Surprising Magnetotelluric Results from the Eastern North American Margin

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The Magnetotelluric Method

3 orthogonal magnetic field components

GPS
Recording
Batteries

$H_x$, $H_y$, $H_z$

Dear 100 m

2 orthogonal electric field components

G.D. Egbert
Electrical Conductivity in the Mantle

[Diagram showing the relationship between temperature and resistivity for different mantle compositions and water contents.]
Southeastern United States MT
Inverse Solution: Anomalous Resistor

Murphy & Egbert, *EPSL*, 2017
Interpreting Electrical Resistivity
The Piedmont Resistor
More Resistive Than Cratonic Lithosphere?!?

[Image of resistivity map with labels for Wyoming Craton and Yellowstone]
Seismic Studies

Schmandt & Lin, GRL, 2014
Seismic Studies

Pollitz & Mooney, *GRL*, 2016
Resolution Tests
Resolution Tests
Resolution Tests

Preferred Model

![Image of depth and distance along transect with resistivity scale]
Apparent Resistivities & Phases

T ~ 1000 s
Apparent Resistivity Contrast

- **Currents Oriented 45 Degrees E of N**
  - Log-log plot showing apparent resistivity (RhoXY) vs. period (s)
  - Two sets of data: blue and red lines representing different sites.
  - Bar chart showing number of sites at different apparent resistivity levels.

- **Currents Oriented 45 Degrees S of E**
  - Similar log-log plot as above, but with data for sites oriented 45 degrees South of East.
  - Bar chart for number of sites at different resistivity levels.

- **Apparent Resistivity (RhoXY) at ~1000 s**
  - Comparison between Highland Sites and Lowland Sites.
  - Chart showing apparent resistivity levels for different sites.

- **Apparent Resistivity (RhoXY) at ~1000 s** (Currents Oriented 45 Degrees S of E)
  - Similar comparison as above, but for sites oriented 45 degrees South of East.
Lithospheric Temperature
How Did It Get There?

Early Jurassic Basalts of the Central Atlantic Magmatic Province

Greg McHone (http://www.auburn.edu/academic/science_math/res_area/geology/camp/)
How Did It Get There?

~230 Ma: Assembly of Pangea
- Laurentia →
- Incipient Slab Foundering
- Eclogitized Crust & Pyroxenite-Rich Mantle
- Gondwana ←

~190 Ma: Rifting
- Melt Assimilation (?)
- Regrown Lithosphere

~200 Ma: Delamination & CAMP Magmatism
- Asthenospheric Upwelling
- Delamination
- CAMP Lavas

~150 Ma: Cooling & Subsidence
- Passive Margin

~100 Ma - Present: Edge Convection
- Topographic Rejuvenation

Modern Appalachians ← Piedmont

Murphy & Egbert, EPSL, 2017
Northeastern United State MT

~100 km

~200 km

Resistivity ($\Omega_m$)

EW Distance (km)
Northeastern United States Seismics

Schmandt & Lin, GRL, 2014
Northeastern United States MT

~100 km

~200 km

EW Distance (km)

Resistivity ($\Omega_m$)
Margin-Wide Link to CAMP?

Greg McHone
(http://www.auburn.edu/academic/science_math/res_area/geology/camp/)
Conclusions

→ Anomalous, highly resistive, cold, thick lithosphere beneath Piedmont/Coastal Plain in Southeastern United States… Link to CAMP?

→ Highly resistive lithosphere may extend beneath coastal New England… margin-wide link to CAMP?

So much for the boring “passive” margin!