COnflictional Tectonics of the Southern Appalachian Orogenic Belt – Reinterpretation of ADCOH and COCORP Seismic Reflection Data with Constraints from New Potential Field Data

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Major Findings

• Grenville basement extends eastward underneath the Carolina Terrane.

• Appalachian Paired Gravity Anomaly can be explained without a change in lower-crustal density (Grenville basement).

• The low-density Piedmont Blue Ridge Allochthon over-thrusts dense footwall duplex structures (Grenville basement) and not platform sediments.
Paired magnetic anomaly for suture zone between Laurentian and Amazonian terranes.

Paleozoic Gabbro plutons in Amazonian arc terrane.
### Densities Used in Gravity Forward Modelling

<table>
<thead>
<tr>
<th>Unit</th>
<th>Density (g/cc)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allochthonous Crust (Carolina Terrane)</td>
<td>2.79</td>
<td>Warren et al. (1966); Christensen (1989)</td>
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<td>Mafic Intrusions</td>
<td>2.8 - 2.9</td>
<td>Christensen (1989); Duff (2014)</td>
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<tr>
<td>Paleozoic</td>
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<td></td>
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<td>Laurentian</td>
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<td>Sumner (1977); Cumbest et al., (1992)</td>
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<tr>
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<td>0 - 4 X 10^{-3}</td>
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<tr>
<td>Coastal Plain Sediments</td>
<td>0</td>
<td>Cumbest et al., (1992)</td>
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<tr>
<td>Grenville</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mantle</td>
<td>3.4</td>
<td>Warren et al. (1966); Christensen (1989)</td>
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</table>

### Magnetic Susceptibilities Used in Magnetic Forward Modelling

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<th>Reference</th>
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</table>
Previous Models of the Appalachian Paired Gravity Anomaly

1) Low density crustal root

2) Dense accreted block

(Cook, 1984)

(Thomas, 1983)
Appalachian Decollement
COCORP Seismic Data

Uninterpreted Seismic

Interpreted Seismic

Interpreted Seismic Merged with 2D Potential Field Forward Model Profile

Model polygons are represented by red points and thin green lines.

(Cook and Vasudevan, 2006)
Appalachian Paired Gravity Anomaly - explained by:

- change in crustal thickness to the SE
- increase average density of the Carolina Terrane.
- does **not** require density change in lower crust
Haysville Anomaly:

- Anomaly matches the shape of the seismically imaged footwall anticline

- Model density of 2.8 g/cc (Dolomite) is insufficient to model the anomaly
Haysville Anomaly:

- Anomaly matches the shape of the seismically imaged footwall anticline
- Required model density of 2.96 g/cc is too dense to be Paleozoic shelf strata
Model with Basement Grabens

2.96 g/cc
Seismically defined basement grabens only produce a ~ 1 mGal anomaly, and cannot make a major contribution to the Appalachian gravity gradient as proposed by Favret and Williams (1988).
Appalachian Paired Gravity Anomaly -

- explained without a density contrast in the lower crust
- possible that Grenville basement rocks extend eastward underneath the Carolina Terrane
Conclusions and Implications

Relative Gravity High within Appalachian Low –

- dense material required is unlikely to be platform sediments
- eastern edge of platform sediments does not underlie the Blue Ridge, as previously interpreted
- instead, the material forming the basement duplex or imbricate structures may need to be reinterpreted as basement horse blocks and not Paleozoic shelf strata
Retro-Deformed Model

- Model illustrates block configuration at ~ 330 Ma, prior to final closure of the Paleo-Atlantic and Alleghanian Orogenesis.

- Retro-deformation was created by pulling out the 210 km of crustal shortening in the Appalachian Fold/Thrust Belt (Valley and Ridge), proposed by Hatcher (2007).

- Crustal shortening in the Blue Ridge, Inner Piedmont, and Carolina Terrane is not taken into account.

- Thus, this model represents minimum estimates of the eastward extent of platform sediments and the Central Piedmont Suture.
Acknowledgements

Thank you to SCDNR – SC Geological Survey, Bill Clendenin and Scott Howard, for supporting this research.
• Hatcher, Robert D., Peter J. Lemiski, and Jennifer Whisner, Character of rigid boundaries and internal deformation of the southern Appalachian fold and thrust belt, 2007, GSA Special Publication 433.
Regional Geologic Map
Velocity Structure of BR, IP, CT

(Cook, 1984)

(Hawman Khalifa, 2012)
Shelf Strata under CPS