COASTAL ENVIRONMENT AND GEOMORPHOLOGY

Student Handbook

Coastal Fieldwork Student's Handbook

Name:_____ **Group:**_____

Date:	
Location:	Ma Shi Chau
Duration:	180 minutes

Things to Note

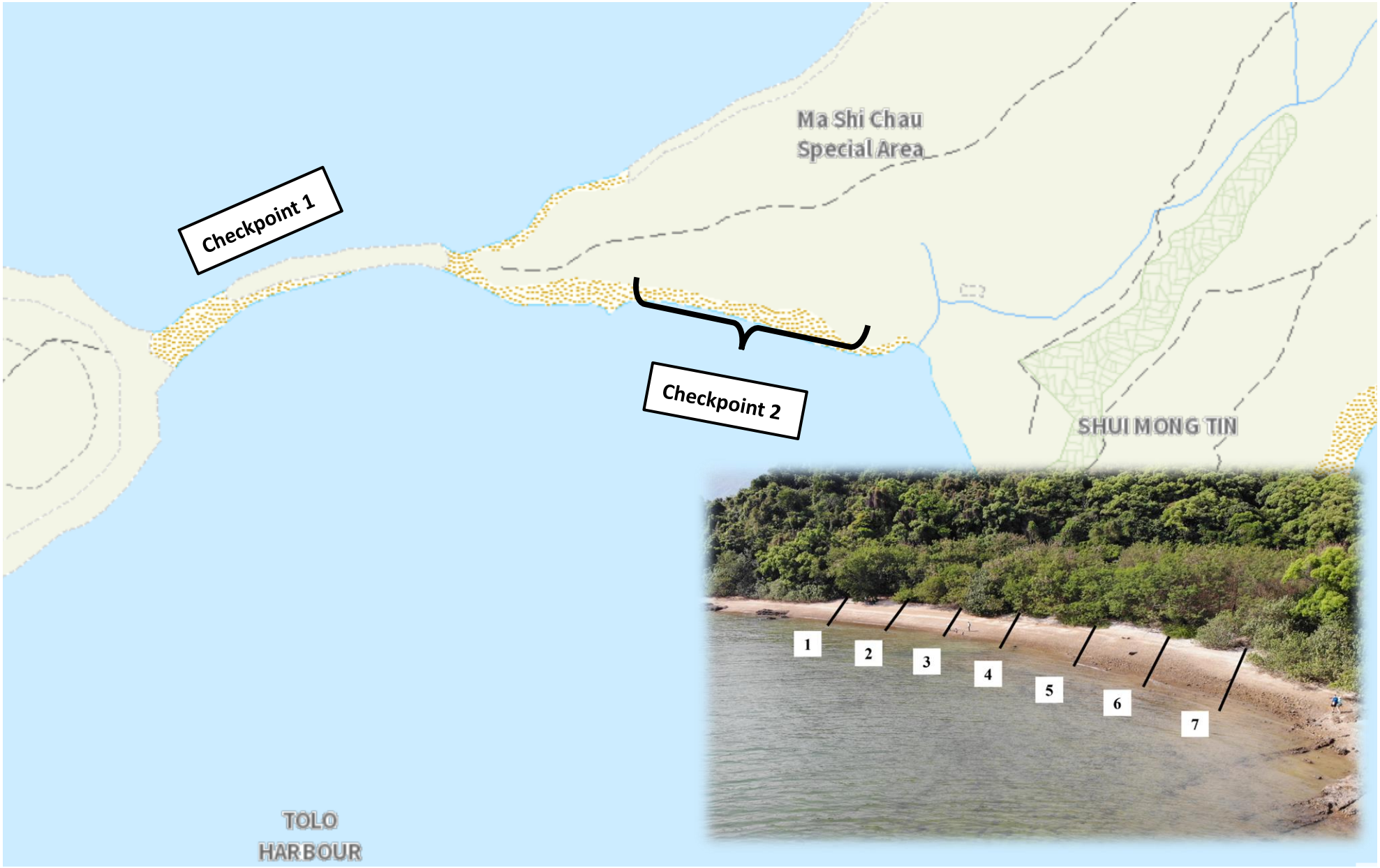
- ✧ Wear water-friendly, non-slippery and toe-covering shoes (will get wet wading).
- ✧ Bring sunblock lotion, insect repellent, windbreaker, umbrella and spare clothing.
- ✧ Stay away from exposed shores with strong waves.
- ✧ Check in advance the time and height of high and low tides. It is recommended to carry out fieldwork at the coast when the tide is below 1.5 m (Chart Datum).
- ✧ Be careful when students work close to the shoreline, should pay attention to slippery rock surfaces.
- ✧ Student should stay with their respective groups.

Learning Objectives	
Knowledge	✧ To identify the features of coastal landforms. ✧ To investigate the relationship between beach profile, sediment size, shape and sorting. ✧ To examine how coastal processes shape the coastal environment.
Skills	✧ To apply coastal field work data collection methods. ✧ To apply accurate sampling methods in data collection. ✧ To develop teamwork with groupmates.
Attitude	✧ Appreciate the beauty of nature in country parks and special areas. ✧ Recognise the need for sustainable management of our physical environment. ✧ Be more aware of the unique and spectacular natural resource in country parks and special areas and recognise the need of conservation.

Equipment Checklist

Equipment/Materials	Quantity for each group	✓
Abney Level	2	
Measuring Tape (50m)	1	
Ranging pole	2	
Compass	1	
Calliper	1	
Float (e.g. tennis balls)	1	
Quadrat	1	
Clipboard	1	
Pencil/Pen	1-2	
Gloves (in pairs) (optional)	2-4	

Map of Field Site



Planning and Preparation

Topic: Coastal Study

Part 1. Inquiry Questions

How do coastal processes shape the land?

1. How are the beaches shaped at Ma Shi Chau?
2. How do the coastal processes affect the sediments at Ma Shi Chau?
3. How does the transportation of sediments occur along the coastline at Ma Shi Chau?

Think Over:

Can you suggest one potential risk of conducting coastal fieldwork?

Think Over:

How can we develop hypothesis from our inquiry questions and our presumed answers to them? Try to develop hypothesis from the inquiry questions provided above.

Try to develop hypotheses for the inquiry questions provided above:

	Hypothesis Setting
1	
2	
3	

Part 2. Data Collection

Please fill in the following information before data collection

Background information of collection data	
Date:	Time:
Tidal levels[1]:	
Weather warning and signals within the last 2 days:	
Precipitation within the last 2 days[2]: heavy rain / drizzle / no rain	

Location of data collection
Direction which the beach faces:

Activity 1: Identification of Coastal Landforms

Observe the coastal environment at checkpoint 1, could you identify any erosional and depositional coastal landforms? Name the coastal landaform below and draw an annotated diagram to illustrate how the landforms are formed.

Depositional landform
Name: Tombolo
Annotated diagram:
Erosional landform
Name: **Wave-cut platform**
Annotated diagram:

[1] Tidal information can be obtained from HKO: https://www.hko.gov.hk/en/tide/marine/realtide.htm

[2] Daily rainfall can be obtained from HKO: https://www.hko.gov.hk/en/cis/climat.htm

Activity 2: Measuring Beach Profile

Inquiry question 1:
How are the beaches shaped at Ma Shi Chau?

Primary Data Needed	Equipment Needed
• Slope gradient	• Ranging pole × 2 • Abney level × 2 • Measuring tape × 1

1. The transect for measuring beach profile usually starts from the safe distance of the foreshore (the low tide mark) to the backshore (the end of the beach) (refer to Figures 1 and 2). Measure the length (m) of the transect using a measuring tape.
2. Identify any breaks/slope angle changes along the transect. Mark each break of the slope with a marker and record their distance from shore(m) using a measuring tape (the distance between each break of slope = a segment).
3. Along the segment, have two students stand at opposite ends of the segment. Student A holds the ranging pole upright at point A (the low tide mark). Student B holds another ranging pole upright at point B (the break of the slope) (refer to Figures 3 and 4).
4. Measure the length between points A and B using a measuring tape (length AB).
5. Measure the slope angle using an Abney level[3] sighting at the *same height* of the opposite ranging pole (refer to Figures 3 and 4).
6. Read the angles of elevation (a: facing backshore) and depression (b: facing foreshore).
7. Calculate the average **slope angle** ($\theta = \frac{a+b}{2}$) and **beach gradient**[4] $(1/\tan\theta)$.
8. Moving up to the beach and repeat steps 5-8 for each segment until the end of the chosen transect.
9. Record your data in Table 1 on P.13.

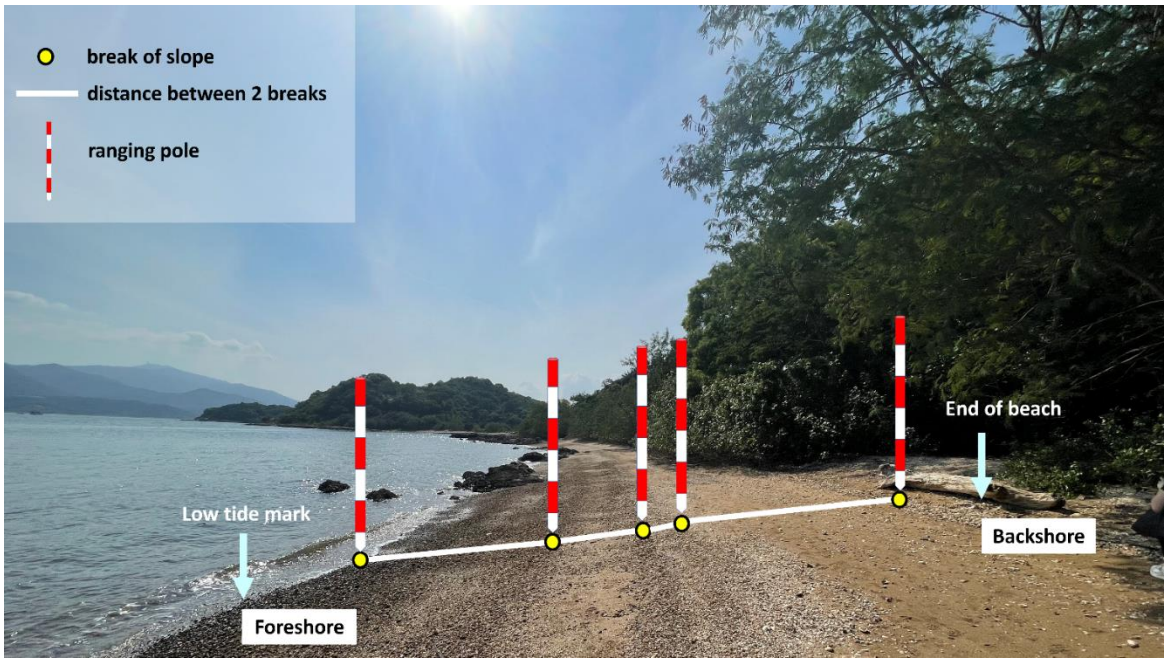


Figure 1. Transect and break of slope

[3] Abney level measures the angel between the line of sight and the horizontal level.
[4] Gradient can be expressed as an angle or grade. Grade refers to unit change of vertical height to a certain horizontal distance and can be expressed in percent or a ratio.

Figure 2. Measuring the length of the transect

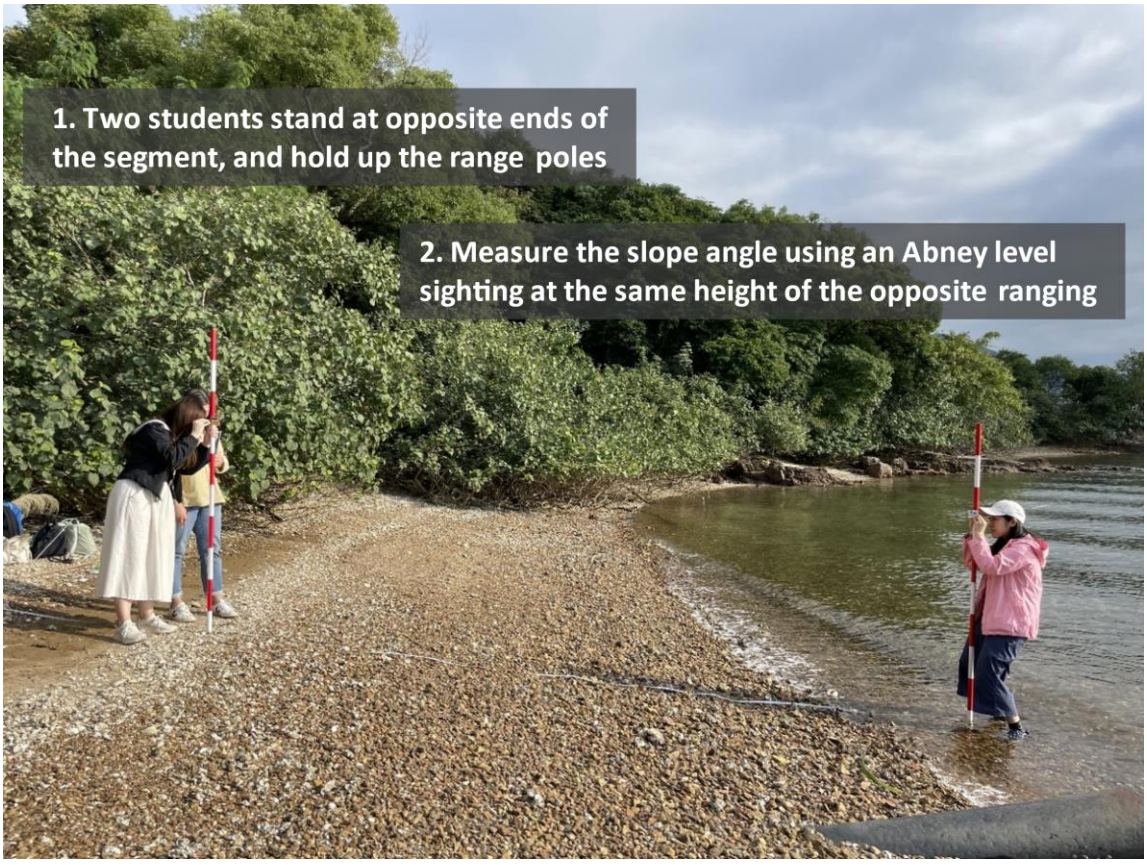


Figure 3. Measuring the slope angle

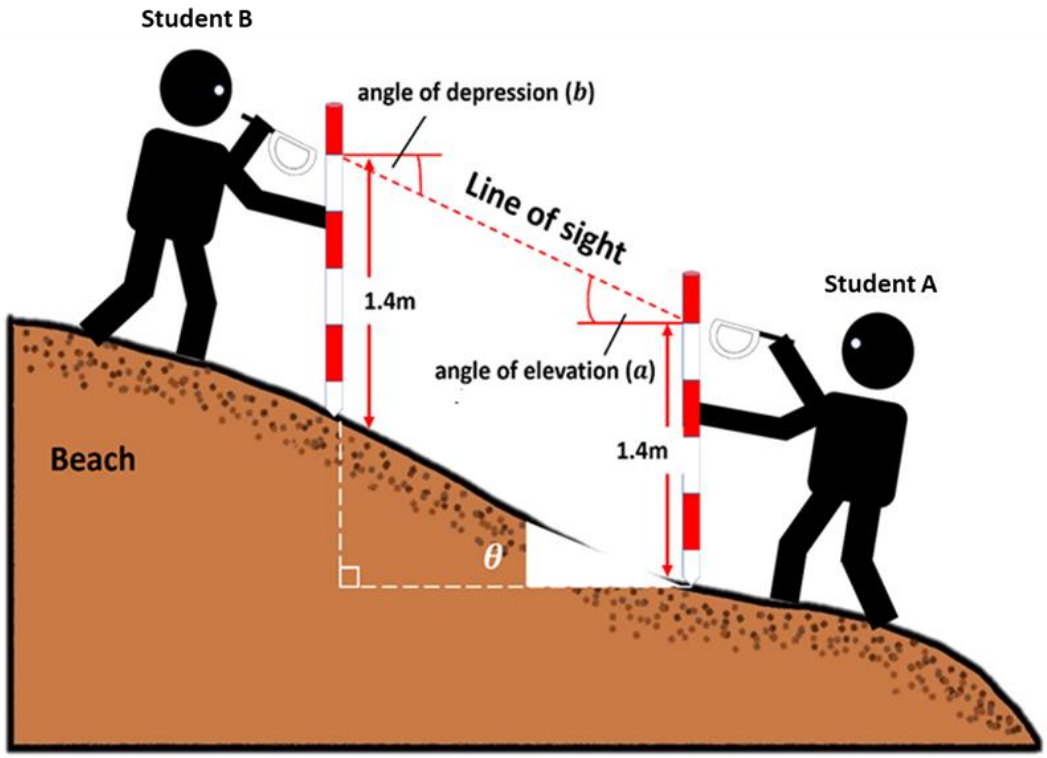


Figure 4. Measuring beach profile with ranging poles and abney levels

Activity 3: Sediment Analysis

Inquiry question 2:
How do the coastal processes affect the sediments at Ma Shi Chau?

Primary Data Needed	Equipment Needed
• Grain size • Grain roundness • Grain sorting	• Calliper × 1 • Sediment ruler × 1

1. Along the chosen transect, decide six sites for quadrat study with fixed intervals (e.g. 5m) from foreshore to backshore. Avoid trampling on the beach surface along the transect. Figure 5 illustrates the locations of quadrat study sites along the transect.
2. Place the quadrat at each study site and collect 5 sediment samples within the quadrat at each site randomly. Spread the sediment samples on a piece of white cardboard paper or a tray and observe the following features of the samples using the Sediment Ruler provided (Appendix A).
3. **Measuring size:** Use the visual ruler printed on the Sediment Ruler or a calliper to measure the longest axis (*l*) of each particle by laying it on a flat surface (refer to Figure 6). Table 4 shows the classification of particles with reference to their size.
4. **Analysing roundness:** Apply the visual scale of the Sediment Ruler and assess the grain roundness. The grain roundness is divided into 6 categories, ranging from very angular to well-rounded. It is a visual comparison. Based on the shape of the sediment sample, you compare each piece of sediment sample to the visual scale of roundness and decide which category the piece of sediment sample belongs to. Generally, the more rounded the grains are, the

more they have been moved around (i.e., the longer the length of time or distance they have moved). In contrast, angular grains generally mean that they have not travelled far.

5. **Analysing sorting:** Apply the visual scale of the Sediment Ruler and assess the grain sorting in the quadrat. Sorting refers to the distribution of the particle size. Sorting of sediments can occur when a group of particles with different size ranges is transported by an agency such as wind or water. The visual scale of sorting is divided into 5 categories, ranging from very well sorted to very poorly sorted. Different categories indicate the variance observed in particle sizes, for example, very well sorted indicates that the particle sizes are all the same, while very poorly sorted indicates that the particle sizes are varying. Generally, sediment sorting changes along their transportation route. Poorly sorted sediments are usually deposited more quickly or close to the source (e.g., by a flood or from flows/mudflows). In contrast, better sorted sediments are usually sorted out during longer transportation by a river or sea (e.g. sand deposits on beaches, in shallow seas or in deserts).
6. Record your data in Table 3 on P.14.

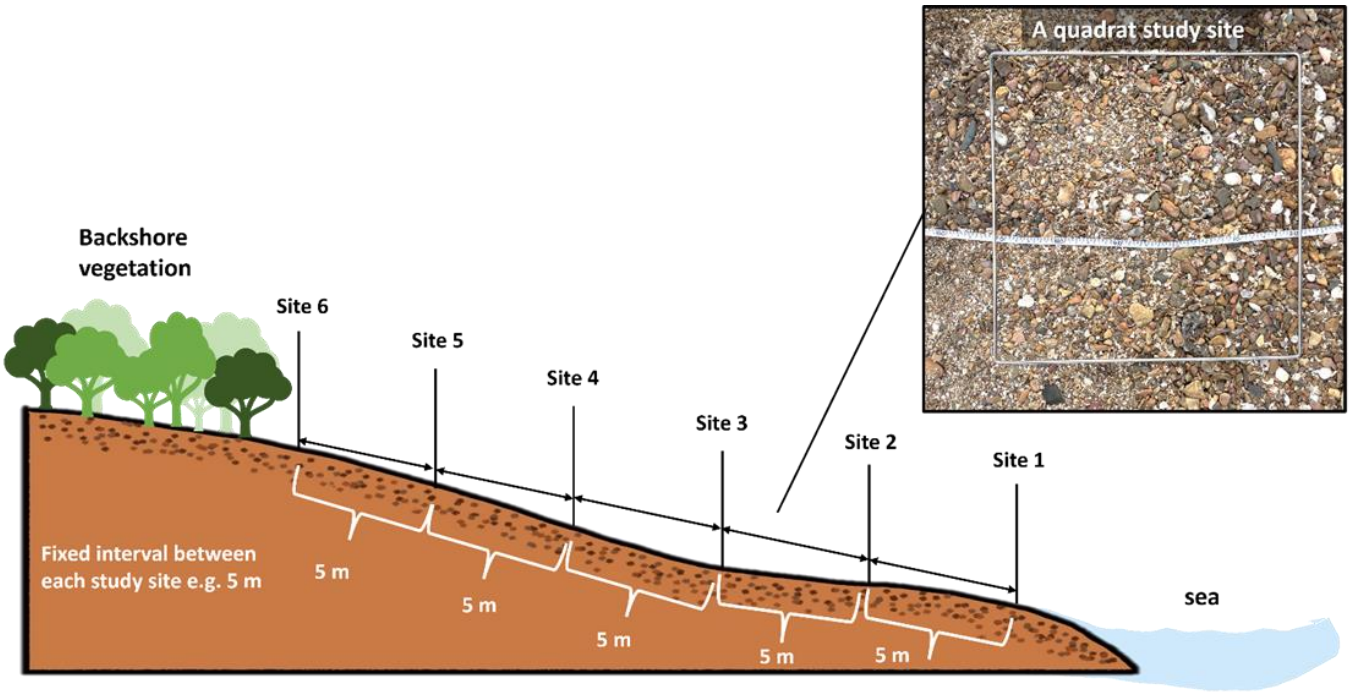


Figure 5. Quadrat Study

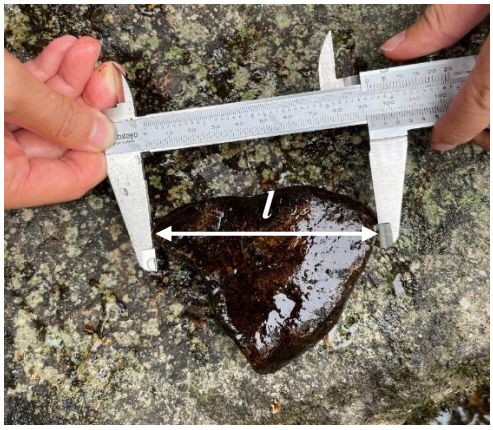
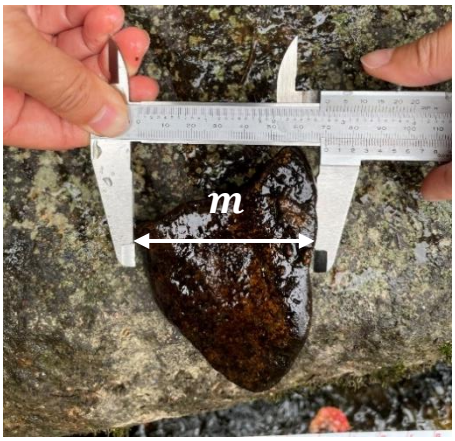
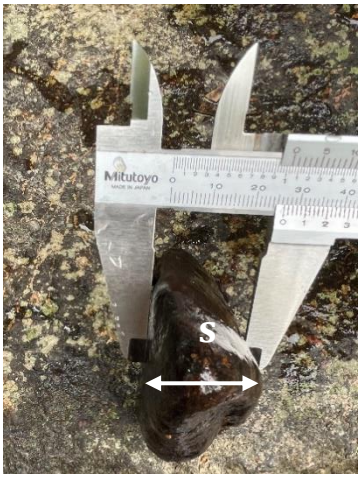
The longest axis ($\boldsymbol{l}$)	The intermediate axis ($\boldsymbol{m}$)	The shortest axis ($\boldsymbol{s}$)
		

Figure 6. Measuring different axis of a particle using calliper

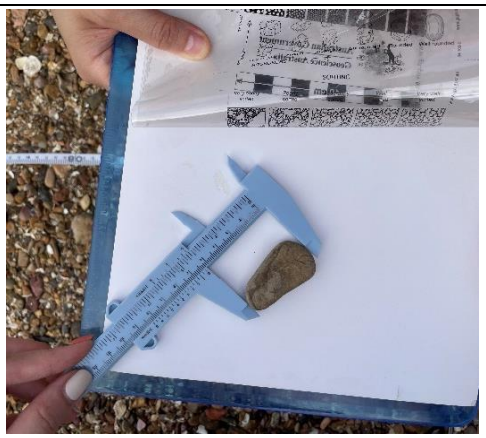
		
Picking up 5 sediments from the quadrat randomly	Measure the longest axis of the sediments using calliper	Assess roundness and sorting using the visual scale

Figure 7. Sediment analysis

Activity 4: Measuring Longshore Drift

Inquiry question 3:
How does the transportation of sediments occur along the coastline at Ma Shi Chau?

Primary Data Needed	Equipment Needed
• Direction of longshore drift	• Float × 1-2 • Compass × 1

1. Identify the swash and backwash zone, then throw a float (e.g., a tennis ball/plastic bottle/fruit) at the starting point along the zone.
2. Observe the direction of the waves approaching the shore and the direction the float travels.
3. Record the direction of longshore drift in Table 5 on P.14 with reference to a compass. Indicate with "East" or "West".
4. Suggested to conduct the measurement multiple times to avoid error.

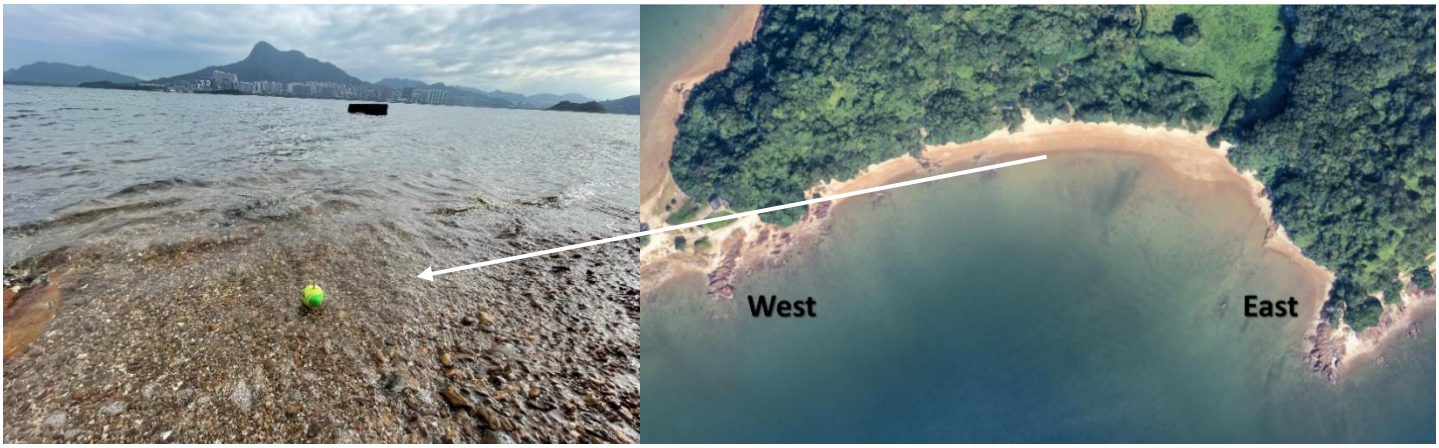


Figure 8. Measuring longshore drift

Safety and Other Concerns:

- ✧ **Be aware of the wind and tidal conditions. High wind speed may induce strong waves and high tides. Always keep a safe distance from the sea, and start the measurement where you will not get wet from any waves.**
- ✧ **Be aware of the strandline, do not walk close to the strandline and pick up any potentially dangerous objects from the coast/beach.**
- ✧ **Be aware of obstacles in the water, such as a rock. These obstacles may interrupt your results.**

Record Sheet

Table 1. Measuring beach profile

Transect no: **Transect length (m):**							
Segment (From foreshore to backshore)	**Length of slope segment (m)**	**Distance from shore (m)**	**Angle of slope segment (°)**		**Average slope angle** $\theta = \frac{a+b}{2}$	**Slope gradient** $\frac{1}{tan\ \theta}$	**Description of steepness (refer to Table 2)**
			Elevation (a)	**Depression (b)**			
1							
2							
3							
4							
5							
6							
7							

Table 2. Slope gradient reference

Average slope angle (θ)	Slope gradient	Description
<1°	**NA**	**Flat**
1°-3°	**1:60**	**Undulating**
3°-6°	**1:20**	**Moderately sloping**
6°-12°	**1:10**	**Hilly**
12°-20°	**1:3**	**Moderately steep**
20°-35°	**1:2**	**Steep**
35°-45°	**1:1**	**Very steep**

Table 3. Sediment analysis

Transect no: **Transect length (m):**						
Site	**Distance from the sea (m)**	**Length of the longest axis (cm)**	**Average size of particles (cm)**	**Particle size classification**	**Sediment roundness**	**Sediment sorting**
1						
2						
3						
4						
5						
6						

Table 4. Classification of Particle Size

Size Class	**Particle diameter [mm]**	**Size Class**	**Particle diameter [µm]**
Boulder	>256	Very coarse sand	1000 – 1999
Large cobbles	128 – 256	Coarse sand	500 – 999
Small cobbles	64 – 127	Medium sand	250 – 499
Very large pebbles	32 – 63	Fine sand	125 – 249
Large pebbles	16 – 31	Very fine sand	63 – 124
Medium pebbles	8 – 15	Silt	3.9 – 62
Small pebbles	4 – 7.9		
Granule	2 – 3.9		

Table 5. Measuring longshore drift

Direction of longshore drift
East / West

Activity 5. Human Activities

Human Activities on Beaches

Along the coastline, can you spot any human activities that may have impacts to the coastal environment, write them down and explain the effects of human activities on the coastal environment.

Human activities	Possible Effects

Conservation of Special Area

As Ma Shi Chau is one of the geosites of Hong Kong UNESCO Global Geopark, conservation of the coastal environment and important geological sites is of utmost importance for sustainable development and geo-tourism of the park. What measures have been implemented by AFCD to conserve the site? Please locate these conservation measures at the field site and record them down in the box below.

Type of conservation measures	Purpose of the conservation measures

Activity 6: Geomorphology at Ma Shi Chau

Ma Shi Chau is best known for its unique geomorphologic landforms. Along your walk at Ma Shi Chau, you may be able to see some of the following landforms. Try to fill in the name of the landforms with reference to options A-E, more details and their formations will be discussed in the post-trip lesson.

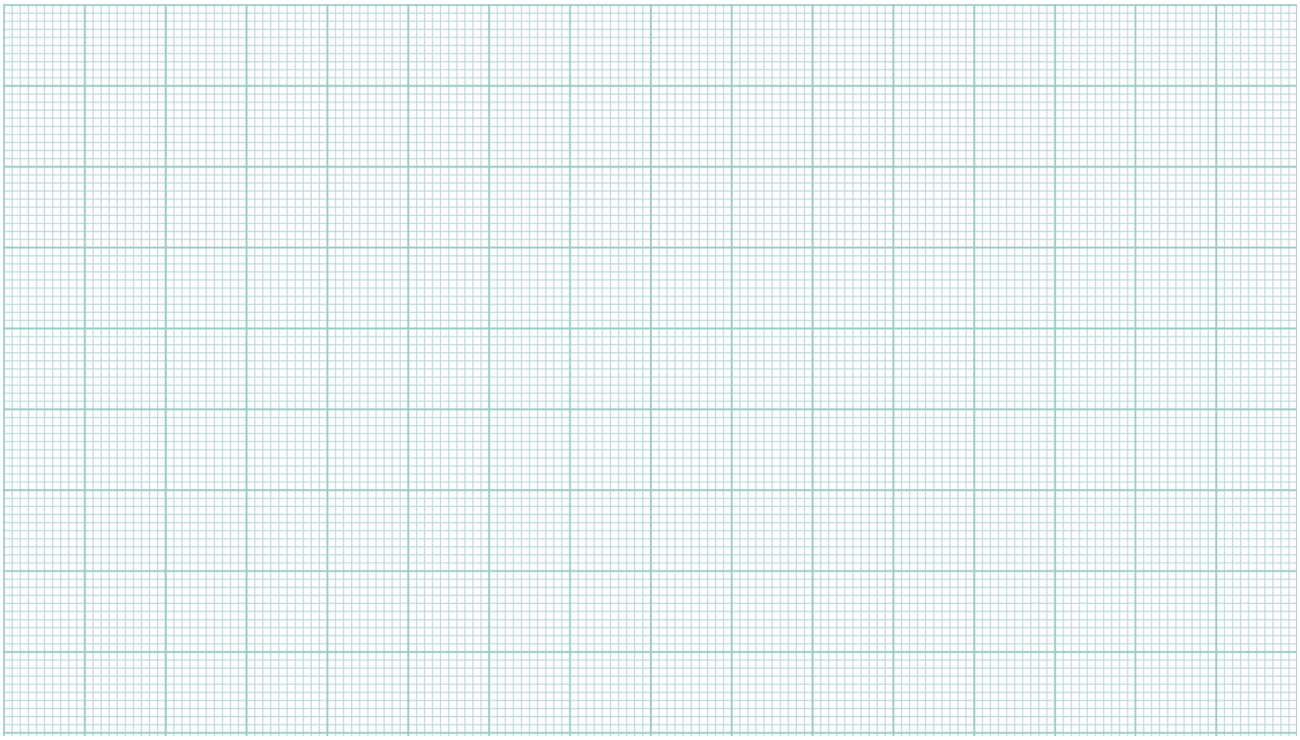
A. Quartz vein	**B. Differential erosion**	**C. Kink-band structure**	**D. Weathering**	**E. Faults**

Geomorphologic Landforms

Data Presentation and Analysis

Answering *Inquiry Question 1*:

Based on the collected data (refer to ***Table 1***), draw the **beach profile** for the transect on the grid graph paper provided below.



Questions for thought:

1. **Which type of presentation method is used to present the result of the beach profile? State one advantage and disadvantage of this method.**

Presentation method:

Advantage:

Disadvantage:

Data Analysis:

Based on the data collected, and compare your data with other groups, then answer the following inquiry questions:

How are the beaches shaped at Ma Shi Chau?

How do the coastal processes affect the sediments at Ma Shi Chau?

How does the transportation of sediments occur along the coastline at Ma Shi Chau?

Data Analysis:

The following questions may help you to answer the above inquiry questions:

How do winds and waves affect the beach profile and sediments?

Compare your data of beach profile with other groups, are there any differences? Describe and explain the differences.

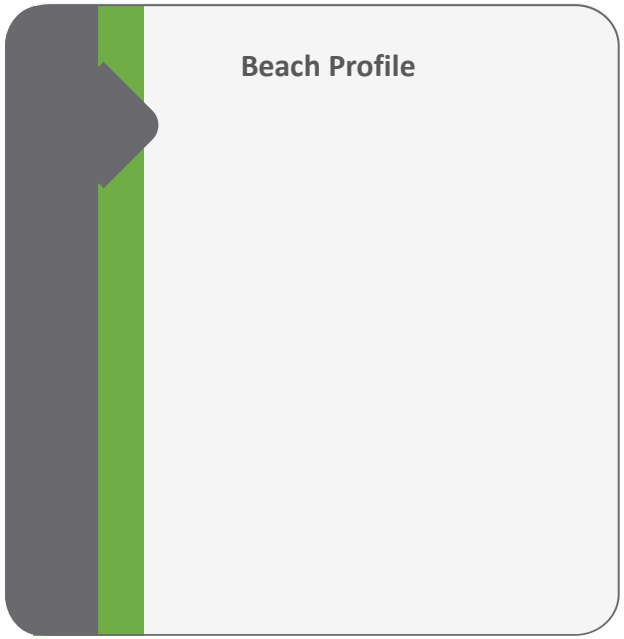
Compare your data of sediment analysis with other groups, are there any differences? Describe and explain why there are variations of sediment size and shape along the shoreline or along the transect.

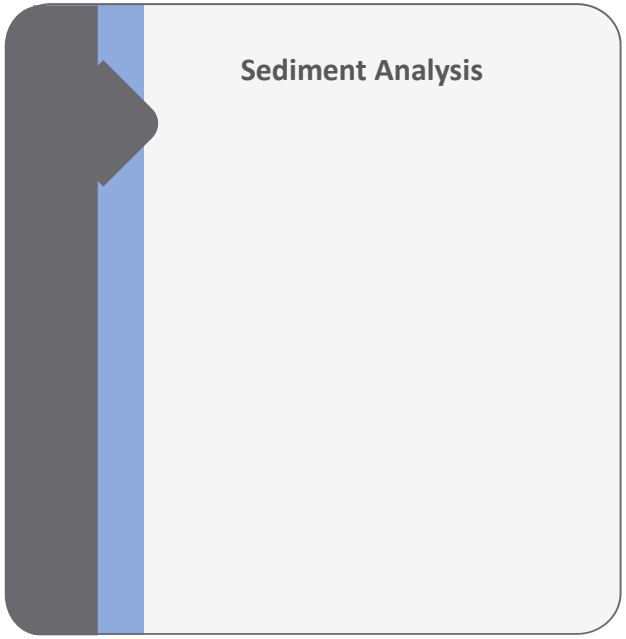
Conclusion

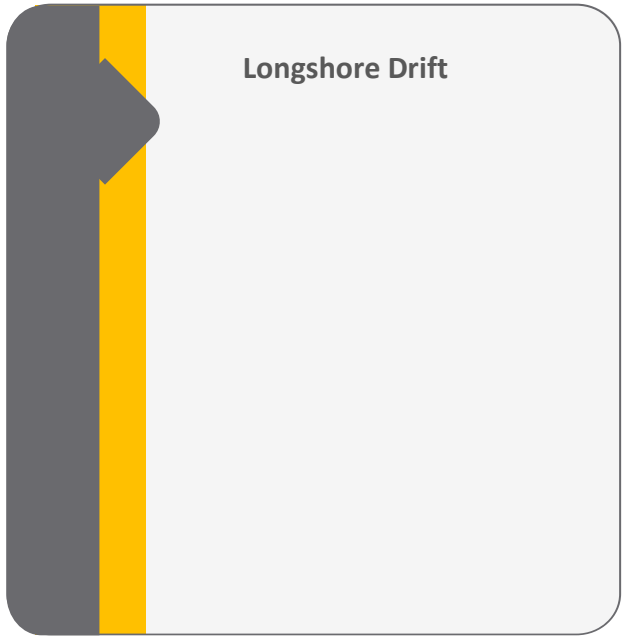
Taking into account of all the primary data collected, answer the inquiry question:
How do coastal processes shape the land at Ma Shi Chau?

Evaluation

After completing the coastal fieldwork, what factors affected the accuracy of your data? Support your answer by referring to actual examples from your own fieldwork.







With regards to the above problems, suggest ways to improve the data collection processes:

Appendix A: Sediment Ruler