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Grant Proposal 1st Draft

Topic:

Character of survivor taxon from the mass extinction: Case study from Dinosauria during end-Triassic extinction in South Africa

Hypothesis and Objectives:

End-Triassic extinction is thought to be triggered by volcanic CO_2 emission from the Central Atlantic Magmatic Province, which shows similar global warming trend with modern sixth extinction (Ruhl et al., 2011). One of the terrestrial vertebrate survivors of this extinction is Dinosaurs. Studying Dinosaurs will help identifying the character of terrestrial survival during mass extinction. To identify this character, firstly, I will compare the morphological difference of dinosaur faunas in South Africa between Norian and Hettangian by using morphometric analysis using skull and femur. Second, environmental analysis of Elliot Formation will be performed to compare the change of environments between two time periods. Third, morphological and environmental data will be compared to find the character and mechanism of the survival of Dinosaur during end-Triassic extinction.

Significance:

Earth is facing the sixth extinction right now (Baronsky et al., 2011). Therefore, conservation of ecosystem and understanding past extinction records are highly on the rise among the scientific field. One of the understudied subjects about the mass extinction is

about survivors of the extinction. Studying traits of mass extinction survivors is important because it would give a deeper understanding of nature and ideas about conservation of species. Terrestrial extinction research is relatively understudied compare to marine realm due to their high preservation possibility, and wide range of ocean compare to the landmass. Studying the terrestrial extinction is critical to gain knowledge about sixth extinction since humans are land-dwellers, and most of the conservational efforts are focused on the terrestrial realm. In result, studying terrestrial record of mass extinction is worth studying despite its small amount of samples.

One of the most understudied mass extinctions is end-Triassic mass extinction. End-Triassic mass extinction happened around 201.3 million years ago and brought extinct of various marine invertebrate faunas such as conodonts (Hallam, 2007; Schoene et al., 2010). In terrestrial realm, extinction of large amphibians and archosauromorphs led the way to the dominance of dinosaurs (Brusatte et al., 2010). Therefore, early dinosaurs are regarded as survivor from mass extinction and their traits are worth studying to understand what kind of traits actually helped dinosaurs from surviving the mass extinction. Unfortunately, early dinosaur fossil records are patchy and do not show many continuous Triassic to Jurassic transition record. However, one of the few exceptions for this is South Africa's Elliot Formation. Elliot Formation spans from Norian to Sinemurian, which is the best place to study dinosaur fossil records during end-Triassic Extinction.

Dinosaur paleontology of Elliot Formation is actively researched field due to its abundance of fossil and significance (Barrett, 2009; Butler, 2010). However, detailed quantitative analysis of dinosaur evolution in Elliot Formation has not published yet. Therefore, this research will provide not only quantitative morphological analysis of Elliot Formation dinosaur to find out traits of survival taxon but also environmental information to

find the relationship between environment and evolution.

Methods:

Most of the research will be performed in South Africa since most of the specimens related to this research are located in South Africa. For environmental analysis, fieldwork will happen around September to December of 2016 since the climate is amicable to conduct field work. Most of the field work will focus on facies analysis for lower and upper member of Elliot Formation to understand the environment of both members. Moreover, fossil collection will also happen alongside the facies analysis to enable precise ecosystem construction of the Elliot Formation. These environment data is associated with the published research and museum collection to draw better resolution of the environment. Furthermore, literature analysis of carbon and oxygen isotopic study around Africa during Norian and Hettangian will be reviewed to reconstruct climate around these time periods.

For quantitative morphological analysis, skull and femur of dinosaurs from museum collection will be thoroughly measured and recorded to perform a geometric morphometric analysis. Skull is an important part of the animal since it is strongly correlated to the food process. Therefore, skull shows a high disparity among animals and important in studying evolution (Marugán-Lobón & Buscalioni, 2003). Femur is another important aspect of this study since it is a good proxy for estimating body mass. Moreover, even though femur is not presented, skull length will give a precise measurement of femoral length which gives huge advantages for this research (Sookias et al., 2012). Skull disparity and femoral length will be plotted in the morphospace and analyzed to find out the pattern and the paleobiological difference between Late Triassic and Early Jurassic dinosaurs.

Global scale taxonomic analysis will be performed using Paleobiology Database and R program. The goal of this analysis is to find out and compare the taxonomic diversity trend of dinosaur between Norian and Hettangian. I thought this is important because this analysis would validate whether the result I get from South Africa is only confined trend to the South Africa or worldwide phenomenon.

Reference

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