Tectonic influences on the geochemical evolution of the continental crust

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The continental crust displays secular trends controlled by tectonic processes with, for example distinctive peaks and troughs of ages for igneous crystallization, metamorphism, continental margins and mineralization. This temporal distribution is argued to reflect the different preservation potential of rocks generated in different tectonic settings, rather than fundamental pulses of activity, and the peaks of ages are linked to the timing of supercontinent assembly.

We recognize 5 stages of Earth evolution: 1) Initial accretion and differentiation of the core/mantle system within the first few 10's of millions of years, on an anoxic prebiotic Earth; 2) Generation of crust prior to 3.0 Ga, in a pre-plate tectonic regime associated with the evolution of early life and large fluctuations in atmospheric chemistry; 3) Early plate tectonics involving hot, presumably shallow subduction over the period from 3.0-1.7 Ga, associated with changes in the composition of new crust from mafic to felsic and an increase in crustal thickness and recycling, along with massive changes in the biosphere, ocean and atmospheric chemistry, and global climate, including the initial rise in atmospheric oxygen and global glaciations; 4) Earth's middle age from 1.7-0.75 Ga, characterized by lithospheric, environmental, and evolutionary stability, and the evolution of early eukaryotes; 5) Initiation of modern cold subduction at ~0.75 Ga, associated with a second rise in atmospheric oxygen, extensive global glaciations, and the radiation of animal life. Supercontinents have operated during the last three stages and their assembly and dispersal require horizontal motion of the lithopshere through plate tectonics. This evolving tectonic character has likely been controlled by secular changes in mantle temperature and its resultant impact on lithospheric behavior. Crustal volumes, reflecting the tectonochemical interplay of crust generation and recycling, increased until Earth's middle age and they may have been decreasing for the last ~1 Ga.