



Melt and mineral inclusions as messengers of volatile recycling in space and time

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Changing recycling budgets of surface materials and volatiles by subduction of tectonic plates influence the compositions of Earth's major reservoirs and affect climate throughout geological time. Fluids play a key role in processes governing subduction recycling, but quantifying the exact fate of volatiles introduced into the mantle at ancient and recent destructive plate boundaries remains difficult.

Here, we report on the role of fluids and the fate of volatiles and other elements at two very different tectonic settings: 1) at subduction settings, and 2) within the subcontinental lithospheric mantle (SCLM). We will show how olivine-hosted melt inclusions from subduction zones and mineral inclusions in diamond from the SCLM are used to reveal how changing tectonic settings influence volatile cycles with time.

Melt inclusions from the complex Italian post-collisional tectonic setting are used to identify changing subduction recycling through time. The use of CO₂ in deeply trapped melt inclusions instead of in lavas or volcanic gases provides a direct estimate of deep recycling, minimizing possible effects of contamination during transfer through the crust. The aim is to distinguish if increased recycling of sediments from the down-going plate at continental subduction settings results in increased deep CO₂ recycling or if the increased CO₂ flux results from crustal degassing of the overriding plate. Both processes likely affected climate through Earth history but could thus far not be discriminated.

The study of mineral inclusions and their host diamonds from the SCLM can link changes in the cycling of carbon-rich fluids and the time and process through which the carbon redistribution took place. We use Sm-Nd isotope techniques to date the mineral inclusions and use the carbon isotope data of the host diamonds to investigate the growth conditions. I will present case-studies of peridotitic and eclogitic diamonds from three mines in Southern Africa.