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Fossils of the Plio-Pleistocene

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Background

Documenting fossil communities within their environment through time can help us understand the underlying ecological processes that cause ancient communities to change or remain static (Jackson et al 2006; Erwin et al. 2006). Collecting abundance data in combination with diversity data, creates a more detailed picture when reconstructing ancient community (Jackson et al. 2006; Erwin et al. 2006). The Plio-Pleistocene boundary (~2.5 million years ago) marks an interesting time in geological history because previous research indicates that the Earth shifts from a warm house to icehouse conditions (Stanley et al. 1984). Reconstructing fossil communities from this time interval can help examine how marine communities responded to changes in global ocean temperatures. Past examples of how marine communities respond to global temperature changes can help us predict how marine communities will respond to present and future temperature changes. Previous studies of the Atlantic Ocean revealed that a decline in temperature and nutrient supply affected the abundance and diversity of marine communities (Allmon et al. 2001). For example, 65%-75% of large molluscan faunas declined within the early Pleistocene in the Western Atlantic and the Caribbean reported similar effects (Stanley et al. 1984). However, fewer studies from the Pacific Plio-Pleistocene boundary exist. Based on previous observations, we expect the Pacific marine communities to drop in diversity with the in early Pleistocene; thus, this work tests the hypothesis that two late Pliocene sample will have a greater abundance and diversity compared to the Late Pleistocene sample.

Methods



- We collected three 5-gallon buckets samples from Pacific Beach, CA; two samples from the late Pliocene and one from the early Pleistocene.
- I, along with two other students, separated the fossils from the sediment using a wet or dry sieving technique.
- After sieving, we identified each specimen to genus and species level by comparing our specimens to the literature and museum collections.
- Once identified, we counted each specimen to determine its abundance.
- To compare abundance and diversity through time, we used a two-way cluster analysis. Then we used the ANOSIM (analysis of similarity) to determine if the paleo-communities statistically differ through time.

Results

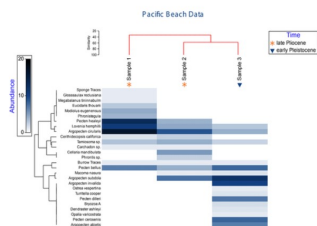


Figure 2: abundance and diversity of our samples. Species cluster is along the vertical axis and sample cluster is along the horizontal axis. Central dividing shows species abundance within samples.

Results indicate:

- Different taxa are dominant in different samples this can be seen by the dark blue shading differing between samples.
- Many taxa overlap within all samples in the middle section of figure 2.
- All three samples are significantly similar in abundance and diversity. This is confirmed with SIMPROF (similarity profile analysis).



Figure 3: These are common taxa found in all three samples that show similarity in abundance.

Conclusion

(Our results showed different taxa are dominant in different between sample, but there is a greater overlap of abundance per taxa between all three samples. Reasons as to these results could have been produced is some taxa preserve better than others. For example, there was some taxa that were stuck in a cement like sediment which made it difficult to either extract the taxa from and or visually see identifiers on the fossils. On the opposite spectrum there was also very delicate taxa that would crumble on contact during extraction from the site or during the sieving process. This could then create a bias towards the better-preserved fossils. If so, fully capturing the differences within the samples would be more difficult. Another thing that must be taken into consideration when understanding the results is the oceanic temperature difference between Atlantic and Pacific Ocean. Pacific Ocean naturally has a cooler temperature as opposed to the Atlantic ocean thus, making their inhabitants more successful in adaptability when the temperature cooled.

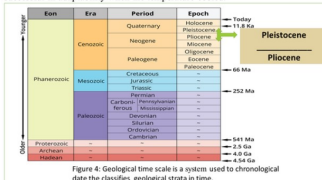


Figure 4: Geological time scale is a system used to chronological date the classes' geological strata in time.

Future Work

Through the analysis of the Plio-Pleistocene boundary we will enhance our understanding of how temperature changes affect marine invertebrate communities. This time period endured a drastic event due to the closure of the Central American isthmus resulting in rapid climate change (Jackson et al. 2006; Erwin et al. 2006). This project is part of a larger study that will continue to investigate additional Plio-Pleistocene boundary within the eastern Pacific. Future investigation involves examining oxygen isotopes and nutrient levels to see how, and if, they influenced extinction and origination of marine fauna. Further studies within the Pacific will result a fuller, more global picture of how climate change affected marine communities in the past.

References

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My project focused on the marine life of Plio-Pleistocene. We excavated and reconstructed ancient marine communities across different time periods throughout Earth's history and we try to relate our fossil findings to the underlying processes of ecological and evolutionary change through deep time.

Alternate Text:

Jazmin Blue Araujo

Quote: "My project focused on the marine life of Plio-Pleistocene. We evacuated and reconstructed ancient marine communities across different time periods throughout Earth's history and we try to relate our fossil findings to the underlying processes of ecological and evolutionary change through deep time."

Image of Jazmin Blue Araujo

Image of text and graphic laden project presentation entitled "Fossils of the Plio-Pleistocene. Jazmin Blue Araujo, Dr. Nicole Bonuso"