

## SPEAKERS CLUB

WEBB 1100 • THURSDAY OCT 19th. • 2:00 PM

# Chemical geodynamics revisited: modeling carbon cycles in Earth's deep interior through deep time

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*Carbon is one of the most important elements in the Earth, but the mass distribution and temporal evolution of carbon in Earth's deep interior are relatively poorly understood. Using an approach called chemical geodynamics that combines reservoir models with computational models of mantle dynamics, it is possible to compute time-dependent models for the evolution of carbon in the major reservoirs through Earth's history. At the present time, the 3 largest reservoirs for carbon are the core, the mantle, and the continental crust. Early in Earth's history the atmosphere was also a major reservoir for carbon. The smaller reservoirs - the oceans, the present atmosphere, and organic carbon - contain far less than the major reservoirs. It has been proposed that initially most of the Earth's carbon resided in the atmosphere, by analogy to Venus, which has a carbon-rich atmosphere. Atmospheric CO<sub>2</sub> reacts with eroded calcium silicates to produce calcium carbonates plus silica; most carbon in the continental crust is in the form of carbonates, largely produced by this process. In one scenario, the remainder of the carbon originally in the atmosphere also generated carbonates, which were subsequently subducted and rapidly mixed into the mantle, creating an early flux of carbon from the surface into the interior. This mechanism for extraction of carbon from the atmosphere would have been substantially completed by 3 Ga before the present, with the flux into the mantle at subduction zones generally balanced by the flux out of the mantle at mid-ocean ridges for most of Earth's history. Thus carbon plays a significant role in mantle dynamics as well as on the surface.*