Carbon recycle and climate changes

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Carbon recycle is a key factor that controls the climate of the Earth. Concentrations of atmospheric carbon dioxide fluctuated dramatically in the Earth's history, ranging from percent levels to parts per million levels, which is responsible to major climate changes. Most of the Earth's C is stored in the mantle. Therefore, the "extra" carbon dioxide comes from the mantle and is produced by degassing of mantle-derived magmas: plume related basalts (e.g., large igneous province and ocean island basalt, OIB), mid-ocean ridge basalt (MORB) and arc volcanic rocks. Both carbon abundance, speciation and storage in major reservoirs of the Earth mantle are of critical importance to C recycle and climate. Diamond is the hardest and thus the least compressible natural mineral so far recognized. Experiment and modeling results show that it is denser than silicate minerals and melts in the Earth's mantle at depths above the 660-km discontinuity, but becomes less dense deeper inside the Earth [1] [2]. Meanwhile, diamond is one of the earliest minerals formed in the solar nebula prior to the formation of the Earth and other planets [3], which has very high melting temperatures of ~5000 K [4]. It is the dominant carbon species at depths below 170 km in the Earth's mantle under current mantle oxygen fugacities [5]. Therefore, diamond should have accumulated at the bottom of the upper mantle, which was oxidized to carbonate later on. This layer is essential for mantle plume induced fluctuations in atmospheric carbon dioxide concentrations and climate changes. Methane is another very important greenhouse gas, which emits abruptly during deglaciation. It is another key factor, in addition to CO2 that controls the climate [6] [7].

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