Giant Reptiles

Fossil Snapshots of Biotic Response to Climatic Shifts

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Image modified from:
swordlord3d.deviantart.com/art/Titanoboa-The-Stomping-Land-01-458275652
Most reasonable models: 7–11 degrees (F) warmer than today by 2100

Must travel back in time to see what the planet was like when it was last that warm...
Look to the past

- Hot temperatures and getting hotter
- How do rising temperatures impact life?
Ectotherms & Climate

- Reptiles are ectothermic ('cold-blooded')
- Require energy from their environment
- More connected to changes in climate
Ectotherms & Climate

- Land-living ectotherms can reach larger sizes in warm climates

- Often reach higher diversity as well

Makarieva et al. 2005

reptileforums.co.uk

natureandscience-alb.blogspot.de
The Paleogene World

- ‘Greenhouse’ environment, no year-round polar ice

Map by R. Blakey: http://jan.ucc.nau.edu/~rcb7/50moll.jpg
Tropics hold most of Earth’s biodiversity
Fossil Record in the Tropics
Fossil Record in the Tropics

Cerrejón Formation, Northern Colombia

Paleobiology Database
Cerrejón Coal Mine

- World’s largest open pit coal mine
- 5º North latitude during Paleocene
Turtle Diversity at Cerrejón

- At least 4 different species
- Related to modern side-necked turtles
Much More at Cerrejón
Crocodyliform Diversity at Cerrejón

Illustration by J. Bourque
Turtle Chomper

- Bite marks on turtle shells
The chomper?

- Vertebra of a **very** large, unidentified crocodyliform
And then there was something else...
Biggest Snakes Alive Today

- Anaconda
- Reticulated Python
Another Reptile at Cerrejón

- Large vertebrae
- Around 140 individuals
Another Reptile at Cerrejón

- Large vertebrae
- Around 140 individuals
How big was it?

- Need to know where in the body it's from
Size from vertebrae

Titanoboa = \(45 \pm 5\) feet
How did it get so big?

- Would have required higher temperatures to metabolize
- Mathematical relationship between size and temperature

Head et al. 2009
Mathematical Relationship

- Physiology & temperature summarized by:

\[ MAPT = MAT + 3\alpha 10^\circ C \left( \frac{\log_{10} \frac{TBL_f}{TBL_m}}{\log_{10} Q_{10}} \right) \]

- MAPT = Mean Annual PaleoTemperature
- MAT = Mean Annual Temperature
- TBL\textsubscript{m} = Total Body Length (modern)
- \( \alpha \) = metabolic scaling exponent
- \( Q_{10} \) = mass-specific metabolic rate
- TBL\textsubscript{f} = Total Body Length (fossil)

Head et al. (2013)
Greenhouse ecosystem with giant & diverse reptiles
Titanoboa as a learning tool

- Documentary
- Traveling Exhibit
- Promotions
A new look at old bones

- 3D scans of *Titanoboa* vertebrae
- Data files available at morphosource.org (by request)
Potential for *Titanoboa* & Education

- Biological evolution in tandem with climate of a changing world
- Modern technological applications
- Inquiry-based mathematics
Material available for lessons

- 3D files for:
  - 3 *Titanoboa* vertebrae
  - 2 *Titanoboa* ribs
  - 1 Anaconda vertebra

- Data gathered from many modern relatives and all recovered specimens of *Titanoboa*
Future Directions & STEM

- 3D scanning to reconstruct skull from fragments
- Muscle modeling to determine strength
- Mechanical modeling for large snake motion
Funding Sources

- National Science Foundation
- Smithsonian Institute
- Florida Museum of Natural History

Thanks!!