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Crustal structure of the French Guiana continental margin – implications for rifting and the early spreading of the equatorial Atlantic

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During November/December 2003, a marine geophysical survey of the continental margin offshore French Guiana was conducted onboard RRS Discovery. The survey combined coincident multi-channel seismic (MCS) reflection and wide-angle seismic refraction data along two transects across the margin. In addition, gravity and magnetic anomaly data were acquired.

Wide-angle refraction data from 39 ocean bottom seismographs (OBSs) and 9 land-based instruments together with the MCS data, have been modelled along two transects of the margin. The results are summarised as P wave velocity and density models of the crust and upper mantle structure along a 535 km profile across the Demerara Plateau and a 427 km profile across the margin $\sim$175 km to the south.

The models show that crustal velocities are generally lower than 7 kms^{-1}, which indicates that the margin is not underplated. This result is supported by the MCS data which contain no distinctive seaward-dipping reflectors. Furthermore both profiles show abnormally thin oceanic crust with combined oceanic layer 2 and 3 thicknesses of the order of 3.5-5 km. Upper oceanic crustal basement surface roughness analysis suggests that initial spreading proceeded at a relatively slow rate. These results imply that there was no significant magmatism at the

margin pre- or during rifting and that there was a low magma budget post-rift.

The models also suggest two contrasting margin structures separated by ∼175 km along strike. Whilst the northern profile reveals continental crust thinned over a wide region of over 300 km, the southern profile reveals rapid thinning over a 60 km zone, which suggests that the northern profile is a non-volcanic rifted margin, whilst the southern profile was rifted with a large component of shear motion.

The margin segmentation suggested by these results has important implications for the equatorial Atlantic and may provide structural evidence for a two phase opening in the Demerara Plateau region in which initial rifting is followed by shearing as a result of changes in orientation of plate motion.