What is the role of serpentine in subduction and release of H2O?

Questions: Serpentine has 13% H2O and is known to be present anywhere that mantle and water are juxtaposed. Small amounts of serpentine have enormous influence on the water budget in the subducting slab and the mantle wedge. Unknowns include the extent of serpentinization of subducting slabs and the chemical signature of serpentine dehydration in arc magmas.

Thematic – study serpentinization fronts and their associated fluxes in exhumed mantle wedge terranes, particularly carbon since most such terranes are heavily carbonated. Modelling of migration of serpentine hydration front above the slab.

Primary Sites – multidisciplinary studies of outer rise faulting and hydration, involving water column surveys for low-T hydrothermal venting sources, natural seismicity, seafloor topography-gravity-magnetic mapping, deployment of OBSs for active source and teleseismic imaging studies, EM studies – designed with possible anisotropy in mind.

What is the relationship between dehydration reactions and the release of fluids and/or melts from the slab?

There was a strong feeling that this question should be rephrased as *devolatilization*. Modeling of dehydration reactions down to ~120km depth is fairly mature, but these need to be ground-truthed with field studies of fossil subducted slabs, and work should be extended to greater depths (120km down to transition zone @ 410 km). Also need to understand relative importance of porosity, cracking, channeling and diapirism in delivering volatiles from slab to mantle wedge where melting takes place.

Thematic – high-pressure lab experiments at equivalent depths >120 km. New experiments at all pressures to determine which elements are fluid mobile, and scale to fluxes. Experiments on solubility of minerals in subduction fluids is critical to determine slab-to-mantle element fluxes. Modelling of deep dehydration and hydrous mineral transport.

Primary Sites – how well do we know the input fluxes into trenches? Site-specific integration of IODP data for sediment cores (H2O and carbon) and improved studies of full sections of altered oceanic crust (esp. for carbon). What geophysical studies can be conceived to distinguish crack flow from channellized flow from mantle diapers – as opposed to simple porous flow through laminar-corner-flow mantle?

What are the melting reactions and loci and melt pathways from the mantle wedge to the surface?
What are the fluxes of volatiles delivered to the mantle from the subducting slab and how are fluids and melts focused to the volcanic front?

Magmas are generated in the hottest and most fluid-rich parts of the mantle wedge predicted to occur over wide regions. How is melt then transported upward and ultimately focused beneath individual volcanic centers? Associated with this magma transport are element fluxes that are the return paths for various geochemical cycles. Element fluxes in subduction zones are critically dependent on magma generation and arc crustal growth rates (sampling & geochronology).

Thematic – timescales, how quickly do fluids/melts transit mantle wedge to arrive at volcanic centers (U-series)? Experimental studies of role of other volatiles (F, Cl) on the melting of the mantle, mantle deformation, and mineral phase stability. More data on element solubility in subduction zone fluids. Laboratory studies on seismic velocity, attenuation, etc – in order to better interpret geophysical tomographic images. Modelling of magma migration between regions of melting and base of arc volcanoes.

Primary Sites – detailed accounting of magma production (chronology) and CO2 emission in the "capture area" of a single volcano, or arc segment several volcanoes wide. A community 3D experiment to determine sources and distribution of deep long-period seismicity and its relation to melt & fluid delivery to volcanoes, high resolution maybe 3-4 volcanoes wide. Could have impact in other GeoPRISMS areas. Improved earthquake locations in 5-40 km depth region, relationships to ETS events, etc. Should be combined with an additional large-scale teleseismic & EM experiment to image outer rise, slab and mantle wedge under the same area.

How do surface processes and climate modulate volatile inputs and outputs at subducting margins, and vice versa?

Input fluxes for many volatile elements (H_2O, CO_2, prob Cl) are likely not influenced by presence/absence or amount of sediment; other elements (REE, Th) are strongly influenced by amount of sediment subducted.

Most discussion involved role of CO_2 delivery from arc volcanoes, and its possible influence on climate variations (over various timescales). We know very little about the CO_2 budget through subduction zones and how this impacts short- and long-term climate evolution. Subducted CO_2 is at least 10X more than estimated volcanic CO_2 – where is the remaining 90%? Passively degassed? Trapped by groundwaters? Subducted into deep mantle?

Thematic – modeling of relationships between glaciation/deglaciation, volcanic activity, CO_2 emission, climatic impact. How past climate records related to past volcanic activity – magma production.

Primary Sites – multidisciplinary study(s) of an outer rise site? - mapping of an exhumed fossil mantle wedge? - of mantle wedges with different tectonic settings along-strike of a subduction zone in 3D? - determination of full (active + passive) CO_2 outputs from specific volcanoes?