インド南部太古代ダールワール岩体チトラドゥルガ片岩帯における炭素質物質の石墨化について
Graphitization of cabonaceous materials from the Archaean Chitradurga schist belt, Dharwar Craton, Southern India

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Sedimentary rocks often include small amounts of organic material as an accessory phase, called as “Carbonaceous Material” (CM), during sedimentation. In this study, we report that the structural change and the isotopic composition of CMs within the carbonate rocks from the Chitradurga schist belt, Dharwar craton, southern India. Because CM (RSCM) geothermometer have been mainly developed by using pelitic rocks, this study verifies whether graphitization of CM in carbonate rocks is suitable as a geothermometer. The carbonate rocks from this region can be divided into two types by its occurrence and mineral assemblage Type-I is partly exposed at the southern part of the study area, and it is characterized by the lens-shaped limestones in dolostones. XRD patterns, Raman spectroscopy along with SEM observations indicate that the CM contained in Type-I carbonate rocks has been metamorphosed to about 450 ~ 500ºC, and the graphite show a hexagonal platy structure. In addition, $\delta^{13}C$ value of CM ranged between -11 and -7.8 permil. On the other hand, Type-Ⅱ is exposed at the northeastern part of the schist belt and is characterized by laminated dolomite which is cut across by numerous quartz and carbonate veins. The CM in Type-2 carbonate rocks has been affected by the metamorphism at about 350 ~ 400ºC, and the graphite was found to be characterized by sheet-like and two-dimensional crystal structure (2H) based on the analysis with XRD and Raman spectroscopy and the observation with SEM. In addition, the $\delta^{13}C$ value ranged between -16.1 and -10.9 permil, which is suggesting a temperature dependent equilibrium carbon isotopic fractionation between graphite and carbonate. On the other hand, CM of pelitic rocks and CM in stromatolites from this region retain original $\delta^{13}C$ value (-29 ~ -22.9 permil) of organic matter origin. However, some samples of Type-II carbonates showed anomalous $\delta^{13}C$ values (-16.1 permil)., and the morphology of graphite differs from the Type-I. They have globule forms and secondary overgrowth was observed on the sheet-like graphite. We consider these graphite to have recrystallized under the presence of a carbon-bearing fluid. The fluid crystallized graphite was found to have globular form, heterogeneous crystallinity and negative $\delta^{13}C$ values. Furthermore, it was found that metamorphic temperature estimated using CM in carbonate rocks have larger error even at high metamorphic grades as compared with those of the pelitic rocks. We discuss the reasons for this differnce and whether the graphitization process has been affected by the difference in fluid composition, abundance of CO_2 and recrystallization and growth rate of the host mineral. The results of this study might put forward questions on the suitability of RSCM geothermometer in low to medium grade metacarbonate rocks and suggests the necessity of selecting samples which are suitable for analysis through the comprehensive evaluation.

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