

GLOBAL PALEOBATHYMETRY RECONSTRUCTION WITH REALISTIC SHELF-SLOPE AND SEDIMENT WEDGE

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Figure 8: Reconstructed modern global bathymetry.

Figure 9: Difference between ETOPO1 and modeled bathymetry excluding seamounts, plateaus, hotspots. Some

anomalous regions in Arctic Ocean and south of Australia need further investigation. Some shelf slope regions

exhibit deviation due to complex model inputs.

T51E-2520



Objective

To create a realistic bathymetry for the present-day global ocean in a parametric form that can be used to estimate the bathymetry of paleoceans.

Data:

- Age of ocean crust
- ETOPO1
- Sediment thickness

Algorithm Elements:

T51E-2520

- Plate Model
- Shelf-Slope Model
- Interpolation for complex regions

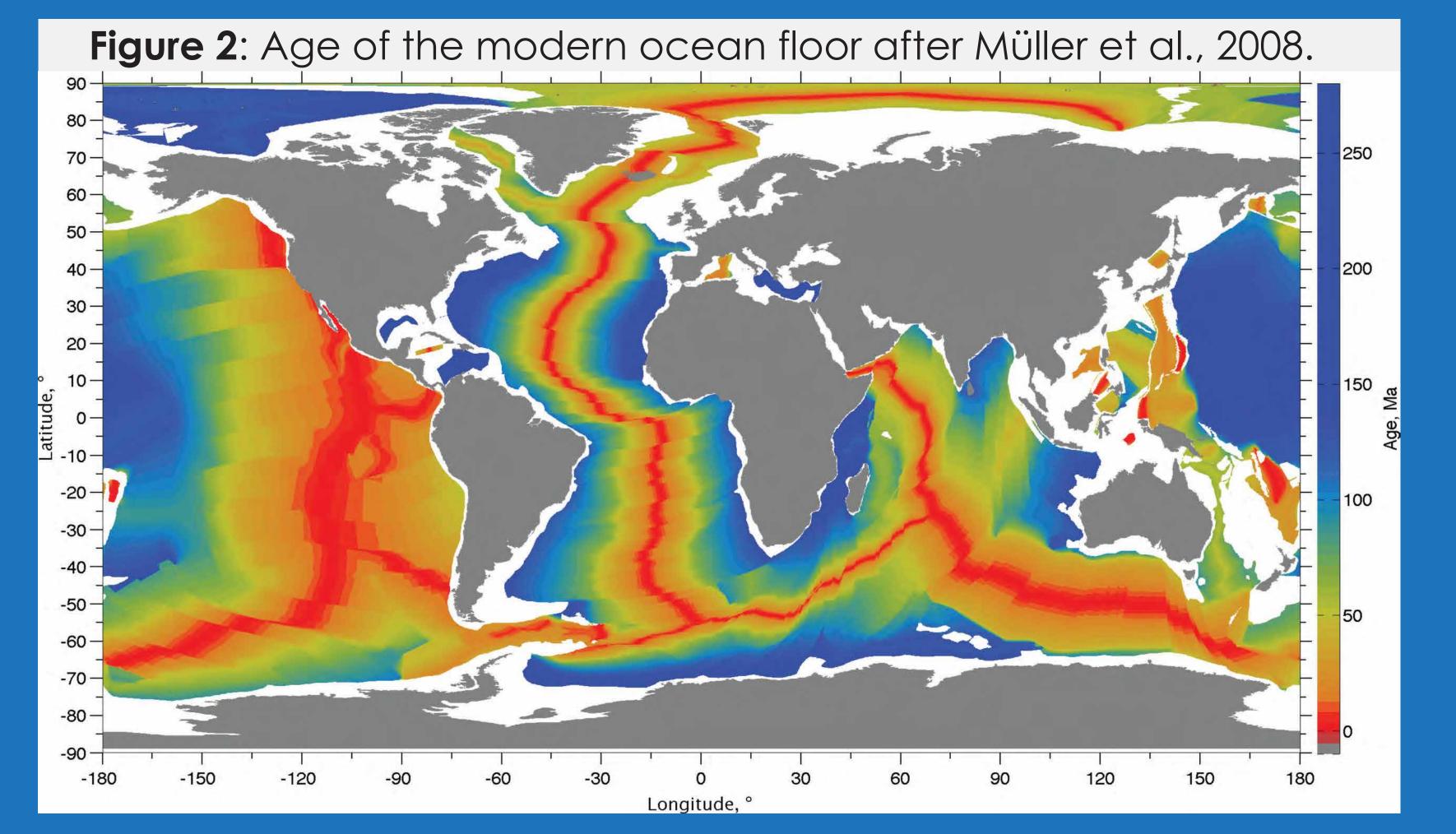


Figure 3: Depth to basement for the modern world as calculated from the Plate Model Equation.

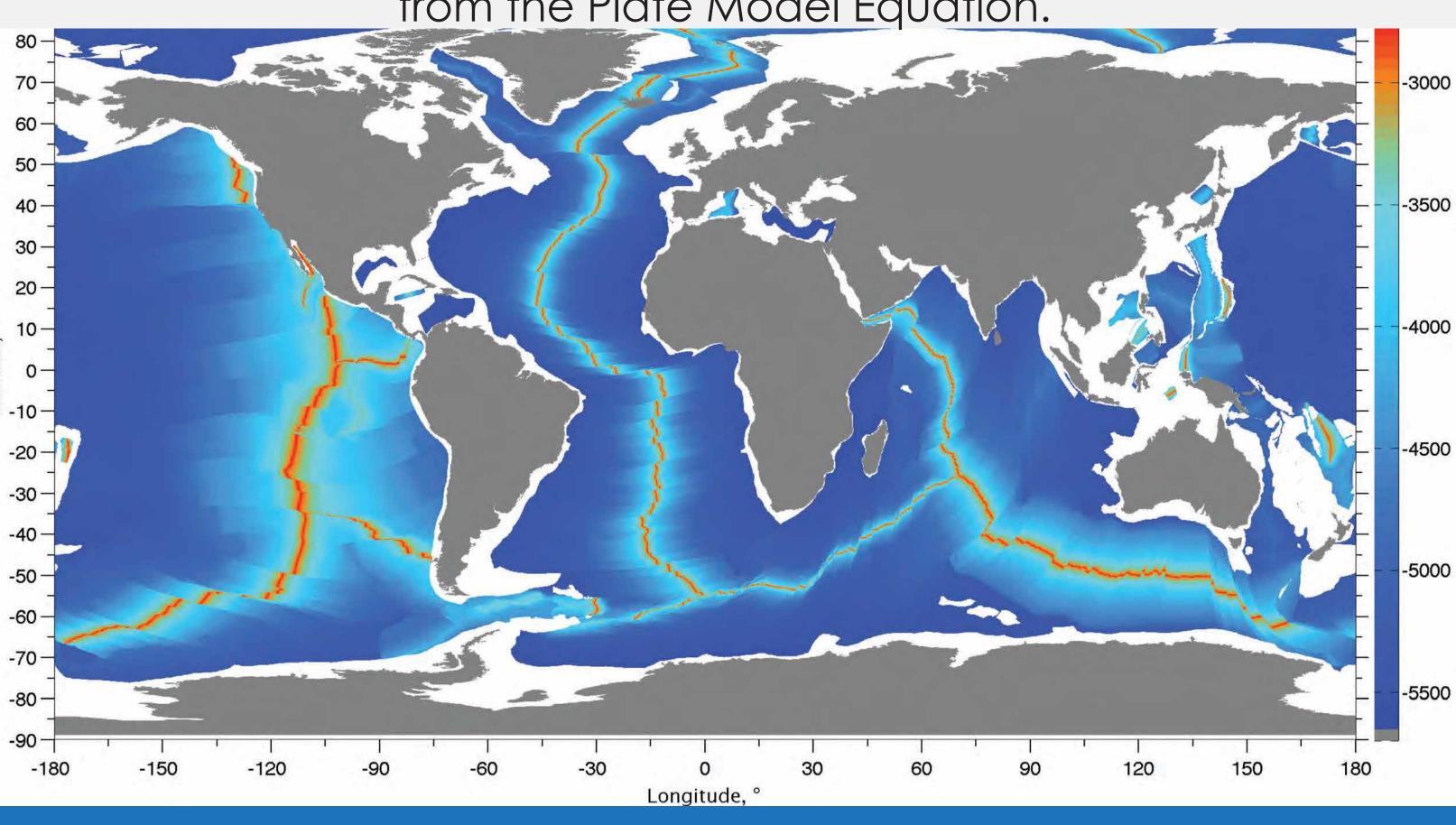


Plate Model Equation α = 3E–5 K⁻¹ (Volumetric coefficient of thermal expansion), $\rho_{\rm m}$ = 3300 K m⁻³, $\rho_{\rm w}$ = 1000 K m⁻³, κ = 1 mm²S⁻¹ (Thermal Diffusivity), τ = Time, $\gamma_{\rm L}$ = Plate Thickness, $T_{\rm m}$ - $T_{\rm w}$ = 1300 K

$$\omega_{d} = \frac{\alpha \rho_{m} (T_{m} - T_{w}) y_{L}}{(\rho_{m} - \rho_{w})} \left[\frac{1}{2} - \frac{4}{\pi^{2}} exp(-\frac{\kappa \pi^{2} \tau}{y_{L}^{2}}) \right]$$

Figure 4a: Bathymetry with one sediment layer $\rho = 1.87 \text{ g/cm}^3$.

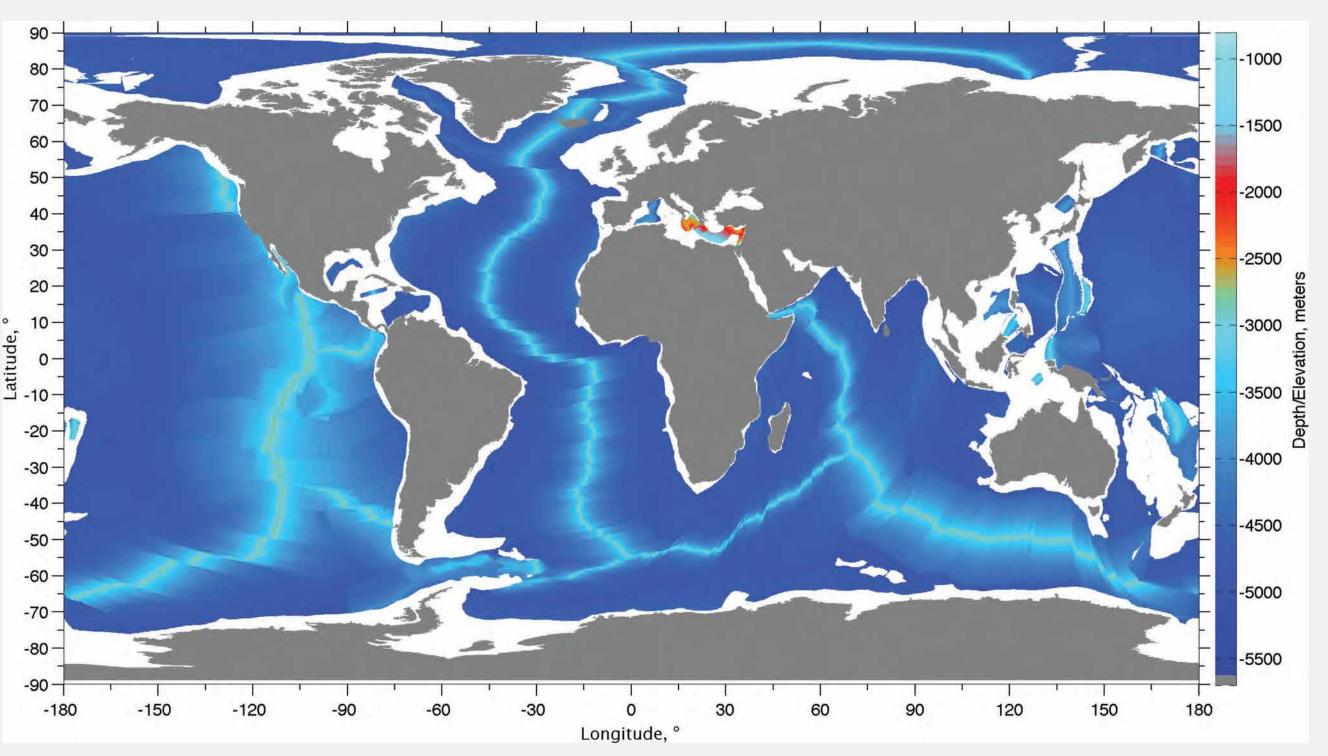
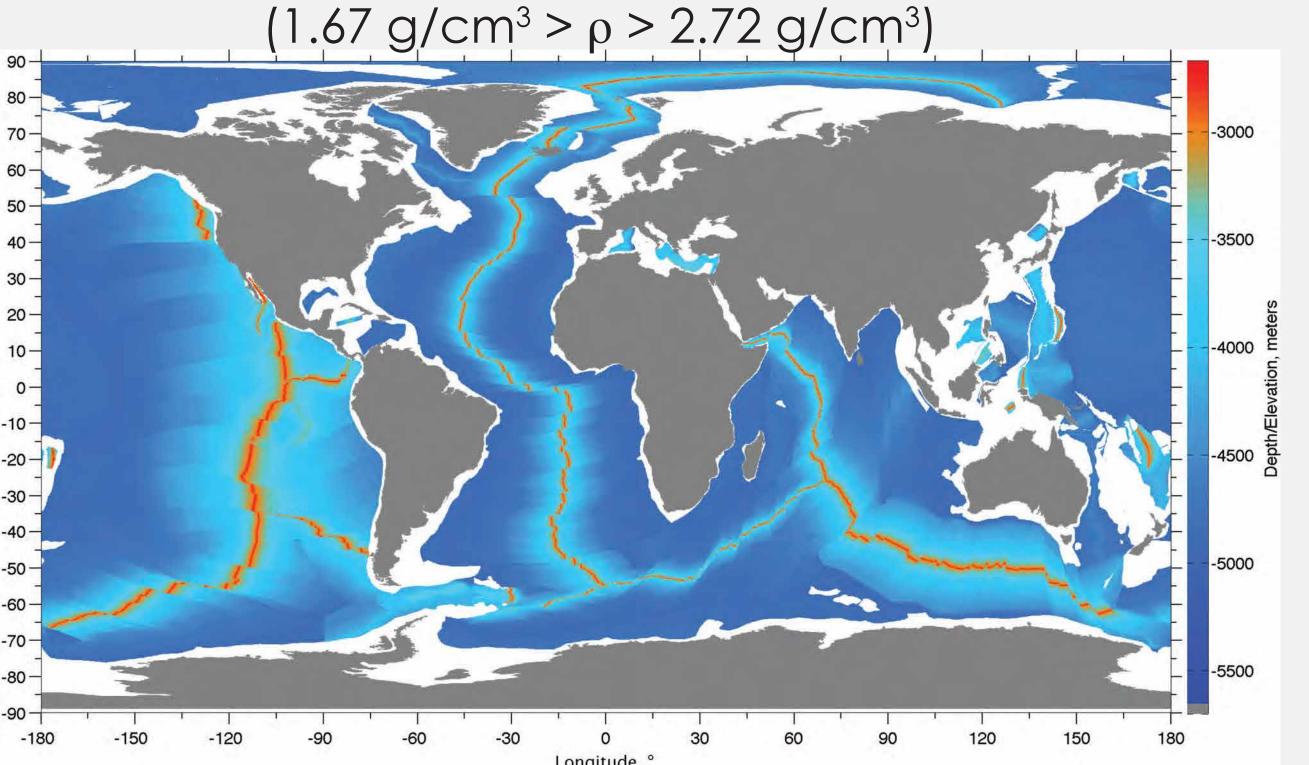


Figure 4b: Bathymetry with sediment layers (100 m increment) of varying densities



Acknowledgments

This work is part of the Open Earth Systems Project supported by the Frontiers in Earth System Dynamics Program of the US National Science Foundation, Award EAR-1135382. We are also thankful to Dr. Dietmar Müller (EarthByte) for consultation, Dr. Christopher R. Scotese (PALEOMAP) for PaleoAtlas Data and Evan Reynolds for all technical help throughout the course of this study. Lastly, but not least, authors would like to acknowledge the critical discussions and review given by the Open Earth Systems Project group members at Johns Hopkins University.

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Take Home Points

- Studying modern world shelf-slope structure, a wedge model can be generated.
- This wedge model produces realistic ocean bathymetry in a 0.1°x 0.1° resolution for the modern world when used together with a plate model and published ocean floor ages.
- The difference figure (Figure 9) demonstrates overall match/mismatch between modeled bathymetry and ETOPO1.
- This technique can be used to reconstruct paleobathymetry for global climate models.
- This modeled bathymetry reconstruction will be applied to generate paleobathymetry for PETM (55 Ma) and Cenomanian-Turonian (90 Ma) paleoceans.

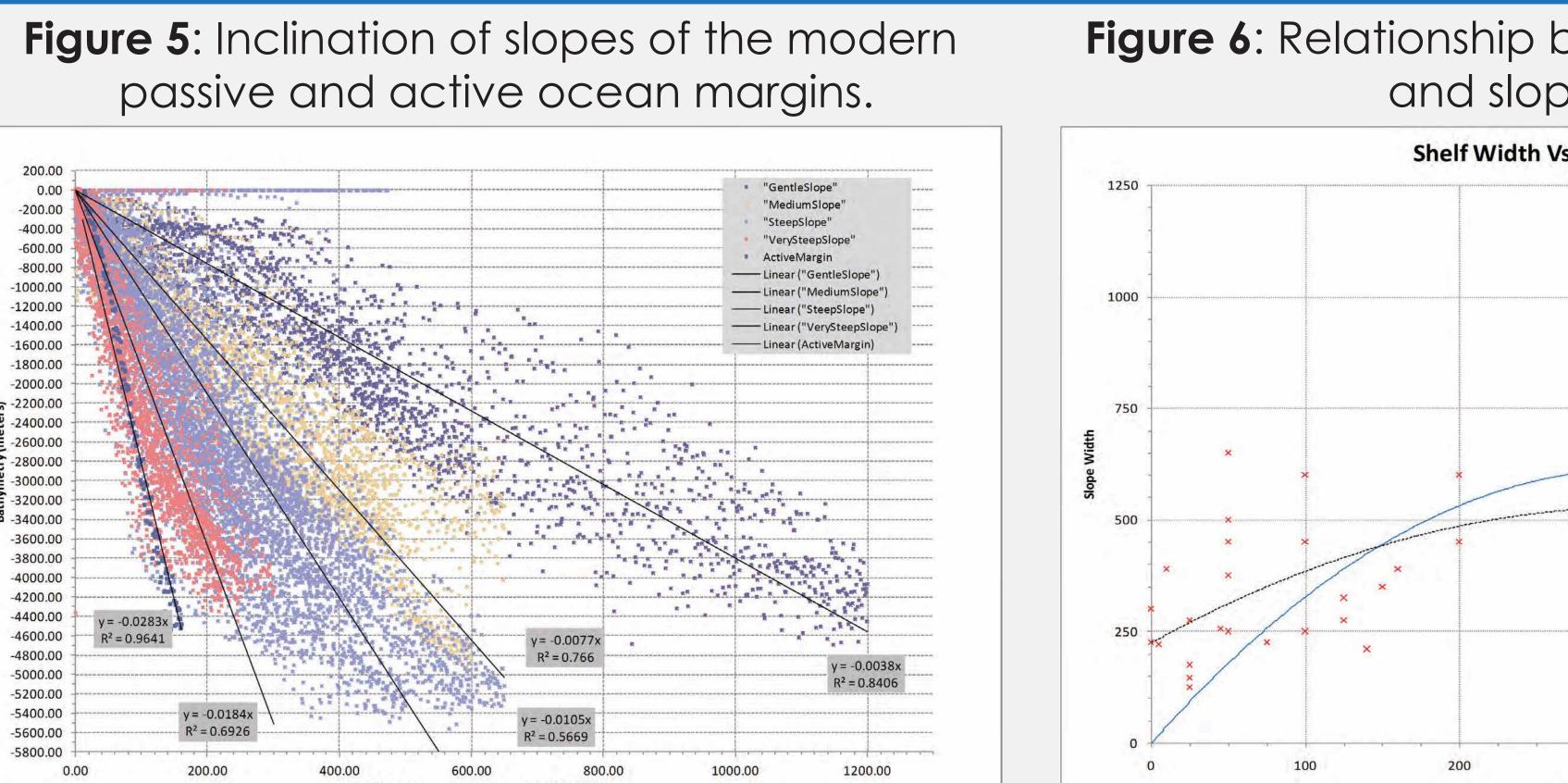


Figure 6: Relationship between modern shelf and slope width.

