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Compound-specific carbon isotope ratios from the Ediacaran-lower Cambrian in the Three Gorges area, South China

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In order to reveal the organic carbon cycle in the early Cambrian ocean, compound-specific carbon isotope ratios of aliphatic hydrocarbons which records the change of the composition of organic matters derived from phototrophs were first measured for the drill cores from the Three Gorges area. The differences between the carbon isotope ratios of short chain n-alkanes and pristane (Δap) show relatively high ($\sim$-3-4 ‰) in the Ediacaran, decreased down to $\sim$-6 ‰, and subsequently increased up to $\sim$6 ‰ in the early Terreneuvian (the earliest Cambrian; 541-521 Ma), and again decreased down to $\sim$-4 ‰ in the Epoch 2 (the early Cambrian; 521-509 Ma). The differences between the carbon isotope ratios of pristane and phytane (Δpp) were $\sim$0 ‰, decreased down to $\sim$-5 ‰ in the Terreneuvian, and increased up to $\sim$6 ‰ in the Epoch 2. ^{13}C-depleted β-carotane was found only from the black shale at the Series 2.

Δpp indicate that a single phototroph community has existed in the Ediacran, whereas multiple phototroph communities existed in the early Cambrian. The decrease in Δap indicates enhanced burial of lipids derived from eukaryotic phototrophs, probably in response to the emergence of faecal pellets, which has consumed the large dissolved organic carbon reservoir. ^{13}C-depleted β-carotane and negative Δpp values indicate that the anaerobic phototrophs utilized CO_2 derived form degraded organic matters.

Thus, the aerobic phototrophs and the anaerobic phototrophs coexisted on the continental shelf in the early Cambrian. An anoxic water reached on to the photic zone on the continental shelf, and that lasted until Epoch 2. The increase of the burial of lipids derived from aerobic phototrophs is consistent with the intensified biological pump by the radiation of SSFs in the early Terreneuvian.

Keywords: Ediacaran, Cambrian, oxygen level, molecular fossil, South China