Manchester Geographical Society

Funding Report

Investigating records of dune activity in the Thar Desert, India by combining portable optically stimulated luminescence (port-OSL) with laboratory techniques

Shashink Nitundil,
Department of Geography, University of Manchester.

PhD Supervisor: Dr. Abi Stone, University of Manchester

Email: Shashank.nitundil@postgrad.manchester.ac.uk

The Thar Desert of India is one of the world's most densely populated drylands where reactivation of currently stable dunefields can cause damage to life and property, requiring appropriate hazard mitigation strategies. Designing such strategies needs accurate prediction of the future response of dunefields to anthropogenic pressures and the changing climate, informed by study of past records. Dunes in the Thar are shaped by the Indian Summer Monsoon and act as palaeo-environmental archives that reveal past changes in the system but have a complex developmental history with high spatio-temporal variability, necessitating a high-resolution (density across space and depth) dunefield level investigation. However, establishing chronology of dune accumulation histories using traditional approaches is costly, laborious and resource intensive.

This study overcomes these limitations by combining portable luminescence (port-OSL) measurements with laboratory-based chronologies to rapidly estimate dune ages in the Thar desert. The rationale for the research is to produce a dataset of past dune accumulation history in the Thar Desert, India. This will be used alongside an understanding of past climatic forcing to allow us to make more informed predictions of future changes to dune activity in the densely populated Thar Desert under future climate change. Such post-dictions (reconstructions) and predictions need to be made at the landscape scale, with the former requiring high sampling resolution across space and with depth to capture the spatio-temporal variations in dune accumulation history.

Fieldwork for the project was conducted in two seasons, supported partially by the Manchester Geographical Society Postgraduate Research Fund. The study utilises rapid-age estimates derived from the more cost effective and time-efficient portable luminescence reader signals (port-OSL), calibrated via a regression against existing laboratory-based luminescence ages. A total of 222 samples were collected from ten linear dunes along a 100km transect. IRSL/BSL signal ratios, depletion index and particle size analysis suggested a similar provenance for all samples from across the desert, demonstrating the feasibility of using calibrated port-OSL measurements for rapid age estimates.

Calibration of port-OSL measurements was carried out using ages of samples with previously established chronologies from central and northern Thar (n=40) as well as newly dated samples from arid western Thar collected as part of this study (n=4) and showed a good fit using a linear regression model approach (R_2=0.85). Palaeo-dune activity was then reconstructed by using the port-OSL age estimates. All investigated samples dated to the Holocene period, ranging between ~11ka to ~0.5ka, corresponding to port-OSL totals of 14 million and 0.2 million counts, respectively.

The patterns of accumulation suggest an eastward migration of the dunes in the recent past. A period of high accumulation was observed between ~8.5ka and 5.5ka in six of the ten dunes investigated, corresponding to the Holocene warm period during which the driving monsoon winds were stronger but also drier, creating favourable conditions for deflation and deposition in the Thar. This study demonstrates the utility of the port-OSL reader in reconstructing palaeo-dune accumulation at large spatial scales and the generated port-OSL calibration can now be used across the Thar desert for investigating dune activity rapidly and cheaply.

The results of this study were presented in the following two conferences:

1. Poster in UK Luminescence and Electron Spin Resonance Dating Meeting 2022 (UKLum22)
2. Oral presentation in Asia-Pacific Conference on Luminescence and Electron Spin Resonance Dating (APLED22)

Further work (Summer 2023):

Deeper samples will be collected using coring equipment and dated using traditional luminescence. This will improve the age range and the robustness of the port-OSL calibration. In parallel, a comprehensive landscape-scale linear dune study will be conducted across the Thar desert, shedding further light on dune development and migration in the past, and its relationship to the monsoon winds.