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MOBILE CRATONS, SUBCRETION TECTONICS AND THE FORMATION OF TTGs IN THE ARCHAEAN

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The formation Archaean cratonic lithosphere and TTG (Tonalite-Trondjemite-Granodiorite) suites is not well understood, in part because the style of global tectonics active at that time is uncertain. The non-plate tectonic hypothesis for formation and evolution of continents we test in this study involves (i) intense magmatism above mantle upwellings in an unstable, single plate regime to form cratonic nucleii and (ii) imbrication and anatexis of crust-dominated oceanic lithosphere at convergent margins driven by mantle flow, with build-up and thickening of cratonic keels by collisions. We use 2D numerical geodynamic models to investigate whether differential motion between the convecting mantle and cratonic keels can induce horizontal motion of a craton to form an accretionary orogen. Using the convection code StagYY (featuring melting and crustal production), we attempt to model a self-consistent subcretion/imbrication of oceanic crust pushed by a pre-imposed craton. Initially, 30 km thick basaltic crust, accompanied by 20 km thick suboceanic lithosphere, is introduced on both sides of the 230 km thick cratonic lithosphere, with an initial potential mantle temperature of 1750 K. The domain is divided into 64 vertical cells and 128 lateral cells corresponding to 660 km in depth and 2000 km in length. Our models show that a 230 km thick cratonic block can be mobilized by the traction generated by imposed sublithospheric mantle flow of 1 cm/yr. Depending on the reference viscosity of the mantle we use, cratonic lithosphere can experience deformation on the margins (10ˆ20 Pa s) or alternatively, with higher viscosity (10ˆ21 Pa s) mantle forcing helps imbricate and subcrete oceanic crust into the mantle as the continent advances. At 40-60 km depth, basaltic oceanic crust undergoes a phase transition, which corresponds to its eclogitization. These denser portions of the crust start to peel away, which leads to localized thinning of the oceanic crust on the offshore parts. Follow-up studies will focus on: the reworking of the cratonic lithosphere above an “Overturn Upwelling Zone (OUZO)”; dependence of structural style in the accretion zone on various parameters.