INTRODUCTION

The mass extinction that had the most detrimental effects on marine biodiversity across the globe came at the end of the Permian period (Sepkoski 1981). There are extensive and diverse ecological communities covering the globe, and each of these may be affected differently based on what type of environmental changes they encounter (Walther et al. 2002). If we could understand what organisms would be the most susceptible to rapid environmental change based on previous extinctions, we may be able to focus our resources on preserving the species of these communities. My objective is to use the Permo-Triassic extinction to look at the changes in diversity experienced between tropical and extratropical latitudes from the Late Permian and Early Triassic. I hypothesize that there will be higher rates of survivorship in extratropical climates than tropical climates.

JUSTIFICATION

The extinction at the end of the Permian period was the worst mass extinction of the Phanerozoic with the loss of more than 90% of marine species (Benton & Twitchett 2003, Jin et al. 2000, Clarkson et al. 2015). There are many hypotheses as to what caused the end-Permian extinction event, but the most likely candidates are related to volcanism from the Siberian Traps releasing massive amounts of greenhouse gases into the atmosphere (Benton & Twitchett 2003, Clarkson et al. 2015). It has been suggested that the end-Permian event could be an analog for our current global conditions (Payne & Clapham 2012). Of particular interest to this study is the impact that this volcanism and the volcanic gases released had on the oceans. Two very important factors likely played a role in the decline of biodiversity: ocean anoxia and ocean acidification (Wignall & Hallam 1992, Wignall & Twitchett 1996, Clarkson et al. 2015). This study will not be focused directly on these causal mechanisms, but will instead focus on

detecting geographic patterns of marine biodiversity loss that coincided with these phenomena.

By examining how ecological communities changed based on latitude, I hope to find patterns that would show a correlation between the geographic latitude at which a species persists and its likelihood of extirpation. This research, in combination with studies on susceptible ecosystems, could give us predictive power to know what species are most at risk (Lindner et al. 2009, Walther et al. 2002, Scholze et al. 2006). Several studies show that organisms that inhabit environments with more thermal variability are more likely to acclimate to new temperature ranges (Clarke 2003, Feder 1982). Due to the stable environments in tropical marine latitudes, many of these organisms have reduced physiological tolerance for shifts in temperature or salinity (Walther et al. 2002). For this reason, I hypothesize that tropical organisms will be more susceptible to extinction than extratropical organisms in a scenario of rapid global climate change.

Preservation of the biodiversity on this planet is not only important to the balance and sustainability of ecological communities, but also to the sustainability of our own species (Norton 2014). An understanding of past extinction events may enable us to predict which environments would experience the greatest losses in such an event, and from that knowledge, we can focus our efforts on preserving those ecosystems.

RESEARCH PLAN

I will begin this study by compiling presence data for marine invertebrate taxa from the Paleobiology Database (PBDB) into R. The PBDB is an online collection of fossil occurrences that records many useful components of each occurrence, such as the taxonomic affinity, number of

occurrences, paleogeographic coordinates, and time interval of occurrence. The data collected will be from four marine invertebrate groups – *Bivalvia*, *Brachiopoda*, *Foraminifera*, and *Ostracoda* – from the Mid-Permian through the Mid-Triassic to encompass a wide range of taxa from the intervals before and after the end-Permian extinction (Leighton & Schneider 2008, Jin et al. 2000). These four groups of marine invertebrates were selected because, although they were strongly affected by the event, some members persisted into the Triassic unlike some other important Paleozoic groups.

The data will be divided into two groups, those genera present during the middle to late Permian and those present from the early to middle Triassic. To analyze the geographic location of each occurrence, I will arrange the data into two groups using the paleolat component of the data housed in the PBDB and compare which genera are present at latitudes between 23.5° S and 23.5° N, the Tropic of Capricorn and Tropic of Cancer respectively, and which genera are present at extratropical latitudes. I will then test the data using a binary logistic regression, with the two components being survivorship and extinction (Payne & Finnegan 2007). The data will also be analyzed with an odds ratio test to determine if geographic latitude is a likely explanation of patterns of extinction or if it cannot account for the extinction patterns observed in the fossil record.

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