

IRS fluids revisited

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In his 1981 compendium, *Orogenic Andesites and Plate Tectonics*, Jim Gill coined the phrase "IRS Fluids" to describe the Incompatible element, Radiogenic strontium and Silica-enriched fluids that emanate from the subducting plate, drive melting in the mantle wedge, and emerge dissolved in erupting arc magmas. Such fluids have also been described as slab components, aqueous fluids, sediment melts and supercritical fluids, often with cameleon-like trace element compositions. The explosion in recent years of relevant laboratory experiments and water measurements in arc magmas has led to a more precise description of the chemistry and origins of subduction-zone fluids.

The traditional approach to calculating trace element compositions of fluids/melts is from the equations of mass balance, using estimates of the bulk composition, the fluid fraction and partition coefficients of individual minerals. In subducting assemblages, this approach has not been tractable, given the variety of lithological types and trace element fluxes entering a subduction zone, and the array of mineral phases and fluids that may exist along different P-T paths. Instead, we focus here on components that will depend on solubility relationships, and not bulk composition: H₂O and LREE (light rare earth elements); and explore how they vary with temperature. Low temperature (< 600°C) subduction-zone fluids will be H₂O-rich, with low solute contents (< 10 wt%), and low solubility for LREE-containing phases (allanite and monazite). High temperature (> 800°C) melts or supercritical fluids will be solute-rich (< 25 wt% H₂O), and have high LREE contents (> 100 ppm). Thus, H₂O/Ce in fluids will decrease by several orders of magnitude (from > 10,000 to < 1000) as temperature increases across this relevant range, making this ratio a potentially powerful proxy for slab fluid temperatures. These inferences are supported by wide variations in H₂O/Ce observed in least degassed melt inclusions and their magma hosts, from > 5,000 in Tonga and Marianas magmas, to < 1500 in Mexican and Costa Rica magmas, consistent with the different thermal structure of these subduction zones. Thus, one outcome of our improved understanding of subduction zone fluid chemistry will be the ability to quantify the temperature and solute content of different IRS Fluids.

Ectomycorrhizal fungi and mobilisation of organic phosphorus from forest soil: Novel data and actual role

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It has been demonstrated that forest soils contain a high proportion of phosphorus (P) in organic form (Po) that is represented by phosphomonoesters (such as glucose-1-P, ATP, phytic acid, ...) or phosphodiester (such as nucleic acids or phospholipids). To be used by trees, the phosphate group (Pi) must be released by the hydrolysis of the strong ester bond by enzymes that are phosphatases (Pases). We are currently working on the hypothesis that phosphatases released by ectomycorrhizal (ECM) fungi play an important role in the recycling of P in forest soil, thus contributing to plant P nutrition. We addressed this question in the context of spodosols of "Landes de Gascogne" as these soils, ensuring around 40% of conifer wood production in France, are very poor in Pi and high in Po contents relative to total P contents, making P limiting for maritime pine (*Pinus pinaster*) growth.

We worked on (i) *Hebeloma cylindrosporum*, a model fungal ECM species able to release huge amounts of Pase activity when grown in vitro in P-starved conditions, and (ii) on native ECM species. We found that *H. cylindrosporum* released 4 acid Pase isoforms able to hydrolyse a broad range of phosphate monoesters and to a low extent, the phosphodiester bis-pNPP. However, the efficiency of each isoform to release Pi from Po extracted from spodosols was low. The role of native species was studied by cultivating *P. pinaster* seedlings in intact soil samples from plots of different ages or fertilisation design. Despite a high pNPPase activity in ECM tips, P mobilisation from soil Po, measured by plant P accumulation, was very low in those soils with the lowest mineral P availability and the highest Po concentrations. Surprisingly, we found a significant decrease in Po fractions in soils that were annually fertilised and irrigated. Finally, based on our findings, we will propose a novel scheme of the possible role of ECM fungal Pase in Po mobilisation from forest soil.