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Heterogeneous deformation in the Cascadia convergent margin and its relation to thermal gradient (Washington, NW EEUU)

G. Booth-Rea (1), D. Klaeschen (2), I. Grevemeyer (2), T. Reston (3)

(1) Departamento de Geodinámica and Instituto Andaluz de Ciencias de la Tierra, Universidad de Granada-CSIC, Granada, Spain, (2) IFM-GEOMAR, Leibnitz Institute of Marine Sciences, Kiel, Germany, (3) School of Geography, Earth and Environmental Sciences, University of Birmingham, Birmingham, UK (gbooth@ugr.es)

We combine structural balancing with thermal and strength-envelope analysis of the Cascadia accretionary wedge to determine the influence thermal gradient has on the structure of the prism. Extension of the thermal gradient to the top of the oceanic crust shows that the base of the prism reaches temperatures between 150-200ºC and 250-300 ºC at the deformation front and the base of the upper slope, respectively. This high thermal gradient favours the development of a vertical strain gradient, which is accommodated by heterogeneous deformation. This process produces two overlying thrust wedges, a basal duplex and an overlying landward- or seaward-vergent imbricate stack. The thermal structure also influences the deformation distribution and structural style along the shortening direction. Initiation of plastic deformation below the base of the Cascadia upper slope affects the wedge geometry, changing its taper angle and favouring the development of a mid-crustal duplex structure that propagates seaward as a dynamic backstop. Uplift related with this underplating process is accommodated by deep incision of submarine canyons, sliding and normal faulting in the upper slope. Heterogeneous deformation is accommodated by the development of lateral ramps separating landward-vergent from seaward-vergent domains along the margin. Landward-vergent areas accommodate 30-40 % shortening at the front of the wedge, whilst in the narrower and thicker seaward-vergent segments shortening occurs mostly by underplating below the upper slope.