Paleogeographic and Paleoclimatic Atlas*

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Abstract

During the last six years the PALEOMAP Project has constructed a digital atlas of plate tectonic and paleogeographic reconstructions. This “PaleoAtlas” runs in ArcGIS (ESRI). The PaleoAtlas is made up of 53 palaeoreconstructions in six volumes: Cenozoic, Cretaceous, Jurassic and Triassic, Late Paleozoic, Early Paleozoic, and Late Precambrian (Neoproterozoic). For each reconstructed time interval there are more than 25 feature layers that describe important tectonic, paleogeographic and paleoclimatic information, such as: modern geographic features, plate tectonic features (active plate boundaries, age of the ocean floor, and ancient plates), palaeorivers and drainage basins, a 3D digital paleogeographic model (PaleoDEM), as well as estimates of highstand and lowstand shorelines, and geological information (outcrop geology, regional lithofacies, coral reefs, and ophiolites.

Work has recently begun on a companion PaleoClimate Atlas. Climate simulations were run using the Fast Ocean and Atmosphere Model (FOAM) which illustrate the Earth’s evolving climate during the past 750 million years. There will be more than 50 paleoclimatic reconstructions in the completed Paleoclimate Atlas. As of June 2010, 18 simulations had been run. For each paleoclimatic reconstruction, there are ~20-feature layers describing important aspects of the Earth’s ancient climate: atmospheric circulation (seasonal pressure systems and winds), seasonal temperatures, rainfall, runoff, palaeorivers and drainage basins, oceanography (seasonal surface currents, salinity, areas of upwelling, areas of anoxia), and the predicted location of deltas and clastics influx to the oceans). The plate tectonic, paleogeographic and climatic information collected in the PaleoAtlas and Paleoclimate Atlas will be the principal input for the “Earth System History Archive” (ESHA). The Earth System Archive is a compilation of important paleo-environmental variables (e.g., elevation, bathymetry, temperature, rainfall, ocean currents, salinity, upwelling, etc). The goal of the ESHA is to provide earth scientists and earth historians with a concise, accurate, and informative digital description of the evolution of the Earth System during the past one billion years. Using GIS technology it is now possible to store, retrieve, and visualize this wealth of information about the Earth's distant past.
Selected References


Websites

Blakey, R., Global Paleogeography: Web accessed 19 September 2011, [http://www2.nau.edu/rcb7/65moll.jpg](http://www2.nau.edu/rcb7/65moll.jpg)

PALEOMAP Project Philosophy

“To use an integrated, multidisciplinary, Earth Systems Science approach to model: plate tectonics, paleogeography, and paleoclimatology in order to better understand the History of the Earth.”
△ 피로도인 월간 △ 피로도인 월간

- 시·리사바늘축성에 대해 보도하면서 염육바늘축성의 문제점과 그 해결 방안을 소개합니다.
- 몸의 월간과 시·리사바늘축성의 문제점과 그 해결 방안을 소개합니다.
- 시로 나아가기로 하세요. 시로 나아가기로 하세요. 시로 나아가기로 하세요. 시로 나아가기로 하세요. 시로 나아가기로 하세요.
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PALEOMAP
PaleoAtlas for ArcGIS
사례보고서는 동시에 바람과 새로운 비상사태가 발생하여

■ 공사재해사례
■ 공사재해사례
■ 바람사고사례
■ 사고사례
■ 바람사고사례
■ 바람사고사례
■ 바람사고사례
■ 바람사고사례
Assembly of Gondwana

Collision of Congo craton with Rodinia during Pan-African Orogeny
Modern Features

- Coastlines
- Political Boundaries
- Cities
- Lakes & Rivers
- Sedimentary Basins
Modern Coastlines & Political Boundaries
High Resolution Modern Coastlines & Political Boundaries
Rivers, Lakes & Sedimentary Basins
Sedimentary Basins from XOM Tectonic Map
Paleogeography

- High Resolution
- Simplified
- High & Low Shorelines
PALEOGEOGRAPHIC RECONSTRUCTIONS

"Interpreting the rock record to map past distribution of lithofacies and environments of deposition."

Resolution of Paleogeographic Maps
Horizontal = .1x.1 degrees
Vertical = 40 m

Temporal Resolution
Nearest Sequence Boundary and Maximum Flooding Surface

Lithological Data - Stage
High Resolution Paleogeography

Aptian
120 Ma
Simplified Paleogeography

Aptian
120 Ma
Simplified Paleogeography with Highstand and Lowstand coastlines

Aptian
120 Ma
PaleoRivers & Drainage

- Drainage Basins
- PaleoRivers
Paleo-Rivers and Drainage Pattern

Aptian
120 Ma
Paleo-Rivers & Drainage on Simple Paleogeography (close-up)

Aptian
120 Ma
Lithology

- Reefs
- Ophiolites
- Lithology
- Depositional Environment
- Climatic Lithofacies
Lithofacies (U. Chicago, Ziegler et al., 2003)

Aptian
120 Ma
Lithofacies (close-up)

Aptian
120 Ma
Environments of Deposition (Ziegler et al., 2003)

Aptian
120 Ma
Clastic/Carbonate Ratio (Ziegler et al., 2003)

Aptian
120 Ma
Combined Environments & Clastic/Carbonate Ratio

Aptian
120 Ma
Lithologic Indicators of Climate (Boucot et al., in press)
Climatic Zones derived from Lithologies

Aptian
120 Ma
Climatic Zones derived from Lithologies (close-up)
Plate Tectonics

- Ophiolites
- Age of Ocean
- Isochrons
- Active Plate Boundaries
- Ancient Plates
Plate Tectonic Reconstruction

80 Ma
Plate Tectonic Reconstruction

360 Ma
Ophiolites

120 Ma
XOM Tectonic Map on Late Cretaceous Paleogeographic Reconstruction

80 Ma
XOM Tectonic Map on Late Cretaceous Paleogeographic Reconstruction (close-up)

80 Ma
Plate Tectonic Reconstruction: XOM Tectonic Map Overlay

120 Ma
Plate Tectonic Reconstruction: XOM Tectonic Map Overlay (close-up)
Plate Tectonic Reconstruction: Ancient Plates

120 Ma
Plate Tectonic Reconstruction: Ancient Plates & Oceanic Isochrons

120 Ma
Plate Tectonic Reconstruction: Ancient Plates & Active Plate Boundaries

120 Ma
Plate Tectonic Reconstruction: Ancient Plates & Age of Ocean Floor

120 Ma
Geology

Global Geological Map
Paleoreconstruction with Global Geological Map Overlay

120 Ma
Paleoclimate

- Temperature
- Winds & Pressure
- Rainfall & Runoff
- Rivers & Deltas
- Salinity
- Ocean Currents
- Upwelling
Phanerozoic Global Climate Change

This curve describes the changing mean Annual Temperature (MAT) during the past 600 million years.

The Earth’s climate has alternated between ice house and hot house states.

The dashed lines are 18 time Intervals for which paleoclimate simulations have been run.
KT Boundary

Ice-Free Antarctica

65 Ma
Latest Ordovician

445 Ma

Ice House
# Time Intervals with Paleoclimate Simulations

<table>
<thead>
<tr>
<th>EON</th>
<th>ERA</th>
<th>PERIOD</th>
<th>EPOCH</th>
<th>Ma</th>
<th>INTERVAL</th>
<th>GANDOLPH TIME SLICES</th>
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<td>Late 11.6</td>
<td>30</td>
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<td>Middle 16.0</td>
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<td>Late 28.4</td>
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<td>Early 33.9</td>
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<td>Middle Eocene (Thanetian)</td>
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<td>Early 48.6</td>
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<td>Late 55.6</td>
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<td>Early 176</td>
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<td>Early Cretaceous (Albian-Aptian)</td>
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<td>Late 228</td>
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<td>3400</td>
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</table>

Age of FOAM Simulation
Winter Mean Annual Temperature with Isotherms

070 Ma
Summer Mean Annual Temperature with Isotherms

070 Ma
Winter Atmospheric Pressure with Surface Winds

070 Ma
Summer Atmospheric Pressure with Surface Winds
Test of Paleoclimatic Simulation of Rainfall & Runoff with Evaporites, Calcrites, Coals, Bauxites, Kaolinites & Reefs
Salinity & Winter Surface Currents
Basin Restriction (Anoxia) & Summer Surface Currents

070 Ma
Climatic Zones (after R. Blakey) plotted on PALEOMAP Paleogeographic Shaded Relief Map
Climatic Zones plotted on PALEOMAP Paleogeographic Shaded Relief Map with Coastlines & Political Boundaries
시바에 오스 • 래브랑시오 • 라프 던시 오 • 쿠파스 모 • 충자바바모모