

Tema 4.

A TECTÓNICA DE PLACAS III

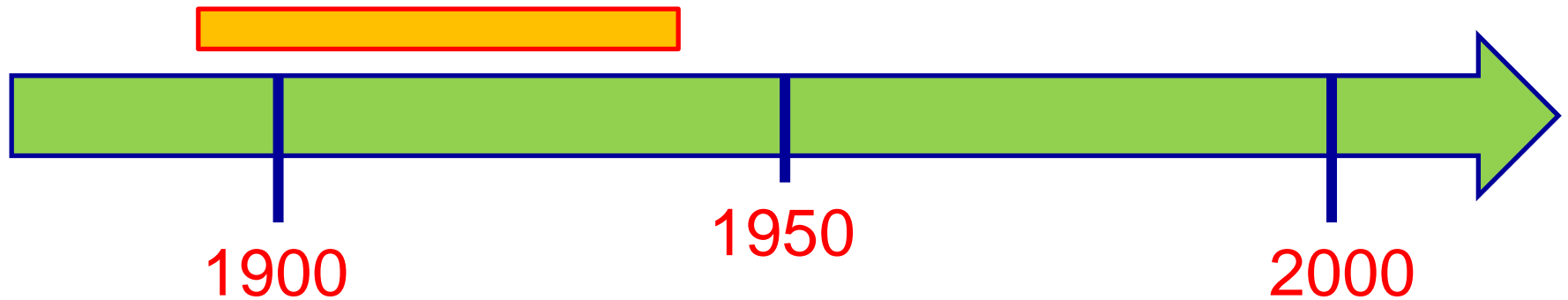




Desenvolvimento histórico

ATA MEDIADOS DO SÉCULO XX

ATA 50 TEORÍAS E HIPÓTESES



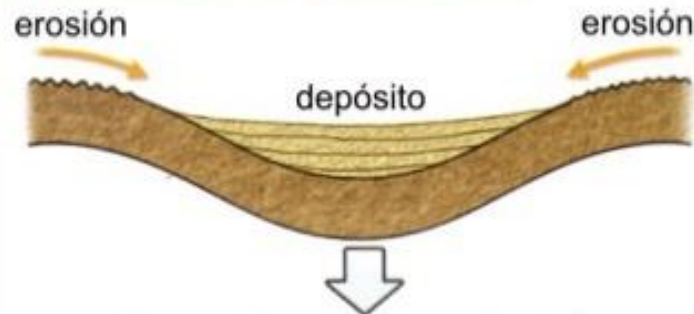
Enfriamiento e contracción



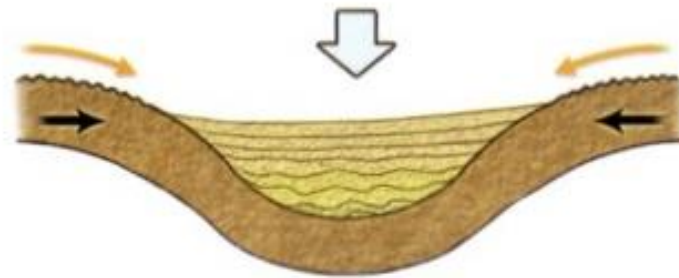
Teoría del geosinclinal

Durante el siglo XX y hasta la sustitución por la teoría de la tectónica de placas, tomó gran importancia una variante del contraccionismo: la teoría del geosinclinal.

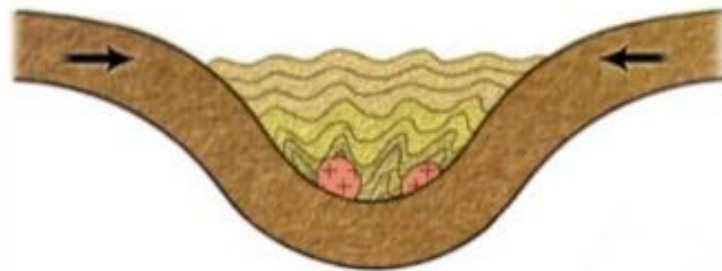
Evolución de un geosinclinal



1. Se acumulan sedimentos en el fondo de un geosinclinal



2. El geosinclinal se acentúa. Continúa el depósito

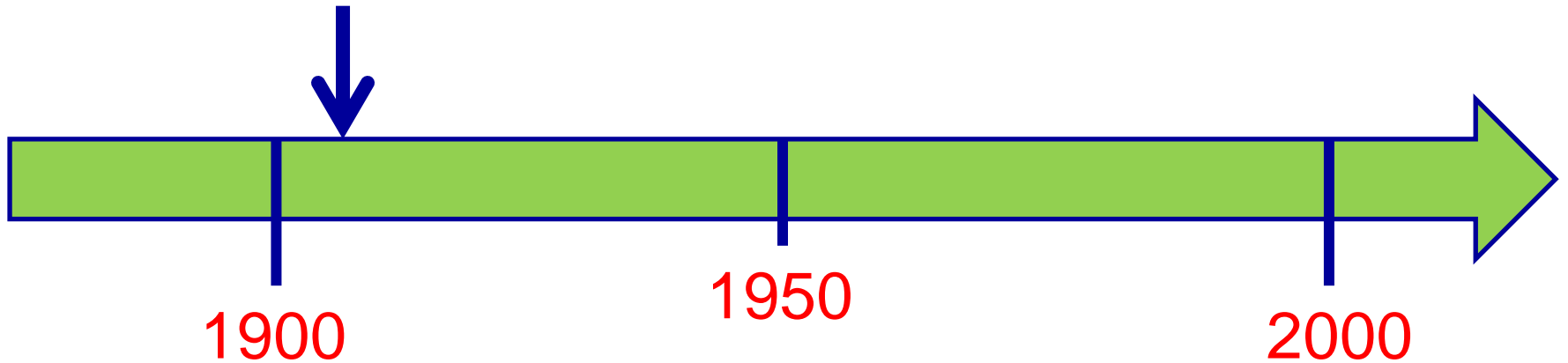


3.- El surco se va cerrando. Comienza la compresión



4. La compresión prosigue. Surge una cordillera

Alfred Wegener e a Deriva Continental



In 1915 Wegener published his work in The Origin of the Continents and Oceans.

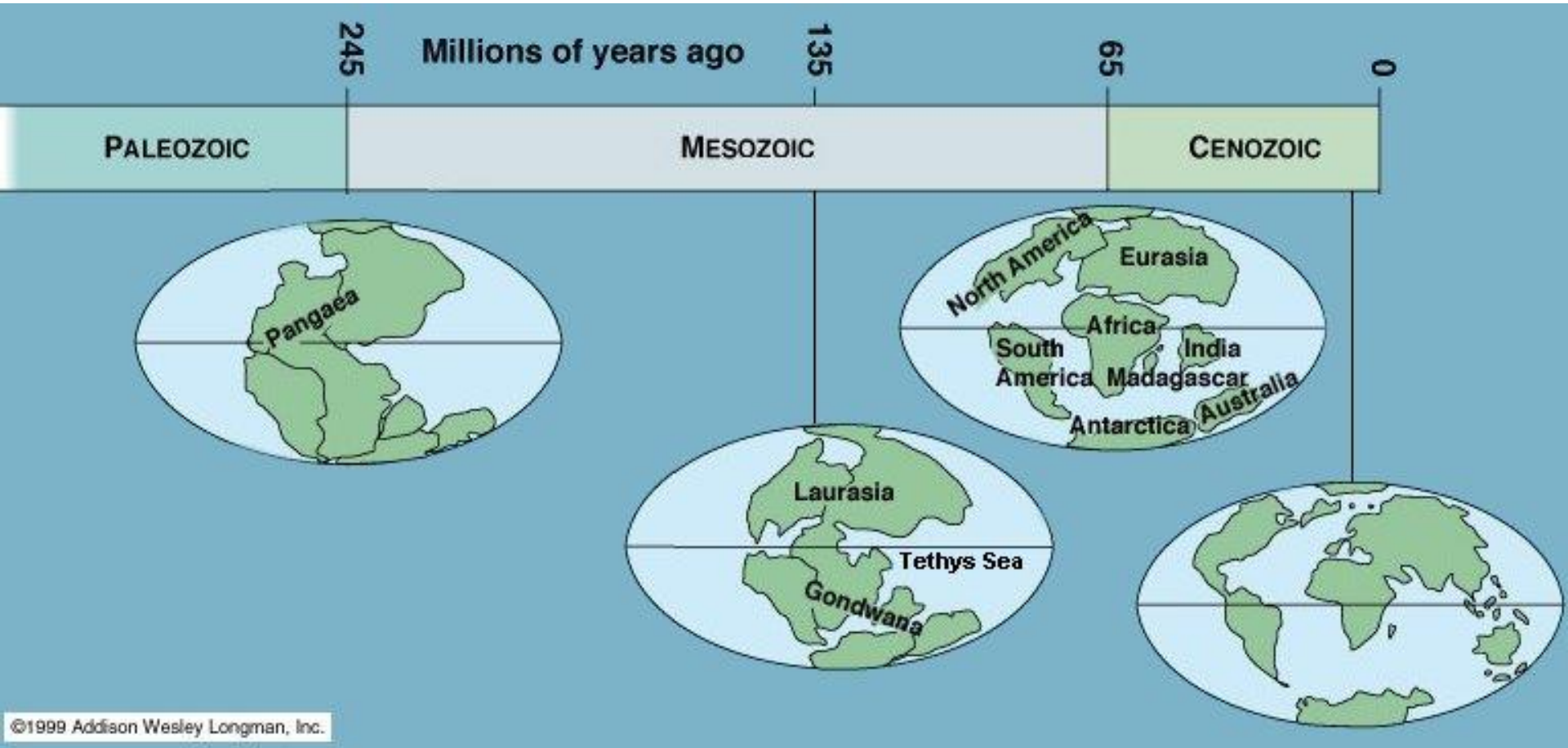
Alfred Wegener e a Deriva Continental

Born: Germany, 1880
PhD: Astronomy
Profession: Meteorologist and Greenland explorer
Died: 1930



Alfred Wegener

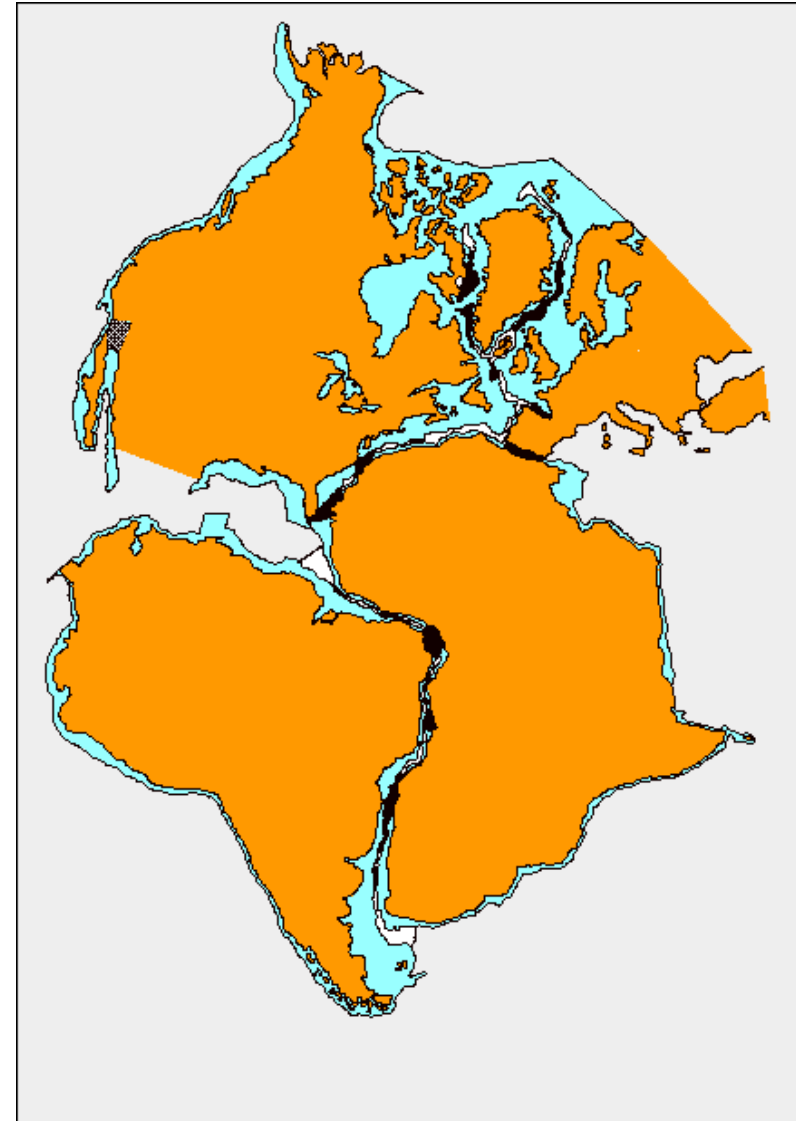
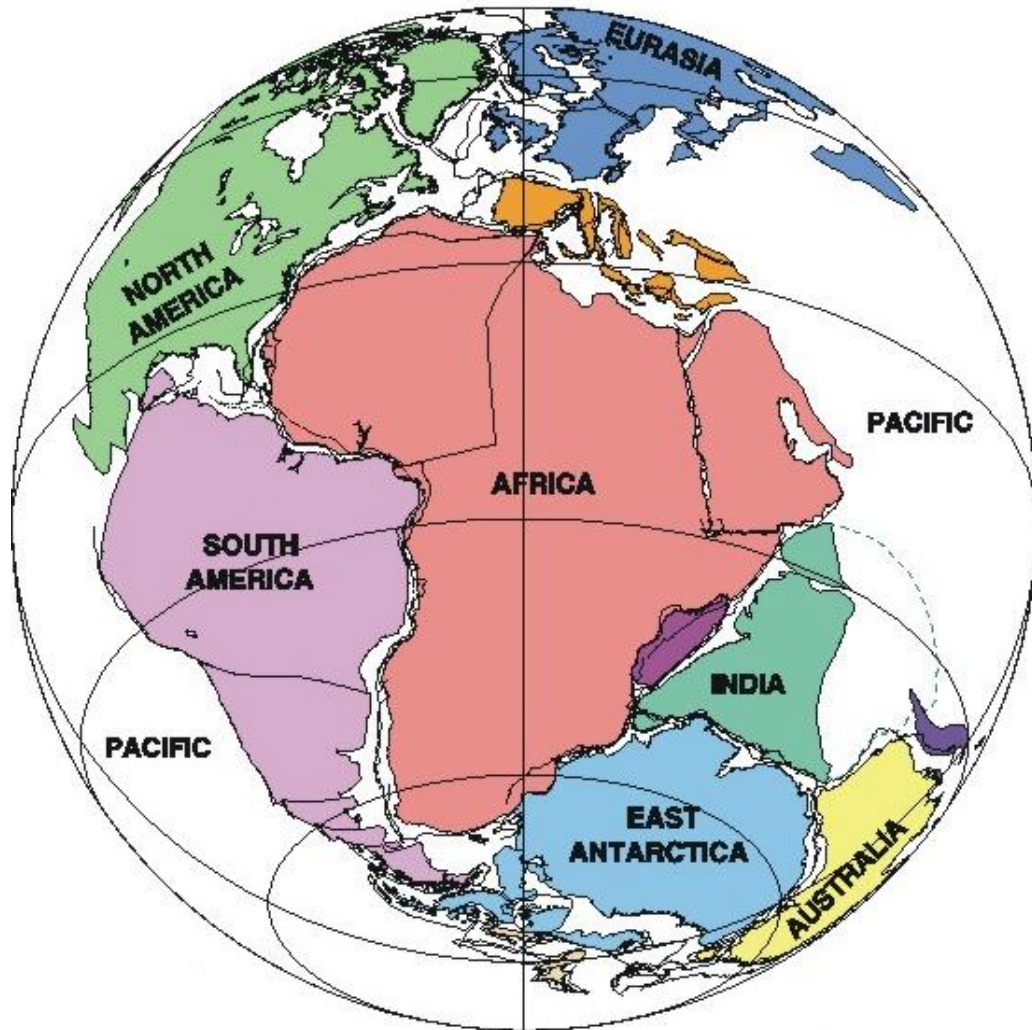
FRAGMENTACIÓN DA PANXEA



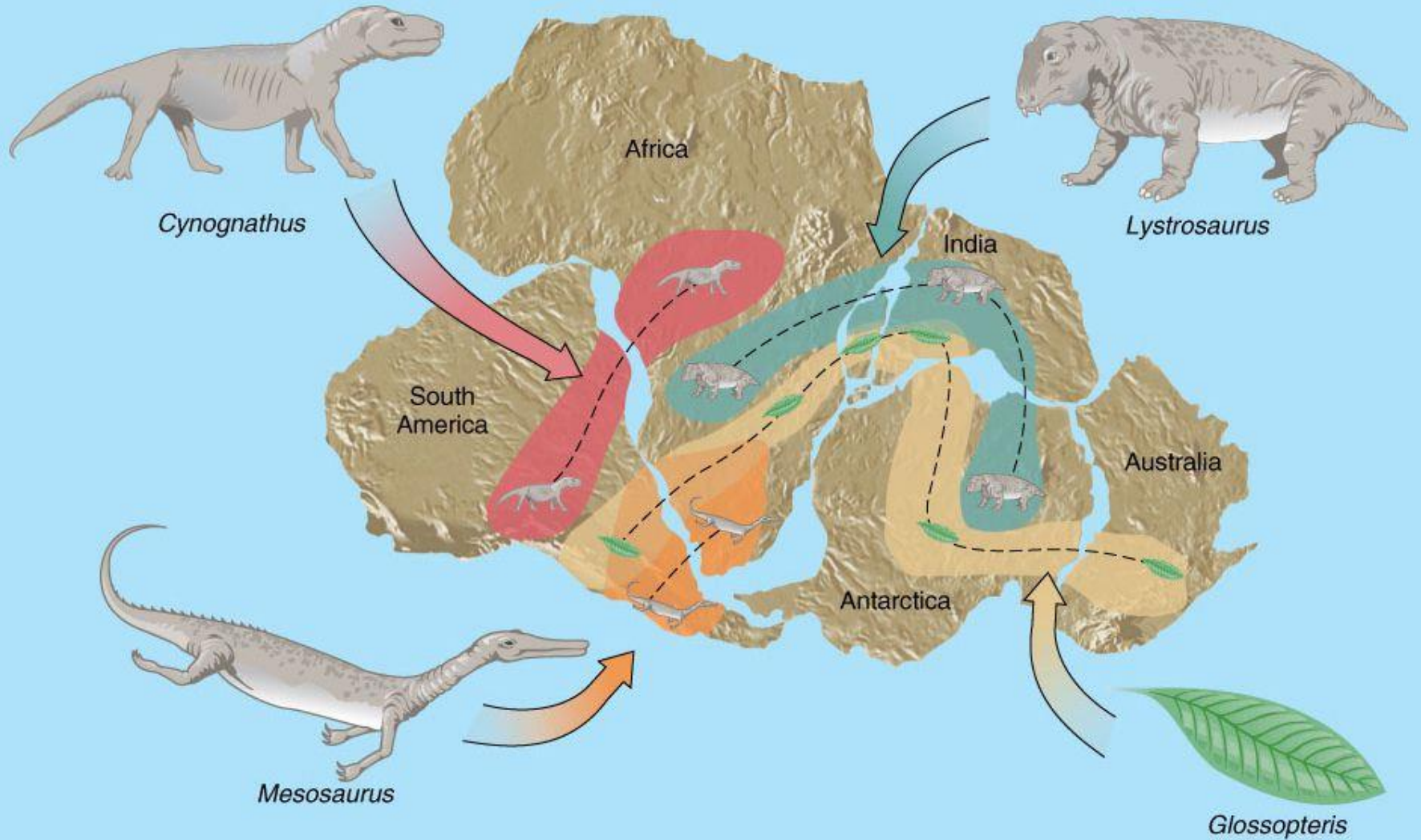
In 1858 Antonio Snider-Pellegrini made the following “before and after” maps of South America and Africa.

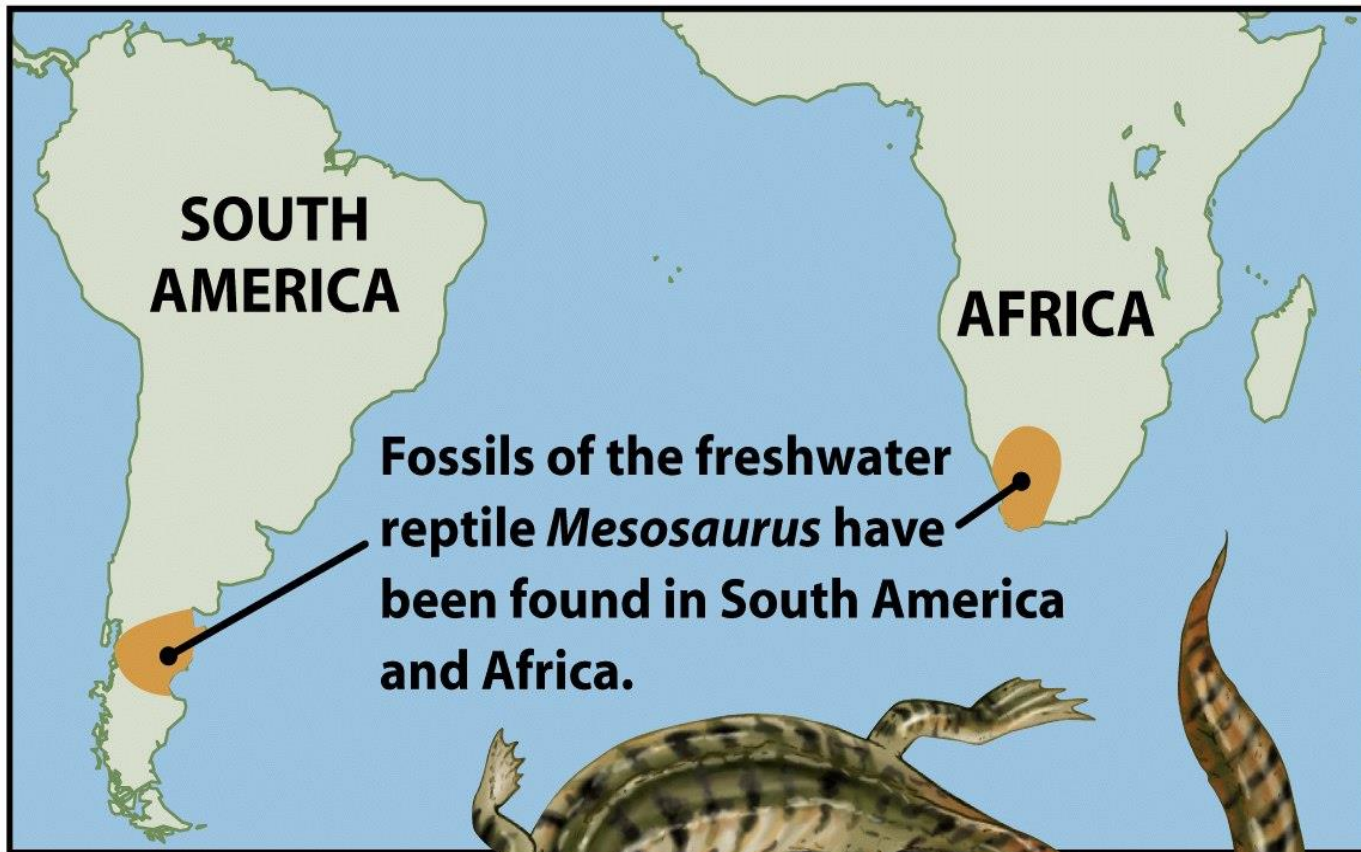


Encaixamento dos continentes



Matching Fossils





Fossils of the freshwater reptile *Mesosaurus* have been found in South America and Africa.

Mesosaurus



Figure 2-2
Understanding Earth, Fifth Edition
© 2007 W. H. Freeman and Company

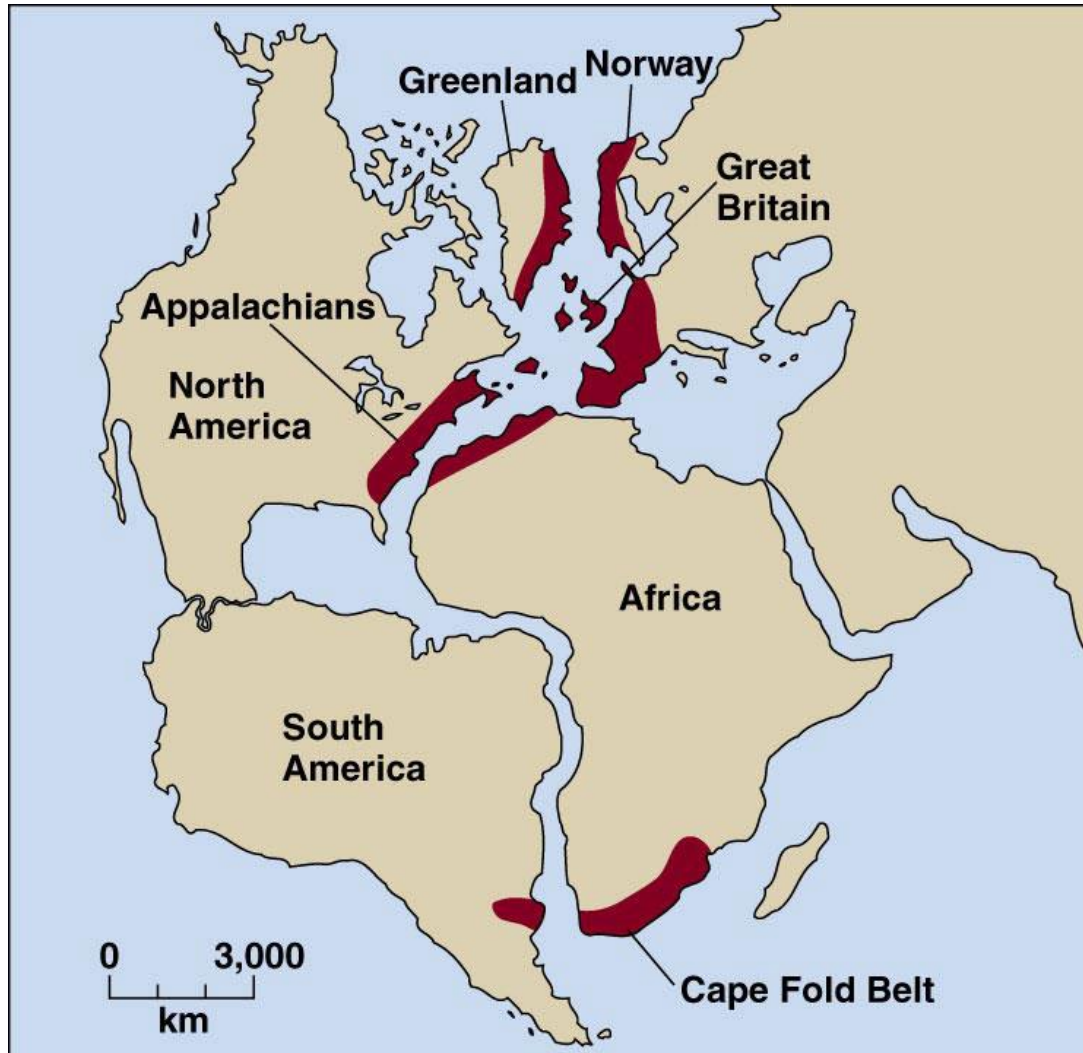
Evidence from Fossils and Rock Formations

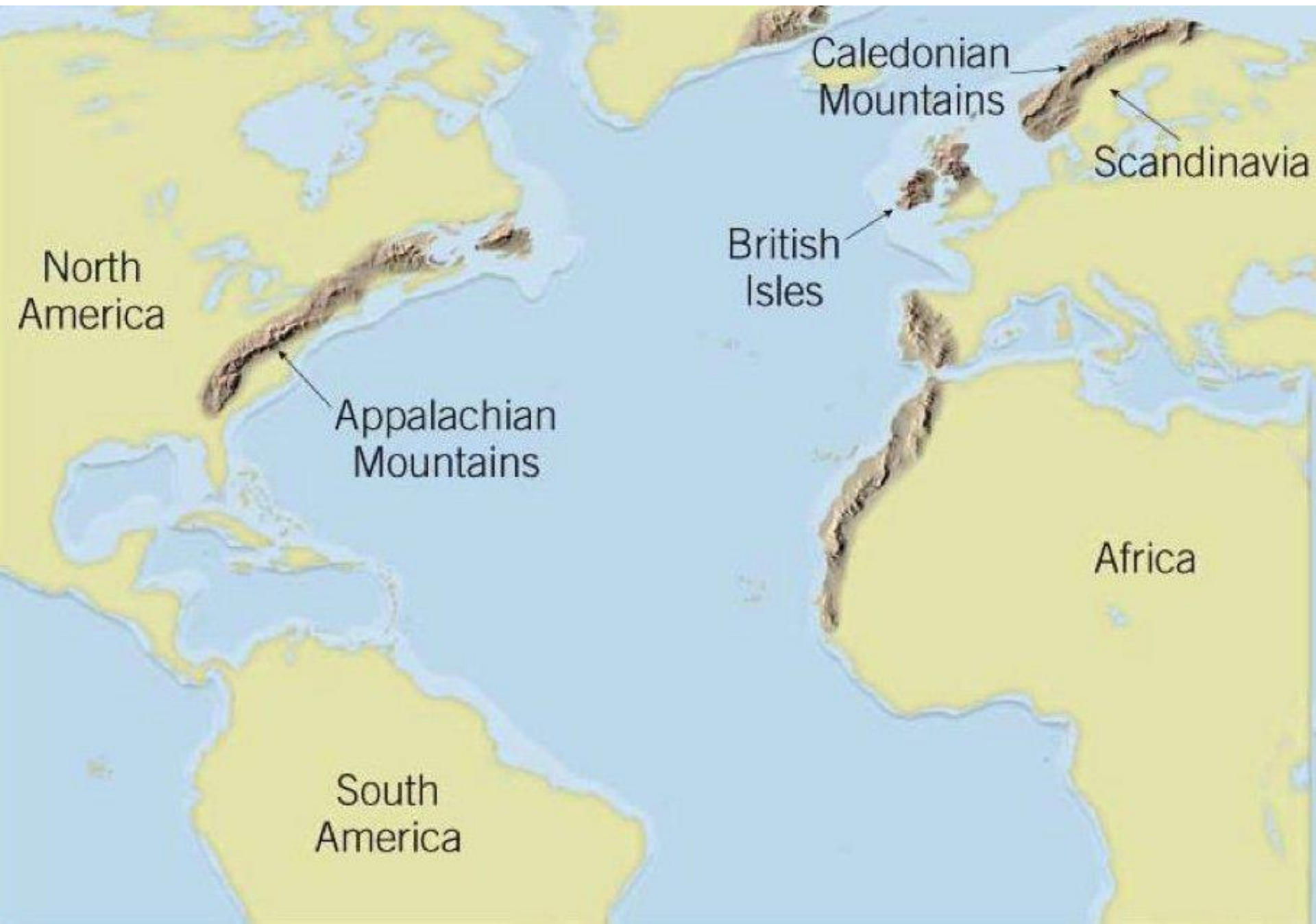
Some Evidence of Continental Drift



EVIDENCIAS XEOLÓXICAS

Matching mountain ranges





North
America

Appalachian
Mountains

South
America

Caledonian
Mountains

British
Isles

Scandinavia

Africa



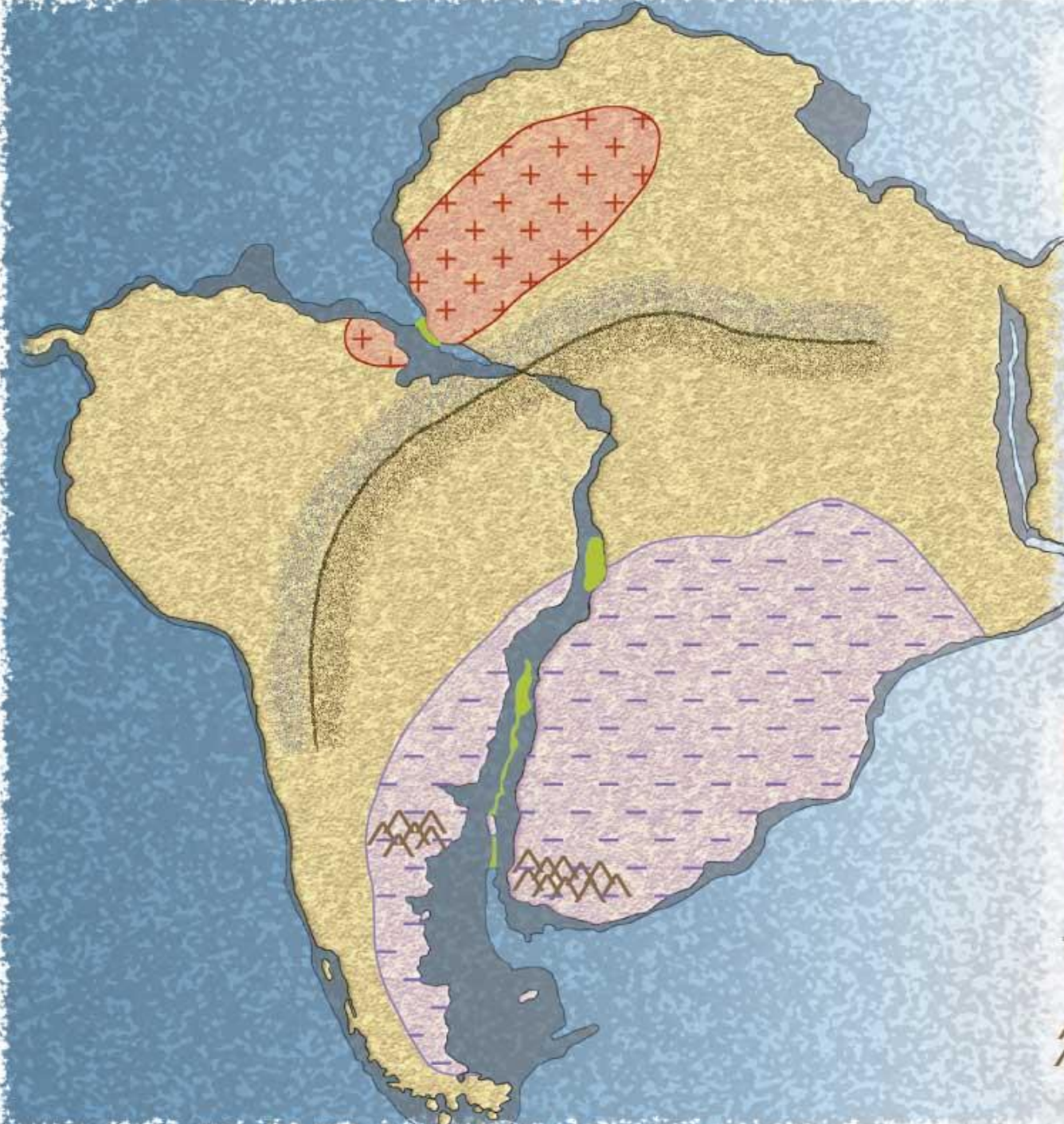
Greenland

Europe

North
America

Africa

South
America



continental shelf

matching continental shelves

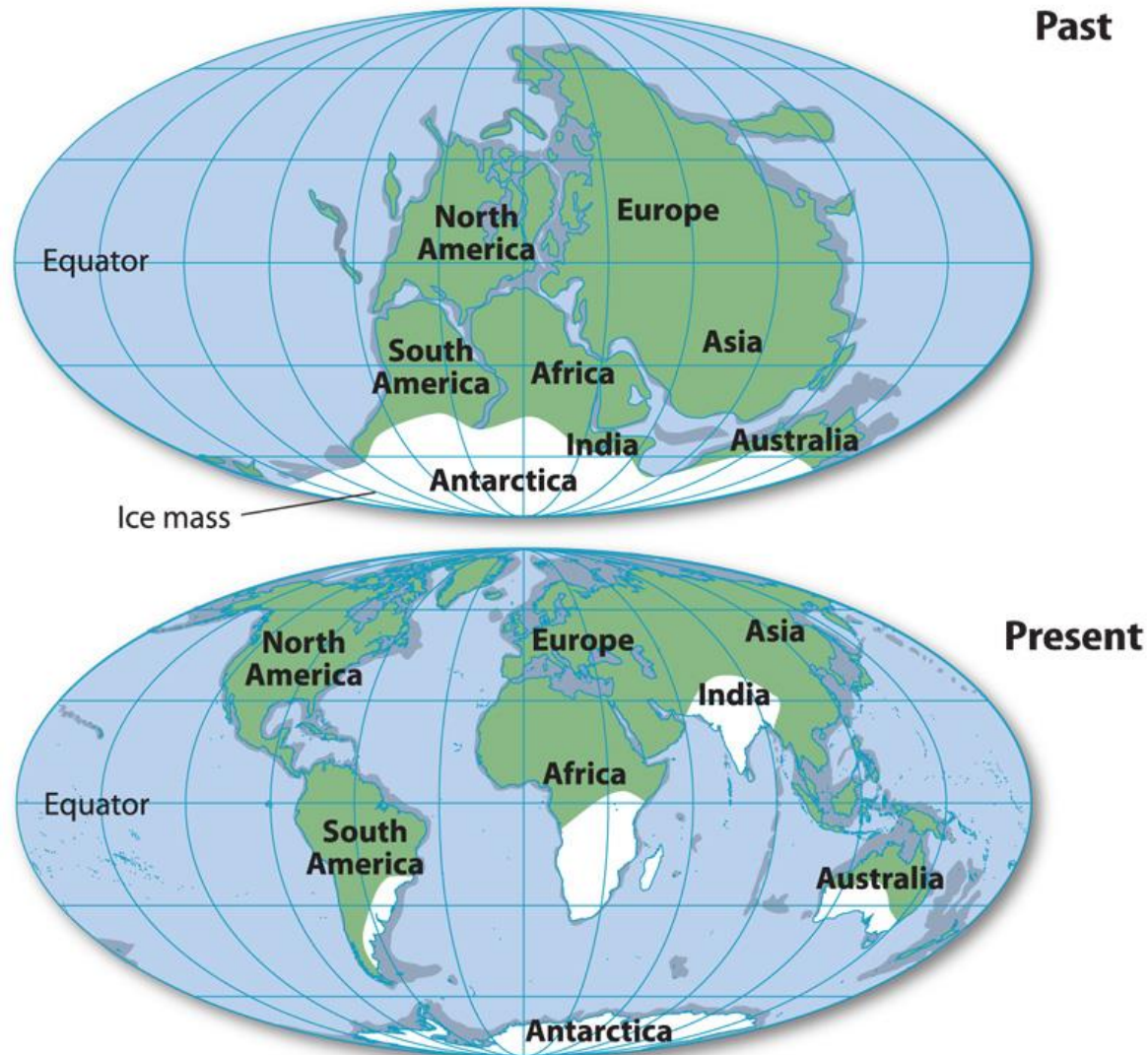
granite rock of the same age

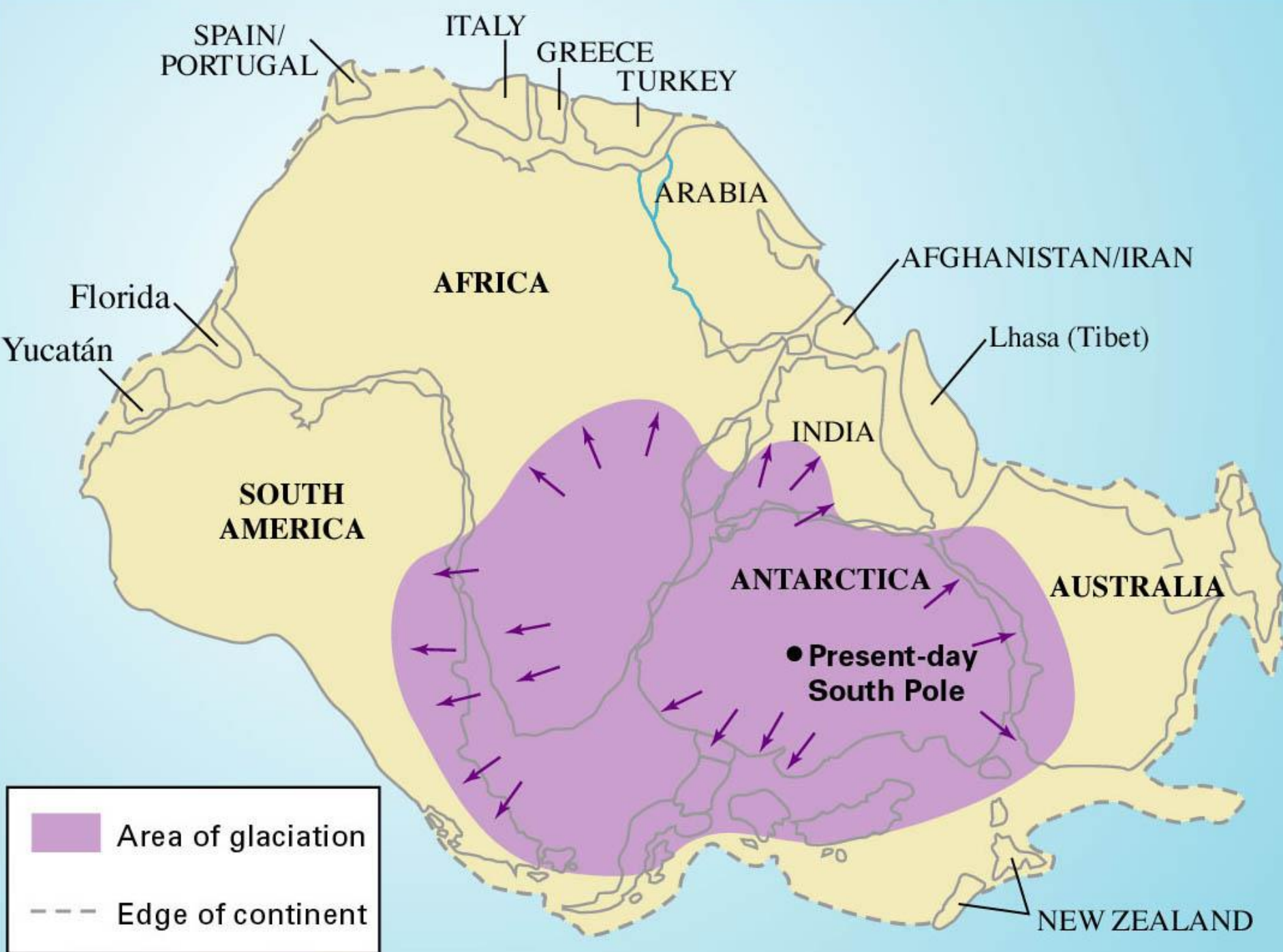
glacier deposits from 300-250 million years old

coastline 400 million years ago

mountain ranges of the same age

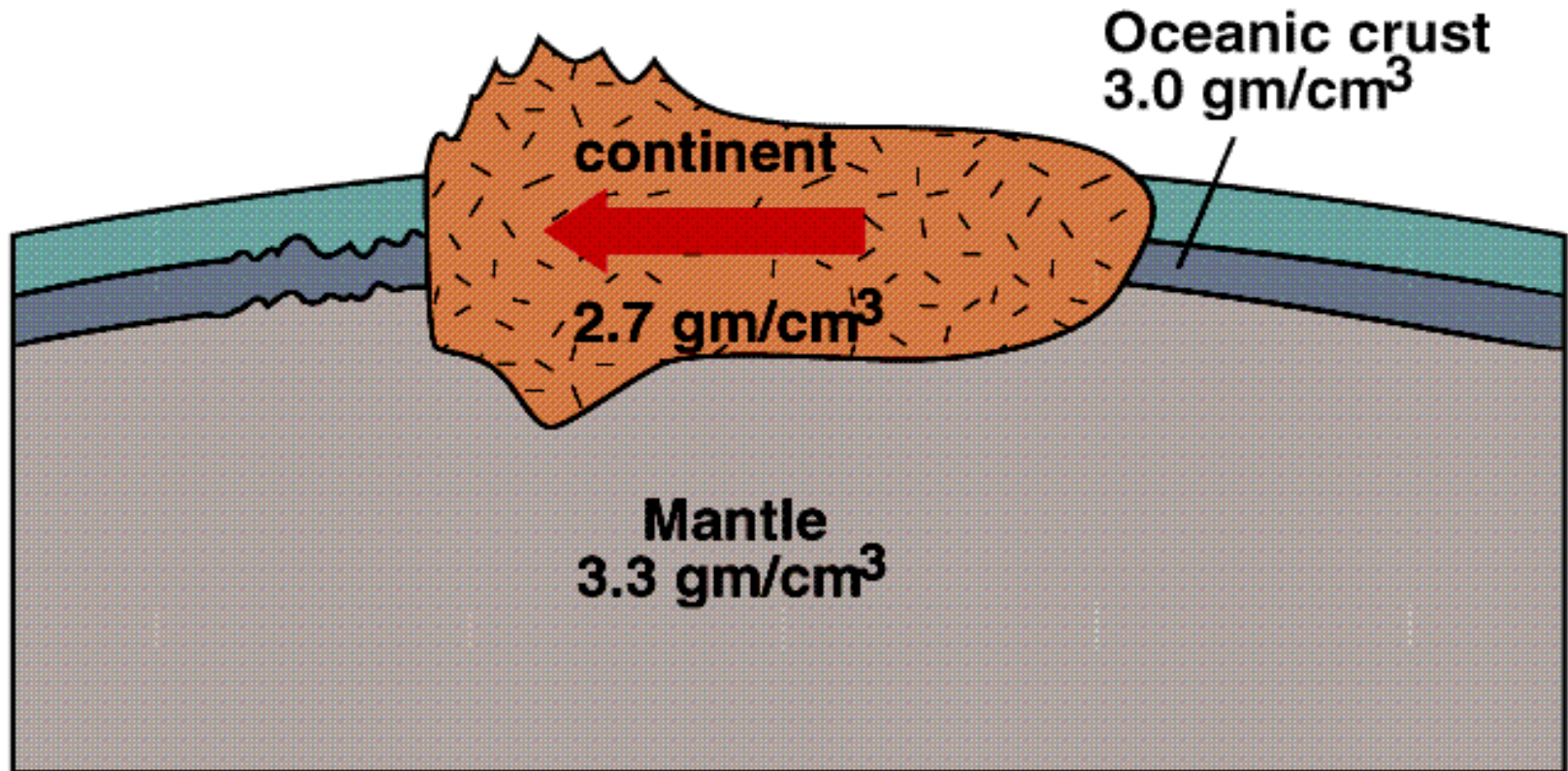
DATOS PALEOCLIMÁTICOS





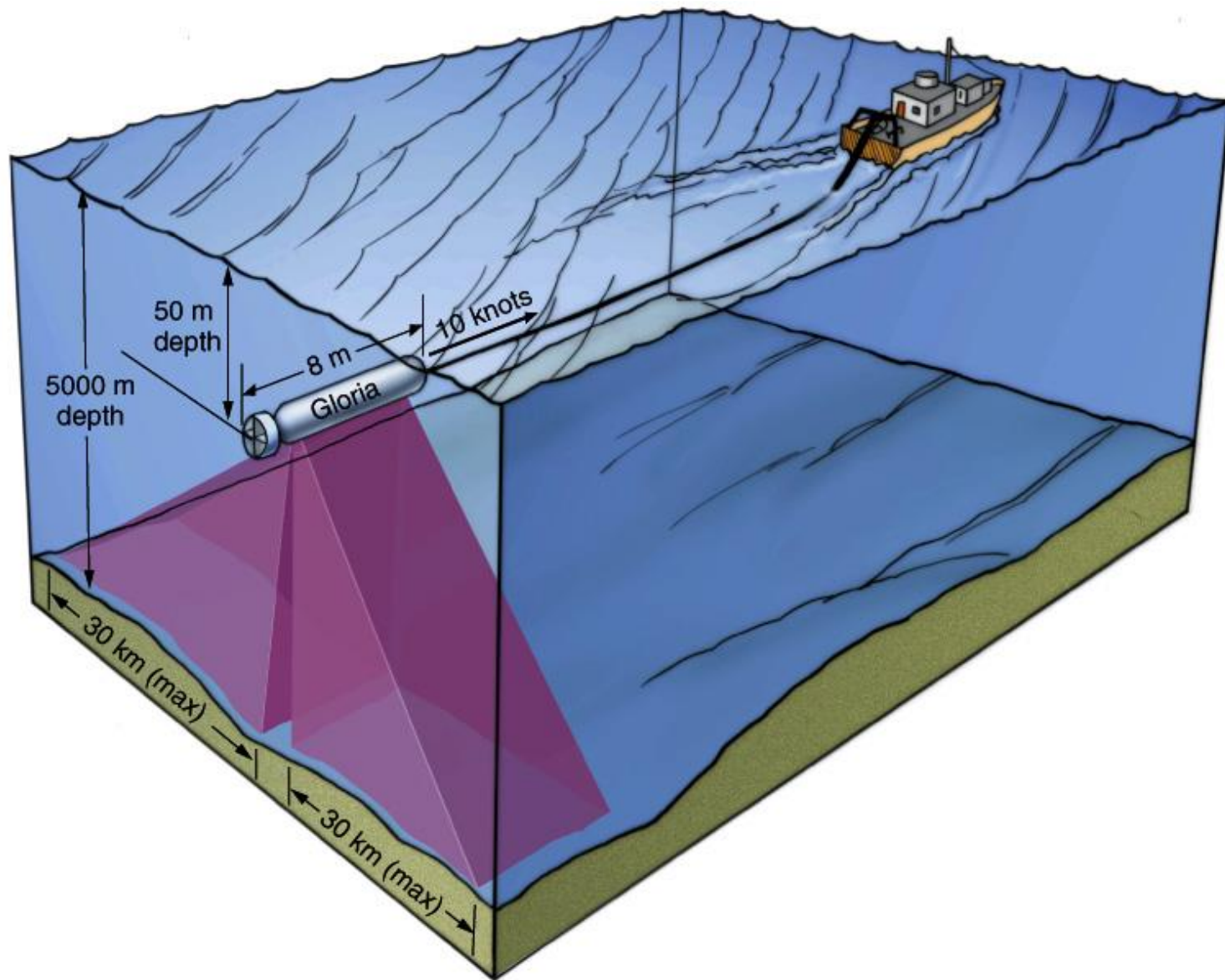
Mechanism of Continental Drift?

Wegener never lived to see the general acceptance of continental drift, largely because of the lack of a mechanism. Wegener considered the buoyant continents to be **'plowing'** through the mantle, resulting in mountain belts on continental edges.



Novas técnicas para a investigación dos océanos trala segunda guerra mundial

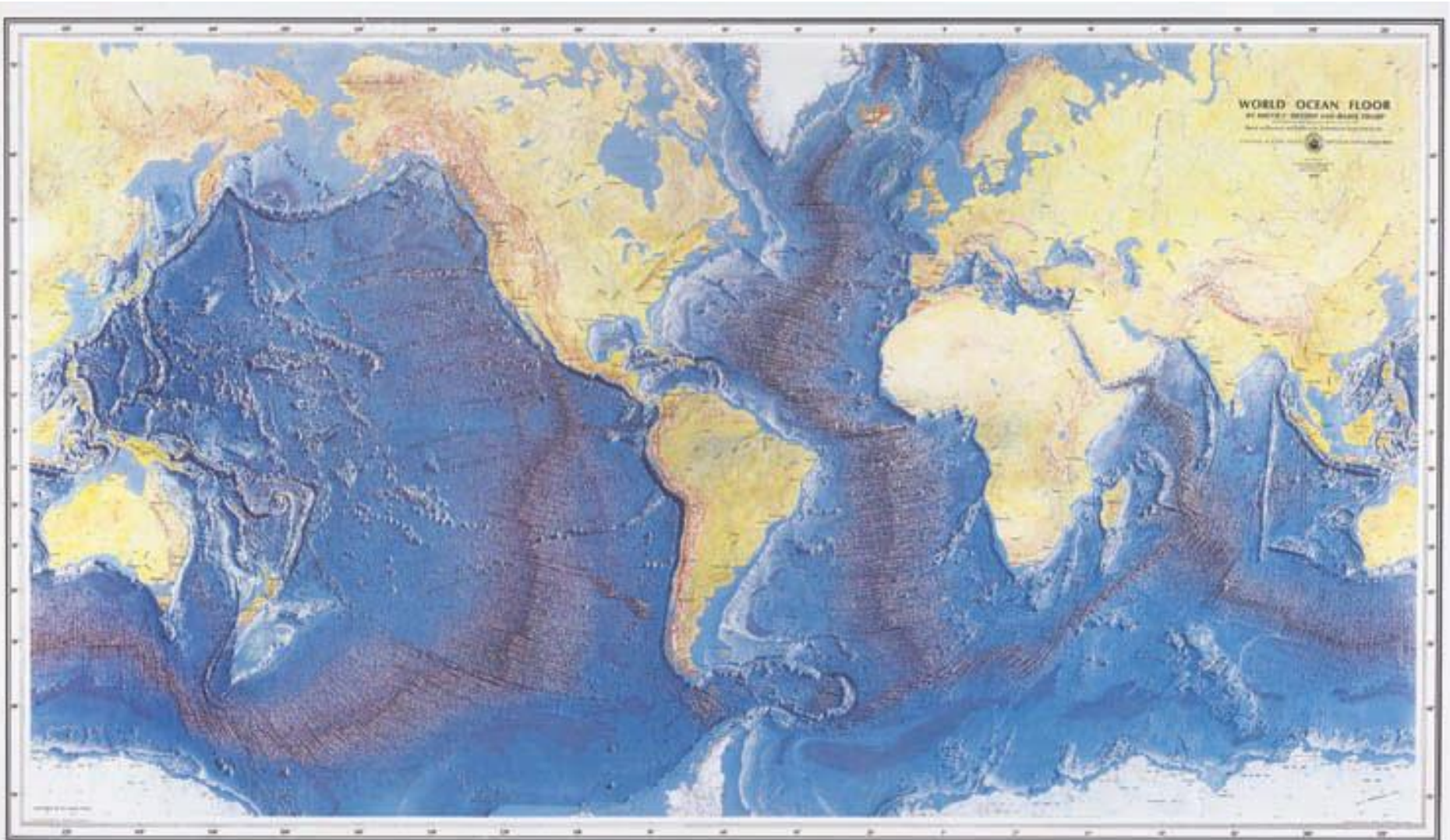
- Sónar
- Sondaxes do fondo mariño
- Láser
- Etc.



Marie Tharp and Bruce Heezen

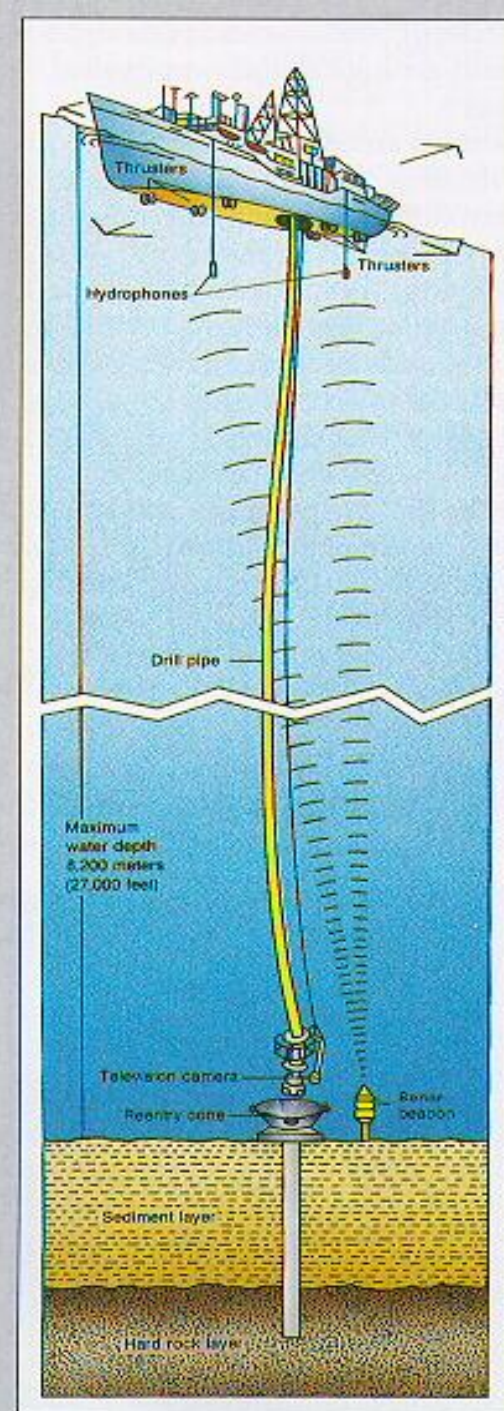
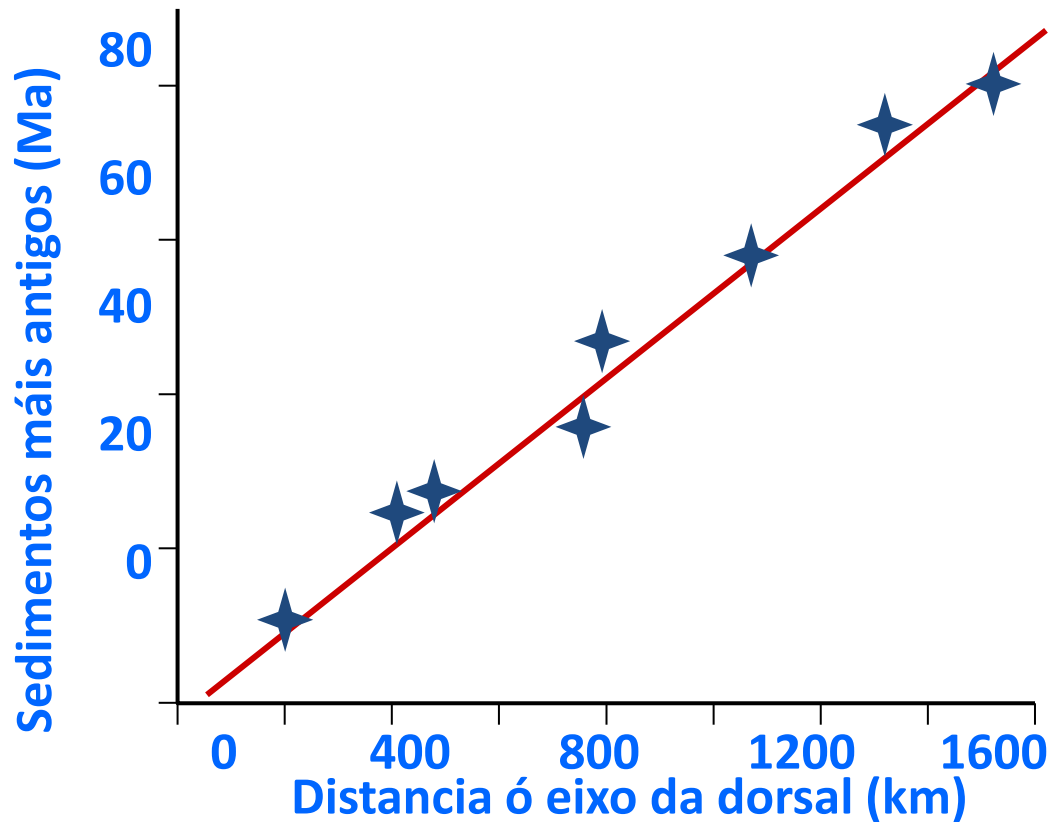


The 1977 World Ocean Floor Map created by Bruce Heezen and Marie Tharp

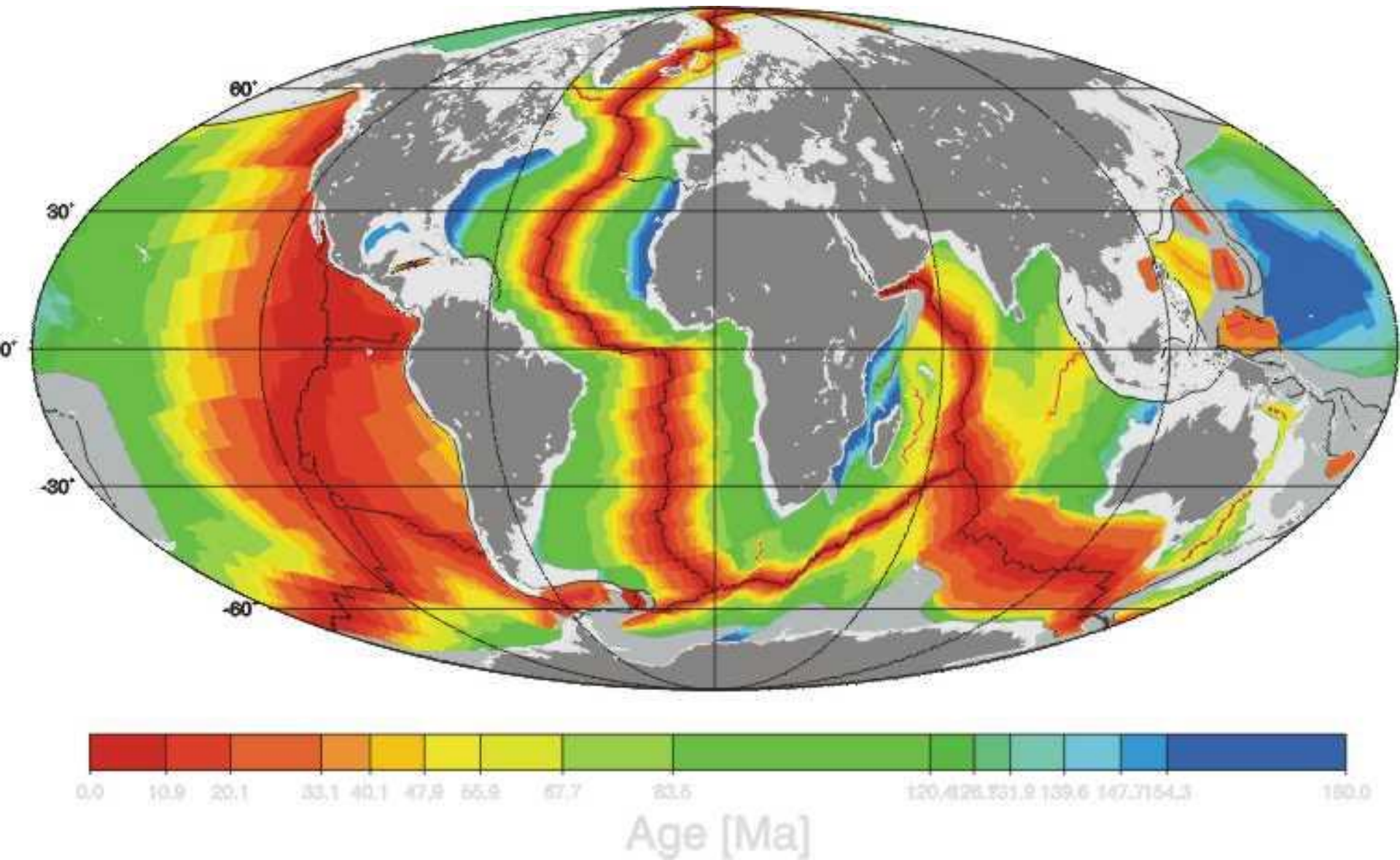


A famous study in the South Atlantic Ocean (Maxwell *et al.*, Nature, 1970) examined the sediment immediately overlying the basalts:

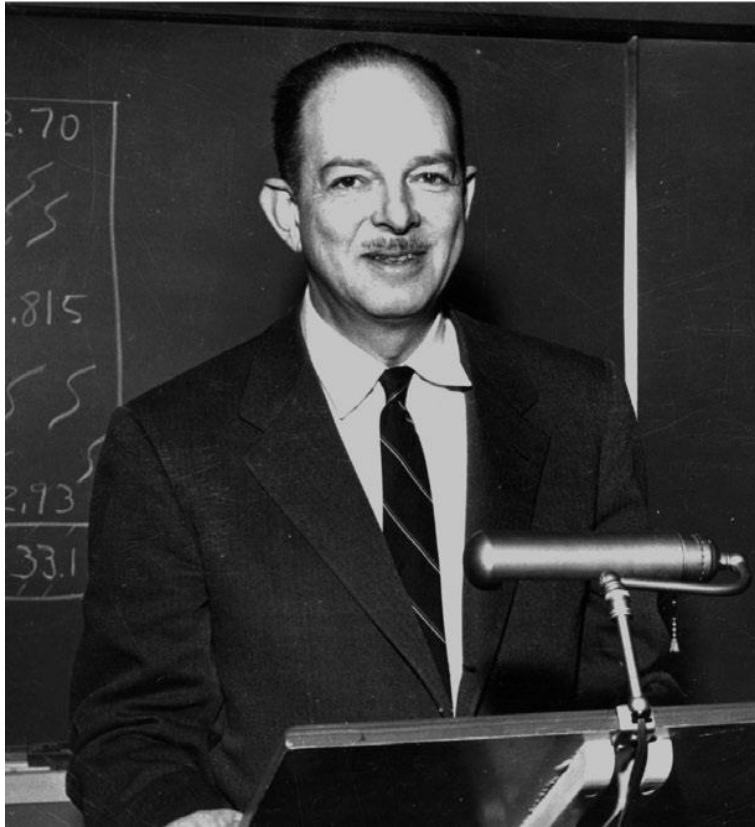
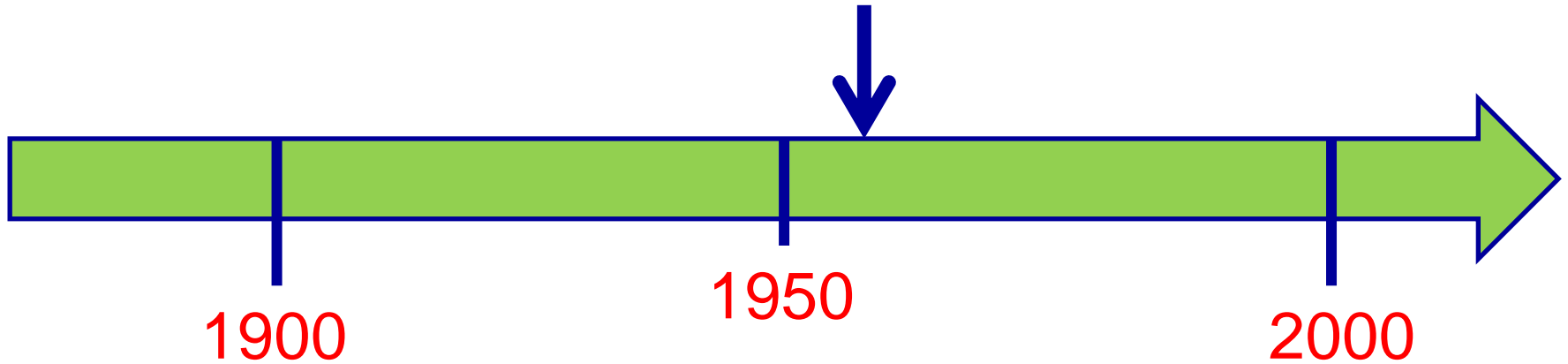
FAMOUS (for French-American Mid-Ocean Undersea Study)



A idade das rochas do fundo oceânico



Harry Hess (1962)



**EXPANSIÓN
DO FONDO
OCEÁNICO**

Harry Hess (1962)



PETROLOGIC STUDIES: A VOLUME TO HONOR
A. F. BUDDINGTON
PP. 600-620 NOVEMBER 1962

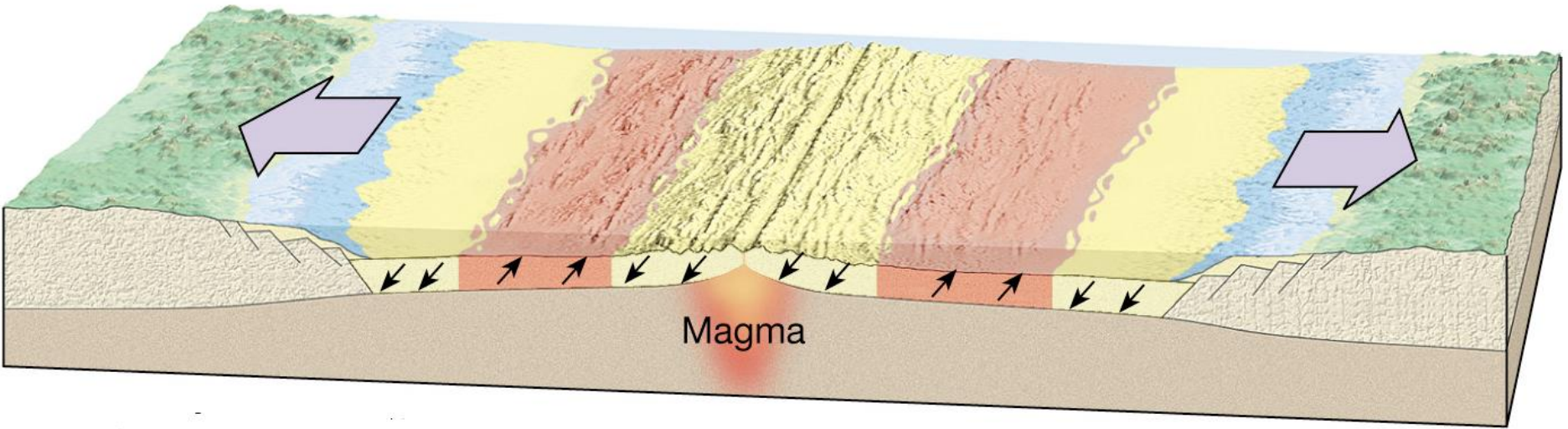
History of Ocean Basins

H. H. HESS

Princeton University, Princeton, N. J.

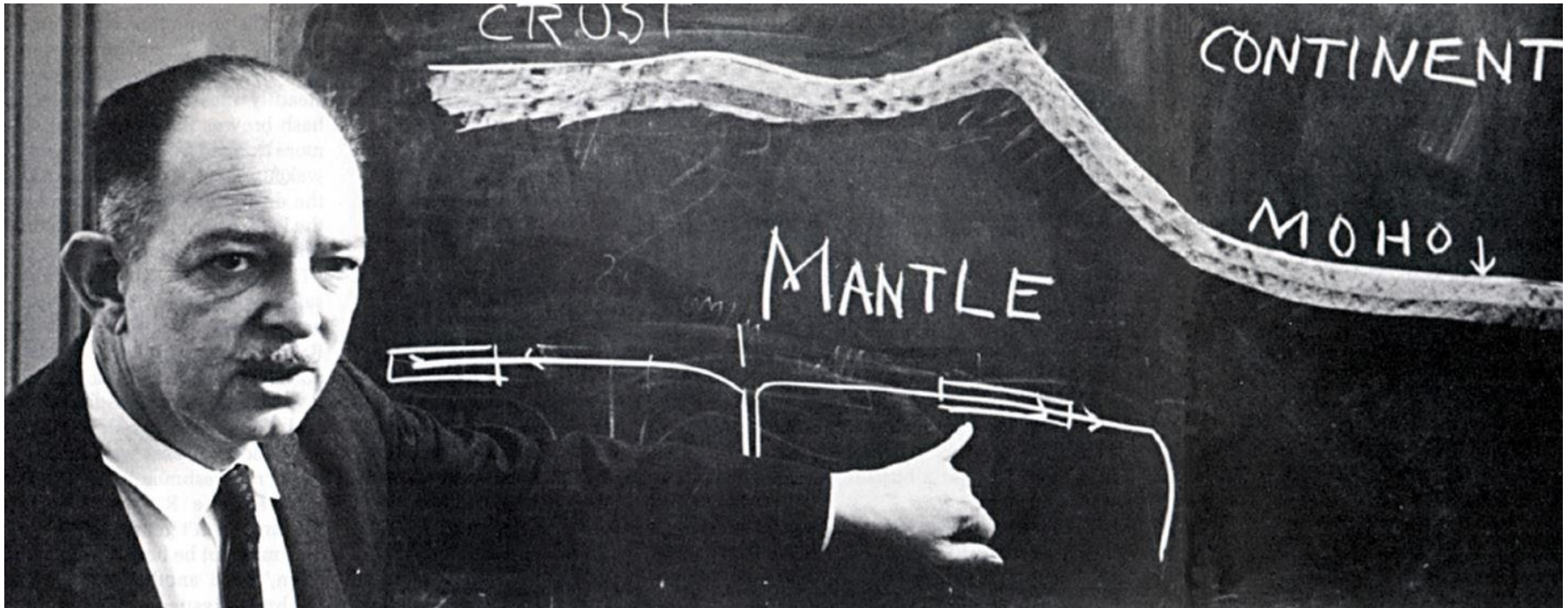
A expansión do fondo oceánico

Expansión do fondo oceánico

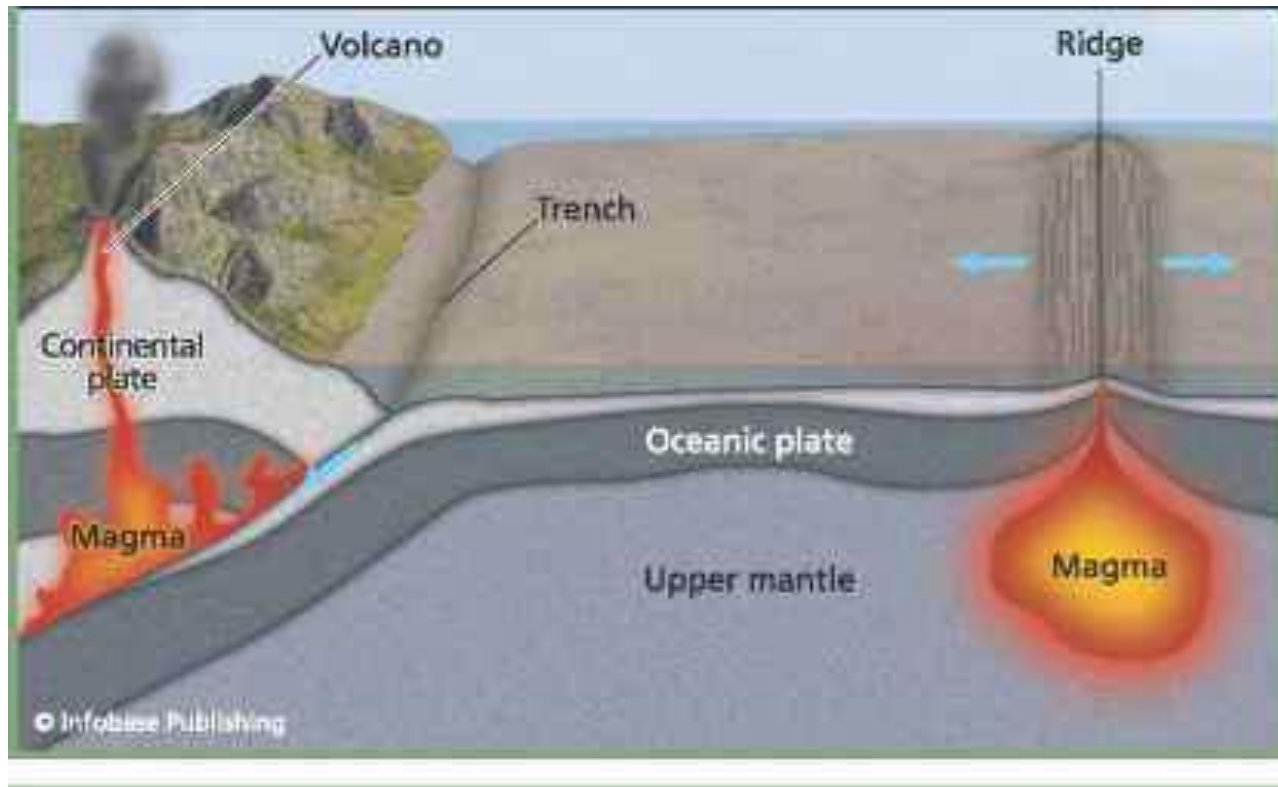


NOVO FONDO OCEÁNICO

SUERFICIE TERRESTRE
CONSTANTE



ZONAS DE SUBDUCCIÓN RECICLAJE LITOSFERA OCEÁNICA



CONVEYOR BELT



Arthur Holmes e Robert Dietz

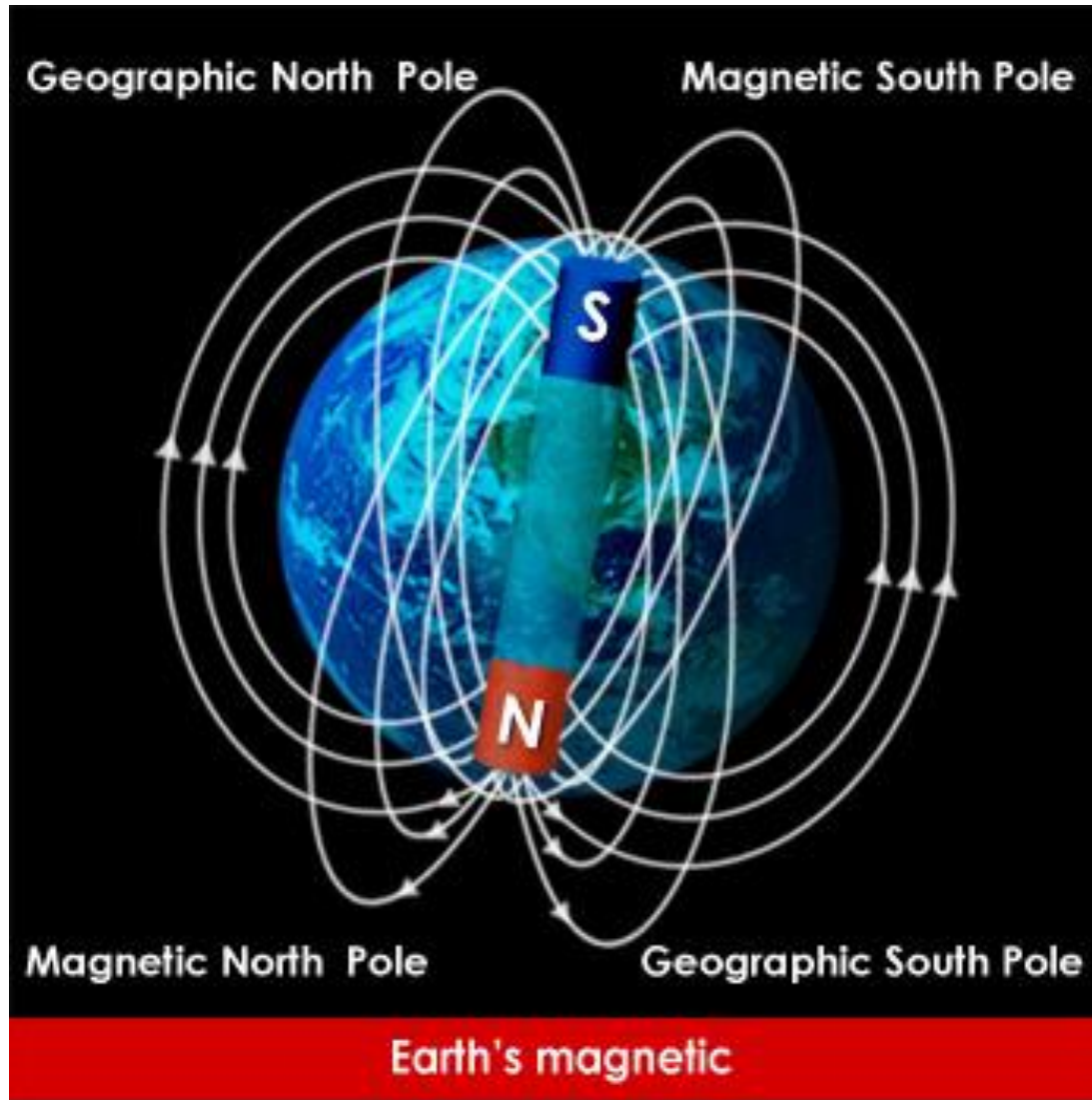


1930



1961

Registro paleomagnético nas rochas

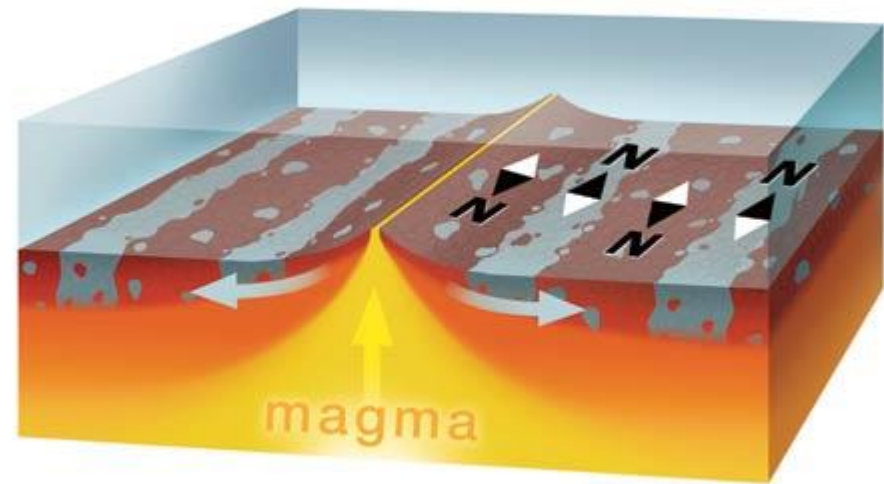
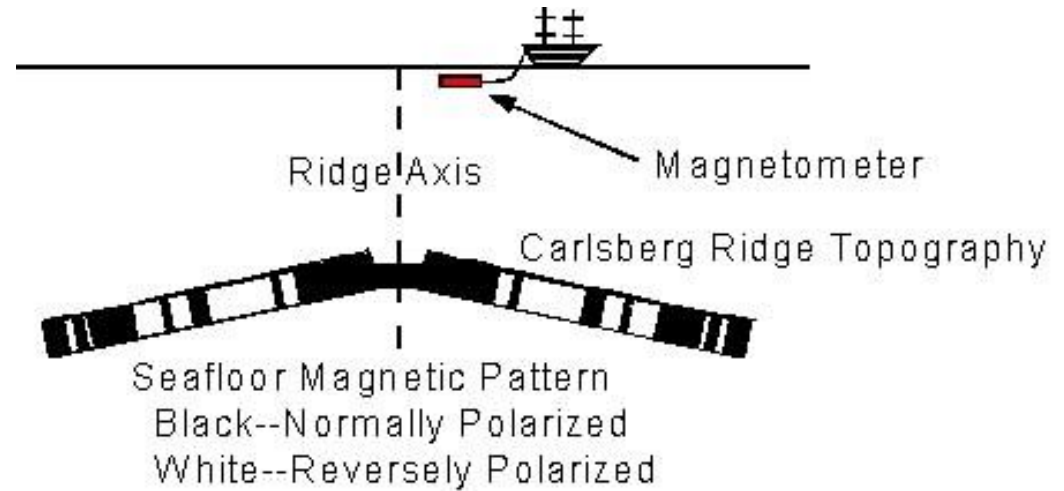


NOVOS DATOS VALIDAN A HIPÓTESE



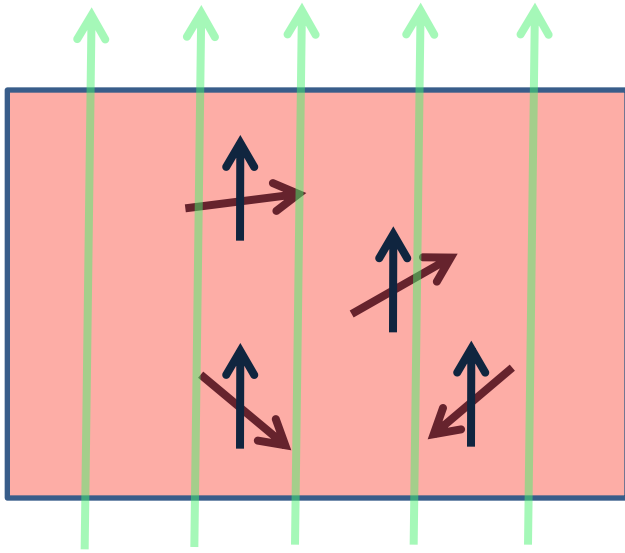
Left: Matthews (1931 - 1997)

Right: Vine (1939 - present)

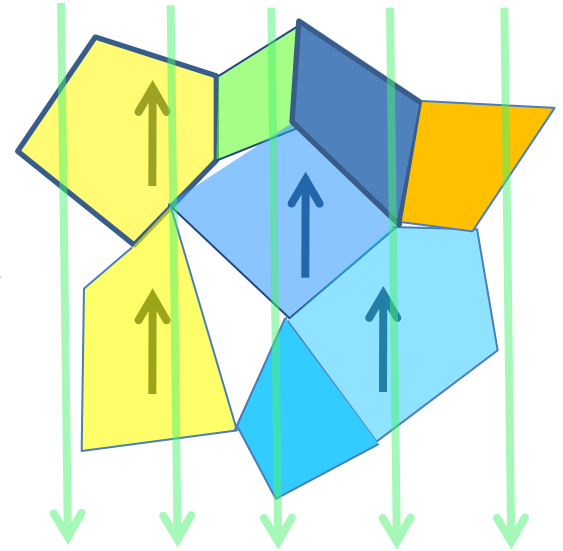




MINERAL MAGNÉTICO

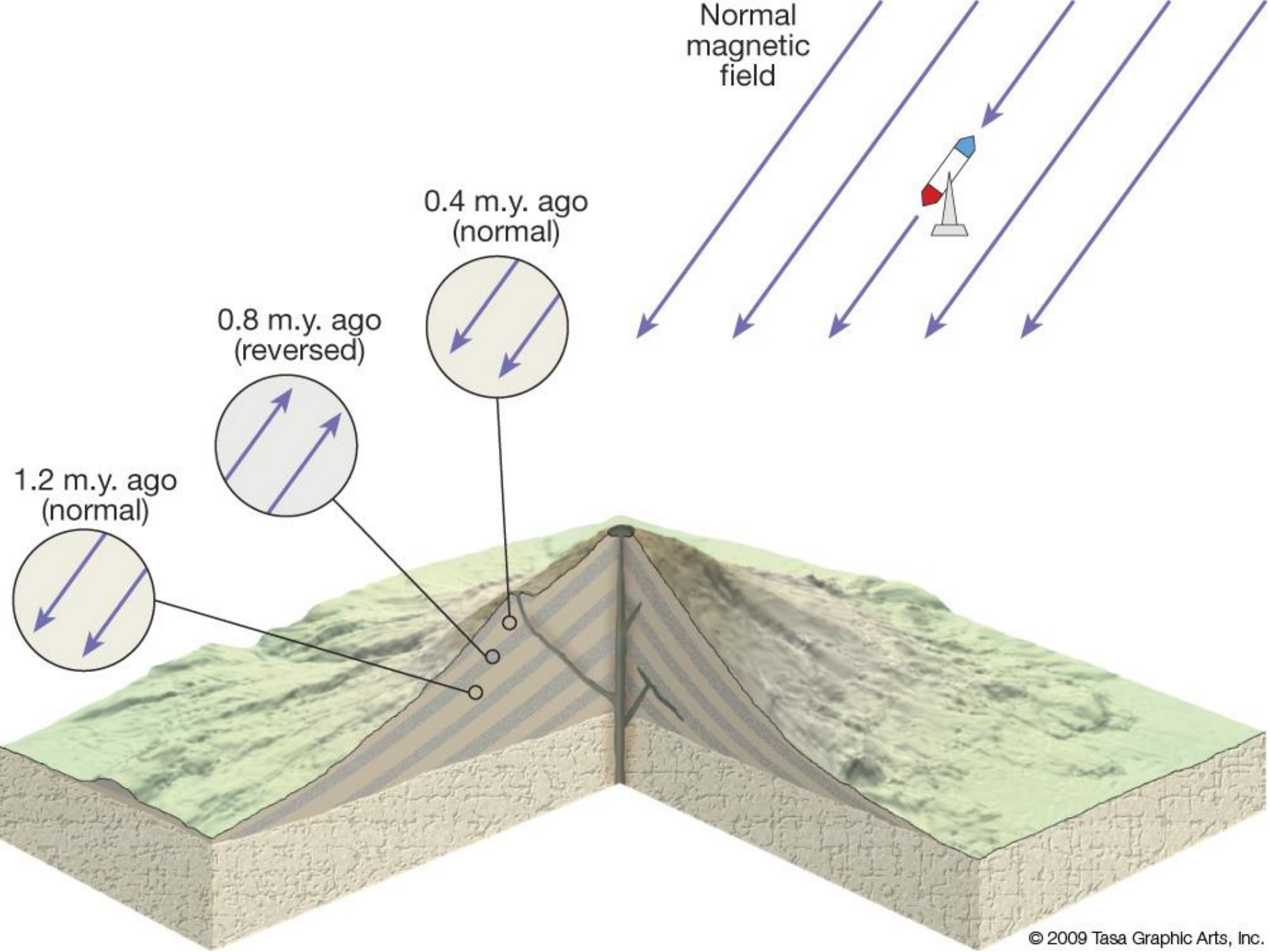


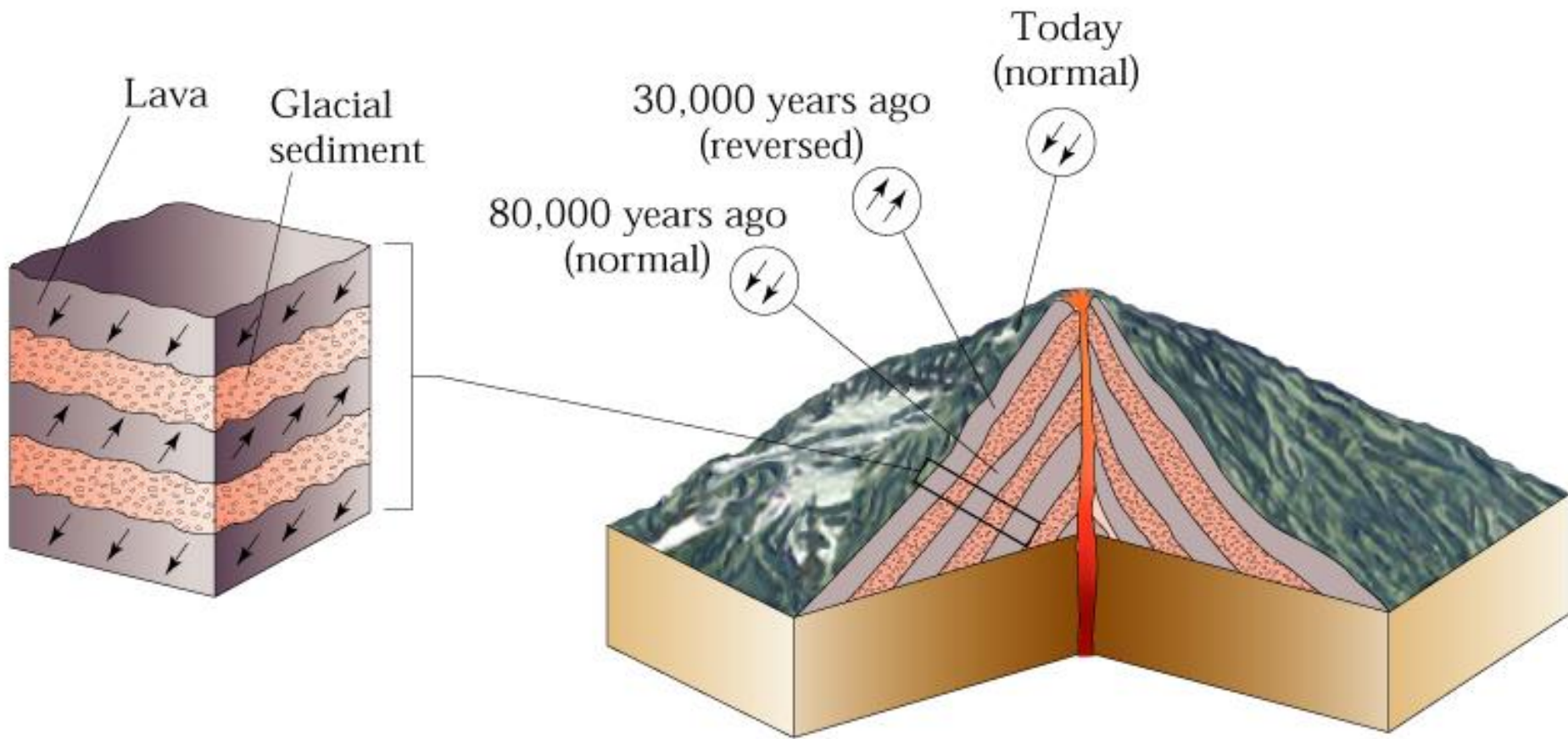
MAGMA



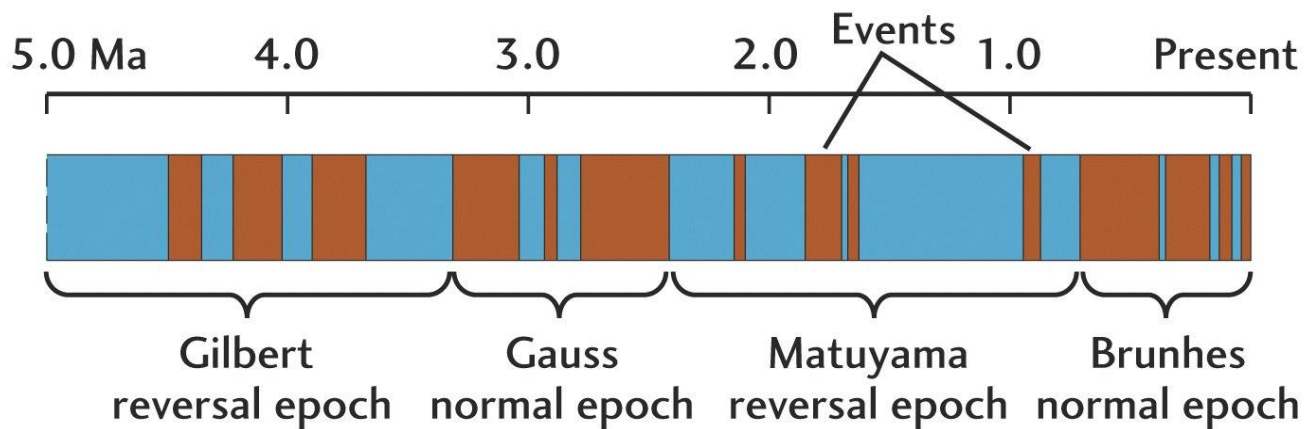
ROCHA ÍGNEA

Registro paleomagnético





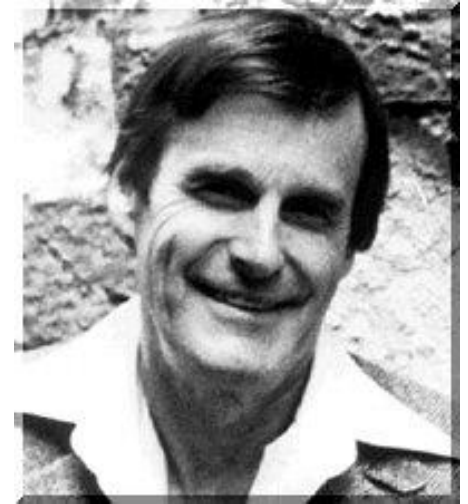
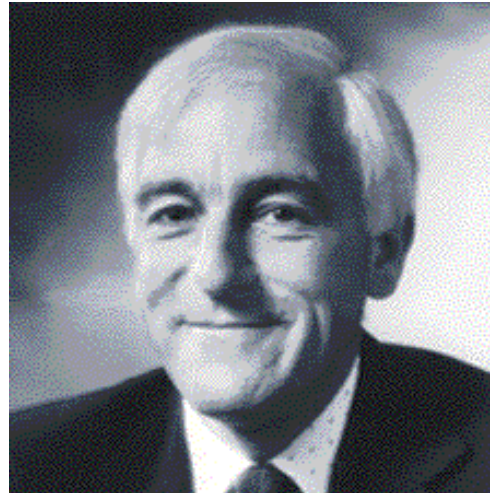
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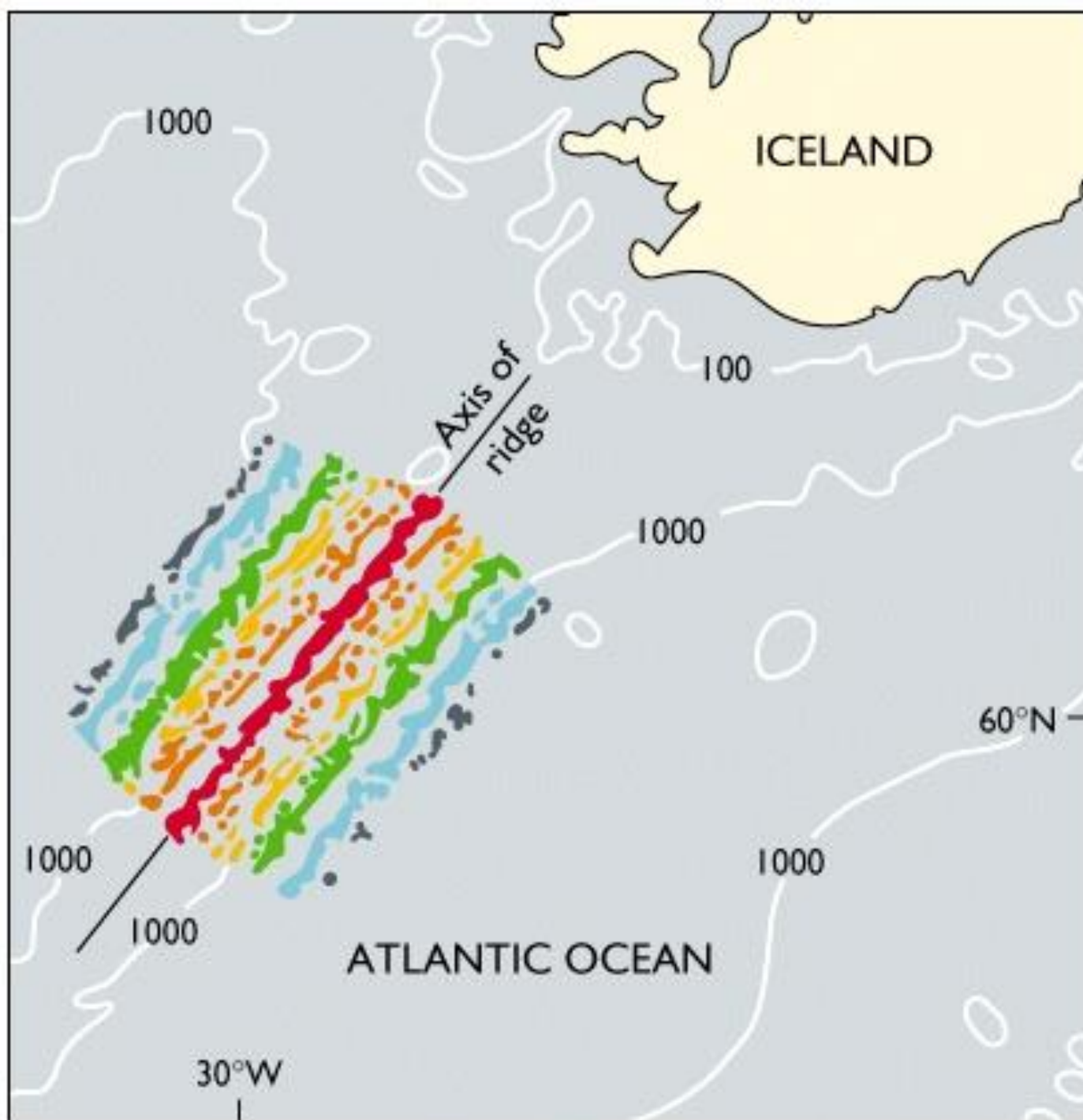
Vine, Mathews, Morley (1963)

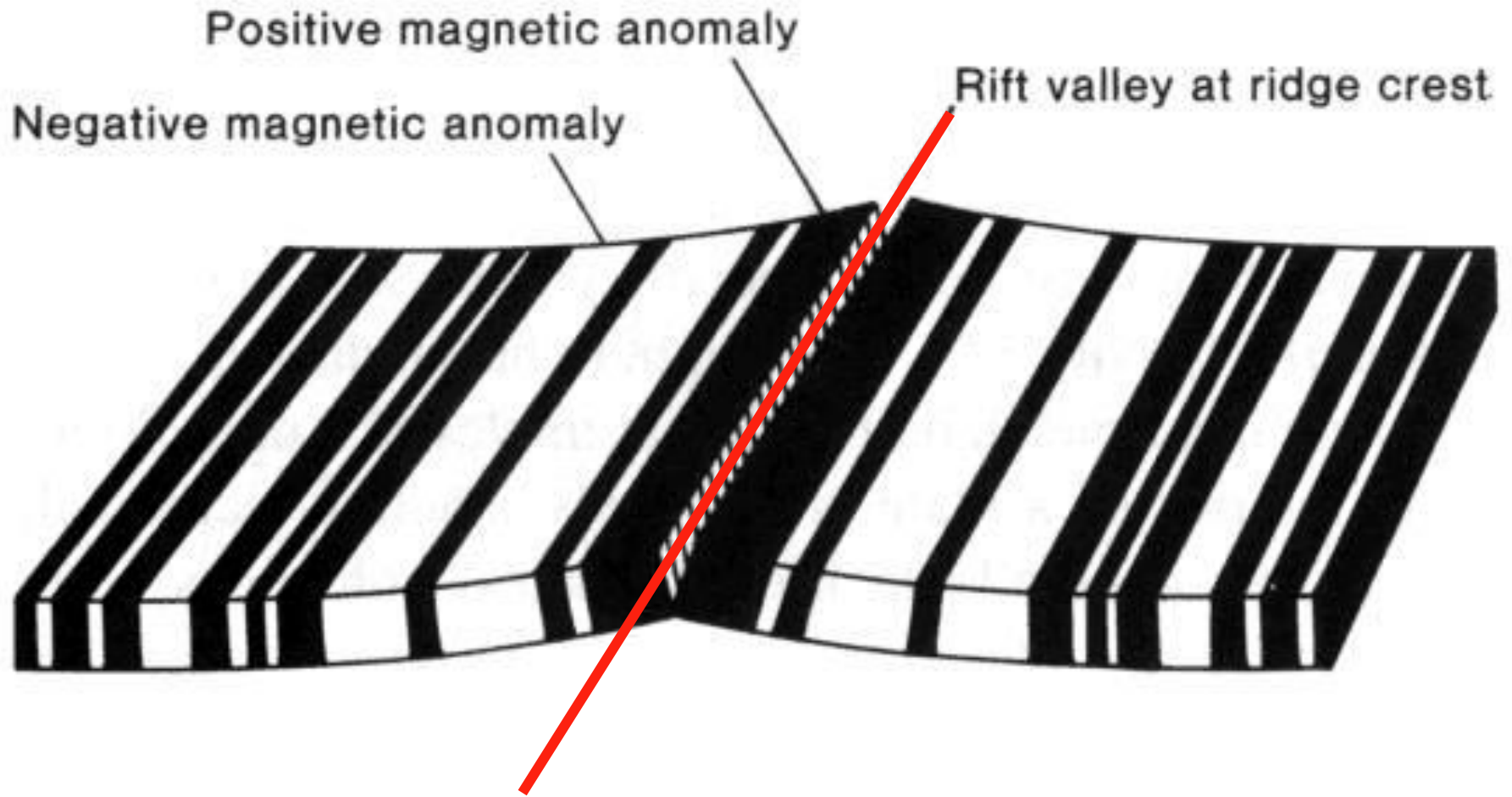


Fred Vine, at Cambridge in 1967, examining magnetic profiles. (Photo courtesy of Fred Vine.)



**ESTUDO DO REGISTRO PALEOMAGNÉTICO NO
FONDO OCEÁNICO**



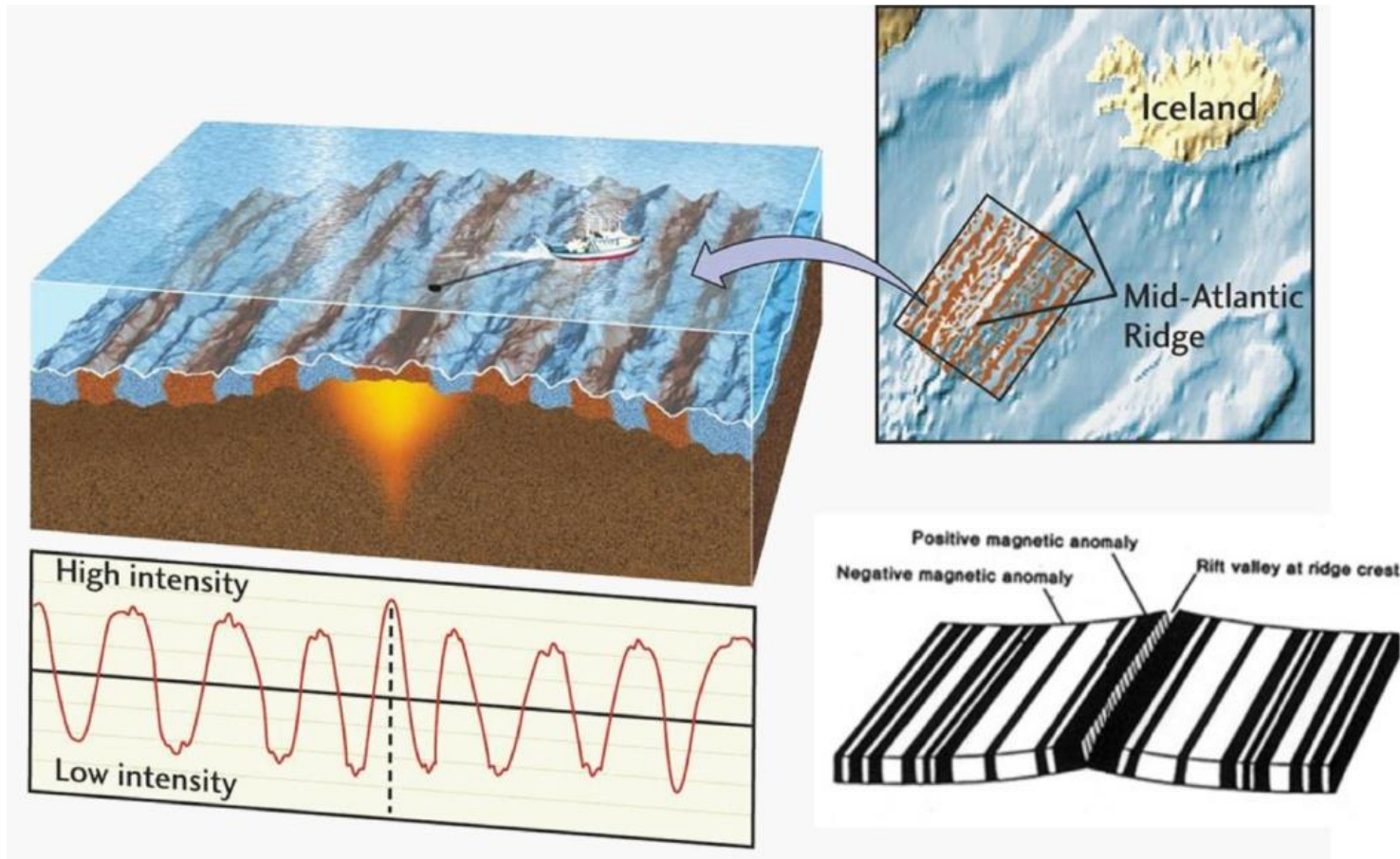


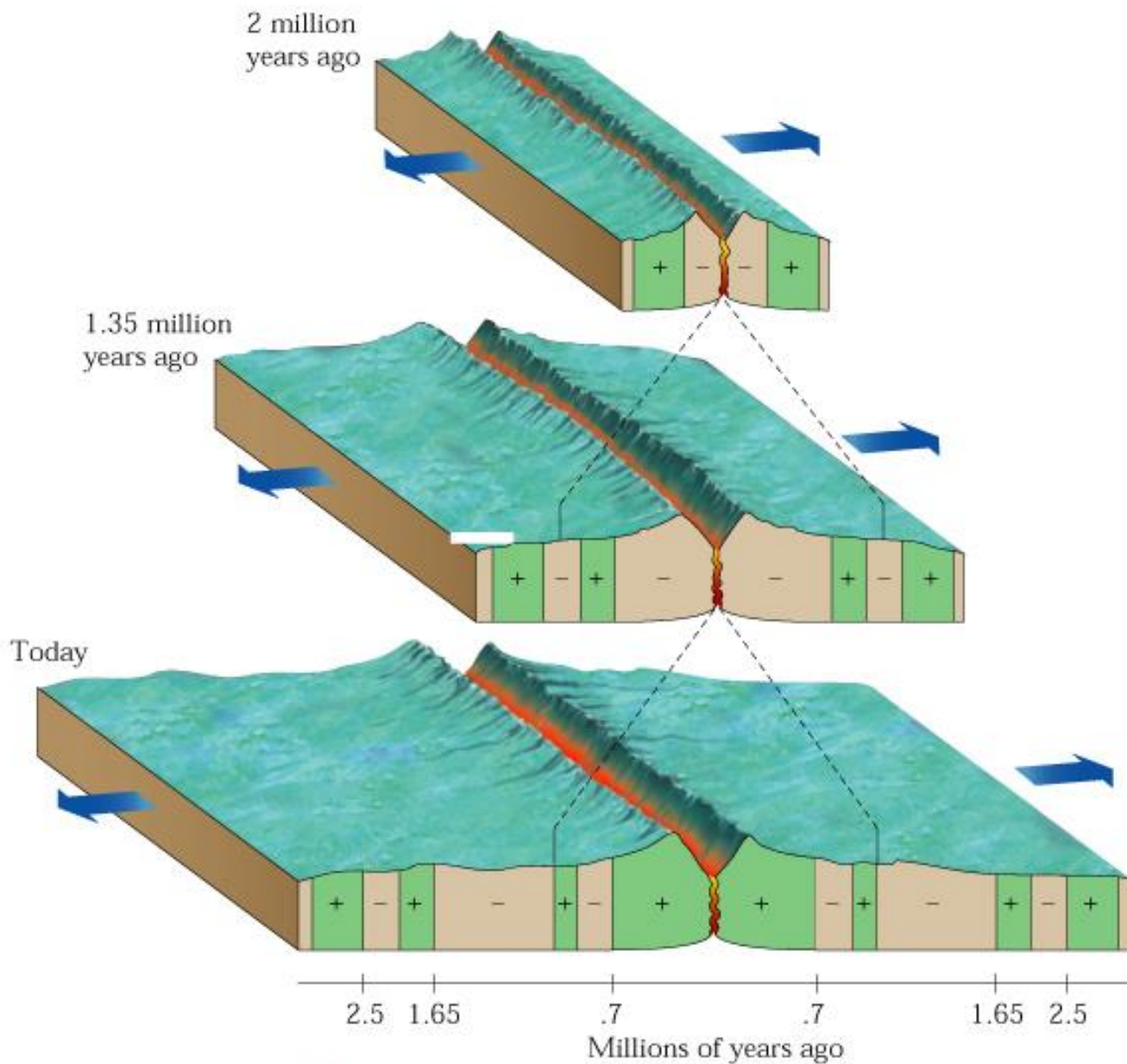
ALTERNANCIA DE ROCHAS CON POLARIDADE NORMAL E INVERTIDA
EN BANDAS PARALELAS Ó EIXO DA DORSAL

O BANDEADO É SIMÉTRICO CON RESPECTO Ó EIXO DA DORSAL

EXERCICIO PÁXINA 62

- Explica de qué xeito estes datos validan a hipótese da expansión do fondo oceánico.
- Por qué a expansión do fondo oceánico ofrece un mecanismo para explicar a deriva continental?





- + Normal polarity
- Reversed polarity

200

MILLION
YEARS
AGO



Quantum
Animation

Mediciones con raio láser e satélites a partir dos anos 70 do século pasado



60 centímetros, 405 kilogramos
426 retroreflectores

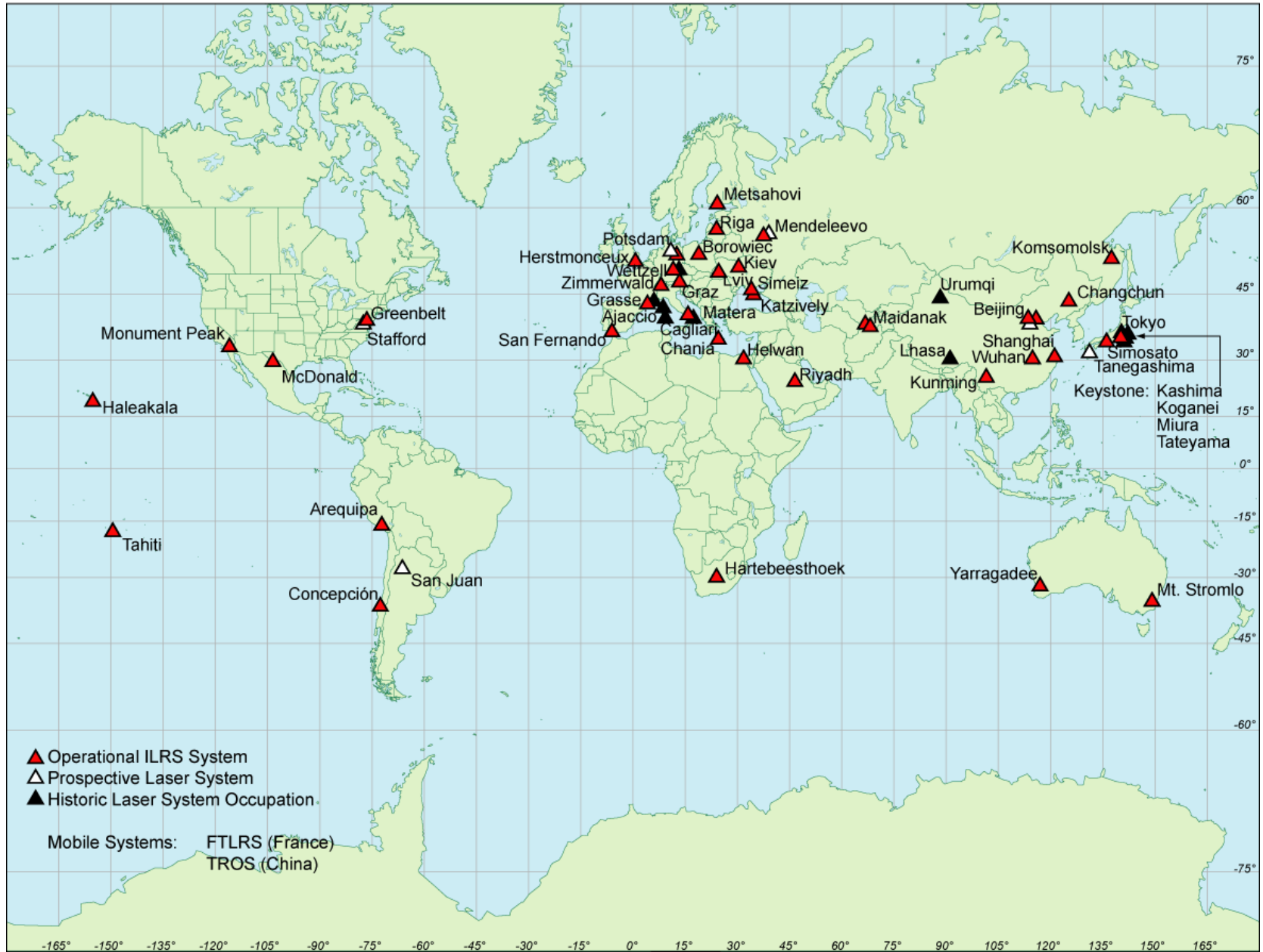
LAGEOS-1, fue diseñado por la NASA y lanzado en 1976. Este fue el primer satélite dedicado exclusivamente a las Mediciones Láser a Satélites de alta precisión y entregó la primera oportunidad de usar datos sin errores originados en la orbita del satélite.

LAGEOS-2, esta basado en el diseño de su antecesor, fue construido por la Agencia Espacial Italiana y lanzado el año 1992.

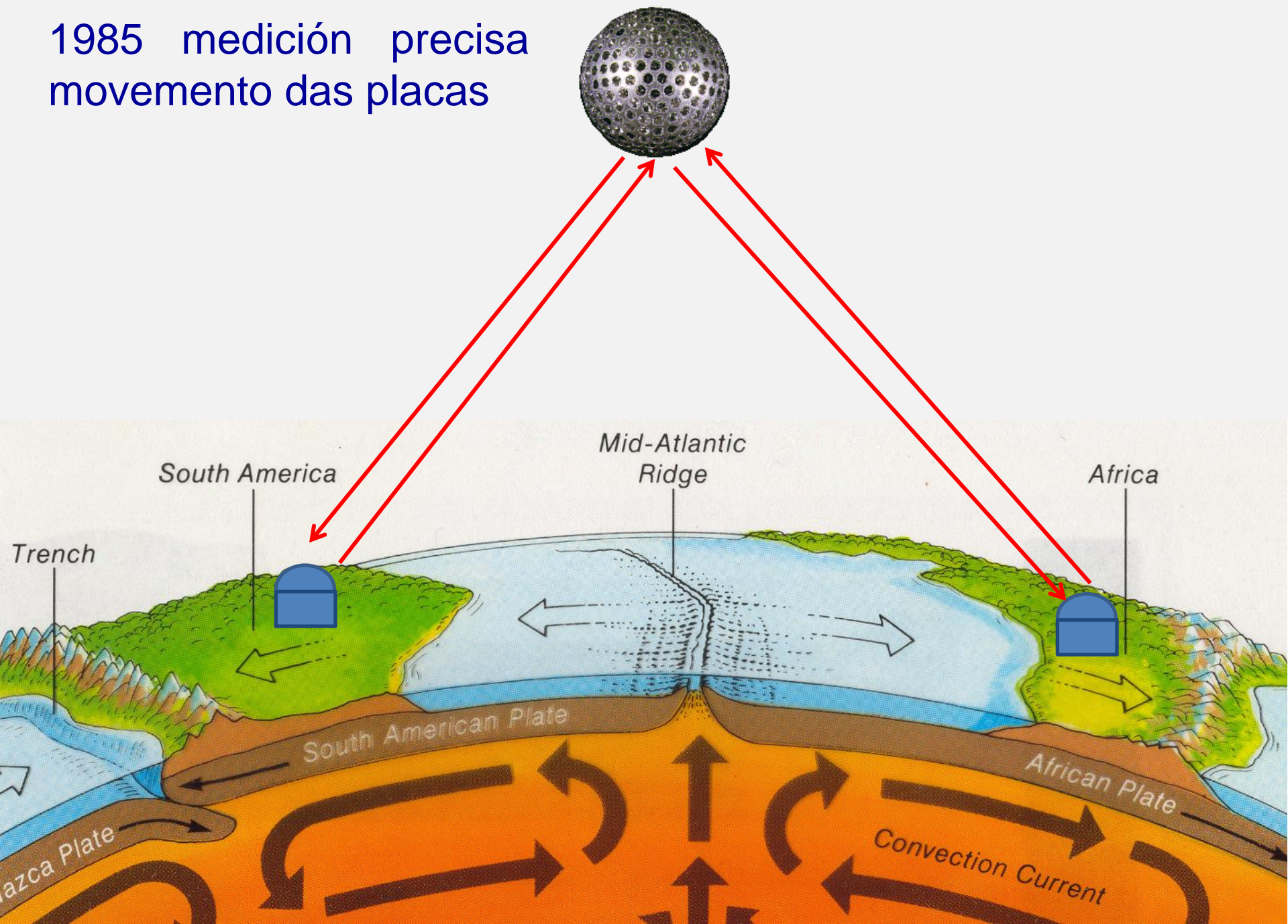
Rede de estações terrestres emisoras-receptoras de raios laser

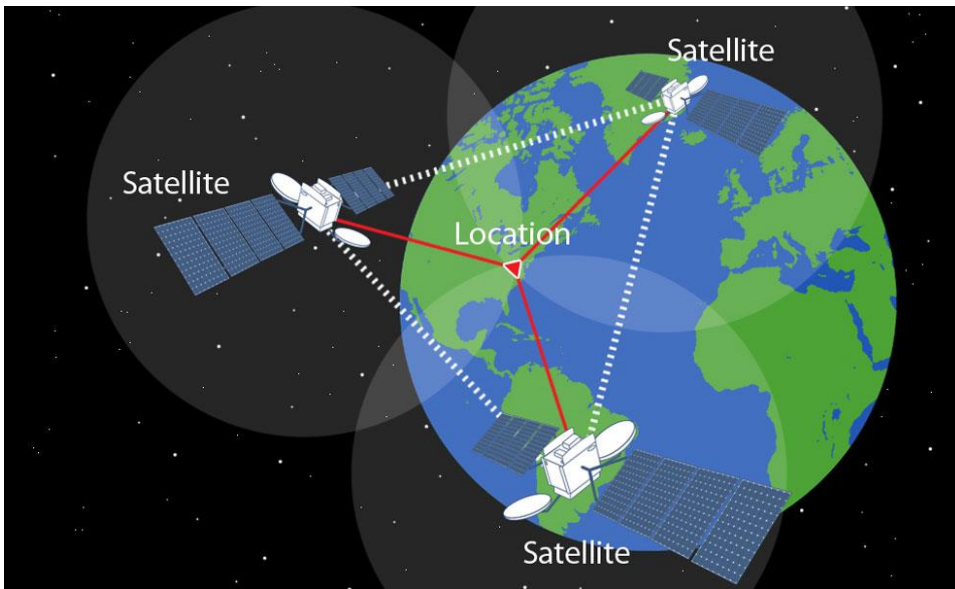


International Laser Ranging Service (ILRS) Network

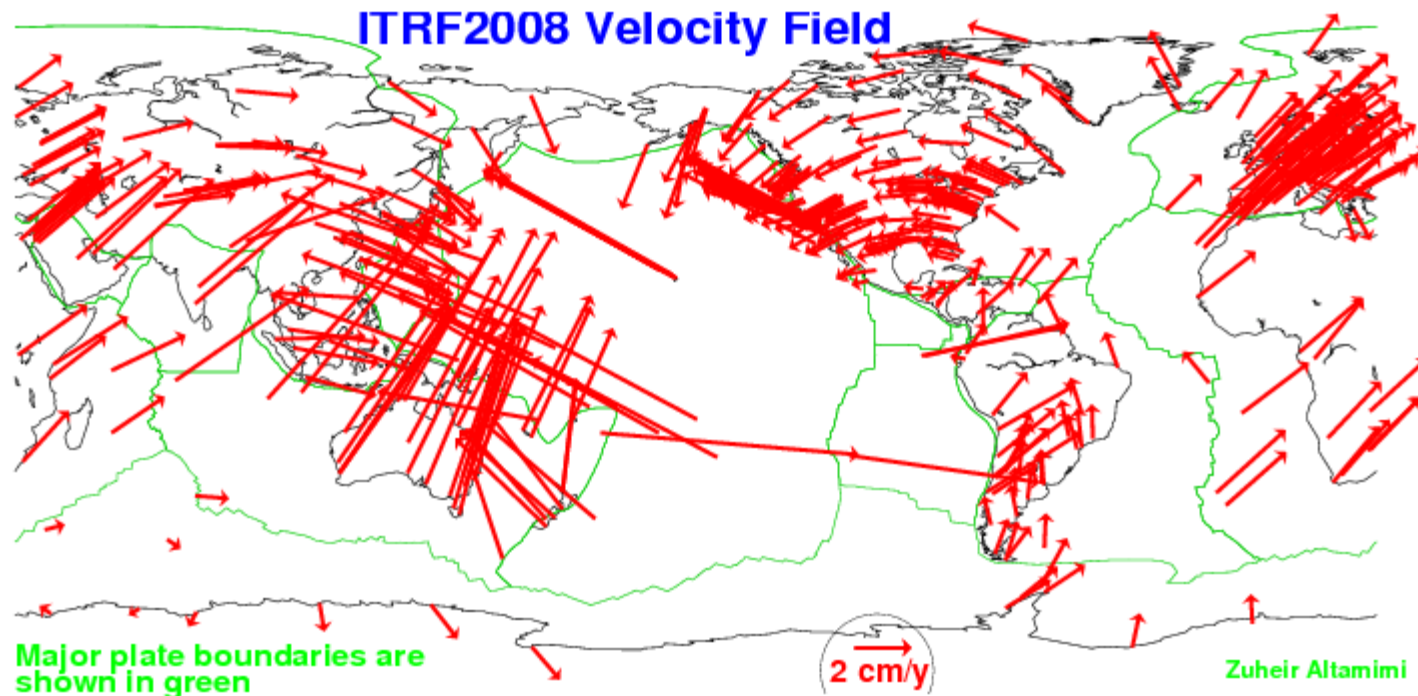


1985 medición precisa
movimiento das placas

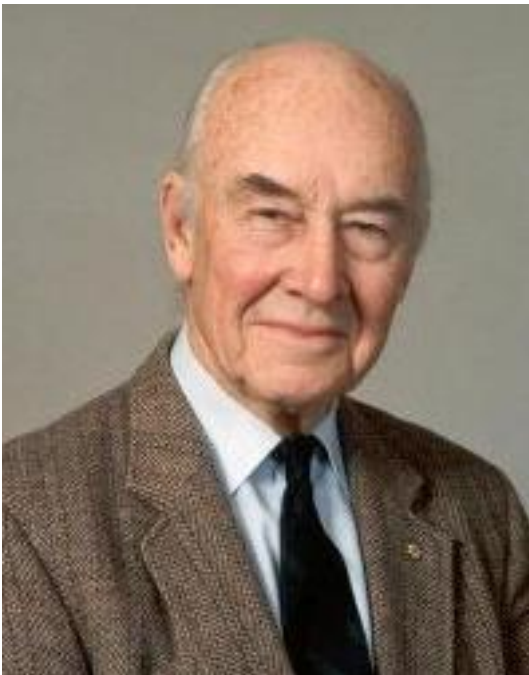
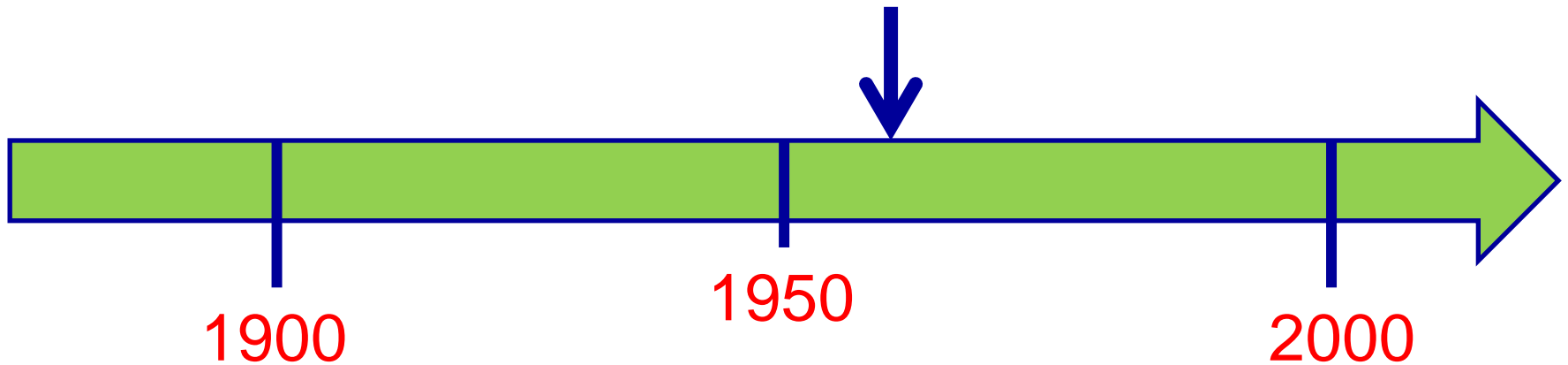




MEDIDAS GPS



JOHN TUZO WILSON



ENUNCIA A TEORÍA DA
TECTÓNICA DE PLACA
NA SÚA FORMULACIÓN
ACTUAL

Puntos quentes, fallas
transformantes

TECTÓNICA DE PLACAS E CAMBIO CLIMÁTICO

PALEOCLIMATOLOGÍA

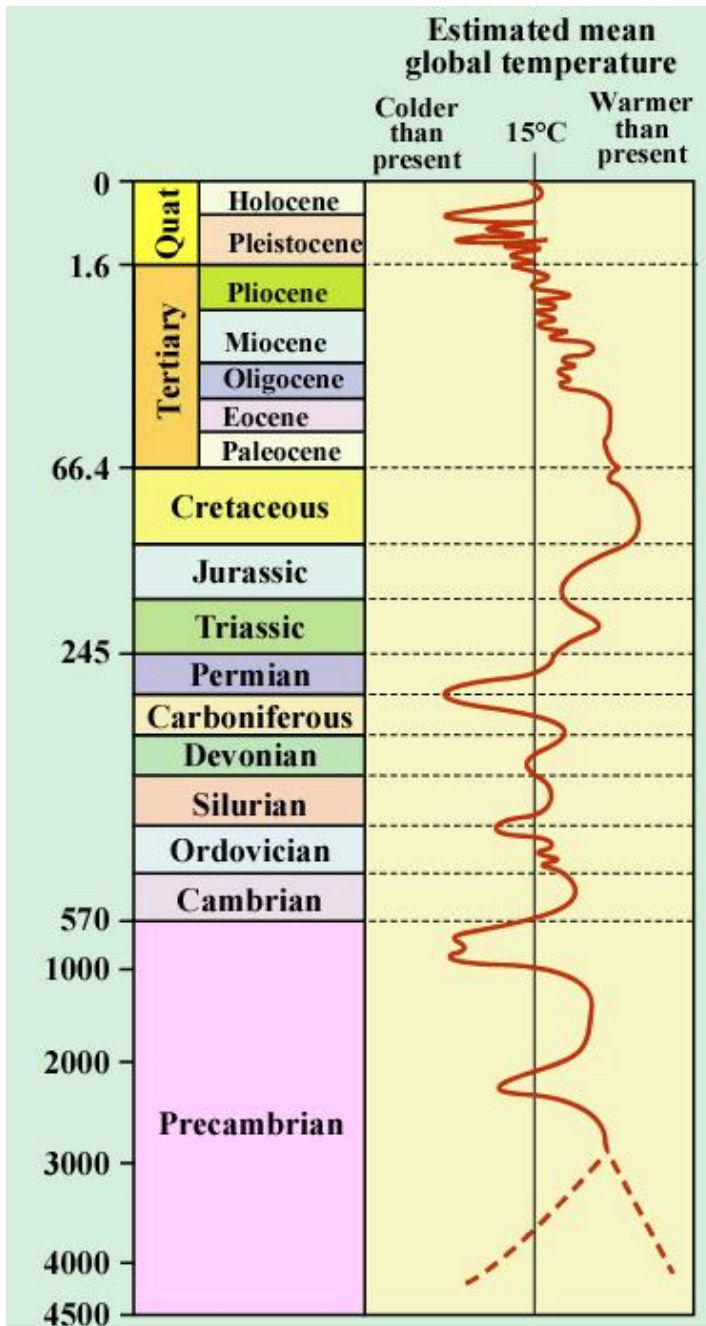
CAMBIO CLIMÁTICO

variaciones nos parámetros que determinan o clima (temperatura, precipitaciones, frecuencia de fenómenos extremos) que se mantienen durante periodos de tempo longos (de centos a miles de anos).

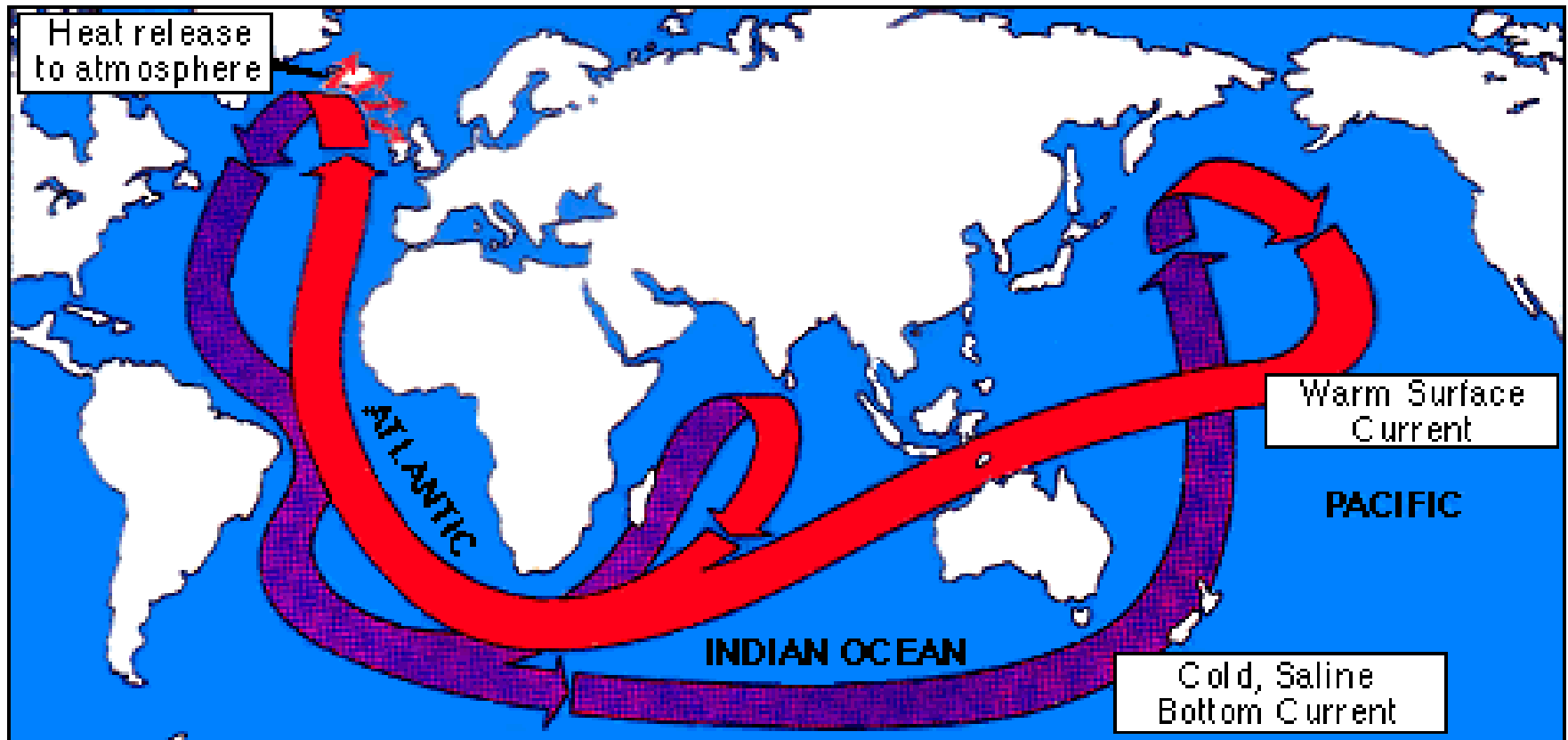
INDICADORES PALEOCLIMÁTICOS

CLIMA MUI
VARIABLE

TECTÓNICA DE
PLACAS ?

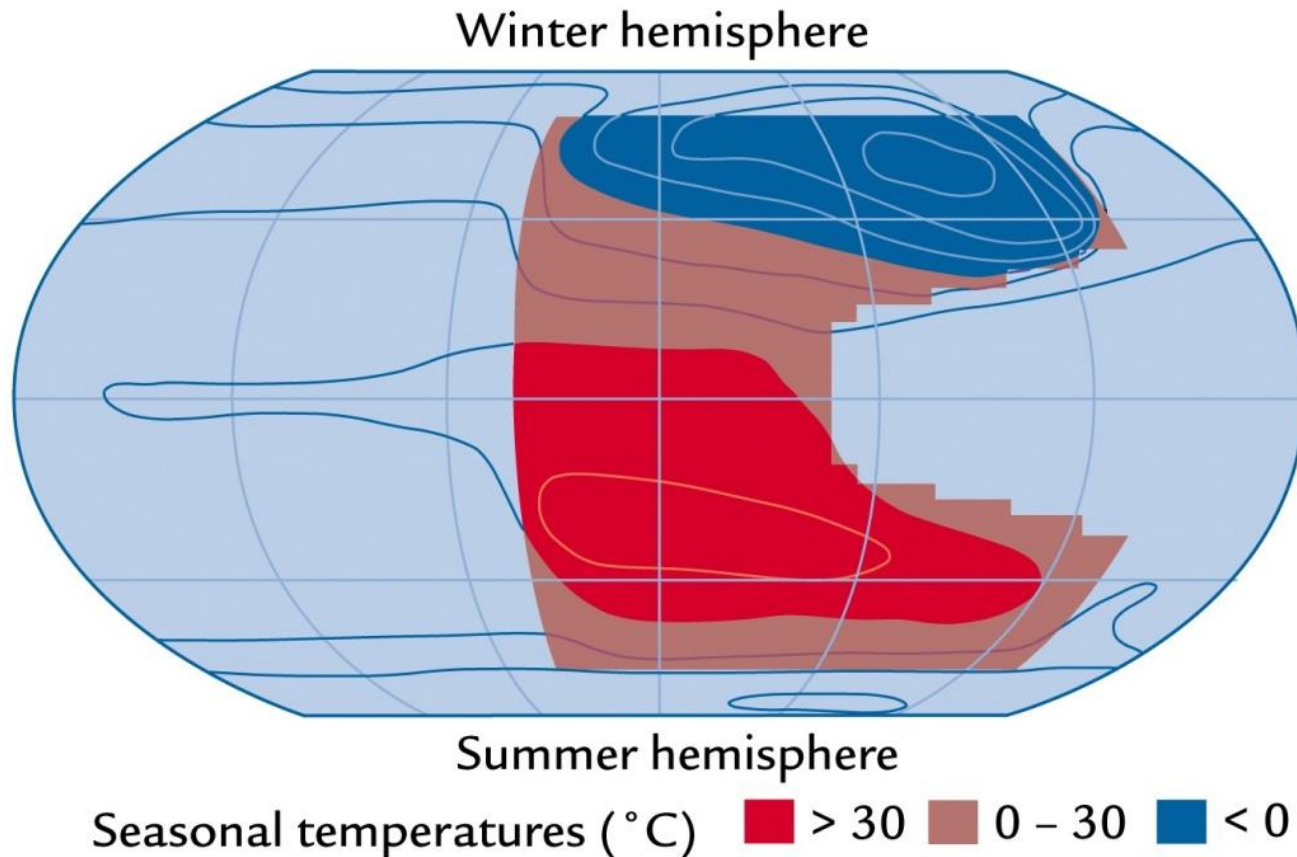


ALTERACIÓN CIRCULACIÓN OCEÁNICA

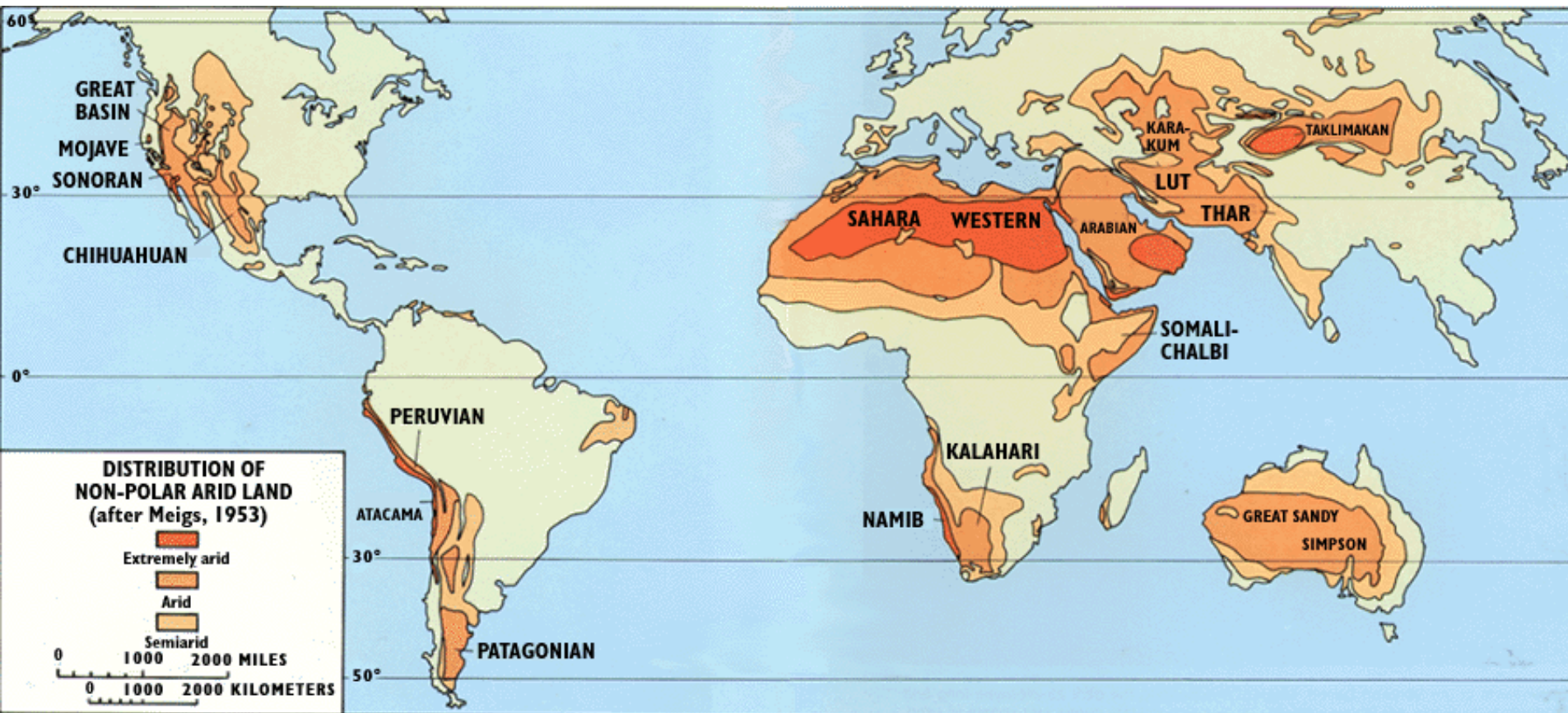


The present large-scale ocean current system determines climate to a great extent. The huge "conveyor belt" reacts extremely sensitively to global temperature changes accompanying each increase and decrease in the content of carbon dioxide in the atmosphere. - Broecker

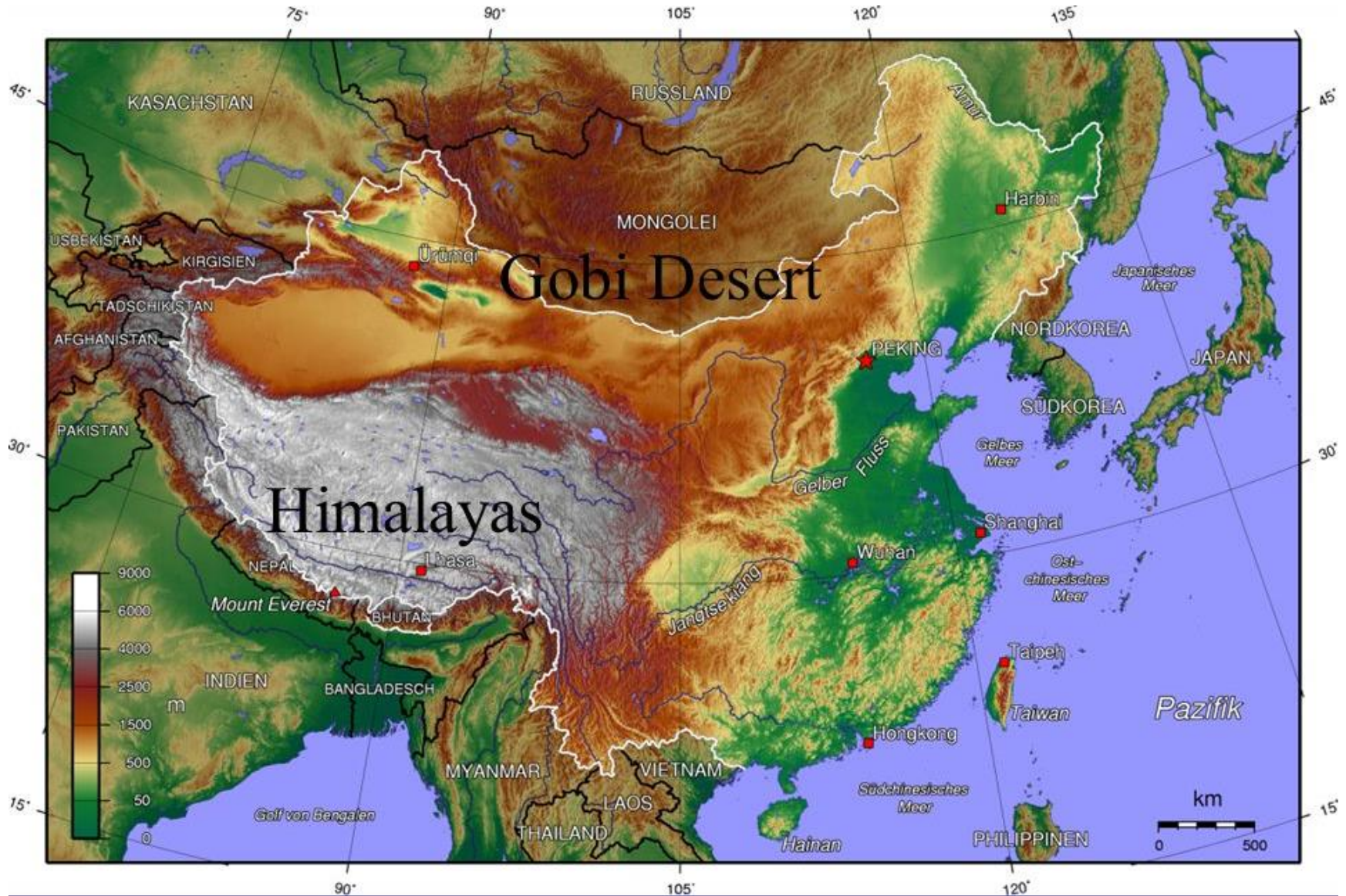
INCREMENTO DA CONTINENTALIDADE



BARREIRAS MONTAÑOSAS



DESERTOS DE EFECTO FOEHM



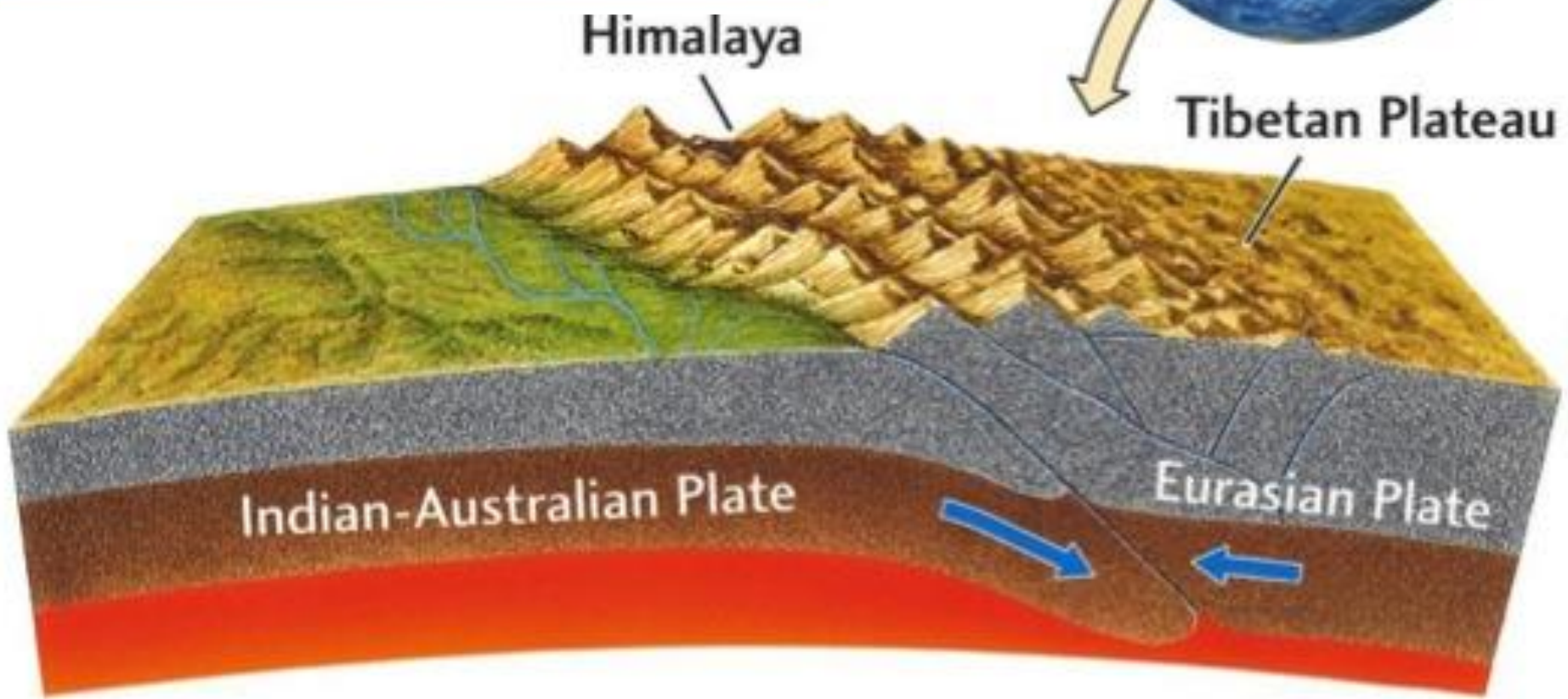
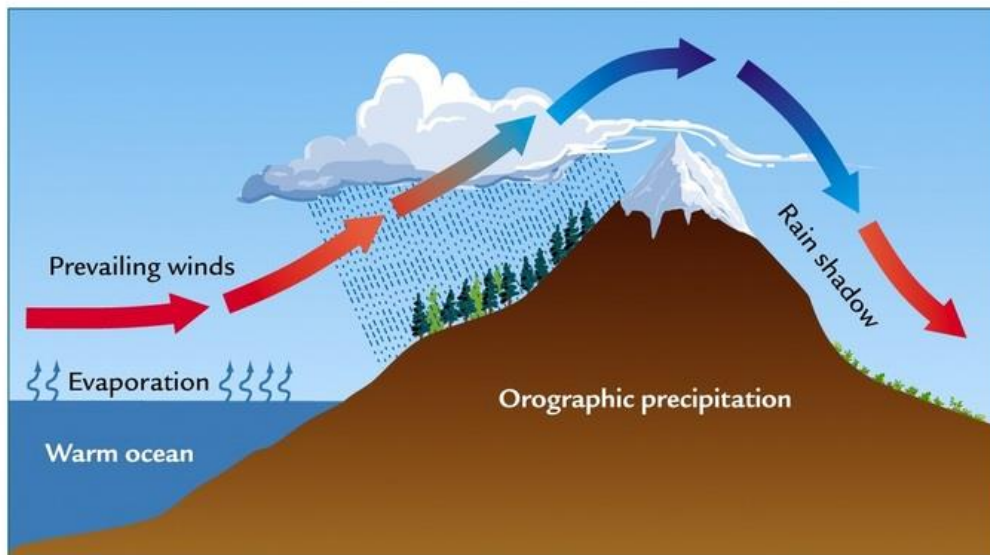
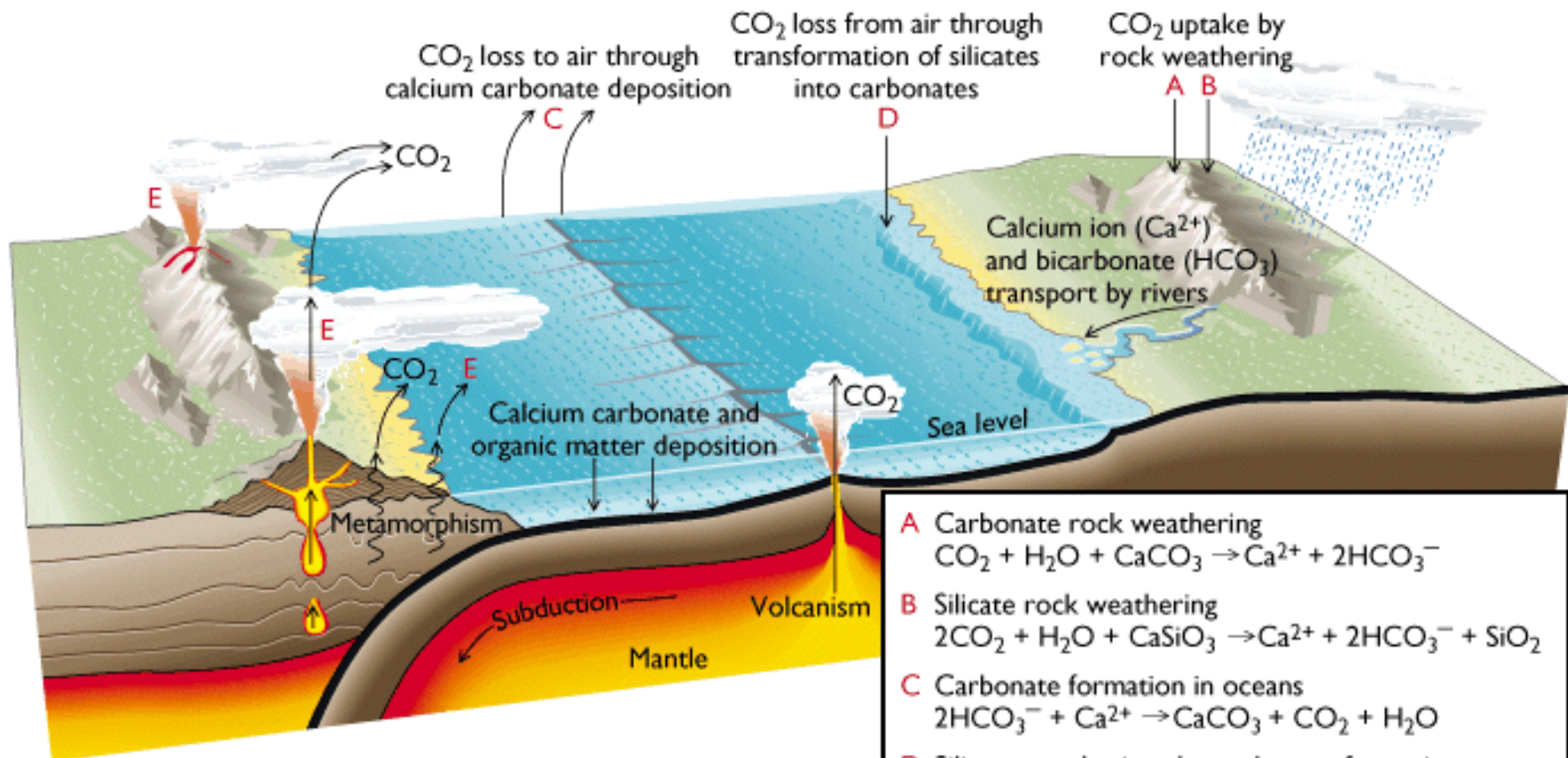


Plate Tectonics and CO₂

Plate tectonics affects atmospheric CO₂, which factors into climate through the greenhouse effect.

Volcanoes produce CO₂. If global volcanism slows, as would be the case when supercontinents stabilize, less atmospheric CO₂ would trigger global cooling. Increased volcanism puts more CO₂ in the atmosphere and results in more greenhouse warming.



- A** Carbonate rock weathering

$$\text{CO}_2 + \text{H}_2\text{O} + \text{CaCO}_3 \rightarrow \text{Ca}^{2+} + 2\text{HCO}_3^-$$
- B** Silicate rock weathering

$$2\text{CO}_2 + \text{H}_2\text{O} + \text{CaSiO}_3 \rightarrow \text{Ca}^{2+} + 2\text{HCO}_3^- + \text{SiO}_2$$
- C** Carbonate formation in oceans

$$2\text{HCO}_3^- + \text{Ca}^{2+} \rightarrow \text{CaCO}_3 + \text{CO}_2 + \text{H}_2\text{O}$$
- D** Silicate weathering plus carbonate formation (reactions B + C)

$$\text{CO}_2 + \text{CaSiO}_3 \rightarrow \text{CaCO}_3 + \text{SiO}_2$$
- E** Metamorphic/magmatic breakdown of carbonate

$$\text{CaCO}_3 + \text{SiO}_2 \rightarrow \text{CaSiO}_3 + \text{CO}_2$$

EXERCICIO

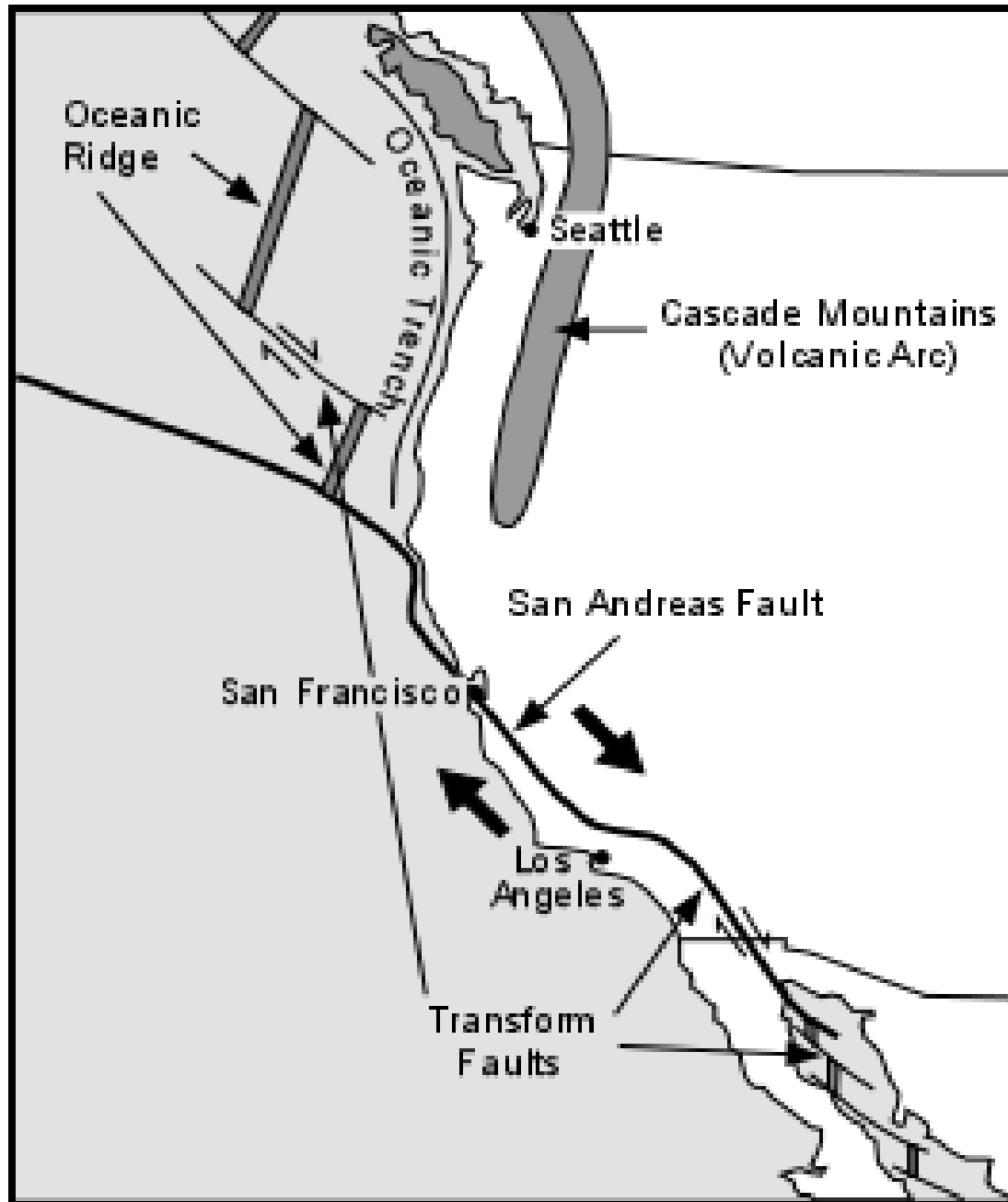
EVOLUCIÓN SW USA



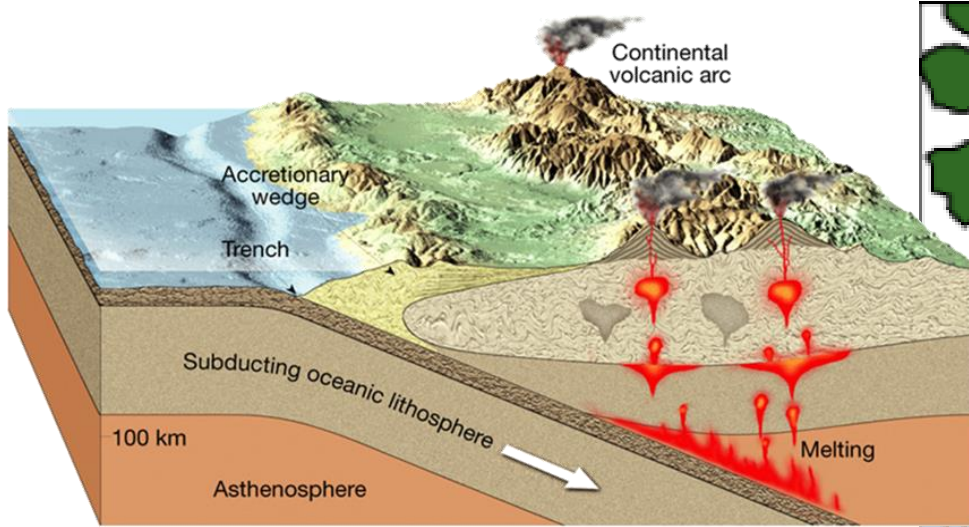


MAPA DE PLACAS

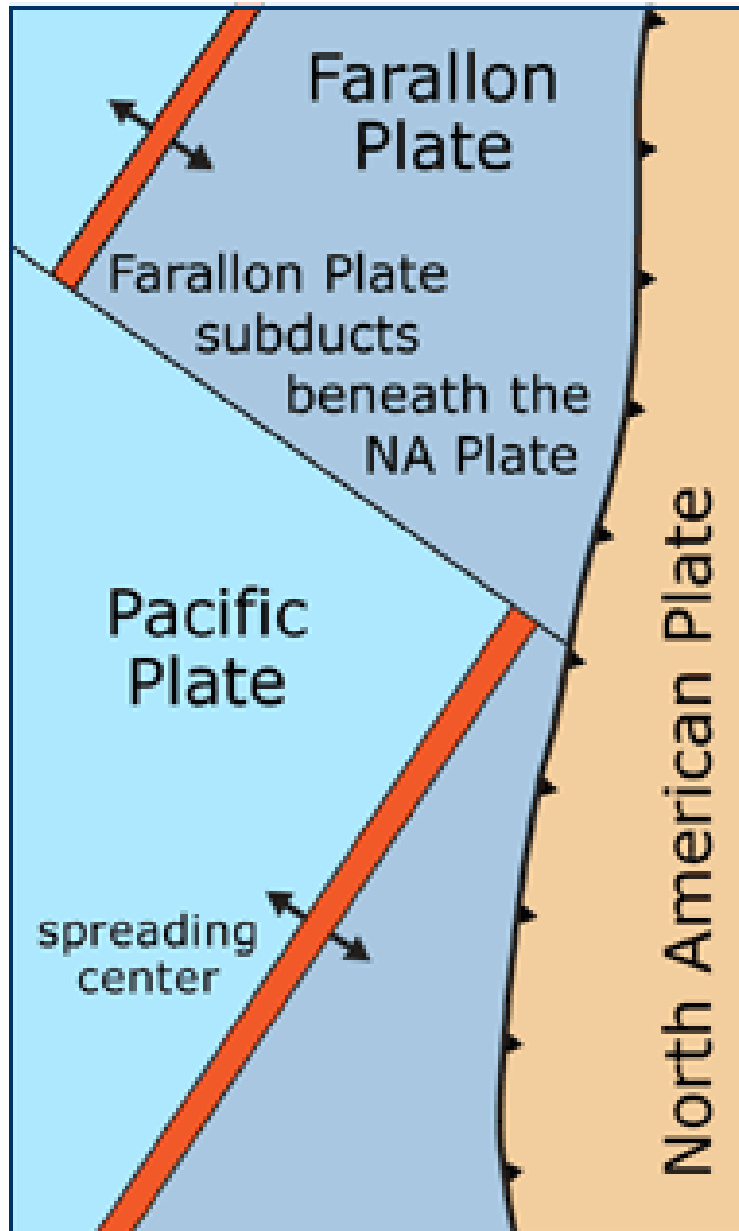




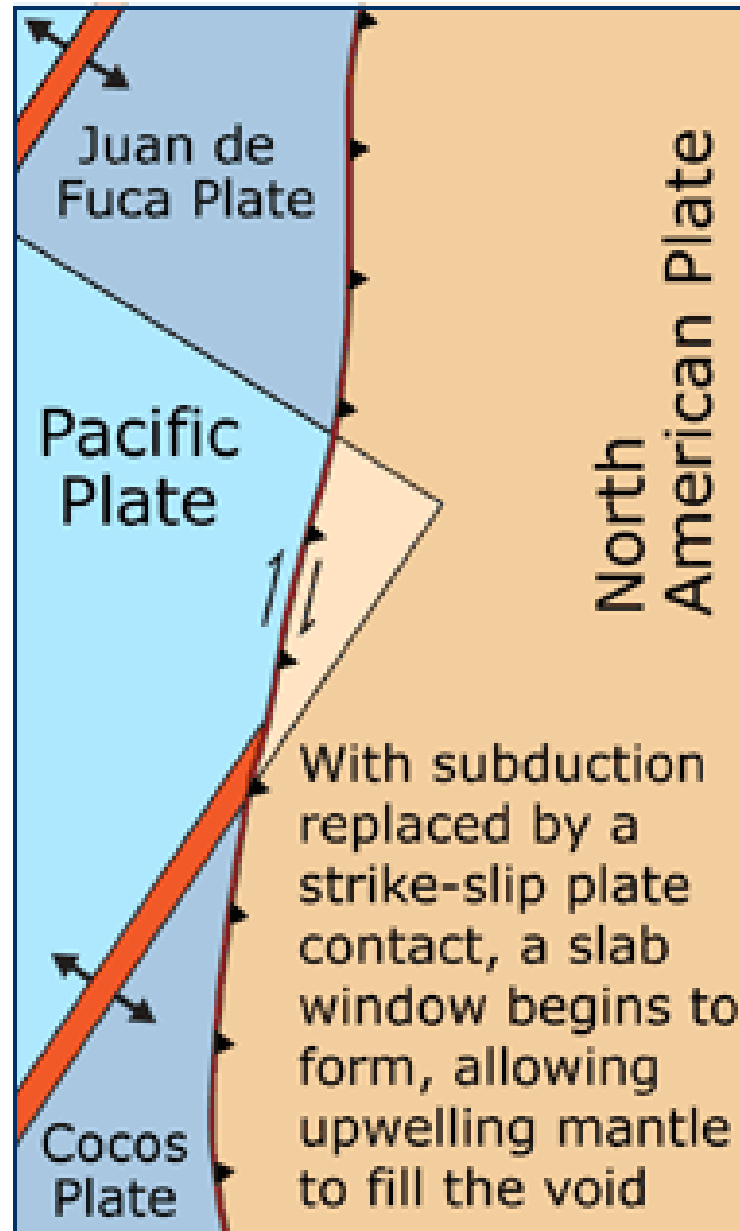
HAI 30 MILLÓNS DE ANOS

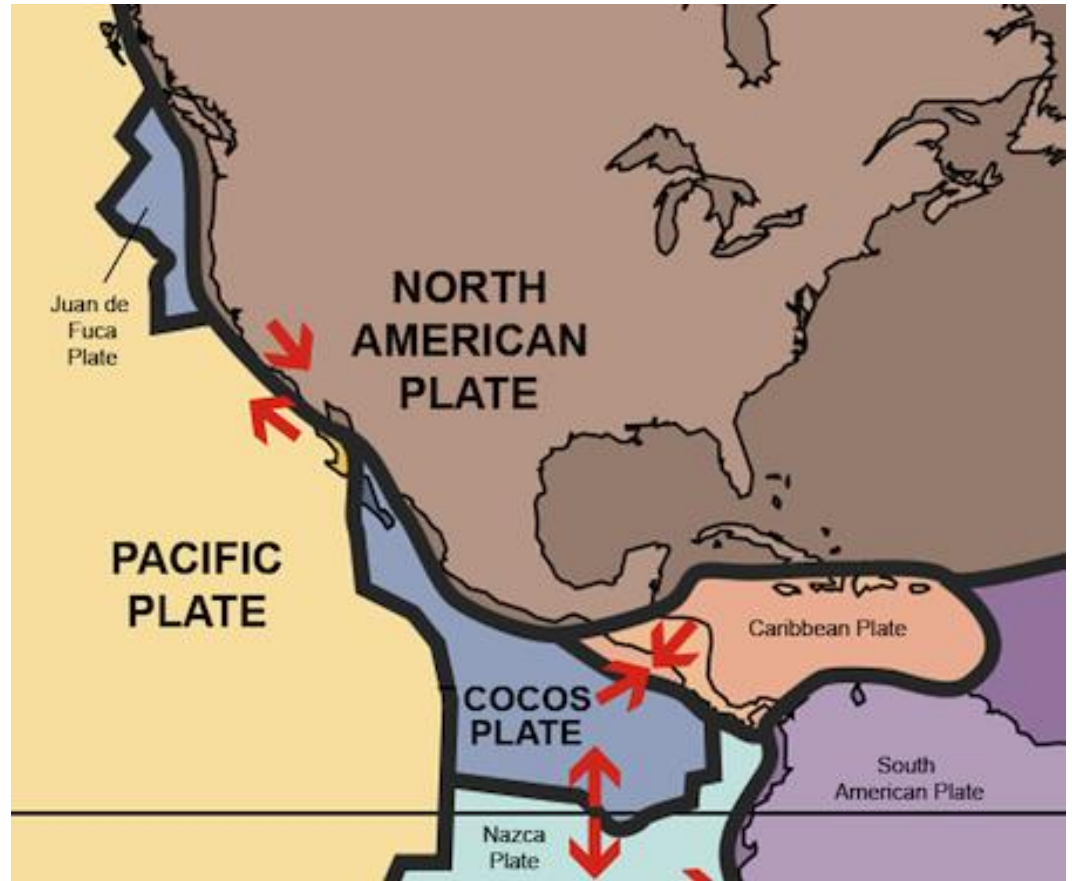
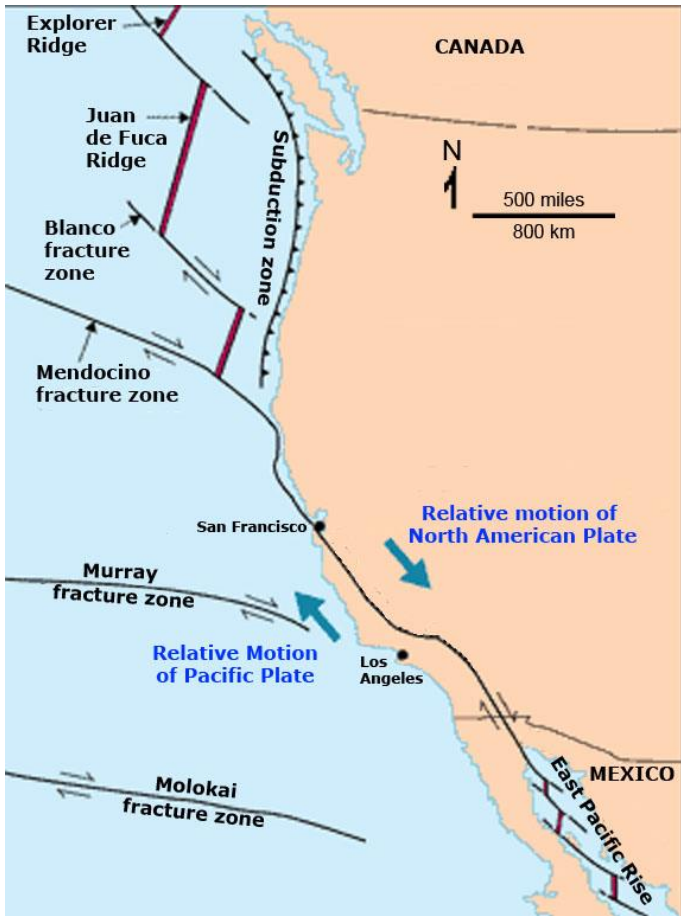


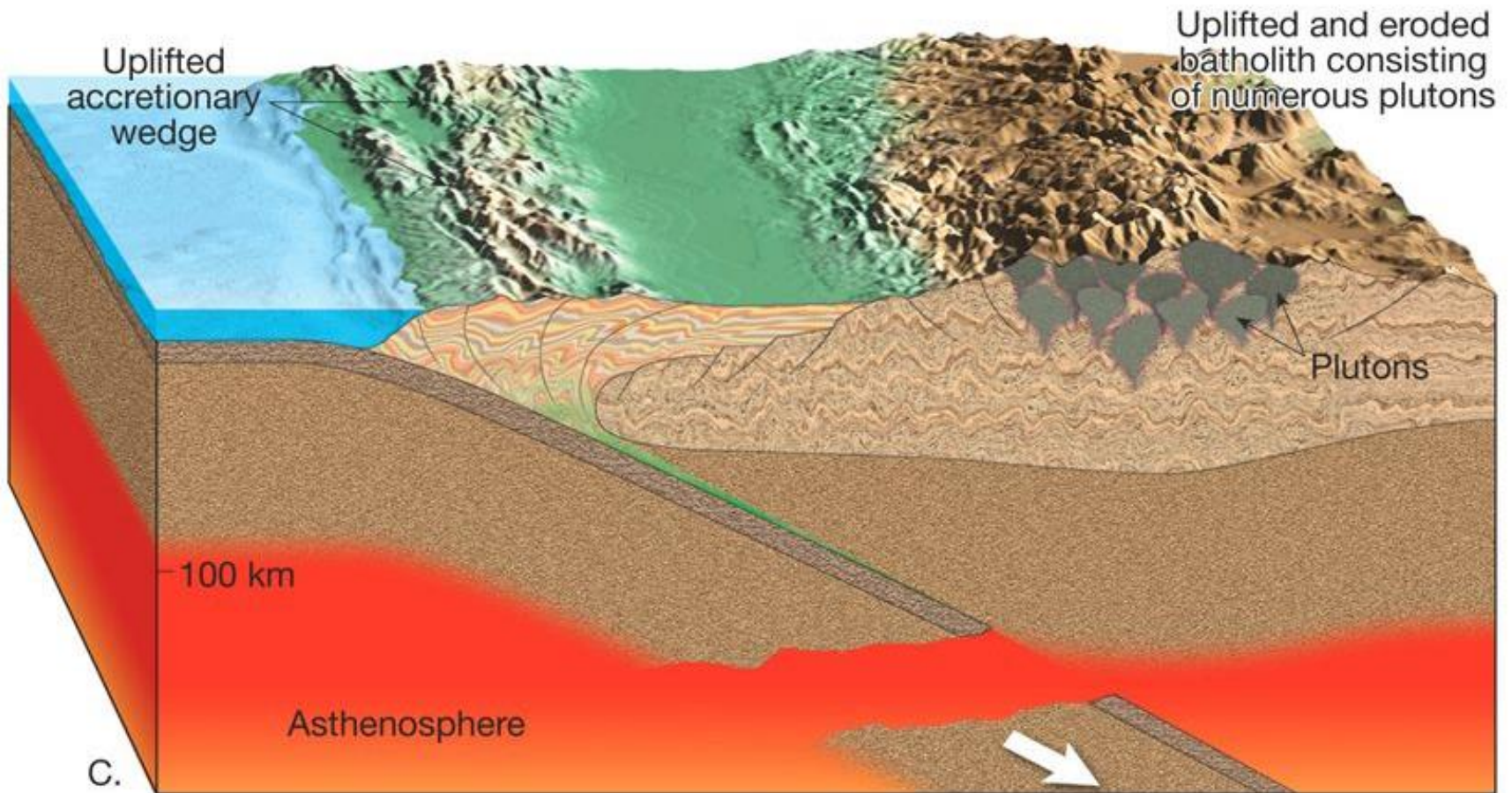
30 million years ago



20 million years ago







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