DEPTH-DEPENDENT EXTENSION, TWO-STAGE BREAKUP AND CRATONIC UNDERPLATING AT RIFTED MARGINS

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Uniform lithospheric extension predicts basic properties of non-volcanic rifted margins but fails to explain other important characteristics. Significant discrepancies are observed at type I margins (such as the Iberia/Newfoundland conjugates), where large tracts of continental mantle lithosphere are exposed at the sea floor, and type II margins (such as some ultrawide central South Atlantic margins), where thin continental crust spans wide regions below which continental lower crust and mantle lithosphere have apparently been removed. Neither corresponds to uniform extension. Instead, either crust or mantle lithosphere has been preferentially removed. Using dynamical models, we demonstrate that these margins are opposite end members: in type I, depth-dependent extension results in crustal-necking breakup before mantle-lithosphere breakup and in type II, the converse is true. These two-layer, two-stage breakup behaviours explain the discrepancies and have implications for the styles of the associated sedimentarybasins. Laterally flowing lower-mantle cratonic lithosphere may underplate some type II margins, thereby contributing to their anomalous characteristics.