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Introduction

(732 of 1,000)

Explanations of global trilobite biodiversity decline 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. Primarily through the use of paleocoordinate data, modeling inward (establishment) or outward (extirpation) familial flux by geoplate between epochs will be possible. A secondary goal will be investigation into the oftentimes transient nature of biodiversity change.

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 decline 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.

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Among the unexplored theories of trilobite familial abundance decline is habitat fragmentation (Jackson and Sax 2010). In this context habitat fragmentation due to origination of brachiopods in trilobite communities. By modeling geoplate flux between epochs with the forcing fragmentary event being origination of brachiopods, an exploration into habitat fragmentation will be possible. More importantly this modeling method will not be restricted to just paleoecology, but will also have applications to modern habitat fragmentation patterns and possible future effects of it on existing communities. The importance of this should not be overlooked, considering humans' massive environmental impact across all biomes.

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 placed at all paleocoordinate positions of a given geoplate. The magnitude of these vectors will be the R.M.S value for the total familial richness of the geoplate, taking into account both data sets. The direction will be between zero and 180 degrees, to be determined by the ratio of trilobite to brachiopod family richness. This process will be completed for each epoch recognized by both data sets. From here, analysis of flux to and from geoplates will be analyzed in two ways. First with regard to magnitude, and secondly with regard to angle.

In addition, by changing the magnitude from total familial richness to just trilobite richness the hypothesis on possible trilobite habitat fragmentation by brachiopods can be tested. If both extirpation of trilobites (decrease in magnitude) and immigration of brachiopods (decrease in slope) are slow (small changes between adjacent epochs), then the incumbents are probably limiting establishment capability of brachiopods. If both are fast (large changes between adjacent epochs), then the new competitors are likely accelerating extirpation of the incumbents (Jackson and Sax 2010).

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