About fluid and element mobility in the subduction channel: Constraints from rehydrated eclogites

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Three sequences displaying the retrograde, fluid-induced transformation from eclogite to blueschist from the Cyclades (Greece) and the Tian Shan (China) have been investigated to constrain composition, reactivity and the main sources of fluids present in the subduction channel (SC). In all 3 cases, blueschist-facies minerals glaucophane, white mica and carbonate formed at the expense of eclogite-facies omphacite and garnet. Oxygen isotopic compositions indicate isotopic equilibria for the eclogite-facies assemblage (omphacite + garnet ± phengite) and for the blueschist-facies assemblage (glaucophane + white mica). The calculated P-T paths are characterized by contemporaneous cooling and decompression, which is characteristic for the exhumation within a SC. The fluid infiltration causes a change in the element budget of the infiltrated eclogites. Particularly, a gain in LILE, CO_2, Mg, Ni and Co and a loss of REE, Si and Ca is observed, while HFSE behave immobile. This element exchange during the eclogite-blueschist transformation implies that the fluid was in equilibrium with rocks of peridotitic composition prior to infiltration [1]. Elevated Sr isotopic compositions of the eclogite-blueschist sequences in the Tian Shan may suggest an inherited Sr signature of the metasomatic fluids from devolatilization of seawater-altered, subducted oceanic rocks. We suggest that the SC fluids derive from devolatisation processes of the subducted lithospheric peridotite with subsequent reactive flow through the subducting slab [2, 3], where they were enriched with LILE and CO_2 from the altered oceanic crust or the above lying sediments. It is evident that the major element composition of the fluids was buffered by the serpentinized matrix of the SC, whereas the most fluid mobile elements still show the slab signature. It appears that many other elements of the released slab fluids are filtered at the slab-wedge interface before they ascend further into the subduction channel.

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PM in global climate and air quality policies: Co-benefits and trade-offs

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Background

Depending on the choices made, strategies to reduce emissions of traditional pollutants may increase or decrease emissions of greenhouse gases. Likewise, strategies to reduce greenhouse gases can have positive or negative effects on air pollution. An integrated approach aimed at designing smart and synergistic abatement policies is highly desirable and should be based on a scientific understanding of the interactions and feedbacks linked with emission reductions (http://www.gapforum.org/).

For this study we developed fully consistent emission scenarios for greenhouse gases and air pollutants, by linking the global partial equilibrium energy model POLES, to the global emission database EDGAR. Emissions are subsequently used as input to a global chemical transport model TM5. We evaluate impacts from scenarios with climate policies only, air pollution policies only, and combined climate-air pollution policies vs. a business-as-usual scenario (BAU), with a focus on particulate matter which plays a pivotal role in both environmental (health) impact and the atmosphere's radiative balance.

Results

The implementation of a global climate policy results in substantial co-benefits in terms of reduced air pollutant emissions. This is due to fuel shift and decreased fuel demand, resulting in global emission reductions (compared to BAU). For example, we find that under climate policies only, life expectancy increases by a global average of 1.7 months/person compared to BAU, this is 46% of the result obtained under air quality policies only.

The climate and air pollution policies have also temporary trade-offs for climate, since reducing particulate matter and precursor (especially sulfur) emissions, leads to a positive radiative forcing and a warming of climate. The faster warming in the short term might however be alleviated by focusing on reductions of short-lived warming agents: soot aerosols, methane and tropospheric ozone.