Fluid and solute cycling and fluxes in subduction zone forearcs

M. KASTNER[1]

[1]Scripps Institution of Oceanography, La Jolla, CA 92093, USA (*correspondence mkastner@ucsd.edu)

At subduction zones, fluid and volatile cycling between the major reservoirs is pervasive. Key questions about the fluid origins, thermal regimes, fluid and solute fluxes, and the role of fluids in earthquake cycles, have been addressed at this dynamic tectonic regime, mostly through scientific ocean drilling and the introduction of sealed borehole hydrologic observatories (CORKs), developed in 1989, with long-term instrumentation, to record background in-situ values of physical, chemical, and biological properties and transients.

A recent in-depth analysis and synthesis of data on the chemical and isotopic composition of forearc fluids, fluid fluxes, and the associated thermal regimes, in well-studied representative erosional and accretionary subduction zone forearcs (Kastner et al, 2014) provides evidence for large-scale fluid flow, primarily focused, associated with faults. It is manifested by widespread seafloor venting, related biological communities, extensive authigenic carbonates, chemical and isotopic anomalies in pore-fluid depth-profiles, and thermal anomalies. The nature of fluid venting seems to differ at representative accretionary and erosive subduction zones; at both, however, fluid and gas venting sites are primarily associated with faults.

The measured fluid output fluxes at seeps are high, ~15-40 times the amount that can be produced through local steady-state compaction, suggesting that additional fluid sources, possibly recirculation of seawater, or non-steady-state fluid flow must be involved.

The newly extrapolated fluid reflux to the global ocean suggests that subduction zones are an important source and sink for several elements and isotope ratios, in particular an important sink for seawater Ca, Mg, and sulfate and an important source of B and Li.