

Thermal cracking and polymerization of a long *n*-alkane under high-pressure and high-temperature conditions of subducting slab

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Hydrocarbons are important carbon components in the subducting slab and play a crucial role in the Earth's deep carbon cycle [1, 2]. In this study, the thermal reaction of pentacosane (*n*-C₂₅), a long *n*-alkane, was experimentally investigated under high-pressure and high-temperature conditions at 0.5–1.5 GPa and 360–400 °C co-existing with Al₂O₃, SiO₂. The gas chromatography–mass spectrometry (GC/MS) analyses of the reaction products revealed that the radical reaction of *n*-C₂₅ progressed above 360 °C at 0.5 GPa and above 380 °C at 1.5 GPa, while the rate constant decreased in the higher pressure. Lighter *n*-alkanes of *n*-C₉ to *n*-C₂₄ and heavier straight/branched alkanes were detected in the reaction products. The formation of lighter *n*-alkanes indicates progression of thermal cracking, even at high-pressure conditions. During thermal cracking, lighter 1-alkenes were likely to form but were instead rapidly added to the initial *n*-C₂₅ to form heavier alkanes when enhanced by pressure. Thus, lighter 1-alkenes were not detected in the reaction products. Raman spectroscopic measurement revealed that formation of amorphous carbon, when the remaining percentage of the initial material became <10% and <20% at 0.5 and 1.5 GPa, respectively. Amorphous carbon is likely to be formed by polymerization with dehydrogenation of the heavier alkanes as the secondary reaction, while the lighter *n*-alkanes were still remained. Both lighter alkanes with high H/C ratios and amorphous carbon with a low H/C ratio eventually formed through the reaction of *n*-alkanes at high-pressure and high-temperature conditions of the deep Earth [3].

References

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