Late Quaternary Landscape Evolution of the Frontal part of Tripura Fold Thrust Belt, India: Connecting Climate and Tectonics

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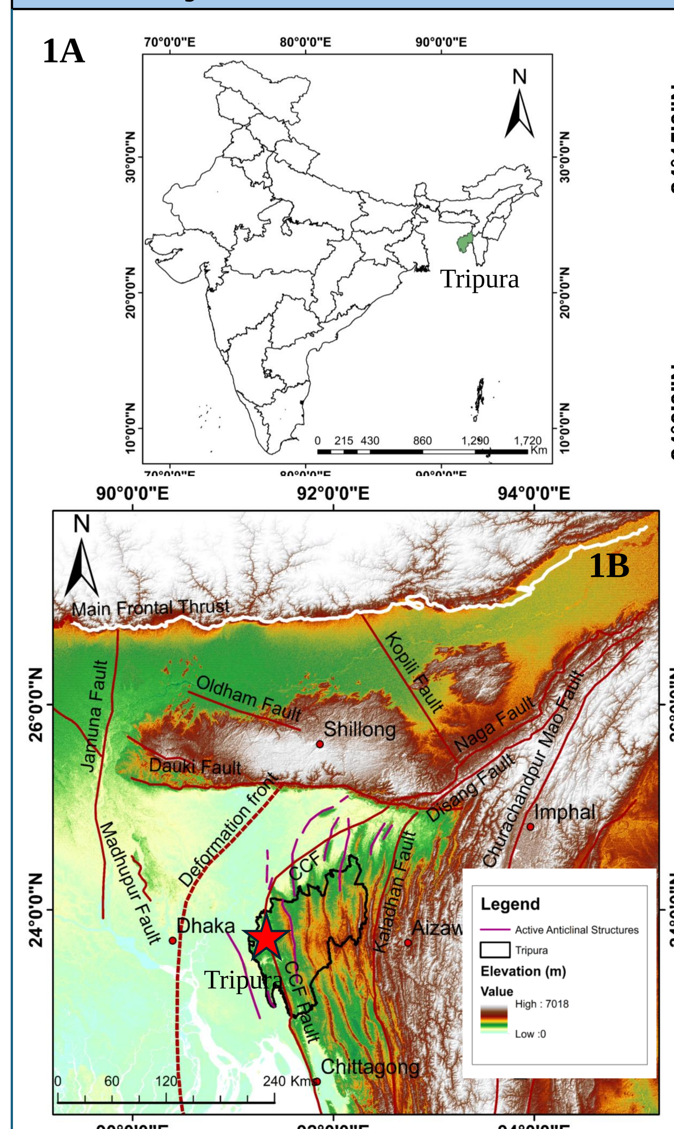
1. Introduction

The Tripura fold-thrust belt is located at the eastern fringes of the Bengal basin, which is also part of the Himalayan foreland basin. It is also considered situated at the outer wedges of deformation front of the Indo-Burmese ranges, eastern Himalayas. It has been developed due to the oblique collision of the Indian, Eurasian, and Burmese micro-plates over the past 2 million years, leading to new antiformal ridges in the western region. It comprises a series of N-S trending narrow antiformal ridges separated by wide synformal valleys. In North and East Tripura, the major rivers such as Khowai and Dhalai flow through the intermontane valley to the north, eventually merging with rivers in Bangladesh. Meanwhile, in West Tripura, rivers like Haora and Gomti flow westward, joining with rivers in Bangladesh. The shifting of major rivers like Khowai and Haora northwards within the antiformal ridges indicates neo-tectonic activities along the transverse fault. Recent Earthquake activities in the area also emphasize that the area is tectonically active. However, due to its inaccessible location, dense vegetation, and ongoing border disputes have resulted in limited research attention. Based on previous structural studies, a series of N-S trending parallel antiformal ridges show a progressive decreasing structural complexity from East to West; however, limited or no systematic studies are available to understand the sequential development of these ridges and valleys concerning tectonic and chronological framework. Our research aims to establish a geochronological framework in the late-quaternary geomorphic evolution of the Tripura fold-thrust belt which has been lacking

2. Study Area



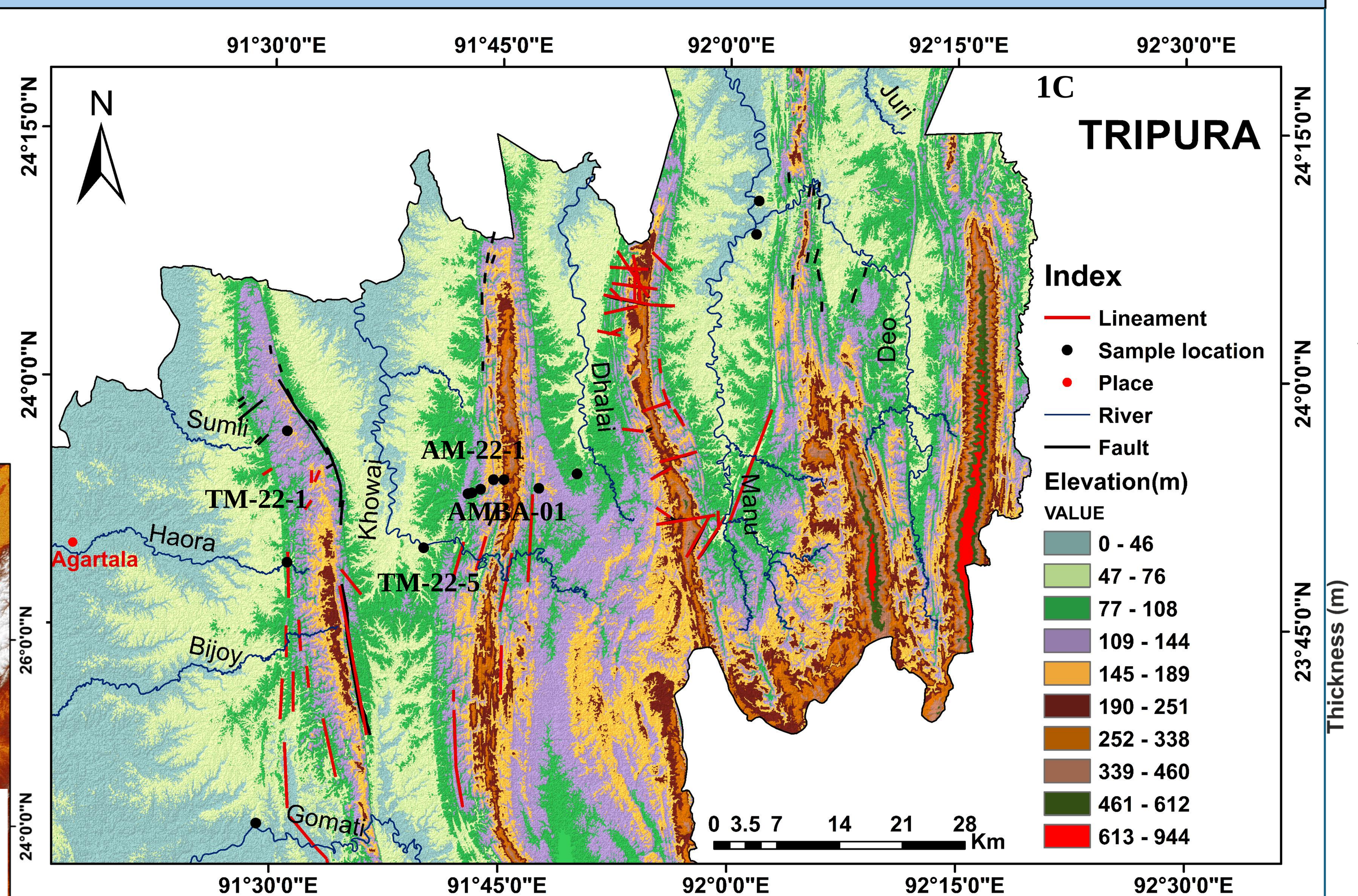


Fig.1A: Geographical location of Tripura in Indian subcontinent. 1B: Tectonic settings of Eastern Himalayas and adjoining Indo-Burmese Ranges (modified after Wang 2014, Hossain 2022), 1C: SRTM DEM (30 m) of Study area. Black points showing sample location for OSL from ridges and valleys (faults marked based on Wang 2014, Bhukosh, GSI)

3. Objective

- Understanding the geomorphic evolution from sedimentary record preserved in antiformal ridges and synformal valleys in time frame using optically stimulated luminescence dating method
- Understanding the role of climate and tectonics and their interactions in millennial scale

4. Methodology

4.1 Optically Stimulated Luminescence dating (OSL):

- Dates the last exposure of mineral grains to sunlight
- Main minerals used are quartz, feldspar
- Assumptions: Natural growth of luminescence signal can be imitated in the laboratory

Age= Equivalent Dose/Dose rate

➢ **Chemical Processing**

- Collect fluvial sediments for OSL
- 1N HCl treatment → 30% H_2O_2 → dry sieving
- Separate grains (90-150 µm) → Sodium polytungstate(2.59 g/cc) for quartz & feldspar separation
- Treat with 48% HF → 35%HCl
- Aliquot preparation & OSL analysis (Lexsyg Smart OSL Reader used)

4.2 Grain Size Analysis

- Particle size analyser using laser diffractometry technique was used to measure vol. % of the particles
- Each sample was measured five times (with an error < 5%), and the average value was calculated.

➢ Grain Size analysis

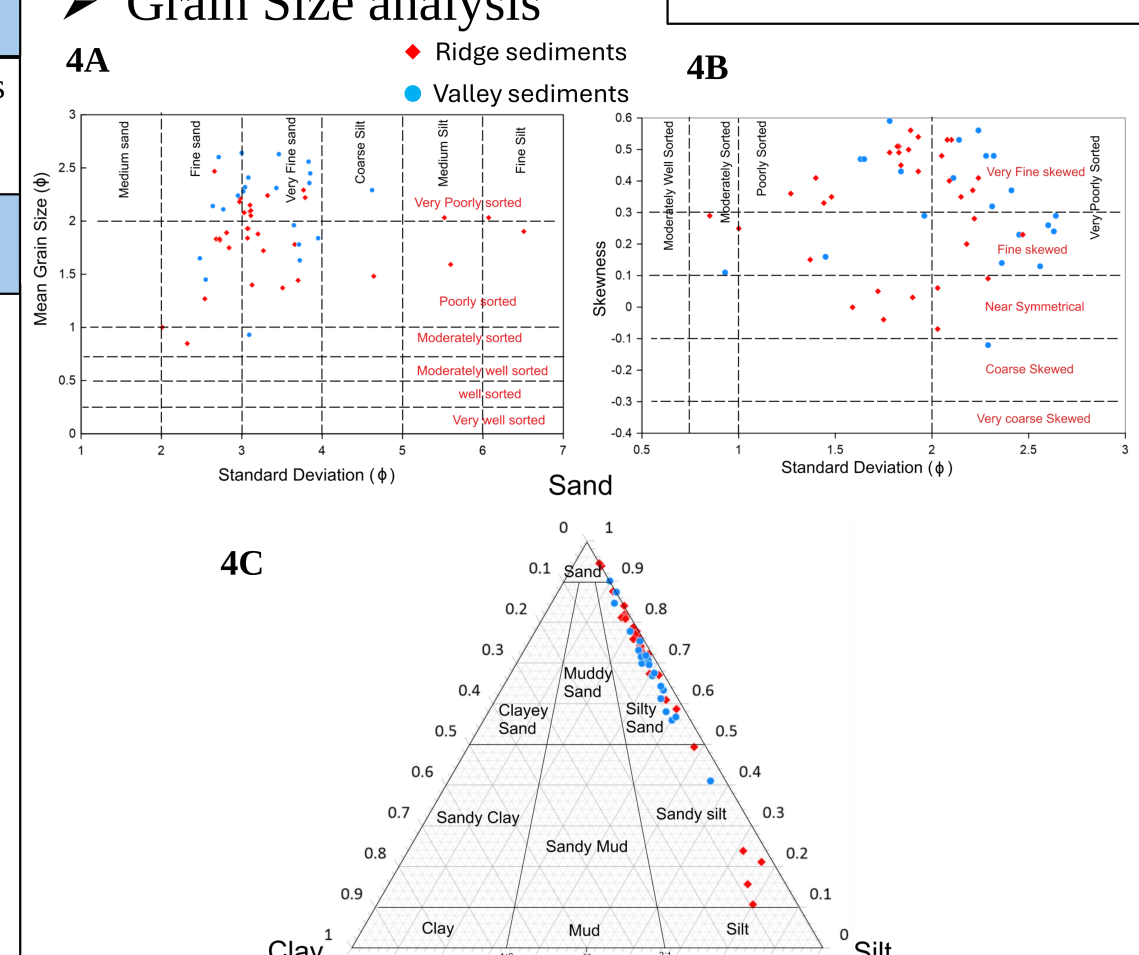


Fig 4A: Bivariate plot showing relationship between mean grain size and standard deviation ; Fig 4B: Bivariate plot showing relationship between skewness and standard deviation; Fig 4C: Ternary diagram showing percentage of sand, silt and clay of fluvial sediments (Folk and ward 1957)

5. Results

➢ 5.1 Lithostratigraphy and OSL ages

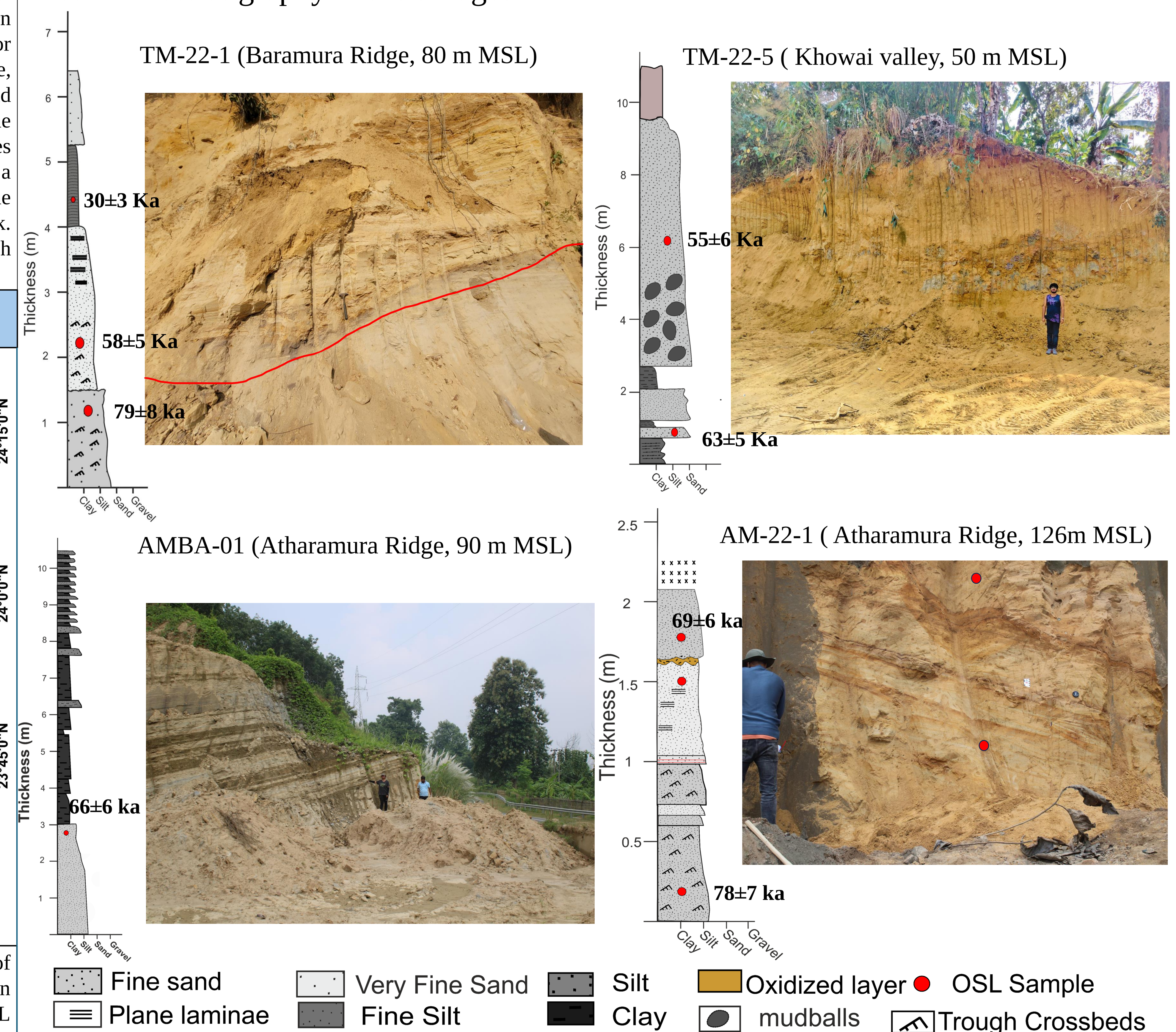


Fig:2 Field photographs and litholog section of the study area showing depositional ages

➢ The signal is dominated by fast component and most of the electrons are detrapped within 2 sec

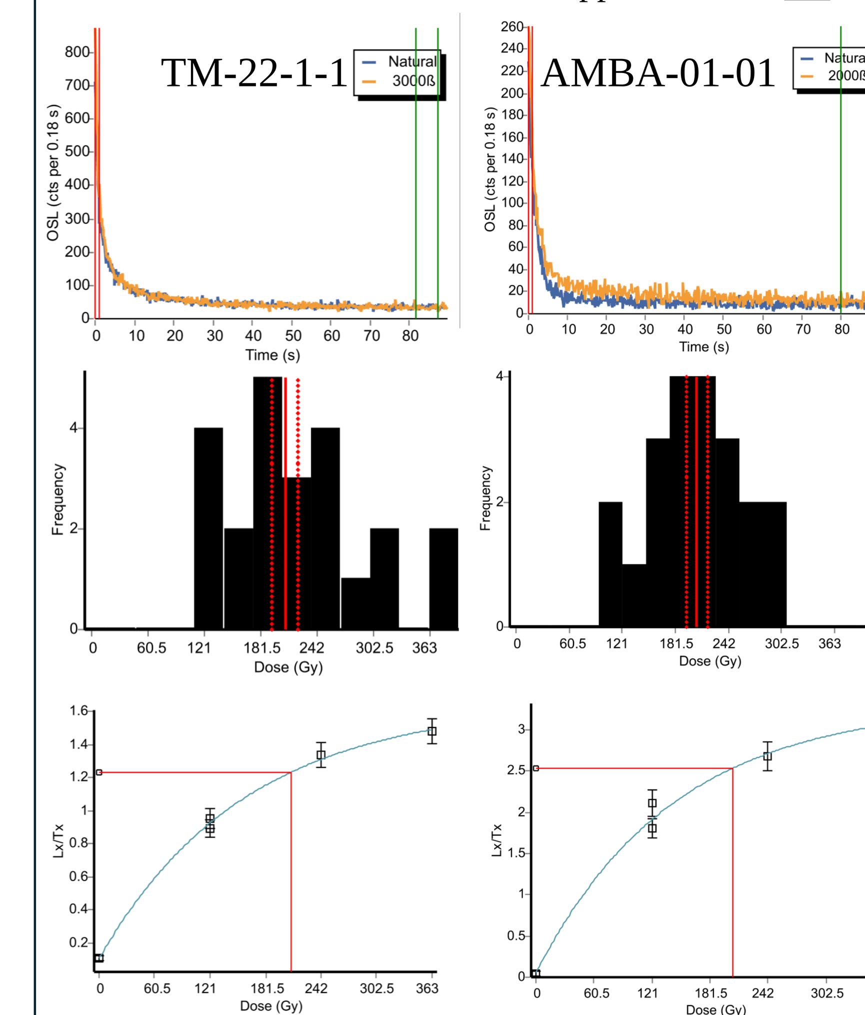


Fig: 3 Shinedown curve, Histogram and dose growth curve of 2 representative samples

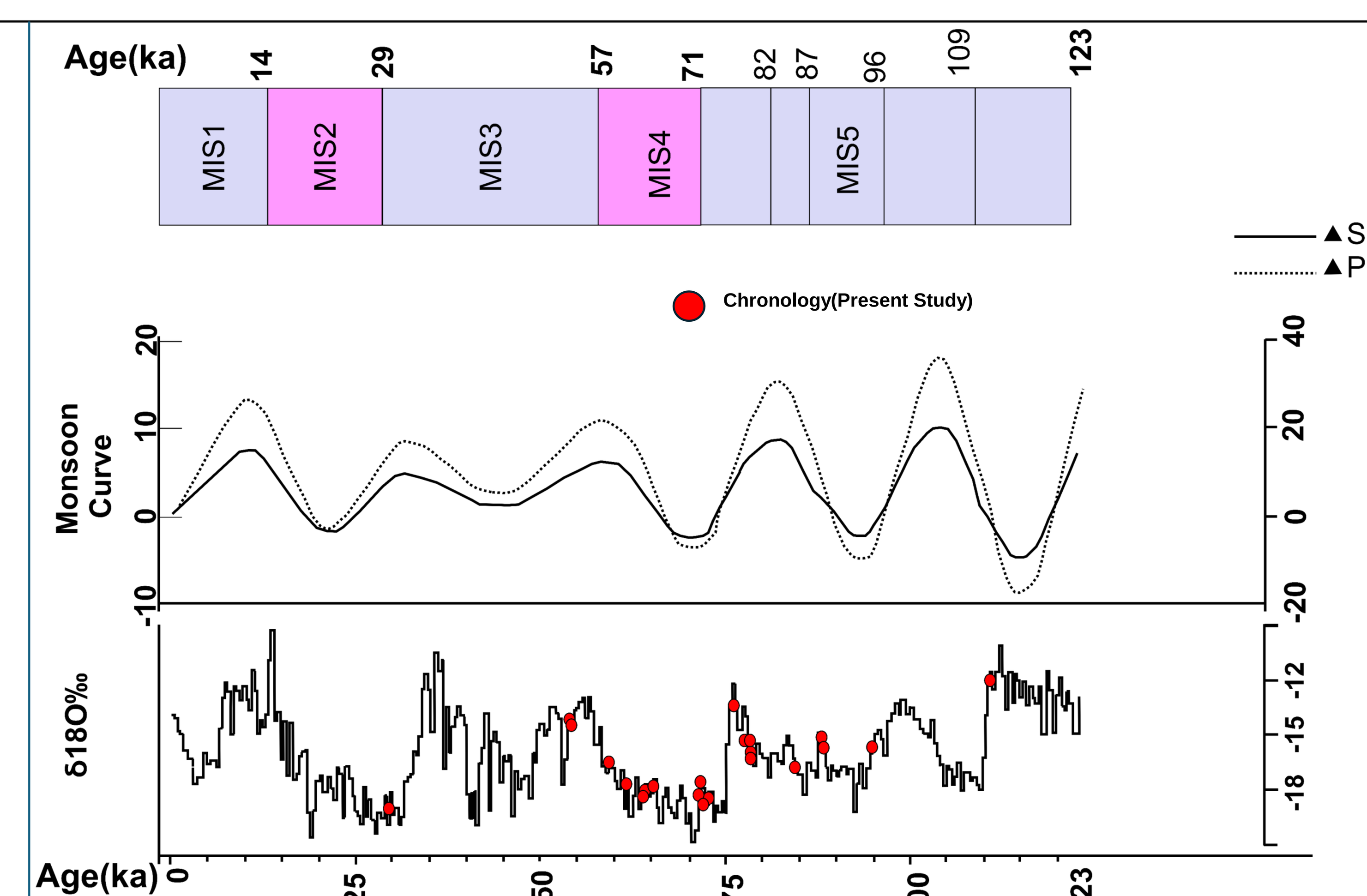


Fig:5 δ18O is the oxygen isotope data from the Guliya ice core (Thompson et al., 1997). P is simulated precipitation changes for southern Asia and S is Northern Hemisphere solar radiation (Prell and Kutzbach, 1987). Modified after Gibling et al., 2005; Waelbroeck et al., 2002; Singhvi et al., 2012. Strength of the Southwest Indian Monsoon based on modeling (from Prell and Kutzbach 1987),(modified Phartiyal 2022)

6. Summary

- Primary field observation suggests a thick deposition of unconsolidated sand and silt layers (fining upwards) indicating fluvial deposits preserved at the flank of antiformal ridges
- Based on grain size analysis, the sediments are mostly fine to very fine grained, poorly to very poorly sorted and positively skewed indicating fluvial deposits from both ridge and valley sediments.
- In the westernmost part, preliminary luminescence ages suggested that it was a depositional fluvial system during 80 ka or even older than that and continued to deposit till 53 ka
- Due to tectonic activities, the Baramura and Atharamura ridges started to develop after 50 ka, evident from the luminescence date from the top layer of sand deposits preserved in the crest of the ridges
- Climate fluctuations significantly influenced sediment supply for fluvial deposition, which was subsequently affected by ongoing neo-tectonism in the Indo-Burmese ranges
- Additionally, it also corresponds with the transition during arid-humid phases that prevailed over the Northern Hemisphere in the global scenario

7. References

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8. Acknowledgement

➢ The authors acknowledge all the members of OSL Lab, IISER Kolkata for the discussions related to this work and for their valuable inputs and UGC for the financial assistance. Authors also acknowledge EGU for this opportunity for providing a platform to present our research work