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Asymmetrical crustal structure across the non-volcanic Nova Scotia-Morocco continental margin conjugates

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The Nova Scotia rifted continental margin is located between the volcanic US East Coast margin to the south and the non-volcanic Newfoundland margin to the north. The abrupt change in character of the East Coast Magnetic Anomaly (ECMA) coinciding with the termination of seaward dipping reflectors (SDR) and syn-rift volcanism, suggests that the central and northeastern segments of this margin are primarily non-volcanic. According to observations on several cross-margin refraction and reflection profiles, the central profiles, SMART-2 and NovaSpan 1400, are the southernmost profiles that show non-volcanic characteristics. Over the non-volcanic region of the margin, continental crust thins within a wide zone (> 180 km) until rupture. Oceanic crust is thinnest in the NE (4–5 km thickness) and thickens to $\sim$ 6 km on the central margin. Between thinned continental and oceanic crust, a wide continent-ocean-transition (COT) zone is characterized by a pervasive layer with velocities of 7.3–7.9 km/s that we interpret as partially serpentinized mantle. Above it, an upper crustal layer with velocities of 5.1-6.0 km/s is observed but was not well sampled due to sparse receiver spacing in the older data (SMART-1,2). However, a recently acquired refraction profile (OETR-2009), along a coincident deep reflection profile (NovaSPAN-2000) to the northeast of SMART-1, has much denser ocean bottom seismometer (OBS) spacing (2.5 km) within the COT that gives greatly improved resolution. It also provides an improved conjugate pair with the SISMAR-4 profile on the Morocco margin. Such improvements in data coverage allow re-interpretations of crustal structures using revised plate reconstructions.

Based on the similarity between the velocity models from OETR-2009 and SMART-1, we now interpret the seaward half of the upper transitional crust as probable oceanic crust and do not see evidence for exhumed mantle. The Moho is related to a strong crustal reflection observed on reflection profile NovaSPAN-5100 transecting diagonally over the region of partially serpentinized mantle. As this reflection may also be interpreted as the base of the continental crust, a 3-D mapping of it along several MCS profiles is underway, which may help to discriminate between the two possible crustal interpretations.

A modification of previous plate reconstruction poles is required to avoid overlapping of salt structures at minimum closure of the margin. The COB on the Moroccan profile is also moved landward by $\sim$70 km to avoid overlapping of extended continental crust. The new COB is coincident with a landward dipping reflection intersecting basement on a nearby MCS profile. With these modifications, we determined the location of maximum closure by restoring extended continental crust to its original thickness. This result shows a marked asymmetrical breakup with most extended continental crust and all serpentinized mantle remaining on the Canadian side. Although the thickness of continental crust is similar across the conjugate at breakup, the oceanic crust on the Morocco margin is much thicker than its conjugate, which may indicate a ridge jump or post-rift volcanism.