Sham Chung Field Study on rocks

Concept recap

Characteristics of igneous rock

---------- **PLANNING & PREPARATION** ----------

Enquiry question

Describe and explain a phenomenon	What are the main characteristics of rocks in Sham Chung field site?

Below are the photos of rocks of Sham Chung field site. Study the characteristics of them with reference to the field guide (p. 2-8).

Plate 1

Plate 2

Figure 1 Hand specimen at Sham Chung field site

Field guide

A. Checklist for describing igneous rock hand specimen in the field

1. Examine weathered surface of rock outcrop, noting texture and colour.
2. From the outcrop, collect and number representative sample(s) with fresh surfaces.
3. Record colour of the fresh surface and estimate the mafic colour index as possible (Figure 2a &b).
   - An easy method of determining the igneous rock composition is by determining the percentage of dark-colored minerals in the rock, without trying to identify the actual minerals present;
   - This method of classification relies on a mafic color index (MCI), where the term mafic refers to any dark gray, black, or green-colored mineral (a collective term for olivine, pyroxene, amphibole, biotite and opaque minerals) (Figure 2a).
4. Record the colour of the weathered surface and any features that were not visible in the fresh surface.
5. Examine the grains under a handlens:
   a) If the rock is aphyric (fine-grained aphanitic groundmass and by an absence of any phenocrysts), note any other textural features and record felsic or mafic composition. (Table 1)
   b) Record coarse, medium or fine grain size of the rock (Table 2&3) and note textural relationship between minerals. (Figure 3)
   c) If the rock is porphyritic, record grain size and textural relationship of phenocrysts to groundmass.
6. Record the degree of homogeneity, the presence of layering, lamination, flow banding, vesicles and other special textural characteristics, such as the presence of inclusions.
7. Estimate the number of proportions of the different minerals present and, for each, record where possible: colour, cleavage, luster, habit, hardness. (Use Table 4 for identification purposes)
8. Use mineral associations to predict the possible presence of other minerals you cannot immediately identify and in classifying the rock. Combine your observations to give the specimen a field name.

B. Principles of classification

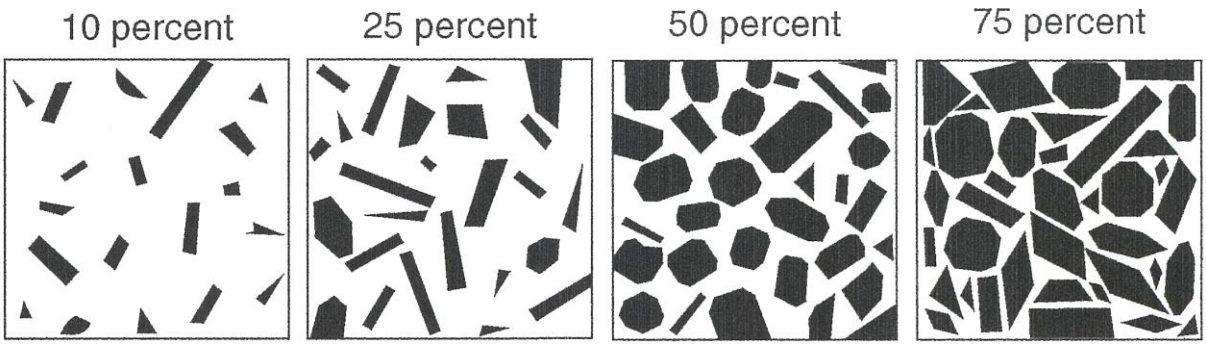


Figure 2a Mafic colour index

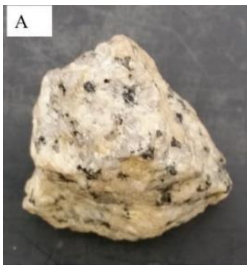
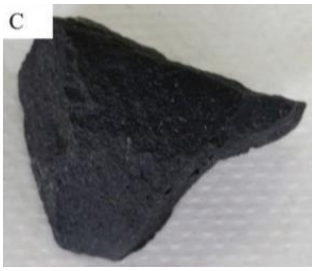
Rock sample				
MCI	0-15%	16-45%	46-85%	85%
Note	few of tiny black phenocrysts (biotite)	Numerous dark phenocrysts (amphibole)	Lacks visible phenocrysts but many dark-colour minerals	Overwhelming amount of olivine

Figure 2b Worked examples of mafic colour index

Geochemical term	Approximate range of colour index	Possible field descriptions
Acid	5-25	Felsic
Intermediate	25-55	Intermediate
Basic	55-85	Mafic
Ultrabasic	85-100	-

Table 1 General rules on MCI

Fine-grained	Few crystal boundaries distinguishable in the field or with the aid of a hand lens; mean grain size below 1mm.
Medium-grained	Most crystal boundaries distinguishable with the aid of a hand lens; mean grain size 1-5mm.
Coarse-grained	Virtually all crystal boundaries distinguishable with the naked eye; mean grain size greater than 5mm.

Table 2 Grain-size descriptions in crystalline rocks

Fine-grained rocks	Medium- and coarse-grained equivalents	Common phenocryst minerals
Rhyolite	Granite	Quartz, alkali feldspar
Dacite	Granodiorite	Quartz, plagioclase feldspar
Trachyte	Syenite	Alkali feldspar, occasional mafic minerals

Table 3 Fine-grained rock-types, their medium- and coarse-grained equivalents, and possible phenocryst minerals of felsic rocks

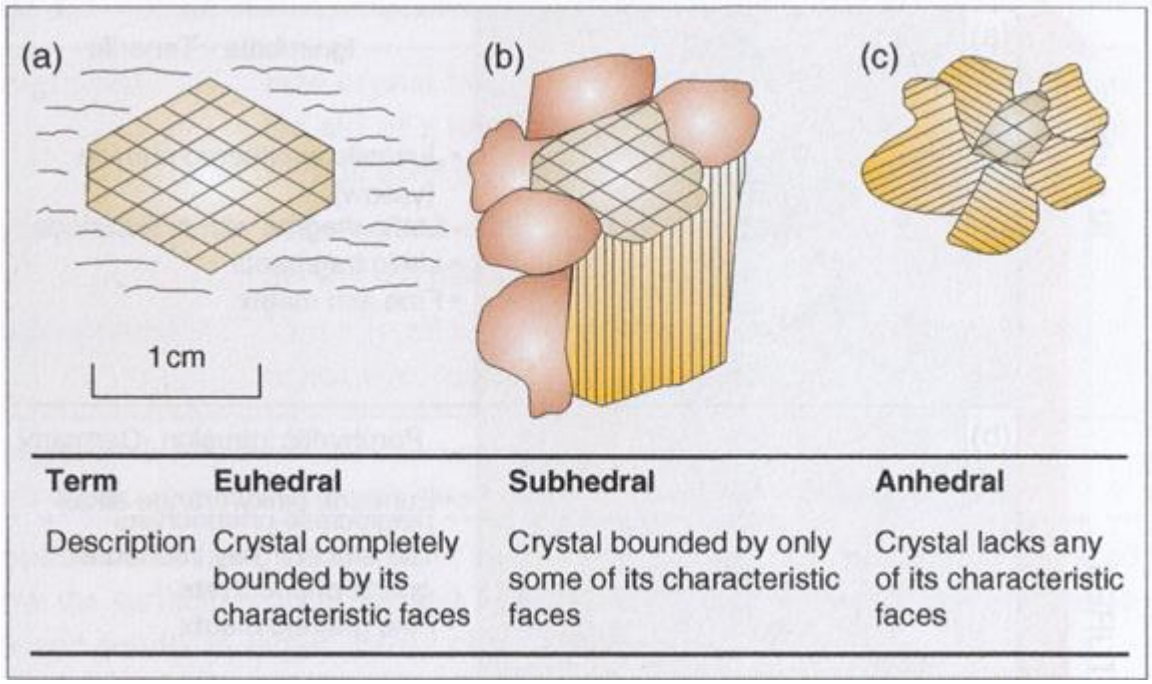
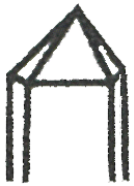
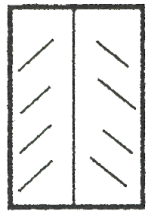
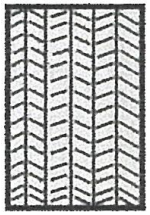
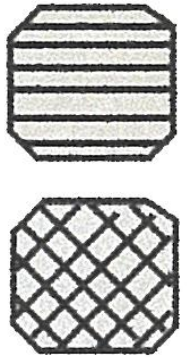
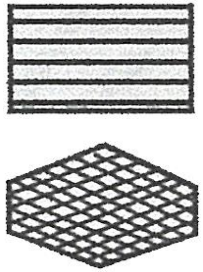
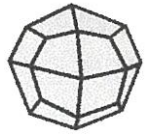


Figure 3 Euhedral, subhedral, anhedral with descriptions.

Mineral	Colour	Cleavage	Luster	Habit		Hardness
	Felsic minerals					
Quartz	Colourless to pale grey when surrounded by dark minerals; transparent	None; irregular or curved fracture surfaces	Glassy, shiny	Rare trigonal pyramids but usually irregular, anhedral		7
Alkali feldspar	White or pink, sometimes orange or yellow	Two sets at 90° poorly visible	Usually dull, sometimes silky or vitreous	Tabular crystals, shiny cleavage surfaces may show simple twins. Elongate rectangular ‘laths’, lamellae, or irregular masses of plagioclase may be noted, in which case the crystal is terms perthite		6
Plagioclase feldspar	White or green, rarely pink or black	Two sets at 90° poorly visible	Usually dull, sometimes silky or vitreous	Lath-shaped crystals; shiny cleavage surfaces may show multiple, parallel twins		6-6.5
Nepheline	White to pale grey	Two poor cleavages, one occasionally distinct	Greasy, vitreous	Usually occurs in micro-crystalline groundmass; occasional aggregates of crystals		5.5-6
Muscovite (mica)	Colourless to pale brown or green	One excellent cleavage, cleaves into thin flexible sheets	Shiny, silver and pearly	Tabular crystals sometimes 6-sided, especially in pegmatites		2-2.5

Mineral	Colour	Cleavage	Luster	Habit		Hardness
Mafic minerals						
Olivine	Olive green, yellow-green, sometimes brown	Very poor, usually fractures	Glassy when fresh, vitreous when altered	Usually rounded anhedral crystals, occasionally equidimensional tabular forms		6-7
Pyroxene	Black to dark green or brown Yellowish-green	Two good sets meeting at 87°/93°	Vitreous when fresh, dull when altered	Four- or eight-sided prismatic crystals occasionally showing cleavage or Aegirine more acicular		6
Amphibole	Black to brownish black or dark green dark blue	Two good sets meeting at 56°/124°	Vitreous when fresh, dull when altered	Prismatic or lozenge-shaped crystals often showing cleavage or Riebeckite more acicular		5-6
Biotite (mica)	Black to dark brown or green	One excellent cleavage; cleaves into thin flexible sheets	Very shiny	Thin tabular crystals, occasionally six-sided, especially in ignimbrites and acid lavas		2.5-3

Mineral	Colour	Cleavage	Luster	Habit		Hardness
Frequent accessory minerals						
Tourmaline	Black, but varieties may be blue, red or green	Very poor	Vitreous shiny	Long thin prismatic needle-shaped crystals, sometimes longitudinally striated and often in clusters; occasionally striated curved surfaces		7
Apatite	Pale green to yellow green	Very poor	Vitreous	Often euhedral, subhexagonal crystals; commonly rounded		5
Sphene	Colourless to yellow, green to brown	One good cleavage	Vitreous	Characteristic euhedral rhombic crystals		5
Garnet	Red, brown or yellow	poor	Usually resinous or dull, good crystals may be glassy	Equidimensional crystals often showing faces typical of cubic system, e.g. dodecahedra and trapezohedra. Common in meta-granites		6-7
Leucite	White or grey	None	Vitreous or resinous	Often euhedral trapezohedral crystals in alkaline lavas		5.5-6
Hematite	Red to red-brown, sometimes black	None	Dull	Usually fine and powdery, occasionally scaly or fibrous crystals		5.5-6
Magnetite	Black, brownish-black	Poor	Metallic, dull	Small equidimensional granular crystals, occasional cubes or octahedra		5.5
Ilmenite	Black, brownish-black or grey	None	Metallic or dull	Thin plates or scale usually elongate crystals, sometimes rod-like		5.6
Monazite	Pale yellow to dark brown	Moderate single cleavage	Resinous	Thick tabular crystals in granites and gneisses		5-5.5

Mineral	Colour	Cleavage	Luster	Habit	Hardness
Secondary minerals					
Calcite	White, translucent	Three sets rhombohedral	Vitreous, rarely glassy	Usually granular or fibrous in igneous rocks, common in veins, cavities, and so on. NB: reacts with dilute acid	3
Zeolite group	White, pale yellow or pale green, rarely pink, red or blue	Variable according to mineral type	Usually vitreous or silky	Massive or granular crystals lining cavities, particularly, amygdales; radiating fibrous clusters or needles	5-6
Clay group	White to pale browns and greens	Good, but not visible in hand specimens	Dull	Fine powdery aggregates replacing mainly feldspar in igneous rocks	1
Epidote	Pale yellows and apple green, rarely brown or red	One good cleavage	Vitreous	Variable, often elongated crystals, needles and radiating groups, coarsely crystalline varieties in hydrothermal veins and vesicles	6-7
Chlorite	Mid-green to dark greenish-yellow	One good cleavage gives thin sheets	Dull to pearly and ‘micaceous’	Usually aggregates of fine crystals, sometimes thin tabular flakes replacing mafic minerals in igneous rocks	2-3
Pyrite	Brassy yellow, occasionally brown or black	Poor	Metallic; iridescent tarnish	Often good cubic crystal faces, occasionally striated. Granular aggregates, particularly along veins in igneous rocks	6-6.5
Zircon	Colourless pale brown	Two poor	Adamantine/ glassy	Small prisms with terminal faces often euhedral	7.5

Table 4 Mineral properties in igneous rock hand specimens

What data to collect

Primary data	Characteristics of rock in Sham Chung field site
Secondary data	Geology of Sham Chung

When to collect data

Fieldwork date	
Fieldwork time	
Present weather conditions	
Precipitation three days before the fieldwork	

Is today suitable for fieldwork? (Things to consider: weather conditions/ some phenomena occur only under specific time)

Where to collect data

Sham Chung (refer to the *Map: Fieldwork sites for rock study*)

Is it an appropriate location for fieldwork? (Things to consider: safety/ accessibility/ appropriate scale/ match with fieldwork topic)

How to collect data

- Work in groups, each of 4 students.
- As your group walk through the field site, observe the designated rock using the tools provided (see Figure 4) and complete Data record sheet (p.10).
- Each group should collect data with appropriate methods and tools.

Select appropriate data collection methods and tools provided and complete the table below.

Research items	Data collection methods	Required equipment/ tools, if any *(Can select more than one)*
Characteristics of rock		
Geology of field site		

Data collection methods

A) Observation	B) Measurement	C) Counting
D) Scoring	E) Interviewing	F) Questionnaire

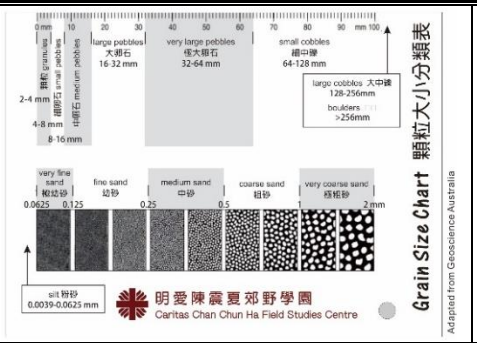
		
1. Phone camera lens	2. Grain size chart	

Figure 4 Fieldwork tools

------ DATA COLLECTION, DATA PROCESSING & PRESENTATION ------

Properties	Description	What do they tell us about the rock?
1. Colour		
2. Crystal or grain? Relative abundance		
Texture		
1. Crystallinity		
2. Grain size Any variation?		
3. Porphyritic		
4. Form of individual grains		
5. Forms of grains in the rock as a whole		
6. Pyroclastic terms		
7. Fragments? *		
8. Distinct feature? (e.g. stains along joints…)		

* Fragments <2mm = Tuff;
Fragments >2mm = Volcanic breccia

Data record sheet [1]

[1]https://geo.libretexts.org/Bookshelves/Geology/Book%3A_An_Introduction_to_Geology_(Johnson_Affolter_Inkenbrandt_and_Mosher)/04%3A_Igneous_Processes_and_Volcanoes/4.01%3A_Classification_of_Igneous_Rocks

---------- INTERPRETATION & CONCLUSION ----------

1. What are the main characteristics of rocks in Sham Chung field site? Explain with field evidence.

---------- EVALUATION ----------

1. What sampling methods are used to collect the information of rocks? Explain the merits and demerits of the methods.

Supplementary information

A. Rock type of Sham Chung field site[2]

1. Shing Mun Formation (Jts)

Age: Jurassic (164.7 ± 0.3 to 164.2 ± 0.3 Ma)

Lithology: coarse ash crystal tuff, tuff breccia and siltstone.

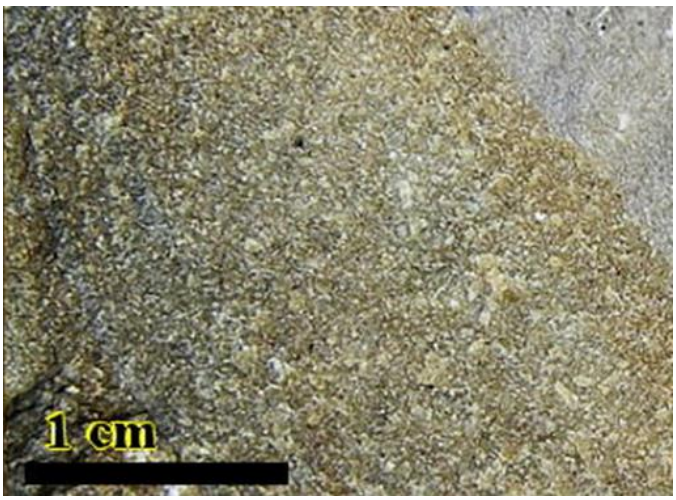
Coarse ash crystal tuff

2. Sham Chung rhyolite (Jks)

Age: Jurassic (146.6 ± 0.2 Ma), in the form of sill.

Lithology: a) flow-banded rhyolite, intruded by coarse ash crystal tuff of the Shing Mun Formation. b) contains phenocrysts of quartz, alkali feldspar and plagioclase, setting in a fine-grained, grey to dark grey, aphanitic matrix, containing minor biotite and accessory minerals of zircon, allanite and Fe-oxide.

Sham Chung rhyolite



Sham Chung rhyolite[3]

[2] https://www.cedd.gov.hk/eng/about-us/organisation/geo/pub_info/memoirs/geology/index.html

[3] http://www.ngensis.com/HKR/HKR2/HKR2-1.htm

3. Lai Chi Chong Formation (Jll)

Age: Late Jurassic (146 ± 0.2 Ma)
Lithology: well-bedded succession of pale grey cherty tuffite, coarse ash crystal tuff, thin eutaxitic fine ash tuff, flow-banded porphyritic rhyolite, conglomerate, tuffaceous sandstone and dark grey laminated silty mudstone.

Tuffaceous sandstone

Coarse ash crystal tuff

4. Quaternary (Superficial) Deposits (Q)

Age: Quaternary (1.6 million years - present day)
Lithology: Alluvial deposits typically consist of well-sorted to semi-sorted clay, silt, sand and gravel. Colluvial deposits are generally poorly sorted and commonly comprise a slightly clayey sandy silt to gravelly silty sand matrix enclosing angular to subangular weathered boulders.

ms – marine sand, partly silt

Qa – clay/silt, sand and gravel; well-sorted to semi-sorted

Qd – unsorted sand, gravel, cobbles and boulders; clay/silt matrix

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