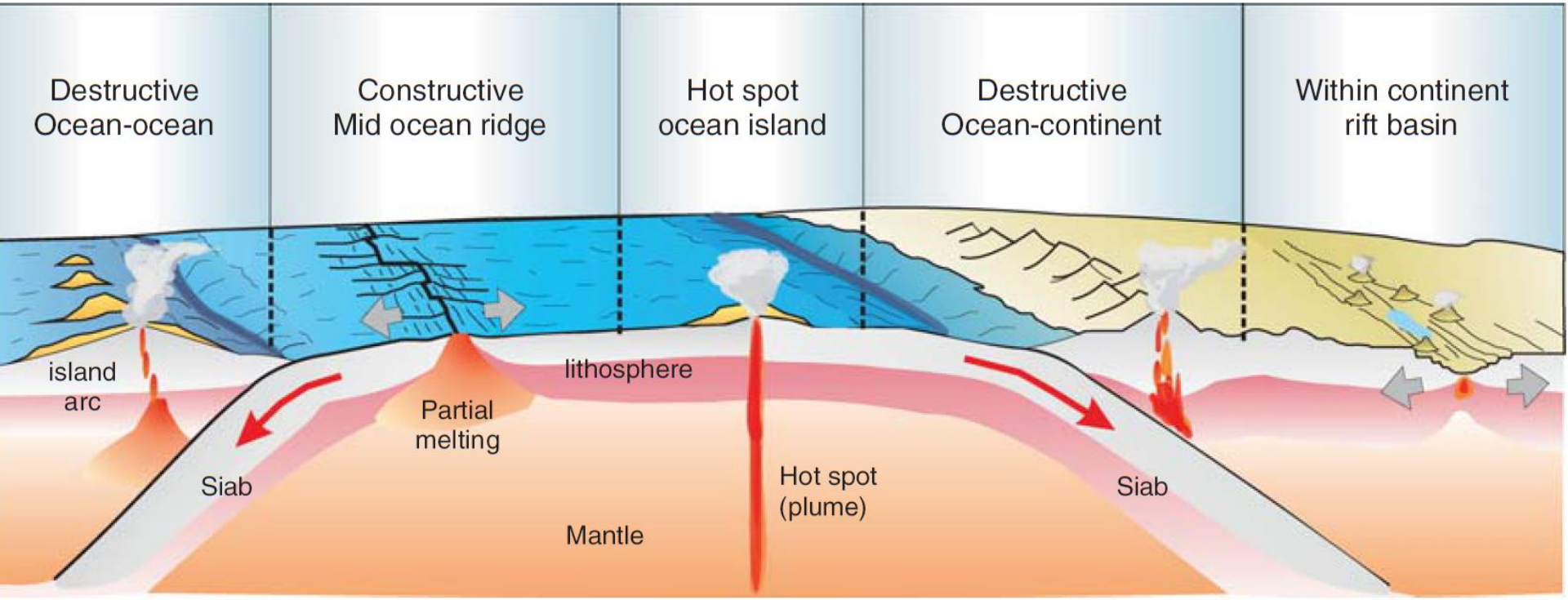
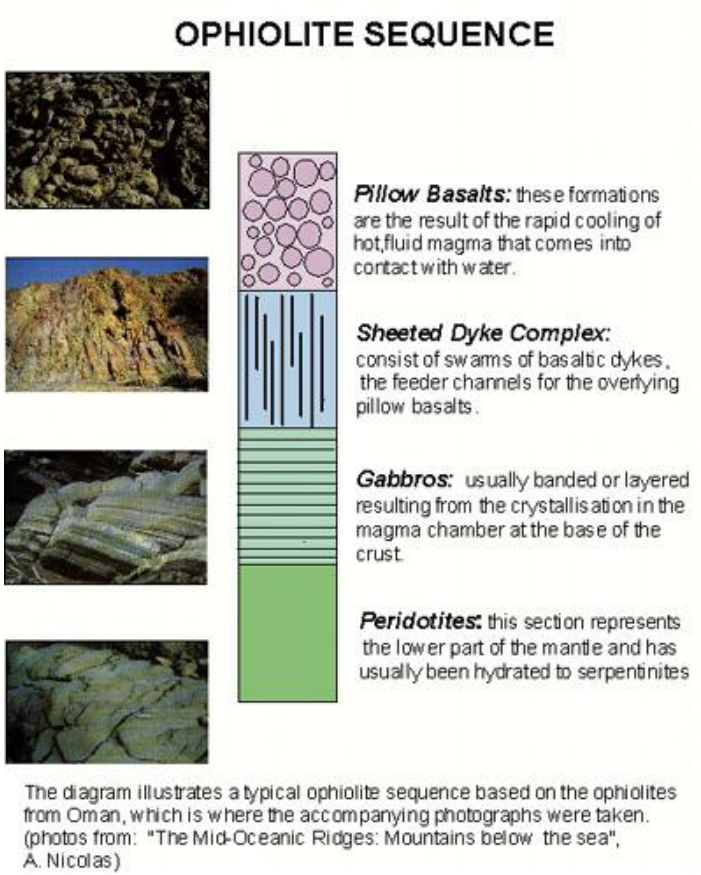
Recording features of igneous rocks



Schematic of plate tectonic associations and igneous rocks

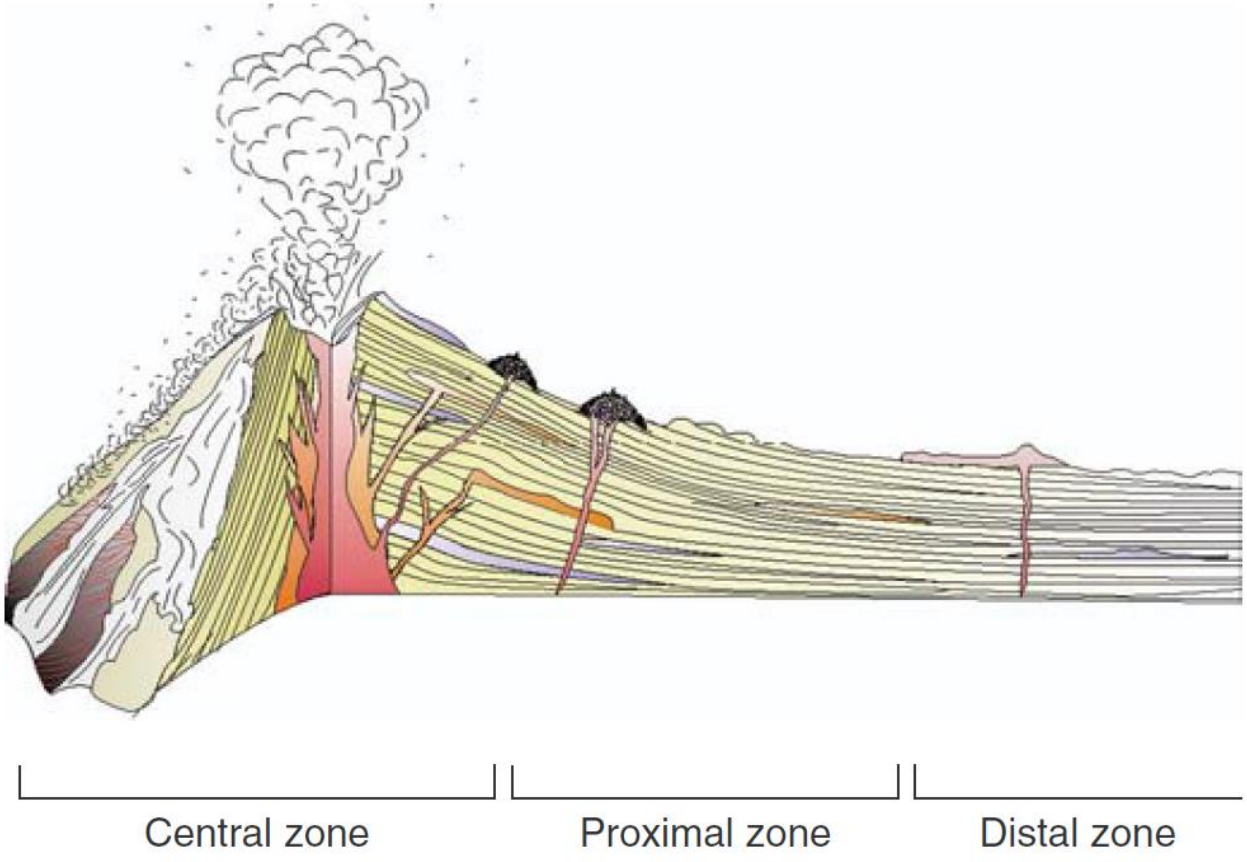
ophiolites

- The recognition of such associations is clearly of great palaeogeographic importance?



Mode of Occurrence of Igneous Bodies

- Volcanic rock



- The central zone (within circa 2 km of the central vent) is characterised by **lava conduits** (later exposed as volcanic plugs, dykes and sills) associated with **coarse**, **poorly-sorted** pyroclastic materials which have been deposited near to the vent.

- **The *proximal zone*** (circa 5–15 km from the central vent) has a higher proportion of lava flows, with a variety of pyroclastic flow deposits
- **the *distal zone*** is characterised by pyroclastic flow deposits associated with fine air-fall deposits dispersed by wind away from the volcano.

Intrusive rock

- Minor intrusions
- Plutonic intrusions

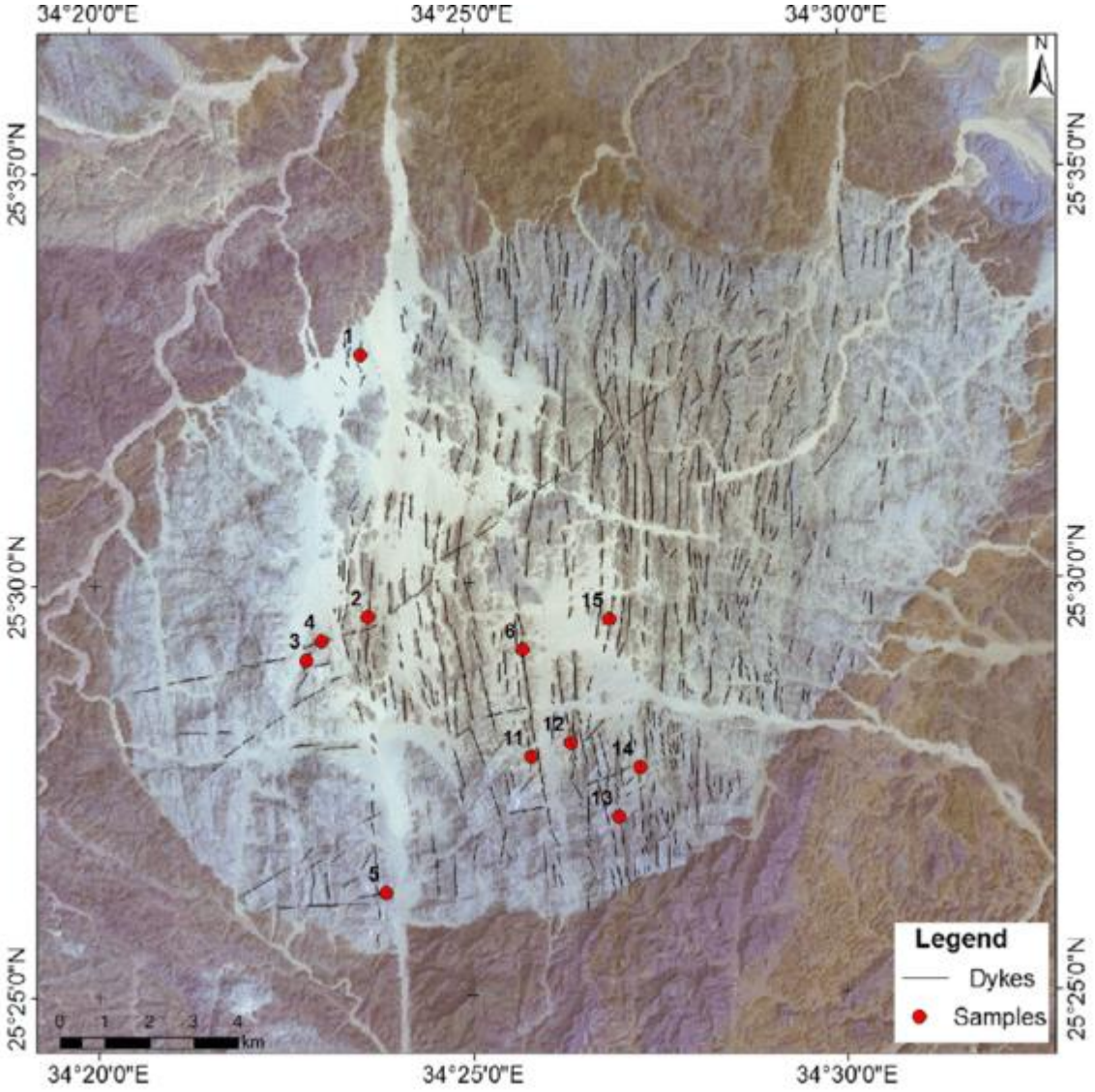
Minor intrusions

- ***Dykes*** are sheet-like intrusions which were approximately vertical at the time of emplacement and are hence *discordant* to host rocks such as shallow dipping sedimentary rocks.
- The width of dykes ranges from centimetre size to sizes measured in hundreds of metres, but in general the average width is probably in the range 1–5 m.

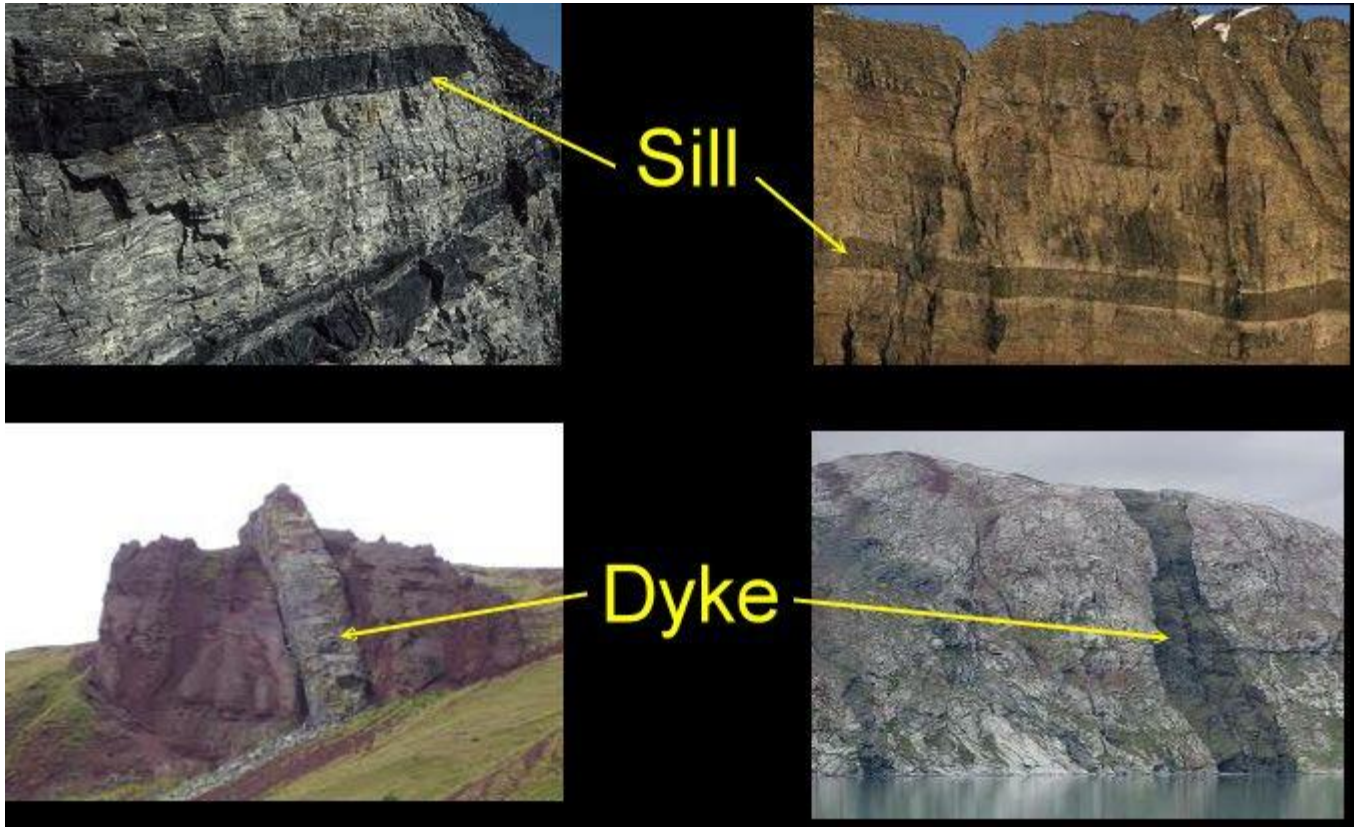

A

Dike swarm

- A **dike swarm** or **dyke swarm** is a large geological structure consisting of a major group of parallel, linear, or radially oriented dikes intruded within continental crust


34°20'0"E
34°25'0"E
34°30'0"E
25°35'0"N
25°30'0"N
25°25'0"N
N
1
2
3
4
5
6
11
12
13
14
15
0 1 2 3 4
km
Legend
Dykes
Samples

- Sheet intrusions that were approximately horizontal at the time of emplacement are termed *sills*


Sill
Dyke

Chilled margin

- A **chilled margin** is a shallow intrusive or volcanic rock texture characterised by a glassy or fine grained zone along the margin where the magma or lava has contacted air, water, or particularly much cooler rock.

This is an intrusive contact between a fine-grained gabbro, below, and a dike, above. The dike has an obvious chilled margin, grading from microscopic grain size against the gabbro to ~1 mm crystals at the image top.

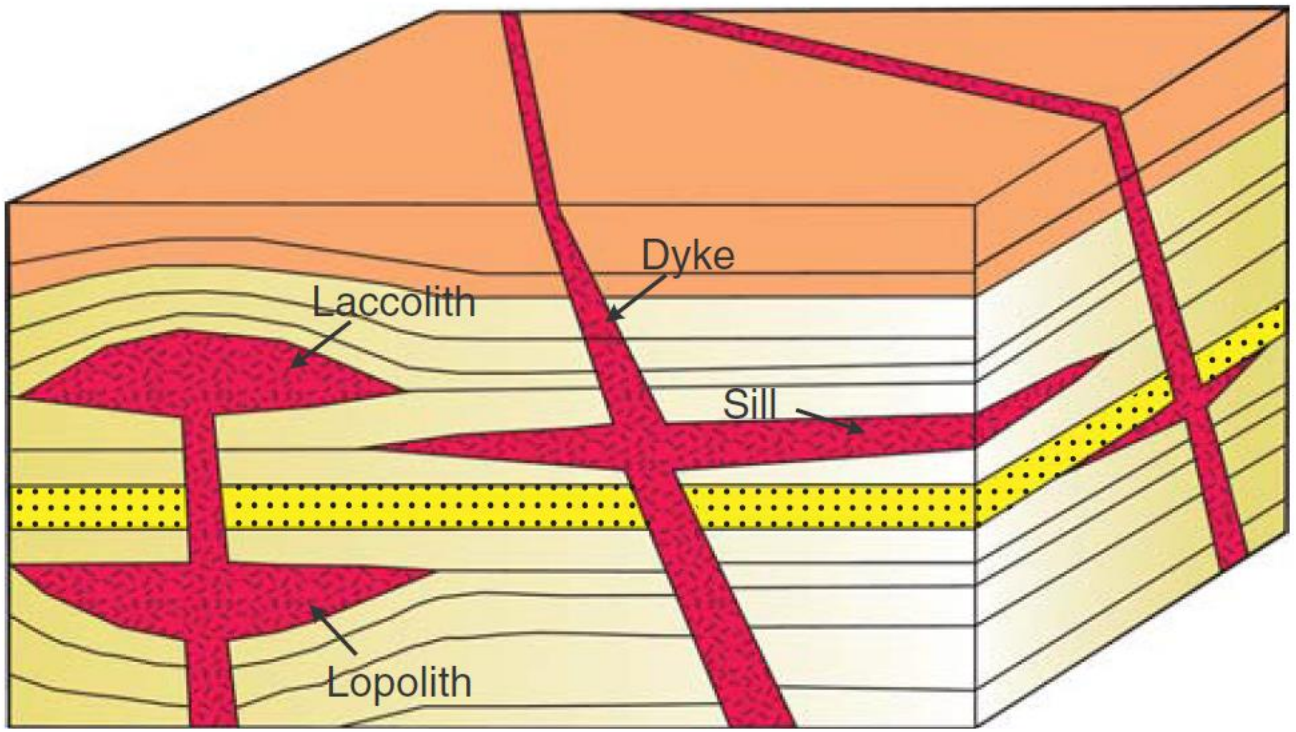
Vein

- Sill, dyke and vein; what is the difference?

laccoliths

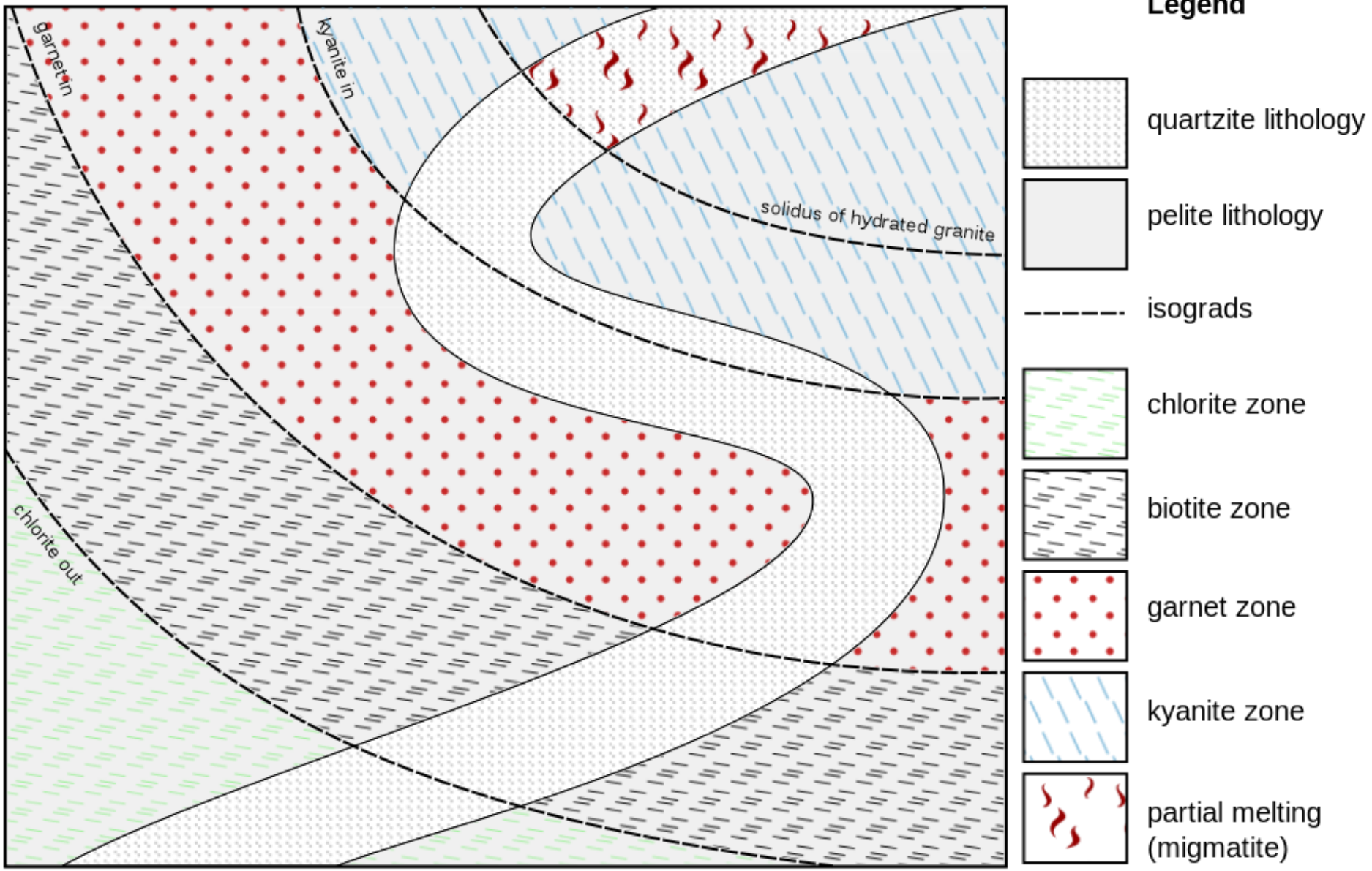
- Are concordant intrusions with the surrounding strata are blister-shaped masses with a subhorizontal base and elevated upper surface.

Lopolith



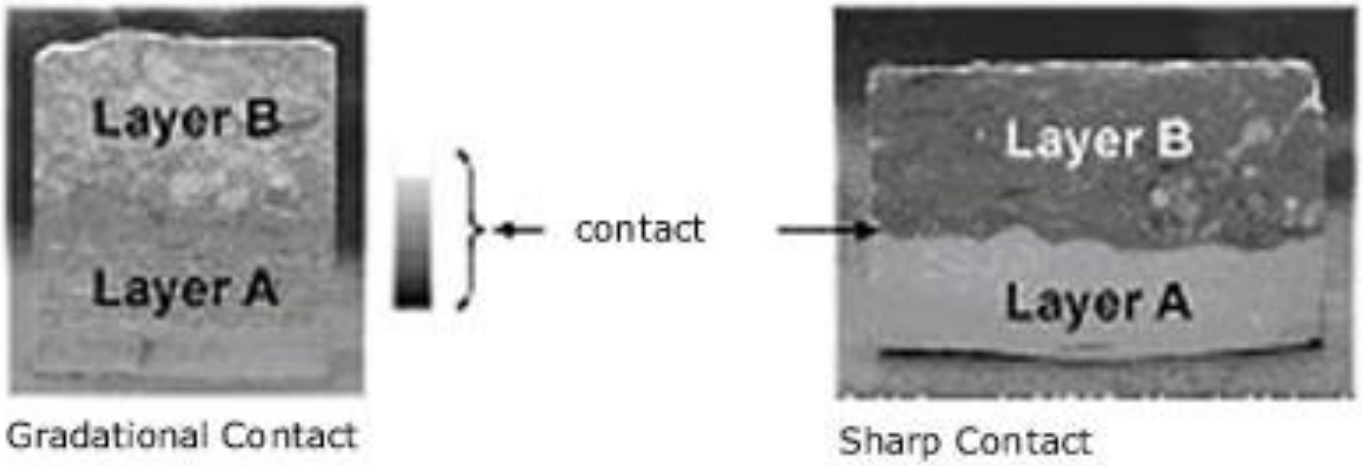
Plutonic intrusions

- *Batholiths*
- *Plutons*
- *Roof pendants*
- metamorphic aureole
- Xenoliths

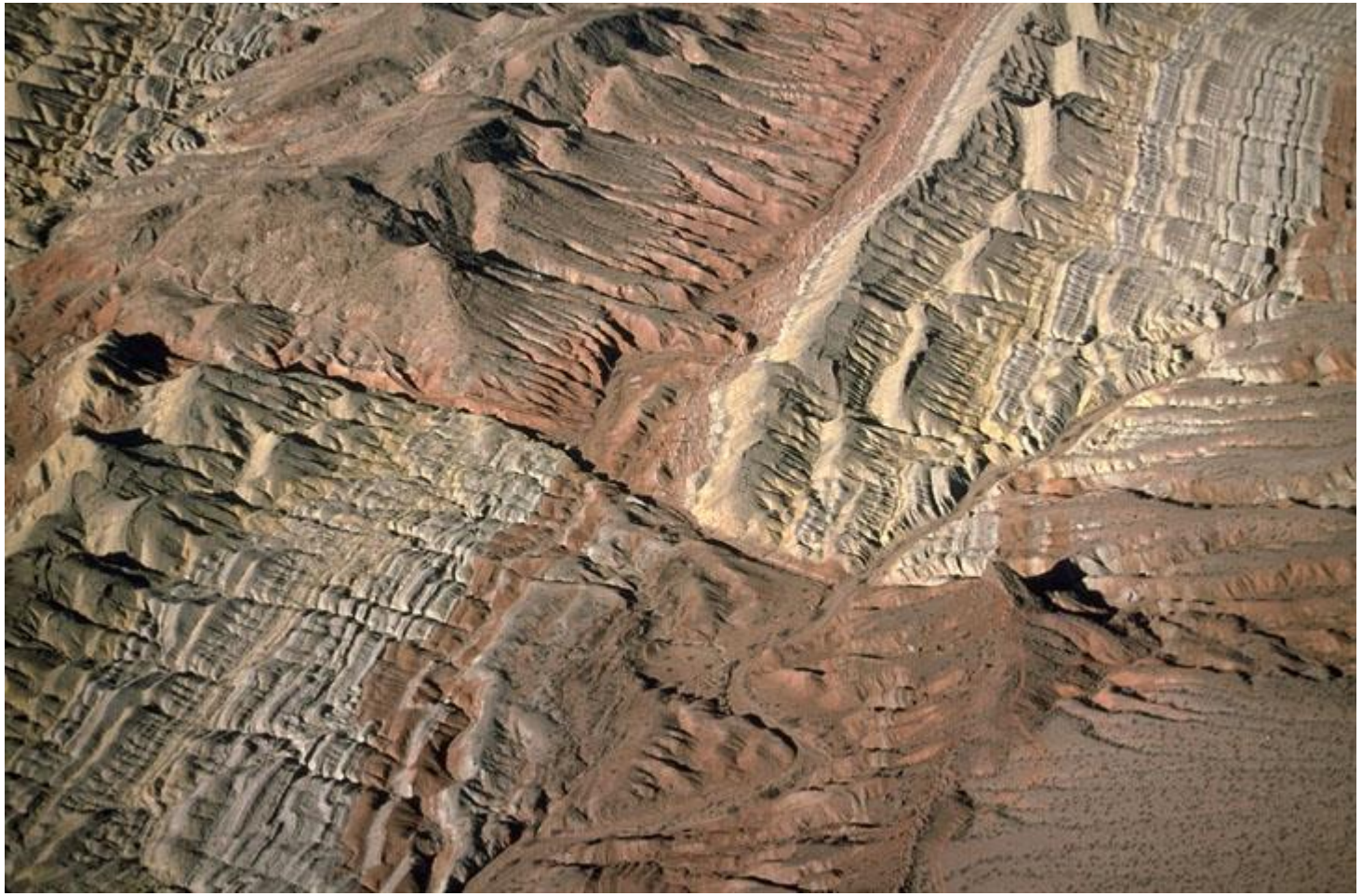

garnet in
kyanite in
solidus of hydrated granite
chlorite out
Legend
quartzite lithology
pelite lithology
isograds
chlorite zone
biotite zone
garnet zone
kyanite zone
partial melting
(migmatite)

Intrusive Contact

Gradational contact



Fault contact



Unconformities

- **Nonconformity**

A nonconformity exists between sedimentary rocks and metamorphic or igneous rocks when the sedimentary rock lies above and was deposited on the pre-existing and eroded metamorphic or igneous rock.

IGNEOUS TEXTURES AND CLASSIFICATION

- **Describing Rock Types**:

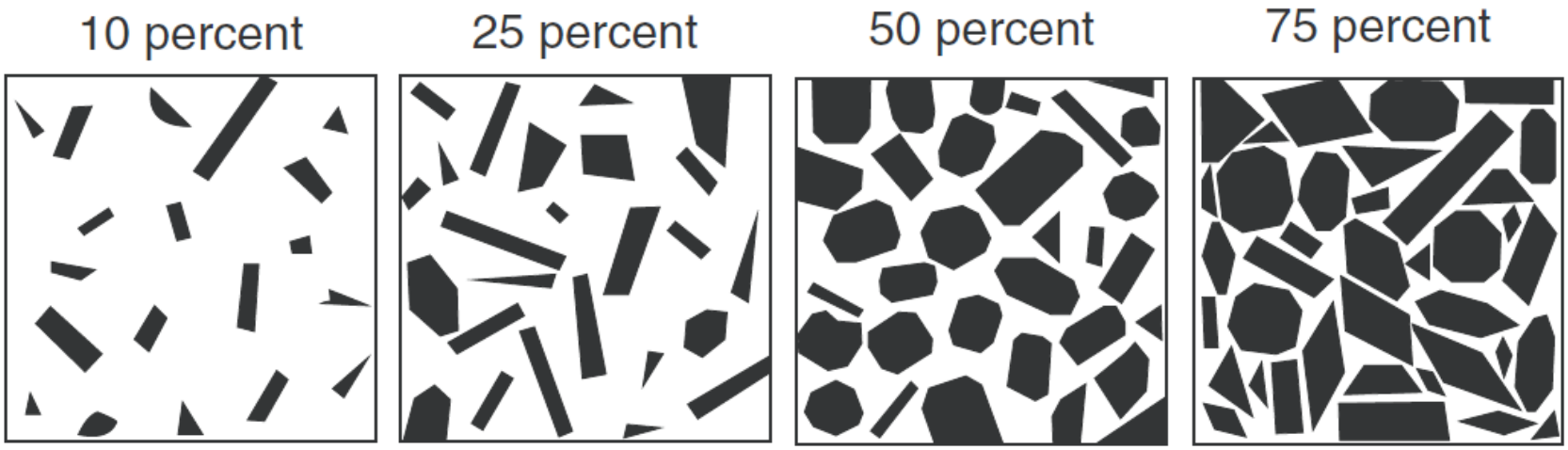
Colour

Texture, grain size and fabric

Mineralogy

Weathering

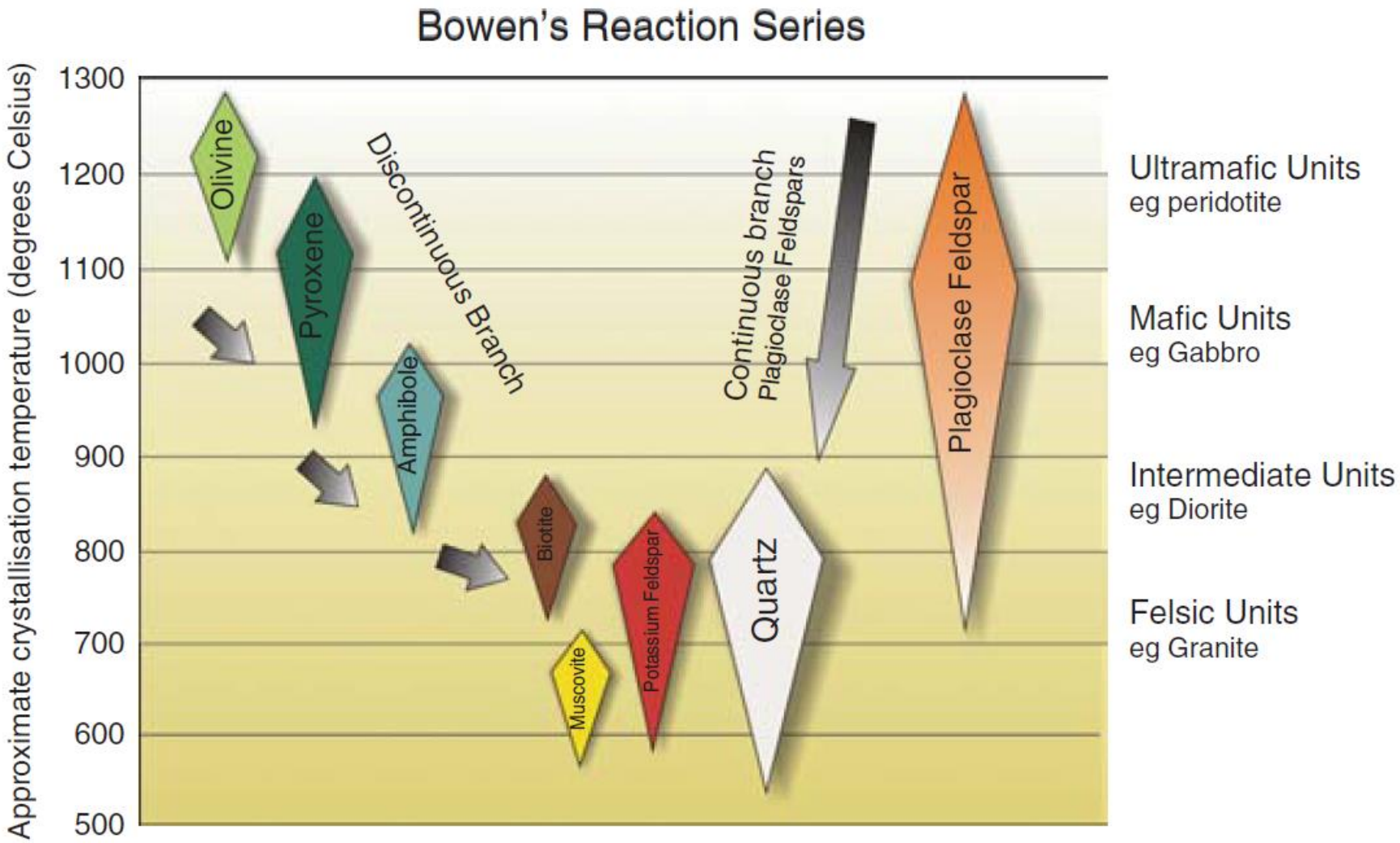
Colour and Composition



Comparison diagram for estimating the mafic mineral content of two-dimensional igneous rock surfaces.

The left specimen is felsic/ leucocratic, that in the middle is intermediate/mesocratic, and that on the right is mafic/melanocratic.

Geochemical term	Definition wt%	Approximate range of colour index[1]	Possible field descriptions
Acid	>65	5–25	Felsic/leucocratic
Intermediate	52–65	25–55	Intermediate/mesocratic
Basic	45–52	55–85	Mafic/melanocratic
Ultrabasic	<45	85–100	–

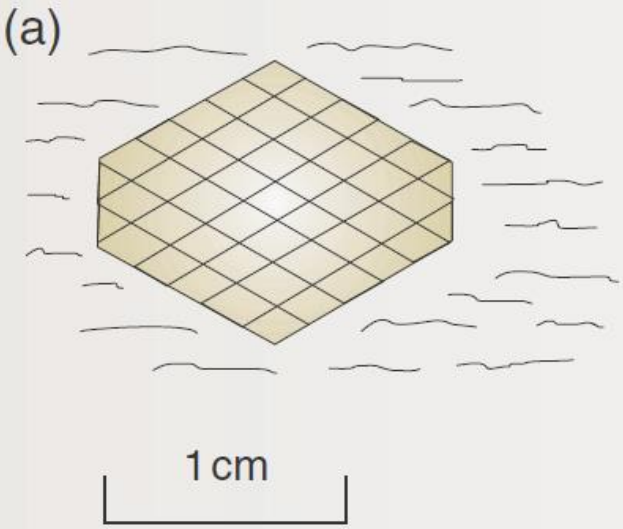

Bowen's Reaction Series
Approximate crystallisation temperature (degrees Celsius)
1300
1200
1100
1000
900
800
700
600
500
Olivine
Pyroxene
Amphibole
Biotite
Muscovite
Potassium Feldspar
Quartz
Plagioclase Feldspar
Discontinuous Branch
Continuous branch
Plagioclase Feldspars
Ultramafic Units
eg peridotite
Mafic Units
eg Gabbro
Intermediate Units
eg Diorite
Felsic Units
eg Granite

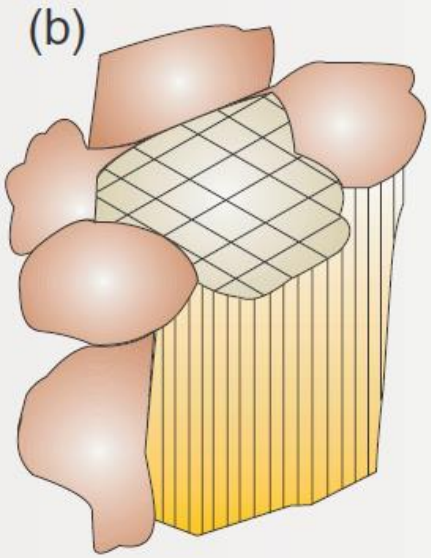
Texture, Grain-Size/Shape and Fabric

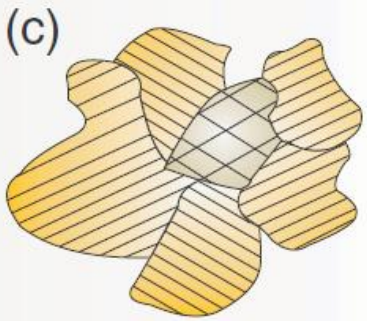
- **When describing the texture of a field sample, examine:**
- 1. The *grain-size* of the rock which can reflect the rate at which it crystallised.
- 2. The *fabric*, or geometrical characteristics and arrangement of the crystals including, where possible, observations of the number of minerals present and the characteristic shapes, or *habits*, of their crystals.
- 3. The overall *homogeneity* of the specimen (that is, whether it is uniform and equigranular, or contains mineral segregations, banding and irregular inclusions).

- These features all provide clues to the **physical conditions** under which the magma crystallised; thus, whereas the colour of a specimen is generally related to its chemical composition (for example, granites are usually lighter in colour than gabbros), the texture reflects its history and mode of occurrence.

Fine-grained[1]	Few crystal boundaries distinguishable in the field or with the aid of a handlens; mean grain size below 1mm. If the rock is glassy, the term *hyaline* may be used
Medium-grained[2]	Most crystal boundaries distinguishable with the aid of a hand lens; mean grain size 1–5 mm
Coarse-grained[2]	Virtually all crystal boundaries distinguishable with the naked eye; mean grain size greater than 5 mm







Term	Euhedral	Subhedral	Anhedral
Other terms	(Idiomorphic, Automorphic)	(Hypidiomorphic, Hypautomorphic)	(Allotriomorphic, Xenomorphic)
Description	Crystal completely bounded by its characteristic faces	Crystal bounded by only some of its characteristic faces	Crystal lacks any of its characteristic faces

Mineral Identification

- **Colour** Generally, alkali/alkaline earth silicates (Na, K, Ca silicates) are light-coloured whereas silicate minerals rich in transition elements, particularly iron, are dark-coloured.
- **Cleavage** is the tendency of minerals to split along well-defined planes that are related to weaknesses in their atomic structures.

- **Lustre** describes the reflective properties of a mineral and is assessed by turning the specimen until the mineral surfaces, particularly any cleavage surfaces, are caught by the light.
- Lustre varies from *dull* (non-reflecting), through *resinous* and *silky* to *bright*, which may be metallic, glassy or vitreous

- **Habit** refers to the characteristic morphology of euhedral crystals.
- *lath-shaped* feldspars which are long and thin
- rectangular, dodecahedral or trapezohedral garnets.
- Acicular (that is, needle-like) tourmalines

- **Hardness**, a property related to the strength and uniformity of atomic bonding within a crystal, is described using a simple but *non-linear scale* of increasing hardness from 1 to 10 known as *Mohs' scale*

MINERAL	MOH'S RELATIVE HARDNESS	COMMON OBJECTS
Talc	1	
Gypsum	2	Finger nail (2.5)
Calcite	3	Copper coin (3.5)
Flourite	4	
Apatite	5	Steel nail (5.5)
Orthoclase	6	Glass plate (6)
Quartz	7	Streak plate (7.5)
Topaz	8	
Corundum	9	
Diamond	10	

Naming and Classification