Reevaluating carbon fluxes in subduction zones

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We reevaluated carbon inputs and outputs in convergent margins using new estimates of C concentration in subducting mantle peridotites, carbonate solubility in aqueous fluids along subduction geotherms, melting and diapirism of carbon-bearing metasediments, and diffuse degassing from arcs [1]. Carbon input to the global subduction system, including altered peridotite, is 40-66 megatons carbon/year (MtC/y). Estimates of C lost from slabs (14-66 MtC/y) must take into account the high $CaCO_3$ solubility in H_2O, which contributes significant C that must be added to that derived from mineral decarbonation. Carbon loss to fluids is further enhanced via pH buffering by host rocks, addition of alkali halide salts, and C reduction [2-4]. When combined with metasediment diapirs and slab-derived hydrous silicate and carbonatite melts [5,6], it is possible that nearly all C can be scavenged from subducting lithosphere. The return of C to the atmosphere by arc-volcano degassing is 18-43 MtC/y, but deep volatile saturation of arc magmas, magma ponding in the middle and deep arc crust, and venting of CH_4 and CO_2 in forearcs can account for the remaining C lost from the slab. Whereas previous studies concluded that about half of subducting C is returned to the convecting mantle, we find that the large uncertainties in key pathways make it possible that little C is currently being recycled. In this case, substantial C is stored in the mantle lithosphere and crust and the C content of the lithosphere + crust + ocean + atmosphere is rising, consistent with inferences from noble gas data.

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