Lipid biomarkers in the Fe-Mn nodules from the Clarion-Clipperton Fracture Zone, NE Pacific

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An organic geochemical study of biomarker composition (n-alkanes, fatty acids, hopanes, steranes) as well as TOC, C/N, $\delta^{13}C$ measurements were carried out on total lipid extracts from Fe-Mn nodules and underlying sediments. Nodule and sediment samples were collected at three sites in the northeastern part of the Clarion-Clipperton Fracture Zone in the Pacific (2015). Identification and analysis of organic matter contained in nodules is a complicated task that will significantly improve our knowledge about a role of biochemical processes in formation of ore deposits. Interplay of these processes should be considered on scale of millions of years.

The studied nodules demonstrate wide range of sizes and morphologies. They are characterized by an average TOC content of about 0.15% that is lower than in underlying sediments. Nodules from different sites have different C/N ratio changing from 7.9 to 14.2. The molecular composition and distribution of n-alkanes in nodules demonstrated a significant influence of modern bacterial activity. Hydrobiont components of OM had undergone bacterial influence with preservation of terrestrial components in the ore-forming environment. Along with the presence of mature geological forms of terpenoids (tri-, tetracyclic and αβ-hopanes, m/z 191), the nodule samples contain moretanes ($C_{29}\beta\alpha$, $C_{30}\beta\alpha$), which are the primary products of the diagenetic transformation of hopanoids. Sterane biomarkers (m/z 217) are represented mainly by stable αββ-forms, while $C_{29}\alpha\alpha R$ (64% on average) predominates in the nodules among the biosteranes ααR $C_{27\text{-}29}$, which marks the terrigenous input. The $\delta^{13}C$ values of individual n-alkanes n-$C_{26\text{-}34}$ in nodules varies in a range of -21.27 ‰ to -27.51 ‰ (vs PDB), that can confirm the presence of organic source of land plant epicuticular waxes.

Comparison of biomarkers in nodules collected at the same site and characterized by different size allowed to conclude that intensity of diagenetic processes of OM transformation gradually decreases with nodules growth. Obtained morphological, mineralogical and geochemical results allowed a suggestion that all types of studied nodules were significantly affected by diagenesis inside of the nodules and identified variations in biomarker values related to (or resulted from) these diagenetic processes.