Geodynamic cycle of carbon in the continental crust

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Carbon, the fourth most abundant element in the solar system, is a key element that controls life, environment and resources. In the past decade, renewed attention is being paid for understanding the global carbon cycle, especially to link the less known deep carbon cycle within the Earth to those related to the surface processes. Carbon isotope geochemistry has served as a common and widely applied tool for understanding the movement of carbon through different reservoirs in the Earth. Here I present a comprehensive synthesis on the forms of carbon, its movement among the various reservoirs and the evolution of carbon isotopes in the middle to lower continental crust, where large volumes of carbon are stored as “long-term sinks”. In particular, the carbon geodynamics in orogenic belts is evaluated based on vein-type graphite occurrences in Antarctica and Sri Lanka and disseminated forms of in other terrains of the Neoproterozoic to Cambrian East African Antarctic Orogenic belt.
Carbon mobility occurs in the crust mainly in the form of fluids, such as CO_2 and CH_4, along fractures and lithological contacts where graphite concentration is observed. A detailed carbon isotope study of graphite and examination of fluid inclusions were carried out in different occurrences in continental collisions zones in the Lützow Holm Complex, East Antarctica, Sri Lanka, southern India and Madagascar. Based on the mode of occurrence, they were classified into three types, vein-type, disseminate flakes and coarse aggregates. In addition, graphite concentration is also observed along the contact between marble and country gneiss. The concentration of disseminate flakes increases near the contact zone between meta-carbonate rocks and surrounding gneisses. In order to understand the source carbon isotope composition, we considered the carbon isotope fractionation behavior between calcite, graphite and carbon-bearing fluids (CO_2 or CH_4). For example, at the Skallevikshalsen locality in the Lützow Holm Complex, East Antarctica, all three forms of carbon-bearing phases were present. Field evidences suggest that carbon is being pooled at lithological contacts and deposited as graphite. Carbon isotopic composition of graphite and associated carbonates are consistent with graphite precipitation from the CO_2 released by decarbonation reactions.
The case with vein-type graphite in Sri Lanka is considered to be different as large volumes of highly crystalline graphite is deposited. The origin of graphite is considered to be mantle derived fluids. The CO_2 -rich fluids are observed in quartz pods within the graphite veins, recording evidence of original fluids that resulted in the deposition of graphite veins. In my presentation I will provide a comprehensive review of carbon isotopic composition of graphite in continental crust to understand the role of graphite as "long-term sinks" of carbon.

Keywords: Carbon, Continental crust, Graphite, CO2 fluids, Carbon isotopes

