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Mode of thickening of weak Precambrian lithospheres: insights from field observations

D. Gapais (1), F. Cagnard (1), J.P. Brun (1)

(1) Géosciences Rennes, UMR 6118 CNRS, Université de Rennes 1, France

The question of uniformity between Precambrian tectonics and modern- plate tectonics remains an important subject of debate. One central question concerns the modes of convergence-induced thickening and the relative role of body and boundary forces during compression.

Gravity is often considered as playing a major role during Archaean tectonics, with important vertical motions due to inverse density profiles (sagduction of greenstones belts and (or) rising of gneiss domes). The transition between the Archaean and the Paleoproterozoic is in particular marked by a strong reduction of greenstone and komatiite production, combined with cratonisation and decrease in crustal growth processes. Several works have associated these features to the transition to modern tectonics involving rather rigid plates and lithospheric-scale thrusting.

Archaean domains show some specific characters, such as the occurrence of TTGs and greenstones belts arranged in dome and basin geometries. Associated strains commonly attest to important and rather distributed vertical stretching. Associated metamorphic conditions are generally of HT-LP type. Except the greenstone belt specificity of the Archaean, many younger Proterozoic belts show rather similar deformation and metamorphic patterns, with in particular (1) widely developed domains showing HT-LP-MP metamorphic conditions and important magmatism, (2) rare evidence for exhumation of HP units, (3) major sub-vertical shear zones associated with steeply dipping stretching lineations, (4) regional-scale fold patterns defining dome and basin structures, and (5) absence of large-scale thrusts and detachments.

Field observations emphasize that the critical factor that controlled the bifurcation between “old-type” and “modern-type” deformation belts is the associated primary thermal state. Weak and dominantly ductile lithospheres, like juvenile ones, are ex-

pected to favour distributed horizontal shortening and vertical motions, irrespective of their age; whereas strong lithospheres favour strain localisation along gently dipping lithospheric-scale shear zones. We therefore propose that the evolution toward modern thickening processes has been gradual in space and time, probably rather long-lasting, and not strictly attached o the Archaean-Paleoproterozoic transition.