Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.12283

Carbonate Platforms Subducted into the Upper Mantle

LUCIAN PETRESCU[1], MIHAI DUCEA[1,2], CLAIRE CURRIE[3], CONSTANTIN BALICA[4], IULIANA LAZAR[1] AND ANANYA MALLIK[2]

[1]University of Bucharest
[2]University of Arizona
[3]University of Alberta
[4]Babes-Bolyai University

Presenting Author: luc_pet27@yahoo.com

Subduction of lithospheric plates at convergent margins leads to transport of materials once close to or at the surface of the Earth to great depths. Some of them later return to the surface by magmatism or degassing whereas others end up being stored in the mantle for long periods of time. The fate of carbon-bearing minerals in subduction is of particular interest because they can arbitrate the long-term availability of CO2 at the surface.

To demonstrate the dynamics of subducted carbonates, we use a two-dimensional viscous-plastic numerical models of oceanic plate subduction. These models simulate several types of carbonate sequences that could be involved in the interaction with subduction environments: shallow-water carbonate sequences (including here carbonate platforms, ramps, mud-mounds, rimmed and non-rimmed shelves) and pelagic carbonate platforms developed along continental margins, pelagic carbonate seafloor sediments developed on oceanic crusts. Our models predict that carbonate diapirs lift-up, mix with the convective mantle, cool and pollute the mantle wedge during subduction only to end up being added to the bottom of the lithosphere or even at the Moho, depending on the rheology of the mantle lithosphere. Our models can be used also to quantify how much CO2 returns to the lithosphere by solid state diaprisim versus the amount of carbonate lost to the forearc, how much is entrained in carbonatitic or highly alkalic low silica melts entering the crust and the fraction that is delivered to the deeper mantle along the subduction plane.

We show that the majority of carbonate load detaches from the sinking slab and rises up diapirically through the mantle wedge end eventually mixes with the mantle lithosphere. A smaller fraction gets accreted under the forearc, whereas another, descends deeper into the mantle. The cold diapiric plume has a significant role in retarding silicate mantle melting above these subduction zones and promoting the formation of carbonate-rich melts and in some cases, alkaline silica-undersaturated silicate melts. We propose that large amounts of CO2 can be stored as carbonate in the shallow uppermost lithospheric mantle.