Geodynamic processes during heroic collisions revealed from geochemical, microstructural and geodynamic information

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Large peridotite massifs scattered along the 1500km length of the Yarlung–Zangbo Suture Zone (southern Tibet, China), the major suture between Asia and Greater India, provide an outstanding natural laboratory to track multiple lithosphere evolution events throughout the complex history of this major collisional tectonic terrane. The massifs reveal: a sequence of repetitive docking of distinct lithospheric mantle domains over at least 250 My; repeated metasomatic and magmatic episodes that can be distinguished with detailed geochronology; mineral phases that indicate metamorphism under the conditions of the Mantle Transition Zone (MTZ); others that require a super-reducing environment over a range of depths; and microstructural analysis of chromites with fine-grained inclusions of olivine (inverted wadsleyite), diopside and silica, indicates the first evidence for deformation by dislocation creep in the MTZ, an important consideration for interpreting seismic signals [1,2].

Re-Os-isotope data suggest that the subducted mantle consisted of previously depleted subcontinental lithosphere, dragged down by a younger subducting oceanic slab. Thermomechanical modeling shows that roll-back of a (much later) subducting slab would produce a high-velocity channelized upwelling that could exhume the buoyant harzburgites (and their chromitites) from the Transition Zone in <10 Myr. This rapid upwelling, which may explain some characteristics of the diamonds, appears to have brought some massifs to the surface in forearc or back-arc basins, where they provided a basement for oceanic crust. This model can reconcile many apparently contradictory petrological and geological datasets. It also defines an important, previously unrecognized geodynamic process that may have operated along other large suture zones such as the Urals.

These nano- to micro-scale to global observations using geochronology, geochemistry, mineral microstructures and geodynamic modelling are starting to fill in the huge 4D sudoku that encompasses the complex evolution and deep architecture of such large-scale (heroic) collision events. This may allow identification of analogue ancient events lurking in the geological record.

[1] Griffin et al., 2016., *J. Petrology*, 57, 655-684.

[2] Satsukawa et al., 2015. *Scientific Reports* 5, 16484, doi: 10.1038/srep16484