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Wide hot orogens and flow regimes of weak lithospheres: a Precambrian perspective

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Macro- to regional-scale structural analysis of the tilted, late Archean Dharwar craton (India) combined with published studies of other Precambrian provinces is used to address the tectonic and mechanical significance of crustal-scale strain and shear zone patterns of wide Precambrian orogens. The main results may be summarized as follows.

Newly formed / rejuvenated continental lithospheres lack stiff mantle and respond to shortening by flowing laterally against previously stabilized continental nucleus. Crustal-scale shear zones do not accommodate large displacement and do not play a major role in the deformation of weak lithospheres. They contribute to smoothing out of late strain heterogeneities between differentially flowing rock masses, flow being also noticeably partitioned between supracrustals and granitoids due to their contrasted density and strength. Crustal-scale shear zone patterns in weak lithospheres therefore primarily reflect the bulk strain and kinematics of wide hot orogens instead of large displacements between stiff blocks.

Horizontal, plane strain deformation is an end-member orogen development mode in an extremely weakened lithosphere that cannot sustain thickening. In the framework of a sustained crustal thickness, lower crustal, horizontal longitudinal flow absorbs / compensates transpressive thickening of supracrustals in the thin upper brittle crust. Such hot orogens are typified by HT-LP regional metamorphism and slow and nearly

isobaric cooling paths.

Three-dimensional strain deformation would be the dominant orogen development mode in a lithosphere sustaining moderate, distributed thickening. This orogen development mode involves alternation of crustal-scale transpressive deformation belts with vertical elongation and domains of flat fabrics with orogen-parallel elongation. Such hot orogens record Barrovian metamorphism and slow, non-isobaric retrograd P-T-t paths.

A large volumetric component of strain is expected to take part in the development of hot Precambrian orogens due to voluminous, syn-orogenic juvenile magmatic accretion. Very slow cooling and denudation of these wide orogens is most likely due to erosion only. The post-orogenic thermal history and preservation of wide hot Precambrian orogens are controlled by the lithospheric root formed under the orogens during the latest stages of deformation and magmatic accretion.