CONTINENTAL CORE AND MARGIN CONDUCTIVITY STRUCTURE: CASCADIA TO GREAT PLAINS, MCR AND KEWEENAW HOT SPOT

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EarthScope MT

EarthScope MT projects

USArray Transportable Array

Cascadia

Midcontinent

Ongoing work

Future

What we’ve learned about 3D MT
Transportable Array
Continent-scale MT survey designed for 3D modeling

1st footprint: Pacific Northwest (~250 stations)
  • 2006 to 2011

2nd footprint: Midcontinent Rift (MCR) (~250 stations)
  • 2011 to 2013

Continuing work: Grenville Orogeny
  • 2014: extend SE to Tennessee
  • 2015: continue to Georgia, Carolinas
  • Future: Virginia, Maryland, Pennsylvania
  • Distant Future: Dakotas, California-New Mexico

Identify areas for more detailed study
ADDITIONAL EARTHSCOPE MT STUDIES

MOCHA (Magnetotelluric Observation of Cascadia Something Something)
- Amphibious MT survey of Cascadia Subduction Zone
- 80 land, 55 marine MT stations, incorporate legacy MT data from 1990s
- Data collected 2013-2014, processing underway

MUSH (Imaging Magma Under St. Helens)
- 150 MT stations around Mounts St. Helens, Rainier, Adams
- Data collection as we speak
FIRST EARTHSCOPE FOOTPRINT

Cascadia, Yellowstone, Craton boundaries

Meqbel, Gary D. Egbert, Philip E. Wannamaker, Anna Kelbert, Adam Schultz, EPSL, 2014.
MIDCONTINENT RIFT

geology

three branches: MCR, east arm, Nipigon dikes
stopped after ~70 km
likely plume-initiated
flood basalt eruption
transform offset zone in southern MN
offset suture zones

Model: 1500 x 1500 km, 306 stations
Possibilities:

- Residual fluids and sulfides
- Delamination
  - Elevated asthenosphere
  - Mass deficit
  - Gravity low at SW Lake Superior
DATA ANALYSIS

Questionable data is meaningful.
- Weak signal at long periods can indicate strong conductor
- Large error bars, data looks suspicious
- Still meaningful and should be kept

Test case: Site MND38
- Unusual-looking data
- Relocated 10 km away, got same thing
- Site is important in resolving deep conductor.
- Difficult to fit, tempting to discard.
- It fits.
CONCLUSIONS

- Resistive craton
- Rift fairly shallow
- Deep, conductive possible plume remnants
- Conductive suture zones
  - Ancient 1.85 Ga, 1.75 Ga
  - Grenville front

3D MT
- Weird data is fine – don’t assume it won’t fit.
  - 2D generally inadequate on large scales
- Need full impedance tensor.