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Exploring new frontiers in fluids processes in subduction zones

Reduction and abiotic synthesis of hydrocarbons in subduction zones: widespread or anecdotal?

Alberto Vitale Brovarone (1), Isabelle Martinez (2), Dimitri Sverjensky (3), and Francesca Piccoli (4)

(1) CNRS, IMPMC, Paris, France (alberto.vitale_brovarone@upmc.fr), (2) IPGP, Université Paris Diderot, Paris 7, Paris France, (3) Department of Earth and Planetary Sciences, Johns Hopkins University, Baltimore, Maryland 21218, USA, (4) IMPMC-Sorbonne Université, Paris France

The understanding of the speciation of C in subduction zone aqueous fluids is undergoing extensive reconsiderations, some of which challenge common paradigms on the nature and composition of geological fluids at these conditions. Redox is a fundamental parameter because it can govern fluid-rock equilibria and the evolution and speciations of redox-sensitive volatile elements. When dealing with slab-forming rocks, great variations in fO_2 have to be expected based on the geology (i.e. pre- and syn-subduction evolution) of single lithological domains, and fluid moving through slab-forming lithologic can experience significant variations over small scales. Most works dealing with the fluid speciation at these conditions typically refers to oxidized species only, most notable CO_2. However, recent works have demonstrated that extremely reducing fluid-rock processes can exist in subducting slabs and lead to abiotic genesis of hydrocarbons. Nevertheless, these conditions have been documented only in isolated localities so far, questioning the significance of these processes at meaningful scales. The goal of this study is to consider a series of common geological conditions at subduction zones where reducing conditions are expected and confirmed by past and new natural observations, and to show that these conditions can be spatially and volumetrically relevant to subduction zone fluid-rock budgets. The direct implication of this is the the possibility to produce and transport hydrocarbon compounds of abiotic origin over large scales, as well as the possibility for these reduced fluid compounds to mobilize elements of interest.