Luminescence chronology of point bars and their utilization in past discharge estimation in the Southern West Bengal

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Introduction

- Oxbow lakes are abandoned sinuous loops of meandering river formed by continuous erosion on the outer arc of meandering river, these features are always associated with accretionary ridges made up of packages of sand and silt known as Point bars.
- Morphology of oxbow lakes is largely controlled by discharge and underneath geology from which river drains. However grain size carried by river also shapes the oxbow lakes.
- Point bars consists rhythmic stratas composed of sand and silt (up to clay also). These stratas store information regarding energy condition in form of sedimentary structures.
- Palaeo-discharge is ancient discharge carried by a river, it has been widely incorporated in several geological studies as climate reconstruction and especially disaster management.
- Wavelength, width, depth and grain size of any meandering river can be empirically related for discharge calculation (Schumm 1968, Carlston 1965, Dury 1976).
- Luminescence dating is one of the popular dating methods for quaternary sediments, it can be used to date fluvial deposits, associated with grain size analysis and sedimentological studies can be used for past energy fluctuations.
- Quantitative aspects of oxbow lakes (Wavelength, Width) and grain size fraction are used to calculate the discharge values for the dates acquired by luminescence dating.

Objectives

1. To calculate the palaeo-discharge using the morphometric aspects and grain size fractions from oxbow lakes and point bars respectively.

2. To decipher the fluvial evolutionary history and monsoonal fluctuations using point bars.

Study Area

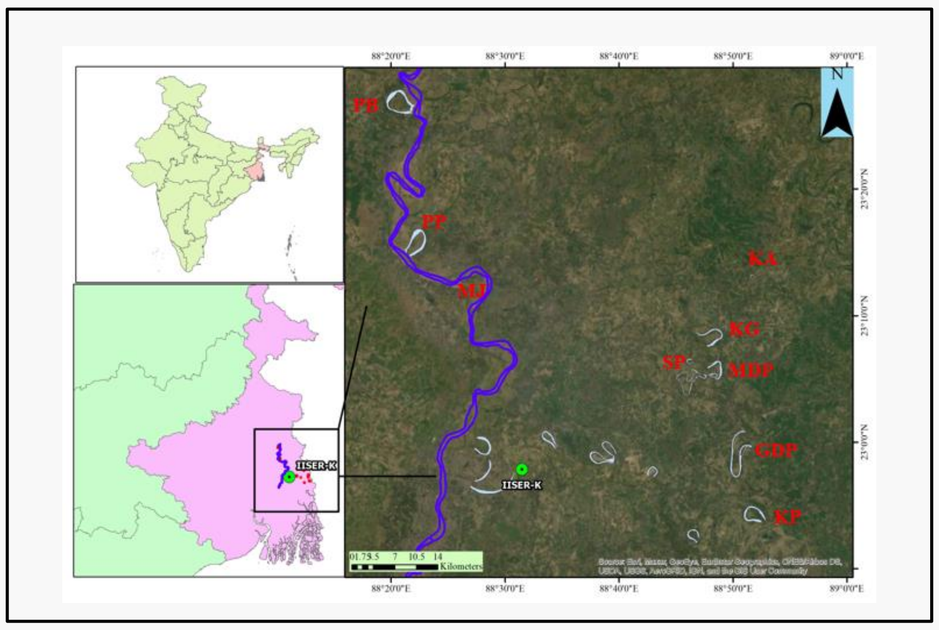

Fig.1. Satellite imagery of the study area taken from Google Map.

Results

S No.	Sample	Mean Size(Mz)	Skewness(SK)	Kurtosis(KG)
12	GD	2.16 to 2.43	0.06 to 0.36	1.04 to 1.53
1	MJ	2.73 to 3.68	-0.13 to 0.23	1.11 to 1.64
7	MDP	4.32 to 4.96	0.22 to 0.33	0.99 to 1.13
13	KD	3.04 to 4.80	0.05 to 0.13	1.04 to 1.54

S No.	Sample	U	Th	K	Dose Rate	Age
16	GD-2	3.9±0.20	6.5±0.3	1.7±0.09	2.78±0.08	3.38±0.1
17	GD-4	3.8±0.19	13.8±0.7	1.76±0.09	3.28±0.09	0.33±0.2
1	MJ-1	3.3±0.17	14.2±0.7	2.05±0.10	3.41±0.10	1±0.4
2	MJ-2	3.5±0.18	16.2±0.8	1.67±0.08	3.28±09	0.56±0.3
10	MDP-1	3.2±0.16	16.3±0.8	1.92±0.10	3.40±0.10	0.35±0.1
11	MDP-3	3.1±0.16	15.1±0.8	2.1±0.11	3.51±0.10	0.58±0.2
22	KD-1	3±0.15	18.8±0.9	2±0.10	3.58±0.10	2.78±0.1
23	KD-4	3.2±0.16	20.2±1.0	1.9±0.10	3.61±0.10	2.33±0.2

S No.	Sample	Radius	Width	Wavelength	Silt+Clay	River	Discharge (Schumm)	Discharge (Carlston)
16	GD	587	335	1200	13.24	JMN	79	876
4	MJ	2335	476	3600	11.24	HGY	1487	14449
8	MDP	292	129	800	40.34	ICM	278	212
14	KD	661	129	1140	28.65	JMN	377	1115

$$L = 1890Q_m^{0.34}/M^{0.74} \quad \text{(Schumm, 1968)}$$

$$Q = (L/106.1)^{2.18} \quad \text{(Carlston, 1965)}$$

Note: All values are calculated after verification with present day known discharge values.

Table consisting Grain size analysis, Age, and Discharge data

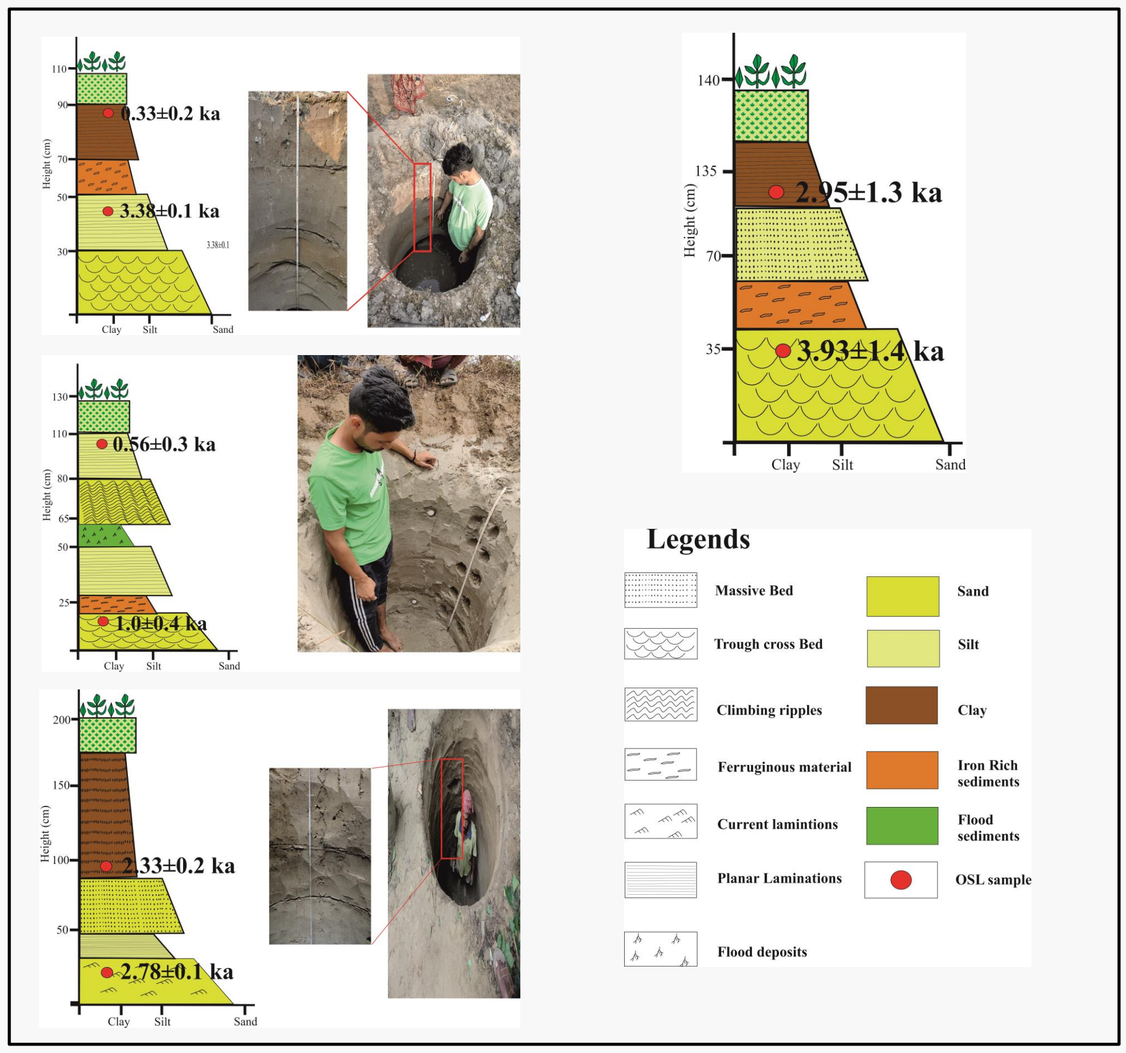

Fig.2 Lithologs for the sampled point bar dig holes.

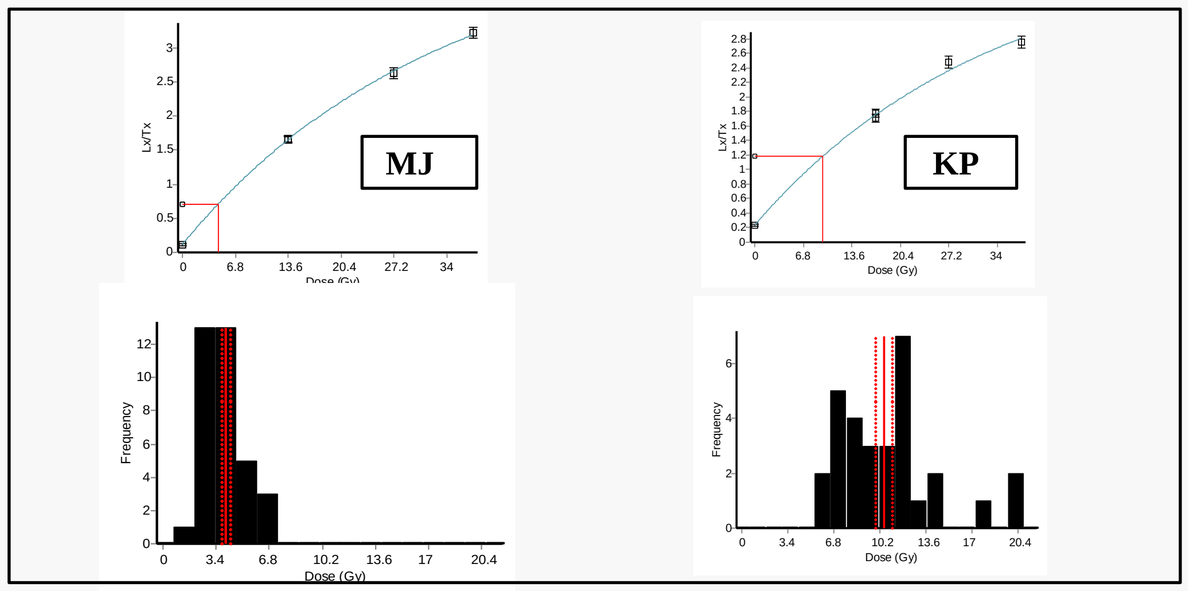

Fig.3. Dose growth and histogram plot (Ed) for samples MJ and KP.

Discussion

- Grain size analysis gives Mz, SK, KG for the sediments from different depth Mz varies from 2.16 to 4.96, whereas Skvaries from a minimum -0.13 to 0.36 and KG ranges from 0.99 to 1.64.
- OSL dates lies within typical climatic periods of late quaternary . These dates lies in between a minimum with age from Little Ice Age 0.33±0.2 and maximum close to Meghalayan aridification time 3.93±1.4.
- Discharge values ranges from a minimum of 212m3/s when climatic dry period has been recorded upto 14449 m3/s when there was a period of high discharge.

Conclusion

- Grain size analysis and remote sending studies enabled us to calculate the discharge values from different shapes of oxbow lakes, this methods of past discharge calculation can be a proxy for river not belonging to bedrock rivers.
- Paleochannel demarcation along with OSL dates provide a detailed fluvial evolutionary history of the area. MWP has flooded rivers with high discharge on contrary dry periods has caused ceasing of discharge and causing rivers to change their path and inturn abondoned.
- Inferences from data pertaining to point bars has been consistent with pre established monsoonal records, thus point bars has the potential for continental proxy for monsoonl reconstruction.

Acknowledgment

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Reference

- Schumm, S. A. (1968). River adjustment to altered hydrologic regimen, Murrumbidgee River and paleochannels, Australia (Vol. 598). US Government Printing Office.