

Geological study of carbonatization of the 3.8 Ga Isua rocks and abiological graphite generation

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Geological study of carbonatization in the 3.8Ga Isua Supracrustal belt(ISB),southern West Greenland was performed. Carbonatization in ISB occurred during metamorphism by CO₂-rich metasomatic fluids. But its geological significance, nature of associated fluids and detailed chemical reactions are unknown. Therefore, clarification of the geological extension and traces of lithological change of carbonatization is the primary object. Ultramafic rocks and banded iron formations (BIFs) were selectively carbonatized, probably due to their high Mg and Fe concentrations. The specific mafic dyke are spatially associated with carbonatized ultramafic rocks. This is probably because mafic dyke behaving as thermal driving force of carbonatization.

The degree of carbonatization was variable even in one single formation. (1) The thickness of carbonatized ultramafic rocks changes from a few meters to dozens meters within several tens m. (2) In a few hundred meters, BIF changed into three lithologies, primary BIF, quartzite, and massive siderite ore (a few m in thickness). We suggest that (1) primary carbonate formation on the seafloor, (2) formation of CO₂-rich fluids during metamorphism from the primary carbonate, (3) localization of carbonate in the Isua crust.

Field observation indicates that massive siderite ore was developing inside of BIF. This massive siderite ore is chemically zoned in Mg and Fe contents confirmed by X-ray scanning microscope (XSM) analyses. Such zoning is probably reflecting the different degree of metasomatism. Abundant graphite is found in the massive siderite ore. For mineral assembles, graphite was generated by decomposition of siderite. This phenomena indicates that the abiological graphite had formed largely in the 3.8 Ga Isua Supracrustal Belt.