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The coupling control of biological precursors and environmental factors on β -carotane enrichment in alkaline lacustrine source rocks: a case study from the Fengcheng Formation in the western Junggar Basin, NW China

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The organic-rich mudstones and dolostones of the Permian Fengcheng Formation (Fm.) are typically alkaline lacustrine source rocks, which are typified by impressively abundant β -carotane. Abundant β -carotane has been well acknowledged as an effective indicator of biological sources or depositional environments. However, the coupling control of biological precursors and environmental factors on the enrichment of β -carotane in the Fengcheng Fm. remains obscure. Based on a comprehensive investigation of the bulk and molecular geochemistry of sedimentary rocks and the biochemistry of phytoplankton in modern alkaline lakes, we proposed a new understanding of the biological precursors of β -carotane and elucidated the coupling control of biological precursors and environmental factors on the enrichment of β -carotane in the Fengcheng Fm. The results show that the biological precursors crucially control the enrichment of β -carotane in the Fengcheng Fm. The haloalkaliphilic cyanobacteria are the primary biological sources of β -carotane, which is suggested by a good positive correlation between 7-+8- methyl heptadecanes/ C_{max} and β -carotane/ C_{max} in sedimentary rocks and the predominance of cyanobacteria with abundant β -carotene in modern alkaline lakes. Land plants and algae do not significantly contribute to the enrichment of β -carotane, which is indicated by negative or weak correlations between terrigenous/aquatic ratio, C_{19} tricyclic terpene/ C_{23} tricyclic terpene ratio, the concentration of C_{27} sterane, and β -carotane/ C_{max} . The environmental factors such as paleoclimate, paleoredox, paleosalinity, and thermal maturity are the indirect factors that control the enrichment of β -carotane by affecting the precursor supply from cyanobacteria and the preservation conditions in the Fengcheng Fm.