Province of British Columbia
Ministry of Energy, Mines and
Petroleum Resources

MINERAL RESOURCES DIVISION
Geological Survey Branch

THE IDENTIFICATION OF COMMON ROCKS

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The Identification of Common Rocks

INTRODUCTION

The entire earth's surface is made up of rocks. Although in many places the rocks are covered with river, wind or glacially deposited materials, there are few places in British Columbia where rocks cannot be found. A large number of different rock types exist. The identification of common rocks may, however, be complicated by the fact that certain rock types grade into each other. For example there is every gradation between a shale and a sandstone — including sandy shale and shaly sandstone, and also between granite and gabbro. In addition a single rock type may vary in appearance.

The booklet deals mainly with rock types found in British Columbia and is therefore addressed to British Columbia readers. The rocks of this province are however not unique, and the principles used here can be applied anywhere. The geology of British Columbia is fascinating; it is complex, many processes are at work, and there are a great variety of rocks. Rocks are an integral part of the landscape; being able to identify them can greatly enhance your enjoyment of the natural world.

Before starting to identify rocks it is helpful to know a little about what rocks are, how they are formed, and how they are classified. These topics are dealt with in the next few pages. A brief discussion of the major rock groups — **igneous, sedimentary** and **metamorphic,** and their most common forms — is also included.

Rocks are precisely classified using various properties which are determined by petrologists using microscopes and other complicated and sophisticated equipment . More approximate, "field" terms are used by geologists in the field and this booklet describes ways to look at and **identify rocks in outcrop.** The purpose of this booklet is to aid the non-specialist to easily identify the rocks, using simple techniques which can be applied in the field or at home. The methods used assume little prior knowledge and the **equipment** required is limited to:

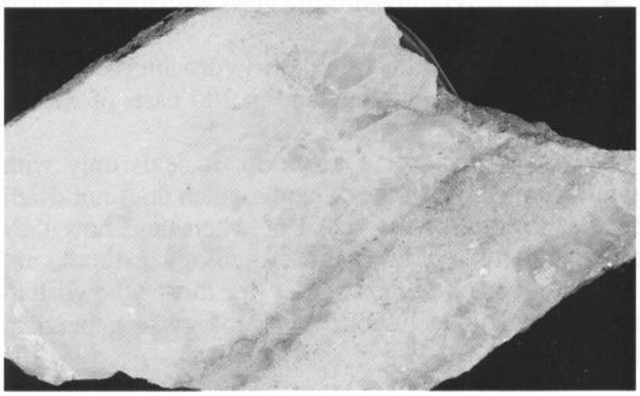
- a rock hammer to break off pieces of rock
- a pocket knife
- a hand lens or magnifying glass with 6 to 10 power magnification
- a dropper bottle of dilute hydrochloric acid (5 parts of concentrated acid in 100 parts of water).

The booklet is not a textbook, it deals only with identifying common rocks, and as such does not dwell on the geology of the rocks or where and how they occur. A number of introductory geology textbooks are listed at the back of the booklet, for those who wish to pursue the study of rocks and geology in general in more detail.

WHAT ARE ROCKS?

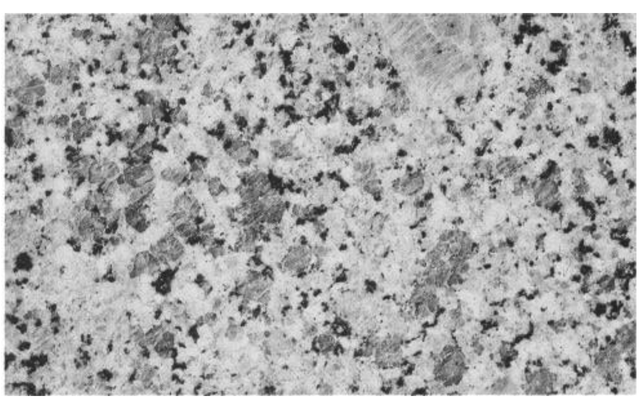
A great variety of definitions have been applied to rocks. For example, engineers may define rocks as materials which must be blasted to make dams, roads and so on, while a builder may define a rock as a hard, resistant building material. Geologists, however, define rocks as **collections or aggregates of mineral grains.** Most rocks fall into this category; however, there are exceptions, such as conglomerate, which is made up of pebbles which are themselves mineral aggregates; obsidian, which is a volcanic glass that cooled so fast that no crystals had time to form; and coal, which is an aggregate of plant material as opposed to mineral matter. A large number of mineral types may be present in a rock, for example quartz, feldspar and muscovite in granite, or the entire rock may be made up of many grains of a single mineral, for example quartz in some sandstones (see Figure 1). Rock generally refers to aggregates of mineral grains that are **coherent**; in other words, the grains stay together and don't disintegrate under normal conditions; thus sand and mud, which disaggregate, are not rocks.

Mineral grains have various shapes and are held together in a rock in a number of ways. Minerals can be rounded or irregular in shape. The **rounded** grains are held together by cement, just as sand grains are cemented together to form sandstone. Irregular or angular shaped grains are **interlocking** and this is how grains in granite or gabbro are held together (see Figure 2). These features are important tools in classifying rocks and assigning them to one of the three major rock groups. As will be discussed following, **sedimentary** rocks are made up of fragments of pre-existing



0 2
cm

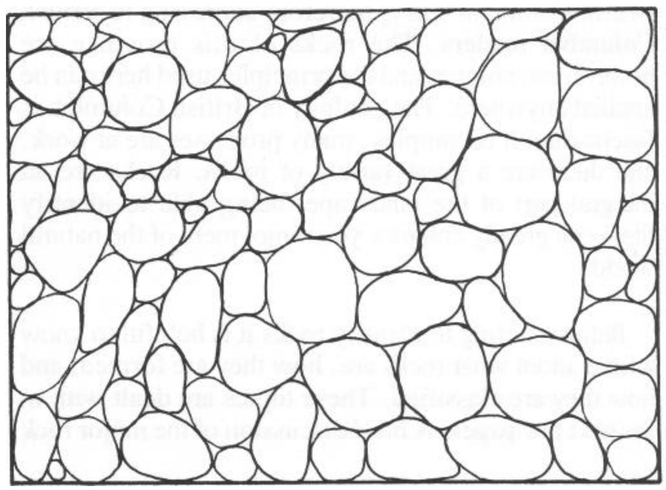
(1A) all the same mineral



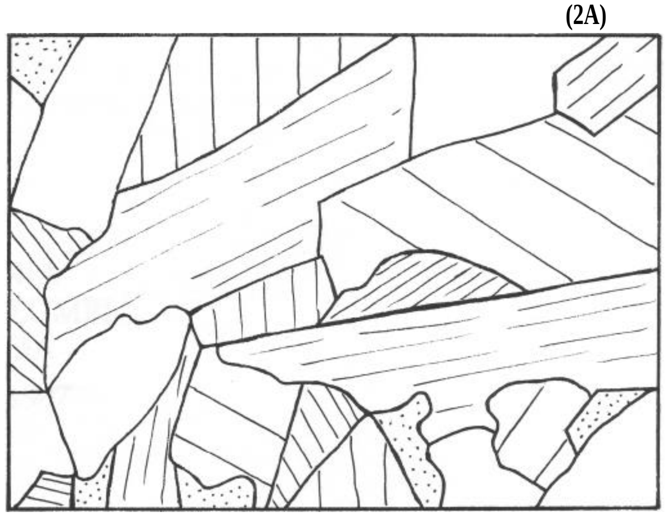
0 2
cm

(1 B) different minerals

Figure 1. Aggregates of minerals: (A) all the same mineral and (B) different minerals.



(2A)



(2B)

Figure 2. Rock held together by (A) cemented and (B) interlocked grains.

rocks which have been weathered and eroded. The rocks which result have rounded grains held together by mineral cements. **Igneous** and **metamorphic** rocks on the other hand crystallized at high temperatures and the minerals are interlocking and irregular.

While rocks consist of aggregates of minerals, **minerals** themselves are made up of **one or a number of chemical elements** with a definite chemical composition. Minerals cannot be broken down into smaller units with different chemical compositions in the way that rocks can. More than two thousand three hundred different types of minerals have been identified, luckily many are rare; the common rocks are made up of a relatively small number of minerals.

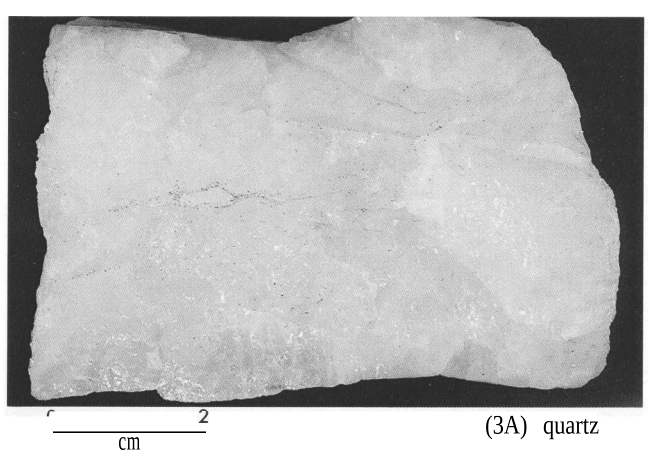
Since minerals are the building blocks of rocks, it is important that you learn to identify the most common varieties. Minerals can be distinguished using various physical and/or chemical characteristics, but, since chemistry cannot be determined readily in the field, geologists use the physical attributes of minerals to identify them. These include features such as crystal **form, hardness** (relative to a steel blade or your fingernail), **colour, lustre** and **streak** (the colour when a mineral is ground to a powder). More detailed explanations of these terms and other aspects of mineral identification may be found in the guidebooks listed on the last page of this booklet. Generally the characteristics listed above can only be determined if the mineral grains are visible in a rock. The **identification flowchart (see** Figure 5) distinguishes between **rocks in which the grains are visible and those in which the individual mineral components are too small to identify.**

COMMON ROCK-FORMING MINERALS

A small number of minerals, including olivine, quartz, feldspar, mica, pyroxene and amphibole, are the common rock-forming minerals. Because they are so common, and are used as important **tools in classifying igneous rocks,** descriptions which will help you to identify them are included in this booklet. Except for quartz, all the minerals listed above are actually groups of minerals which have many common characteristics. Instead of trying to separate all the minerals which make up a certain group, they are dealt with here as a single mineral with common characteristics.

Olivine: Olivine, or peridot in the jewelry trade, is yellow-green, translucent and glassy looking. Crystals are uncommon; it usually occurs as rounded grains in igneous rocks or as granular masses. Olivine is almost as hard as quartz; it does not have a well-developed cleavage.

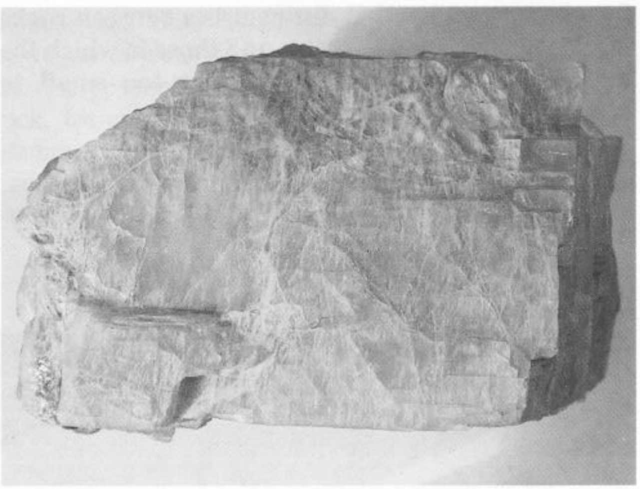
Quartz: Quartz is a glassy looking, transparent or translucent mineral which varies in colour from white and grey to smoky. When there are individual crystals they are generally clear, while in larger masses quartz looks more milky white. Quartz is hard — it can easily scratch a steel knife blade. In the rock, quartz grains are irregular in shape because crystal faces are rare and quartz does not have a cleavage (that is, it does not break on regular flat faces).



(3A) quartz

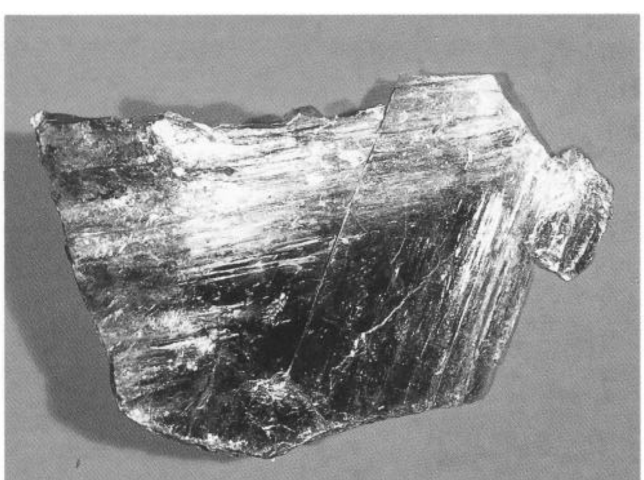
Figure 3. Common rock-forming minerals: (A) quartz, (B) feldspar, (C) mica, (D) pyroxene and (E) amphibole.

Feldspar: Feldspar is the other common, light-coloured rock-forming mineral. Instead of being glassy like quartz, it is generally dull to opaque with a porcelain-like appearance. Colour varies from red, pink and white (orthoclase), to green, grey and white (plagioclase). Feldspar is also hard but can be scratched by quartz. Feldspar in igneous rocks forms well-developed crystals which are roughly rectangular in shape, and they cleave or break along flat faces. The grains, in contrast to quartz, often have straight edges and flat rectangular faces, some of which may meet at right angles.



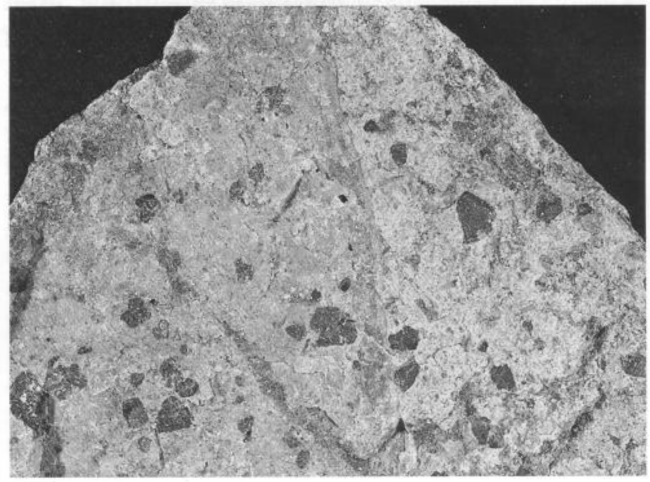
0 2 cm (3B) feldspar

Mica: Mica is easily distinguished by its characteristic of peeling into many thin flat smooth sheets or flakes. This is similar to the cleavage in feldspar except that in the case of mica the cleavage planes are in only one direction and no right angle face joins occur. Mica may be white and pearly — muscovite, or dark and shiny — biotite.



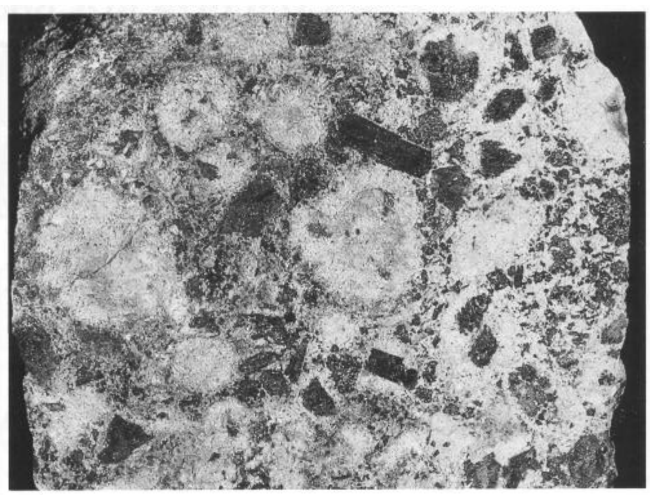
0 2 cm (3C) mica

Pyroxene: The most common pyroxene mineral is augite. Augite is generally dark green to black in colour and forms short, stubby crystals which, if you look at an end-on section, have square or rectangular cross-sections.



0 1 cm (3D) pyroxene

Amphibole: The most common amphibole is hornblende. Hornblende is quite similar to augite in that both are dark minerals, however hornblende crystals are generally longer and thinner and shinier than augite and the mineral cross-sections are diamond shaped.



0 2 cm (3E) amphibole

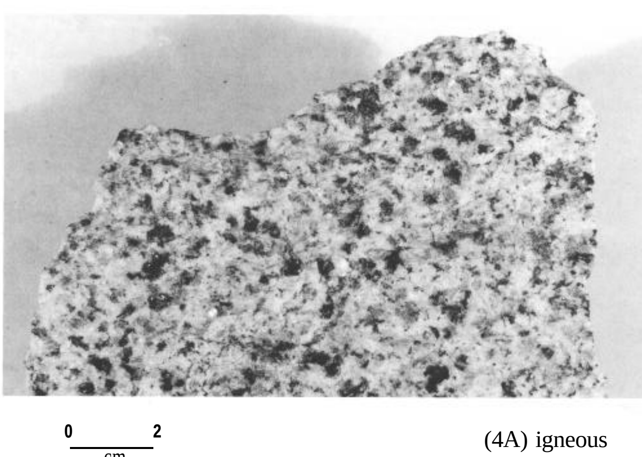
Quartz and feldspar are light-coloured minerals; mica, pyroxene and amphibole are dark coloured. The colour of a rock will be determined by the proportions of light and dark-coloured minerals present. If most of the grains are quartz and feldspar then the overall appearance of the rock will be light, while the opposite will be true if the minerals are mainly mica, pyroxene and amphibole. The colour of a rock with between 25 and 50% dark minerals is intermediate.

ROCK CLASSIFICATION

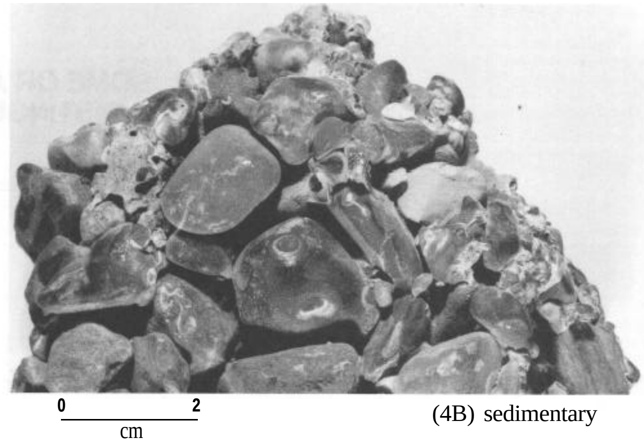
Rocks are classified or grouped together as igneous, sedimentary and metamorphic according to how they were formed. Rocks form in three main ways: **igneous —** by crystallization of minerals from molten material or magma as it cooled; **sedimentary** --- by accumulation of materials which have been eroded and weathered from pre-existing rocks at the earth's surface; **metamorphi c —** by modification of pre-existing rocks by heat, pressure or the action of chemical solutions.

Every rock has characteristics that reflect its process of formation; these are used to determine whether the rock is igneous, sedimentary or metamorphic (see Figure 4). For example, a rock with rounded grains cemented together is sedimentary, while one with a strong banding and orientation of the minerals is metamorphic. Identification of rock types within the three divisions depends on the nature of the mineral grains, including their composition and size and relationship to surrounding grains; the way the rock occurs; how uniform it is; its hardness; how it reacts with acid; its colour; and the way in which it breaks. Before trying to identify a rock, break a piece off with a rock hammer. This will expose a clean, fresh surface. (WARNING — **do not use a carpenter's hammer, they are hardened steel and will chip.)**

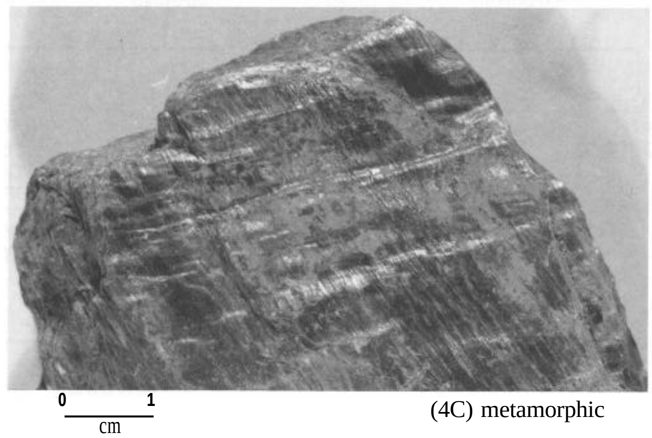
When a rock is dirty or covered with lichen many of its characteristics are obscured, preventing you from accurately identifying the rock. Identification of beach pebbles that are smoothed and rounded is not considered here because this booklet deals specifically with fresh surfaces. Many pebbles are relatively easy to identify without breaking, but many are extremely difficult, and breaking usually destroys their interest and charm. As a rule a pebble catches the eye and is picked up because it is an object which shows some special effect of colour or pattern, often due to layering, veining or alteration. Such pebbles are not good examples of common rock types.



(4A) igneous



(4B) sedimentary



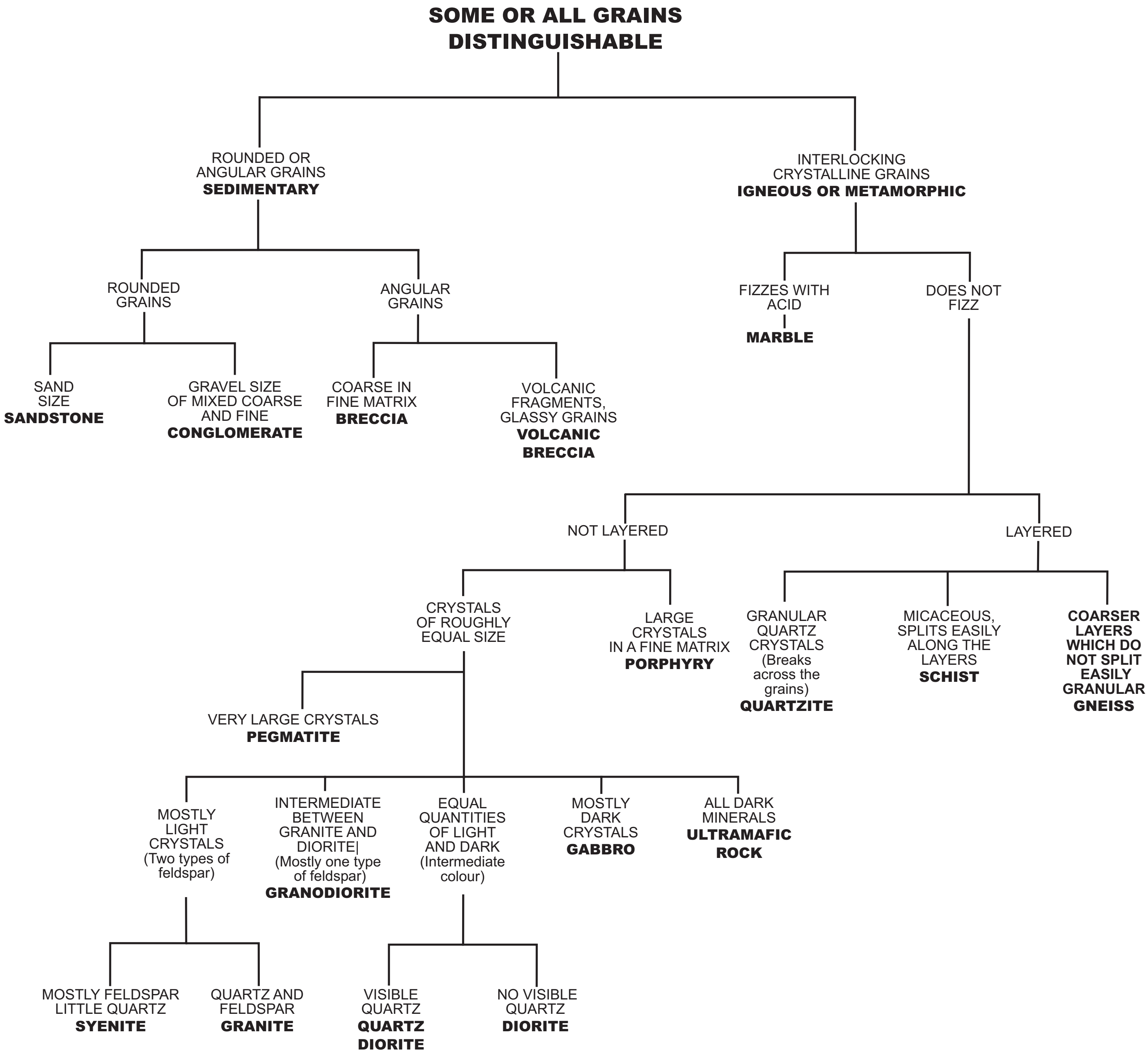
(4C) metamorphic

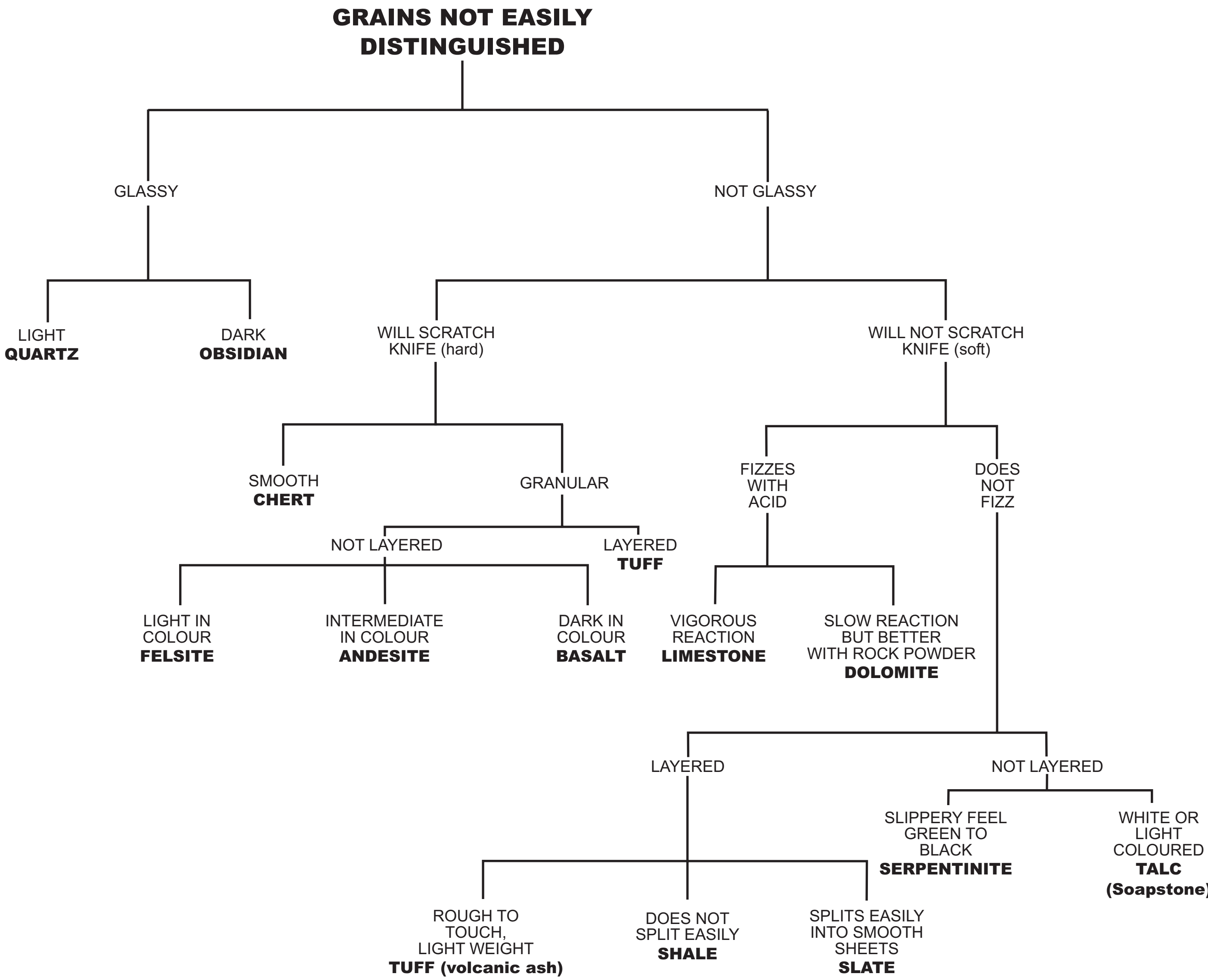
Figure 4. Appearances vary for (A) igneous, (B) sedimentary and (C) metamorphic rocks.

KEY TO USING THE ROCK IDENTIFICATION CHART

To identify a rock which is of interest, first, take a fresh surface and examine it carefully with the naked eye. Starting at the top of the chart, decide whether the grains which make up the rock can be distinguished or not. Where some of the grains can be seen, for example a rock in which there are a number of large grains in a very fine matrix, go to the right side and proceed from there. From here on use a hand lens and, where it is required, a knife or dilute hydrochloric acid (5%). Follow the flow lines downward and at each branching check all the possible options and decide which one most closely fits your specimen. Continue downwards until you come to a rock name. Check the rock description in the igneous, sedimentary and metamorphic sections of the booklet and if the features and the way the rock occurs fit your sample — BRAVO! Otherwise go back to the chart and check for alternative choices at places where you may have been unsure of your observations; rocks vary so don't be surprised or discouraged if this happens.

Figure 5. Rock Identification Chart




GRAINS NOT EASILY DISTINGUISHED
GLASSY
NOT GLASSY
LIGHT QUARTZ
DARK OBSIDIAN
WILL SCRATCH KNIFE (hard)
WILL NOT SCRATCH KNIFE (soft)
SMOOTH CHERT
GRANULAR
NOT LAYERED
LAYERED TUFF
LIGHT IN COLOUR FELSITE
INTERMEDIATE IN COLOUR ANDESITE
DARK IN COLOUR BASALT
FIZZES WITH ACID
DOES NOT FIZZ
VIGOROUS REACTION LIMESTONE
SLOW REACTION BUT BETTER WITH ROCK POWDER DOLOMITE
LAYERED
NOT LAYERED
SLIPPERY FEEL GREEN TO BLACK SERPENTINITE
WHITE OR LIGHT COLOURED TALC (Soapstone)
ROUGH TO TOUCH, LIGHT WEIGHT TUFF (volcanic ash)
DOES NOT SPLIT EASILY SHALE
SPLITS EASILY INTO SMOOTH SHEETS SLATE

IGNEOUS ROCKS

Igneous rock forms as molten material, called **magma,** cools and solidifies. As the hot magma rises to the surface and cools the chemical elements within it combine, and minerals begin to crystallize. As cooling continues, crystals get larger and more numerous and begin to interfere with the neighbouring crystals which are also growing; the result is a mass of partially formed and interlocking crystals. If cooling is slow minerals with sharp edges and perfect faces are rare; normally so many form at once that they don't have room to grow in this way.

Magma when it cools deep within the earth cools very slowly, allowing the crystals to grow to be quite large, 3 to 10 millimetres or more. This results in a medium or coarse-grained igneous rock — termed **intrusive or plutonic.** Examples of this type of rock are granite or gabbro. If on the other hand the magma cools close to or at the earth's surface. as for example in the Hawaiian volcanoes, cooling takes place very rapidly allowing little time for crystal growth. This type of igneous rock — **volcanic or extrusive** — will be very fine grained. An example is basalt. In some cases the magma cools so quickly that no crystals grow and volcanic glass results. Another common scenario is where cooling of the magma begins deep inside the earth where a number of quite large crystals grow, then is moved nearer to the surface where it is cooled rapidly. The resulting rock has some large, well-formed crystals sitting within a fine-grained matrix; it is called a porphyry. The large crystals are called phenocrysts.

A large number of igneous rocks exist and they grade from one type into another. **Classification** schemes are usually based on the types and amounts of minerals present (see Figure 6), and the size of the crystals. While the compositional variations of the rock groups are important to petrologists, here we will only introduce you to the basic rock types.

To use this figure, read from the ottom up You can decide what the rock is from the minerals it contains For e ample, if the rock is dark coloured and consists mainly of pyro ene and oli ine, with a out plagioclase, it is a ga ro if it has com ined mica and amphi ole, uart , orthoclase and the rest is pagioclase, it is a granodiorite

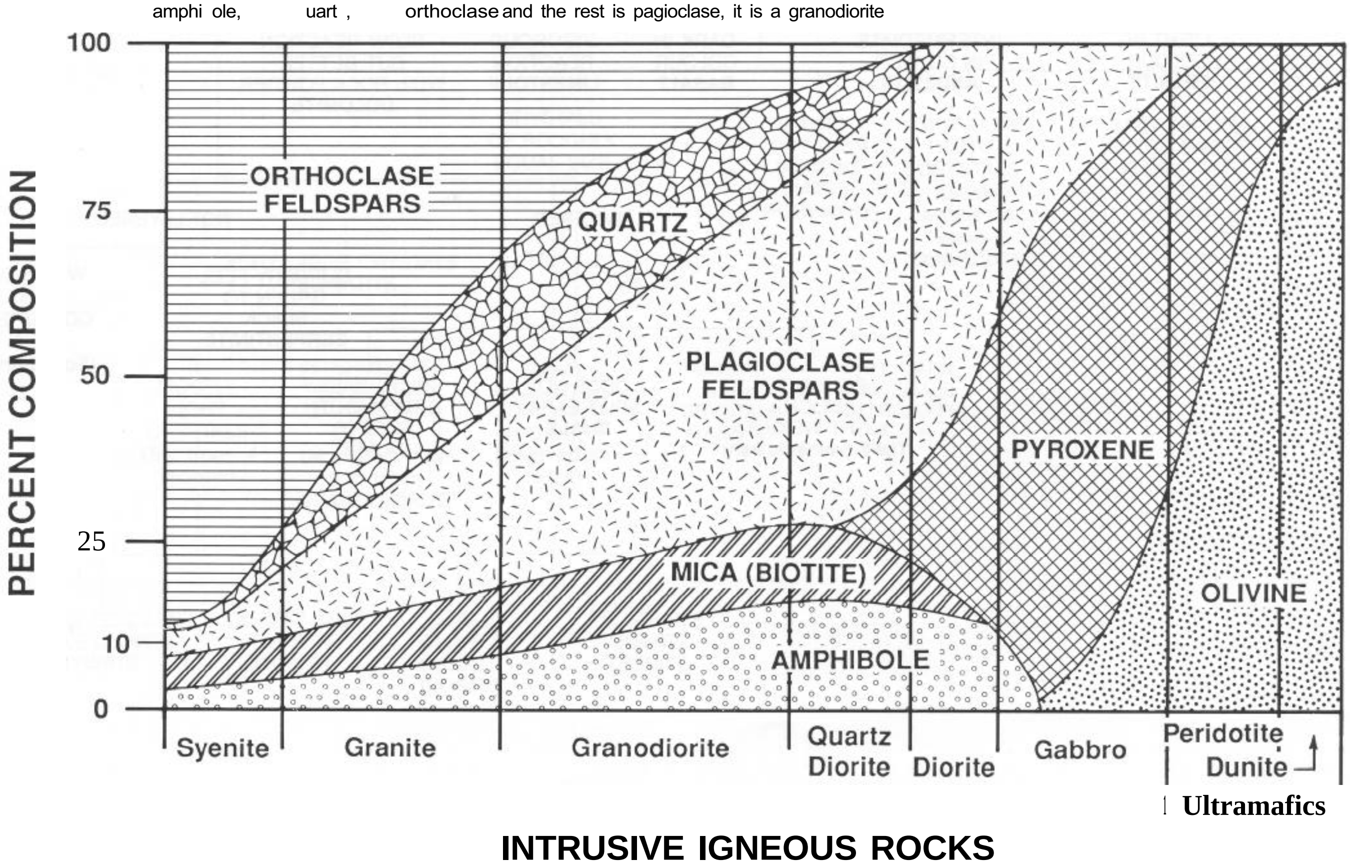


Figure 6. Classification of igneous rocks by mineral composition.

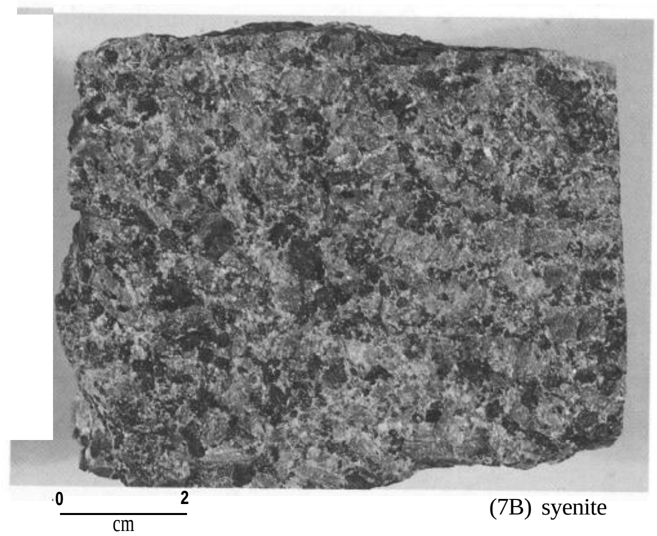
INTRUSIVE OR PLUTONIC ROCKS

Intrusive rocks, because they crystallized at depth, are completely crystalline, generally unlayered, and consist of interlocking crystals that are **medium to coarse grained.** Differing proportions of light and dark minerals result in a colour range from light to dark. These colour variations, and the presence or absence of quartz, are used to distinguish the different kinds of intrusive rocks (see Figures 6 and 7).

Most igneous rocks are of intermediate composition and colour. These intermediate-coloured intrusive rocks form a series which grades between granite on the light-coloured side, through granodiorite, quartz diorite and diorite to gabbro on the dark side.

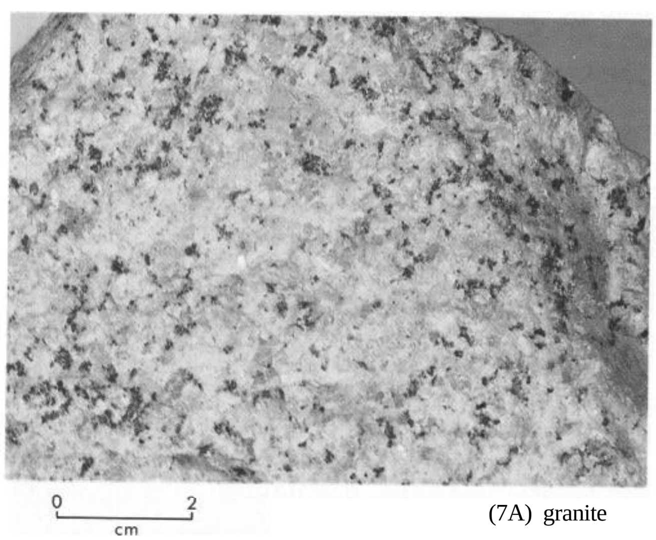
Granite: is a pink or greyish coloured, medium to coarse-grained, evenly granular rock which represents the lightest coloured variety of intrusive rock. The grains are mainly white/pink orthoclase feldspar, with lesser amounts of white/grey plagioclase feldspar, and quartz; small amounts of dark biotite and/or hornblende are mixed in with these light mineral components. In some granites, where the feldspar is red in colour, the rock will appear darker. True granite is not common in British Columbia.

Syenite: is also light coloured. It is similar to granite except that it contains very few or no quartz grains. It is therefore made up predominantly of interlocking feldspar crystals with minor amounts of mica or hornblende. Syenite is rare in British Columbia. If the crystals are very large (more than 2 centimetres), the rock can be called a pegmatite.

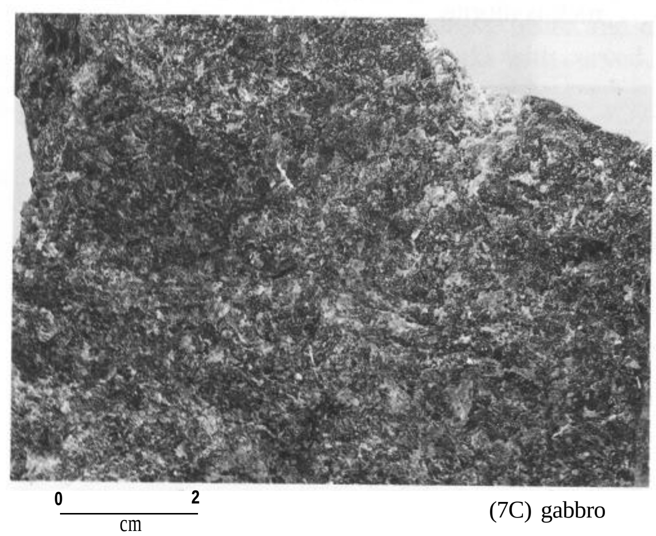


(7B) syenite

Gabbro: is a dark, medium to coarse-grained intrusive rock, containing more than 50% dark crystals and interlocking light crystals. The dark minerals are mainly pyroxene, with minor amounts of hornblende or biotite; the light minerals are usually light grey plagioclase feldspars. Gabbro is not common in British Columbia. If there are NO light crystals at all, the rock is an ultramafic.



(7A) granite

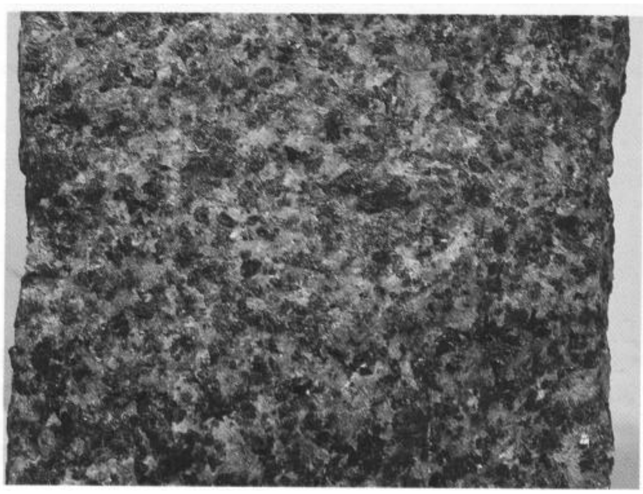


(7C) gabbro

Figure 7. Common slowly cooled igneous rocks of the plutonic or intrusive type are (A) granite, (B) syenite, (C) gabbro, (D) diorite (E) quartz diorite and (F) granodiorite.

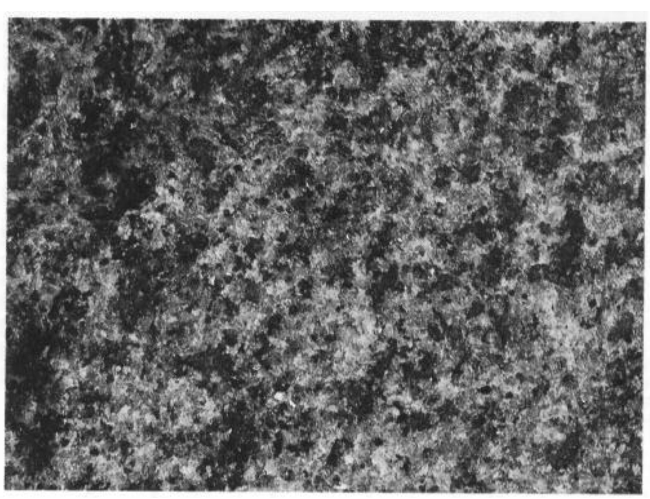
Diorite - Quartz Diorite - Granodiorite: These intermediate-coloured intrusive rocks form a series which grades between granodiorite on the light-coloured side, through quartz diorite and **diorite,**

to gabbro on the dark side. The gradation represents an increase in dark minerals, a decrease in quartz, and an increase in the amount of grey plagioclase. The intermediate rocks may be difficult to separate. Only the most common varieties in British Columbia **— quartz diorite and granodiorite —** are discussed here.



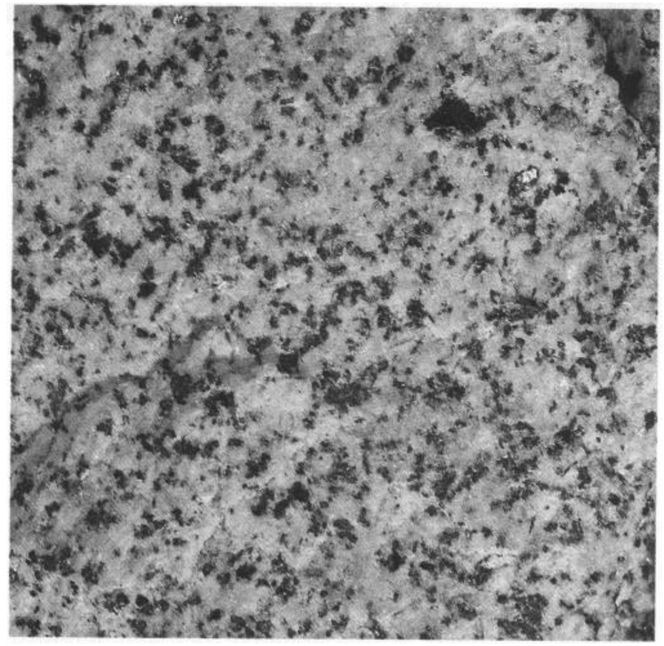
0 1 cm (7D) diorite

Quartz Diorite: is a medium to dark grey, medium to coarse-grained rock consisting mainly of plagioclase feldspar, some quartz, and abundant dark minerals (roughly a third). If there is no quartz, the rock is diorite.



0 1 cm (7E) quartz diorite

Granodiorite: falls between granite and quartz diorite; it contains more dark minerals than granite but fewer than quartz diorite. The light-coloured minerals are quartz and feldspar; the feldspar is a mixture of orthoclase and plagioclase.



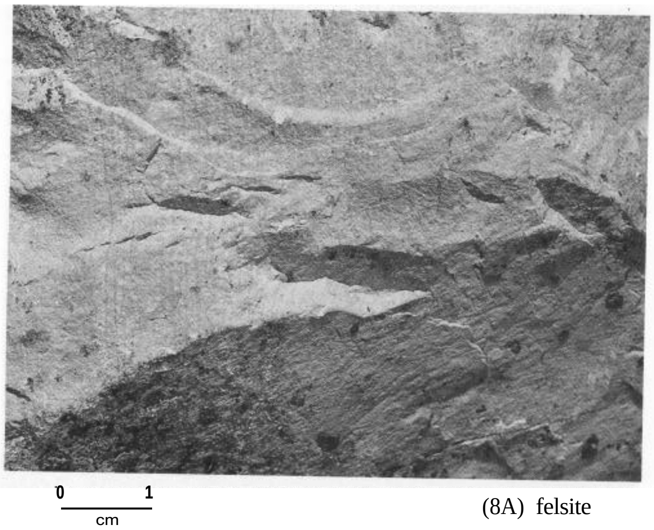
0 2 cm (7F) granodiorite

EXTRUSIVE OR VOLCANIC ROCKS

When magma is erupted from volcanic vents at the earth's surface it cools very rapidly and a **fine-grained** rock results. Although the grains may not be clearly visible, generally the rock will still have a granular texture. Different types of volcanic eruptions give rise to different types of volcanic rocks. If magma pours out onto the surface, a **volcanic lava** with flow structures, phenocrysts, and abundant vesicles (or gas bubble cavities) may result.

If the eruption is forceful, like Mauna Loa in Hawaii, or explosive, like Mount St. Helens, the rock formed may consist of a variety of fragments including glass shards, volcanic bombs, ash and pumice. These deposits are commonly layered and are termed **agglomerates or volcanic breccias.** Volcanic rocks form from the same magma as intrusive igneous rocks. Although the crystals are too small to identify without a microscope, they show the same series of mineral gradations and corresponding colour variations as their medium and coarse-grained counterparts (see Figure 8). Volcanic rocks are often difficult to crack with a hammer and break with a rough fracture surface.

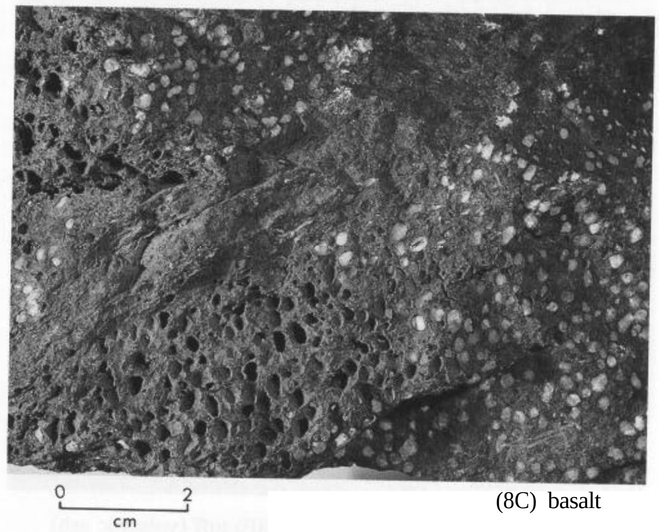
Felsite: is a general term for all light-coloured volcanic rocks. The most common variety, which is the fine-grained or volcanic equivalent of granite, is called rhyolite. Felsites are generally granular, rough to the touch, and in some cases show a series of more or less parallel bands of different colours called flow bands. These may be wavy and swirly and can therefore be distinguished from sedimentary bedding or metamorphic foliation. Felsites are not common in British Columbia.



(8A) felsite

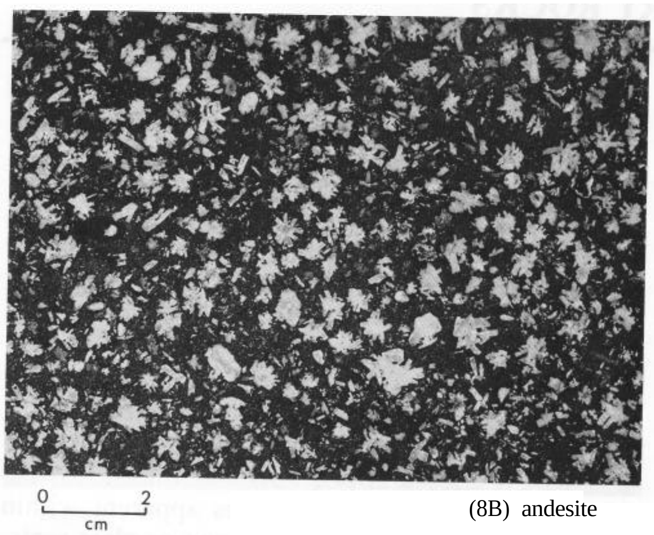
Andesite: is intermediate in composition and colour between felsite and basalt; it is the fine-grained, volcanic equivalent of diorite and is generally a dark grey rock consisting mainly of plagioclase feldspar and abundant dark minerals. Colours range from grey and grey-green to red or pink. Andesites are generally porphyritic, that is, they contain some large crystals floating in a fine-grained matrix. In British Columbia andesites are more common than felsites, but less common than basalt.

Basalt: is a fine-grained, dark-coloured, dense rock which has a dull, granular appearance. Basalt, which is the volcanic equivalent of gabbro, is often porphyritic. Commonly basalt is vesicular, that is, it has holes (vesicles) which were once gas bubbles; later, these holes often fill with mineral matter (amygdules). Basalts which formed by underwater eruptions characteristically develop pillow-like shapes. Basalt is a common rock in British Columbia.

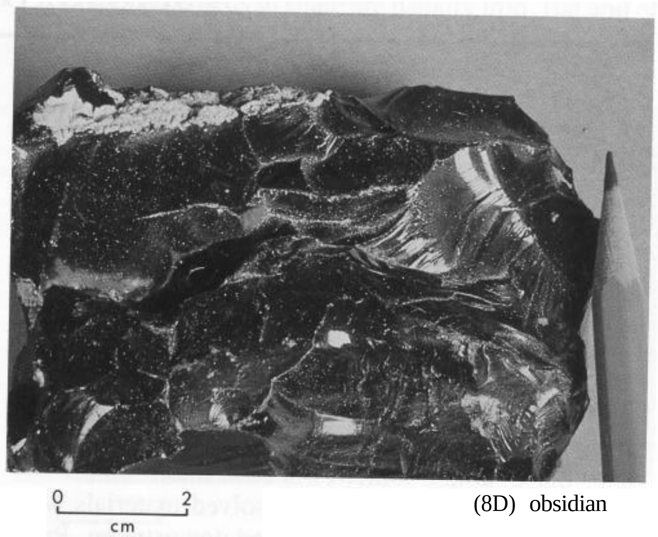


(8C) basalt

Obsidian: is a natural volcanic glass. It is generally dark in colour, with a bright glassy lustre and a conchoidal fracture, that is, it breaks with curved, striated faces like glass. Obsidian is not common in British Columbia.



(8B) andesite

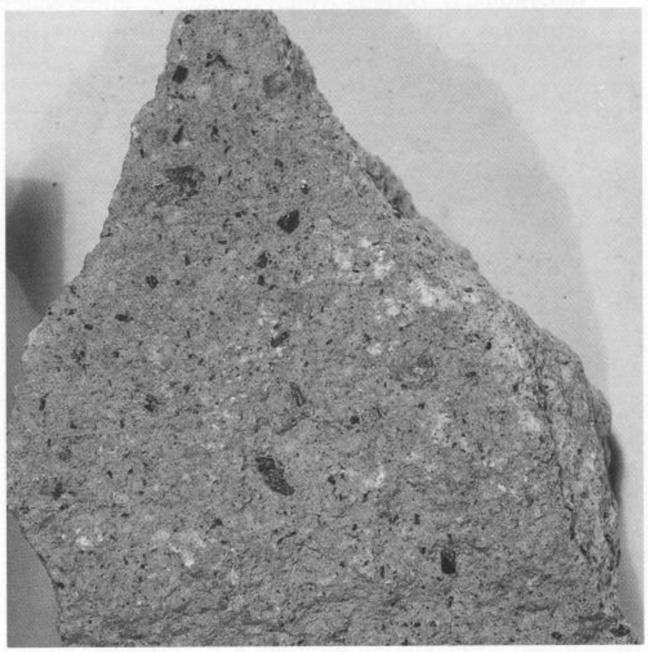


(8D) obsidian

Figure 8. Common quickly cooled igneous rocks of the volcanic or extrusive type are (A) felsite, (B) andesite, (C) basalt, (D) obsidian, (E) volcanic ash (tuff) and (F) volcanic breccia.

Tuff or volcanic ash: contains a variety of small or large angular fragments. Because they were blown out of the volcano and fell through the air, bigger and heavier fragments fell faster and the rocks formed tend to be layered like sedimentary rocks.

Fine-grained accumulations of material are called ash or tuff, and coarser grained deposits, **agglomerates** or **breccias.** The composition of these rocks is variable. Volcanic agglomerates are not very common in British Columbia.



0 cm

(8E) tuff (volcanic ash)

(8F) volcanic breccia

SEDIMENTARY ROCKS

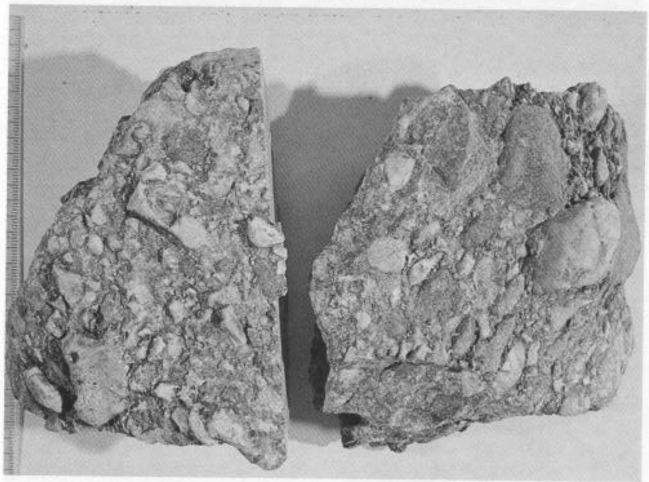
Sedimentary rocks form at the earth's surface by the action of weathering and erosion of pre-existing rocks. Rocks are gradually broken down by physical and chemical means when they are exposed to the atmosphere. Wind-blown particles abrade; rain pounds and the rainwater dissolves some parts; alternate freezing and thawing of water in microcracks break down the surface layer; gravity and weather shift unstable particles down slope and they abrade or break other rocks that they hit. Catastrophic events also occur: earthquakes trigger massive rockslides; floods move huge amounts of materials and undercut their banks; volcanos blast cubic kilometres of rock into rubble.

Broken rocks, grains and dissolved materials wash into rivers and are carried or rolled downstream. Particles are abraded and gradually rounded off as they grind together like pebbles in a lapidary tumbler. When the rivers enter lakes or the ocean, particles are dropped and dissolved materials tend to deposit as fine precipitates of mud or ooze. Particles vary in size from boulders through gravel and sand to silt and mud. Sediment may also be transported by glacial ice or the wind.

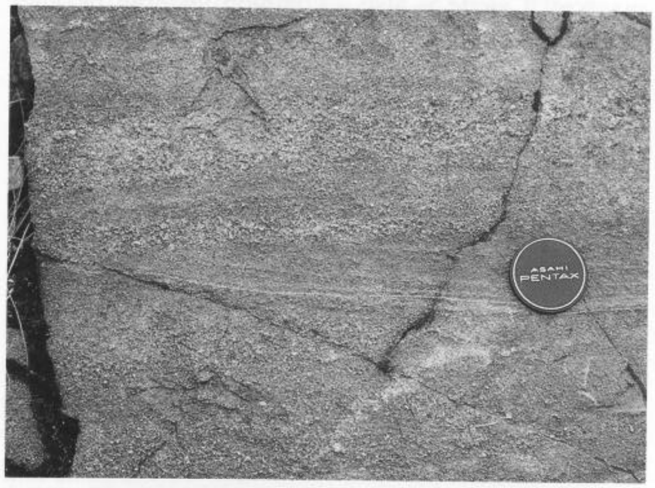
The deposited materials, when other layers of transported sediment are added on top, become compacted and mineral matter precipitates from trapped water and **cements** the grains together forming sedimentary rocks. Because sedimentary rocks are formed by the accumulation of layers of deposited material, they very often have **a layered appearance.** Sedimentary rocks may have various other structures apparent within them, such as ripples, animal burrows or plant roots. Often plants and animal remains drop into and become buried in the accumulating sediment, becoming **fossils.**

Conglomerate: is a cemented-together gravel that consists mostly of rounded rock fragments which are greater than 2 millimetres in size. The spaces between the grains are filled with varying amounts of fine-grained material or cement. Conglomerate, as with most sedimentary rocks, is laid down in layers, however, these layers are often so thick that they are not visible in an isolated outcrop.

Sandstone: consists of rounded sand grains cemented together; it is one of the most common sedimentary rocks. A sandstone may contain obvious layers (bedding) or lines at angles to the layers (cross-bedding), but in some cases the beds are too far apart to see in one exposure, as is the case with conglomerate.



(9A) conglomerate



(9C) sandstone

Breccia: is similar to conglomerate in that it consists of coarse-grained fragments surrounded by finer grained material. The fragments in a breccia, however, are sharp and angular, looking as if they were just broken, while those in conglomerates are rounded.

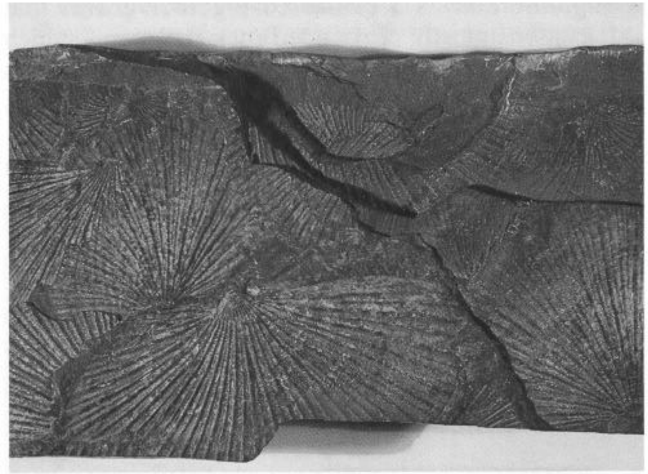
Shale: has the appearance of earthy, hard, mud or clay, which is not surprising since shale is a compacted version of these materials. Shales vary in colour but are generally grey to black or brown. Shale is a soft rock and can easily be scratched with a knife. When hit with a hammer, a mark will remain and the rock breaks into chunks as opposed to sheets (as would be the case for metamorphosed shale — slate). The beds in shale are usually thin, flat and of uniform thickness.

(9B) breccia

(9D) shale

Figure 9. Some common sedimentary rocks are (A) conglomerate, (B) breccia, (C) sandstone, (D) shale, (E) fossiliferous limestone, (F) dolomite and (G)

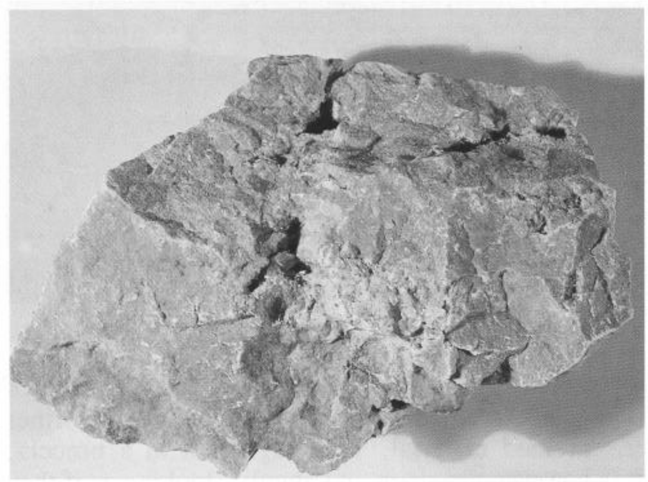
Limestone: is a white, grey or black, fine-grained rock which fizzes **vigorously** when a drop of dilute hydrochloric acid is put on it. It commonly contains fossils, such as shells or other animal remains, and in some cases the fossils may make up most of the rock. When limestone is hit with a hammer it may give off a sulphurous smell. Calcite is the dominant constituent in limestones and it is the material which causes the rock to effervesce in acid. Calcite is also a common material in other sedimentary rocks, where it can occur in fossils or in veins and fracture coatings. For this reason one must be careful when testing for a reaction to acid, and put the drop of acid on a fresh rock surface which does not contain fossils or veins.



0 3 cm

(9E) fossiliferous limestone

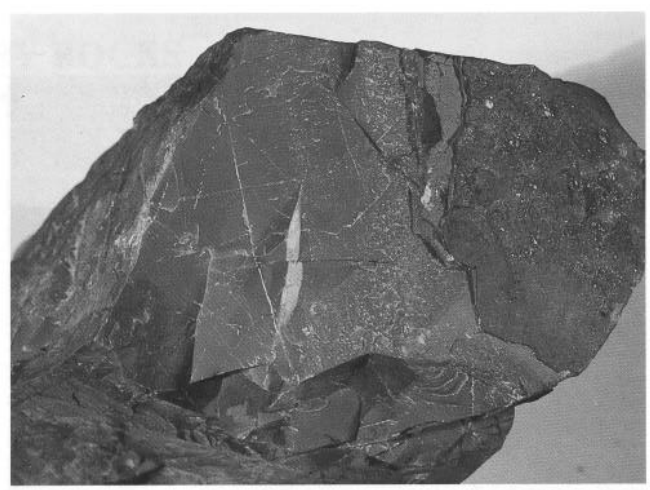
Dolomite: looks very much like limestone except that it is generally tan in colour and fizzes **weakly** if at all when a drop of cold dilute hydrochloric acid is put on it. If dolomite is ground to a powder or hot acid is applied, it will fizz strongly. Limestone and dolomite also weather differently: weathered dolomite often becomes brown or reddish and rough and finely angular; limestone, on the other hand, weathers smooth and light grey or white.



0 3 cm

(9F) dolomite

Chert: is a hard, compact, dense, brittle rock which generally varies in colour from white, through light grey to dark grey. The appearance is waxy and smooth; quartz, with which chert might be confused, is glassy. When struck with a hammer, chert breaks with a conchoidal fracture, like broken glass, or shatters into splinters. These properties result because chert consists of very fine-grained silica. Chert occurs as nodules or irregular bands in limestone, or as thin beds or ribbon-shaped layers separated by thin films of shale.



0 2 cm

(9G) chert

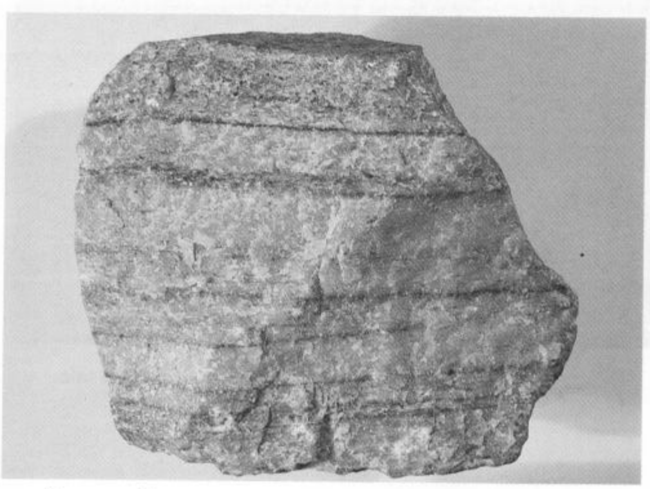
NOTE: For sedimentary rocks, which are classified mainly on the basis of grain size, all **gradations** between each category are found. This means that you may encounter a sandy conglomerate or a muddy sandstone. Gradations should be kept in mind when classifying these rocks.

METAMORPHIC ROCKS

Metamorphic rocks (see Figure 10) form when pre-existing rocks are subjected either to **elevated temperatures or pressures,** or to the actions of chemically active solutions. One or more of the following changes take place:

a) the rock recrystallizes to form a coarser grained rock
b) new minerals form overgrowths on the original minerals
c) a foliation or strong banding develops, along which the rock splits into sheets, bands or flakes. Foliation is caused by the orientation of flattish or elongate minerals on a planar surface.

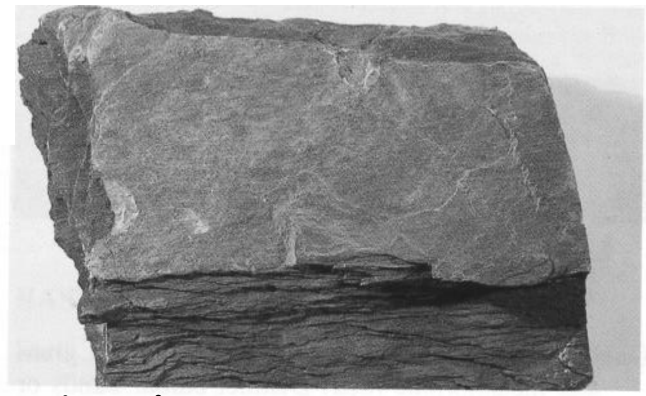
Quartzite: is metamorphosed quartz sandstone. It is a very hard, sugary textured rock that consists of interlocking quartz grains. The original quartz sand grains are also enclosed in and bound together by quartz cement. This makes the rock hard; when hammered, it breaks across the grains and cement as opposed to around the grains as is the case in sandstones. Freshly broken faces have a glassy appearance. Quartzite is generally light in colour but impurities such as mica are common and any gradation between quartzite and schist, which is described following, may occur. Quartzite may retain some of the original bedding of the sandstone.



0 2 cm

(10A) quartzite

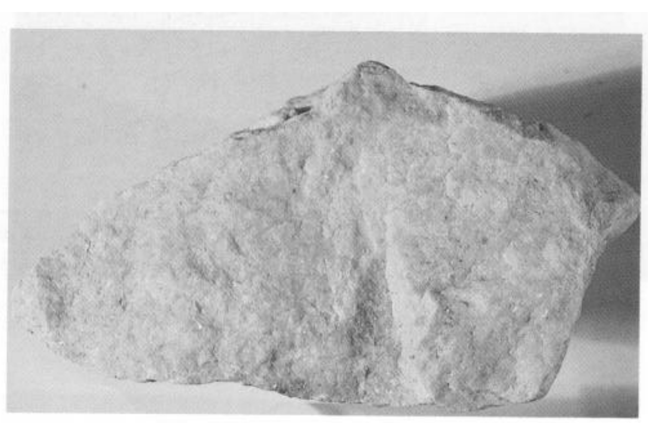
Slate: is the metamorphic product of shale. Slate is a fine-grained brittle rock which splits readily into thin smooth-faced layers or sheets. Slates are generally dark grey, green or black in colour, but may also be red or brown. Individual grains cannot be distinguished with the naked eye. The term argillite refers to rocks with characteristics intermediate between shale and slate; they are harder than shale but do not break into sheets like slate.



0 3 cm

(10B) slate

Marble: is limestone or dolomite that has recrystallized due to metamorphism. It is a light-coloured rock and consists of medium to coarse-grained interlocking calcite or dolomite crystals. A marble formed of calcite crystals will fizz with dilute acid and a dolomite marble will fizz if powdered or reacted with hot or concentrated acid. Darker streaks are often present in marble as are calcite veins. Marble scratches easily with a knife.



0 cm

(10C) marble

Figure 10. Common metamorphic rocks include (A) quartzite, (B) slate, (C) marble, (D) schist, (E) gneiss, (F) serpentinite crossed by an asbestos vein and (G) talc.

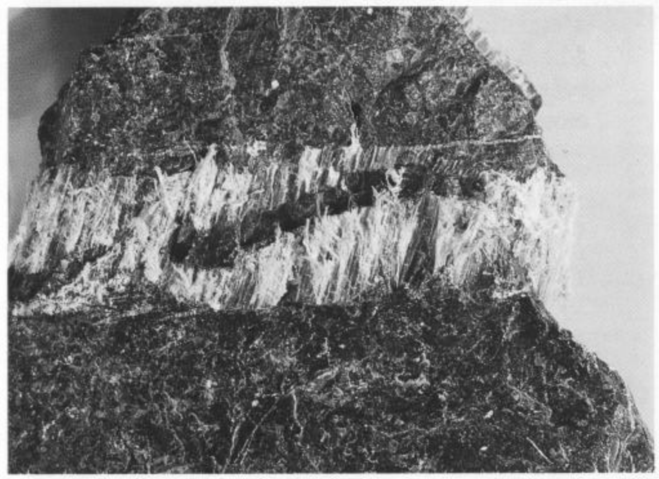
Schist: is a metamorphic rock which is intermediate between slate and gneiss. The rock has layers consisting of aligned mica or mica-like minerals which give the rock a glistening appearance. It splits readily along these layers and the broken faces usually consist of wavy or lens-shaped slabs or flakes rather than thin sheets.

0 2 cm (10D) schist

Gneiss: is a medium to coarse-grained, banded, granular metamorphic rock. Distinct colour bands or streaks are produced by the alternation of layers of light and dark-coloured minerals. The layers do not split readily and when broken are not smooth. Gneiss may form from diorite, granite, shale, sandstone, schist or other rocks.

0 2 cm (10E) gneiss

Serpentinite: is an oily looking green to black fine-grained rock that can be scratched easily with a knife. In many places it is highly sheared and breaks into scaly fragments with smooth shiny faces and a slippery feel. At thin edges the fragments tend to be translucent. Serpentinite is composed of the mineral serpentine. Soapstone is a rock composed of the mineral talc and can be mistaken for serpentine. Soapstone, however, is usually light green to grey in colour and soft enough to be scratched with the fingernail.



0 2 cm serpentinite crossed by an asbestos vein

0 2 cm (10G) talc

ADDITIONAL READING

BOOKS AND PAMPHLETS OF INTEREST

Field Guide Identification Booklets (1986 prices quoted):

The Larousse Guide to Minerals, Rocks and Fossils, W.R. Hamilton, A.R. Woolley and A.C. Bishop, ***Larousse and Co. Inc., New*** York. $13.95

Rocks and Minerals, Zim, Shaffer and Perlman, A Golden Nature Guide, ***Simon and Schuster,*** New York. **$4.95**

A Field Guide to Rocks and Minerals, F.H. Pough, ***Houghton Mifflin Co.,*** Boston. $18.95

The Autobon Society Field Guide to North American Rocks and Minerals, ***Knopf. $19.50***

Simon and Schusters' Guide to Rocks and Minerals, ***Simon and Schuster. $18.50***

GOVERNMENT PUBLICATIONS

B.C. Geological Highway Map, Province of British Columbia, ***B.C. Ministry of Energy Mines and Petroleum Resources —*** available through the Geological Association of Canada, Vancouver. $4.50

An Introduction to Prospecting, ***B.C. Ministry of Energy, Mines and Petroleum Resources,*** Paper 1986-4. Available from the Ministry, Publications Section, 552 Michigan Street, Victoria, B.C. $10.00

* Geology and Canada, ***Geological Survey of Canada*** Publication. Free.

* Rock and Mineral Collecting in British Columbia, S. Learning, ***Geological Survey of Canada*** Paper 72-53. $2.75

* Rocks: Minerals: Fossils: and Gemstones, ***Geological Survey of Canada*** Publication. Free.

* Available from Information Canada, Ottawa, KlA 0S9 or the Geological Survey of Canada, 601 Booth Street, Ottawa, KlA 0E8.

BASIC GEOLOGY TEXTBOOKS

Earth, F. Press and R. Siever, ***W.H. Freeman and Co., 1986. $46.15***

Principles of Geology, J. Gillully, A.C. Waters and A.O. Woodford, ***W.H. Freeman and Co., 1974. $U.S. 30.95***

Physical Geology, C.C. Plummer and D. McGeary, ***W.M.C. Brown Publishers. $27.70***

Essentials of Geology, F.K. Lutgers and E.J. Tarbuch, ***Merrill Publishing, 1986.*** $U.S. 18.95

Queen's Printer for British Columbia
Victoria, 1987