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Petrophysical models of high velocity lower crust on the South Atlantic rifted margins: whence the asymmetry?

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Lower crustal bodies with high seismic velocity (Vp > 7km/s) underlie seaward-dipping reflector wedges on both margins of the South Atlantic, as on many other volcanic rifted margins worldwide. A comprehensive geophysical study of the South Atlantic margins by Becker et al. (Solid Earth, 5: 1011–1026, 2014) showed a strong asymmetry in the development of high-velocity lower crust (HVLC), with about 4 times larger volumes of HVLC on the African margin. That study also found interesting variations in the vertical position of HVLC relative to seaward-dipping reflectors which question a simple intrusive vs. extrusive relationship between these lower- and upper crustal features. The asymmetry of HVLC volumes on the conjugate margins is paradoxically exactly the opposite to that of surface lavas in the Paraná-Etendeka flood basalt province, which are much more voluminous on the South American margin.

This contribution highlights the asymmetric features of magma distribution on the South Atlantic margins and explores their geodynamic significance. Petrophysical models of the HVLC are presented in the context of mantle melt generation, based on thickness-velocity (H-Vp) relations. These suggest that the greater volumes and average Vp values of HVLC on the African margin are due to active upwelling and high temperature, whereas passive upwelling under a thick lithospheric lid suppressed magma generation on the South American margin. The contrast in mantle upwelling rate and lithospheric thickness on the two margins predictably causes differential uplift, and this may help explain the greater accomodation space for surface lavas on the South American side although melt generation was strongest under the African margin.