COLLISIONAL 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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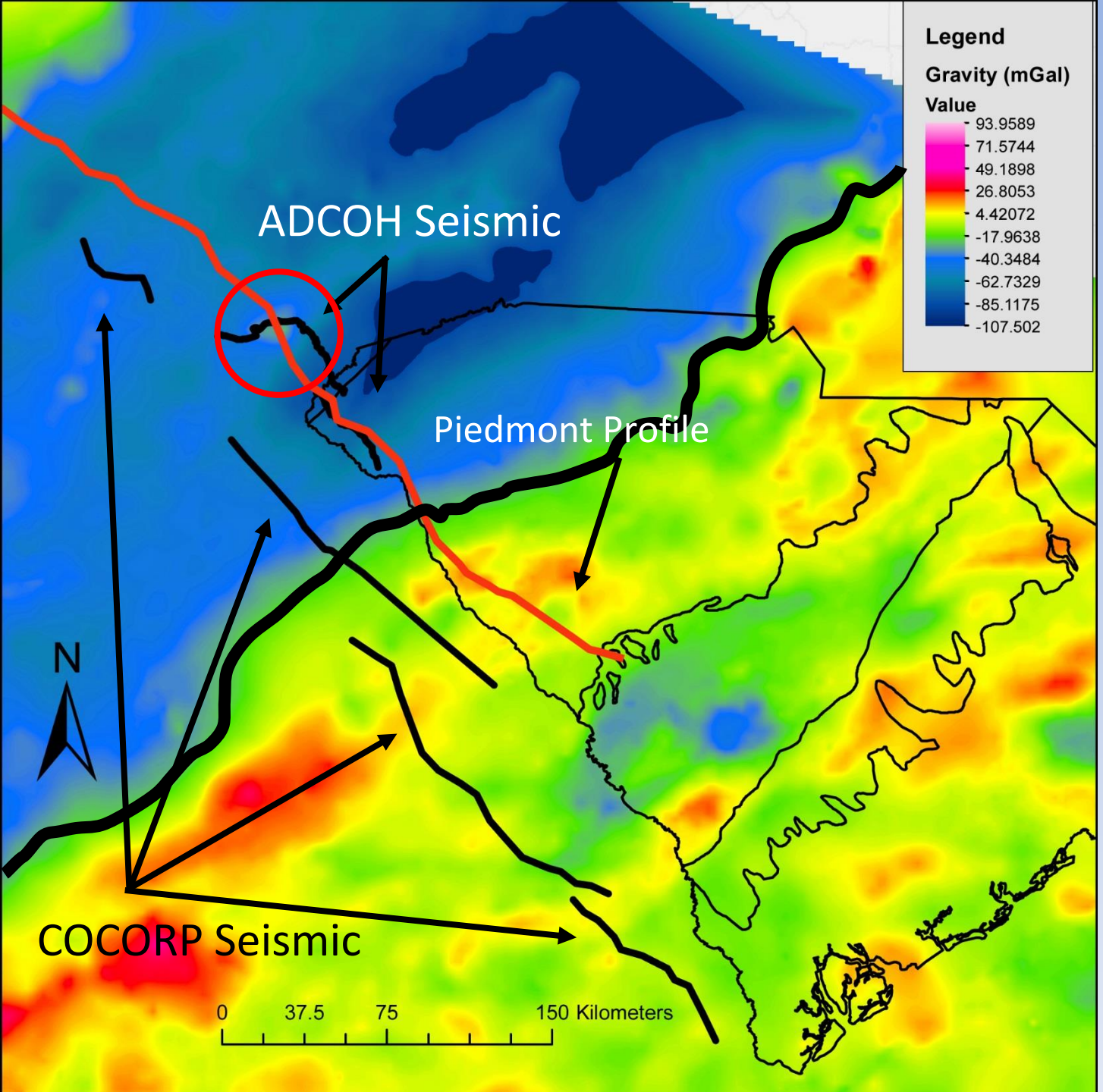
Major Findings

- 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.

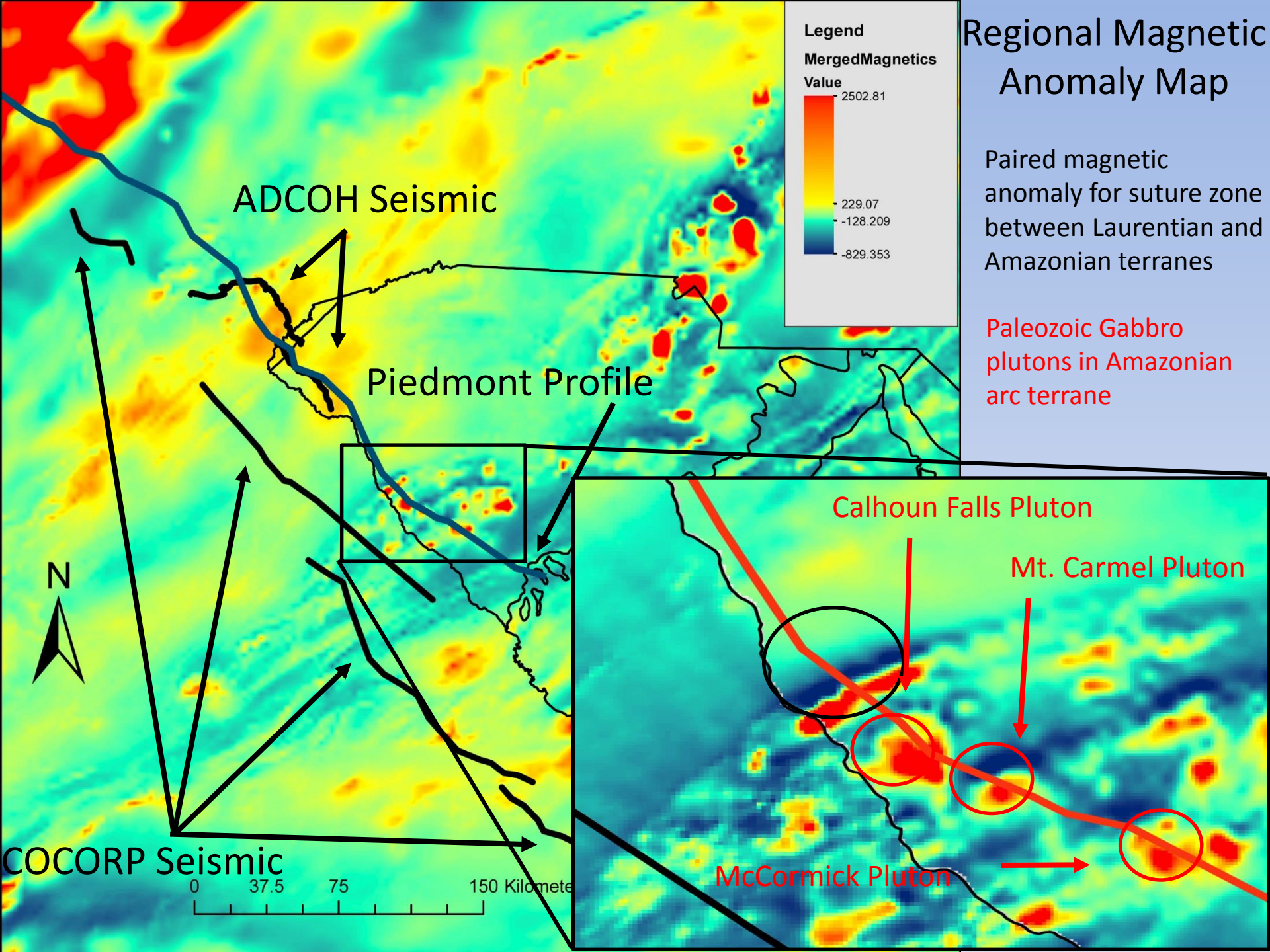
Regional Gravity Anomaly Map



Appalachian Paired Gravity Anomaly

Hayesville Anomaly

Regional Magnetic Anomaly Map



Paired magnetic anomaly for suture zone between Laurentian and Amazonian terranes

Paleozoic Gabbro plutons in Amazonian arc terrane

O p Data

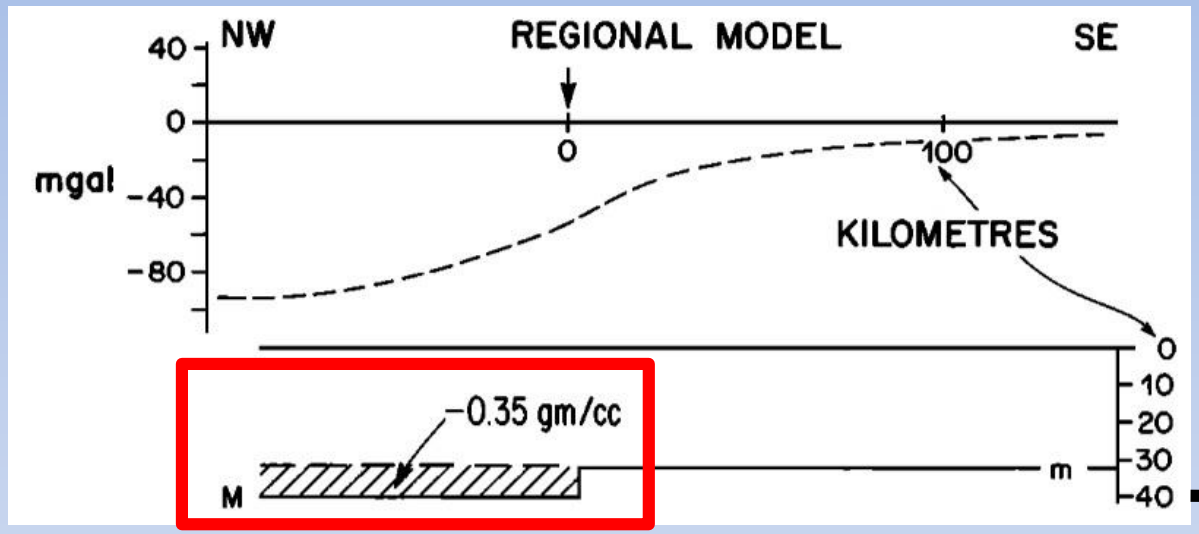
Densities Used in Gravity Forward Modelling

Unit	Density (g/cc)	Reference
Allochthonous Crust (Carolina	2.79	Warren et al. (1966);
Mafic Int		
Paleozoic		
Laurentia		
Proterozo Cambriar		
Grenville		
Mantle	3.4	Warren et al. (1966); Christensen (1989)

Magnetic Susceptibilities Used in Magnetic Forward Modelling

Unit	Density (cgs)	Reference
Allochthonous Crust (Carolina Terrane)	0-1 X 10^{-2}	Sumner (1977); Cumbest et al., (1992)
Mafic Intrusions	6-7 X 10^{-2}	Sumner (1977); Cumbest et al., (1992)
Granite Intrusions	0-4 X 10^{-3}	Cumbest et al., (1992); Tuten and Berry (2013)
Coastal Plain Sediments	0	Cumbest et al., (1992)

Previous Models of the Appalachian Paired Gravity Anomaly

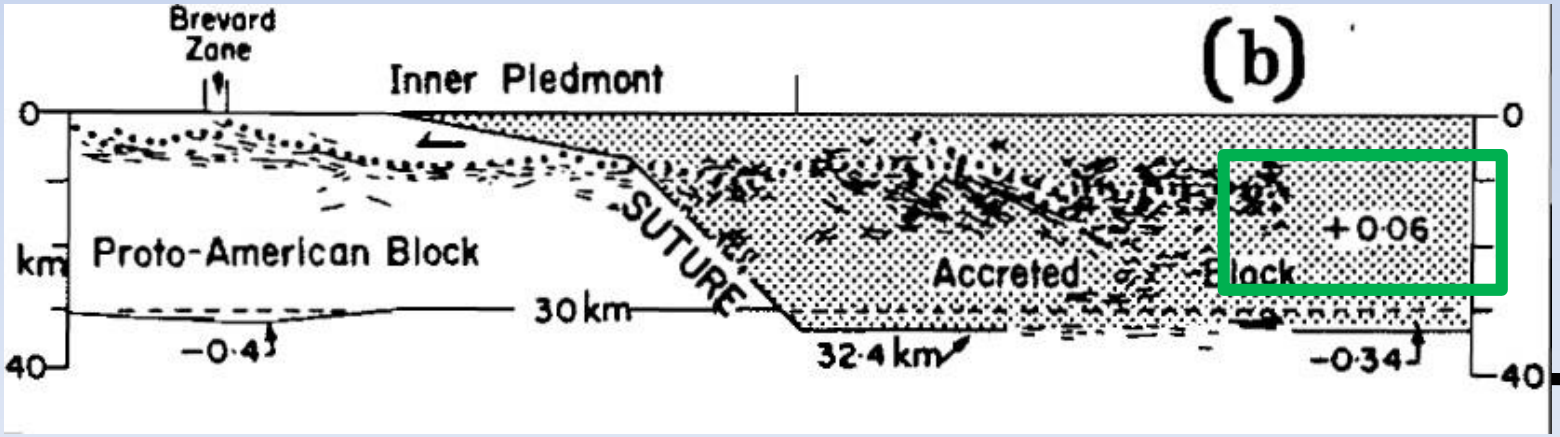


1) Low density crustal root

2) Dense accreted block

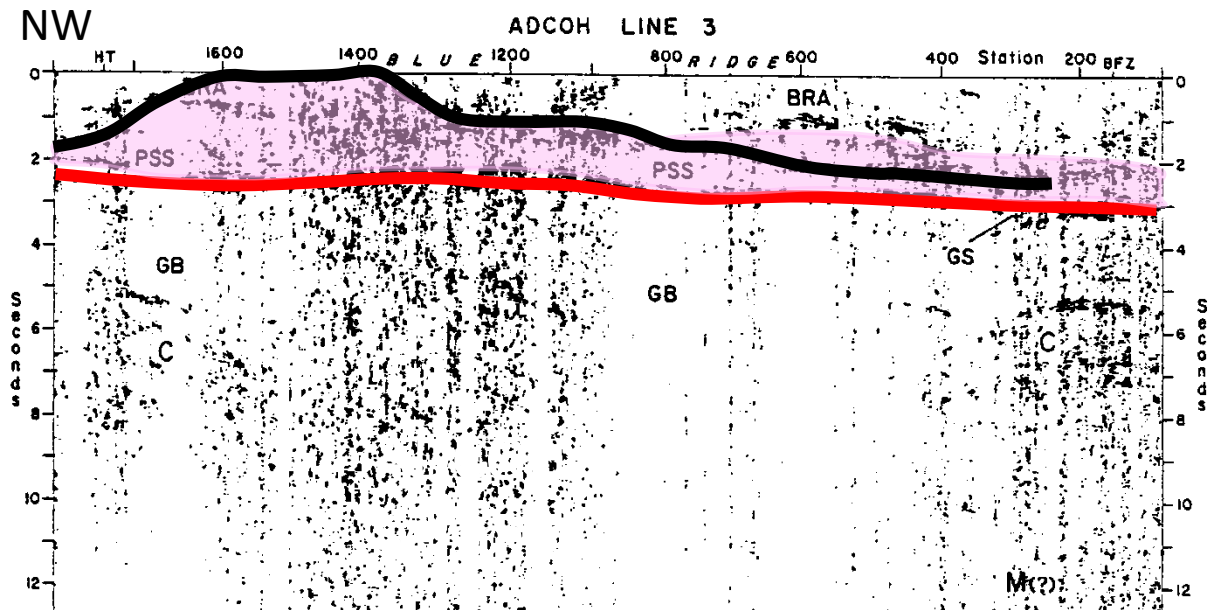
40 km

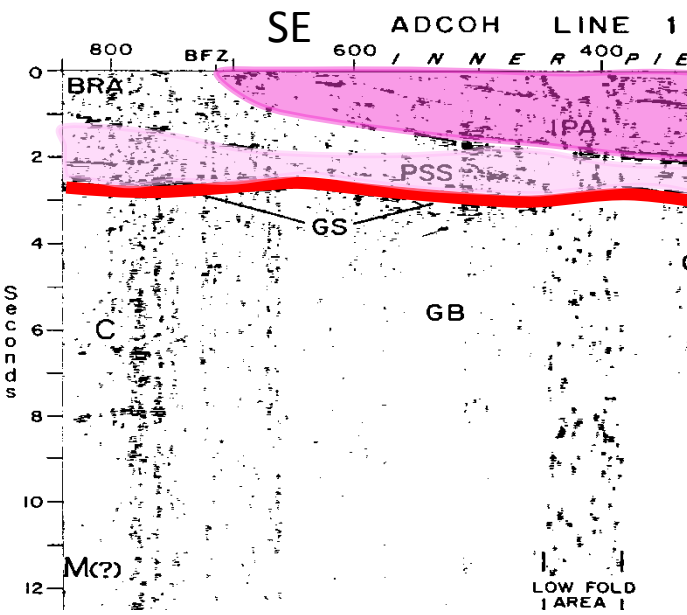
(Cook, 1984)



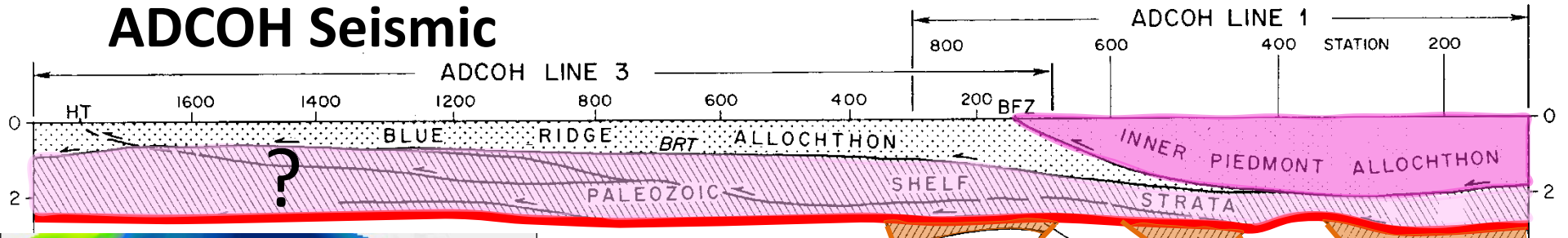
40 km

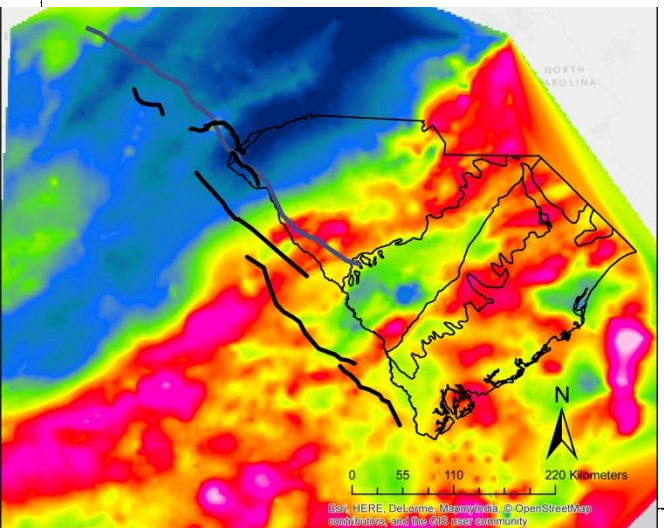
(Thomas, 1983)



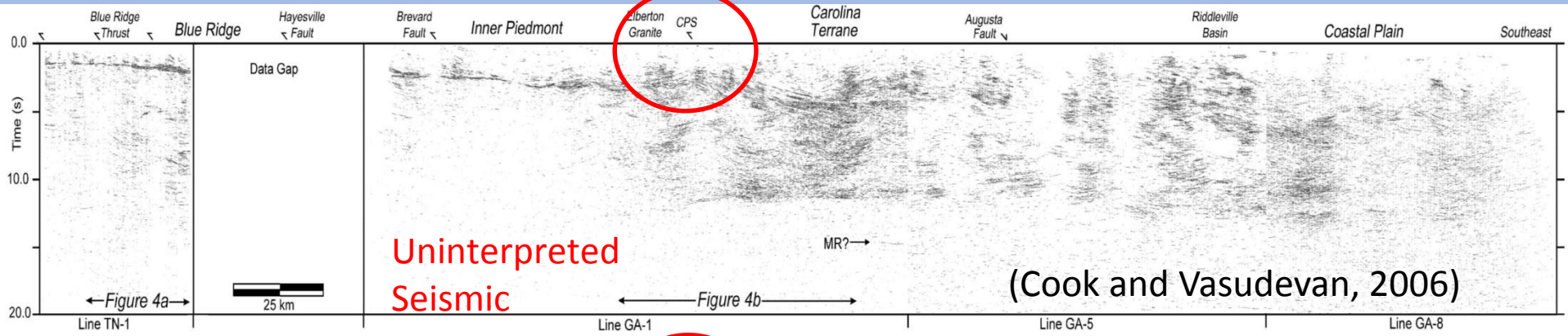


ADCOH Seismic



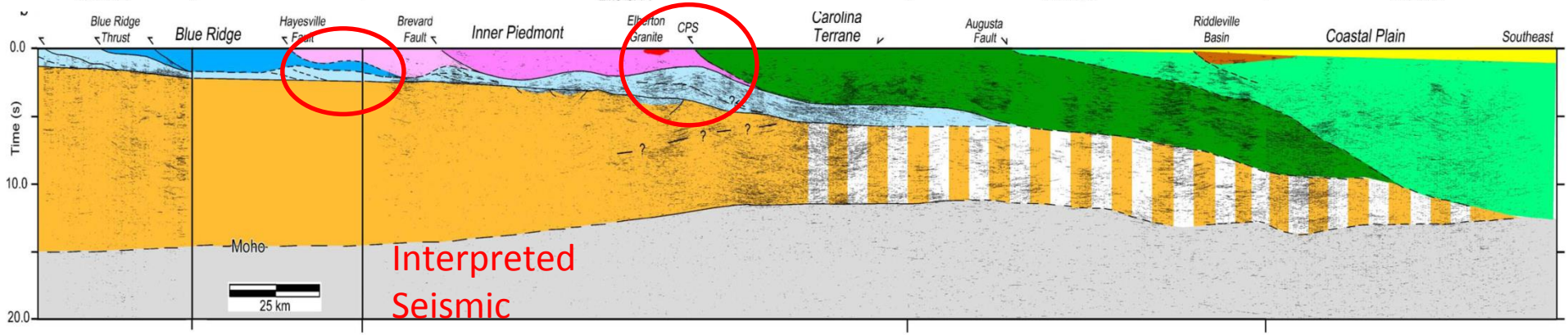


COCORP Seismic Data

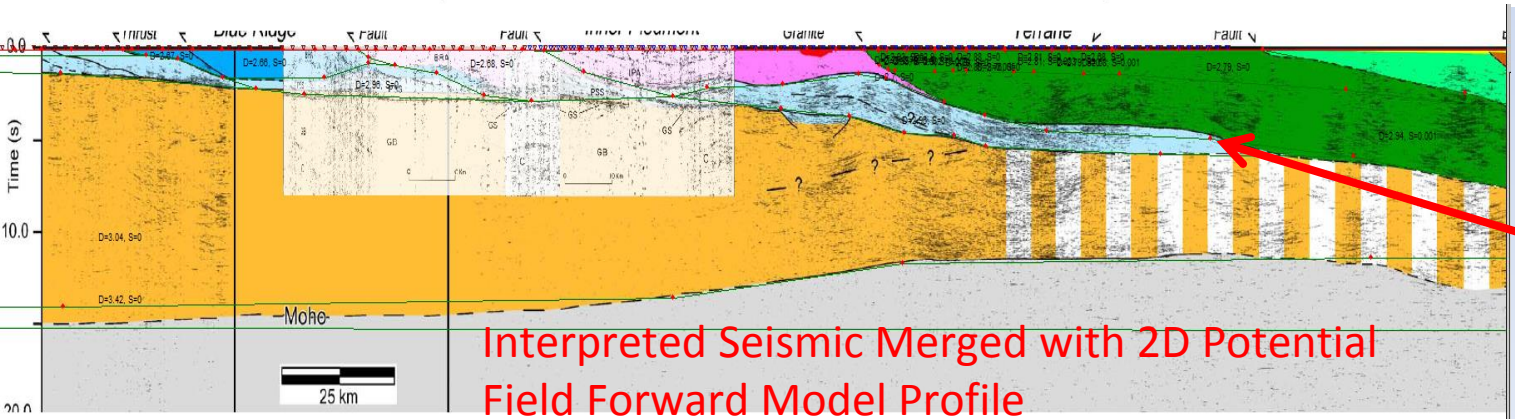


Uninterpreted Seismic

(Cook and Vasudevan, 2006)

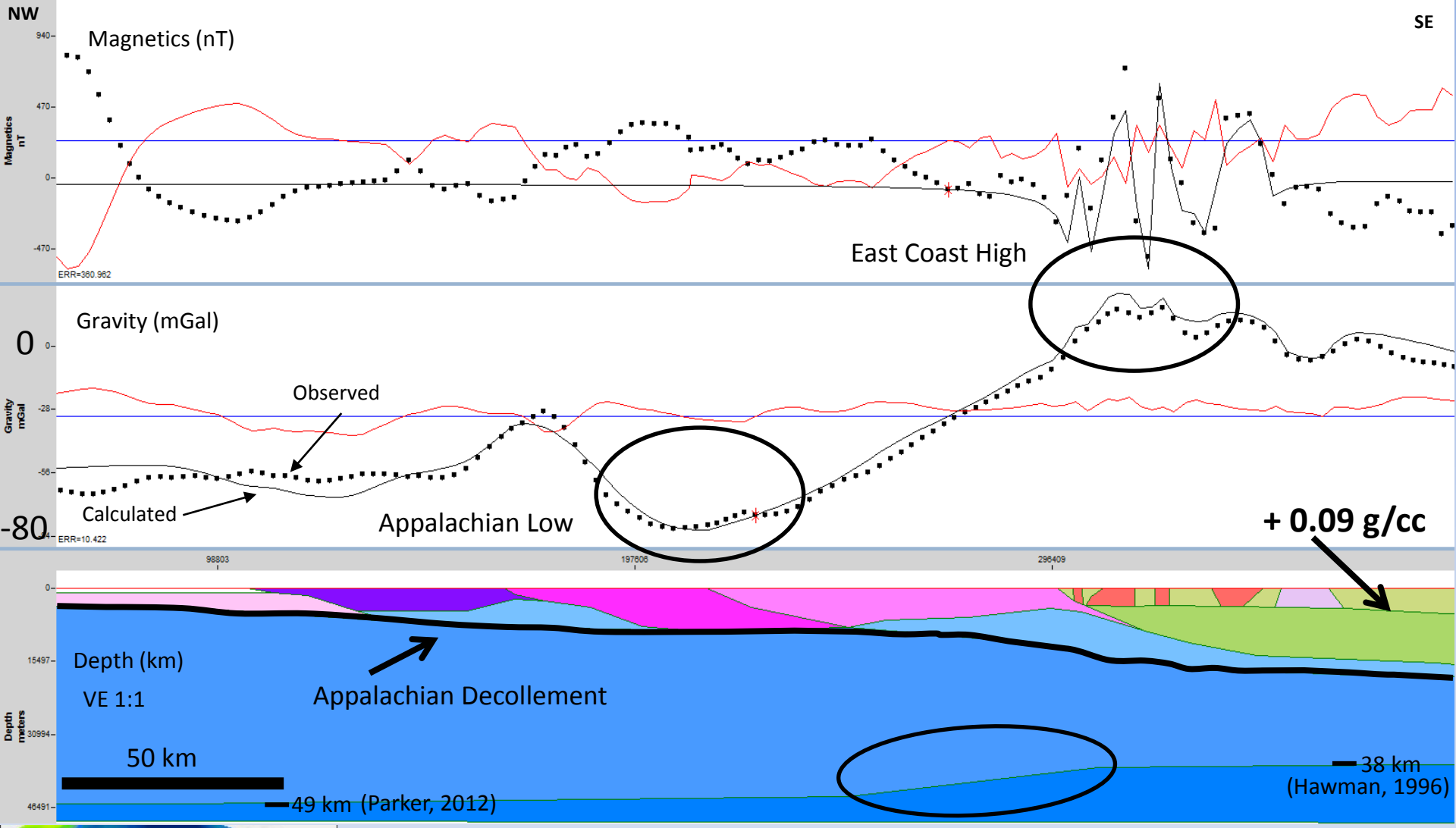


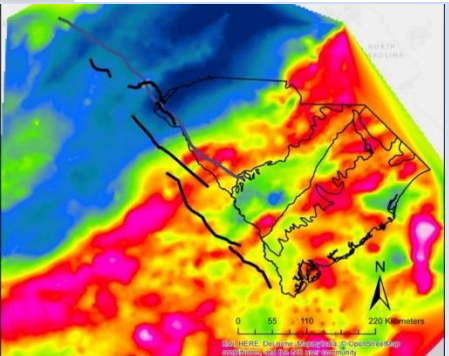
Interpreted Seismic



Interpreted Seismic Merged with 2D Potential Field Forward Model Profile

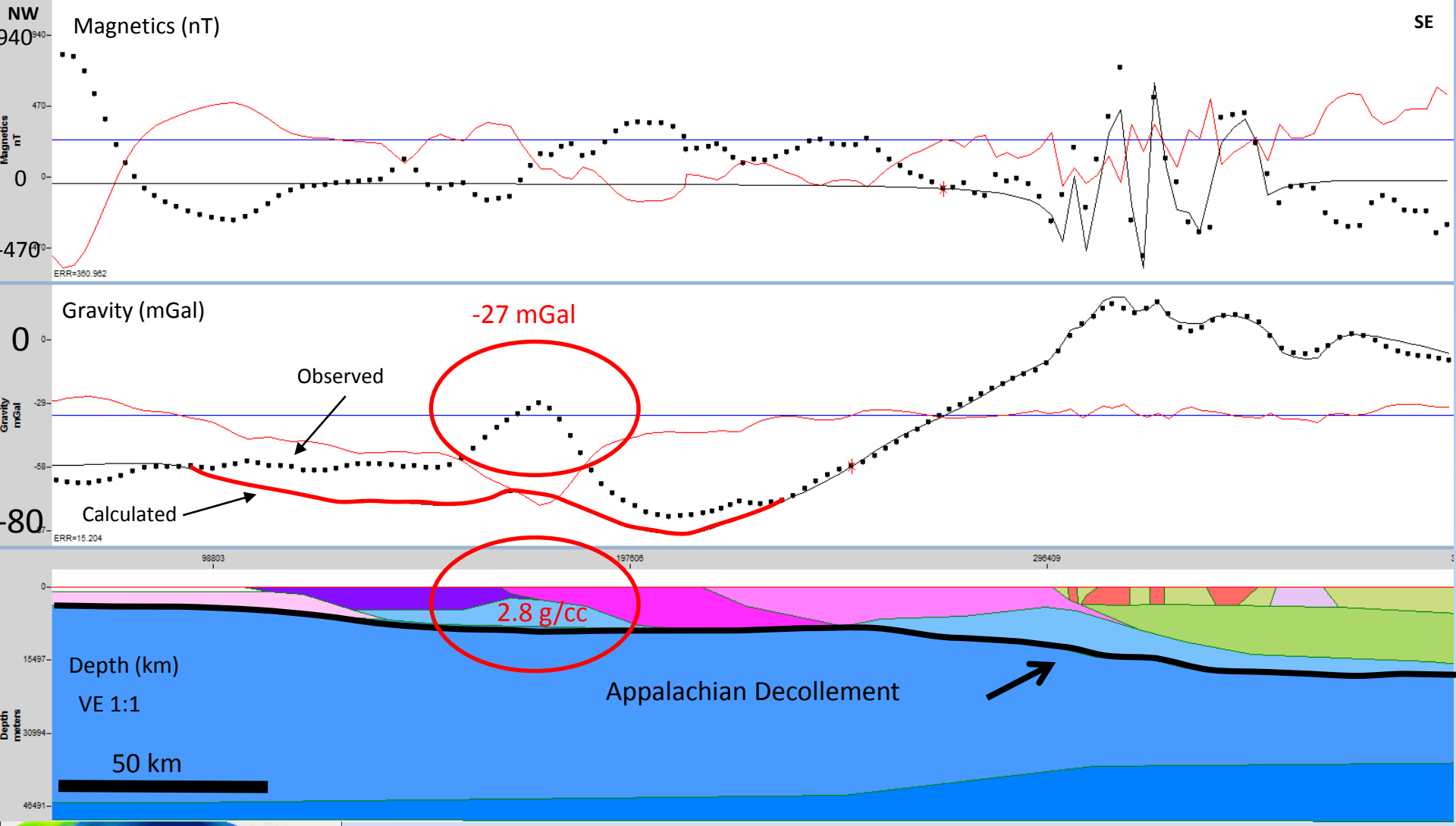
Model polygons are represented by red points and thin green lines.

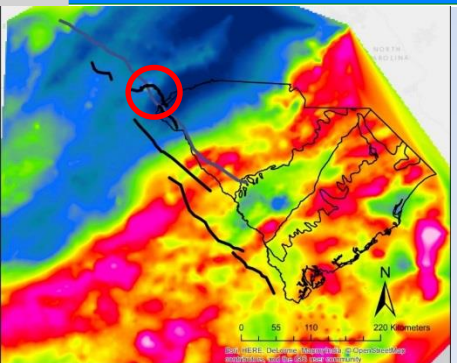




Appalachian Paired Gravity Anomaly - explained by:

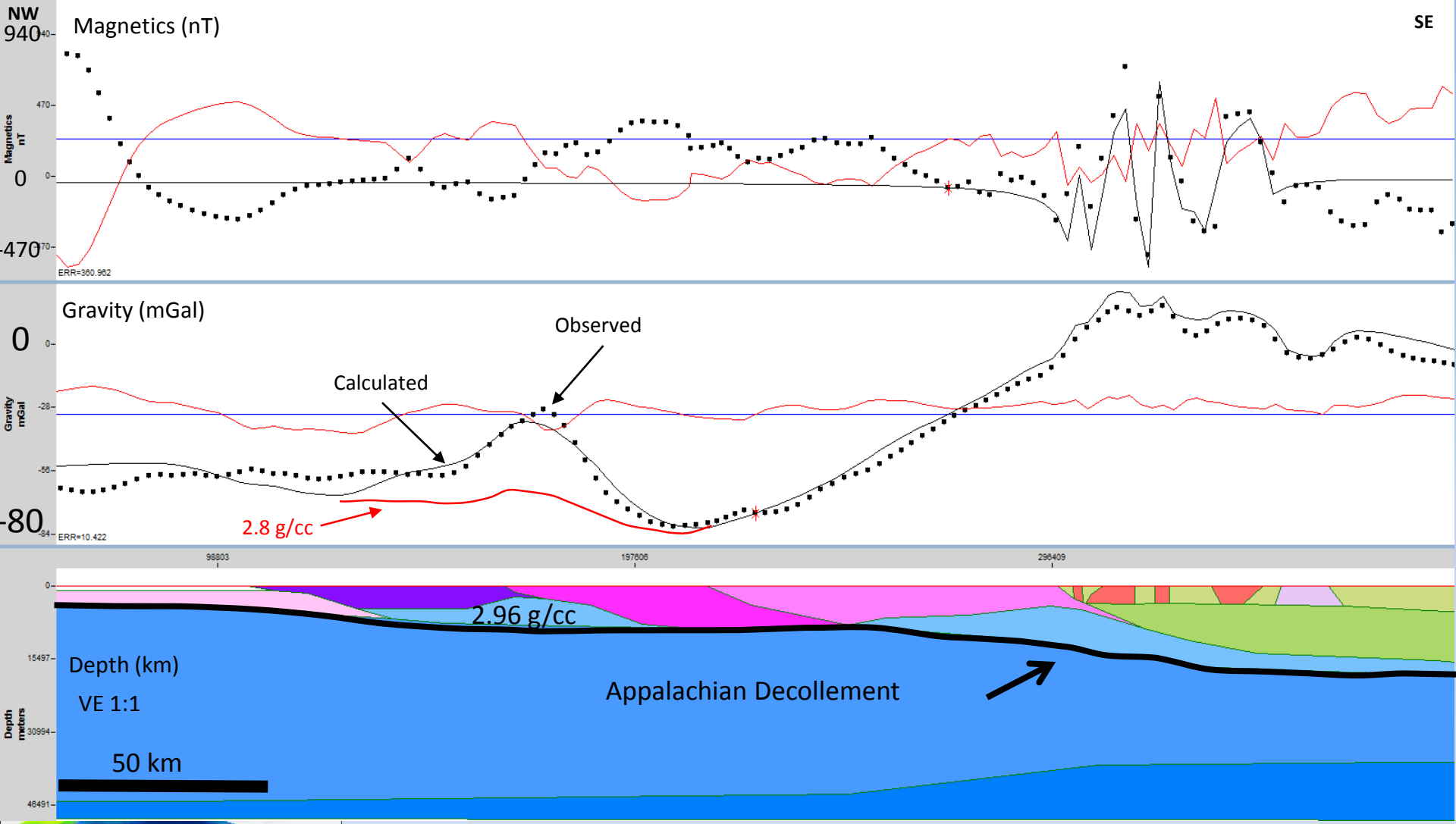
- change in crustal thickness to the SE
- increase average density of the Carolina Terrane.
- does **not** require density change in lower crust

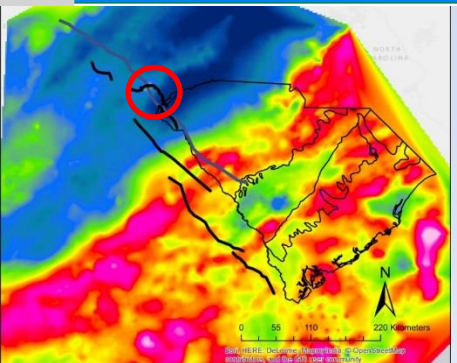




Haysville Anomaly:

- Anomaly matches the shape of the seismically imaged footwall anticline
- Model density of 2.8 g/cc (Dolomite) is insufficient to model the anomaly

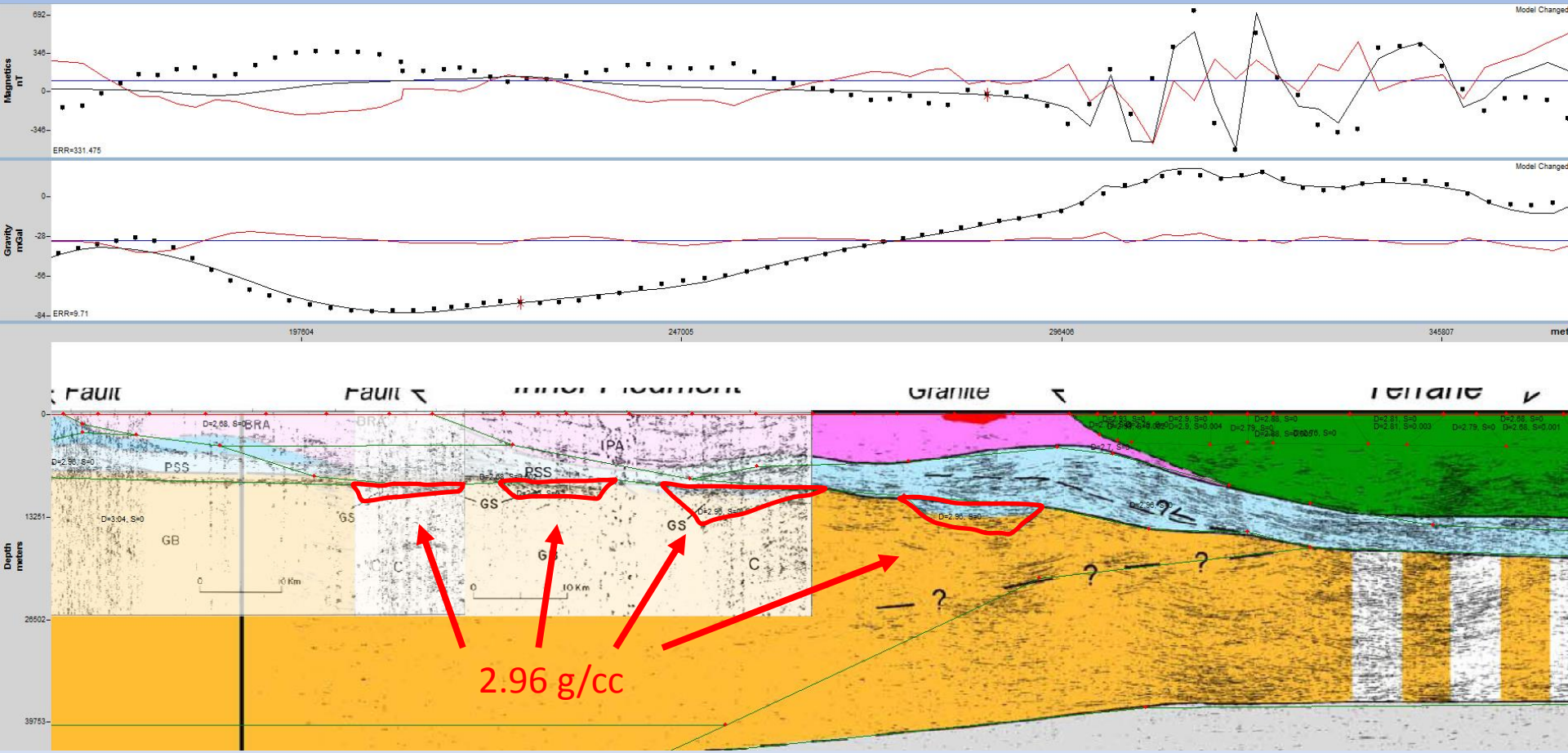




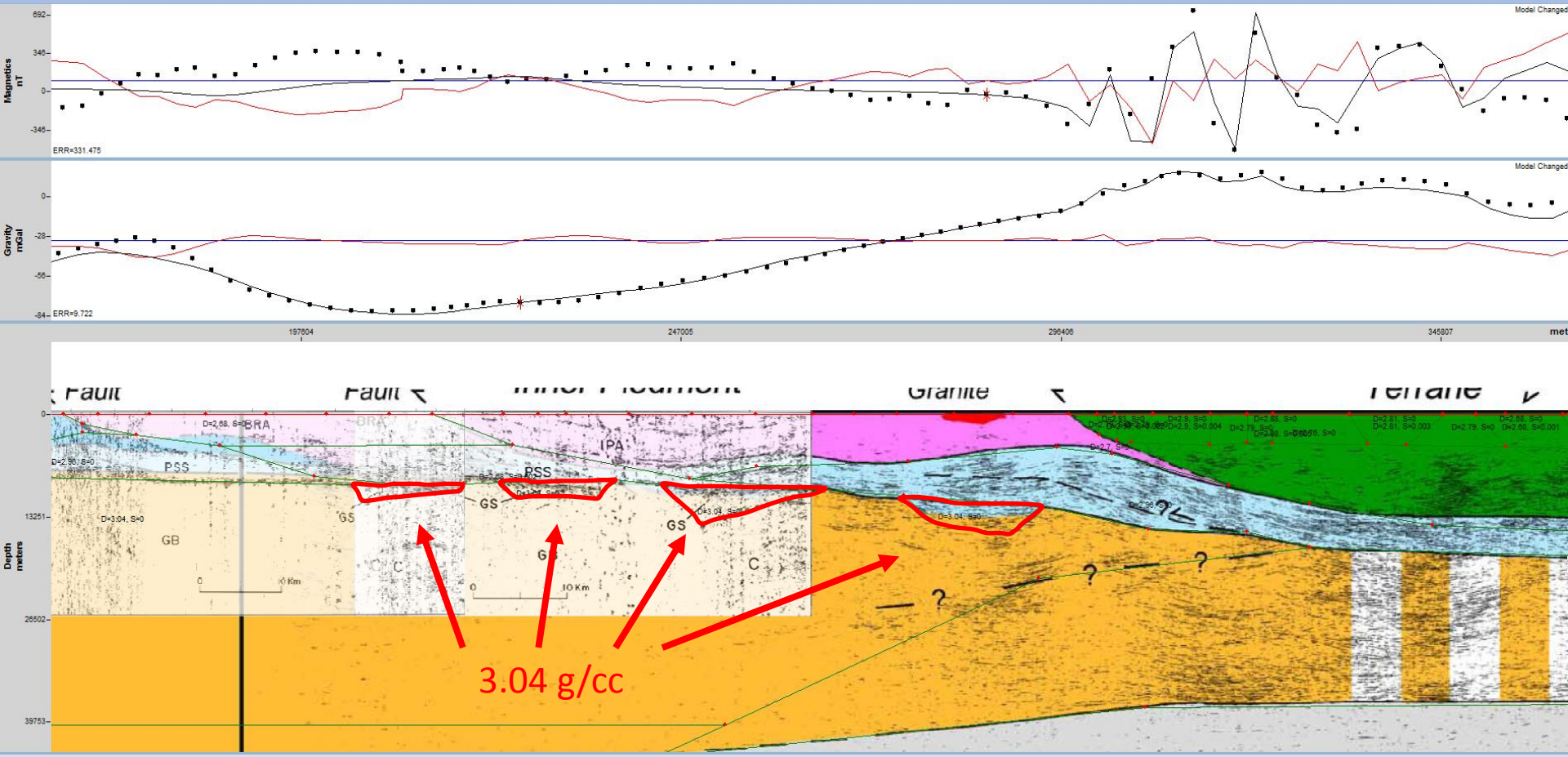
Haysville Anomaly:

- 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

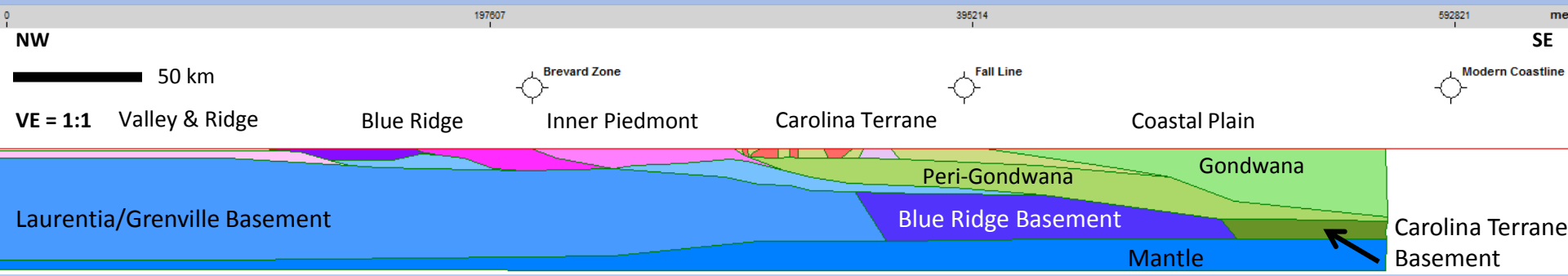


Model without Basement Grabens



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).

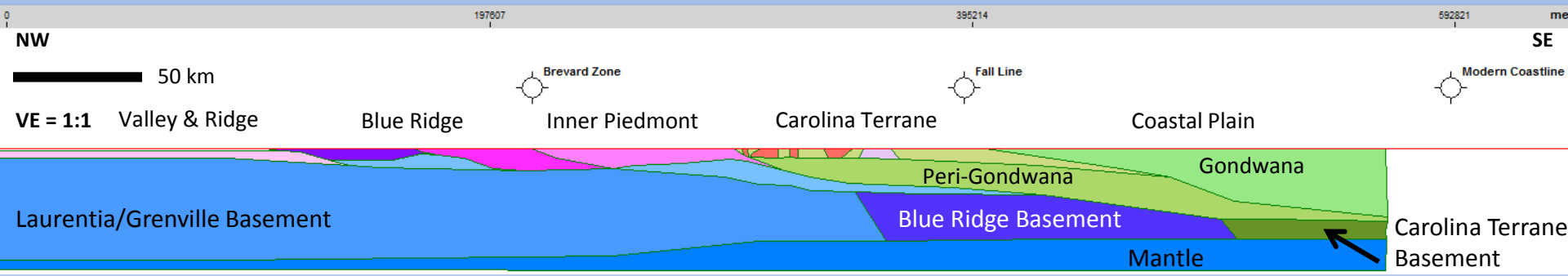
Conclusions and Implications



Appalachian Paired Gravity Anomaly -

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

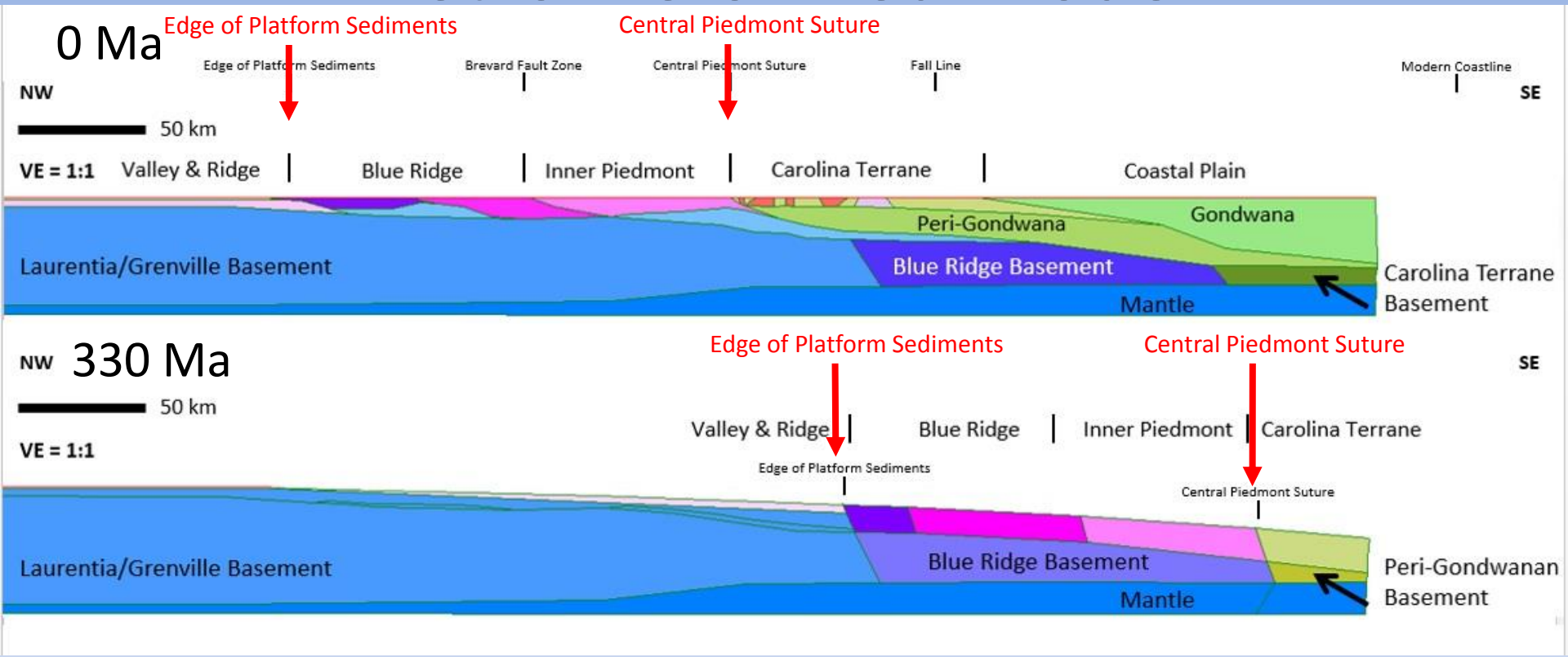
Conclusions and Implications



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

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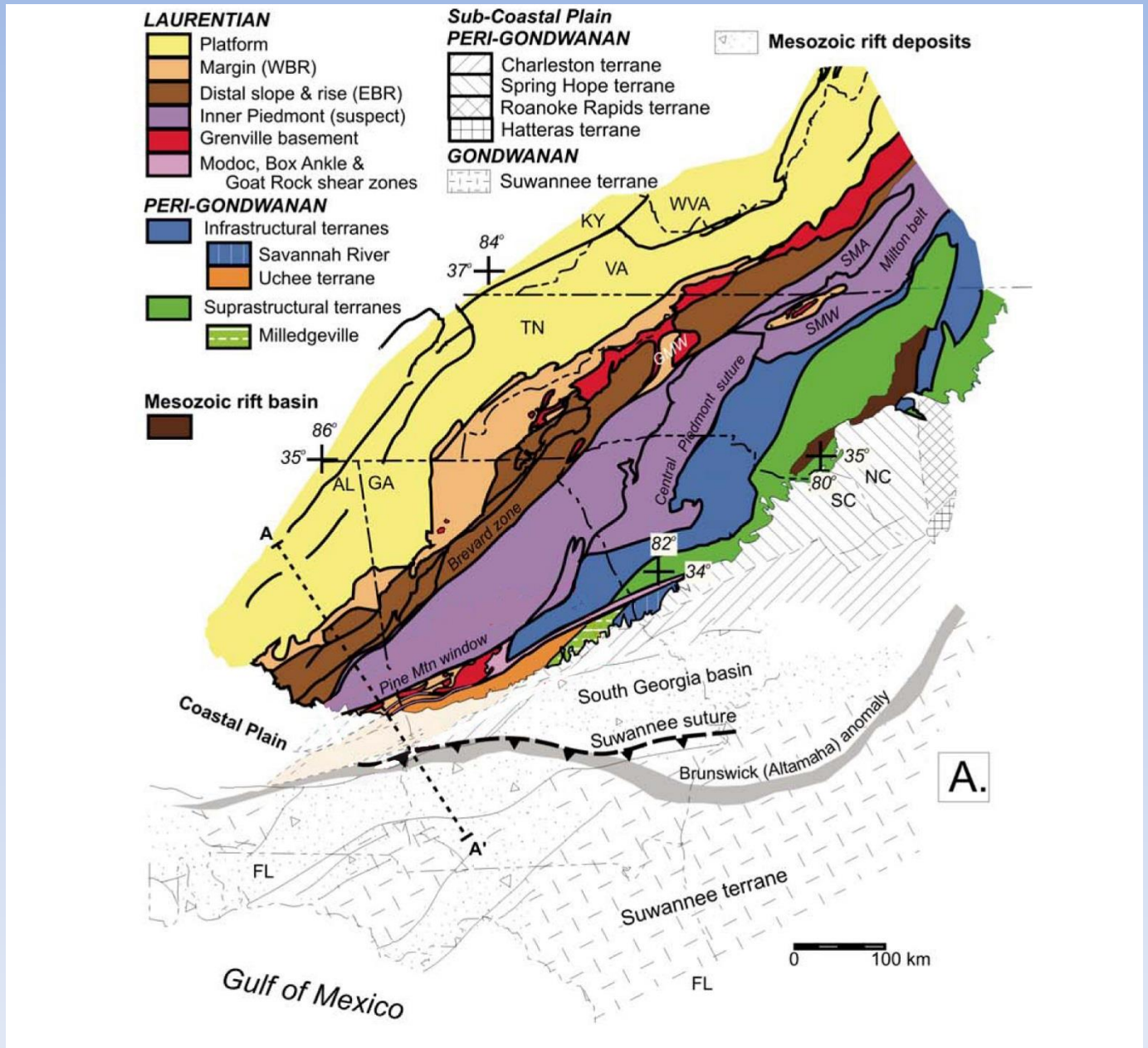
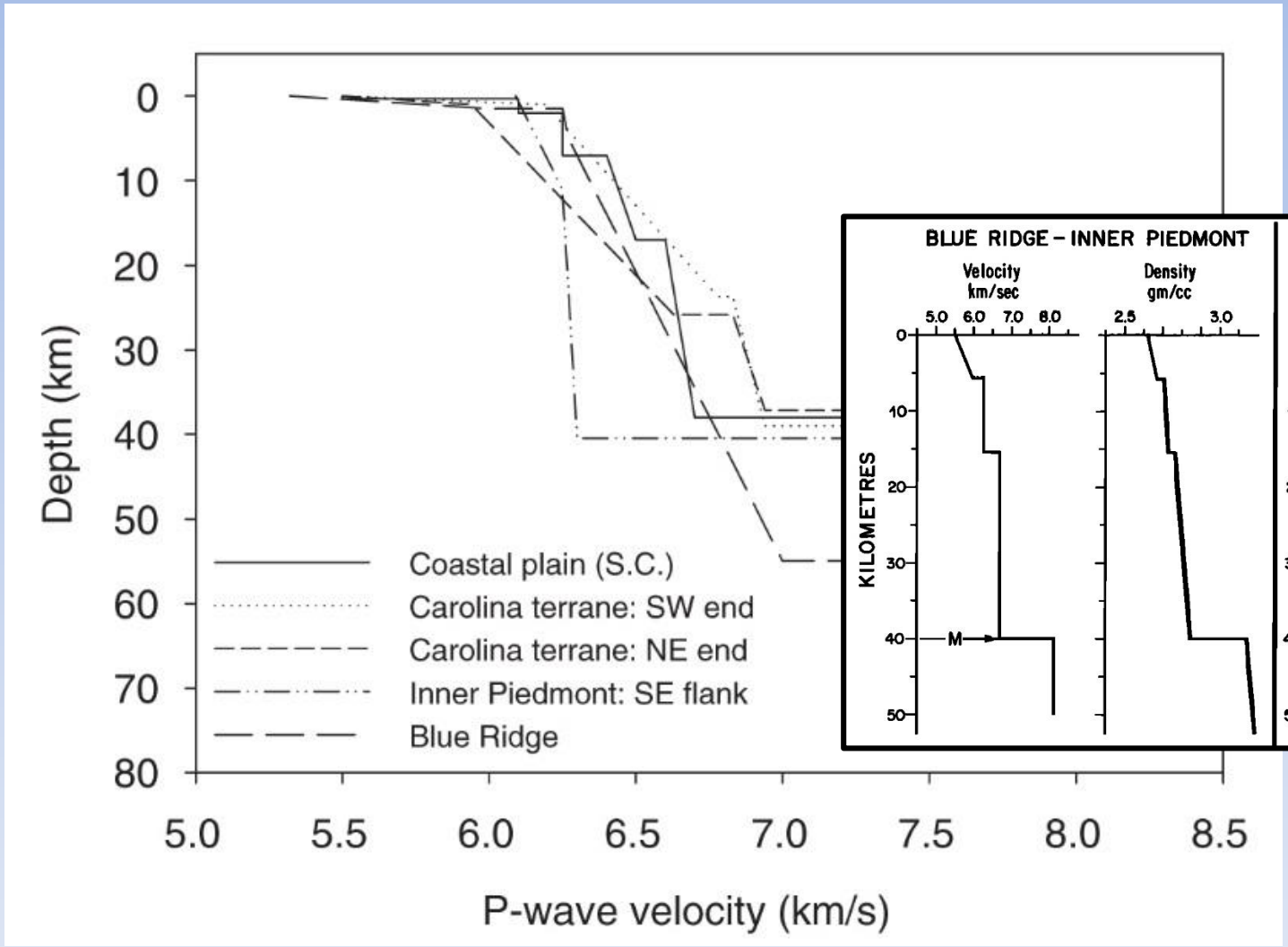
Regional Geologic Map



Velocity Structure of BR, IP, CT



(Cook, 1984)

(Hawman Khalifa, 2012)

Shelf Strata under CPS