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Mechanical analysis of the Lauchapara Formation from the Susang Hills, Sherpur, Bangladesh: Implication for sedimentary environment

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Abstract

Mechanical analysis of the Lauchapara Formation following ASTM (D422-63) and BS 410 standard methods was carried out to depict the mode of sediment transportation as well as depositional process of the formation. This coarse-grained rock unit is outcropped along the lower course of Dumurtala Jhora, Karna Jhora and Jhulgaon Jhora streams in the south-western portion of the Susang Hills. Through detailed field survey, total five lithofacies were identified from two major outcrops of the Lauchapara Formation, namely: Massive sandstone facies (Sm), Parallel laminated sandstone facies (Sh), Trough cross-bedded gravel facies (Gt), Trough cross-bedded sandstone facies (St) and Massive mud facies (Fm). Representative samples were also collected and analyzed from these facies. The Sm facies are moderately sorted, fine to strongly fine skewed, platykurtic to leptokurtic, strongly fine to fine sand; St facies are moderately sorted, fine skewed, leptokurtic, fine sand; Sh facies are moderately sorted, strongly fine skewed, leptokurtic to very leptokurtic, fine sand; and Gt facies are moderately sorted, fine skewed, very leptokurtic, coarse sand. Bivariate scatter plots suggest that this formation is composed of moderately sorted, strongly fine skewed, fine to coarse sandstone with occasional sparsely distributed gravels. In some outcrops, laterally extended thick gravel bed was also observed. CM pattern reveals that the Lauchapara Formation might be deposited through rolling to minor suspension, under high energy current of a braided stream. Inferring from the facies association of the Lauchapara Formation and tectonic position of the Susang Hills, it may be suggested that the formation was likely deposited under alluvial fan environment.

Keywords: Dauki Fault Zone, Braided stream, Alluvial fan, Lithofacies.

Introduction

The study area, the Susang Hills, south western prolongation of the Garo Hills is located at the junction of the uplifted Shillong Plateau and Northern Piedmont Plain of Sherpur district, traversed by the Dauki Fault (REDAY *et al.* 2023). The area is marked by high seismicity and has become the home of several major earthquakes. This

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tectonic activity and high relief along with intense southwestern monsoon largely control the sedimentation pattern as well as river morphology of this region (PICKERING *et al.* 2014; REDAY *et al.* 2023). The huge sediment-water originating from the highs of the Shillong Plateau is transported by following a pathway that traverses toward south through the piedmont plain into the depressional wetlands (SAHA & KHAN 2015).

Now a days, the joint approach of granulometric and textural analyses is widely used to identify and provide basic information on sedimentation processes. According to MCCAVE & SYVITSKI (1991), the sediment transportation history through sediment depositional circumstances can be revealed through granulometric studies. The link between different grain size metrics has also been effectively applied in several research for the understanding of sedimentary environments and depositional setting (FOLK 1954; FOLK & WARD 1957; FRIEDMAN 1961; VISHER 1969; BLOTT & PYE 2001; ALSHARHAN & EI-SAMMAK 2004). The relative efficiency of particle-size descriptors may be explored and patterns of sediment dispersion can be discovered utilizing multivariate approaches, especially the histogram (FRANCKE *et al.* 2013). Multivariate approaches also generate automatic findings based on a variety of sediment variables, avoiding individual sample analysis (CHAMBERS & UPCHURCH 1979).

There are very limited published granulometric studies on sedimentology of this area and the proposed stratigraphic column is not yet nationally accepted. This research is motivated to present a comprehensive statistical analysis of sediment grain size distribution and to explain the relationship between Quaternary sediment distribution and depositional mechanism of different facies of the Lauchapara Formation.

Geology and Tectonic Setting

The study area covers the northern part of the Sherpur district, Bangladesh and lies in the mid-northern part of Bangladesh adjacent to the Dauki Fault Zone (DFZ). The DFZ is a major active east-west stretching tectonic element (DAS *et al*. 1995), whose outcrop-level thickness is ~ 5–6 km (JOHNSON & ALAM 1991). The landscape evolution and sedimentation style of this region is highly influenced by the Dauki Fault. The Shillong Plateau to the north and Sylhet Trough to the south had experienced their origin owing to the upliftment and subduction, respectively along the DFZ. The north-dipping transpressional DFZ with a dextral strike-slip component has activated since the latest Miocene (BILHAM & ENGLAND 2001; BISWAS & GRASEMANN 2005; GOVIN *et al.* 2018; HOSSAIN *et al.* 2020a; HOSSAIN *et al*. 2021). The geological development of the DFZ is directly linked with the N–S shortening related to the Indo-Eurasian collision (GOVIN *et al*. 2018; HOSSAIN *et al.* 2019). However, the geological development of the eastern side of the DFZ is also influenced by the east-west collision of the Indo-Burmese plates (YANG *et al.* 2020; HOSSAIN *et al.* 2022). In the last few hundred years, the DFZ and its adjacent area have experienced several major earthquakes (BILHAM 2004; HOSSAIN *et al.* 2016, 2019). The last rupture along the DFZ occurred in 1897, which produce the Great Indian Earthquake and caused significant damage. According to the earthquake zonation map of Bangladesh (HOSSAIN *et al.* 2020b), the study area falls in the Earthquake Zone III indicating a high risk zone.

The Holocene stratigraphy of the Bengal Basin has been formed continually by the unconsolidated sands and muds, which were transported and deposited by the fluvial process of the Ganges, Brahmaputra, and Meghna River systems (PICKERING *et al.* 2014). The estimated average sediment load for the Brahmaputra-Jamuna River channel is about 590 Mt/yr (DELFT HYDRAULICS and DANISH HYDRAULIC INSTITUTE, 1996) and the current lateral migration rate is about >100 m/yr (EGIS, 1997). Therefore, lateral continuity is eliminated and results a complex stratigraphy. Moreover, the unconsolidated nature of these sediments creates a barrier to the study of active geologic structures along the low hillocks and terrace area.

Stratigraphy

The stratigraphic column of the Susang Hills area has not yet been established. REIMANN (1993) took a preliminary step and proposed a stratigraphic succession for the exposed Plio-Pleistocene formations of the Susang Hills. The overall stratigraphic succession of the study area is given in Table 1.

Table 1. Stratigraphic succession of the Susang Hills (modified after REIMANN 1993)

Age	Established Formation		Proposed Formation	Lithology
Holocene	Alluvium		Colluvium	Grey to light brown colored, loose, sand dominated piedmont deposit with poorly to moderately developed soil at the top
				………………??????????.........................
Pleistocene	Dihing		Lauchapara	Yellowish white to light grey colored, medium to coarse grained, very loose, partially arkosic, occasionally cross bedded sandstone
				…...................*Unconformity*…………………
Plio-Pleistocene	Dupi Tila	Upper	Bilkona	Mainly mottled clays with white arkose-grits and massive sandstone; feldspar weathered kaolinite makes the sandstone white color
				…...…..……..*Unconformity*………………….
		Lower	Dumurtala	Alternating poorly sorted greyish brown sandstone, conglomerates and claystone; cross bedding and channeling are common; conglomerates contain two different types of pebble

Materials and Methodology

In all, 8 samples from five lithofacies of two major outcrops of the Lauchapara Formation were collected for detailed sedimentological analysis during the fieldwork. Each sample was weighted roughly 0.5 to 1.0 kg during sample collection. According to ASTM (D422-63) standard, about 50 gm sample is required for clayey sediments and 100 gm sample is required for sandy sediments to perform particle size analysis. Sodium hexametaphosphate solution (40 g/L) as dispersing agent, ASTM 152H hydrometer and thermometer accurate to 1˚ F (0.5˚ C) were used for particle size distribution analysis. About 200 gm sample was dried at first under sunlight and then dried in oven at (70˚ to 80˚C) for 24 hours to remove sediment moisture. About 100 gm (as most samples are sandy) oven dried sample was placed in the 250-mL beaker, then covered with 125 mL of sodium hexametaphosphate solution (40 g/L) and stirred until the sample is completely wetted. The mixture was then allowed to soak for at least 16 hours. After the completion of the soaking phase, the sample was dispersed further by means of stirring tool. Just after dispersion, the sediment-water slurry was transferred to the sedimentation cylinder, and added distilled or demineralized water until the total volume is 1000 mL. The open end of the cylinder was then closed by using hand palm or a rubber stopper and turned upside down and back for a period of 1 min to complete the agitation of the slurry. After that phase, the cylinder was set in a convenient location and took hydrometer readings at the following intervals

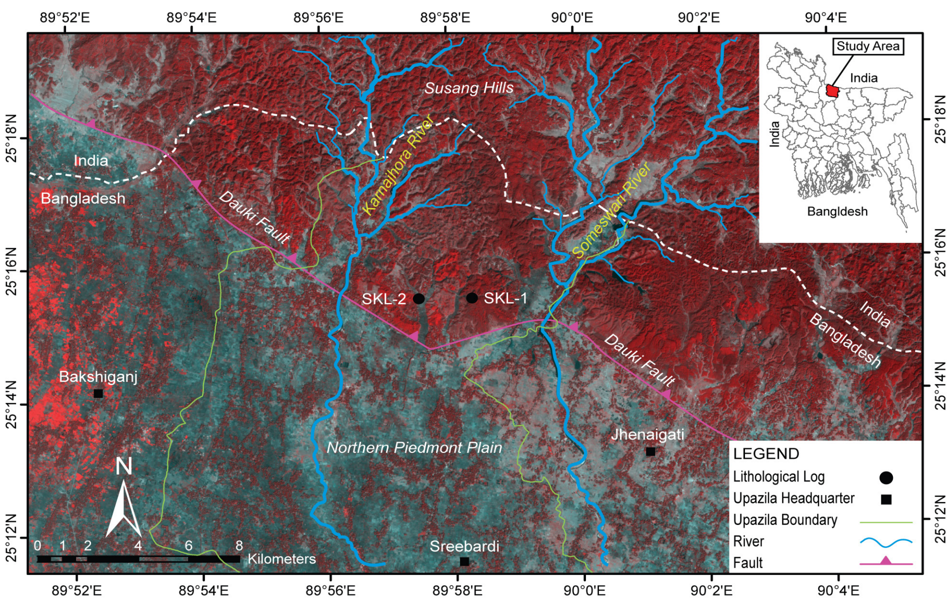

Fig.1. Location map of the study area on false color composite image that processed from Sentinel-2B satellite image (10 m resolution) with bands 3, 4 & 8. Here, white dashed line represents the international boundary between Bangladesh and India.

of time (measured from the beginning of sedimentation), or as many as may be needed, depending on the sample or the specification for the material under test: 0.25, 0.5, 1, 2, 5, 15, 30, 60, 120, 240, 480, 720, 1440 min. The temperature was recored by inserting the thermometer into the suspension immediate after each reading. After taking the final hydrometer reading, the suspension was transferred to 0.063 mm sieve and washed with tap water until the wash water was clear. Then the retained portion was dried in an oven at 110°C and made a mechanical analysis (BS 410) using 6 sieves (2 mm to 0.063 mm). Specific gravity of soil samples was also determined by following BS 1377 procedure.

Lithofacies Analysis

REIMANN (1993) has proposed a stratigraphic succession for this region, where the Dihing Group equivalent to the Quaternary Lauchapara Formation that unconformably overlies the Lower Dupi Tila Group equivalent to the Dumurtala Formation at the study area. During the field study, two lithological logs were constructed within this Lauchapara Formation alongside the Karnajhora-Ghazni Obokash Kendro road. The Hill soils were developed over the Lauchapara Formation. In general, this formation is composed of yellowish-white to light-grey and yellow-brown, fine to coarse grained, very loose, partly arkosic, occasionally cross bedded sandstone (REIMANN 1993). The facies of the outcrops were carefully observed, analyzed, nomenclatured and coded following MIALL (1978) as follows:

Massive sandstone facies (Sm) is composed of light brown colored, moderately sorted, fine to medium sandstones with lack of internal stratification. The thickness of this facies (Fig. 2a, b) varies from tens of centimeter to couple of meter scale and extends laterally for meters to tens of meters. Occasionally sparsely distributed, dark colored Fe/Mn nodules and clay galls are noticed at different locations within this facies. This coarse grained facies is the result of high energy sediment transportation or high seasonal load. MORISON & HEIN (1987) interpreted *Sm* as heavy sediment laden water current deposits of waning periods of a flood stage.

Parallel laminated sandstone facies (Sh) is composed of whitish grey colored, moderately sorted, fine sandstone to silt. Oxidation, leaching and clay illuviation are very common in this facies (Fig. 2c). Lateral extension is limited with a thickness of meter scale. Suspension dominated settling leads to form laminae in fine sandstones and silts from weakening flood water. This is also evidenced by the plethora of fine grained mica.

Trough cross-bedded gravel facies (Gt) is well defined by shallow scour that generally form parallel to current flow direction. This facies (Fig. 2i) consists of moderately sorted, sub-angular to sub-rounded clasts of igneous and/or metasedimentary rock. The thickness of this facies varies from couple of centimeter to tens of meter scale and extends laterally for meter to couple of meters. The foresets is tangential to basal scouring. This facies most commonly occur as channel floor lag deposits of braided river depositional sequence.

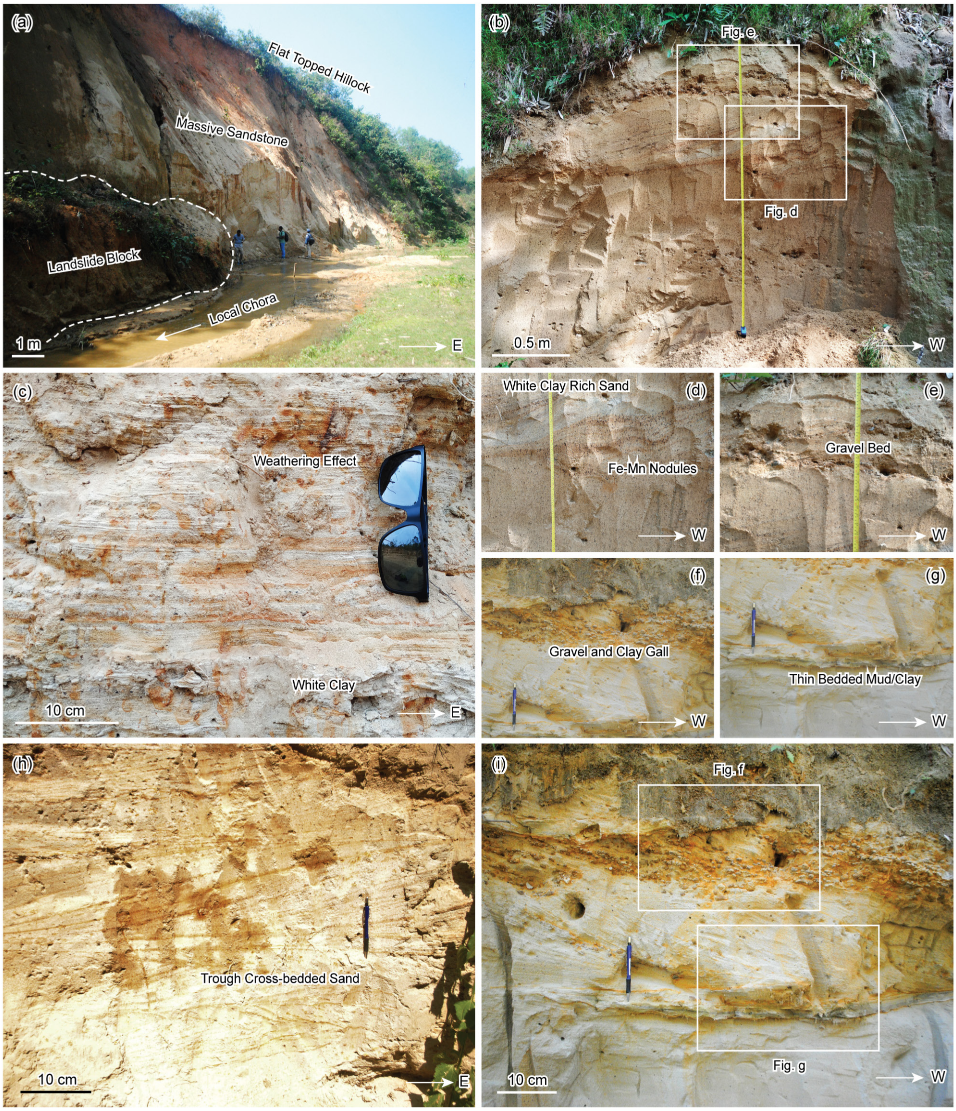

Fig. 2. Photograph showing (**a**) Massive sandstone facies at Jhulgaon section; (**b**) Massive sandstone facies at Karnajhora-Ghazni Obokash Kendro road cut section; (**c**) Parallel laminated sandstone facies at Karnajhora river section; (**d**) White clay rich sand and Fe-Mn nodules within massive sandstone facies; (**e**) Thick gravel bed within massive sandstone facies; (**f**) Gravel and clay galls within trough cross-bedded gravel facies; (**g**) Thin bedded clay/mud within sand; (**h**) Trough cross-bedded sandstone facies at Karnajhora-Ghazni Obokash Kendro road cut section; (**i**) Trough cross-bedded gravel facies and massive mud/clay facies at Karnajhora-Ghazni Obokash Kendro road cut section.

Trough cross-bedded sandstone facies (St) is composed of light brown to brown colored, moderately sorted, medium to coarse sandstones with internal trough -cross stratification. This facies (Fig. 2h) is very much characterized by shallow scour that form corresponding to present stream course. Lateral extension is relatively narrow with a thickness of centimeters scale. The troughs are regularly stacked on each other and may show a decrease in grain size toward down current direction. This deposits commonly developed in the channel sandstone bodies that are the resultant of scoured channel due to sediment laden floodwater that filled them as transporting energy fallen (FIELDING 1986).

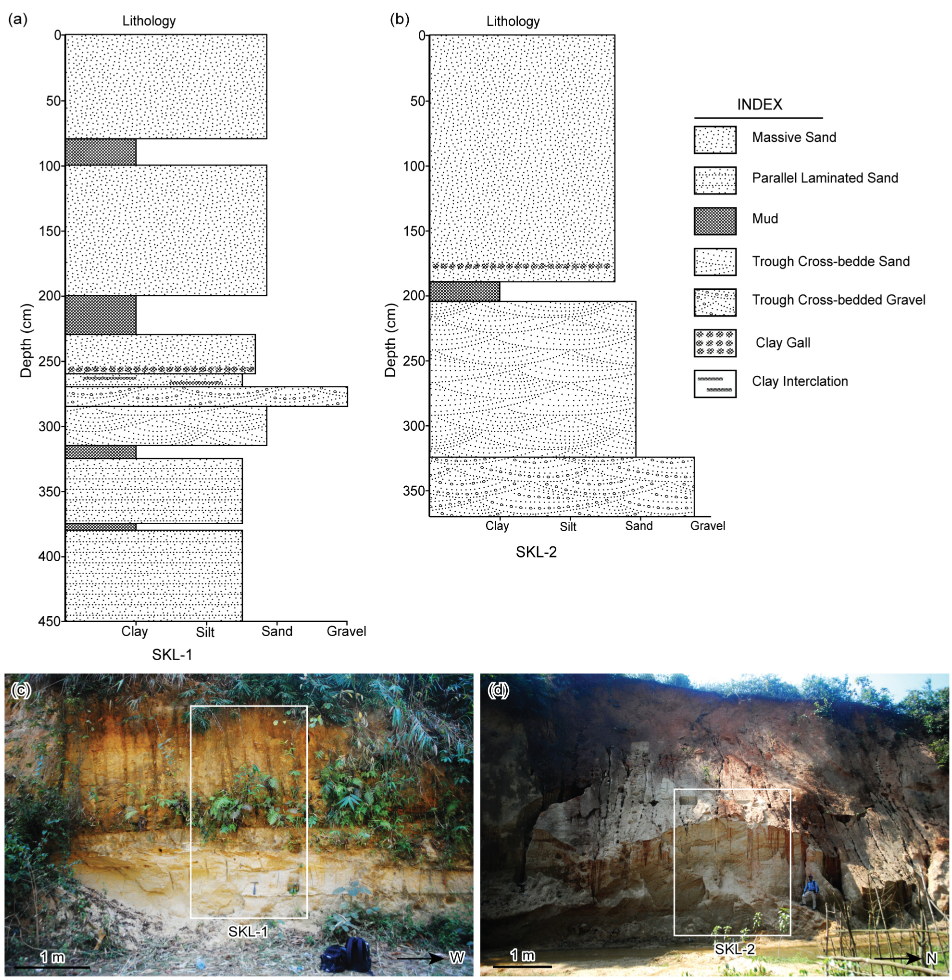

Fig. 3. Illustration showing (**a**) Lithological log of the Lauchapara Formation exposure at Karnajhora-Ghazni Obokash Kendro road cut section; (**b**) Lithological log of the Lauchapara Formation at Jhulgaon section. Photograph showing the Lauchapara Formation outcrop at (**c**) Karnajhora-Ghazni Obokash Kendro road cut section and (d) Jhulgaon section.

Massive mud/clay facies (Fm) is characterized by dark colored, compacted, silt and clay with scarce of internal structure. The thickness of this facies (Fig. 2g, i) varies from couple of centimeters to tens of centimeters. Organic matter is found occasionally within this facies. These are deposited when turbulence was minimum and during the waning of flood. This fine grained facies is the result of low energy sediment transportation and deposition under clam and quite condition.

Textural Analysis

Sedimentary textures are those characteristics of sedimentary rocks that result from the size, shape, and orientation of individual sediment grains (BOGGS 2001). The physical processes of sedimentation are primarily responsible for the growth of siliciclastic sedimentary rock's textures. The size of particles in a particular deposit reflects the denudation processes (BOGGS 2001). Grain size distribution is also an important indicator of processes operating within a sedimentary system (RAHMAN & HUQ 2000). FOLK & WARD (1957) have used statistical parameters of graphic mean, standard deviation, skewness and kurtosis to deduce depositional environment of clastic sediments. While, PASSEGA & BYRAMJEE (1969) took an attempt to establish a relationship between textural and depositional processes, rather than between texture and depositional environment.

Grain Size Parameters and Bivariate Scatter Plots

Grain size parameters are some fundamental attributes of siliciclastic sedimentary rocks. These parameters are derived from mechanical analysis (dry sieving and hydrometer sieving) data by adopting some statistical operation. It is one of the common method used in laboratory to deduce grain size parameters. The following grain size parameters (Table 2) were evaluated by utilizing FOLK & WARD (1957) procedure.

Mean (M_Z), sorting (σ_i), skewness (Sk_i), and kurtosis (K_G) are the four basic sediment textural element commonly applied to recreate the depositional environment of sediments (FOLK 1954). Extensive research from a variety of present and ancient sedimentary settings have demonstrated a link between textural elements and sediment transporting and depositional mechanisms (FOLK & WARD 1957; MASON & FOLK 1958; FRIEDMAN 1962; VISHER 1969; VALIA & CAMERON 1977; RAMAMOHANARAO *et al.* 2003).

The mean grain size of the sediments of the Lauchapara Formation ranges from 0.73ϕ to 3.03ϕ, which belongs to coarse to fine sand (Fig. 4a). The mean size of the sediments advise low to moderate levels of energy of the depositional process at the Susang Hills, because along their depositional paths, sediments get finer as the

Table 2. Showing interpretation of FOLK & WARD (1957) parameters for different facies

Lithofacies	Sample No.	Graphic Mean M_Z	Standard Deviation σ_i	Skewness Sk_i	Kurtosis K_G
Massive sandstone (Sm)	SKL-1/1	2.90ϕ (fine sand)	1.21ϕ (moderately sorted)	0.22 (fine skewed)	1.15 (leptokurtic)
	SKL-1/2	3.03ϕ (very fine sand)	1.02ϕ (moderately sorted)	0.40 (Strongly fine skewed)	0.85 (platykurtic)
	SKL-1/3	2.70ϕ (fine sand)	1.15ϕ (moderately sorted)	0.24 (fine skewed)	1.23 (leptokurtic)
	SKL-2/1	2.77ϕ (fine sand)	1.34ϕ (moderately sorted)	0.33 (Strongly fine skewed)	0.61 (very platykurtic)
Trough cross-bedded sandstone (St)	SKL-1/4	2.63ϕ (fine sand)	0.95ϕ (moderately sorted)	0.25 (fine skewed)	1.50 (leptokurtic)
Parallel laminated sandstone (Sh)	SKL-1/5	2.97ϕ (fine sand)	0.90ϕ (moderately sorted)	0.54 (Strongly fine skewed)	1.64 (very leptokurtic)
	SKL-1/6	2.97ϕ (fine sand)	0.92ϕ (moderately sorted)	0.41 (Strongly fine skewed)	1.28 (leptokurtic)
Trough cross-bedded gravel (Gt)	SKL-2/2	0.73ϕ (coarse sand)	1.26ϕ (moderately sorted)	0.28 (fine skewed)	1.71 (very leptokurtic)

energy of the transporting medium declines. (FOLK 1980). The standard deviation monitors sediment sorting and reflects changes in the depositing agent's kinetic energy or velocity conditions (RAMANATHAN *et al*. 2009). The sorting results of the sediments ranges from 0.90ϕ to 1.34ϕ and belongs to moderately sorted (Fig. 4b). Skewness is a sensitive measure of subpopulation mixing and the energy conditions of the depositional environment. The skewness values of the surface sediments ranged from 0.22 to 0.54. These values of sediments show that they are of fine to strongly fine skewed type (Fig. 4c). The values of skewness for all sediments display a limited range of variances. The flow characteristics of the depositing medium are reflected in the kurtosis values. The kurtosis values of the sediments range from 0.61 to 1.71 and classified as very platykurtic to very leptokurtic type (Fig. 4d). According to FRIEDMAN (1962), the measurements of kurtosis suggest that some of the sediments were sorted under high-energy conditions elsewhere.

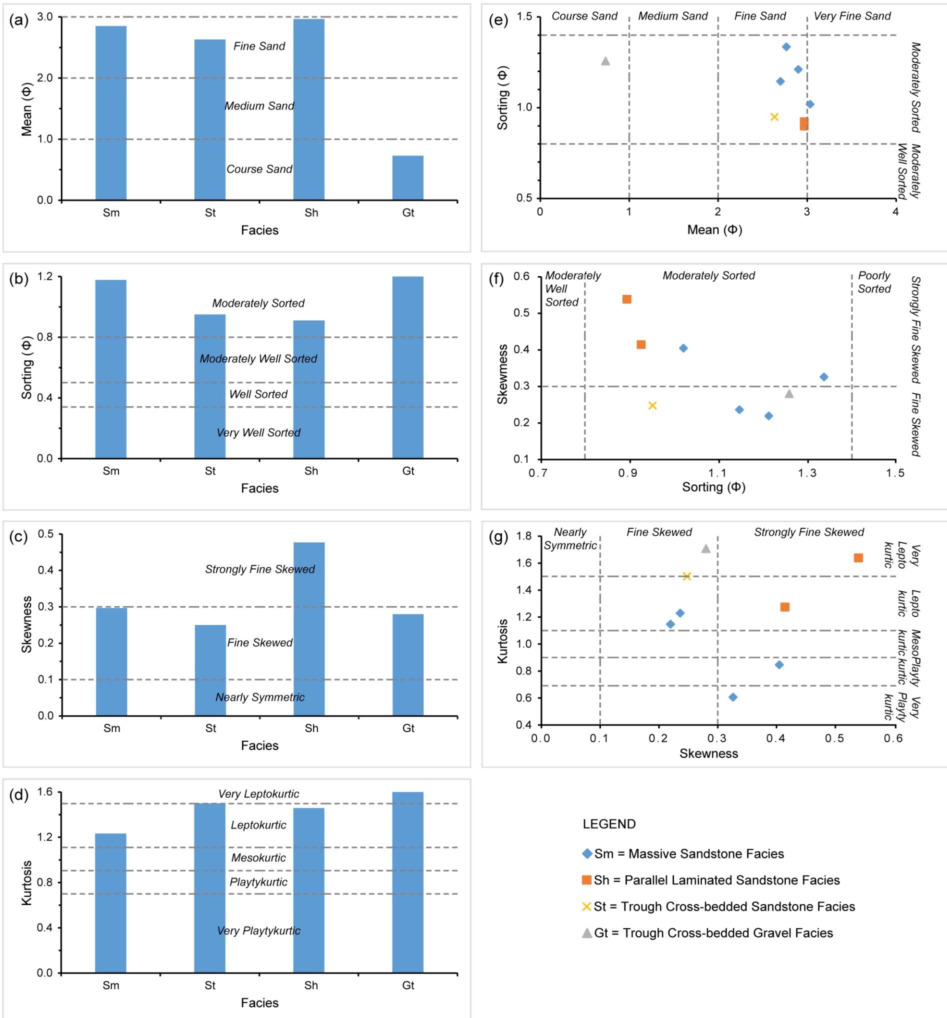

Fig. 4. Overall outcomes from different statistical analysis of several grain size parameters (**a**) result of mean, (**b**) sorting of sediment, (**c**) result of skewness, and (**d**) result of kurtosis. Statistical plot showing the bivariate relationship between (**e**) mean and sorting, (**f**) sorting and skewness, and (**g**) skewness and kurtosis.

Scatter plots between certain textural elements are also useful to distinguish among different depositional environments, infer the energy conditions, medium of transportation and recognizing environmental context (FOLK 1980). The bivariate scatter plots of mean versus standard deviation, standard deviation versus skewness, and skewness versus kurtosis can properly infer the relationship between different parameters and how it translates to illuminate the nature of the depositional environment and hence, these plots have been constructed. Figure 4e shows that all the samples that belong to coarse to fine sand group are moderately sorted. The mean grain size and sorting both are highly impacted by hydraulic condition, so it is expected that the fine sand size sediments should have the best sorting (GRIFFTHS 1967). Moreover, coarse sand size particles may also represent best sorting, depending upon the stability of their mineralogical composition. Figure 4f shows the correlation between sorting versus skewness. All the sediments fall into moderately sorting class with fine to strongly fine skewness (positively skewed). The graphical representation of skewness against kurtosis (Fig. 4g) reveals that the kurtosis values vary within a vast range from very platykurtic to very leptokurtic along with the positive skewness.

Modes of Sediment Transportation

The value of C (1 percentile) and M (50 percentile) are listed in Table 3. Following certain grain size (1 percentile and 50 percentile) of the samples are plotted on CM diagram (Fig. 5) according to PASSEGA & BYRAMJEE (1969). It appears that the value of C ranging from 378.93 µm to 2297.40 µm and the value of M ranging from 153.89 µm to 659.75 µm for the Lauchapara Formation, Susang Hills, Sherpur, Bangladesh. The highest value of C and M have been observed in the trough cross-bedded gravel facies (Gt) and lowest value of C and M have been observed in the parallel laminated sandstone facies (Sh) among the studied samples of the study area. All the samples of the study area are scattered in the class I, II and V and fall in the OPQR segment. The point O represents rolling sediments without any suspension grains, point P represents rolling sediments with few suspension grain, point Q represents suspension sediments with few rolling grains and point R represents graded suspension sediments (PASSEGA 1957). Hence, the mode of transportation of sediments of the Lauchapara Formation was represented as rolling to suspension as well as minor rolling and graded suspension grains.

Table 3. C (1 percentile) & M (50 percentile) data of sandstone samples of the study area.

Sample No	C (Φ_1)	M (Φ_{50})	C (mm)	M (mm)	C (µm)	M (µm)
SKL-1/1	-0.8	2.6	1.74	0.16	1741.10	164.94
SKL-1/2	1	2.7	0.50	0.15	500.00	153.89
SKL-1/3	0.8	2.5	0.57	0.18	574.35	176.78
SKL-1/4	1	2.5	0.50	0.18	500.00	176.78
SKL-1/5	1.4	2.6	0.38	0.16	378.93	164.94
SKL-1/6	1.4	2.7	0.38	0.15	378.93	153.89
SKL-2/1	0.8	2.4	0.57	0.19	574.35	189.46
SKL-2/2	-1.2	0.6	2.30	0.66	2297.40	659.75

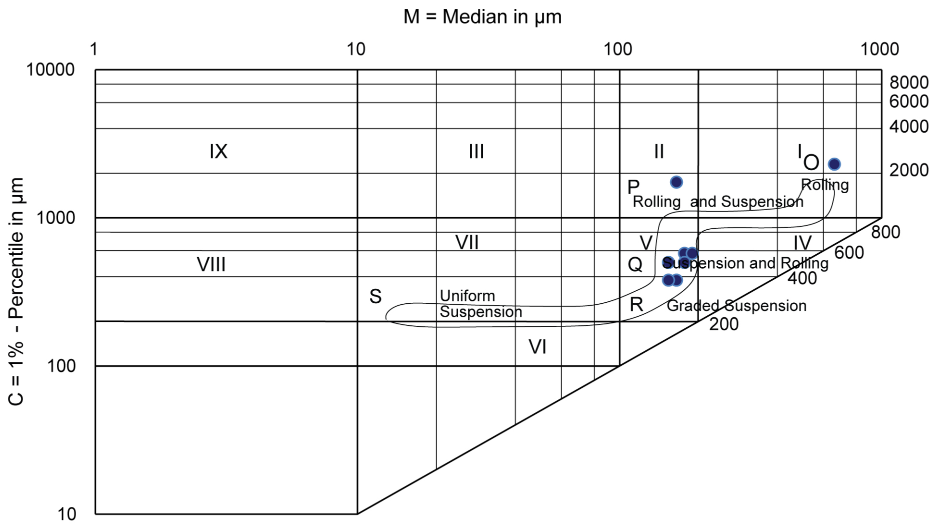

Fig. 5. Scatter plot of the Lauchapara Formation sandstones on CM diagram after PASSEGA & BYRAMJEE (1969).

Conclusion

The statistical analysis and bivariate scatter plots of grain size parameters along with mode of sediment transportation analysis reveal the depositional environment as well as depositional process of Quaternary Lauchapara Formation of Susang Hills. This formation is composed of moderately sorted, fine to coarse sandstone with occasional sparsely distributed gravels. In some outcrops, laterally extended thick gravel bed was also observed. Therefore, based on above findings it can be concluded that the Lauchapara Formation might be deposited through rolling to minor suspension, under high energy current of alluvial fan environment.

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বাংলাদেশের শেরপুর এলাকার সুসং পাহাড়ে বিস্তৃত লাউচাপড়া স্তরসমষ্টির যান্ত্রিক বিশ্লেষণঃ পাললিক পরিবেশের সংশ্লেষণ

মোঃ ইবনে হৃদয়, মোঃ শরীফ হোসেন খান, মোঃ সাখাওয়াত হোসেন,
মোঃ জুল্লে জালালুর রহমান ও মোহাম্মদ মঈনুল হোসেন

সারসংক্ষেপ

বাংলাদেশের উত্তর সীমান্তবর্তী গারো পাহাড়ের দক্ষিণ-পশ্চিম প্রলম্বিতাংশে নিম্ন ও মাঝারি উচ্চতার পাহাড়সমূহের সমন্বিত নাম সুসং পাহাড়। ডাউকি চুত্যি দ্বারা অতিক্রান্ত এই পাহাড় উন্নিত শিলং মালভূমি এবং উত্তরের পাদদেশীয় সমভূমির সংযোগ স্থলে অবস্থিত। লাউচাপড়া স্তরসমষ্টি অত্র সুসং পাহাড়ে বিস্তৃত কোয়াটারনারি পর্যায়ের মোটা দানার শিলা একক যা উক্ত গবেষণা এলাকার ডুমুরতলা ঝোড়া, কর্ণ ঝোড়া এবং ঝুলগাঁও জলধারার ভাটির অংশ বরাবর উন্মুক্ত রয়েছে। লাউচাপড়া স্তরসমষ্টির যান্ত্রিক বিশ্লেষণ করার জন্য এএসটিএম (ডি৪২২-৬৩) এবং বিএস ৪১০ আদর্শ পদ্ধতি অনুসরণ করা হয়েছে যাতে করে উক্ত স্তরসমষ্ঠির পাললিক পরিবহনের রূপ চিত্রায়ণের সাথে সাথে অবক্ষেপনের প্রক্রিয়াও নির্ণয় করা যায়। এএসটিএম (ডি৪২২-৬৩) আদর্শ পদ্ধতি অনুসারে কণার আকার বণ্টন বিশ্লেষণ করতে কর্দম জাতীয় পললের জন্য ১০০ গ্রাম এবং বেলে জাতীয় পললের জন্য ৫০ গ্রাম নমুনার সাথে বিযুক্তকারী ঘটক হিসাবে সোডিয়াম হেক্সামেটাফসফেট দ্রবন (৪০ গ্রাম/লিটার); এএসটিএম ১৫২এইচ হাইড্রোমিটার; এবং ১ ডিগ্রি ফারেনহাইট নির্ভূলতার থার্মোমিটার ব্যবহার করা হয়েছে। এই পদ্ধতির শেষে প্রাপ্ত ০.০৬৩ মিমি ব্যাসের থেকে বড় আকারের কণাসমূহকে পুনরায় বিএস ৪১০ আদর্শ পদ্ধতি অনুসারে যান্ত্রিক বিশ্লেষণ করা হয়েছে। পরবর্তীতে বিএস ১৩৭৭ আদর্শ পদ্ধতি অনুসরণ করে সকল নমুনার আপেক্ষিক গুরুত্ব নির্ণয় করা হয়েছে। বিশদ মাঠ জরিপের মাধ্যমে লাউচাপড়া স্তরসমষ্টির দুইটি প্রধান উন্মুক্ত অবস্থান থেকে সর্বমোট পাঁচ ধরনের পাললিক পর্ব চিহ্নিত করা হয়েছে যথাঃ স্তরবিহীন বেলেপাথর পর্ব (Sm), সমান্তরাল স্তরীভূত বেলেপাথর পর্ব (Sh), আড়াআড়ি স্তরীভূত নুড়ি পর্ব (Gt), আড়াআড়ি স্তরীভূত বেলেপাথর পর্ব (St) এবং স্তরবিহীন কর্দম পর্ব (Fm)। এই পাঁচ ধরনের পাললিক পর্ব থেকে আটটি প্রতিনিধিত্বমূলক নমুনা সংগ্রহ এবং বিশ্লেষণ করা হয়েছে। কিছু কিছু উন্মুক্ত অবস্থানে মাঝে মাঝে বিক্ষিপ্তভাবে ছড়ানো নুড়ি এবং পার্শ্বত বিস্তৃত পুরু নুড়ির স্তরের উপস্থিতি বিনুনি জলধারার (Braided stream) নদী গর্ভের অবক্ষেপ অথবা পলল পাখা অবক্ষেপ নির্দেশ করে। গঠনবিন্যাসগত (Textural) উপাদানের দিক থেকে লাউচাপড়া স্তরসমষ্টি মাঝারিভাবে বিভাজিত (০.৯০ থেকে ১.৩৪ϕ), মোটা থেকে মিহি দানার (০.৭৩ থেকে ৩.০৩ϕ) বালির সমন্বয়ে গঠিত যা নদীবাহিত উৎসের অন্তর্গত। সূক্ষ্ম থেকে প্রবলভাবে সুক্ষ্ম (০.২২ থেকে ০.৫৪) তির্যকতা (Skewness) পললের একমুখী স্থানান্তরের ইঙ্গিত দেয়। অতি প্লেটিকার্টিক (Platykurtic) থেকে অতি লেপ্টোকার্টিক (Leptokurtic) (০.৬১ থেকে ১.৭১) কার্টোসিস (Kurtosis) পলল অবক্ষেপনের পর্যায়ক্রমিক স্রোত পরিবর্তনের একটা গুরুত্বপূর্ণ নির্দেশক। পলল স্থানান্তরের রূপ বিশ্লেষণ (CM Pattern) থেকে পরিলক্ষিত হয় যে লাউচাপড়া স্তরসমষ্টি একটি বিনুনি জলধারার উচ্চ শক্তি প্রবাহের অধীনে গড়িয়ে গড়িয়ে এবং সামান্য ভেসে ভেসে অবক্ষিপ্ত হতে পারে। অতএব, উপরোক্ত সকল বিশ্লেষণের মাধ্যমে প্রাপ্ত উপাত্ত এবং এই স্তরসমষ্টির ভূকাঠামোগত অবস্থানের উপর ভিত্তি করে বলা যায় যে লাউচাপড়া স্তরসমষ্টি পলল পাখা বাতাবরণের উচ্চ শক্তি প্রবাহের অধীনে গড়িয়ে গড়িয়ে এবং সামান্য ভেসে ভেসে অবক্ষিপ্ত হয়েছে।