The non-steady-state behavior of subduction zones: Slab dynamics and fluid fluxes

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Observations of the kinematics of subduction zones and their relation to both geophysical characteristics of the subducting and overriding plate, and seismic tomographic images of slabs, have demonstrated the intrinsically non-steady-state and fundamentally 3D behavior of subduction zones. Our understanding of the dynamic evolution of subduction zones depends on deciphering the physical effects of fluid transport and magma generation on the rheology of the mantle wedge, and the subducting and overriding plates. In recent years, these effects have been studied in numerical and laboratory models, and have shown that rheology can have a first order effect on all stages of subduction from initiation through long term evolution to slab detachment ([1] and references therein).

Recent studies have shown that subduction inititation requires a weak mantle wedge corner, either sustained by high strain-rates and a non-Newtonian viscosity and/or fluid release into the mantle wedge that weakens the dense, overriding plate lithosphere, causing small-scale convection to erode into the overriding plate from below. This process may play a fundamental role in forming a weak mantle wedge beneath the volcanic arc necessary for stable long-term subduction.

Once subduction initiation transforms into stable subduction, 2D models show that trench migration is strongly dependent on slab strength and coupling to the overriding plate; even in the absence of trench migration slab dip and geometry constantly change throughout 10-100 million years of subduction. 3D models also show that slab geometry and mantle flow towards and along the the slab depends on along-strike variation in slab length, duration of subduction and along-strike variation in slab dip.

Because fluids and magma play such an important role in subduction dynamics and carry geochemical tracers, observational studies that link geophysical and geochemical signatures, and numerical models that fully couple solid and fluid flow processes promise to provide fundamentally new understanding of the 3D geometric character and time-scale of mantle flow in subduction zones.

[1] Billen, M. I. (2008) *Annu Rev Earth & Planet Sci.* **36**, 325-356.

Characterization of dike swarms spatially associated with southeastern Dawson Range porphyry-like and epithermal base-metal-bearing silver-gold vein systems, Yukon Territory (Canada)

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The Dawson Range in the Canadian Cordillera hosts porphyry-like and base metals-Au epithermal veins deposits that belong to Tintina Au Province. Mineralization is spatially associated with Early to Late Cretaceous dikes of the Mount Nansen and Carmacks groups, respectively that intruded the Devonian-Permian Yukon-Tanana Terrane.

Dikes of the Dawson Range display a fine-grained groundmass, and the texture varies from equigranular, porphyritic to intergranular. Dikes range from felsic to mafic bodies with the following mineral assemblages: qz-fs; qz- fs ± hb; fs-hb-bt ± qz ± cpx, fs-qz-hb-bt, hb-fs ± qz; hb-fs ±qz ± opx. Dikes are magnetite-titanite-bearing bodies, thus indicating their weakly oxidizing. Quartz-feldspars dikes usually display rounded and broken phenoclasts thus indicative of remelting, abrasion, and fluidization.

Dikes are volcanic arc rocks, mainly acid (>63wt % SiO_2), dacitic to rhyolitic in composition mainly, sub-alkaline and especially high- K, calc-alkaline. The magmas evolved by fractionation of Al, Ca, Ti, Mn, Fe, Na, P, Mg, Sr, Ni, and Cu contents, thus consistent with crystal fractionation of phenocrysts noted above. Dikes are depleted in HREE +Y relative to LREE, thus indicating a garnet –bearing source and adakite-like compositional feature, further supported by Sr (Av=465.7ppm), Y(Av= 11.6 ppm), Yb (Av= 1.35 ppm) and Sr/Y (Av= 26.23 ppm).