Abstract

The Rann of Kachchh (RoK), Gujarat, India is a barren and inhospitable salt-flat terrain with unique geomorphology and curiously hosting several small to large Indus Valley/Harappan [~5.5-3.8 Kyr ($x10^3$ years) before present; B.P.] archaeological settlements, including the UNESCO world heritage site of Dholavira. The rise and decline of such agricultural and trade-based advanced communities in this climatically harsh terrain suggest that the paleoclimatic condition and paleogeography of this region could be largely different than today. A comprehensive understanding of the past change in climate and landscape of the RoK is, therefore, important not only to explain how such advanced human settlements grew there and eventually declined but also has a bearing on mitigating the threats to future human settlements due to ongoing climate change during the Anthropocene. The present thesis, for the first time, attempts to understand the spatiotemporal variations in the past climate and depositional environment at RoK (covering both Great and Little Rann) during the Late Pleistocene/Holocene period. Towards this, a number of sediment cores were drilled from various parts of the RoK to reconstruct its paleoclimatic and paleo-depositional history. Accelerator Mass Spectrometer (AMS) radiocarbon dating from these cores suggests that the sedimentation in the Great Rann of Kachchh (GRK) possibly started around ~15-16 Kyr B.P., much later than the Last Glacial Maximum. Similar sediment thickness atop the basement and an equivalent timing of the initiation of sedimentation vis-à-vis modern geomorphic features suggest that the paleo-topography of the GRK basin was different than today. The recovered sediments of the Little Rann of Kachchh (LRK), on the other hand, provided a history over the last 8 Kyr only. The sediments were analysed for compound-specific biomarker (*n*-alkane) compositions, and carbon isotopic compositions of bulk, oxidation-resistant organic matter as well as *n*-alkanes. Before studying the organic geochemical parameters, an efficient and optimized extraction and purification method for enhanced recovery of the highly volatile short-, mid-, and long-chain *n*-alkanes from different sample types (e.g., algae, leaf, sediments), was developed. This improved analytical protocol was used to extract *n*-alkanes from the RoK sediments. The bulk sediment and wet chemical oxidation-resistant organic carbon $\delta^{13}C$ data indicate extensive oxidation of the organic matter before deposition in the sediments, and negligible microbial alteration due to post-depositional processes. The combined spatio-temporal *n*-alkane proxy data [e.g., Terrestrial/Aquatic ratio, TAR; P_{aq}, or LCNA (long chain *n*-alkane)/SCNA (short chain *n*-alkane) ratio, etc.] from the sediment cores suggest a relatively higher terrestrial input in the RoK between ~15-7 Kyr B.P. owing to a stronger Indian Summer Monsoon (ISM) and very high fluvial discharges. Post ~7 Kyr a considerable decrease in the terrestrial input and a simultaneous increase in the aquatic/marine input is observed till ~3 Kyr. This was possibly facilitated by a contemporaneous rise in the Mid-Holocene relative sea level that inundated the RoK and a decreased strength of the ISM and fluvial discharges. The high sea stand was probably conducive to the local navigability and helped the Harappan settlers in this region to carry out overseas trade with the contemporary settlements in the west (viz. Harappa, Mohen-Jo-Daro, or Mesopotamia). The *n*-alkane $\delta^{13}C$ values measured from the sediment cores record the global paleoclimatic events that occurred during the Last Deglacial and Holocene period (namely, the Bølling-Allerød, the Younger Dryas, 9.2, 8.2, and 4.2 Kyr arid climatic events), and can be correlated across the Indian sub-continent and beyond. The abrupt increase in aridity at the onset of the Meghalayan Stage (~4.2 Kyr) and the gradual disappearance of the rivers, followed by a sea level withdrawal during the latter period were probably the major causative factors for the decline of the ancient settlements from this region. The present landscape of the RoK was possibly achieved in the sub-recent time (~1-1.5 Kyr B.P.?) due to neotectonic activity which might have caused an upliftment of the Median High that eventually restricted the connection between the central RoK with the Arabian Sea.

Keywords: Rann of Kachchh, Harappan settlement, Organic carbon isotopes, Radiocarbon dating, Sedimentary *n*-alkanes, Oxidation-resistant organic carbon, Paleoclimate, Paleoenvironment, Sea level