

Solubilities of carbonate minerals in aqueous fluids under subduction zone conditions: Constraints from high-pressure experiments and thermodynamic models

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Subduction processes link the long-term carbon cycle between Earth's surface and interior, which has a profound impact on the Earth's surface ecosystem through geological time. Despite of years of studies on the carbon fluxes during subduction, the disagreements of estimated carbon fluxes of different processes still exist, especially for the dissolution of carbonates. In the subduction slabs, carbon recycled into Earth's mantle is mainly in the forms of carbonates (e.g. CaCO_3 , MgCO_3). Therefore, in this study, we constrained the solubilities of calcite, dolomite, and magnesite at high-pressure and high-temperature conditions relevant to subduction zones by combining diamond anvil cell (DAC) experiments and Deep Earth Water model (DEW) thermodynamic modeling. Furthermore, a four-apertures gasket technique for DAC is developed and applied to experimentally compare solubility of calcite, dolomite, and magnesite at same P and T conditions in our DAC experiments. The results show dissolution of dolomite is an incongruent process, which is different with congruent dissolution process of calcite and magnesite. Then we used the thermodynamic models calibrated by these experiments to estimate the solubilities of calcite, dolomite, and magnesite at various P-T conditions covering cold to hot subduction paths. By combining these experimental and modeling results as well as the estimated amounts of carbonates and water in subduction zones, we can provide a more accurate constraint on the carbon fluxes from dissolution processes and have a better understanding the deep carbon cycle.