Decarbonation of subducting slabs: a petrological-thermomechamical modeling approach

C. M. GONZALEZ[1*], W. GORCZYK[1] AND T.V. GERYA[2]

[1] Center for Exploration Targeting and CCFS, University of Western Australia, Crawley, Perth, WA 6009. (*correspondence: christopher.gonzalez@research.uwa.edu.au)
[2] Swiss Federal Institute of Technology, Zurich, Switzerland 8092

Subduction of heterogeneous lithologies carry a mixture of volatile components into the mantle. Volatiles can then be mobilized during metamorphic breakdown of hydrous and carbonate phases at shallow forearc depths followed by flux and carbonattite melting at subarc depths and beyond. While H_2O in subduction environments is studied extensively, processes resutling in CO_2 removal from the slab remain poorly constrained.

Mechanical removal of carbonated sediments via diapirism is hypothesized as an efficient mechanism to recycle CO_2 into the arc and mantle wedge. Therfore, we examine subduction decarbonation and sedimentary diapirism by employing a coupled petrological and thermomechanical numerical modeling approach. We modify the thermodynamic look-up tables [1] using Perple_X [2] to account for stable mineralogy and H_2O-CO_2 fluids within the following subducting lithologies: GLOSS average sediments (H_2O: 7.29 wt% & CO_2: 3.01 wt%), carbonated MORB (H_2O: 2.63 wt% & CO_2: 2.90 wt%), and carbonated peridotites (H_2O: 1.98 wt% and CO_2: 1.5 wt%). Our parametrizations include: 1) changing convergence velocity (1-6 cm $year^{-1}$; 1 cm $year^{-1}$ intervals) between a subducting oceanic plate and a continental plate and 2) thermal age of the subducting oceanic plate (20-80 Ma; 20 Ma intervals).

59 numerical models were run illustrating three geodynamic regimes that show extensive decarbonation. 1) Sedimentary diapirism acts as an efficient mechanism as it advects into the hot mantle wedge. CO_2 fluid is produced on the inner side of the advecting diapir. 2) If subduction rates are slow enough, mechanical coupling between the subducting oceanic plate and the continental plate results in a large mélange of fluid producing MORB and sediments. 3) During slab rollback and back-arc extension, interaction between hot asthenosphere and subducting mélange at shallow depths result in small windows (~12.5 Ma) of high integrated CO_2 fluxes (205 kg m^{-3} Ma^{-1}).

[1] Gerya *et al*. (2006) *PEPI* **156** 59-74. [2] Connolly JAD (2009) *Geochem. Geophys. Geosyst.* **10:**Q10014.