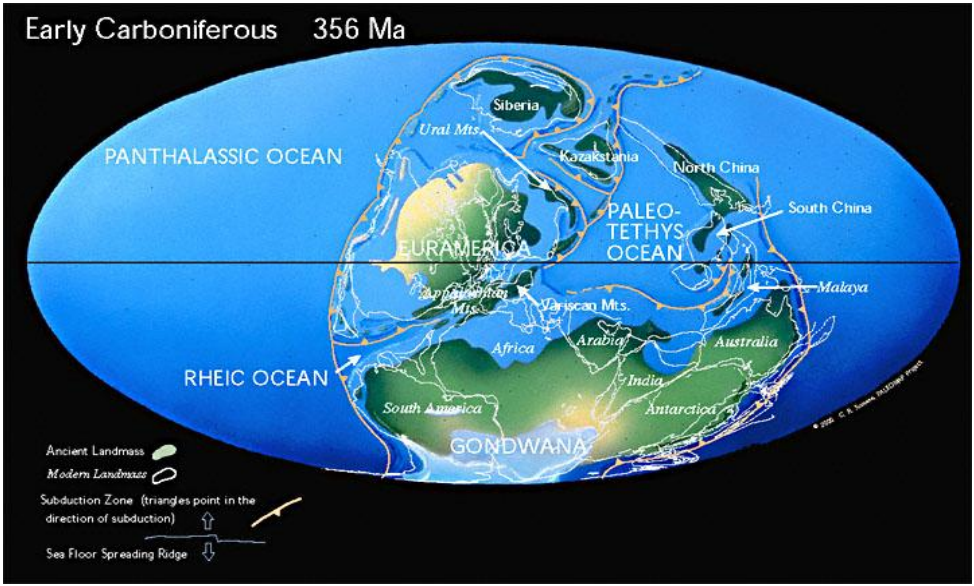
Evolução da Superfície: 425Ma



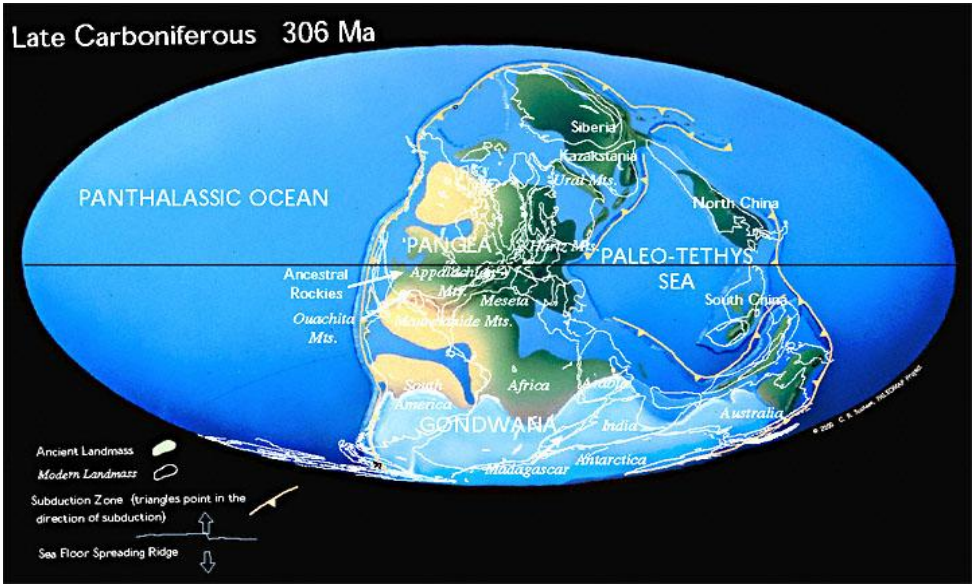
Evolução da Superfície: 390Ma



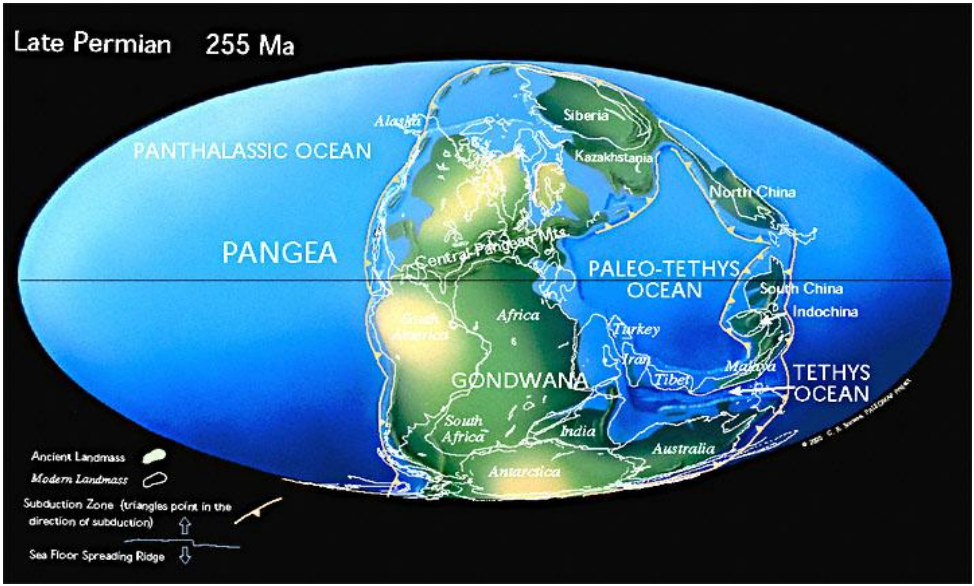
Evolução da Superfície: 342Ma



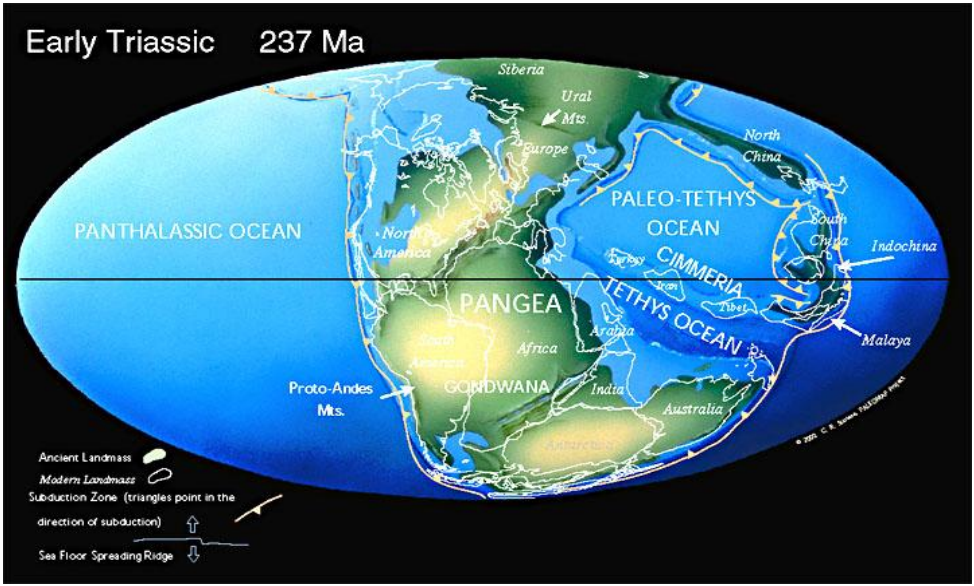
Evolução da Superfície: 306Ma



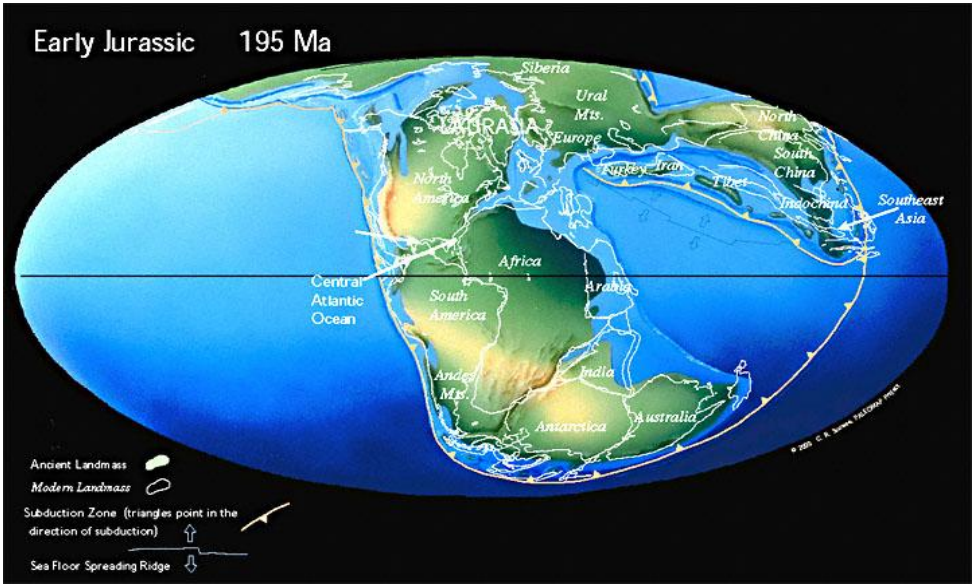
Evolução da Superfície: 255Ma



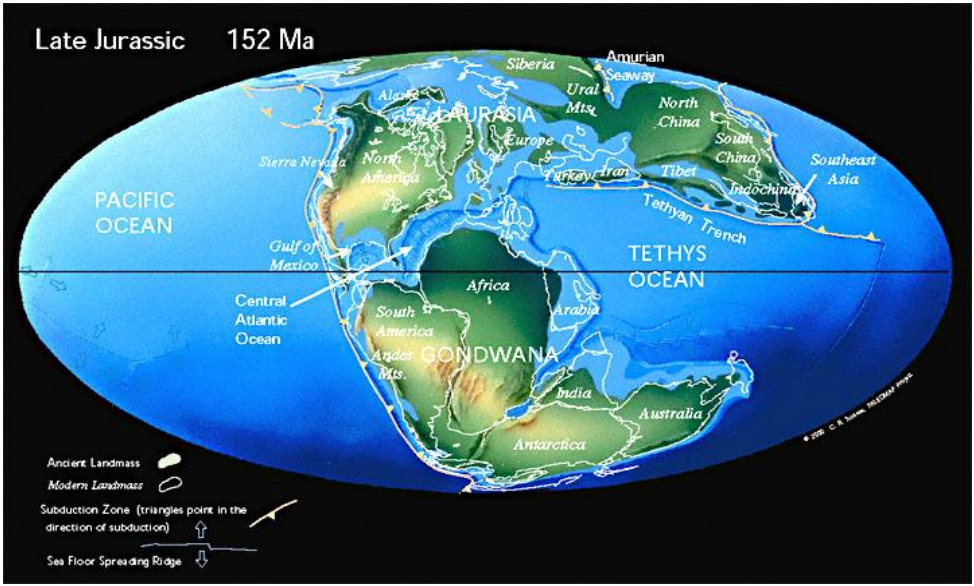
Evolução da Superfície: 237Ma



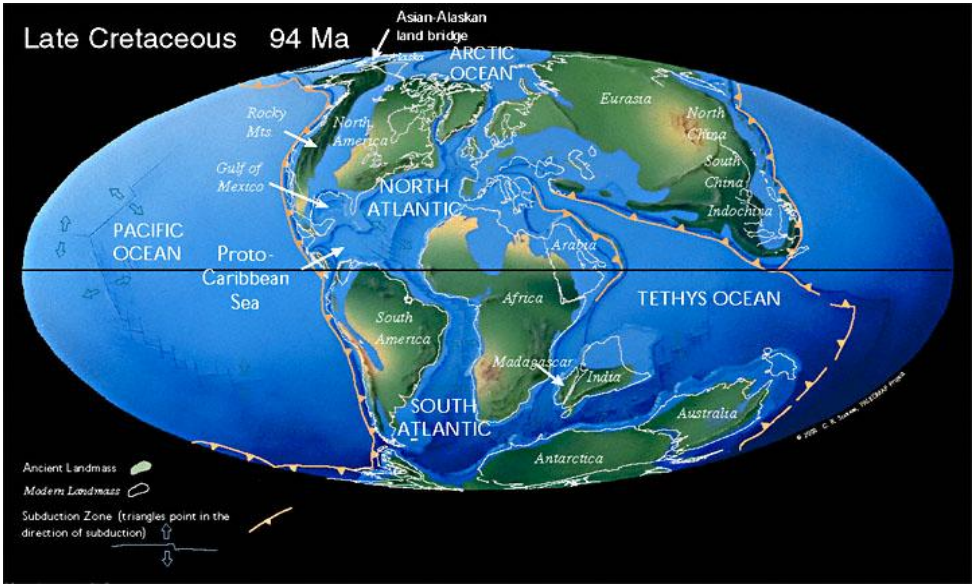
Evolução da Superfície: 195Ma



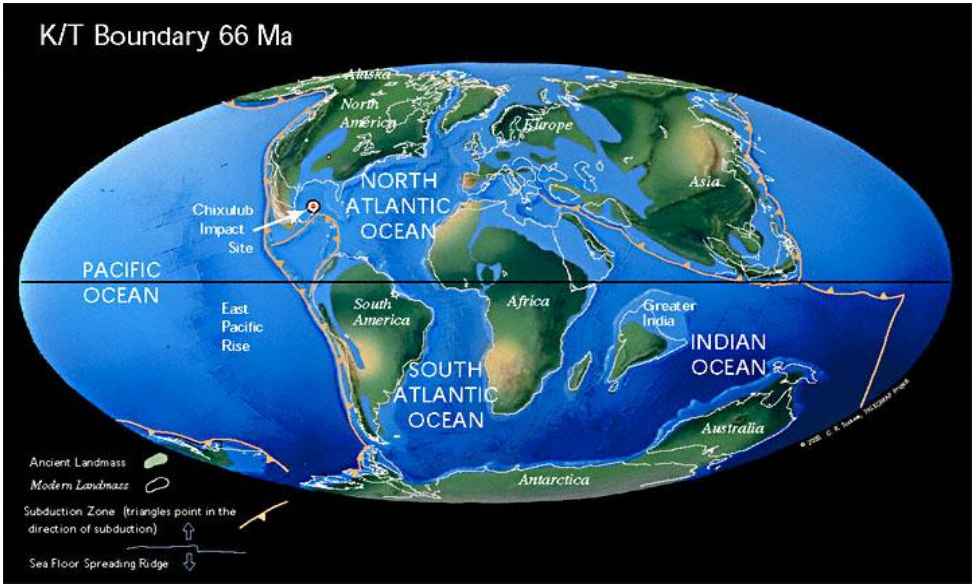
Evolução da Superfície: 152Ma



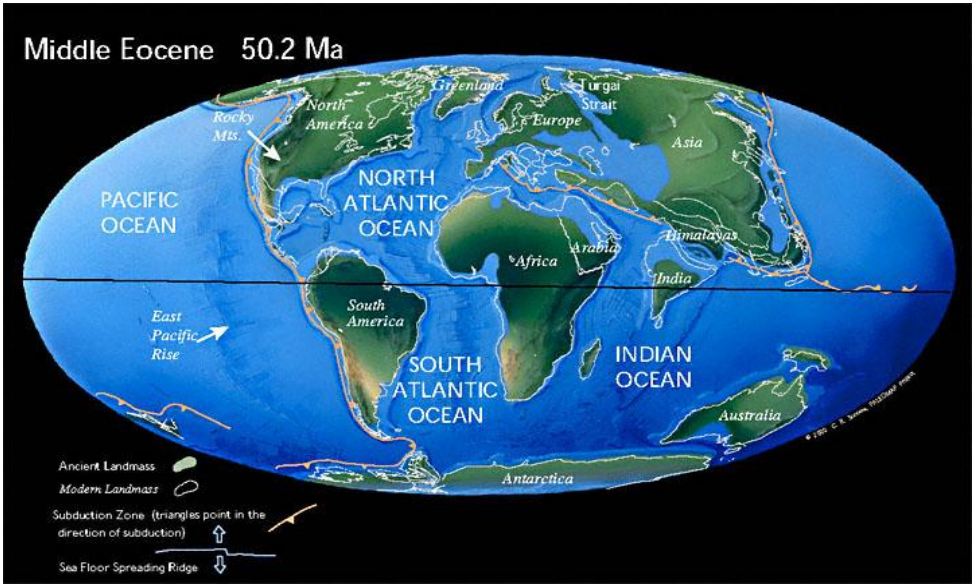
Evolução da Superfície: 94Ma



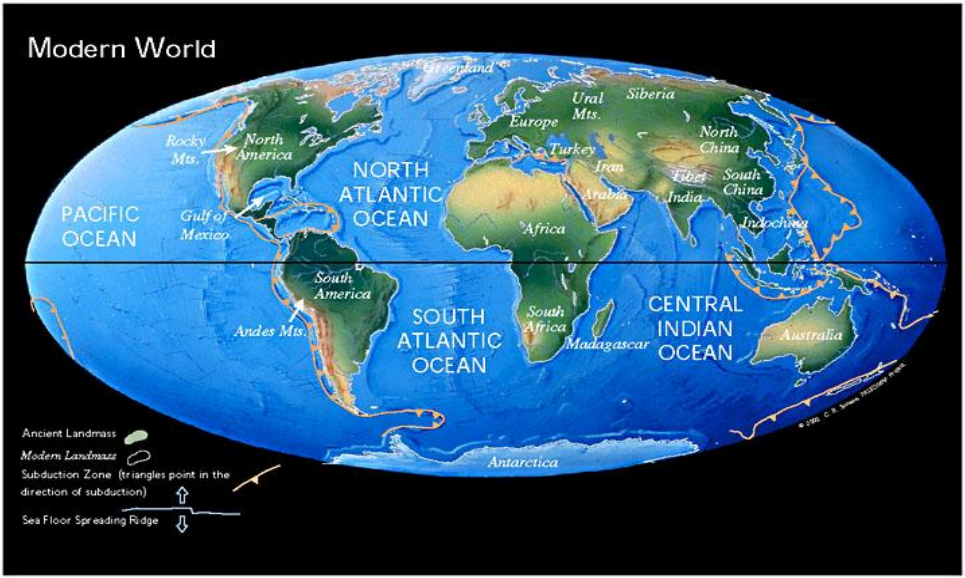
Evolução da Superfície: 66Ma



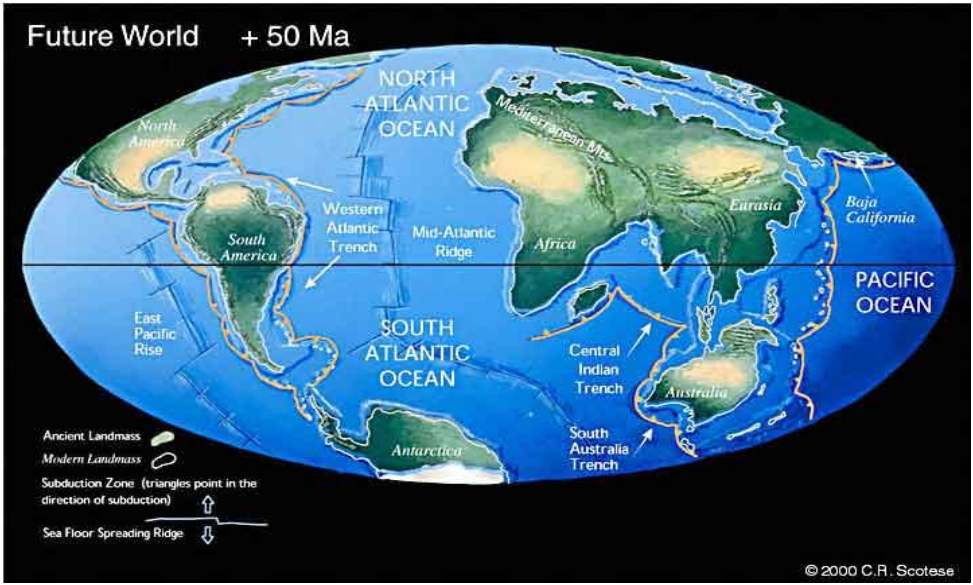
Evolução da Superfície: 50 Ma



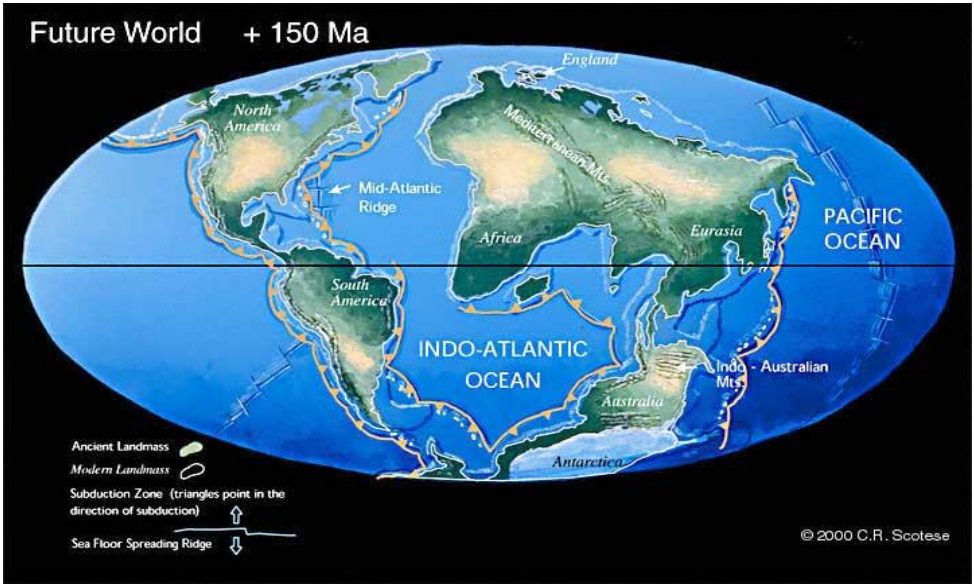
Evolução da Superfície: Hoje



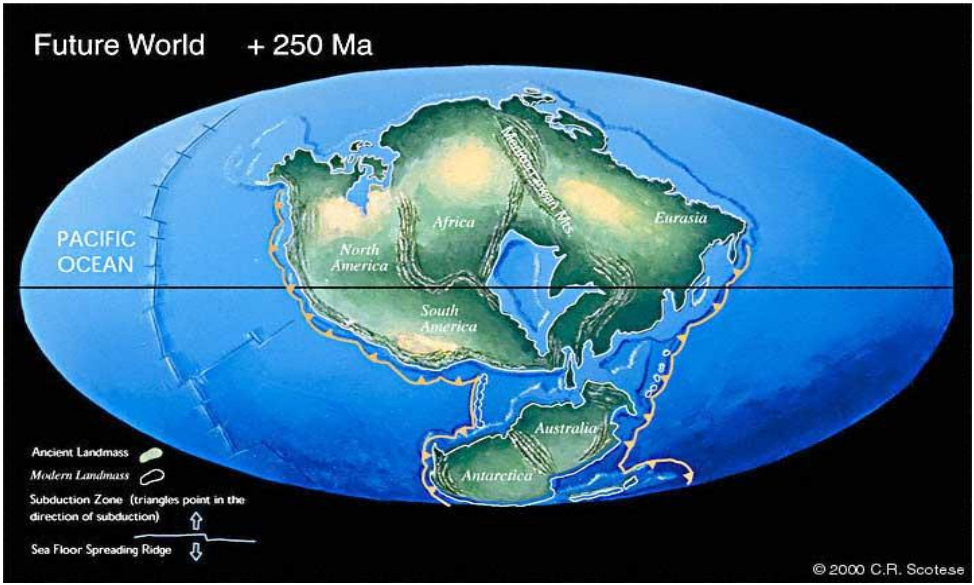
Evolução da Superfície: 50 My



Evolução da Superfície: 150 My



Evolução da Superfície: 250 My



Evolução Mineralógica

$>$	4,6		Minerais de Ur: C, SiC, Si_3N_4, Al_2O_3, silicatos
$\approx$	4,56		mais haxonite
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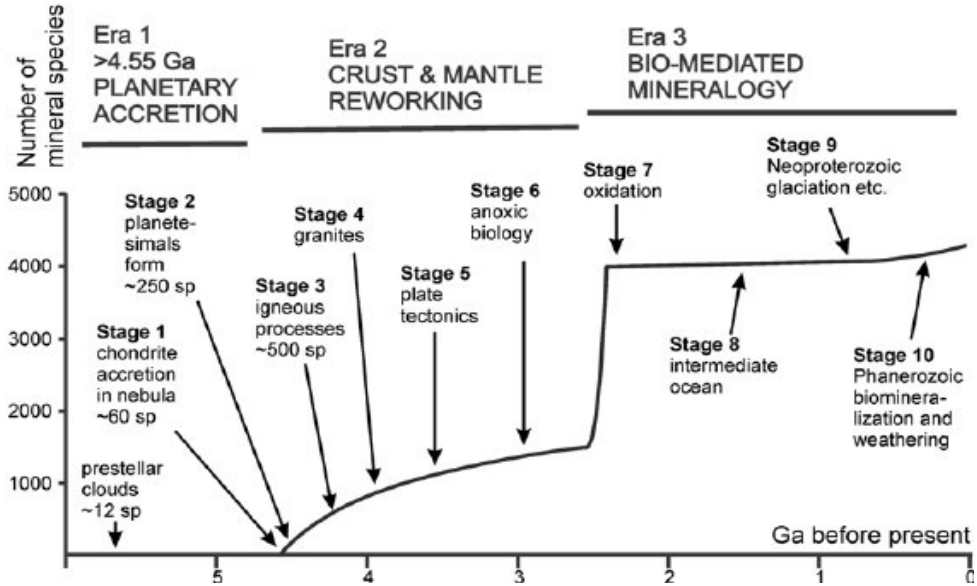
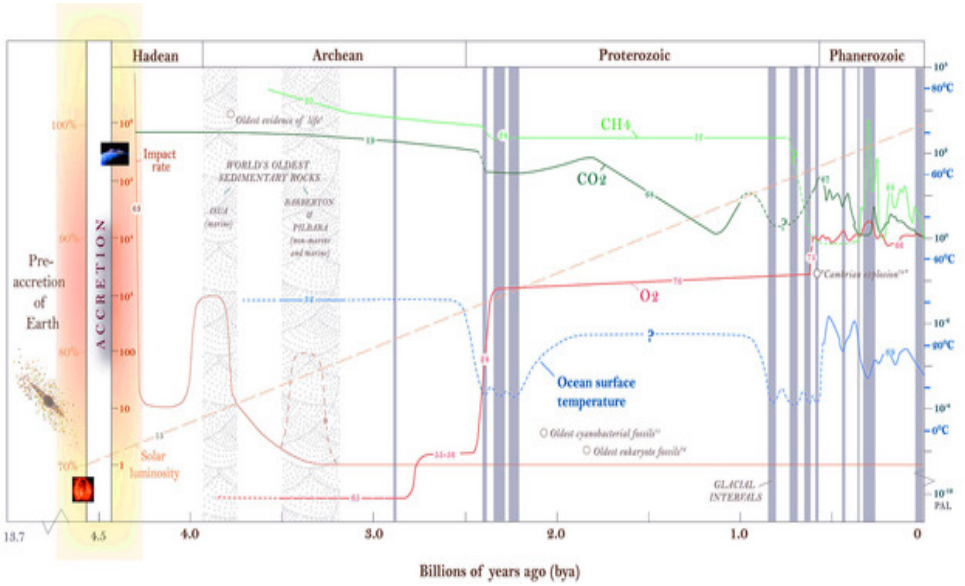
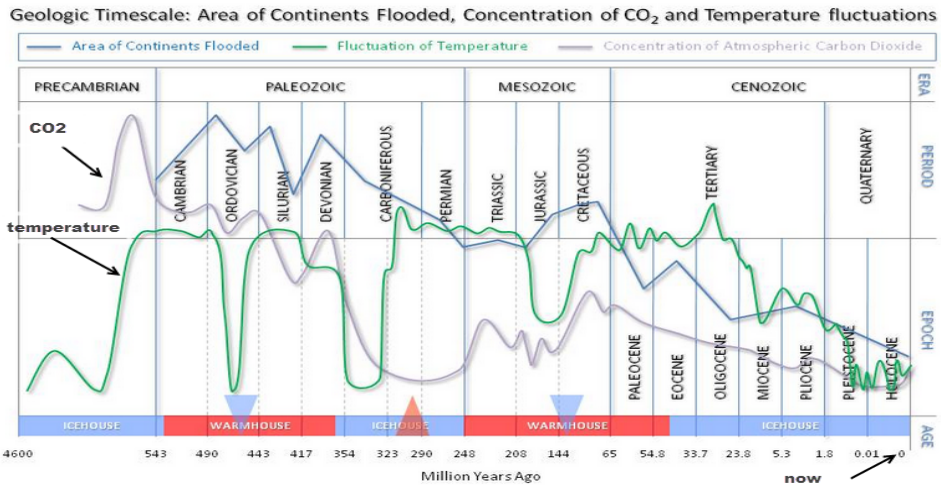
	4,55	4,0	Evolução de rochas Igneas
	4,0	3,5	Granitização e pegmatites
$>$	3,0		Placas Tectônicas: hidratos de metano
	3,9	2,5	Biosfera Anoxica: deposição de carbonatos
	2,5	1,9	Evento da Grande Oxigenação: carbonatos metálicos
	1,9	1,0	Oceano Intermediário
	1,0	0,55	Snowball Earth
	0,55		carbonato esqueletal e minerais orgânicos


Number of mineral species
Era 1
>4.55 Ga
PLANETARY
ACCRETION
Era 2
CRUST & MANTLE
REWORKING
Era 3
BIO-MEDIATED
MINERALOGY
5000
4000
3000
2000
1000
Stage 1
chondrite
accretion
in nebula
~60 sp
Stage 2
planete-
simals
form
~250 sp
Stage 3
igneous
processes
~500 sp
Stage 4
granites
Stage 5
plate
tectonics
Stage 6
anoxic
biology
Stage 7
oxidation
Stage 8
intermediate
ocean
Stage 9
Neoproterozoic
glaciation etc.
Stage 10
Phanerozoic
biominera-
lization and
weathering
prestellar
clouds
~12 sp
Ga before present
5
4
3
2
1
0

Evolução da Superfície: Glaciação

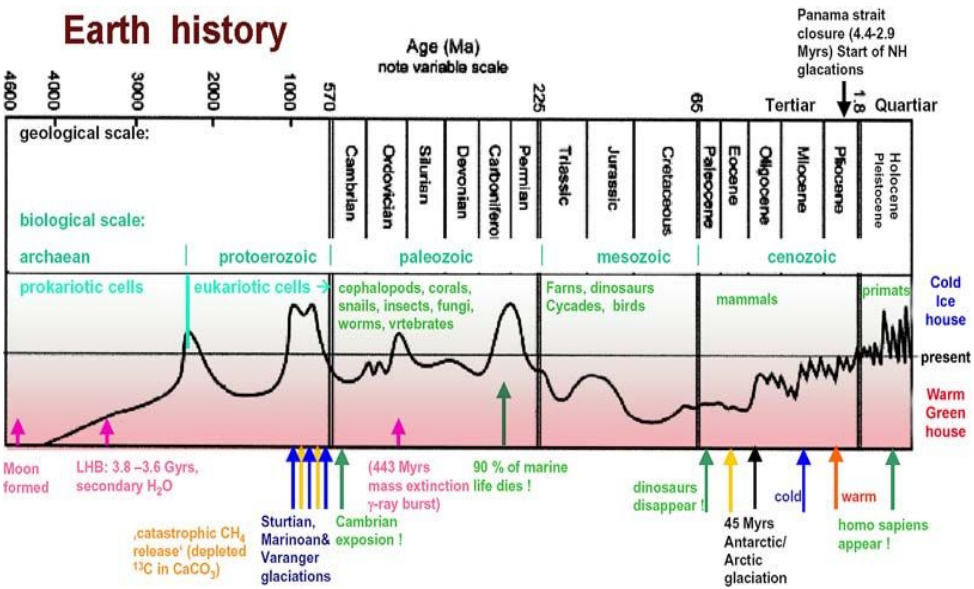


Evolução da Superfície: Temperatura

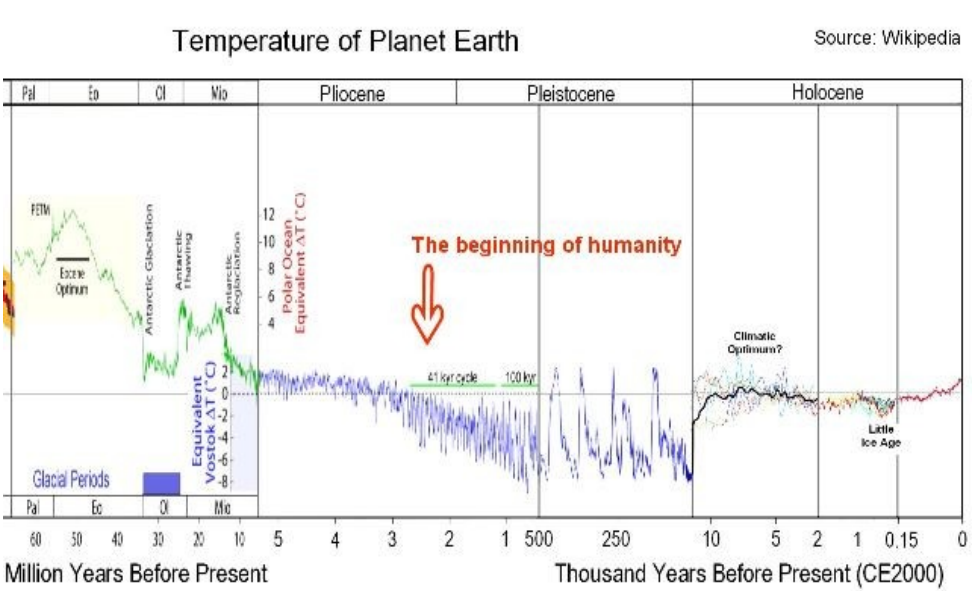


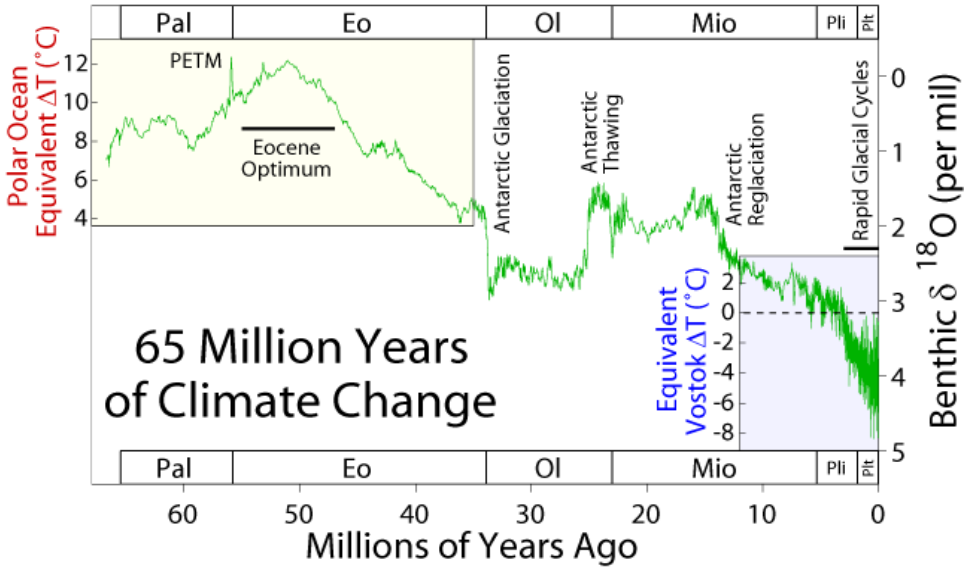
1- *Analysis of the Temperature Oscillations in Geological Eras* by Dr. C. R. Scotese © 2002. 2- Ruddiman, W. F. 2001. *Earth's Climate: past and future*. W. H. Freeman & Sons. New York, NY. 3- Mark Pagani *et all*. *Marked Decline in Atmospheric Carbon Dioxide Concentrations During the Paleocene*. Science; Vol. 309, No. 5734; pp. 600-603. 22 July 2005. 4- Ronov, A. B. 1994. *Phanerozoic Transgressions and Regressions on the Continents: A Quantitative Approach Based on Areas Flooded by the Sea and Areas of Marine and Continental Deposition*. American Journal of Science 294:777–801. 5- *Source for Nomenclature and Ages*: © 1999, The Geological Society of America. Product Code CT5004. Compilers: A. R. Palmer and John Geissman. *Conclusion and Interpretation*: Nasif Nahle ©2005, 2007, 2009. *Corrected on 07 July 2008 (CO2: Ordovician Period).*

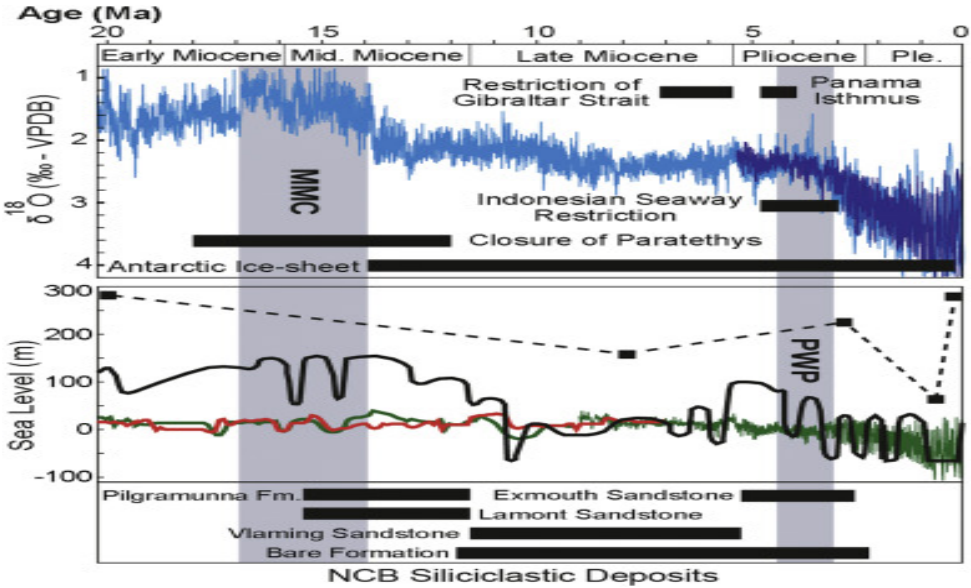
Evolução da Superfície: Temperatura



Evolução da Superfície: Glaciação




Pal
Eo
Ol
Mio
Pli
Plt
PETM
Eocene Optimum
Antarctic Glaciation
Antarctic Thawing
Antarctic Reglaciation
Rapid Glacial Cycles
Polar Ocean Equivalent ΔT (°C)
Equivalent Vostok ΔT (°C)
Benthic δ 18O (per mil)
65 Million Years of Climate Change
Millions of Years Ago


Age (Ma)
20
15
10
5
0
Early Miocene
Mid. Miocene
Late Miocene
Pliocene
Ple.
1
2
3
4
δ 18O (‰ - VPDB)
Restriction of Gibraltar Strait
Panama Isthmus
MMC
Indonesian Seaway Restriction
Closure of Paratethys
Antarctic Ice-sheet
300
200
100
0
-100
Sea Level (m)
PWP
Pilgramunna Fm.
Exmouth Sandstone
Lamont Sandstone
Vlaming Sandstone
Bare Formation
NCB Siliciclastic Deposits