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Diagenetic effects on Boron isotopes in shallow water carbonate sediments from Middle Miocene to Recent

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The partial pressure of atmospheric CO_2 (pCO_2) has significant influence on the global climate change. The boron isotopic composition ($\delta^{11}B$) of carbonates is widely used to reconstruct the paleo-pH, therefore, provide imformation of atmospheric CO_2 concentrations. However, the fidelity of $\delta^{11}B$ records in marine carbonates under diagenesis remains uncertain. We examined $\delta^{11}B$ values of modern corals from Hainan Island, two unconsolidated shallow drillcores: Jiuzhang A and Jiuzhang B (JZ-A and B) in Spratly (Chinese: Nansha) Islands, and bulk carbonates of Late Miocene to Holocene age in Well Xike-1 (XK-1) in Paracel (Chinese: Xisha) Islands, South China Sea. Modern coral samples show a uniform $\delta^{11}B$ range within the previously published $\delta^{11}B$ values for modern corals in other open oceans, while the derived pH values are fractionated from the modern values by 0.2 ± 0.03. The $\delta^{11}B$ values of the unlithified carbonate sediments vary within a narrow range, with the pH and CO_2 concentrations consistent with modern values. The $\delta^{11}B$ values of bulk limestones are not affected by diagenesis (meteoric, mixed-diagenetic, and marine diagenetic processes). However, we note that dolomitization significantly decreases the $\delta^{11}B$ values of bulk carbonates. Our paleo-pH and CO_2 profiles match previously published long-scale climatic trends but provides greater detail. This study concludes that marine limestones are capable of faithfully recording ambient seawater pH values even after undergoing multiple stages of diagenesis, as long as there is no dolomitization.