



Multidecadal wet and dry phases during the Little Ice Age: Palynofacies, dinoflagellate cysts and palynological evidence from the western Bay of Bengal

PREM RAJ UDDANDAM^{1,*}, PUJARINI SAMAL¹, JYOTI SRIVASTAVA^{1,2},
ABHA SINGH^{1,2}, SHALIN K HARI^{1,3}, ABHI S KRISHNA^{1,4} and P MORTHEKAI^{1,2}

¹*Birbal Sahni Institute of Palaeosciences, 53 University Road, Lucknow 226 007, India.*

²*Academy of Scientific and Innovative Research (AcSIR), Ghaziabad 201 002, India.*

³*Kochin University of Science and Technology, Cochin, Kerala, India.*

⁴*Mysore University, Mysore, Karnataka, India.*

*Corresponding author. e-mail: premraj@bsip.res.in

MS received 11 March 2024; revised 6 November 2024; accepted 17 November 2024

Little Ice Age (LIA; 1500–1900 CE) was the most recent cold period. The majority of the summer monsoon precipitation records show weakening of it during LIA. However, few studies have shown wet and dry phases, and southern Indian records show wet conditions. To assess the monsoon variability during the LIA from the western Bay of Bengal we studied dinoflagellate cysts, palynological and palynofacies records from the Bay of Bengal. The present high-resolution record reveals the presence of four phases: Phase I (1500–1700 CE) with high runoff discharge, followed by phase II (1700–1785 CE), which is a dry phase. Phase III (1785–1840 CE) shows a slightly strengthened monsoon, and phase IV (1840–2010 CE) is again a dry phase. In contrast to previously documented uniform cold and dry conditions from the Bay of Bengal, multidecadal wet and dry phases during the LIA are indicated. Primary productivity in the studied region is governed by both runoff-mediated nutrients and wind-driven mixing. High primary productivity since 1900 CE under dry conditions is governed by the enhanced mixing due to the weakening of summer and/or strengthening of winter winds over the western Bay of Bengal. The regional scale records show that the LIA, unlike a period of cold and dry conditions, is characterized by multidecadal scale wet and dry conditions governed by southwest and northeast monsoon intensity in southern India. The southward migration of ITCZ played a major role in the precipitation changes during the LIA.

Keywords. Indian summer monsoon; dinoflagellate cysts; Penna River; monsoon runoff; last millennium.

1. Introduction

Global temperatures show prominent warm and cold phases during the last millennium, such as the Dark Age cold period, the Roman warm period, medieval climate anomaly, the Little Ice Age

(LIA), etc. Monsoon records from the Indian and surrounding regions show prominent changes during medieval climate anomaly and LIA (Sinha *et al.* 2007, 2011; Shekhar *et al.* 2022). In general, the medieval warm period is known for high precipitation and strengthened monsoons (Sinha *et al.*