Sedimentary Cover of Saudi Arabia (Geo 385)

Sedimentary Cover of Saudi Arabia (Geo 385)

Student Learning Objectives:

- **Tectonic history of Arabian Plate**
  - Precambrian
  - Ordovician-Silurian Glaciation / deglaciation
  - Carboniferous (Hercynian Orogeny)
  - Early Triassic (Zagros Rifting)
  - Late Cretaceous (First or Early Alpine Orogeny)
  - Tertiary (Second or Late Alpine Orogeny
  - Neogene Separation from Africa.
- **Phanerozoic stratigraphic units**
  - Paleozoic successions of the Arabian shelf
  - Mesozoic successions of the Arabian shelf
  - Cenozoic successions of the Arabian shelf
- **Sedimentary basins of Saudi Arabia**
- **Intra-basin stratigraphic correlations**
- **Economic geology of the cover rocks**

Sedimentary Cover of Saudi Arabia (Geo 385)

❑ Textbook and further reading

Chapter 2

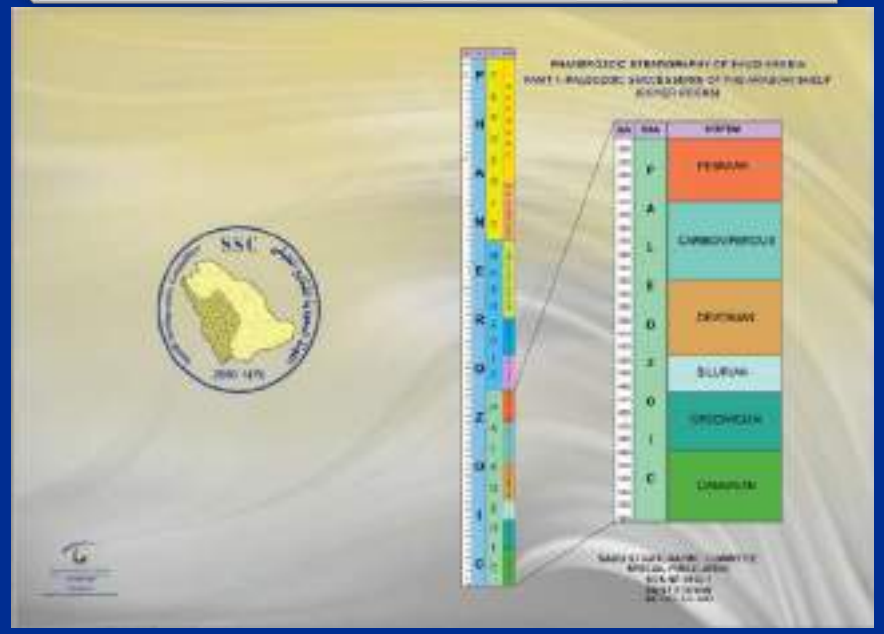
The Mesozoic-Cenozoic evolution of the Tethyan region

CHAPTER 3

Phanerozoic development of the Northern Arabian Plate

by

Saad Z. Jassim and Jeremy C. Goff



CHAPTER 3

Tectonostratigraphic Megasequences

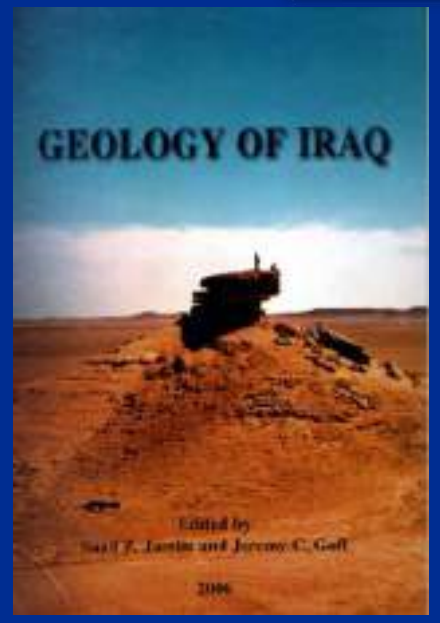
INTRODUCTION

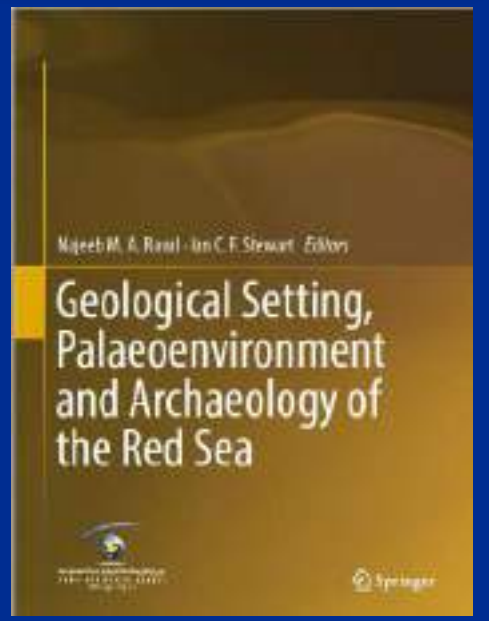
This Chapter reviews the tectonic evolution of the Arabian Plate (Figure 3.1) through its five evolutionary phases, from plate accretion, through intra-cratonic, back-arc and passive margin plate settings to the active margin setting of today. The gross subsurface architecture and large scale sediment packages are defined. These are separated by

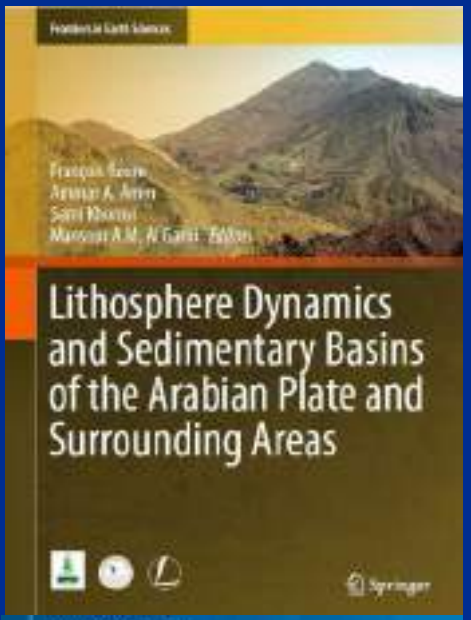
The Evolution of the Tethys Region throughout the Phanerozoic: A Brief Tectonic Reconstruction

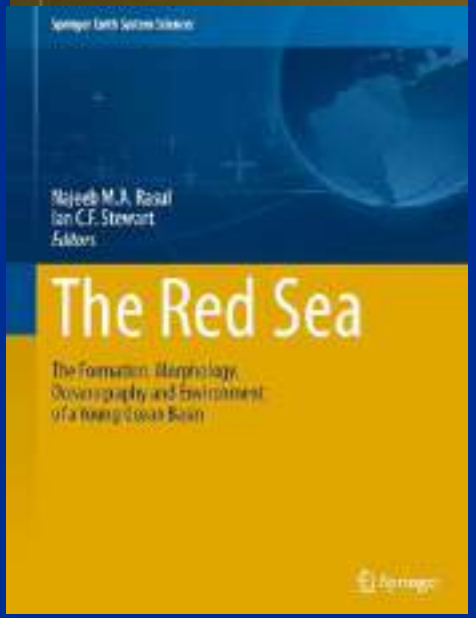
Fabrizio Berra and Lucia Angiolini

University of Milan, Department of Earth Sciences "A. Desio," Via Mangiagalli 34, 20133 Milan, Italy (e-mail: fabrizio.berra@unimi.it)









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❑ Textbook and further reading

GeoArabia, Vol. 10, No. 2, 2005
Gulf PetroLink, Bahrain

Phanerozoic cycles of sea-level change on the Arabian Platform

Bilal U. Haq and Abdul Motaleb Al-Qahtani

Lithostratigraphy, Facies Interpretation and Depositional Environment of the Lower Miocene Gypsified Stromatolites and Microbial Laminates, Rabigh and Ubhur Areas, Red Sea Coast, Saudi Arabia

Mahmoud A. Aref and **Mohammed H. Mandurah**
Department of Petroleum Geology and Sedimentology, Faculty of Earth Sciences, King Abdulaziz University, Jeddah, Saudi Arabia.
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Arabian glacial deposits: recognition of palaeovalleys within the Upper Ordovician Sarah Formation, Al Qasim district, Saudi Arabia

D. B. Clark-Lowes

Organic Petrology, Maturation, Thermal & Burial History Analysis, and Hydrocarbon Generation and Migration Modeling of the Saudi Arabian Paleozoic Petroleum Systems

Von der Fakultät für Georessourcen und Materialtechnik der
Rheinisch -Westfälischen Technischen Hochschule Aachen

zur Erlangung des akademischen Grades eines
Doktors der Naturwissenschaften
genehmigte Dissertation
vorgelegt von
M.Sc. Mahdi A. Abu-Ali
aus Bahrain

Berichter: Univ.-Prof. Dr. R. Littke
Univ.-Prof. Dr. Dr. h.c. D.H. Welte

Tag der mündlichen Prüfung: 02.Juni 2005

Diese Dissertation ist auf den Internetseiten der Hochschulbibliothek online verfügbar

USGS

Total Petroleum Systems of the Paleozoic and Jurassic, Greater Ghawar Uplift and Adjoining Provinces of Central Saudi Arabia and Northern Arabian-Persian Gulf

U.S. Geological Survey Bulletin 2202-H

GeoArabia, Vol. 6, No. 3, 2001
Gulf PetroLink, Bahrain

Late Permian to Holocene Paleofacies Evolution of the Arabian Plate and its Hydrocarbon Occurrences

Martin A. Ziegler
Consultant

Structural geology of the Rub' Al-Khali Basin, Saudi Arabia

S. A. Stewart[1]
[1]Eastern Area Exploration Department, Saudi Aramco, Dhahran, Saudi Arabia

GeoArabia, Vol. 11, No. 2, 2006
Gulf PetroLink, Bahrain

Devonian Jauf Formation, Saudi Arabia: Orbital Second-order Depositional Sequence 28

Moujahed Al-Husseini and Robley K. Matthews

Arab J Geosci (2017) 10: 55
DOI 10.1007/s12517-016-2800-4

ORIGINAL PAPER

The Wajid Sandstone around Abha/Khamis Mushayt and in its type area: lithostratigraphic architecture and correlations

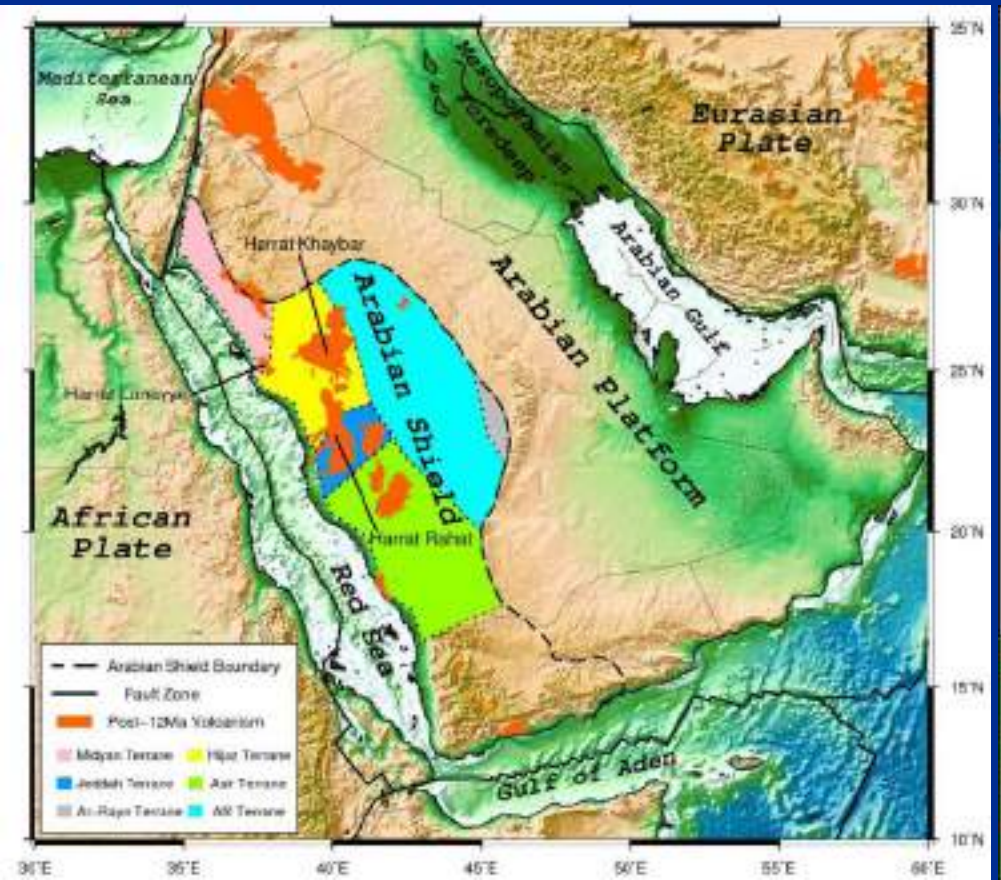
Martin Keller[1,2] **· Bassam Abu Amarah**[3] **· Hussain F. Al Ajmi**[2]

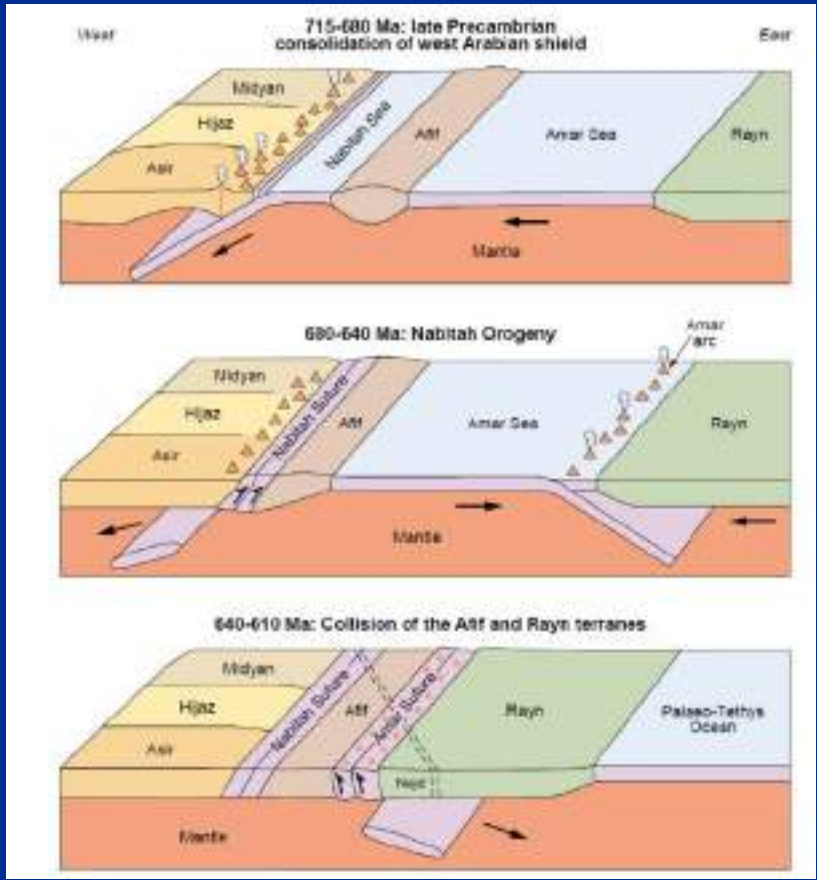
Sedimentary Cover of Saudi Arabia (Geo 385)

Tectonic history of Arabian Plate

- Precambrian

- Complex terrane fabric of the Arabian Shield and Eastern Arabia (by Al Husseni 2000)





Sedimentary Cover of Saudi Arabia (Geo 385)

Phanerozoic stratigraphic units

- Paleozoic successions of the Arabian shelf
- Mesozoic successions of the Arabian shelf
- Cenozoic successions of the Arabian shelf

- The Phanerozoic sedimentary rocks in Saudi Arabia belong to:

  Paleozoic (543-250 Ma),

  Mesozoic (248-65 Ma), and

  Cenozoic (65 Ma to Recent)

- They crop out as relatively flat lying beds of sedimentary rocks such as sandstone, siltstone, limestone, and evaporites (salt deposits).
- The rocks were deposited nonconformably on the underlying Precambrian basement, in riverbeds, in glacial valleys, and in shallow seas.
- The youngest deposits in the region include coral limestone and unconsolidated sand, silt, gravel, and sabkha, which accumulated in the sand seas of Ar Rub al Khali and An Nafud, filled dried-up lake beds and wadis, and fringed the coastlines.

Sedimentary Cover of Saudi Arabia (Geo 385)

❑ Phanerozoic stratigraphic units

❖ Mesozoic successions

❖ Paleozoic successions

❖ Cenozoic successions

Sedimentary Cover of Saudi Arabia (Geo 385)

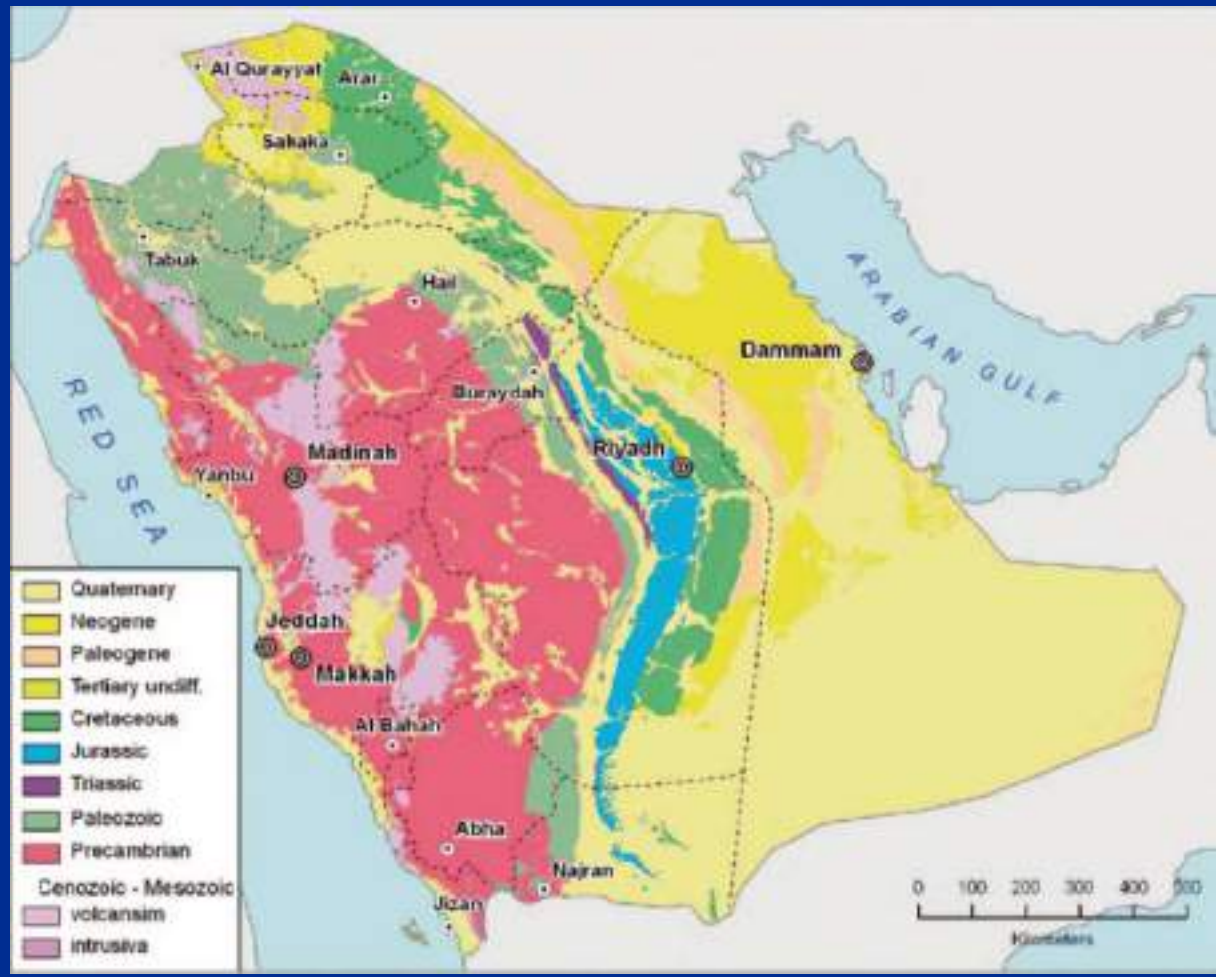
Tectonic history of Arabian Plate

Arabian Shield and Arabian platform

- The Arabian Platform (Shelf) occupies 2/3 of the Arabian Plate
- The Arabian Shield occupies 1/3 of the Arabian Plate

- The Precambrian rocks contain most of Saudi Arabia's known metal deposits, such as gold, silver, copper, zinc, iron, and magnesium.
- The Phanerozoic rocks contain the oil resources and deposits of bauxite (the source of aluminum), phosphate, clay, limestone, silica sand, light weight aggregate, and other mineral commodities that are of increasing importance to the industrial development of the Kingdom.

- Sedimentary cover rocks in the Arabian Plate range in age from Cambrian to Quaternary. They reach a thickness of about 8000 m.

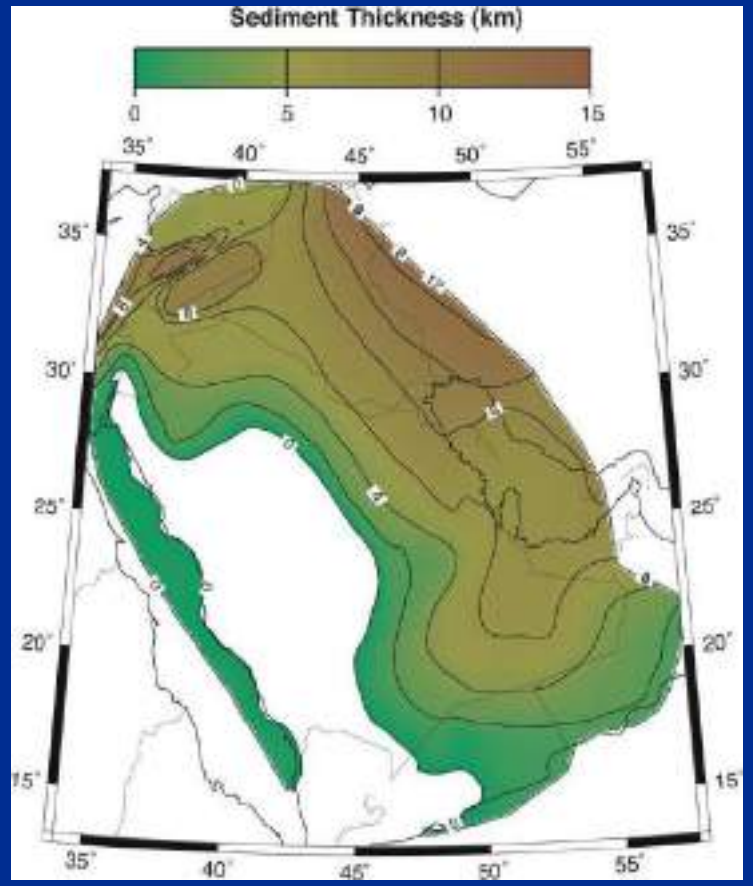


Sedimentary Cover of Saudi Arabia (Geo 385)

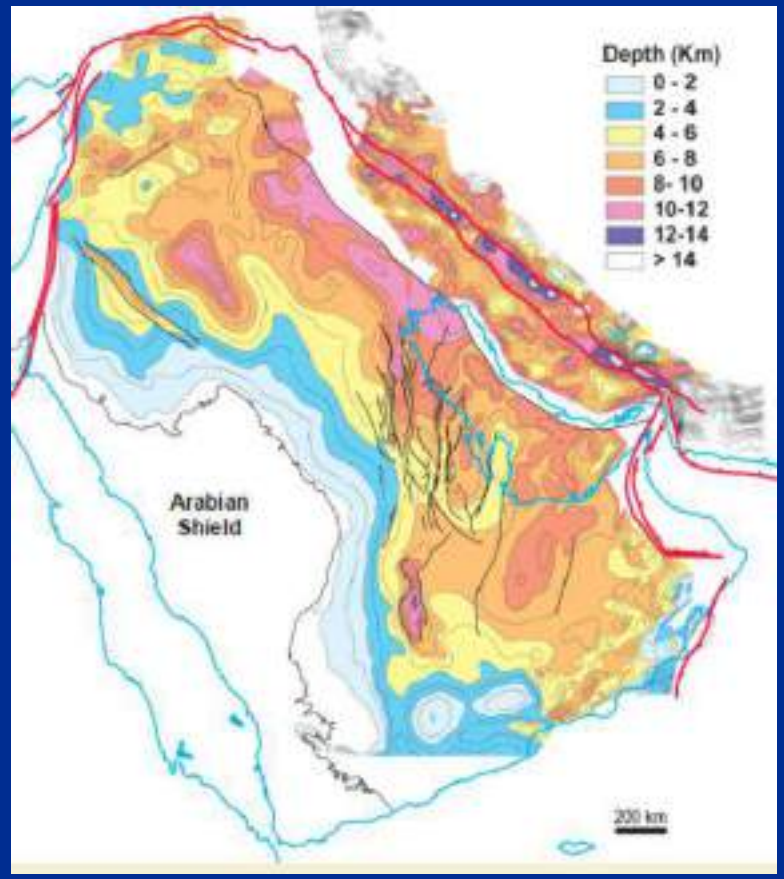
Tectonic history of Arabian Plate

Sedimentary Cover of Saudi Arabia

- Sediment thickness of the Arabian Plate, estimated from compiled drill hole, gravity, and seismic reflection data (Al-Amri et al., 2017)



- Depth of basement in the Arabian Plate (Konert et al., 2001)

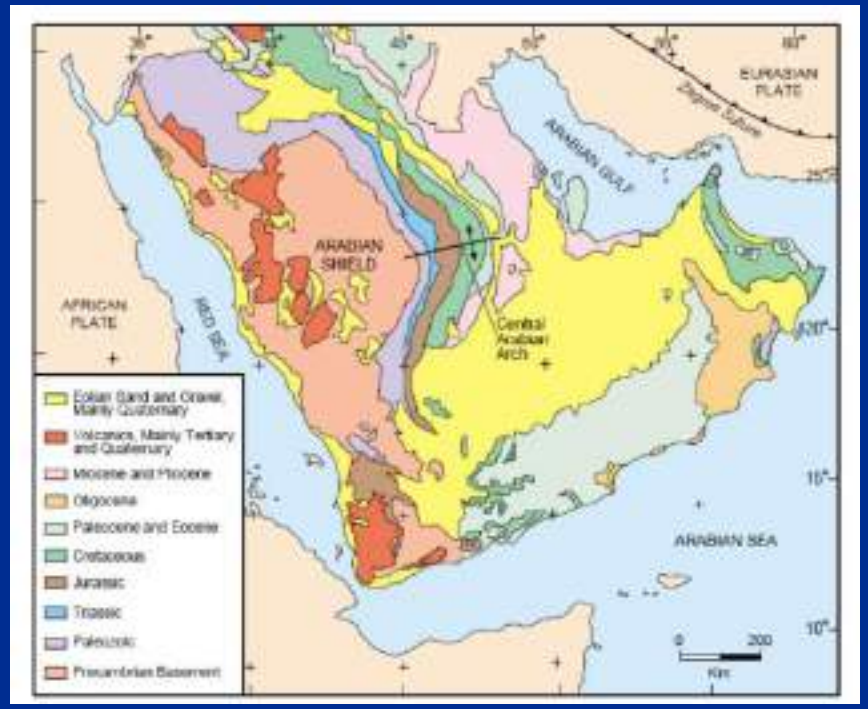


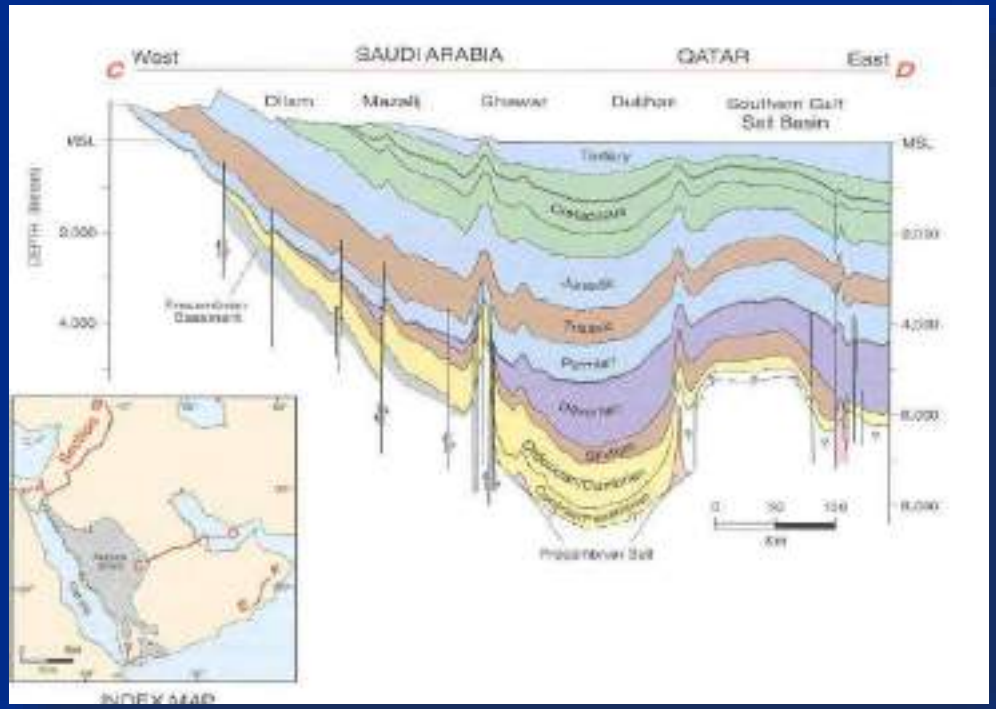
Sedimentary Cover of Saudi Arabia (Geo 385)

Tectonic history of Arabian Plate

Sedimentary Cover of Saudi Arabia

- The outcrops of the Phanerozoic rock units make curved belts flanking the eastern margin of the Arabian Shield and thicken toward the Arabian Gulf.
- In the subsurface, all Phanerozoic formations generally dip at 1°–3° towards the northeast, east and southeast following the Arabian Shield basement rocks' configuration.
- Geologic traverse (A--B) shows the sedimentary Successions of the Arabian Shelf through Saudi Arabia to Qatar (Konert, 2001)



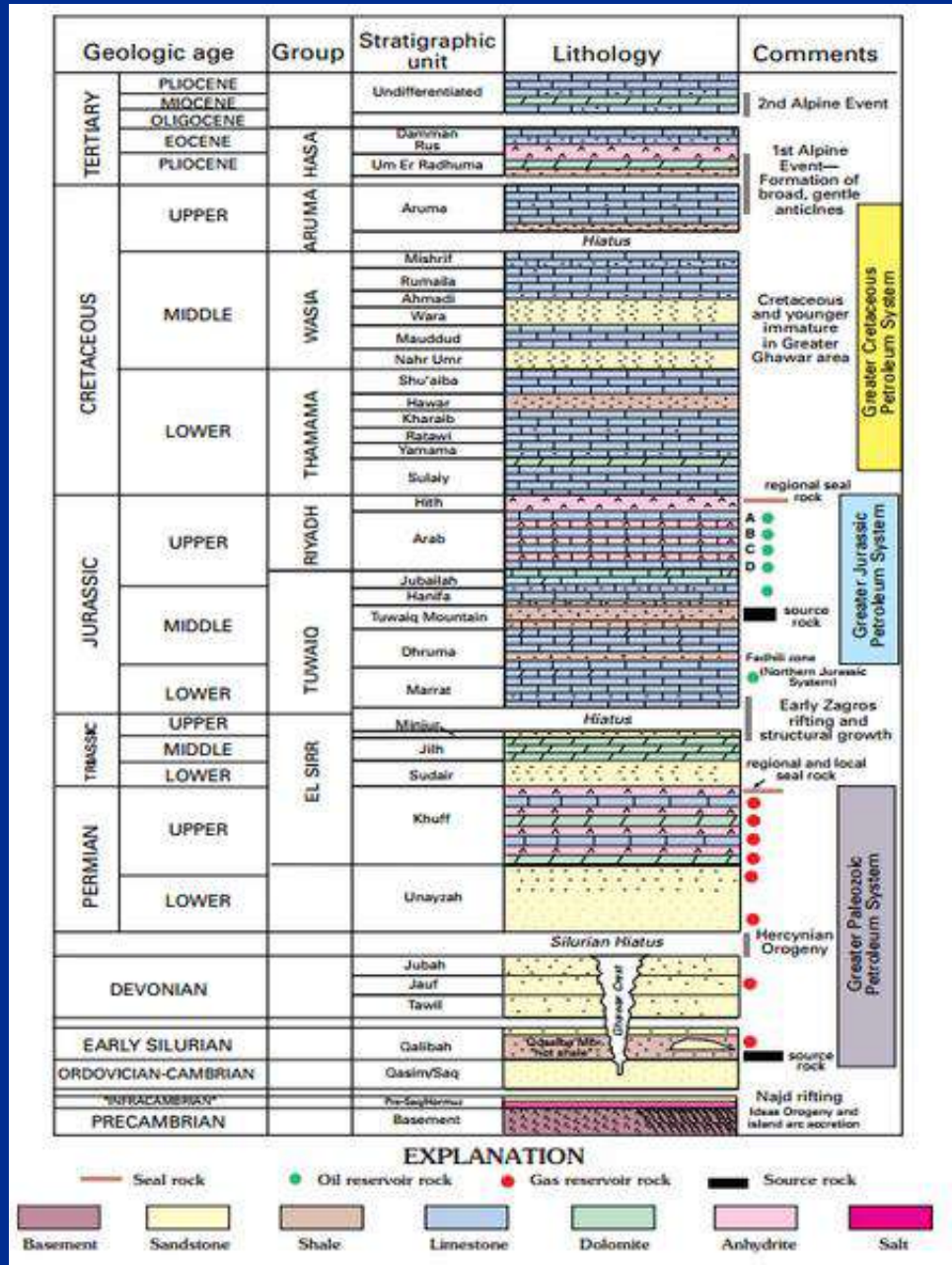


Sedimentary Cover of Saudi Arabia (Geo 385)

Tectonic history of Arabian Plate

Sedimentary Cover of Saudi Arabia

- The lithological characteristics of the Phanerozoic sequence are relatively consistent throughout central and eastern Saudi Arabia.
- The Paleozoic formations generally consist of siliciclastic units.
- The Mesozoic and Cenozoic formations consist mainly of carbonate and anhydrite, with minor shale and sandstone units in the Middle Cretaceous.



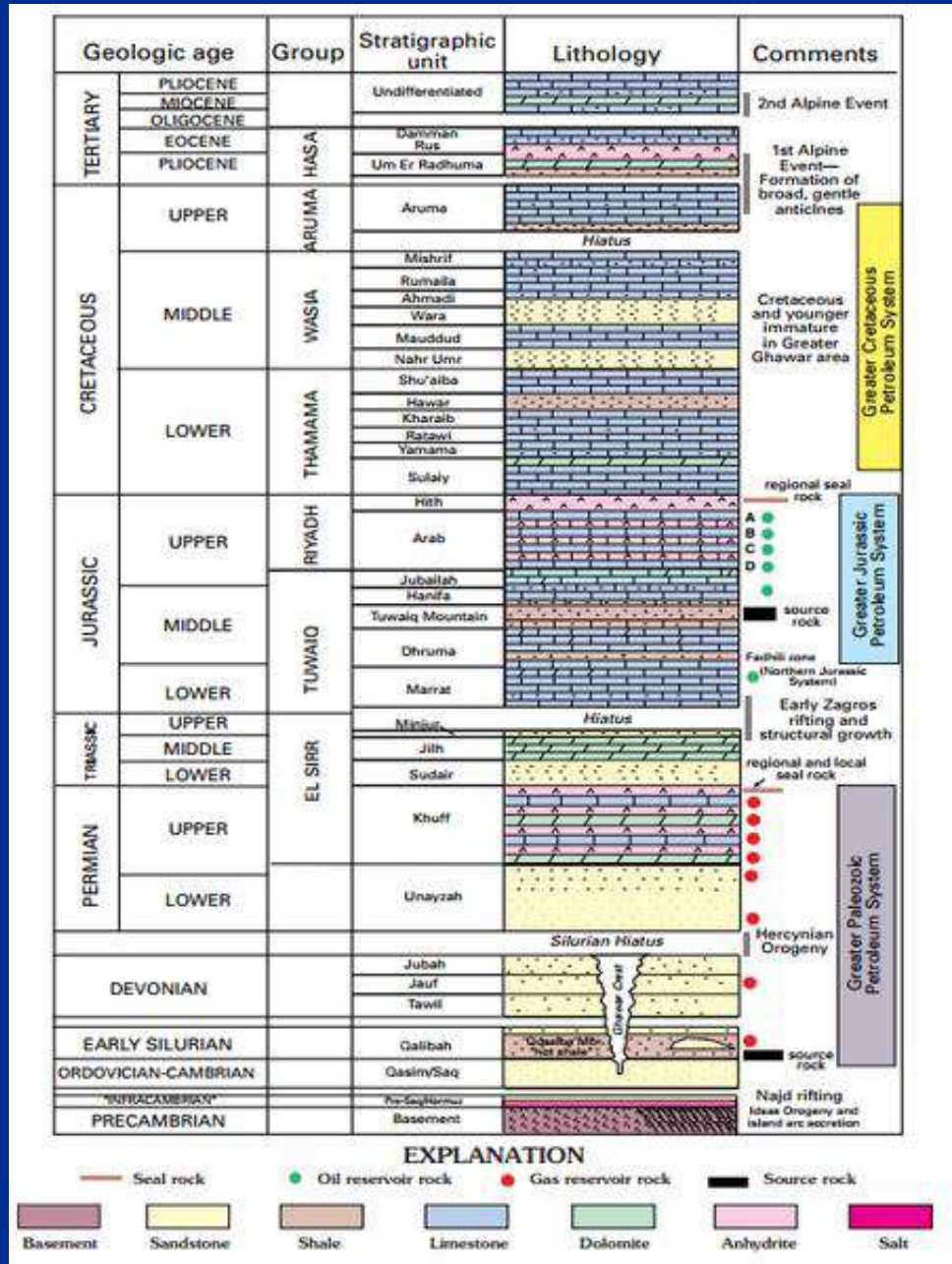
Sedimentary Cover of Saudi Arabia (Geo 385)

Tectonic history of Arabian Plate

Sedimentary Cover of Saudi Arabia

Unconformities

- The sedimentary sequence of Saudi Arabia constitutes several regional unconformities of which the most significant and aerially extensive are the Pre-Unayzah, pre-Marrat, pre-Aruma, and pre-Neogene unconformities.
- Except for the pre-Marrat unconformity, which was caused by the global marine regression of the Early Jurassic (Haq and Al-Qahtani 2005), all these major unconformities are a result of uplift and erosion during tectonic events.
- This uplifting had caused differential erosion of the underlying rock units with the maximum erosion over major anticlines such as the Ghawar Anticline.



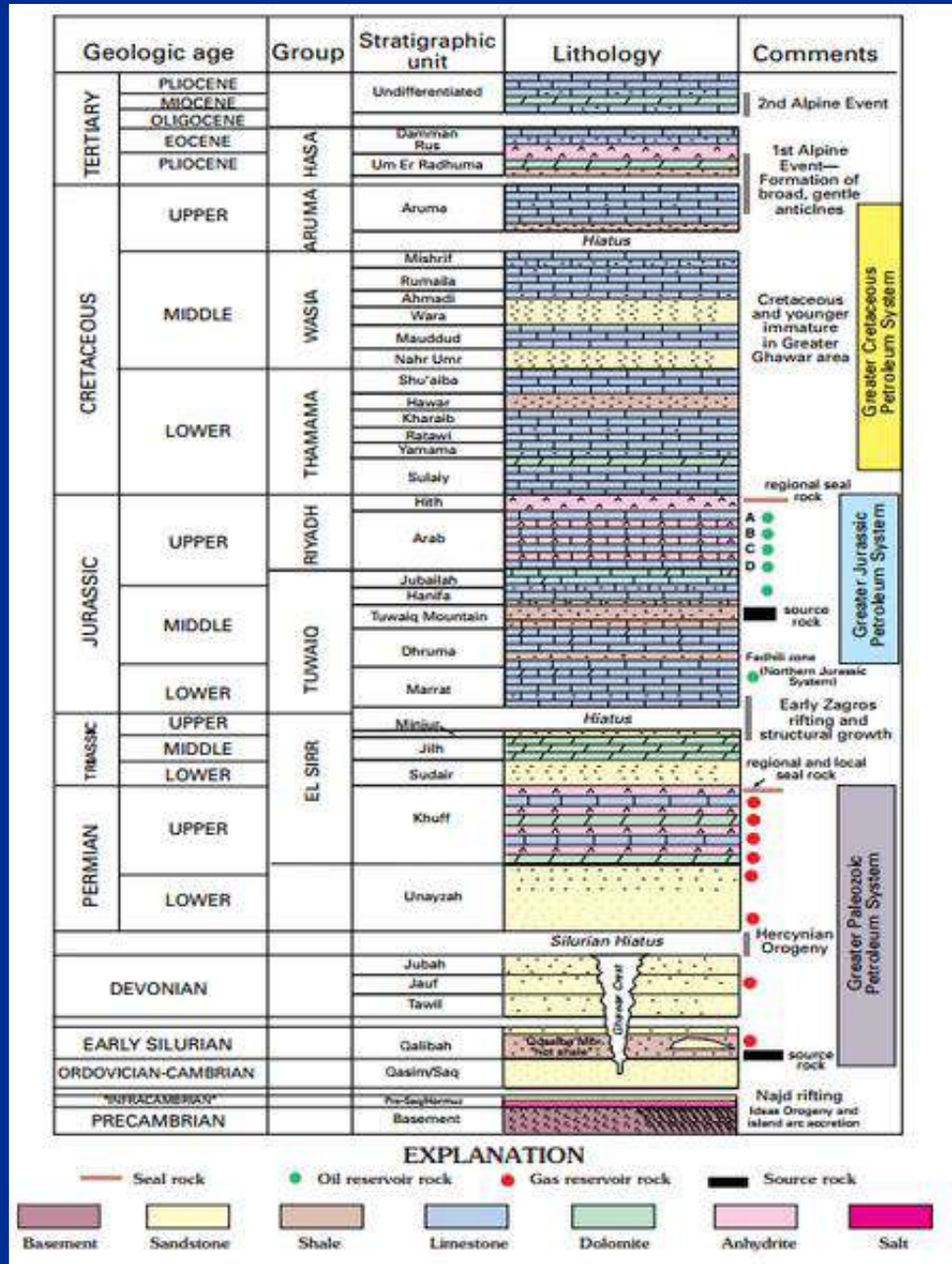
Sedimentary Cover of Saudi Arabia (Geo 385)

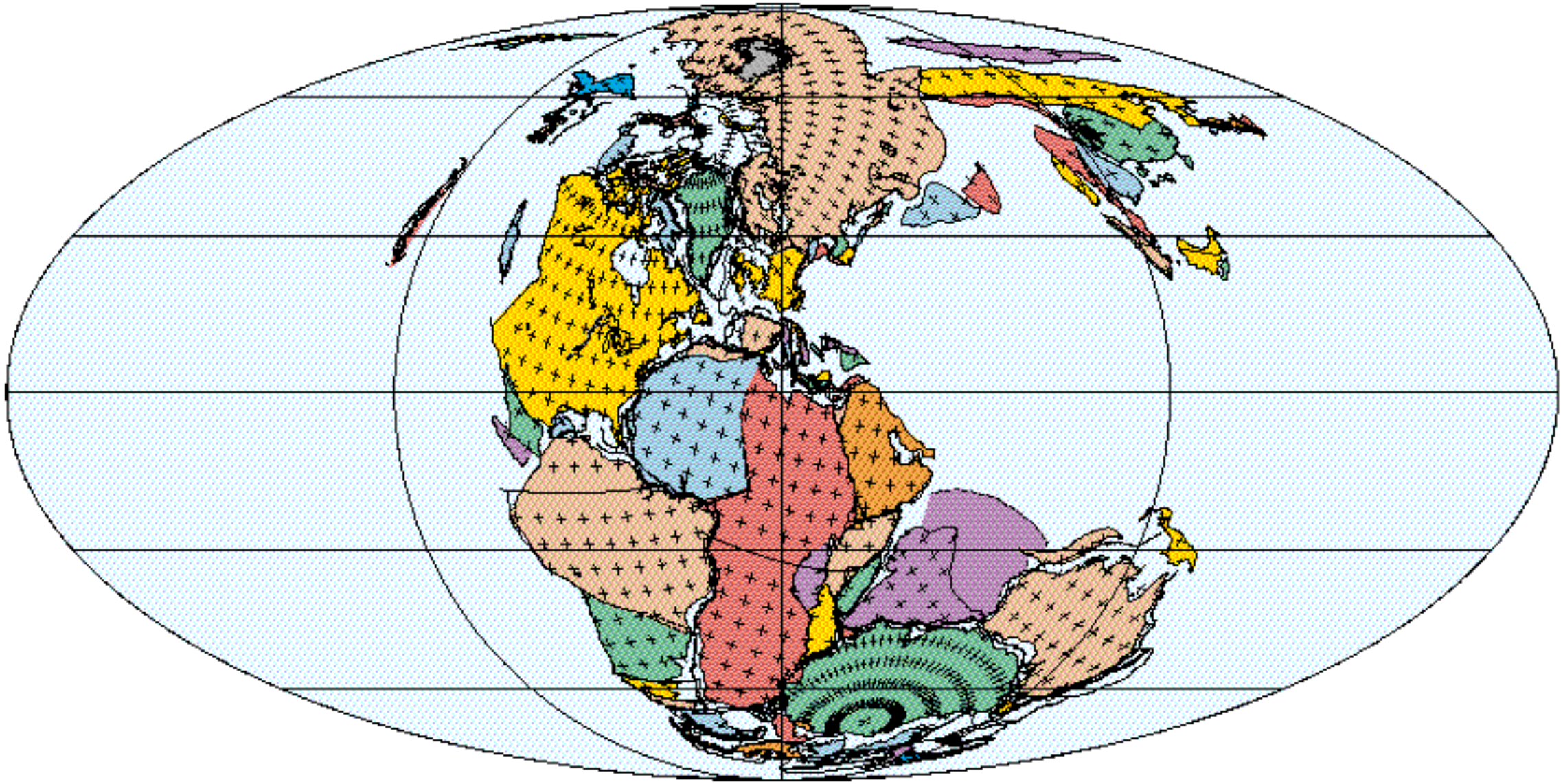
Tectonic history of Arabian Plate

Sedimentary Cover of Saudi Arabia

Unconformities

- The unconformities play important roles in the development of the hydrocarbon and aquifer systems of eastern Saudi Arabia.
- For example, they form hydrocarbon traps flanks of anticlines such the Jauf gas play on the flanks of the Ghawar anticline (Wender et al. 1998).
- They also cause cross-formational flow of groundwater in aquifers (BRGM 1977).



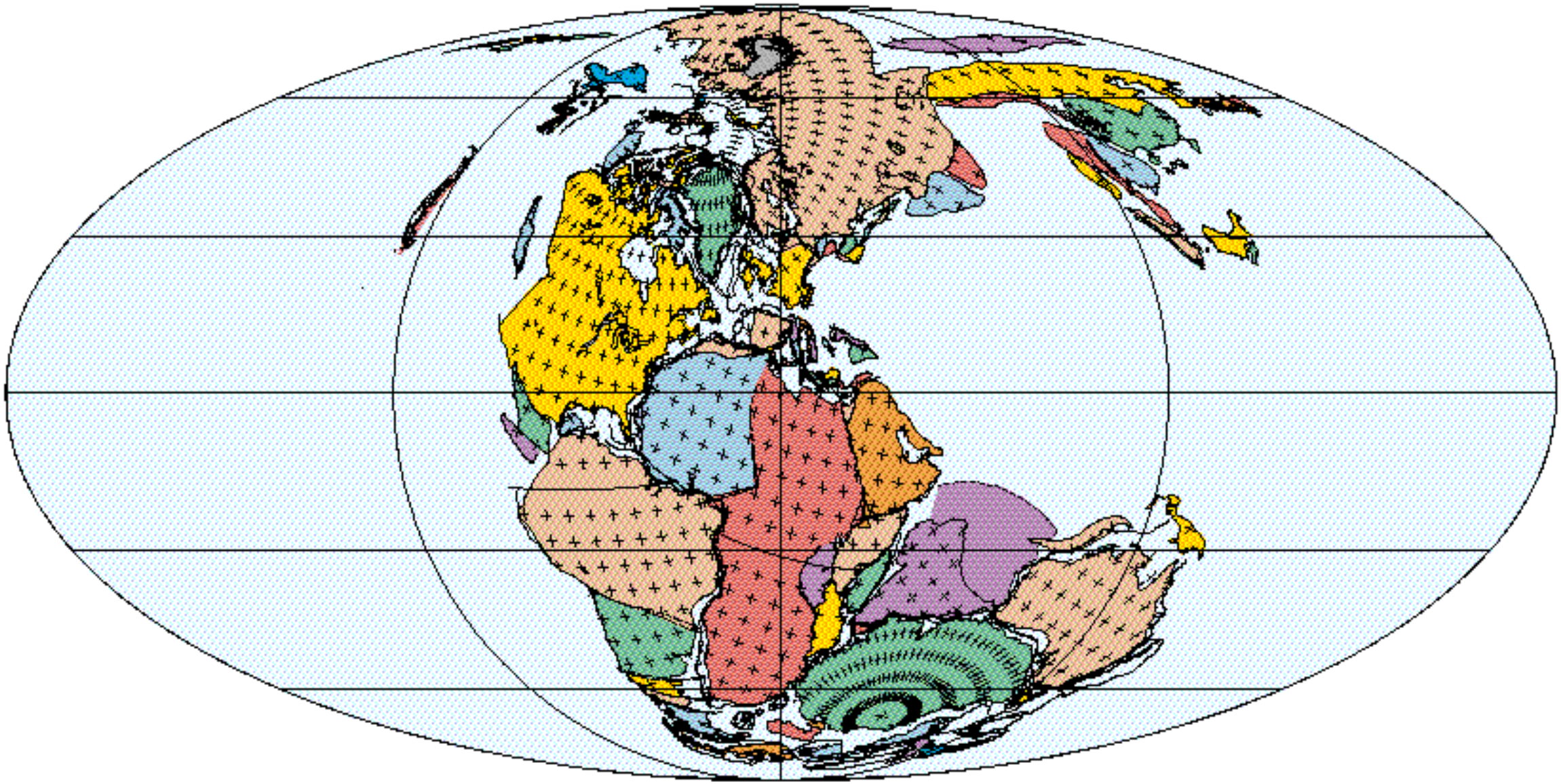


200 Ma

Sinemurian (Early Jurassic)

PLATES/UTIG

July 1999



190 Ma

Pliensbachian (Early Jurassic)

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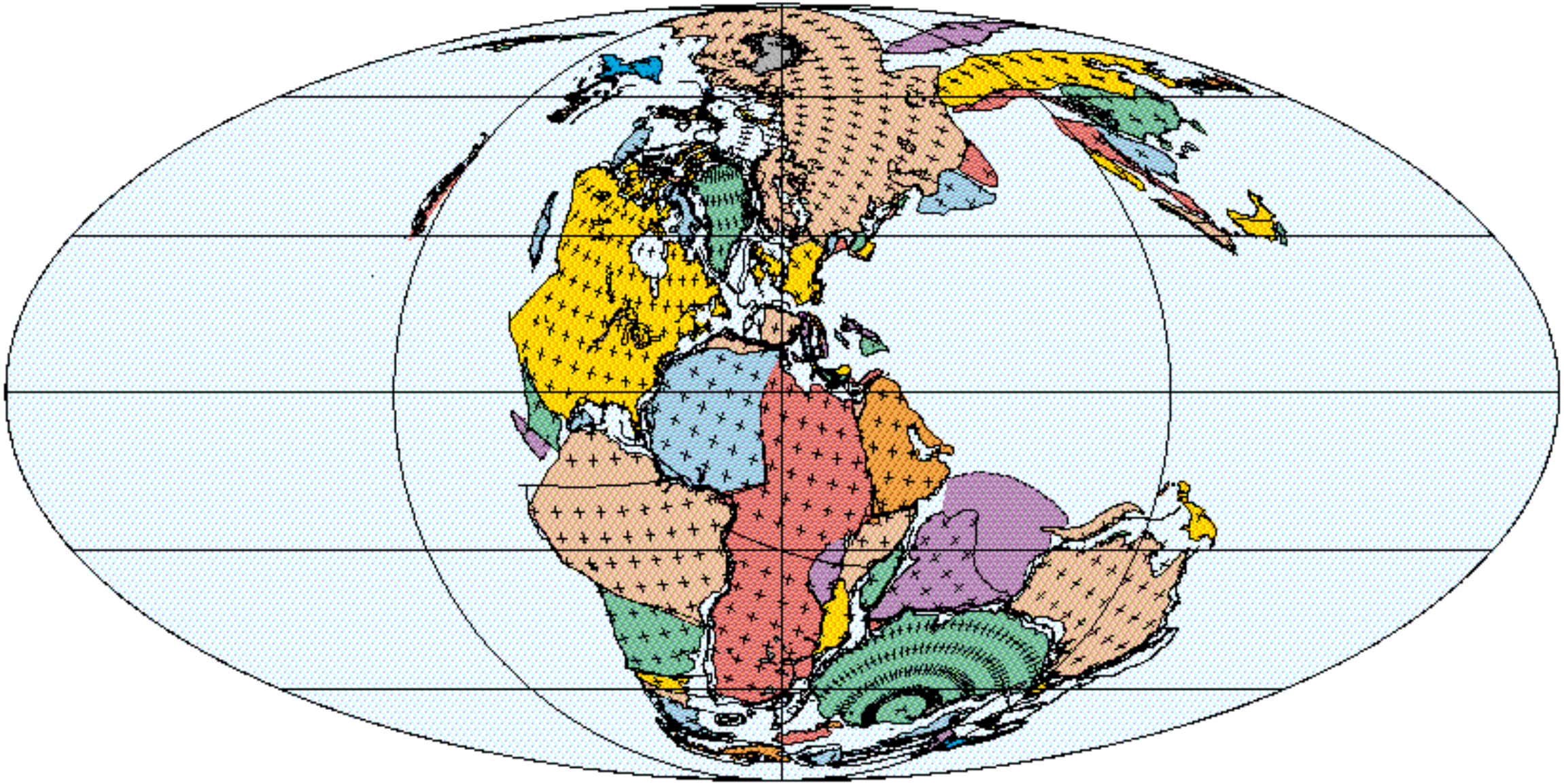

180 Ma

Aalenian (Middle Jurassic)

PLATES/UTIG

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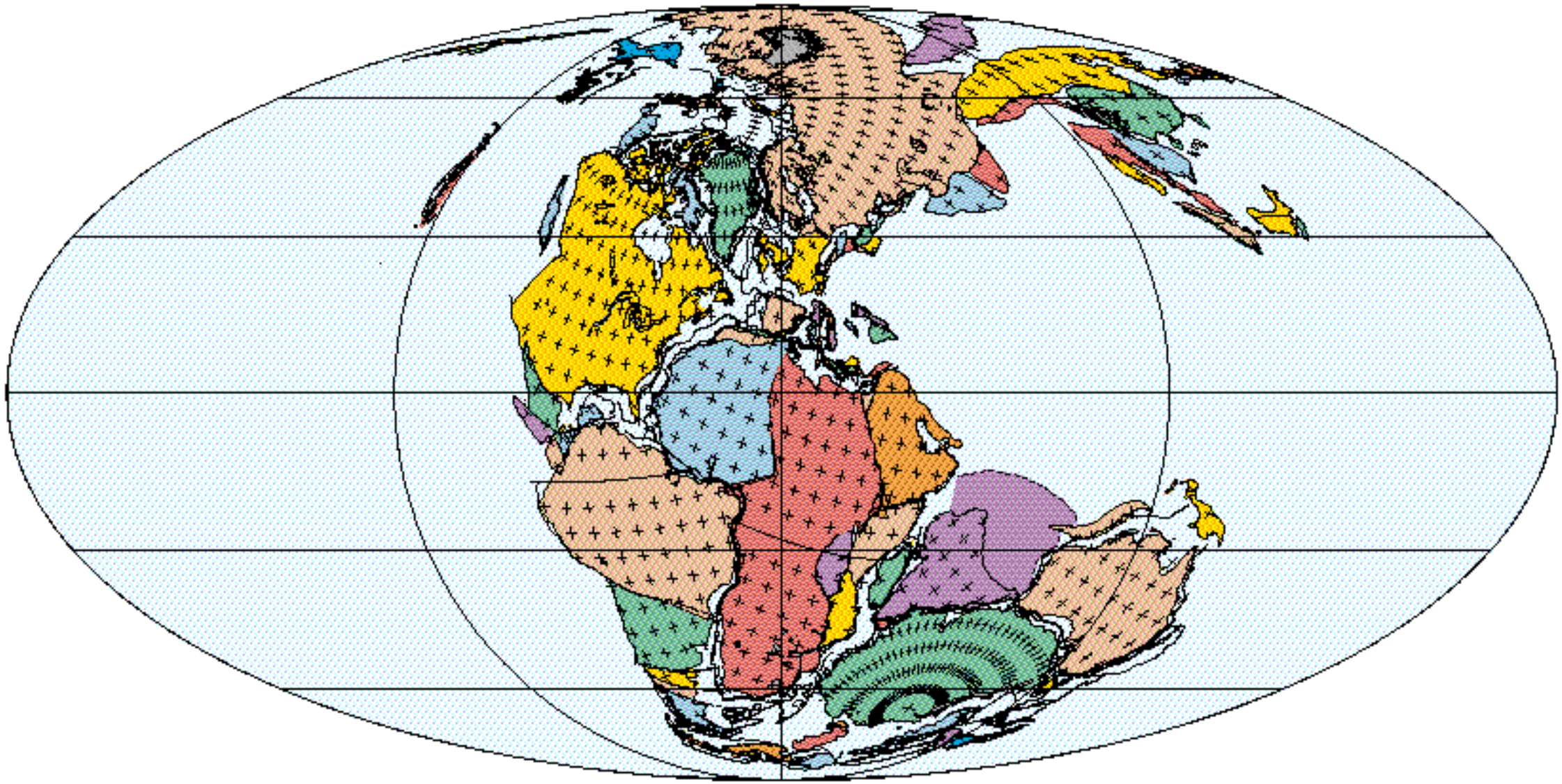

170 Ma

Bajocian (Middle Jurassic)

PLATES/UTIG

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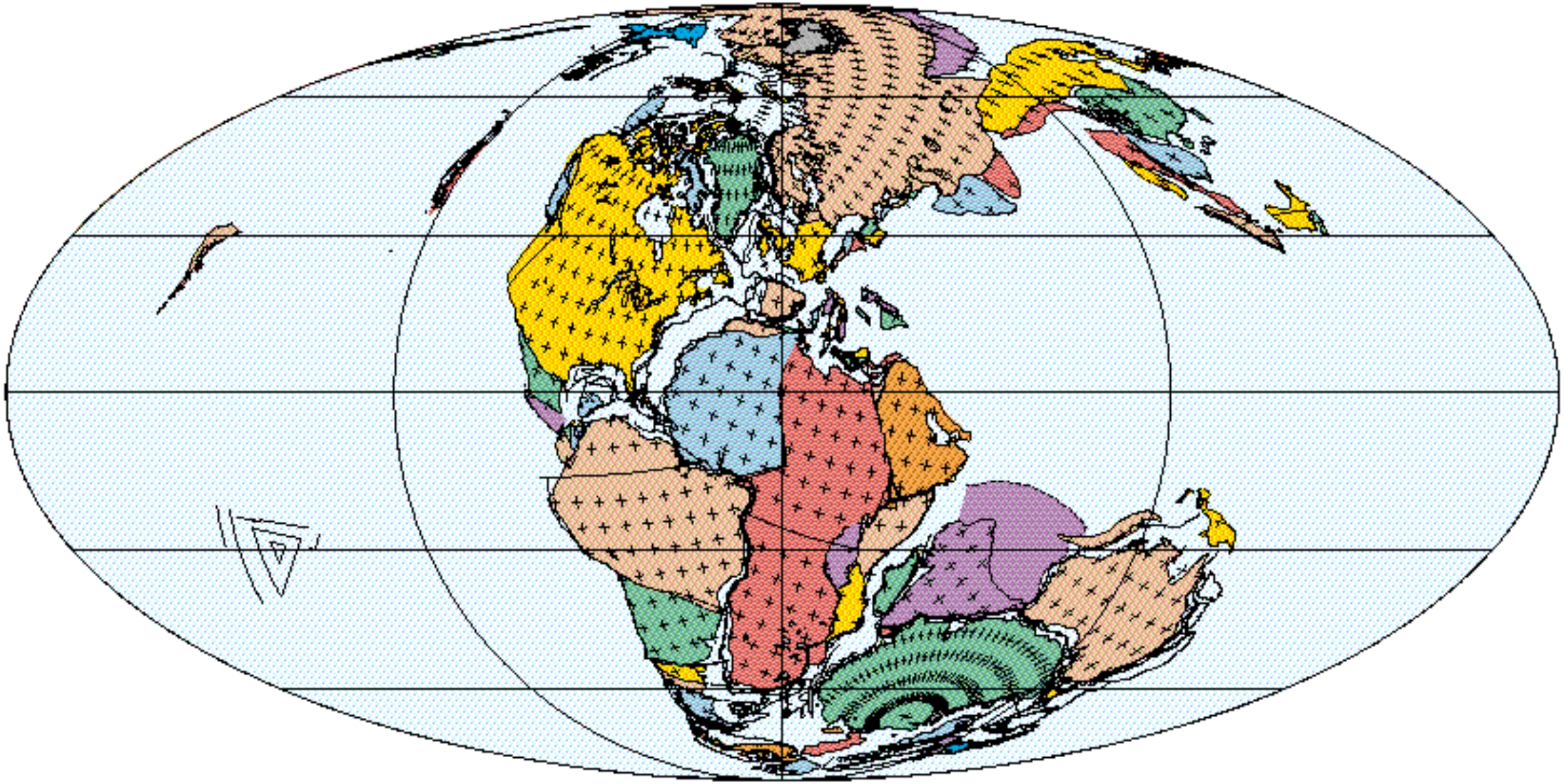

160 Ma

Callovian (Middle Jurassic)

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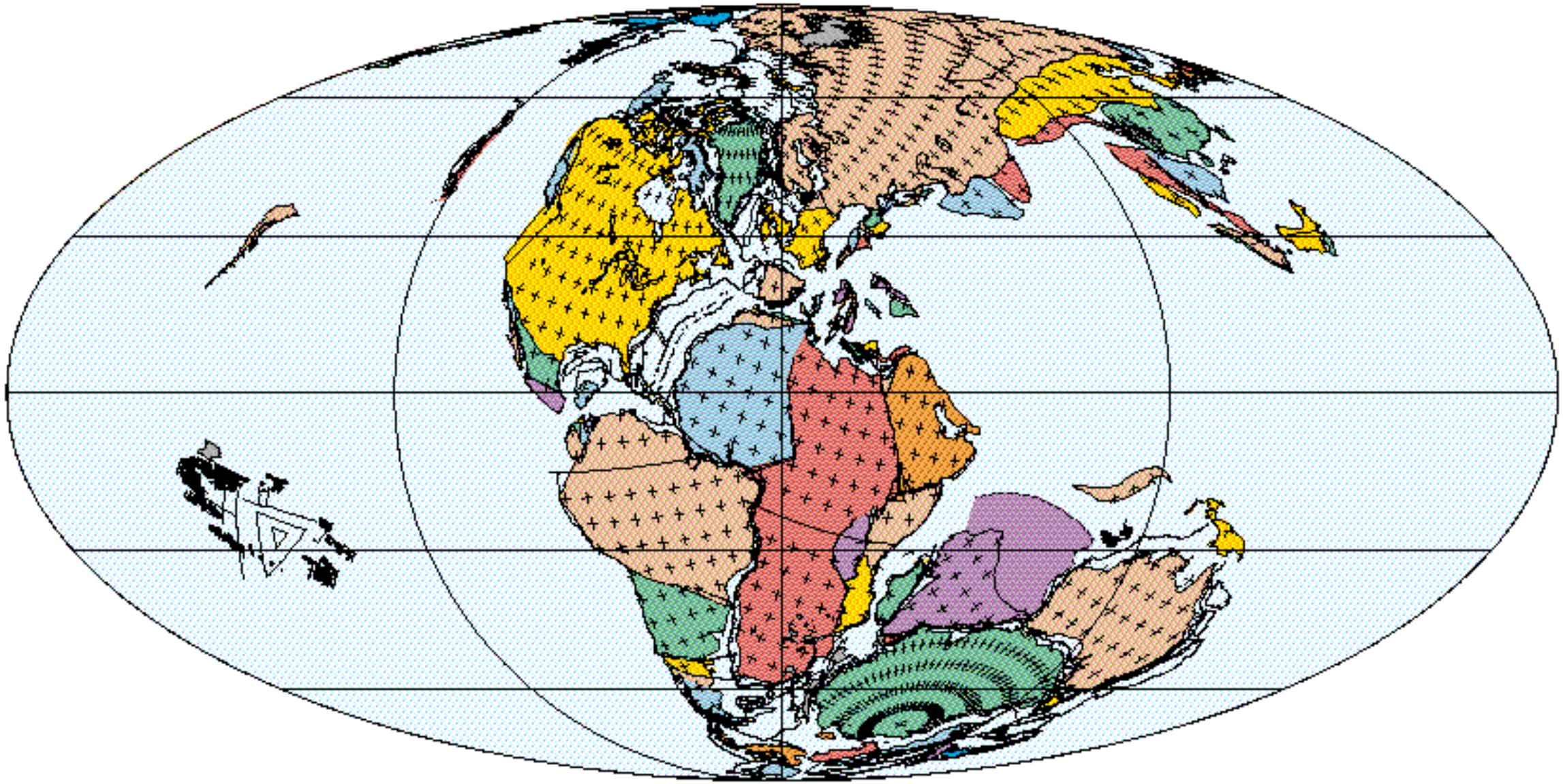

150 Ma

Volgian (Late Jurassic)

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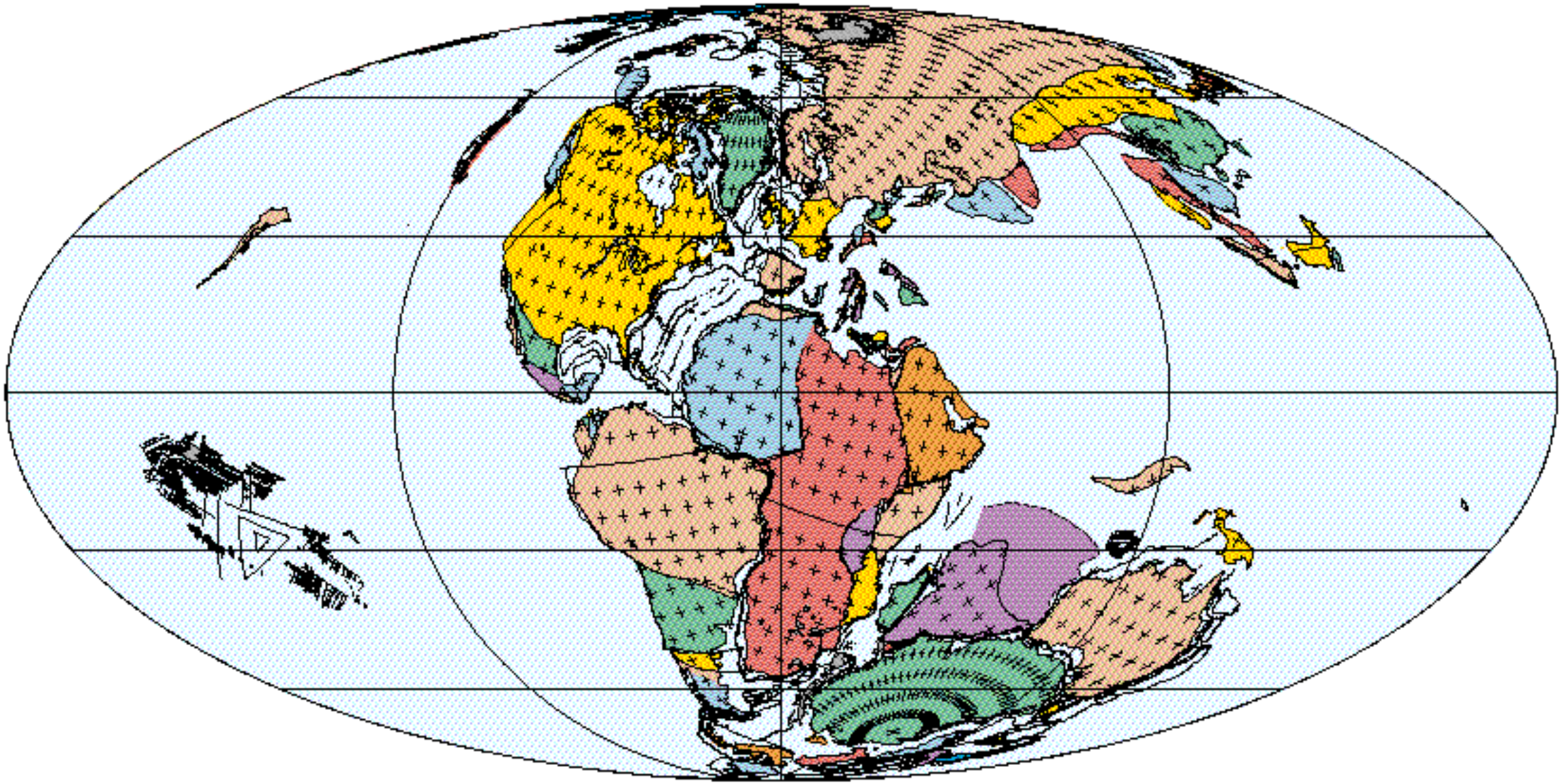

140 Ma

Ryazanian (Early Cretaceous)

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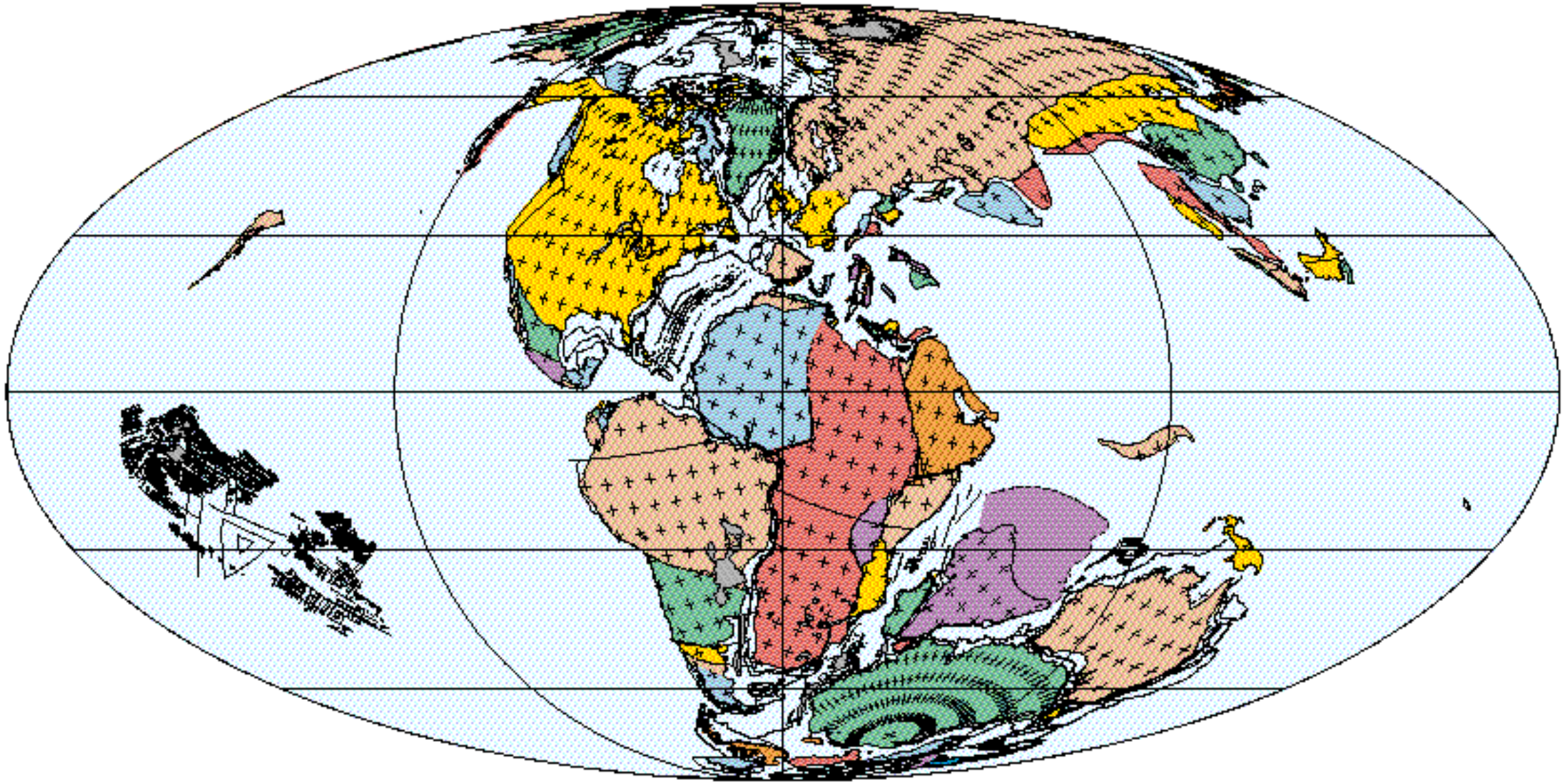

130 Ma

Hauterivian (Early Cretaceous)

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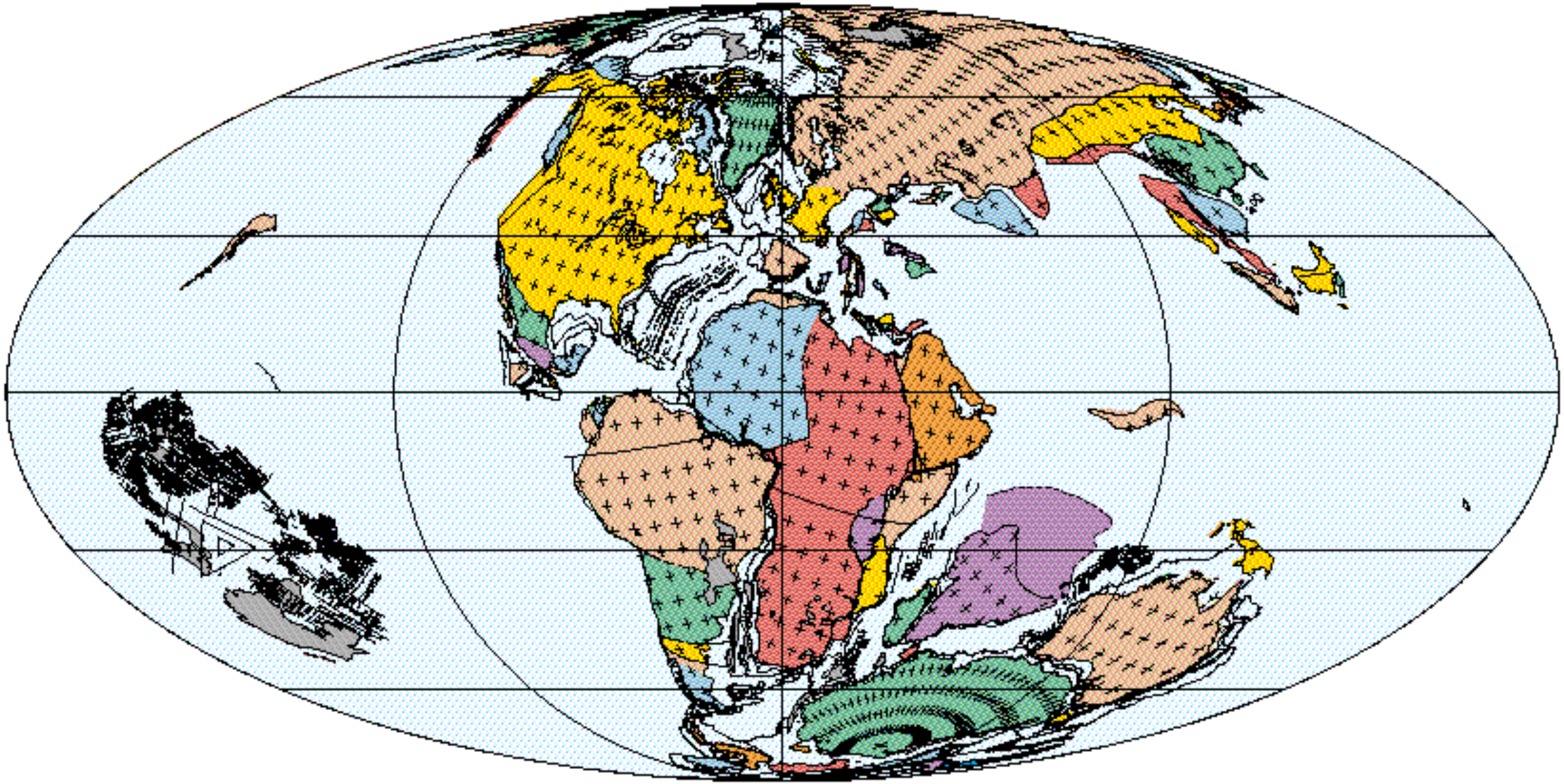

120 Ma

Aptian (Early Cretaceous)

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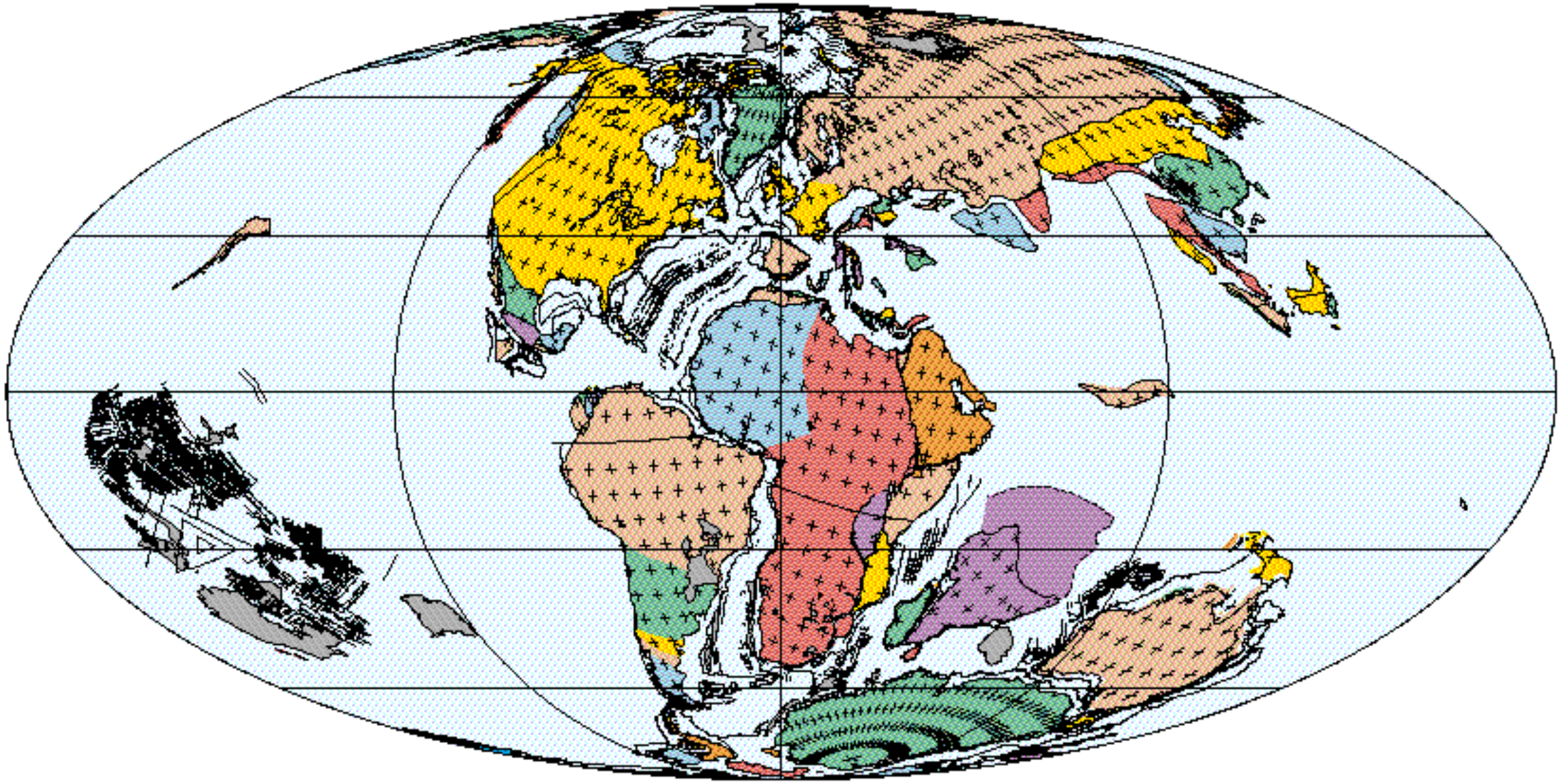

110 Ma

Early Albian (Early Cretaceous)

PLATES/UTIG

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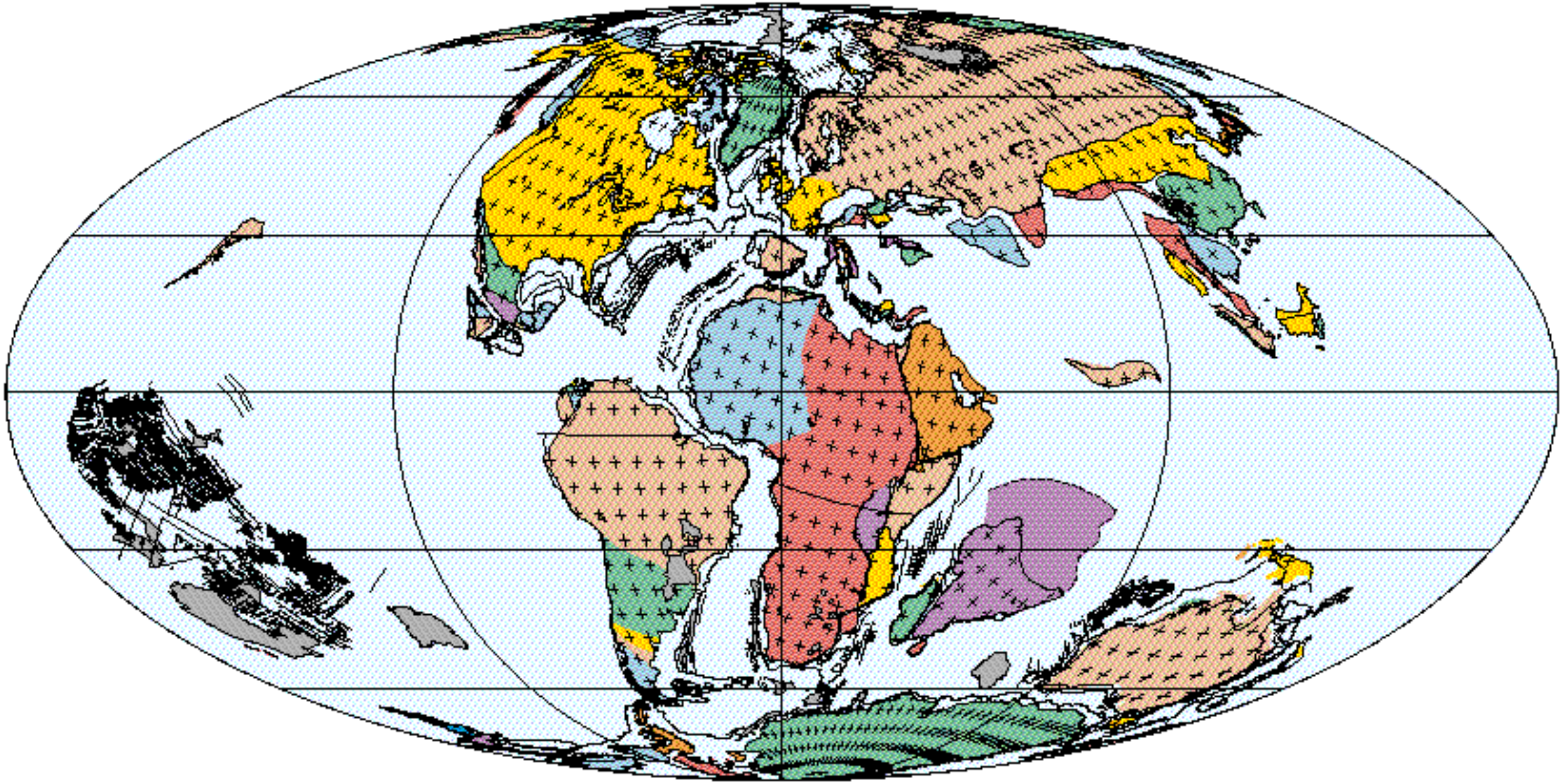

100 Ma

Late Albian (Early Cretaceous)

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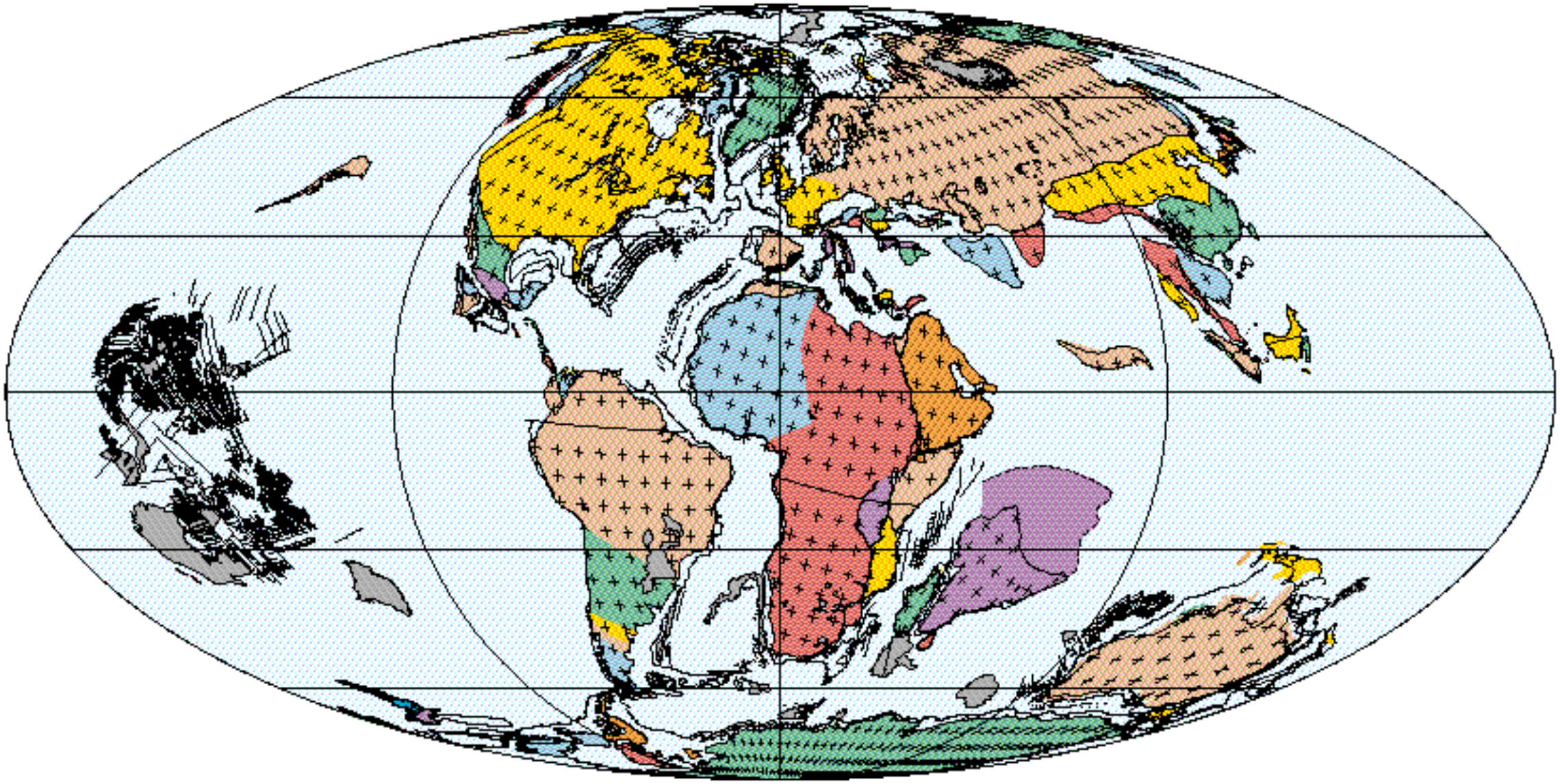

90 Ma

Turonian (Late Cretaceous)

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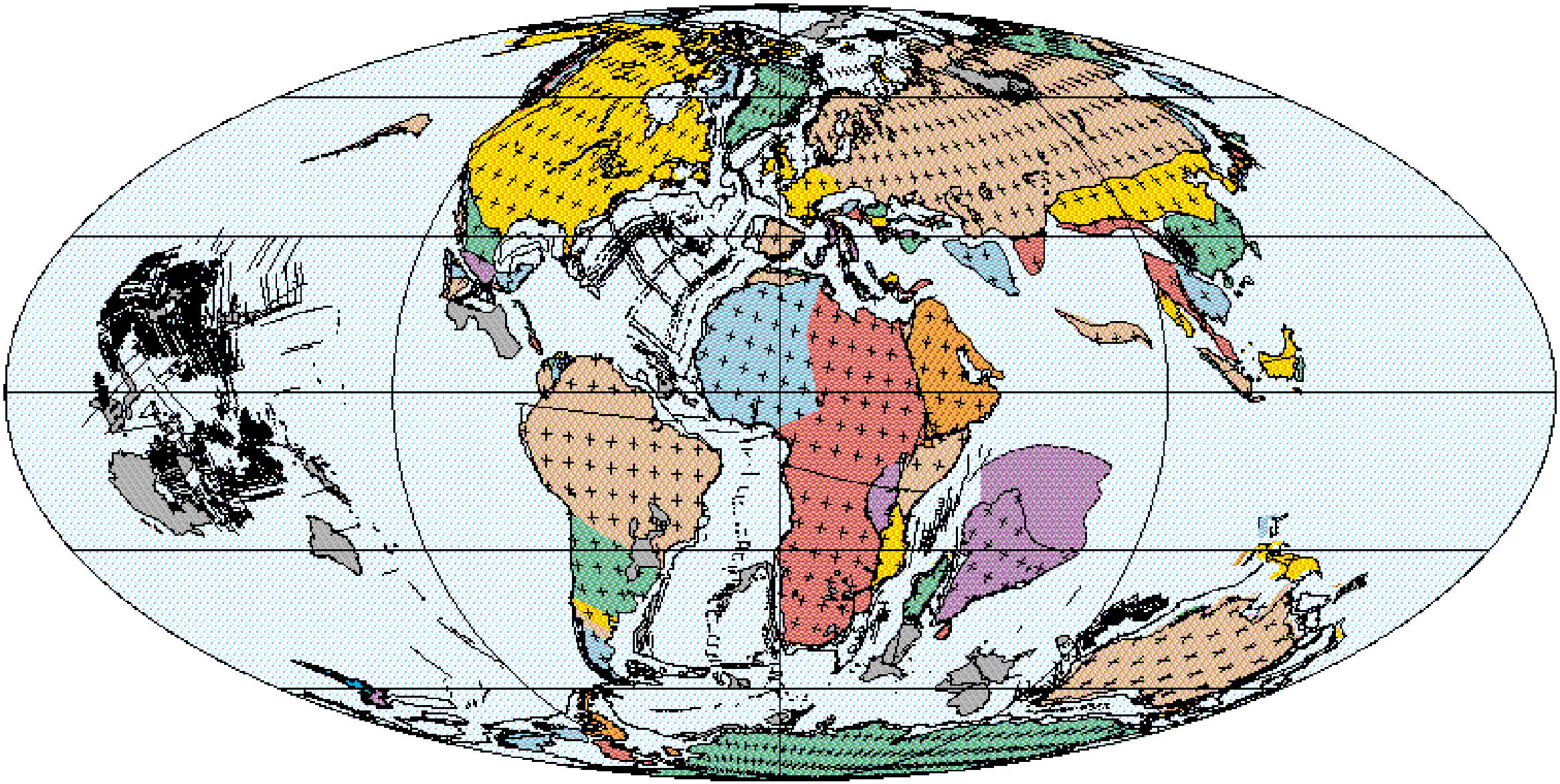

80 Ma

Campanian (Late Cretaceous)

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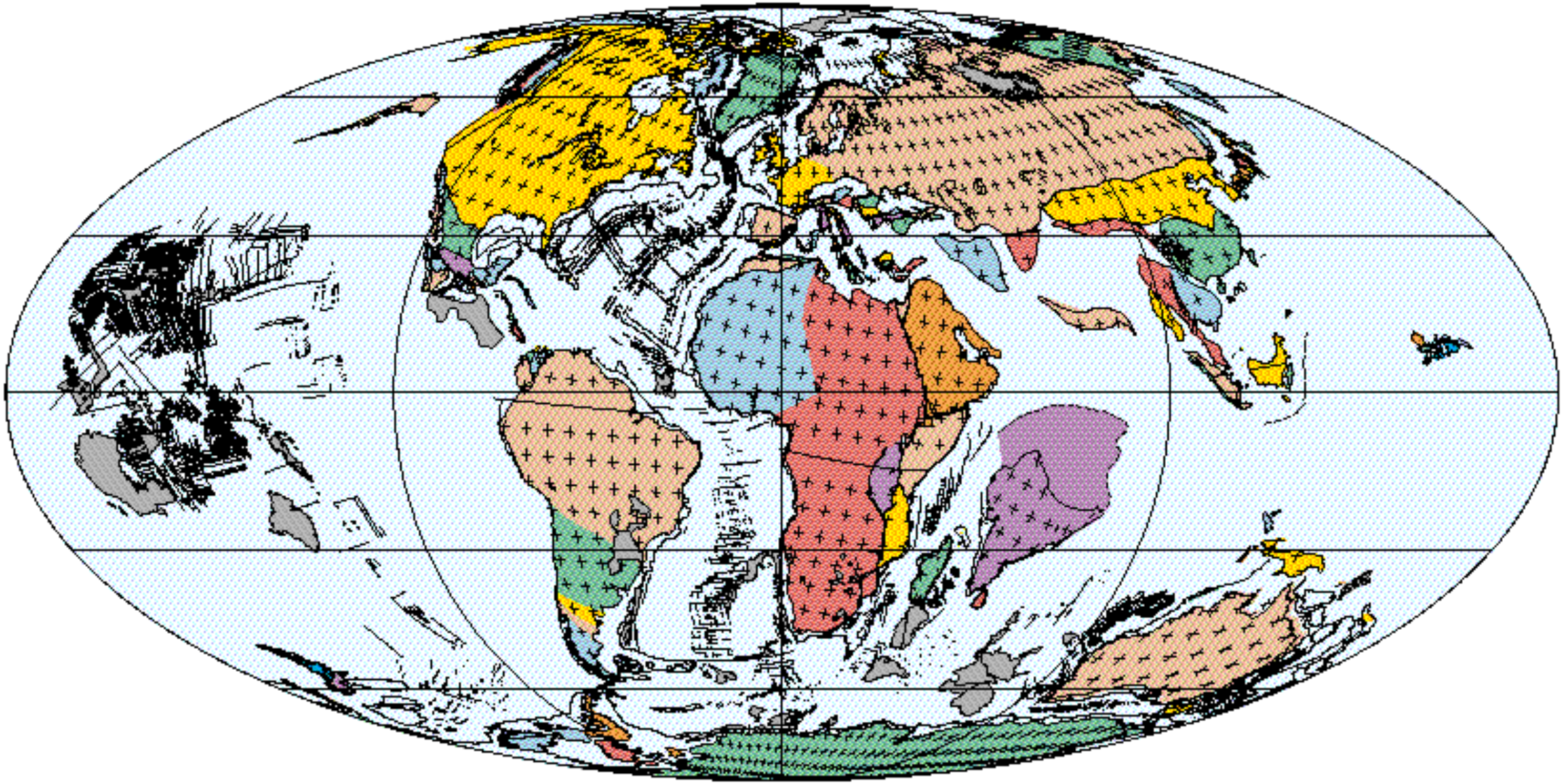

70 Ma

Maastrichtian (Late Cretaceous)

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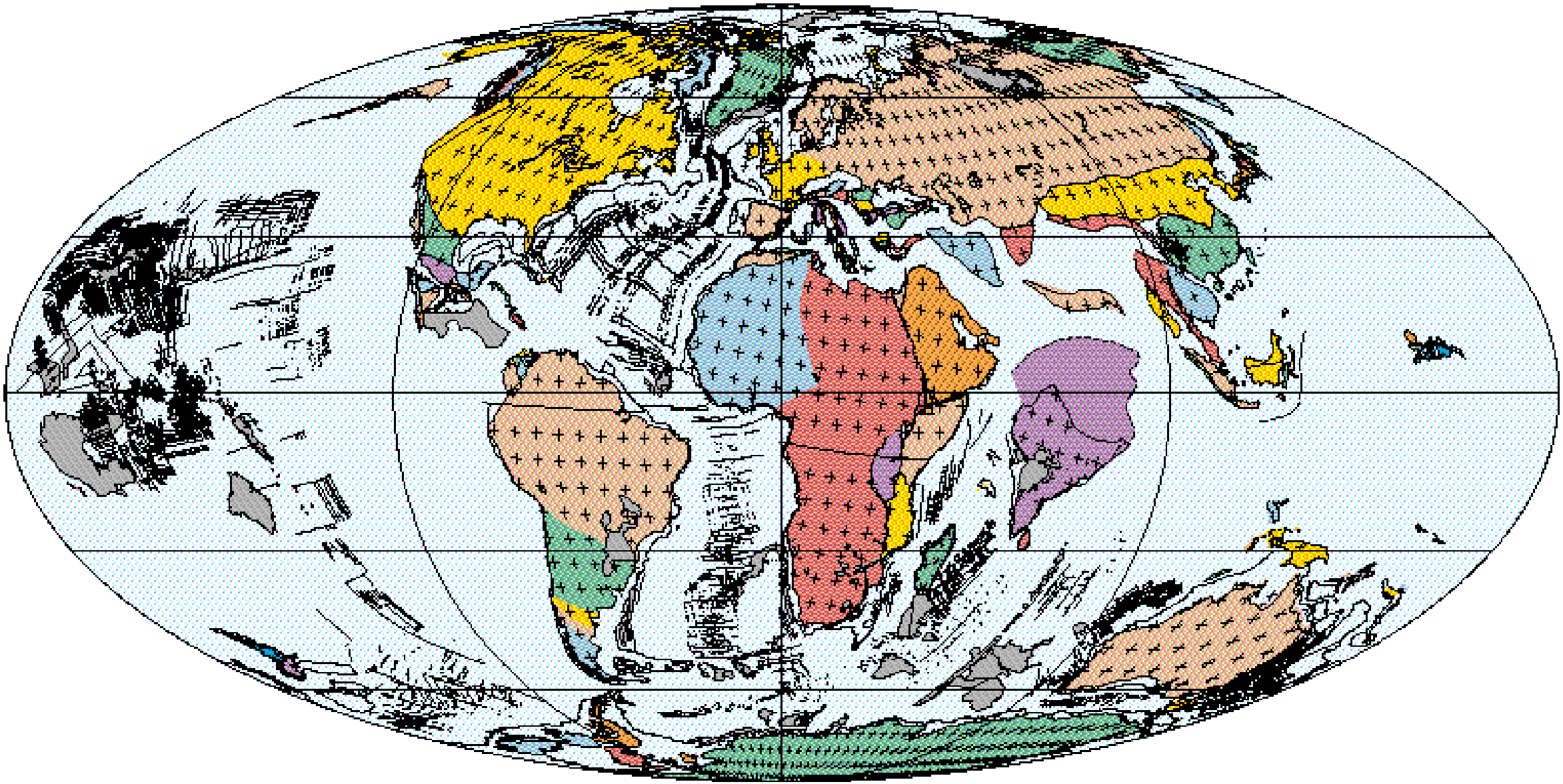
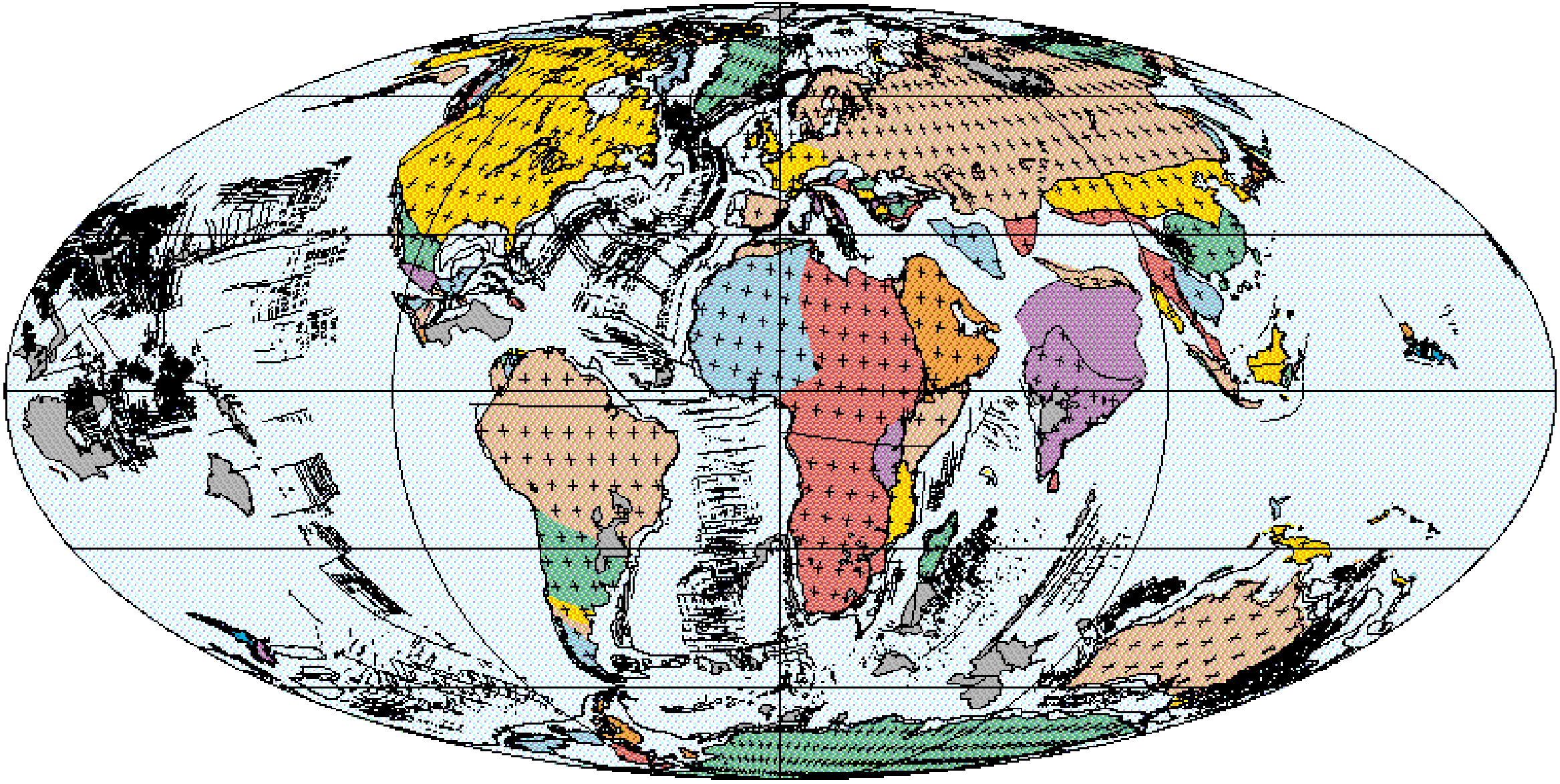


60 Ma

Late Paleocene

PLATES/UTIG

July 1999

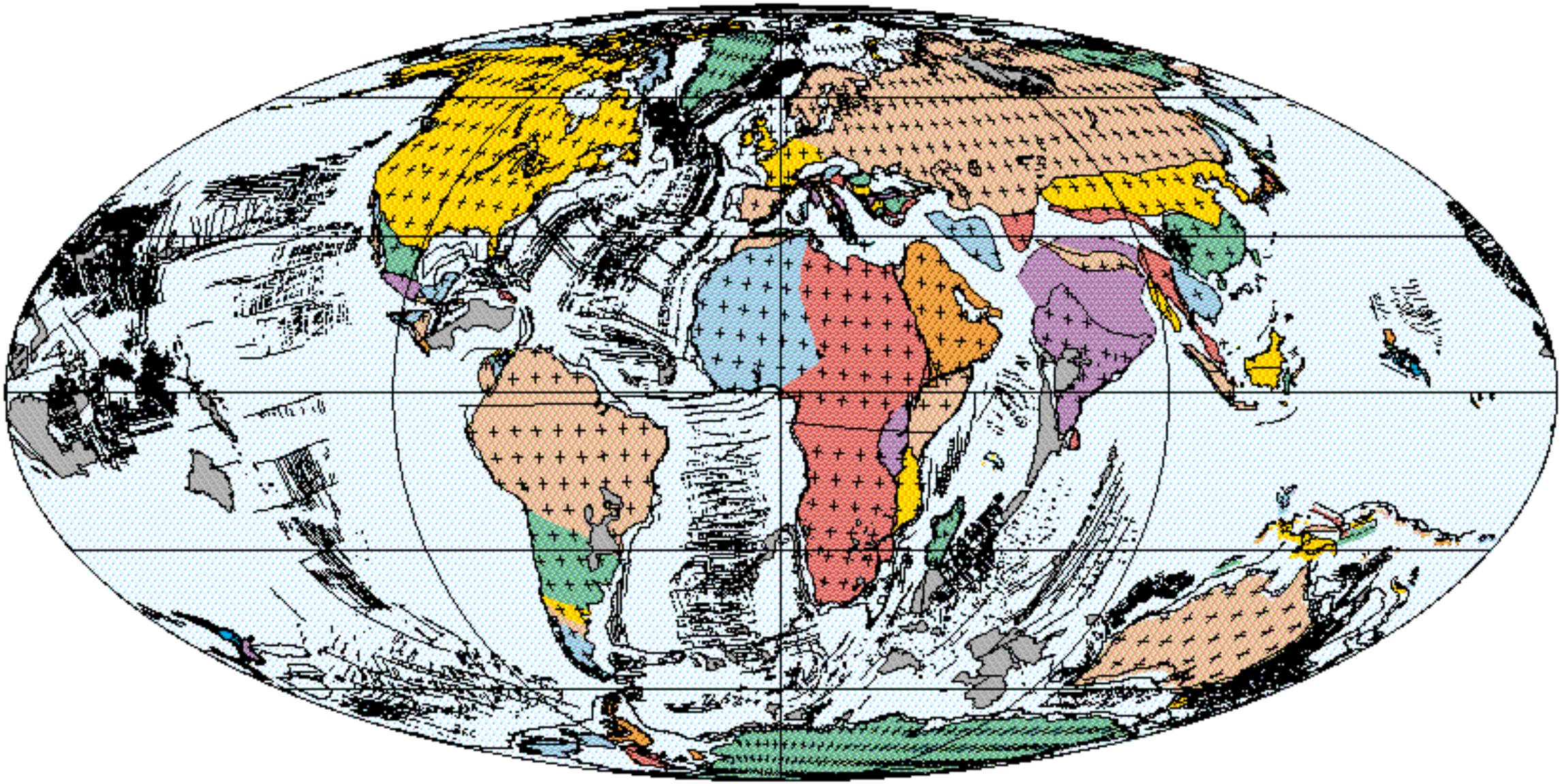


50 Ma

Early Eocene

PLATES/UTIG

July 1999

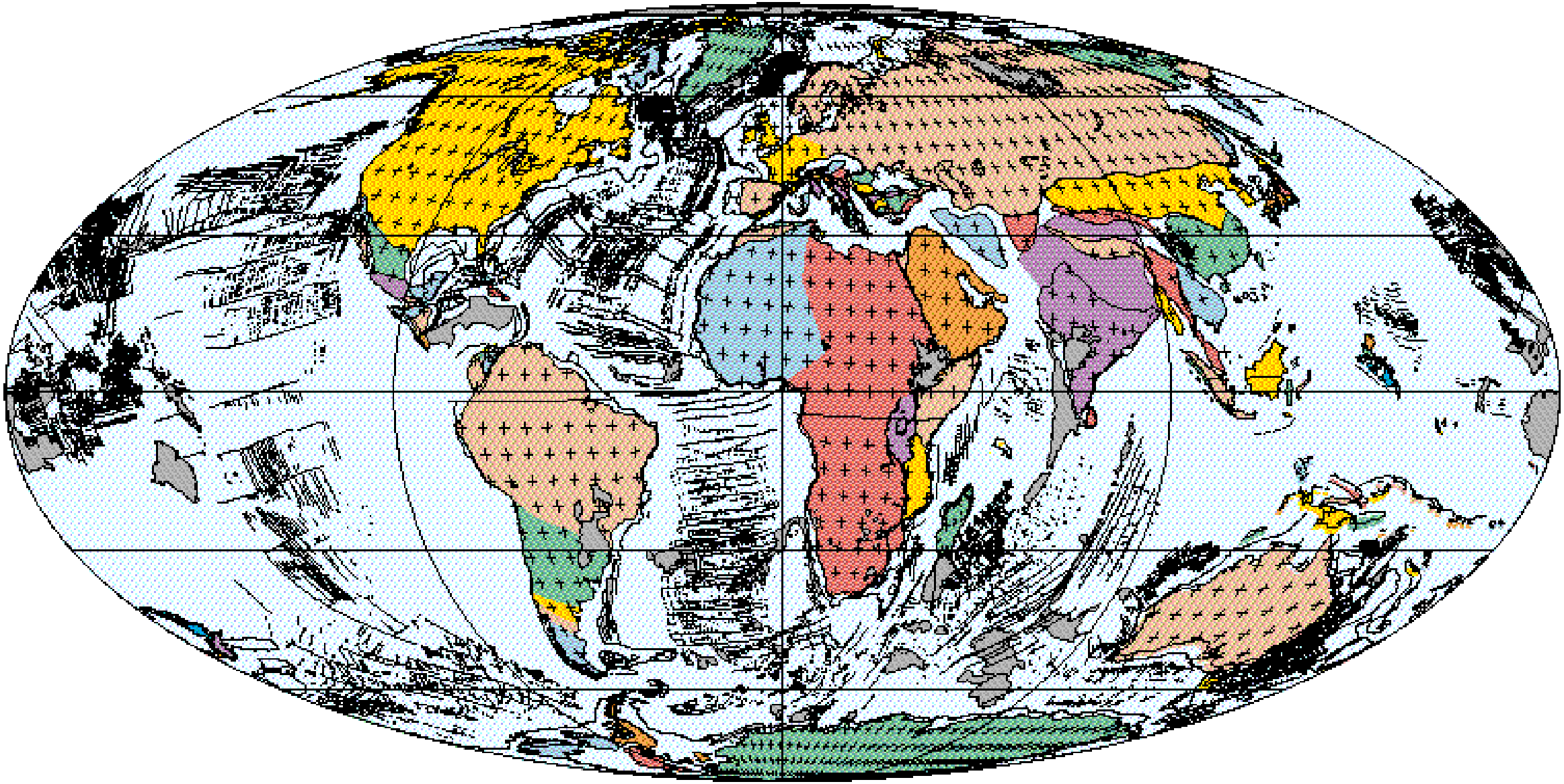


40 Ma

Middle Eocene

PLATES/UTIG

July 1999

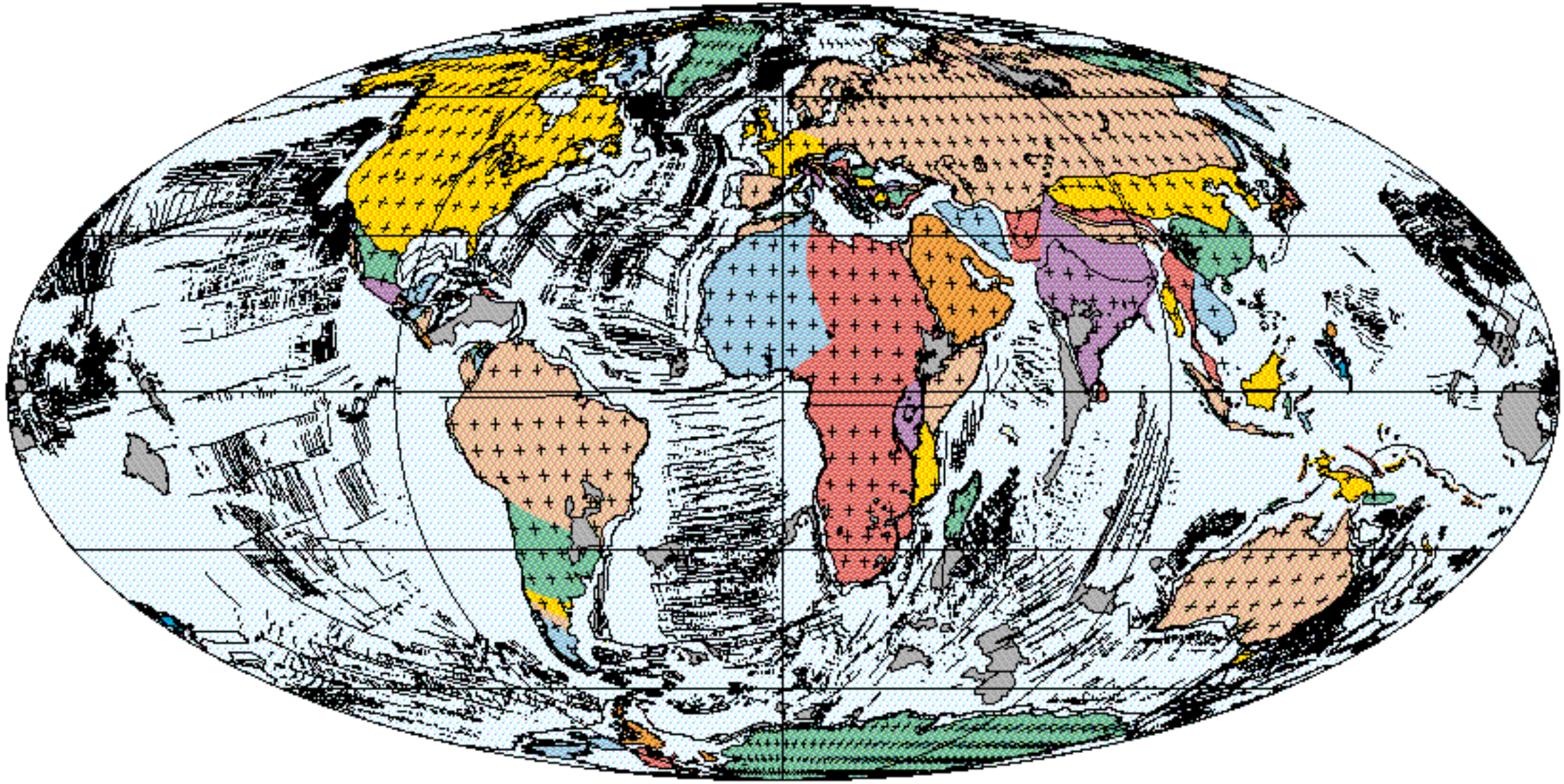


30 Ma

Early Oligocene

PLATES/UTIG

July 1999

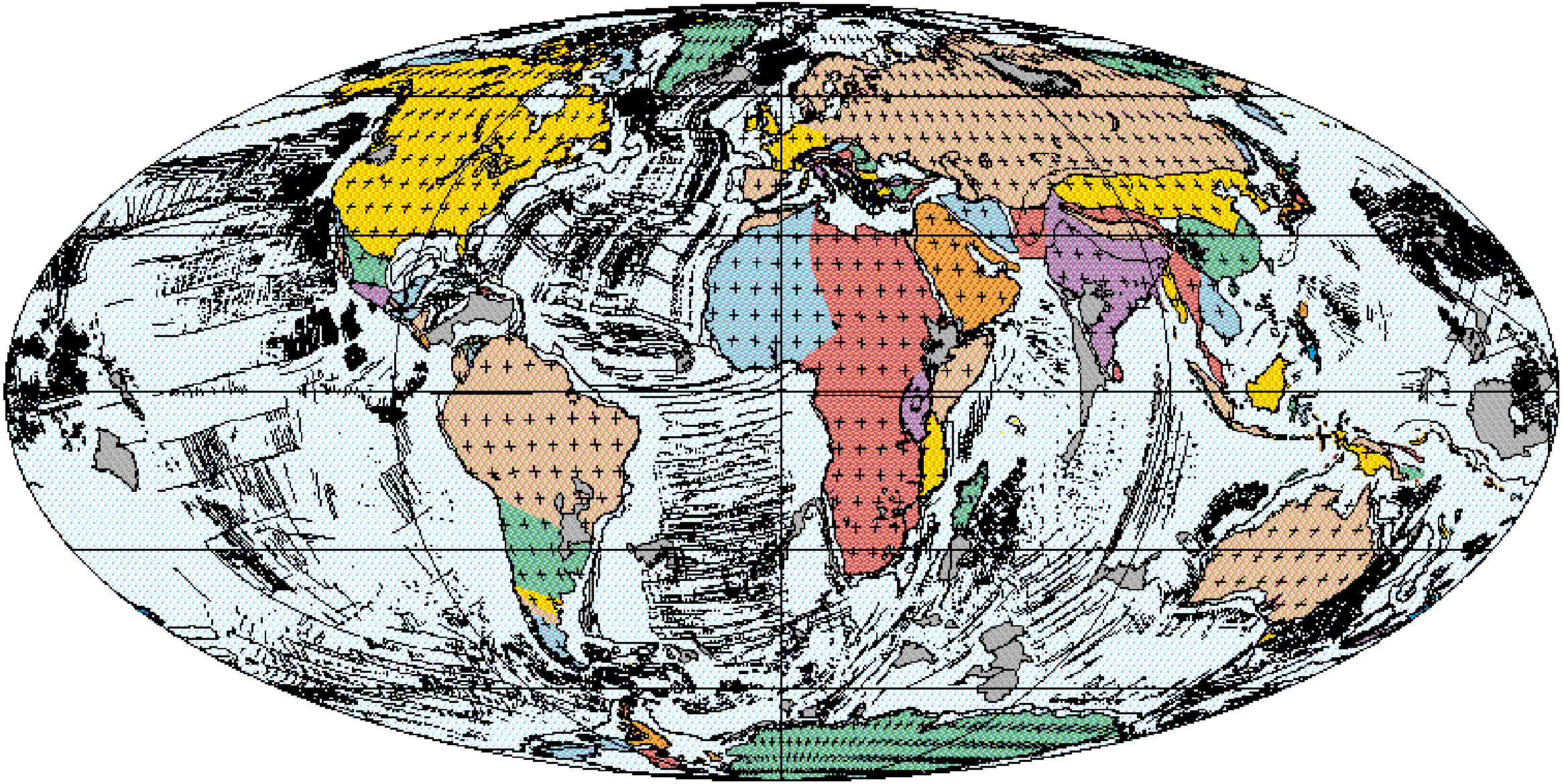


20 Ma

Early Miocene

PLATES/UTIG

July 1999



10 Ma

Late Miocene

PLATES/UTIG

July 1999