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Continental break-up of the Newfoundland rifted margin (ODP Leg 210): L. Cretaceous seafloor formed by exhumation of subcontinental mantle lithosphere and the transition to seafloor spreading

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The results of ODP Leg 210 shed light on the processes of final continental break-up to form oceanic crust. Drilling of the distal Newfoundland margin at Site 1277 recovered part of the transition between exhumed sub-continental mantle lithosphere and N-MORB volcanism related to the initiation of sea-floor spreading. Subcontinental mantle lithosphere was recovered near the crest of a basement high near magnetic anomaly M1 (late Albian?). Serpentinized spinel harzburgite, with subordinate dunite and minor gabbroic intrusives are capped by foliated gabbro cataclastite, interpreted as a seafloor extensional detachment. The serpentinised harzburgite represents depleted sub-continental mantle lithosphere, exhumed to create new seafloor within the ocean-continent transition. The detachment was eroded, producing multiple mass-flows, dominated by clasts of serpentinite and gabbro in a lithoclastic and calcareous matrix. Basaltic lavas were erupted spasmodically, mainly as sheet flows, with subordinate lava breccia, hyaloclastite and possible pillow lava. The sedimentary-volcanic succession and the exhumed mantle lithosphere experienced later-stage, high-angle extensional faulting. Chemical analysis of representative basalts (by XRF and ICPMS) reveals a N-MORB (normal-ocean ridge basalt) compositions. The MORB was produced by relatively high-degree-melting of a fertile mantle source. The basalts also exhibit a distinct negative Nb anomaly on MORB-normalized plots that possibly reflects "contamination" sub-continental mantle lithosphere. Mantle lithosphere was exhumed to the seafloor, faulted to produce peridotite ridges, and then ruptured as large volumes of basaltic magma upwelled, initiating "normal" seafloor spreading.