



Coral records reveal that abrupt intensification in winter monsoon was the direct trigger of the Akkad empire collapse in 4 ka

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Akkad empire in ancient Mesopotamia was established in the flat alluvial plain between the Tigris and Euphrates Rivers around 4.6 thousand years ago (ka). Akkadian could succeed in the development of agricultural system utilizing the winter Mediterranean rainfall. Archeological evidences and paleoclimate reconstruction shown that climate change seriously affected on the collapse of Akkad empire in 4.2 ± 0.2 ka. Speleothems and sediment cores revealed the abrupt aridification in western Asia was one of the factors that influenced collapse of Akkad empire. Intensification of winter monsoon might have reduced rainfall in Mesopotamia via southward migration of Mediterranean rainfall belt. However, there are no direct evidences to show monsoonal changes and seasonal migration of Mediterranean rainfall belt in 4ka. Here, we present the monthly-resolution sea surface temperature (SST) and oxygen isotope in seawater ($\delta^{18}\text{O}_{\text{sw}}$) records in 7 different time-windows from 4.3ka to the present for reconstruction the migration of Mediterranean rainfall belt, by using 6 fossils (3.1, 3.3, 3.4, 3.6, 4.0 and 4.3ka) and 1 modern coral skeletons collected in the Gulf of Oman. Our results suggested that both SST and $\delta^{18}\text{O}_{\text{sw}}$ in winter around 4.0ka were lower than in other time windows. The reduction of SST and $\delta^{18}\text{O}_{\text{sw}}$ in winter would have been induced by cold and wet air flow from Mediterranean due to intensified winter Indian monsoon around 4.0ka. We suggest that the abrupt southward migration of Mediterranean rainfall belt would have seriously affected the collapse of Akkad civilization around 4.0ka.