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A Seismic Refraction Analysis of the Flemish Cap Continental Margin (E Canada): New Evidence for Asymmetric Rifting from Goban Spur (NW Europe)

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The Flemish Cap – Goban Spur conjugate margin was one of the first margin pairs where deep seismic reflection data were used to determine the style of non-volcanic rifting. These studies supported of a symmetric pure shear model of extension followed by an asymmetric breakup. In contrast, a more recent seismic refraction study of Goban Spur indicates that extension is more complex and includes a wide transition zone interpreted as serpentinized mantle. In order to determine a complete conjugate section, the Flemish Cap margin has been re-examined with a 460-km-long refraction seismic profile, including dense airgun shots to 21 OBS receivers along the original deep MCS reflection profile. A P-wave velocity model has been developed by forward and inverse methods to define the crustal thickness, structure and composition of the crust and uppermost mantle along the line. The velocity model displays continental crust with a maximum thickness of 30 km. The crust thins rapidly to a 6-km-thick, 30-km-wide zone of highly extended continental crust. Farther seaward, the velocities in the lower part of the crust increase and this 85-km-wide transition zone is interpreted as partially serpentinized mantle. A sharp boundary separates the transition zone from 6-km-thick oceanic crust. The thin continental crust, transition zone and oceanic crust are overlain by sediment layers of up to 3 km thickness on the thin continental crust, decreasing to 1 km thickness on the oceanic crust. The transition zone on Flemish Cap displays somewhat higher velocities in the lower crust and Moho is a bit deeper than in the zone of serpentinized mantle on Goban Spur, but the transition zones have approximately similar width. On both margins changes in the velocity structure are observed at about the same place relative to magnetic anomaly 33-34. However, the thinning of the continental crust occurs differently on the two margins. The crust thins more rapidly for Flemish Cap than for Goban Spur. Furthermore, a zone of thin continental crust, as observed on Flemish Cap, is not observed on Goban Spur. These new results from Flemish Cap, together with the recent results from Goban Spur, indicate that rifting of the Flemish Cap – Goban Spur conjugate margin is asymmetric and includes transitional zones of serpentinized mantle between continental and oceanic crust, which is similar to results from other non-volcanic margins.