Earthquakes: The great carbon recycler

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Recycling of volatiles from geologic sequestration back into the atmosphere is an essential part of the life cycle. Atmospheric return of volatiles via volcanism is the primary outlet, but what is not always appreciated is the role played by the volatiles themselves in plotting their escape. Subduction drives volcanism, and plate tectonics drives subduction, but subduction would not be possible without a weakening mechanism to overcome the very high confining pressures at depth. Without a significant weakening mechanism, mantle convection would most likely decouple from the overlying rigid lithosphere, resulting in a stagnant, and ultimately dead planet. Dehydration and de-carbonation make earthquakes possible because CO_2 and H_2O are released at very high fluid pressures and allow the lithosphere to fail in earthquakes at low shear stresses.

The role of CO_2 in generating earthquakes and aftershocks has been documented in the 1997 Colfiorito earthquake sequence in Italy [1], and the recent L'Aquila sequence in 2009 adds further evidence for the important coupling between earthquakes, aftershocks, and earth degassing. In talk, I explore the hypothesis that many, if not all, extended aftershock sequences are driven by the post-seismic release of trapped high pressure fluids (CO_2 and H_2O) at depth, and discuss the implications in terms of the isotopic composition of sediments in pull-apart basins that should record an input of deeply-derived CO_2 that correlates with the occurrence of large earthquake events.

Aftershock sequences are studied for the range of tectonic environments, including the 2003 Niigata trust earthquake in Japan, the 1992 strike-slip earthquake and 1994 thrust earthquake in California, and the 1997 and 2009 normal faulting earthquakes in the Apennines. Observations are compared with simple models of fluid pressure diffusion, and show that the general aftershock patterns are consistent with a post-seismic degassing model.

[1] S.A. Miller, C. Colletini, L. Chiaraluce, M. Cocco, M. Barchi, B.J.P Kaus (2004), *Nature* **747**, 724-728.