ABSTRACT

The Nal region is a low lying tract, linking the Gulf of Kachchh through the Little Rann to the Gulf of Khambhat. Lying in the middle of this depression (22°48'N, 72°E) is a large (~120km^2) shallow (average depth 2m, +14m msl) lake, Nal Sarovar. This region lies within the palaeo-Thar Desert margin and is a potential site for palaeoclimatic investigations. On the basis of its location and elevation, it has earlier been surmised by many workers that Nal Sarovar represents the remnant of a sea link that existed between the two gulfs until recently (~2ka BP). Owing to its low elevation, proximity to the Gulfs of Kachchh and Khambhat, and also to the tectonically active Cambay Graben, it is likely that both eustatic sea level changes and tectonism have played a role in the evolution of Nal region. It was, therefore, essential to reconstruct the evolutionary history of this region to provide a framework for any palaeoclimatic investigations.

This study was, therefore, carried out with the dual objectives of understanding the evolution of Nal region, in terms of an interplay of regional tectonism and eustatic sea level changes, and to decipher its Holocene palaeoclimatic history. This study represents the first major attempt in this direction and is based on the application of a variety of techniques that included: (i) remote sensing studies, (ii) subsurface lithological correlation, (iii) sedimentological and mineralogical characterisation of sediments, (iv) isotopic and C/N ratio studies, (v) radiocarbon, and (vi) luminescence dating. Detailed laboratory investigations were carried out on a 54m long core raised from the bed of Nal Sarovar.

Based on the results of various investigations, a three stage model for the evolution of the entire Nal region, during Late Quaternary, has been developed. In STAGE 1 of evolution, spanning the marine isotope stage 5 (127-73ka), a shallow sea linked the Gulf of Kachchh with the Gulf of Khambhat. Fine grained sediments from south and/or west were being deposited in the Nal region. This study also indicated that the sea

connection between the Gulf of Kachchh and Gulf of Khambhat broke up around the beginning of marine isotope stage 4 due to regression of the sea. Subsequently, only a land link remained. In STAGE 2 (73-7ka) of evolution, fluvial sediments from east were episodically being deposited in the Nal region in response to westward migration of depositional front of eastern rivers. This was probably caused by a combination of regression of the sea, leading to lowering of base level and/or tectonic uplift in the region of Cambay Graben. In STAGE 3, as a result of the combined influence of westward advance of the sedimentation front, tectonism and post-glacial sea level rise, the elevation of the Nal Sarovar came to within few metres of its present elevation at about 7ka when it became a closed basin.

Palaeoclimate reconstruction for the last ~7ka was attempted using $\delta^{13}C$ and C/N ratios of organic matter from sediments deposited during STAGE 3 of evolution. This is the first high resolution palaeoclimatic study from the palaeo-Thar margin. The observed variations in $\delta^{13}C$ and C/N indicate that the period from ~6.6-6ka was generally drier than present with the exception of a short wet phase around 6.2ka. From 6-4.8ka the rainfall was lower than present but possibly more evenly distributed as a result of a slight increase in winter rainfall. From 4.8-3ka the climate was wetter than present. The trend towards aridity began around 3ka and present day conditions set in ~2ka BP. This picture is somewhat different to the one deciphered by earlier workers from Rajasthan lakes for the period 6.5-4.8ka when, in opposition to the wetter climate in Rajasthan, the climate here was drier. From 4.8ka to present however the climatic changes in this region are similar to those in Rajasthan. Also, a general agreement between periods of glacier expansion in Eurasia and drier periods in Nal Sarovar is observed. This suggests that the palaeoclimatic record from Nal is a regional feature.