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Tectonic influences on the development of the continental crust

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The recent increase in the amount and the quality of geophysical and geochemical data of the continental crust makes it timely to look again at the processes that shaped its evolution[1]. The thickness of continental lithosphere can be constrained by Rayleigh wave tomography to determine the temperature as a function of depth, and fitting a geotherm to temperature estimates greater than 1173 K at depths >100 km[2]. Contiguous zones of relatively thick (>170km) and thin lithosphere have been mapped out across Pangea. The former occurs as a continuous arc at the centre of Pangea and matches up with relatively old terrains where diamonds are recovered. In contrast the Pan-African and Brasiliano belts, marked by high degrees of crustal reworking in South America, Africa and India, are now above zones of relatively thin lithosphere (<170km). In some areas these belts record histories of as much as 1 Ga of repeated granitisation similar in the range of ages to certain early Archaean terrains and very different from recent continental margin orogenic systems. These orogenic belts impose a strong anisotropy on continental crust, characterized by thrust belts; crustal scale, penetrative fabrics; and steep, continental scale shear zones. Seismic data allow isotropic and anisotropic regimes to be identified in the crust and uppermost mantle, and illuminate the extent to which rifts are guided by pre-existing structures. Phanerozoic rift basins preferentially form in these areas of crustal anisotropy, and are not present in regions of the thickest lithosphere. Yet ~25% of the present continental surface is covered by basins not clearly linked to rift systems, that apparently occur over a wide range of lithospheric thickness, and are referred to as cratonic basins. This dichotomy between the influence of pre-existing structure and the formation of rift and cratonic basins is recorded in reflection seismic data from Gondwana. Major structures reactivate and influence rift basin formation and continental break up, but they remain passive during the formation of cratonic basins, presenting insight in to the formation processes of the latter. We re-evaluate the evolution of the continental crust on the basis of the features identified above and relate them to established models of cratons, mobile belts, accretionary and collisional orogens.

References:

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