Climatic and vegetational changes during the period of the Hemudu Culture in China shown by biomarker compositions

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The Hemudu Culture is a Neolithic culture that flourished in the lower reaches of the Yangtze River in China between 7,000 and 5,500 BP. Based on carbon and hydrogen isotope ratios ($\delta^{13}C$ and δD) of long-chain fatty acids and plant opal content in trench samples at the Tianluoshan site, Patalano et al. (2015) argued that the sowing began with environmental aridification. In this study, we investigated the $\delta^{13}C$ and δD of long-chain fatty acids, polycyclic aromatic hydrocarbons (PAHs), pentacyclic triterpene methyl ethers (PTMEs) of grass origin, and branched Glycerol dialkyl glycerol tetraethers (GDGTs) were analyzed to reconstruct the paleoclimate and environment of the lower reaches of the Yangtze River before and after the start of rice cultivation.
The core from the Tianluoshan site consists of a marine or brackish mud layer, the first rice paddy layer (7000-6400 years ago), a mud layer (6400-6300 years ago, including marine diatoms), and the second rice paddy layer (after 6300 years ago), from the bottom to the top. The core from the northern Hemudu Site shows a similar stratigraphy, although it lacks the second rice paddy layer. Biomarkers and their isotopic ratios in both cores show similar changes. Pyrogenic PAH concentration and the ratio of rice-derived arundoin and cylindrin to the total PTME increased in the rice paddy layer, were maxing. In the overlying mud layer, PAH concentrations were low, and the proportion of arundoin and cylindrin to the total PTME was also low. At the Tianluoshan site, in the second rice paddy layer, the PAH concentration was high, and the proportion of arundoin and cylindrin to the total PTME was high. The $\delta^{13}C$ and δD of long-chain fatty acids also changed in response to this lithological change, showing that the rice paddy layer with low $\delta^{13}C$ was dominated by C3 plants in vegetation, with low δD by high summer precipitation. In the northern core from the Hemudu site, the temperature and precipitation reconstructions from the GDGTs and leaf wax δD indicate that the area became cooler and wetter before the formation of the first rice paddy layer, and warmer and drier during the rice paddy period. The relationship between rice cultivation and climatic change suggests that rice cultivation began with a wet climate rather than a dry one. The interruption or termination of rice cultivation may have occurred due to the submergence of rice paddies due to marine transgression at the Tianluoshan site or as a result of aridification at the Hemudu site.

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