THE VOLCANIC MARGINS OF THE NORTHERN LABRADOR SEA

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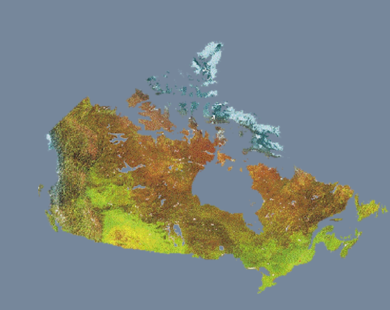


INTRODUCTION

A new interpretation of seismic reflection data on the northern Labrador rifted margin (Keen et al., 2012) shows features which are commonly observed in the igneous crust at volcanic margins, including seaward dipping reflections (SDR), volcanic plateaus, and lava deltas. Below the SDRs, wide angle seismic and gravity data suggest the presence of a thick (~15 km) igneous crust. Comparisons with the well-imaged conjugate west Greenland margin show similar structures there (e.g. Gerlings et al., 2009).

Emplacement of the thick igneous crust of the plateaus is linked by the coincident magnetic chron 27n (~61 Ma) to Paleocene volcanism in the Davis Strait region to the north, extending the region of excess volcanism about 500 km south along the Labrador rifted margin.

Figure A shows the location of seismic data used, the distribution of volcanic features mapped, the location of non-volcanic margins in the south central Labrador Sea, and the magnetic chrons and transform faults.

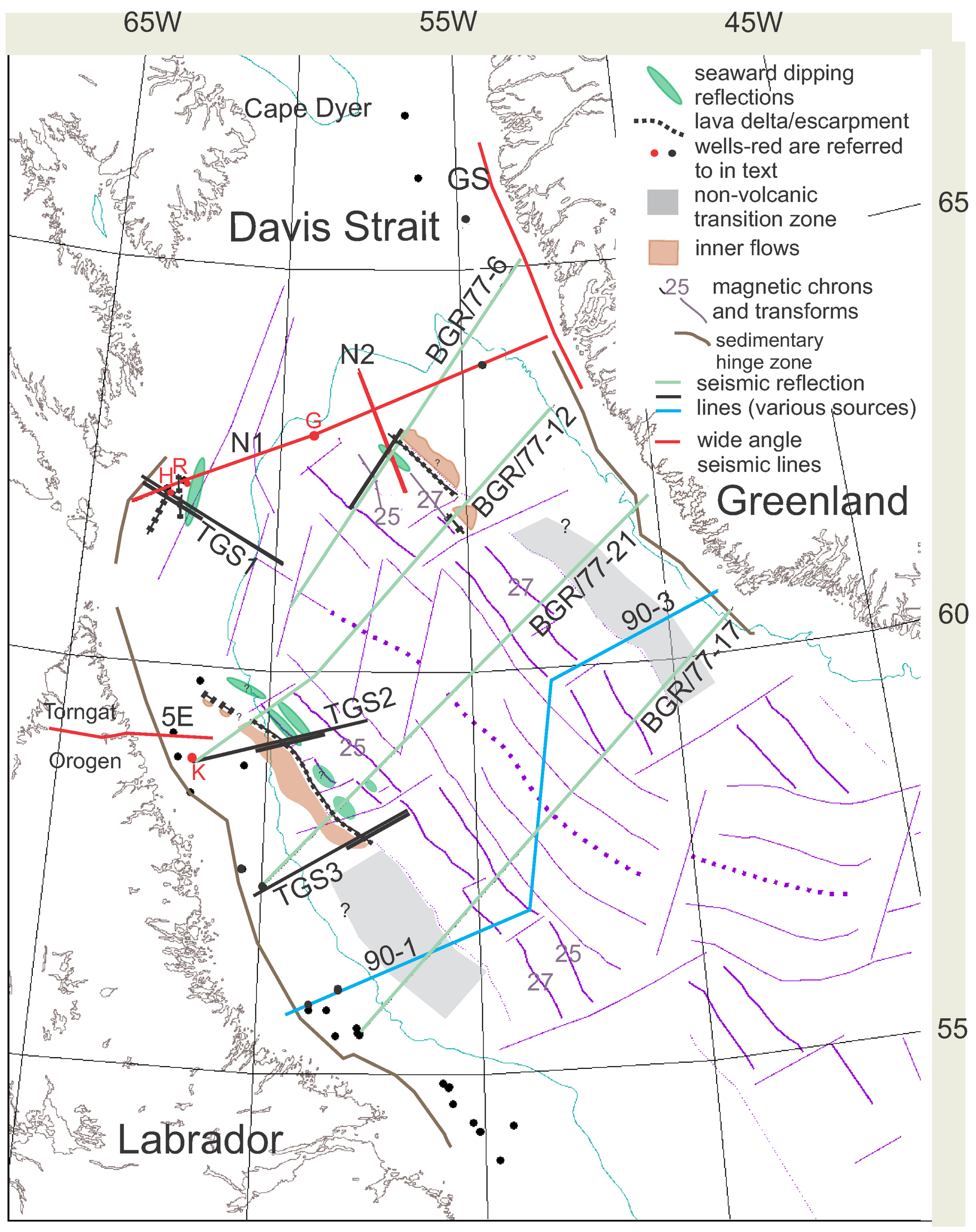
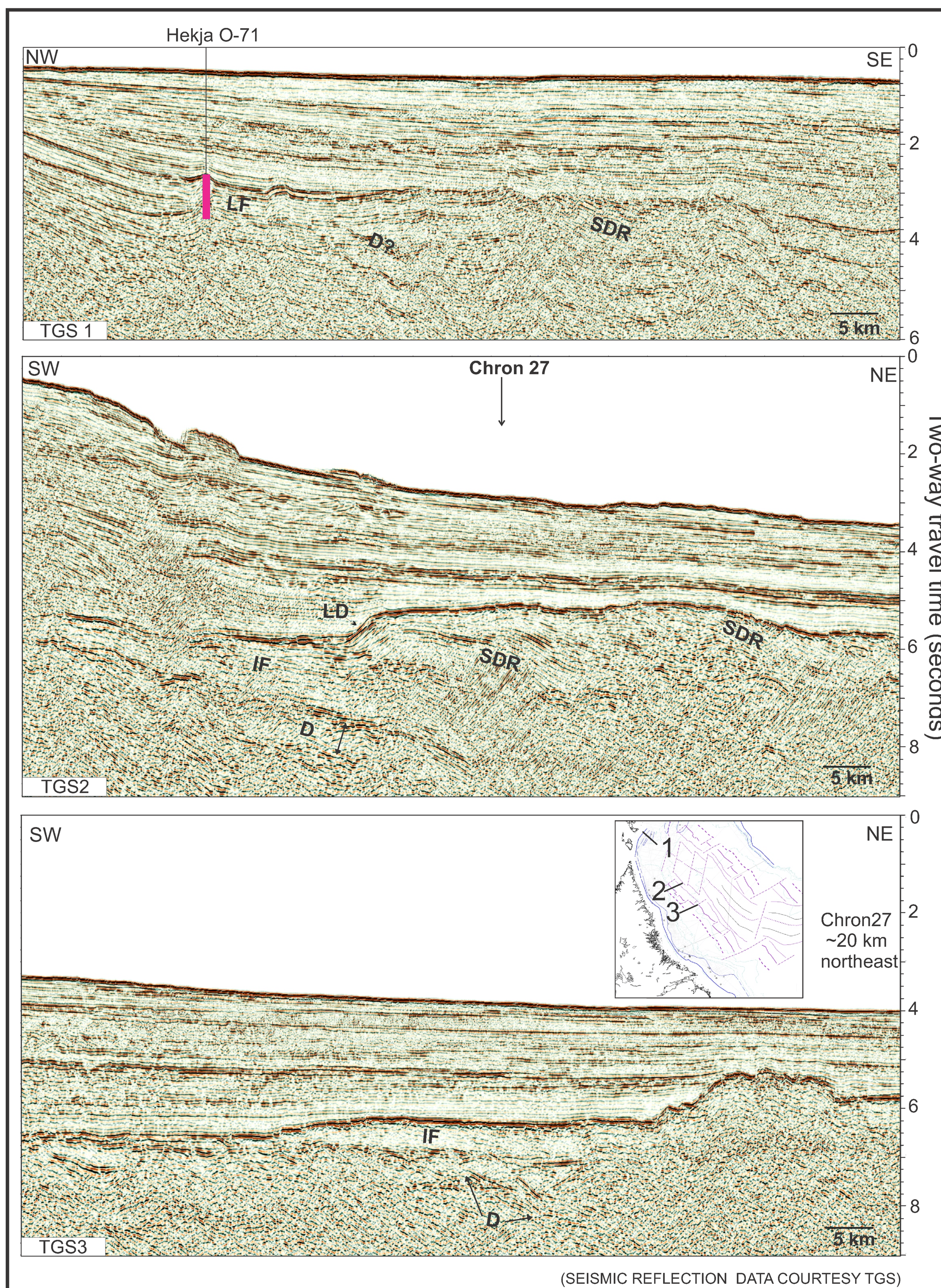
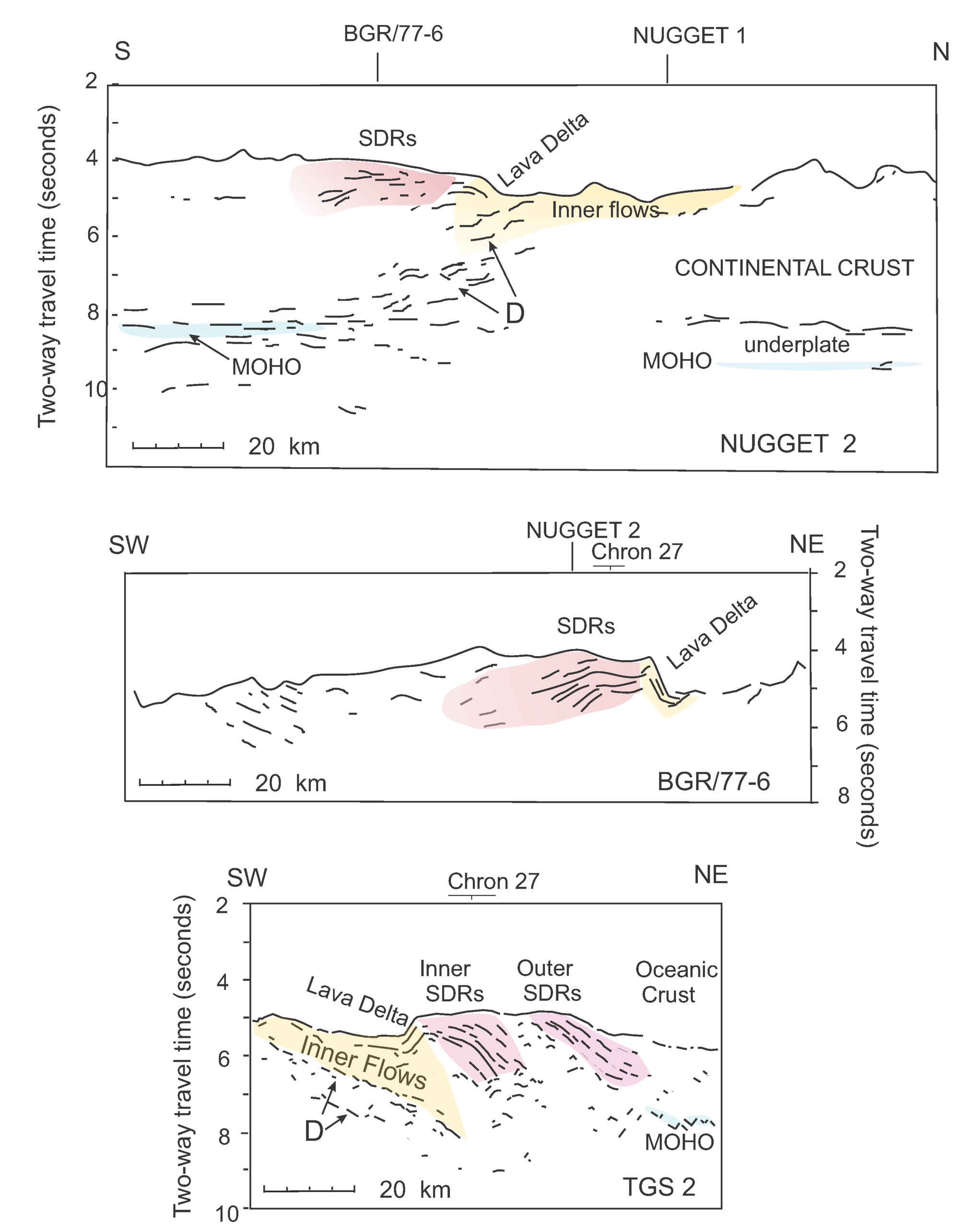


FIGURE A: Location of Data and rifted margin features.



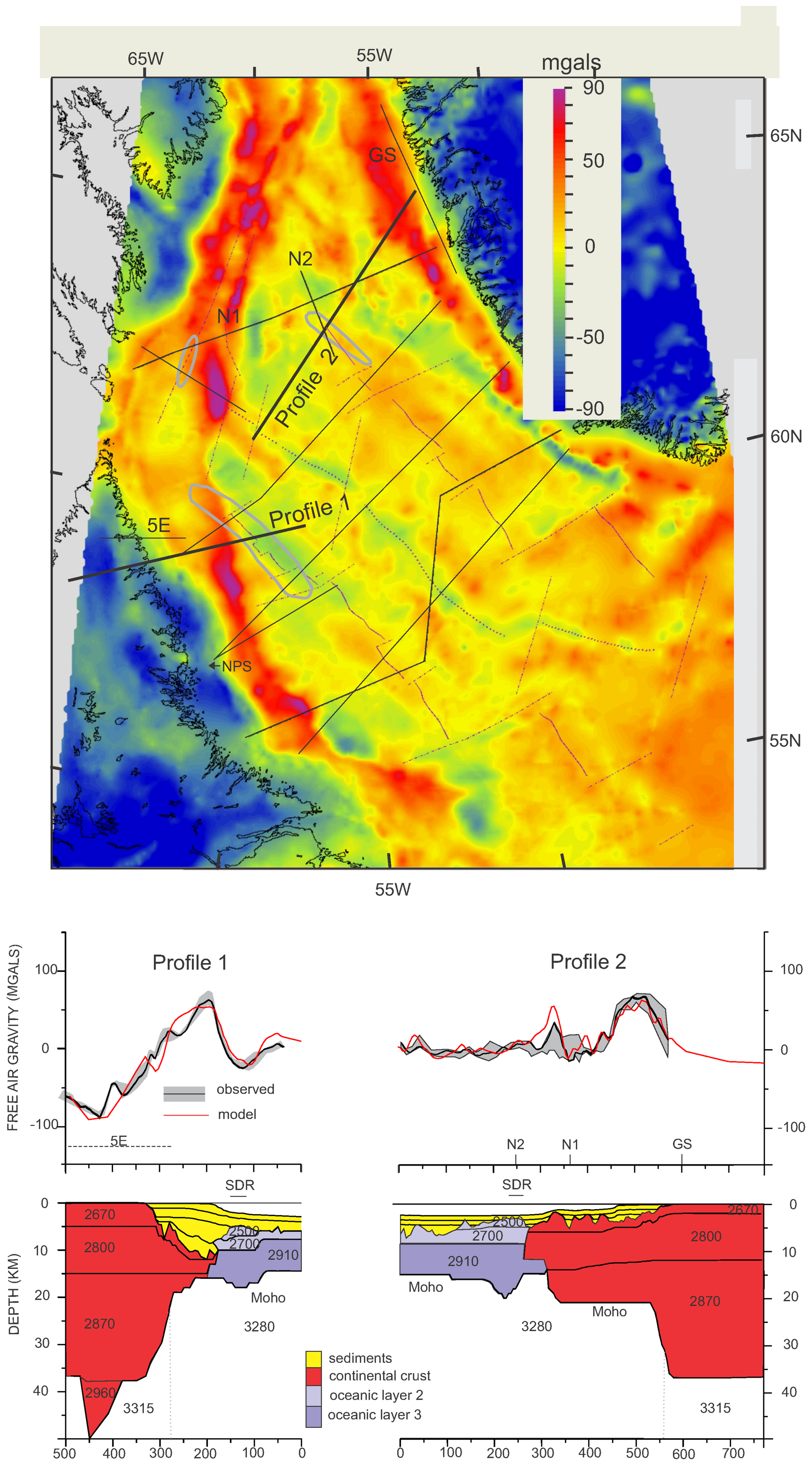


The new interpretation for the LABRADOR MARGIN (left) is presented here, along the three TGS lines. Positions are in Fig. A. Location of magnetic chron 27 and the Hekja well where Early Tertiary volcanics were drilled (pink) are shown. We use the terminology of Planke et al. (2000) to describe the volcanostratigraphy: lava deltas (LD), seaward dipping reflections (SDR) and inner and landward flows (IF,LF) are shown. "D" are a set of deep, dipping reflections, possibly marking the base of volcanic units and the landward limit of major igneous activity.

This new interpretation off Labrador is very similar to that of the conjugate W. GREENLAND MARGIN (above) in terms of its volcanic nature.

We conclude that both margins of the northern Labrador Sea are volcanic margins.

GRAVITY MODELLING OF THE CONJUGATES



We used the gravity anomalies along profiles 1 and 2 to determine the crustal structure below the conjugate margins. The structure is constrained by seismic data, while densities are constrained by seismic velocities and sonic logs in exploratory wells; crustal densities are the same on both profiles.

Results show thickened igneous crust below SDR's, consistent with the volcanic nature of these margins, and little or no underplating of the adjacent thinned continental crust.

The thick igneous crust is fairly symmetrically distributed across the conjugates, but the zone of thinned continental crust is much wider on the west Greenland margin.

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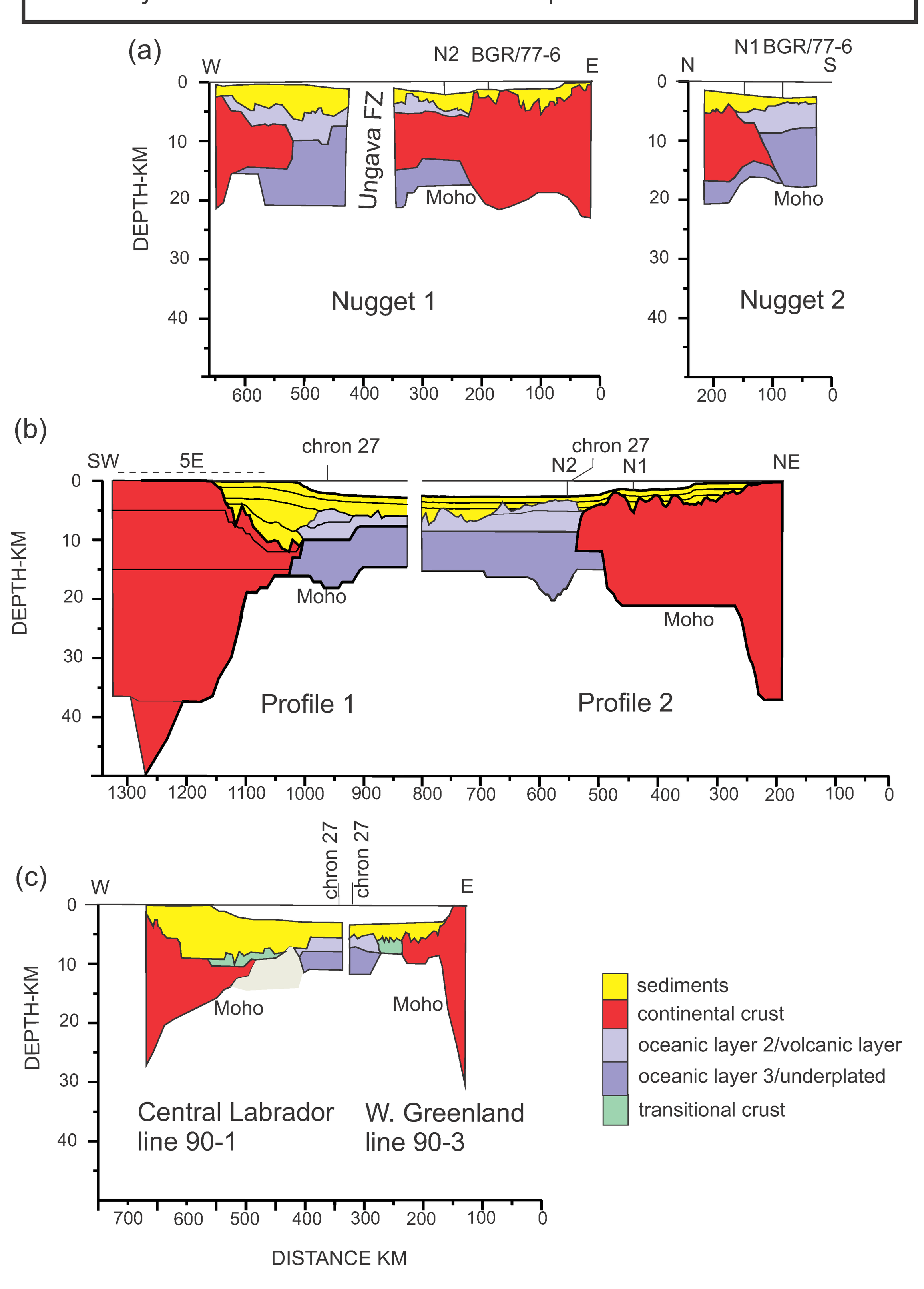
CRUSTAL SECTIONS ACROSS LABRADOR SEA

Three cross-sections showing (a) Davis Strait in the north (Funck et al., 2007; Gerlings et al., 2009), (b) northern volcanic margin of the Labrador Sea (this work), and (c) southern non-volcanic margin (Chian et al., 1995, Keen et al., 1994). *See* Fig. A for locations.

The transition from non-volcanic to a volcanic margin occurs where indicated in Fig. A (south of profiles in b). We postulate that volcanism in Paleocene time overprinted the non-volcanic margin in the north. This may be related to the influence of a plume in Davis Strait.

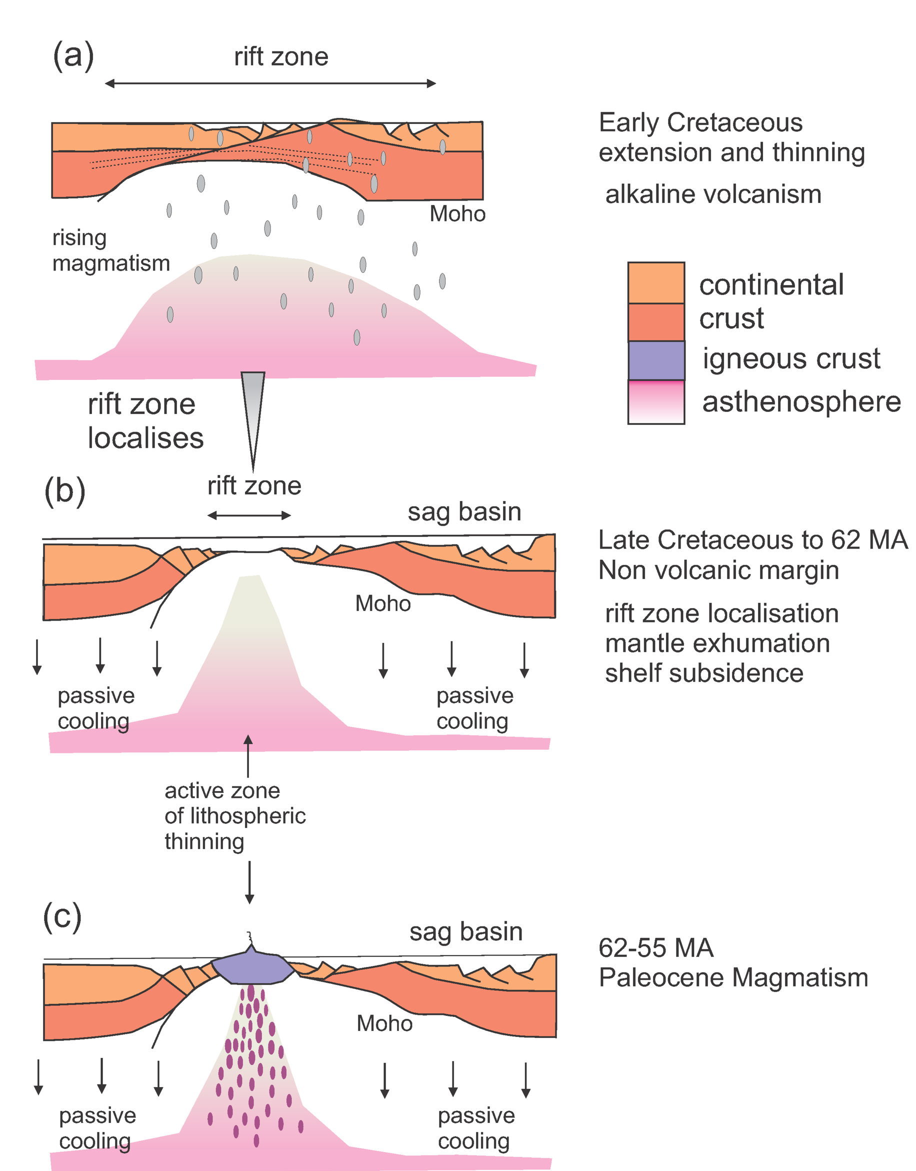


SUMMARY OF MARGIN FORMATION

Three stages are shown in the cartoons below:

(a) E. Cretaceous rifting with minor alkaline volcanism.
(b) L. Cretaceous focusing of rifting further offshore, with cooling and passive subsidence of the proximal regions, where cooling and thickening of the lower lithosphere inhibit further volcanism.
(c) Onset of major igneous activity in northern Labrador Sea in Paleocene time. Source of magmatism may have centred in Davis Strait as part of plume activity there. Melts may have been channelled within the narrowing, hot rift zone and would not have underplated the proximal regions where cooling had occurred.

This interpretation is consistent with the seismic and gravity evidence presented here, and is also compatible with the observed age and distribution of Mesozoic igneous rocks in coastal W. Greenland and Labrador and below the shelves (Larsen et al., 2009).



Thus the margins of the Labrador Sea may have been entirely non-volcanic through Cretaceous time and only in the Paleocene, at the onset of sea floor spreading, were the northern regions affected by the observed magmatism.

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