Guadalupian Paleobiogeography across the Neotethys Ocean*

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Abstract

The Guadalupian was a period of climate change and plate-tectonic reconfiguration. Climate changed from glacial conditions at the dawn of the Permian to warm global conditions in the Guadalupian. The Cimmerian terranes migrated from southern Gondwanan paleolatitudes in the Early Permian to subequatorial paleolatitudes by the Middle-Late Permian as the result of the opening of the Neotethys Ocean. This opening was asymmetrical, with higher seafloor spreading rates for the central Cimmerian terranes (central Afghanistan, Karakorum) than for the western terranes (Iran), and it took place contemporaneously with the transformation of Pangea from an Irvingian B to a Wegenerian A-type configuration.

During this Early to Middle Permian tectono-climatic transition, bioprovincial patterns evolved rapidly across the southern and northern margins of the opening Neotethys Ocean, making brachiopod paleobiogeography a useful tool to test its complex opening. Guadalupian (Wordian) brachiopod faunas from Sicily, Tunisia, Turkey, Oman, North Iran, Central Afghanistan, Karakorum, Salt Range and South Thailand have been compared by multivariate analysis to test their similarity and pattern of distribution.

The results of cluster analysis and principal coordinate analysis have been placed on an independently derived paleogeographic reconstruction, allowing us to draw the following conclusions:

(i) Central Afghanistan and Karakorum faced the Paleotethys open ocean and were bathed by a paleoequatorial current that dispersed larvae towards the Tethyan Gulf and the Gondwanan margin.

(ii) Tunisia and Sicily (Sosio), located in the westemmost Tethyan Gulf, were thus more prone to isolation with respect to Tethyan open-ocean faunas. (iii) North Iran shows affinities to the Perigondwanan regions of Turkey, Oman, and Salt Range being only slightly detached from the Gondwanan margin due to the incipient opening of the Neotethys; a current gyre bathed both the Gondwanan margin and the Iranian block.

(iii) South Thailand and the Salt Range show affinities to the northern Gondwanan margin.
Selected References


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From glaciation in the Early Permian to monsoons in the Middle Permian

Peyser & Poulsen, 2008

Angiolini et al. 2007
From an Irvingian B configuration to a Wegenerian A configuration
Brachiopods: good tools for paleobiogeography?
Angiolini & Bucher 1999
Angiolini & Stephenson 2008
Angiolini & Carabelli 2010
Verna et al. 2010, 2011
Crippa & Angiolini 2012
Middle Permian Paleolatitude Tunis: -1° ± 2°
Middle Permian Paleolatitude Alborz: -12° ± 2°
Middle Permian Paleolatitude Karakorum: 0° ± 1°

Muttoni et al. 2009
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<th>Tunisia</th>
<th>Sosio</th>
<th>Turkey</th>
<th>Oman</th>
<th>N Iran</th>
<th>Afghanistan</th>
<th>Karakorum</th>
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<td>12°S</td>
<td>~ 0°</td>
<td>~ 0°</td>
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| Genera       | 19 | 24 | 30 | 47 | 27 | 37 | 38 | 37 | 75  |

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| Sampling efficiency | SE 43% | SE 43% | SE 56% | SE 94% | SE 87% | SE 81% | SE 87% | SE 87% | SE 94% |

Data matrix of 134 brachiopod genera for 9 faunal stations

Masking of the original data matrix

STATISTICAL ANALYSIS (PAST, Hammer et al. 2001)

CA
PCO
Middle Permian
Cluster analysis

Cophenetic correlation 0.92

Jaccard coefficient of similarity

Simpson coefficient of similarity

Cophenetic correlation 0.87
Muttoni et al. 2009

Cathaysian Province
Cimmerian Province
Transhimalayan Province

RTF: Ridge-trench-fault
KK: Karakoram
A: Central Afghanistan
QT: Qiangtang (north Tibet)
Sibumasu: Myanmar-Thailand-Baoshan-Malaysia

Panthalassa Ocean
Cathaysian Province
Transhimalayan Province
Cimmerian Province

Mollweide full globe projection
MUTTONI et al. 2009

Cathaysian Province
Cimmerian Province

MIDDLE PERMIAN (ca. 272–260 Ma) PANGEA B TRANSFORMING T

Simpson coefficient of similarity
Cophenetic correlation 0.87

Mollweide full globe projection

MUTTONI et al. 2009
Reliable paleobiogeographic patterns can be obtained only by placing biotic associations on paleogeographic reconstructions constrained by paleomagnetic data.
Reliable paleobiogeographic patterns can be obtained only by placing biotic associations on paleogeographic reconstructions constrained by paleomagnetic data.

Guadalupian brachiopod distribution supports the asymmetrical opening of the Neotethys envisaged by paleomagnetic-based reconstructions.

Central Afghanistan and Karakorum faced the Paleotethys. Tunisia and Sosio were isolated in the westernmost Tehyan Gulf. N Iran shows affinities with the Perigondwanan regions. S Thailand and the Salt Range shows affinities with northern Gondwanan.