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# Continent-continent collision styles and exhumation mechanisms as function of thermo-rheological profile and convergence rate.

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We study various scenarios of continent-continent collision as function of thermo-rheological profile and convergence rate. We use a visco-elasto-plastic numerical model that accounts for phase changes, erosion and deposition. It appears that assumption of quartz flow for the crust and of dry olivine flow for the mantle ("jelly-sandwich" rheology) rends continental subduction both possible and stable during the first 10- 15Myrs for initial convergence rates of 40-60mm/yr. On the contrary, models based on the assumption of strong crust but weak mantle "crème-brûlé" rheology fail to reproduce tectonically plausible evolution. Account for metamorphic phase changes reveals strong dependence of subduction style and exhumation processes on the rheology of UHP rocks. Specifically, weak eclogite rheology does not change the subduction style but eases exhumation, whereas strong eclogite rheology induces compressional instabilities and makes exhumation more difficult. The experiments suggest that depending on thermo-rheological parameters, plate convergence can be accommodated by four distinct mechanisms: (1) stable subduction, shortening in (2) pure shear mode or (3) folding, (4) Rayleigh-Taylor instabilities. Stable, "oceanic type" subduction associated with UHP exhumation occurs in case of cold lithospheres (TMoho $< 550°$C) and needs high initial convergence rates ($>$ 4-5 cm/yr). Shortening (pure shear or folding) becomes dominant mechanism when TMoho $> 550°$C or convergence rates are lower than 2 cm/y. Pure shear thickening is important in all cases of hot lithospheres (TMoho $> 650°$C). Large scale folding is favoured in case of TMoho=500-650°C and is more effective in case of mechanical coupling between crust and mantle (e.g. strong lower crust). Raleigh-Taylor instabilities overcome other mechanisms for "crème-brûlé" rheology or for very high values of Tmoho ($> 800°$C).