Carbonates and carbonate melts in the Earth's mantle

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Deep carbon cycle and carbon storage in the Earth's mantle are currently the subject of ongoing researches. Carbon is the building block of life because all living things on Earth are essentially composed of carbon-based compounds. Earth's habitable climate is profoundly affected by long term exchange of carbon between the solid earth and the atmosphere/hydrosphere, because this established the greenhouse effect. Shallow and relatively rapid carbon cycling between the atmosphere, oceans, and shallow crustal environments is well quantified and understood. In contrast, relatively little is known about the deeper and slower carbon cycle between crust, mantle and atmosphere/hydrosphere. Subduction zones are the only ways to deliver surface carbon to the upper mantle, the mantle transition zone or even the lower mantle, in form of carbonated oceanic lithospheric material. The process of partial melting of subducted, carbonated slabs in the upper mantle and the mantle transition zone mobilises subducted carbonate as diverse carbonate to carbonated silicate magmas, which may interact with reduced peridotite wall rock producing diamond. Diamondiferous peridotite may enter the convecting mantle or be incorporated in mantle plumes, oxidising on decompression, leading to "redox melting" to produce carbonate-bearing melts. These may ultimately reach the surface were carbon degassing as CO_2 will moderate Earth's climate on geological timescales. Here I present an overview of the occurrences of carbonates and carbonate melts in mantle samples from different geological settings (mantle xenoliths in volcanoes, orogenic peridotites etc), which provide the important role of carbon, carbonates and CO_2 -rich melts in the evolution of the Earth's mantle.

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