A BIOGEOGRAPHIC QUANTITATIVE ANALYSIS OF EARLY TRIASSIC AMMONOID FAUNAS USING BOOTSTRAPPED SPANNING NETWORKS

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1. OBJECTIVES
- Palaeontology: to investigate the Early Triassic ammonoid recovery in terms of biogeographic patterns.
- Mathematics: construction of a connected network of biogeographic units maximizing the likelihood of the available data without inferring arbitrary taxonomic groupings, i.e., without generating any post hoc hypothesis about the existence of virtual units.

2. METHOD: the Bootstrapped Spanning Network

Problem: as (i) synchronous taxonomic assemblages can viewed as reticulate (i.e., cyclic) relations between them, and (ii) taxonomic similarity does not evolve in a metric space (where the notions of "phylogenetic" and "taxonomic distance" are equivalent) due to phylogenetic and ecologic constraints; classic, metric or ultra-metric clustering techniques are not adapted to graphically synthesize similarity between biogeographic units.

Aims: to visualize the (non-metric) "taxon-localities" similarity structures as a connected network by connecting vertices without inferring additional (but potentially meaningful) "ancestral" nodes.

Proposed solution (Brayard et al. in press): departing from the Minimum Spanning Network (MSN) corresponding to the available data (i.e., the shortest connected network sensu Prim, 1967; see Bandelt et al., 1999), to construct a connected network which: (i) is optimal as possible (i.e., with as few edges as possible), and (ii) maximizes the likelihood of the available data (estimated as the product of bootstrapped confidence intervals associated to each edge).

3. RESULTS

Network reconstructions based on longitudinally and latitudinally interpolated taxonomical data sets.

4. CONCLUSIONS

Possible connections due to current-controlled faunal exchanges between both sides of the Panthalassa are clearly shown and terranes such as SK, SP and Chulitna played an important role as stepping stones in the dispersal of ammonoids. SK and SP terranes show strong subequatorial-Tropical affinities during the Triassic, thus suggesting a location close to South China.

At the same time, the Chulitna terrane shows strong affinities with equatorial faunas of the eastern Panthalassa.

REFERENCES


4. CONCLUSIONS

Griesbachian: Meso-Cimmerian basins are linked together reflecting a cosmopolitan distribution of ammonoids (synthesized by the Density Coefficient).

Dienersian: Strong, autisodal affinities exist between facies, especially on West coasts of Pangaea, where tropical facies appear very closely related to East Facies, but not to West coast high latitudes ones.

Smithian: A latitudinal diversity gradient is established in the Panthalassa less than 1 My after the P/T crisis (Galletti et al., 2007). Tethyan facies are dispersed progressively as the product of bootstraps, suggesting some degree of biogeography (Brayard et al., 2006, 2007, 2009).

Spahtian: The latitudinal diversity gradient grows stronger. Tethyan facies cluster around equatorial terranes (Iran, Afghanistan, South China) and southern Europe (Tunisia).

The emergence of a latitudinal biogeographic structuring of ammonoid faunas during the Early Triassic parallels the appearance of a latitudinal diversity gradient (Brayard et al., 2004, 2006, 2009) closely echoing the climate evolution as evidenced by the paleo, sedimentary and geochemical records (Galletti et al., 2007).