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Long-term legacy of ocean acidification: higher CO2 and altered ocean chemistry

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Fossil fuel-derived CO2 is raising ocean DIC and acidifying the ocean, and is likely to continue to do so over the next few centuries. But what will happen after emissions cease? This talk will attempt a new explanation of a phenomenon first discovered by David Archer: (Archer et al 1997) but not yet widely appreciated. Rather than the perturbation decaying away to zero, as is commonly assumed, it will be shown that the ocean chemistry will converge back to a new and different post-acidification equilibrium state, one which is significantly different from the pre-industrial state. As the new equilibrium is reached, the ocean will converge to higher DIC, higher alkalinity and higher pCO2; the new values may be 50% higher than pre-industrial.

The reason for the changes will be explained: they derive from the operation of the carbonate compensation feedback, which will bring the ocean back into equilibrium in terms of calcium carbonate saturation state (carbonate ion concentration), but in so doing will alter the equilibrium values of DIC, alkalinity and pCO2. Carbonate compensation will occur via adjustment of the lysocline depth but also by reduced calcification in shallow waters and 'burn-down' of calcium carbonate deposited in pre-acidification times.

The long-term implications for climate, for instance whether the current interglacial will be unnaturally prolonged, will be briefly discussed.

Archer, Kheshgi & Maier-Reimer 1997 *Geophysical Research Letters* **24**:405-408

Archer & Ganopolski 2005 G^3, **6**: Q05002,doi:10.1029/2005GL022449

Archer 2005 *J. Geophys. Res*. doi:10.1029/2004JC002625.