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Introduction

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Explanations of global trilobite biodiversity variation over the entirety of the Paleozoic range from active displacement by brachiopod dominated environments to paleocontinental movement and its differing effects on various taxonomic ranks (Harper et al 2015; Westrop and Adrain 2001). Regardless of these potentially confounding effects, trilobite familial abundance change over the Paleozoic was strongly linked to the rate of contemporaneous brachiopod radiation. I hypothesize that brachiopods and trilobites invaded adjacent geoplates at similar times. Primarily through the use of paleocoordinate data, modeling familial flux between adjacent geoplates by epoch will be possible. A secondary goal will be investigation into the role of ecological mutualism through predator avoidance in creating this covariance.

Justification

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In a broad sense, this study will address how the rate of faunal overturn in paleocommunities affects long-term regional biodiversity change. Throughout the literature, studies have postulated many different possible explanations for perceived trilobite diversity fluctuation ranging from transgressive-regressive cycles and tectonics (Balseiro and Waisfeld 2013; DeVries and Primeau 2011; Valentine and Moores 1970; Zhiyi *et al*. 2007) to sampling anomalies (Bambach *et al.* 2004; Connolly and Miller 2001; Peters and Heim 2011) and other biotic factors (Wright and Stigall 2013). Additionally, extensive analyses have already been performed on individual trilobite species distributions and stratigraphic ranges. Yet out of all these studies the sustained, high level of brachiopod diversity radiation has only been tangentially incorporated into the results and most are restricted to one or two well studied species.

Covariance with brachiopod abundance by adjacent geoplate will reveal a fundamental link between the two clades in terms of optimal habitat. Furthermore, predation on brachiopods and trilobites alike created a shared driver for cohabitation of and radiations to geoplates. Specifically, predation by shell-crushing (durophagous) species helped to drive this relationship (Freeman and Miller 2011; Signor III and Brett 1984). This resultant indirect linking of trilobites and brachiopods via a commonly held predation pressure influenced familial abundance change in specific localities throughout the Paleozoic.

Research Plan

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All data for manipulation will originate from the Paleobiology Database. Initial data sets will be downloaded for both *Brachiopod* and *Trilobita* ranging between the Cambrian and the Permian. Soft culls and cleaning of the genus data will then be performed in order to reduce the sampling variability between clades. Next, 34 internationally recognized epochs ranging from the Terreneuvian to the Holocene will be matched to both sets of data. Familial presence and absence data will then be generated by geoplate for each clade. All of this will be done in R, but after this point it may be easier to export the data sets to a more convenient platform such as MATLAB for analysis.

Utilizing the presence and absence data, vectors can be created (during a specific time period) for a given set of geoplates. This step can only be done for each clade separately. Each vector will be placed at the mean latitude and longitude between adjacent geoplates. They will necessarily lie along the line connecting adjacent geoplate latitudes and longitudes, with the heads pointing in the direction of flow. Determining magnitude, however, becomes slightly more involved. It will require tabulation of outward and inward familial abundance flux of each clade for each geoplate while also keeping in mind that if a family disappears from one geoplate in a specific epoch, yet also shows up in an adjacent geoplate in the next time period, it most likely originated from the extirpated population in the first. This movement from one geoplate to another is what was referred to earlier as direction of flow. Magnitude of each vector will be the R.M.S value for the familial abundance change from both geoplates involved (between epochs), with the flow in the direction of greatest increase. In essence, this method will allow for the creation of a vector field; a gradient. This will facilitate the use of two-dimensional flux and circulation theorems, constrained by latitude and longitude contours, in MATLAB.

References

(2,410 of 2,500)

Harper, D.A.T., Zhan, R., and Jin, J. "The Great Ordovician Biodiversification Event: Reviewing two decades of research on diversity's big bang illustrated by mainly brachiopod data." *Palaeoworld* (2015) 24: 75-85.

Westrop, S.R. and Adrain, J.M. "Sampling at the species level: Impact of spatial biases on diversity gradients." *Geology* (2001) 29.10: 903-906.

DeVries, T. and Primeau, F. "Dynamically and Observationally Constrained Estimates of Water-Mass Distributions and Ages in the Global Ocean." *American Meteorological Society* (2011) 41: 2381-2401.

Balseiro, D. and Waisfeld, B.G. "Ecological instability in Upper Cambrian-Lower Ordovician trilobite communities from Northwestern Argentina." *Paleogeography, Paleoclimatology, Paleoecology* (2013) 370: 64-76.

Balseiro, D., Waisfeld, B.G., and Vaccari, N.E. "Paleoecological Dynamics of Furongian (Late Cambrian) Trilobite-Dominated Communities from Northwestern Argentina." *Palaios* (2011) 26.8: 484-499.

Connolly, S.R. and Miller, A.I. "Global Ordovician faunal transitions in the marine benthos: proximate causes." *Paleobiology* (2001) 27.4: 779-795.

Freeman, R.L., and Miller, J.F. "First Report of a Larval Shell Repair Scar on a Lingulate Brachiopod: Evidence of Durophagous Predation in the Cambrian Pelagic Realm?" *Journal of Paleontology* (2011) 85.4: 695-702.

Signor III, P.W., and Brett, C.E. "The mid-Paleozoic precursor to the Mesozoic marine revolution" *Paleobiology* (1984) 10.2: 229-245.

Zhang, Z., Robson, S.P., Emig, C., and Shu, D. "Early Cambrian radiation of brachiopods: A perspective from South China." *Gonwana Research* (2008) 14: 241-254.

Valentine, J.W. and Moores, E.M. "Plate-tectonic Regulation of Faunal Diversity and Sea Level: a Model." *Nature* (1970) 228: 657-659.

Zhiyi, Z., Wenwei, Y., and Zhiqiang, Z. "Patterns, processes and likely causes of the Ordovician trilobite radiation in South China." *Geological Journal* (2007) 42: 297-313.

Peters, S.E. and Heim, N.A. "Stratigraphic distribution of marine fossils in North America." *Geology* (2011) 39.3: 259-262.

Bambach, R.K., Knoll, A.H., and Wang, S.C. "Origination, extinction, and mass depletions of marine diversity." *Paleobiology* (2004) 30.4: 522-542.

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Wright, D.F. and Stigall, A.L. “Geologic Drivers of Late Ordovician Faunal Change in Laurentia: Investigating Links between Tectonics, Speciation, and Biotic Invasions.” *PLoS ONE* (2013) 8.7: e68353.