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Deep structure of the ocean-continent transition in the southern Iberia Abyssal Plain from seismic refraction profiles: Ocean Drilling Program (Legs 149 and 173) transect

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Abstract. We present a wide-angle seismic refraction study of an 80x40 km region of the southern Iberia Abyssal Plain, south of Galicia Bank. An intersecting grid of two E-W and four N-S wide-angle reflection/refraction profiles is used to define variations of the basement velocity structure within this unusually wide ocean-continent transition (OCT). These structures can be systematically linked to variations in acoustic basement morphology and to results from Ocean Drilling Program (ODP) boreholes. Lateral changes in the velocity structure of the basement occur abruptly over distances of ~20 km where complex variations may be found. Thinned upper continental crust, 2-5 km thick with velocities of 5.0-6.6 km/s, is limited to a series of N-S fault blocks immediately south of Galicia Bank. This crust is underlain by a high-velocity layer (7.3-7.9 km/s) of weakly serpentinized (i.e., 0-25%) peridotite, which exists throughout the eastern part of the survey area. Basement within the OCT appears to consist dominantly of a broad region of exposed upper mantle that has been serpentinized heterogeneously both vertically and horizontally. In the southeast sector of our survey where basement topography deepens and becomes subdued, continental fault blocks are absent; instead, basement contains an upper layer of more pervasively serpentinized (i.e., 25-45%) peridotite that is ~2 km thick. This layer is characterized by low velocity at the top of basement (4.2 km/s) that increases rapidly with depth, and it probably corresponds to a seismically unreflective layer, previously identified in reflection profiles to the south of our survey. In the western section of our survey, beneath a series of elevated basement ridges, velocities are reduced within both the upper basement layer (3.5-6.0 km/s) and lower layer (6.4-7.5 km/s). These changes suggest that both upper and lower layers have become more highly serpentinized (with values of 60-100% in the upper layer and 25-45% in the lower layer) probably during the last stages of rifting and immediately before formation of oceanic crust. A normal or slow spreading oceanic crustal structure is not found within the survey region. Thus it appears that the onset of seafloor spreading occurs in the region west of the peridotite ridge sampled at ODP Site 897 and east of the J magnetic anomaly.

1. Introduction

Delineating the nature of crustal variations across passive continental margins is fundamental to our understanding of how the uppermost lithosphere deforms under extension. This information is best obtained from joint analysis of coincident deep multichannel seismic reflection and wide-angle reflection/refraction profiles, across margins where the extensional fabric within the crust has not been significantly modified or obscured by large-scale synrift volcanism. Results of previous studies primarily in the North Atlantic have shown a range of extensional styles. For instance, reflection and wide-angle reflection/refraction profiles across Goban Spur (GS in Figure 1) [*Peddy et al.*, 1989; *Horsefield et al.*, 1994] define a consistent pattern of seawardly progressive, homogeneous thinning of the continental crust over a distance of at least 100 km. These observations are compatible with models of pure shear extension [*McKenzie,* 1978] and are consistent with observed variations in heat flow [*Louden et*

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