Structural changing control of potassium saturated smectite at high pressures and high temperatures: application for subduction zones

L.C.Carniel[1], R.V.Conceição[1,2], N.Dani[1], V.F.Stefani[2]

[1]Instituto de Geociências, UFRGS, Porto Alegre – RS, Brasil.
larissa.colombo@ufrgs.br
rommulo.conceicao@ufrgs.br
norberto.dani@ufrgs.br
[2]PGCIMAT, UFRGS, Porto Alegre – RS, Brasil.
vicentestefani@hotmail.com

The lithospheric mantle is characterized by pressure ranges from ~ 2.0 and ~ 7.7 GPa and a specific mineralogy and composition. This region can be re-hydrated and re-enriched in incompatible elements (*e.g.* potassium) through subduction processes that bring pelagic material, composed of clay minerals and other phyllosilicates, together with the hydrated subducted oceanic slab. A mass transfer from the subducted slab plus sediments into the mantle wedge occurs primarily through the release of aqueous fluids produced by devolatilization of hydrated minerals. In this context, smectite stands out as one of the most important minerals responsible for re-enriching the lithospheric mantle with water and incompatible elements when its structure is destabilized. By pressure and temperature increasing smectite can lose its interlayer water, at the same time that it transforms into a mixed-layer Illite-Smectite, followed by illite crystallization. In this condition of dehydration, and with increasing burial, reactions evolve in transforming illite to phengite, a variety of muscovite which plays an important role as host of potassium in subducted oceanic crust. In this work, we verified the structural and compositional behavior of K saturated smectite under pressure from 2.5 to 4.0 GPa and at different temperatures (400ºC to 700ºC). . X-ray diffraction, scanning electron microscopy (SEM), infrared spectroscopy (FTIR) and transmission electron microscopy (TEM) results suggest that under the pressure of 2.5GPa, which is about 75km depth in the mantle, and at around 500ºC smectite transforms into phengite, while under the pressure of 4.0GPa, equivalent to 120km depth, the same transformation occurs at 400ºC. These results contribute significantly to understanding how pelagic sediment dehydration occurs in a subduction process, as well as the behavior of smectite under the influence of increasing pressure and temperature.

Structural evolution of the retrowedge, SE Canadian Cordillera

Sharon D. Carr[1*] & Philip S. Simony[2]

[1]Carleton University, Ottawa Carleton Geoscience Centre, Department of Earth Sciences, scarr@earthsci.carleton.ca
[2] University of Calgary Department of Geoscience, pssimony@ucalgary.ca

In the southern Canadian segment of the Cordilleran orogen, a Middle Jurassic "small cold accretionary orogen [1]" evolved into a doubly vergent, "warm medium-sized orogen [1]" during Cretaceous to Eocene oblique convergence. In some orogens (e.g. Appalachians, Caledonides, Himalaya) a megathrust sheet or crystalline sheet with basal shear zone overrode the foreland obscuring the relationships between coeval Internal and External structures. However, in the ~400 km wide, east-verging, retrowedge of the southern Canadian Cordillera, the Internal zone is situated to the rear of the External zone preserving evidence of structural and kinematic linkages. The External Rocky Mountains and Foothills comprise three major east-verging, Late Cretaceous to Eocene, thin-skinned, piggyback thrust and fold systems, with ~180 km of shortening, that root westward into a basal décollement. The Western Internal zone is characterized by tracts of metamorphic rocks and metamorphic core complexes (e.g. Kettle, Okanagan, Priest River and Valhalla), some of which are basement-cored domes (e.g. Frenchman Cap, Thor-Odin, and Spokane). They have a downward-younging progression of Late Cretaceous to Eocene metamorphism and deformation in infrastructural flow zones characterized by transposition foliation, migmatites, flow folds and 1-7 km thick shear zones. Nested between the External and Western Internal zones is a relict ~100-200 km wide Early Cretaceous orogen, that predated emplacement of ca. 100 Ma plutons. The geology and architecture of the Western Internal and External zones can be explained by progressive development of major Late Cretaceous to Eocene shear zone systems in the Internal zone that can be directly linked with coeval thrust and fold systems in the External zone. The linkage was via Late Cretaceous activation and Late Cretaceous to Early Eocene reactivation of the 150-200 km-wide central portion of the Rocky Mountain basal décollement that lies beneath and translated the intervening Early Cretaceous orogen. During orogenesis, the craton was progressively underthrusting the developing retrowedge. Thickening in the retrowedge insulated the underlying rocks of the incipient Internal zone, thus resulting in a mechanism of progressive heating, weakening and localization of the basal shear zone. At the base of the wedge, cooler stiffer rocks lay to the east of the Internal zone, at each stage, acting as an indentor. Thus, the development of a basal shear zone was coupled with flow of the hot mass of the Internal zone up and over an indentor, strain softening of it, and incorporation of it into the wedge in successive stages. Our general model is consistent with those of Beaumont et al. (2010) demonstrating the lateral transition from stiff cool crust to hotter weaker crust where the stiff cool crust acted as an indentor, with development of a ramp at the edge of the indentor, and flow up and over the ramp. In the latest stages of Early Eocene shortening, extensional shear zone systems were localized on the margins of tectonothermal culminations. Motion of deep-seated décollements beneath some of these culminations may have contributed to their doming. Crustal shortening ended at ca. 52 Ma due to a change in tectonic setting to that of a transtensional tectonic regime, coinciding with the end of thrusting in the External thrust belt and with crustal-scale extension in the Western Internal zone.

[1] Beaumont *et al.* (2010) *CJES* **47,** 485-515.