Deep structure of the Atlantic margins and neighboring oceanic crust from wide-angle seismic data and plate kinematic reconstructions.

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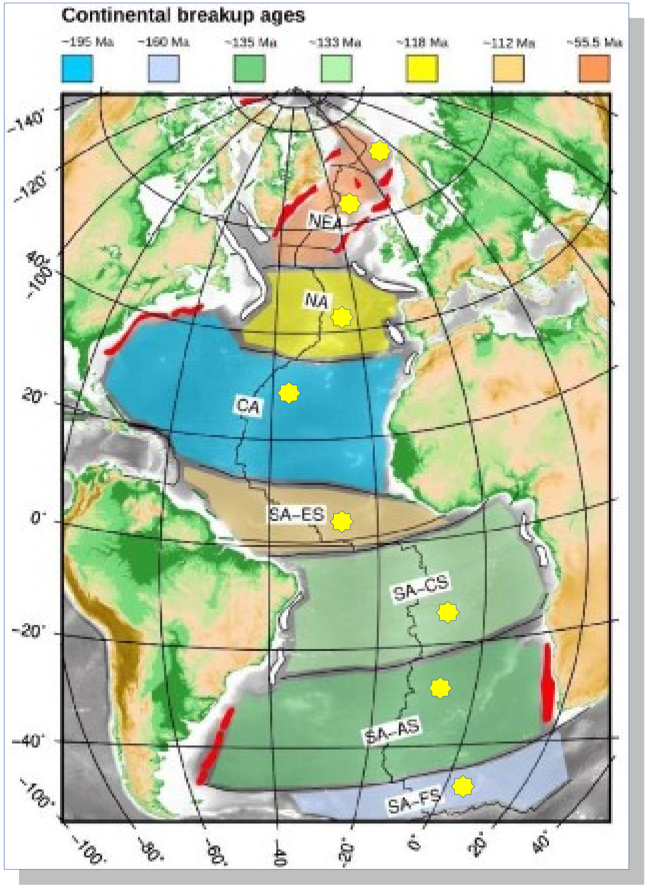
This study [Biari et al., 2021]

Rotational poles [Matthews et al., 2016]

Volcanic provinces [Whittaker et al., 2015]

Marginal plateaus [Loncke et al., 2020]



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Conclusions

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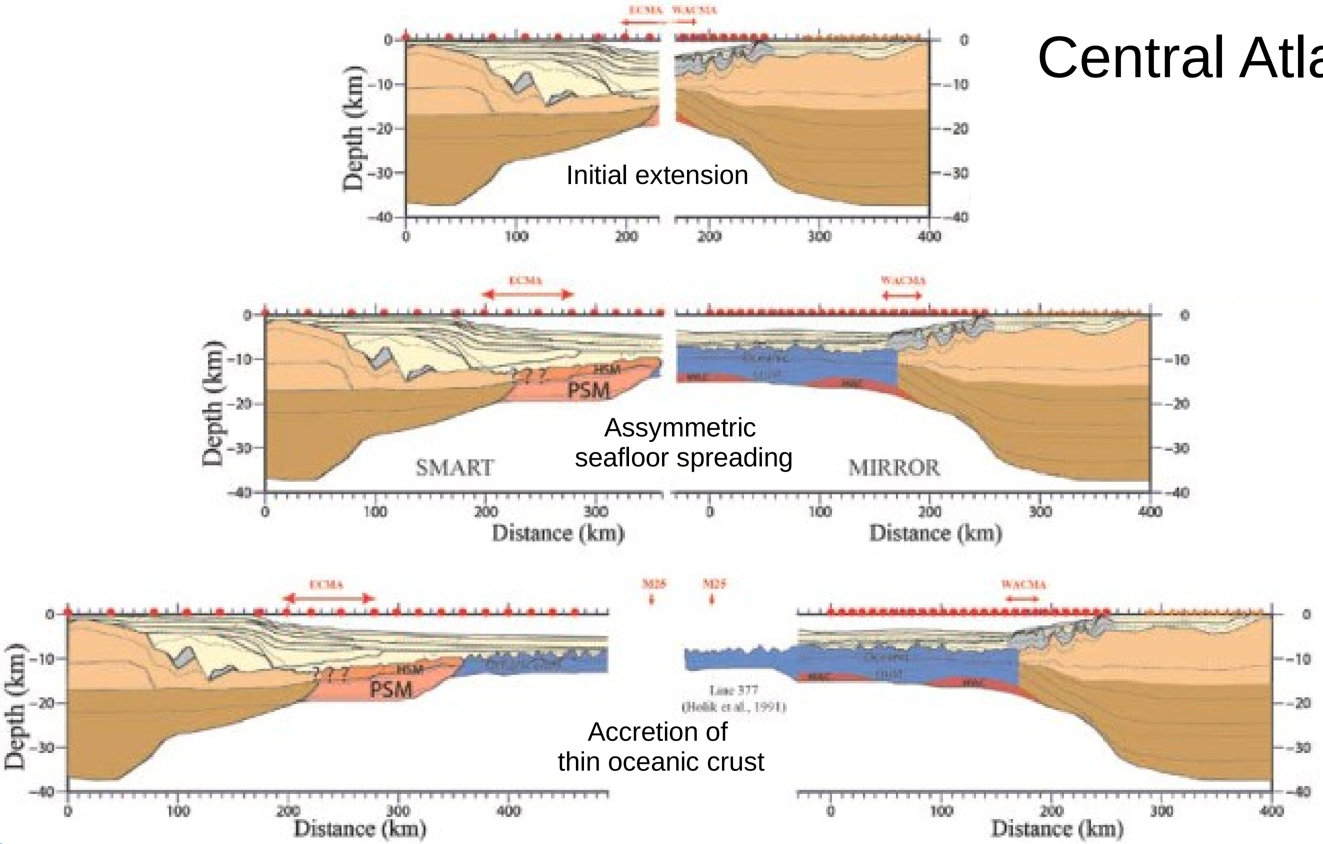
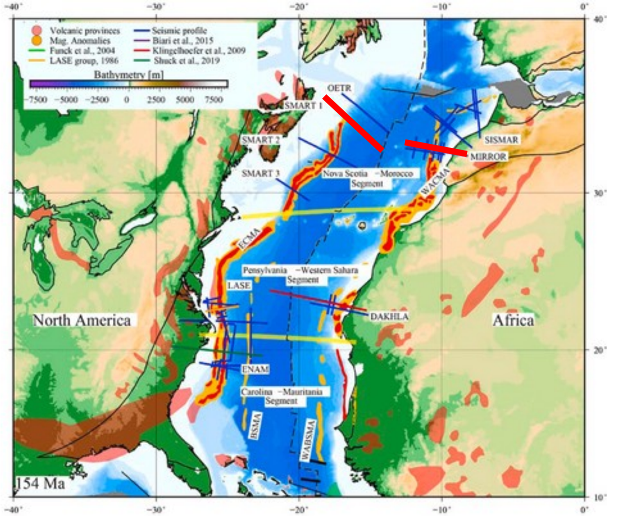
Central Atlantic (~195 Ma)





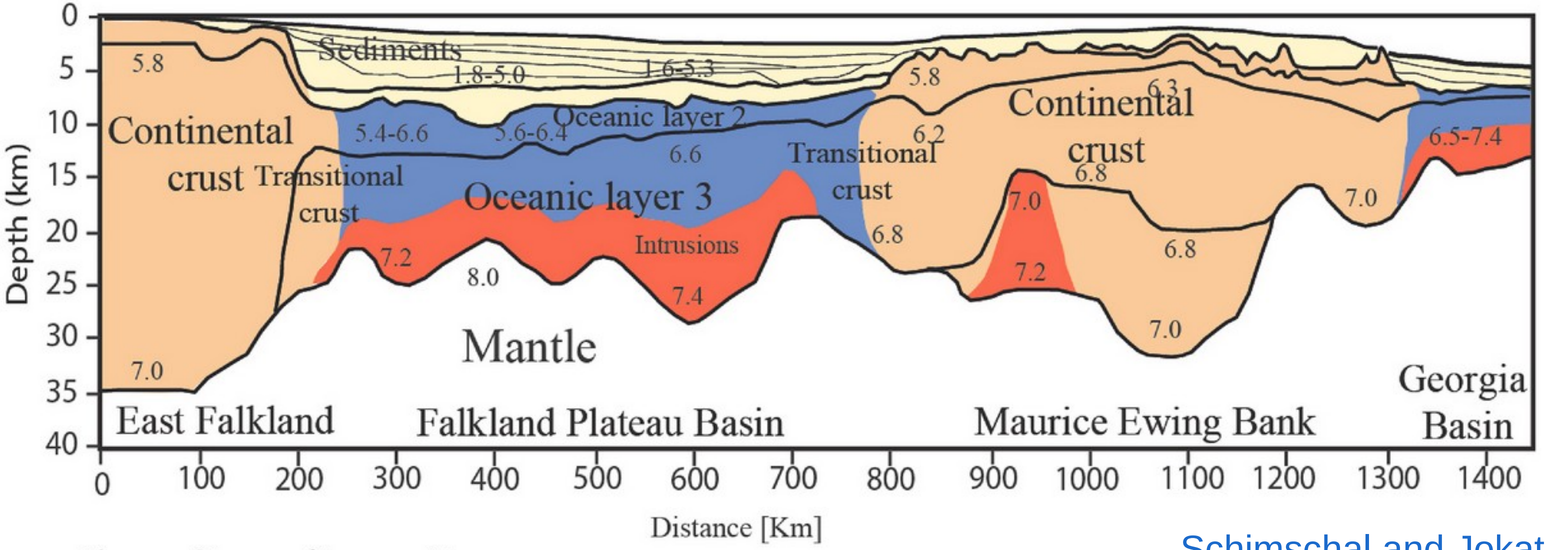
[Funck et al., 2004](#)

- 37 km unthinned continental crust thickness
- 150 km broad region with serpentinized upper mantle material exhumed to the seafloor
- ~3 thin oceanic crust

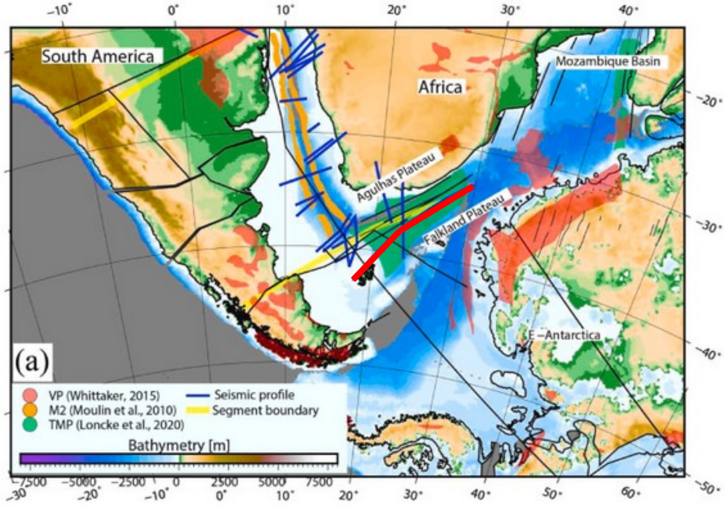
[Biari et al., 2015](#) [Biari et al., 2017](#)

- No indications for the existence of serpentinized upper mantle material
- Oceanic crust of 7–8 km thickness
- Unthinned continental crust has a thickness of ~36 km

South Atlantic – Falkland Segment (~160Ma)



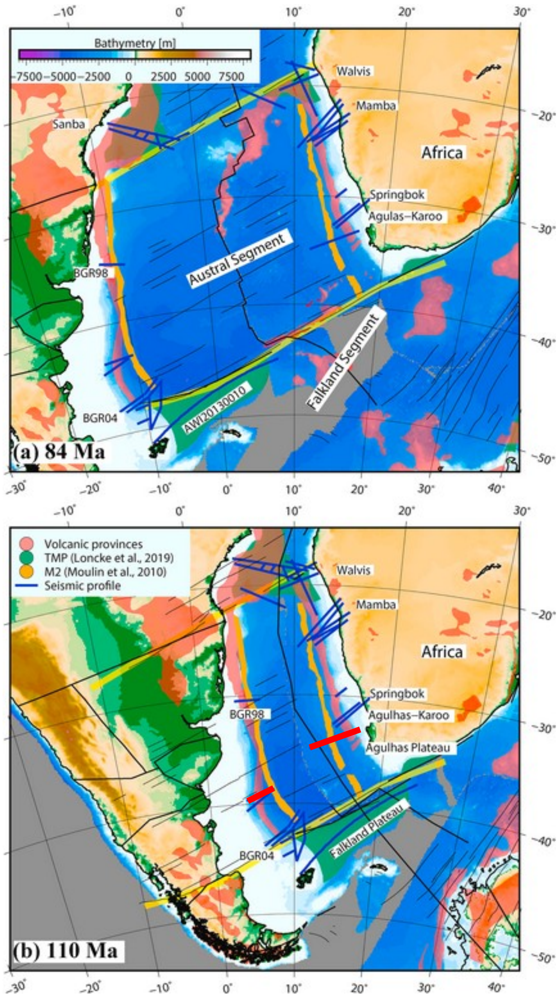
Schimschal and Jokat, 2019

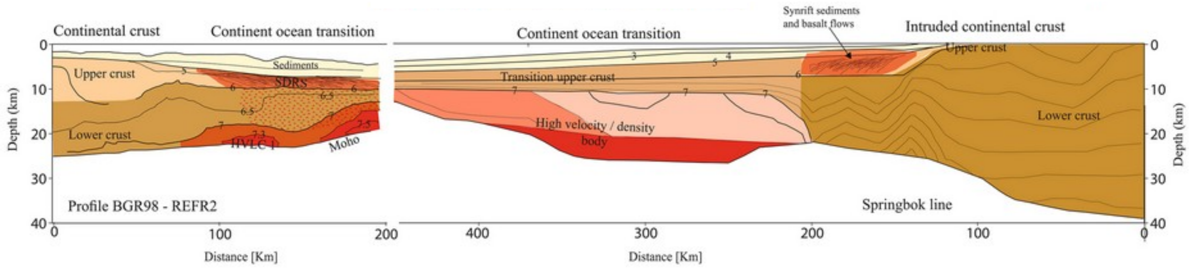


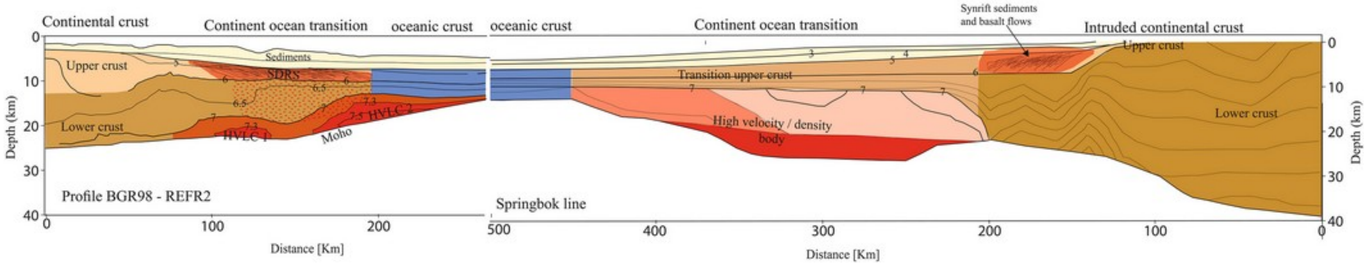
Falkland Plateau comprises three regions:

- the Falkland/Malvinas islands (underlain by a 35 km crust of continental origin)
- the Falkland Plateau basin (underlain by thick oceanic crust)
- the Maurice Ewing Bank (28 km thick continental fragment heavily overprinted by magmatic intrusions)

South Atlantic – Austral Segment (~133 Ma)







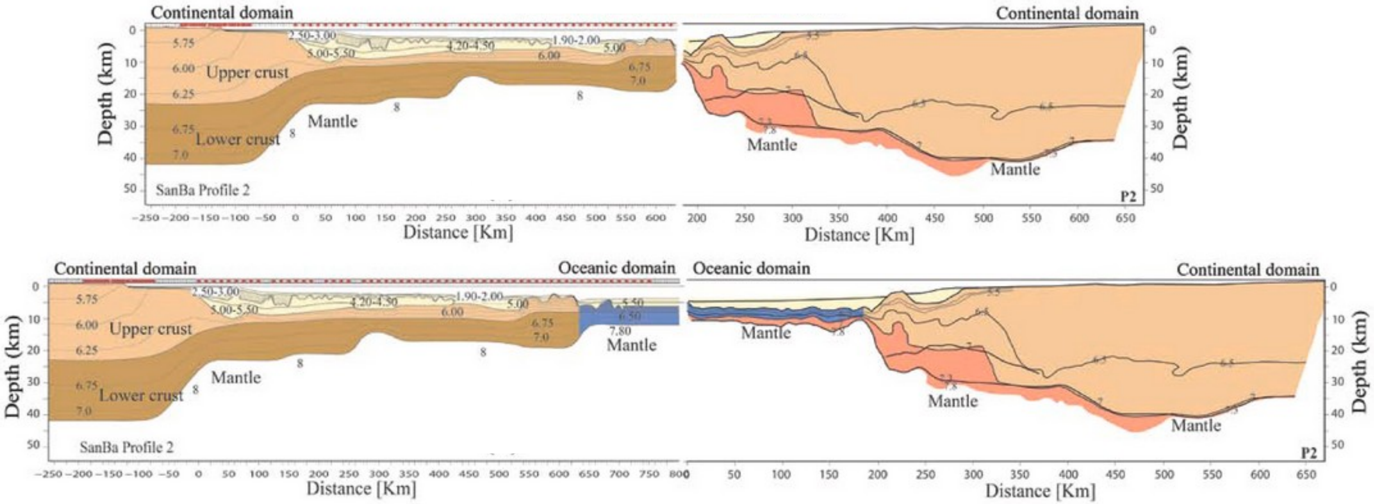
[Schnabel et al., 2008]

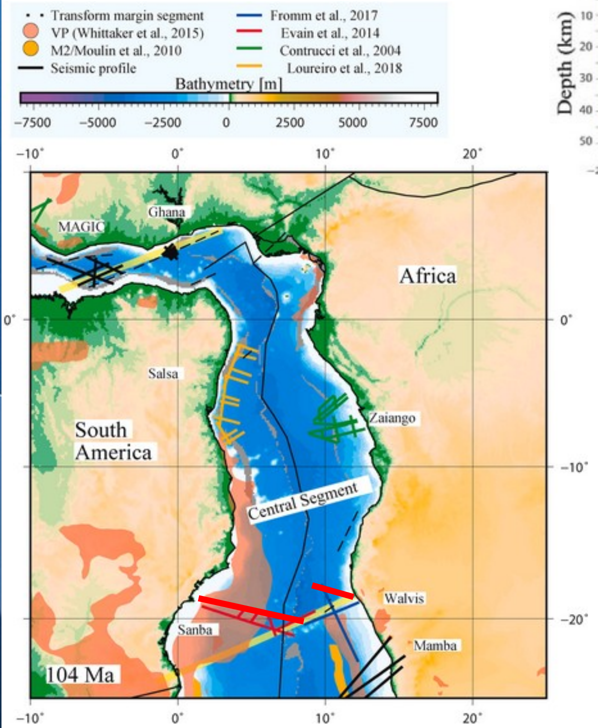
- 20–25 km of thinned continental crust below the SDR
- Further thinning crust seaward of SDR.
- High velocity lower crustal body interpreted to be igneous material.

[Hirsch et al., 2009]

- Continental crust thinning from 40 to 15 km
- One single thick SDR complex
- Up to 10 km thick underplate layers at the transition zone

South Atlantic – Central Segment (~118 Ma)





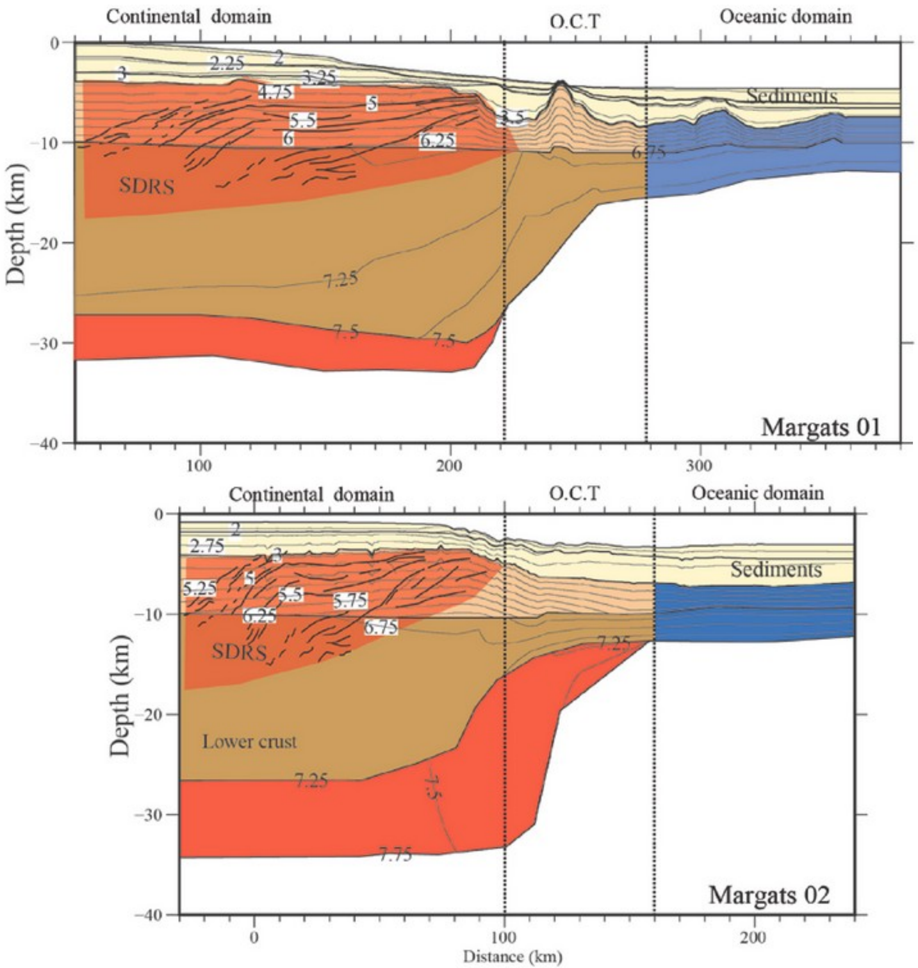
Evain et al., 2015

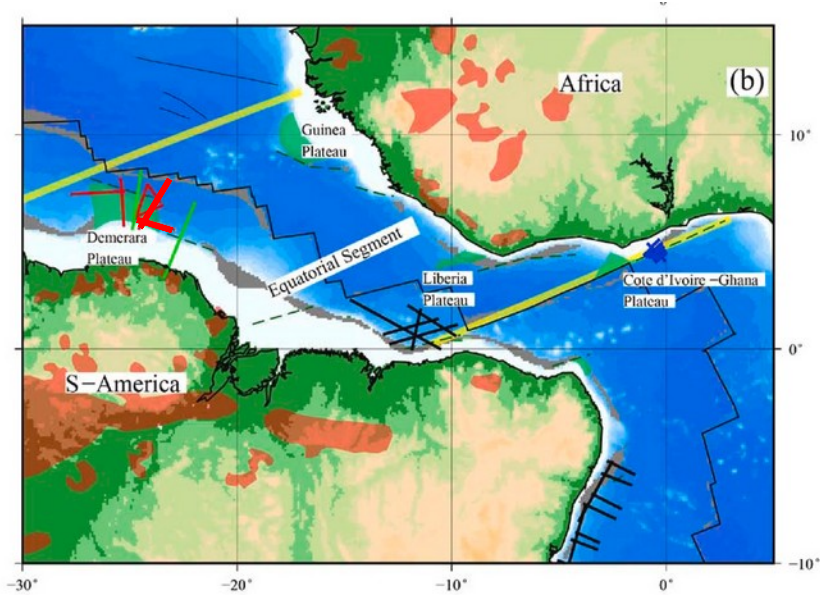
- Abrupt thinning from a 40 km thick continental crust to less than 15 km.
- Adjacent is a 350 km-wide basin underlain mostly by thinned continental crust.
- Parts of this basin might be either atypical oceanic crust, exhumed lower crust or intruded continental crust

Fromm et al., 2015

- 40 km thick continental crust thinning to < 10 km
- High velocity layer extends several tens of kilometers underneath the African continent may be connected to mantle thermal anomaly

South Atlantic – Equatorial Segment (~112 Ma)

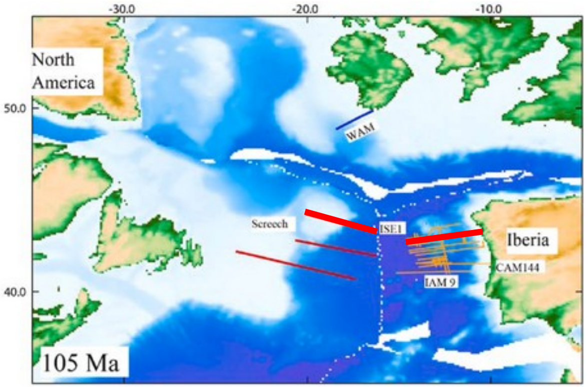


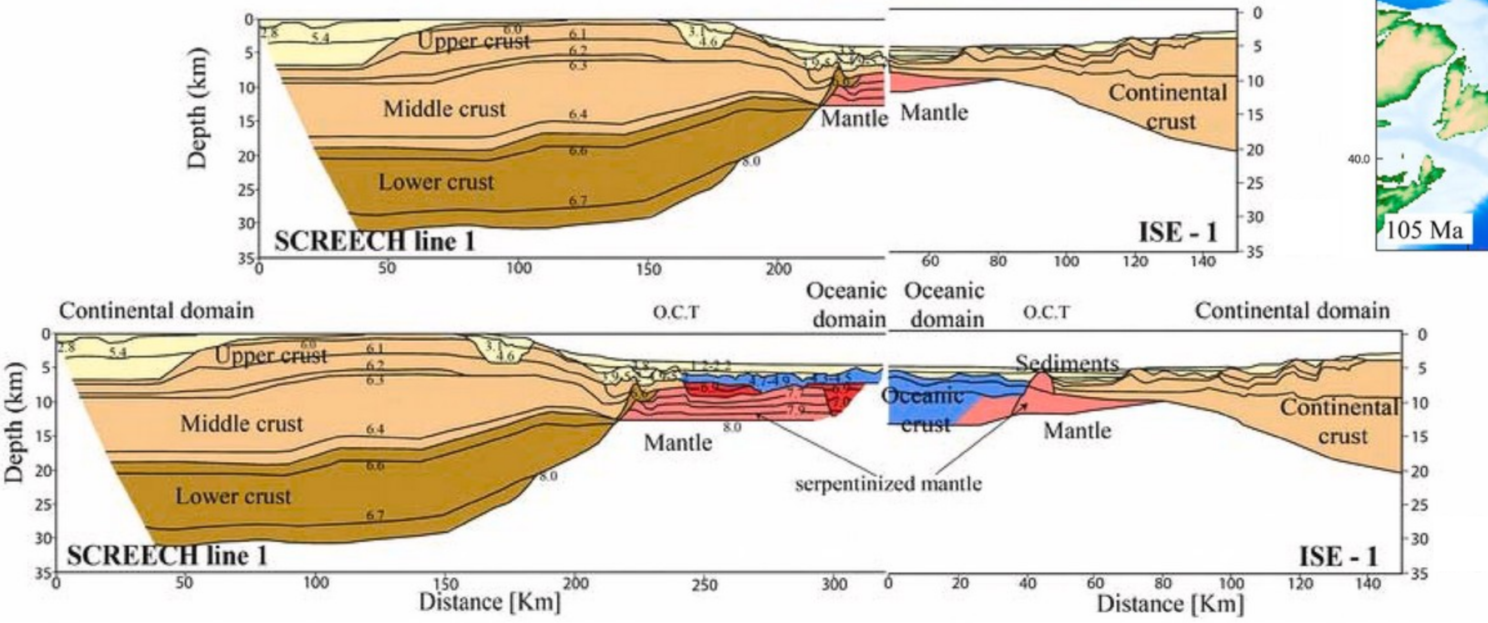


[Museur et al., 2021]

- 30 km-thick crust, including an upper SDR crust and a mixed middle crust
- The deepest layer is interpreted as intruded magmatic material.
- Polyphased origin including a first phase creating the volcanic western margin and a second phase creating its northern (~ transform) and eastern (divergent) margins

North Atlantic - Southern North Atlantic (~133 Ma)





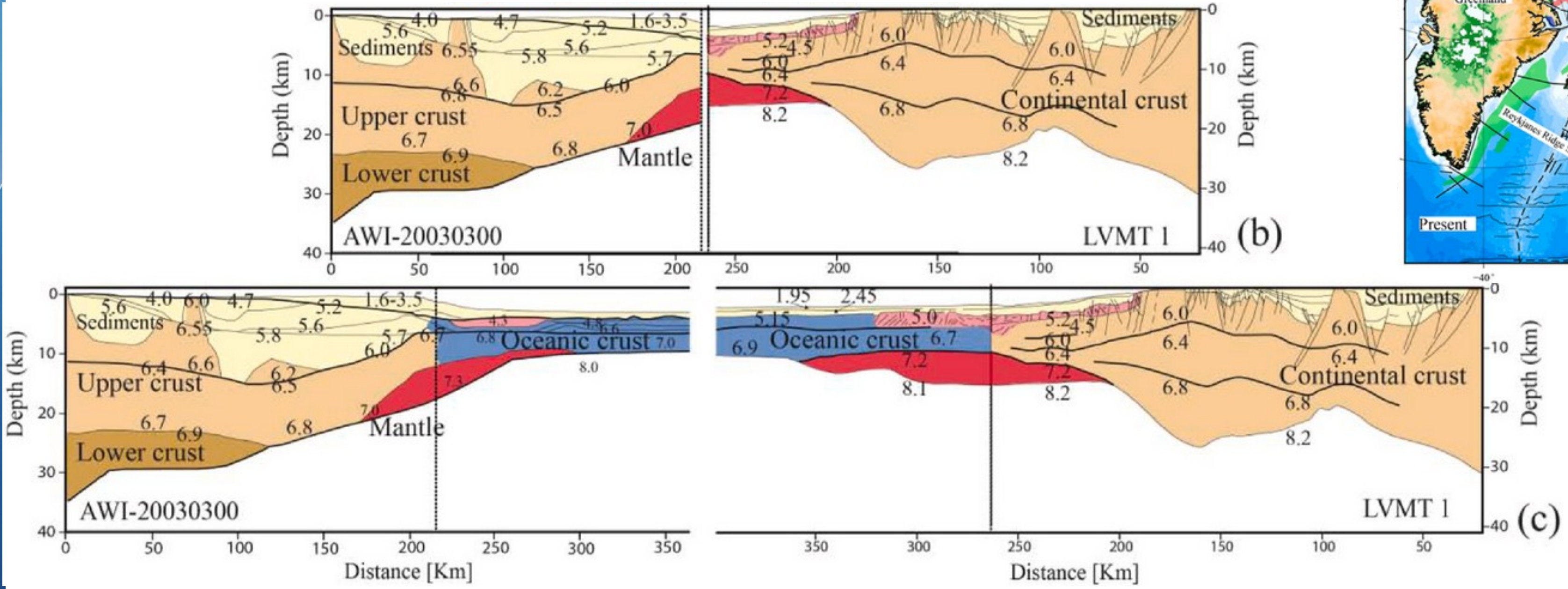
[Funck et al., 2003]

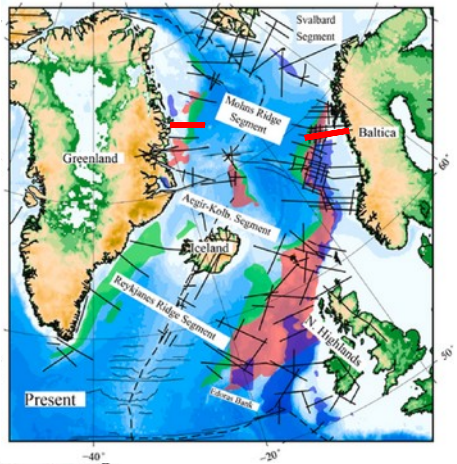
- 30-km-thick continental crust thinning to just 1.5 km.
- 3 km-thick oceanic crust that thins locally to 1 km.
- Over an 80-km-wide zone underlying both the thinned continental crust and the thin oceanic crust is interpreted as partially serpentinized mantle.

[Whitmarsh et al., 1996]

- Continental crust divided into only two layers
- 60 km-wide zone of serpentinized mantle
- A peridotite ridge exposed at the seafloor
- 7 km-thick oceanic crust where overlying serpentinized mantle reduced ~2.5 to 3.5 km

North Atlantic - Northeast Atlantic (~55.5 Ma)





[Korenaga et al., 2000]

[Holbrook et al., 2001]

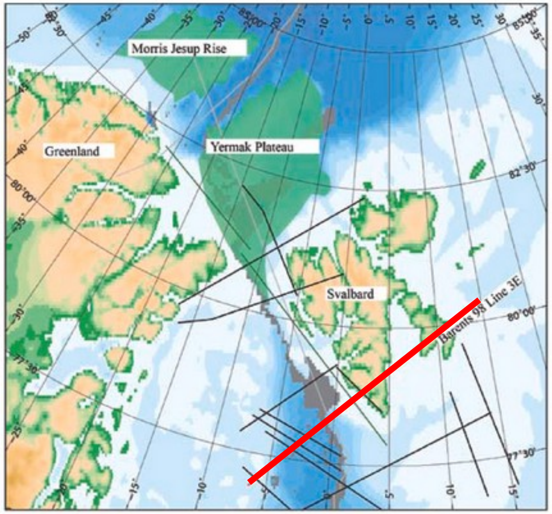
[Voss et al., 2009]

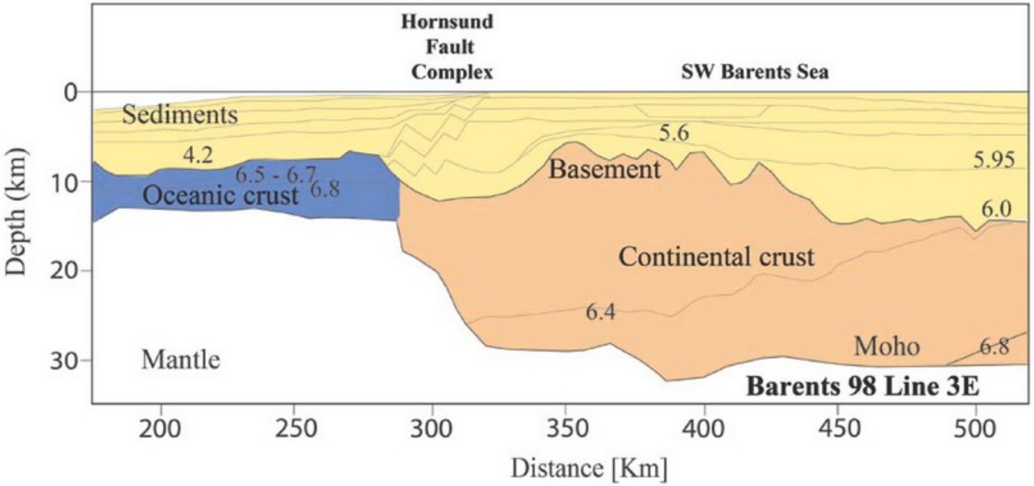
- Sedimentary basin of up to 7 km depth beneath flood basalts.
- The continental region of about 30 km thickness with magmatic underplating.
- Initial oceanic crustal thickness decreases S-N from ~11 km to 5 km.

[Tsikalas et al., 2005]

- The oceanic crust is 1–2 km thicker
- Continental crustal thickness is similar
- HVLC extends to underneath the continent with a max. thickness of 5–8 km

Northern Atlantic – Svalbard Transform Segment



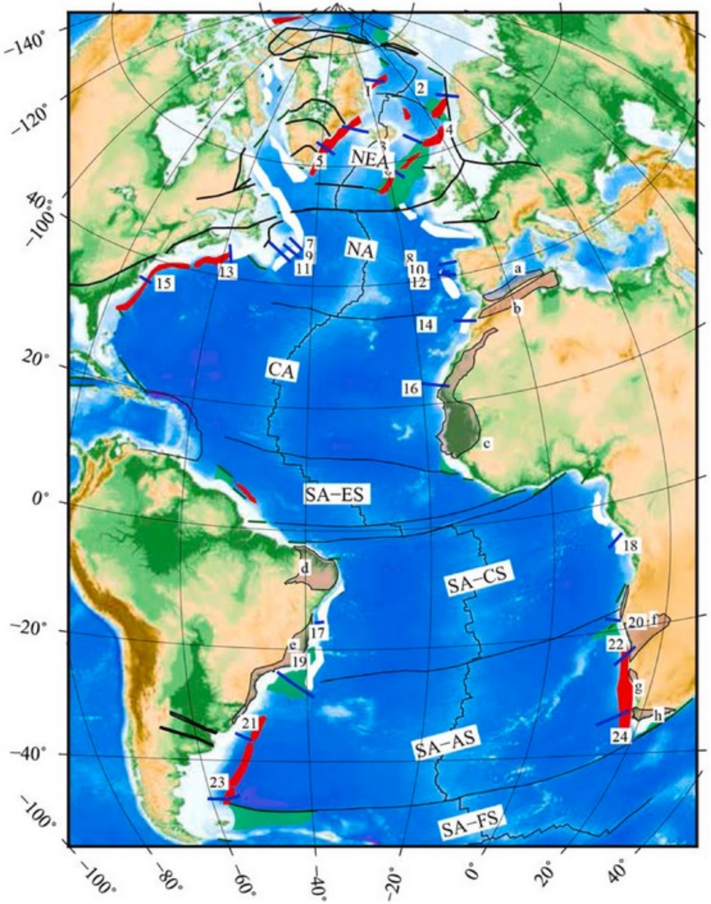


[Breivik et al., 2003]

- Narrow continent-ocean transition zone typical of transform margins
- Thinning from 25 km to 10 km thickness over a distance of only 50 km

Conclusions (1/2)

Profile W	(A)	(B)	Beta	(C)	Profile E	(A)	(B)	Beta	(C)	(D)	Ocean Basin	Magma poor /magmatic
1) AWI-20030300	43	8	5,375	5-6	2) LVMT1	43	10	4,3	6,7	parallel	NE-Atlantic	Magmatic
3) SIGMA 1	43	20	2,15	15	4) FIRE	43	15	2,8	15	craton	NE-Atlantic	Magmatic
5) SIGMA 3	43	15	2,86	8	6) iSIMM	46	13	3,53	9	craton	NE-Atlantic	Magmatic
7) SCREECH1	30	6,5	4,61	4,5	8) ISE1	30	3	10	7,5	-	Southern North Atlantic	Magma poor
9) SCREECH2	30	10	3	4	10) CAM144	30	3	10	?	-	Southern North Atlantic	Magma poor
11) SCREECH3	30	5	6	4	12) IAM9	30	8	3,75	8-10	-	Southern North Atlantic	Magma poor
13) SMART	37	5	7,4	3-4	14) MIRROR	37	9	4,11	7-8	parallel	Central Atlantic	Magma poor
15) LASE	40	20	2	10	16) DAKHLA	37	17	2,17	7-8	parallel	Central Atlantic	Magmatic
17) SALSA11	40	6	6,66	5/?	18) ZAIANGO14	40	5	8	5,5	parallel	South Atlantic/Central segment	Magma poor
19) SANBA2	42	12	3,5	6	20) P2 (Namibia)	40	15	2,66	6	parallel	South Atlantic/Central segment	Magma poor
21) BGR98-REF2	45	5	9	6,5	22) SPRINGBOK	45	10	4,5	7,5	orthogonal	South Atlantic/Austral segment	Magmatic
23) BGR04-01	45	12	3,75	6,5	24) MAMBA2	45	19	2,36	7,5	parallel/oblique	South Atlantic/Austral segment	Magmatic



(A) Orig. crustal thickness
(B) Thinned crustal thickness
(C) Oceanic crustal thickness
(D) Angle to ex. fold belt

Conclusions (2/2)

- None of the wide-angle seismic models from volcanic margins along the Atlantic Ocean revisited in this study shows indications for serpentinized mantle material between the extrusive SDR sequences and HVLC bodies.

- Main factors influencing margin rifting are pre-existing structure, changing stress directions and orogenic fabric of associated fold belts. Where rifts stagnate at a barrier excess magmatism may contribute to the formation of LIPs.

- Volcanic transform marginal plateaus developing at the border of transform margin segments might origin from heating of the mantle when the propagation of rifting is stopped temporarily at the transform. Once it breaks rifting propagates creating the next basin.

- Transform marginal plateaus therefore probably represented last landbridges between oceanic basins, thereby deeply influencing animal migration paths, oceanographic currents, and paleoclimate.