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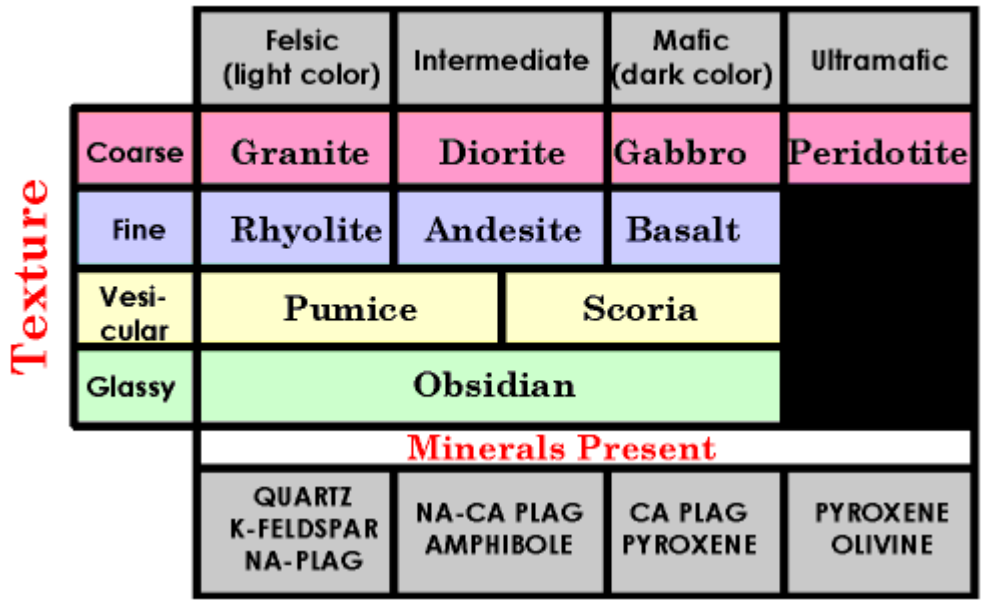
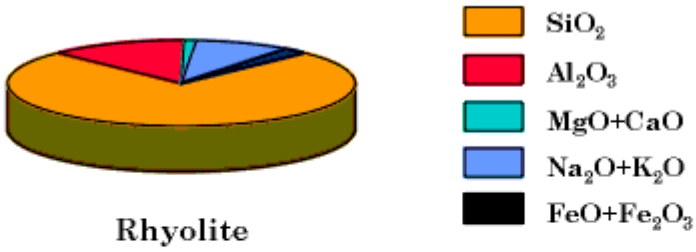
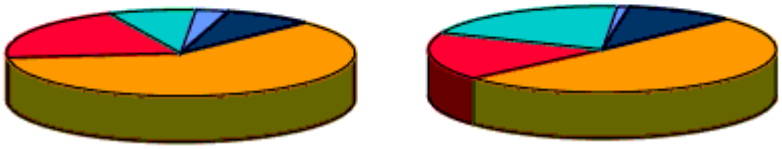




Rhyolite



Andesite Basalt

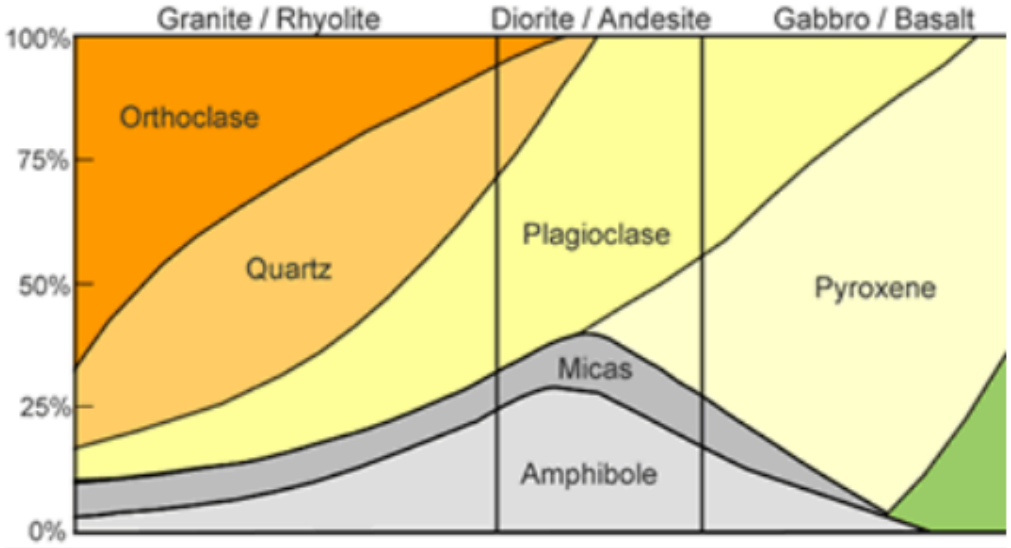
Coarse Igneous Rocks:

Granite:

Granite is the best-known igneous rock. Many people recognize granite because it is the most common igneous rock found at Earth's surface and because granite is used to make many objects that we encounter in daily life. These include counter tops, floor tiles, paving stone, curbing, stair treads, building veneer and cemetery monuments. Granite is used all around us - expecially if you live in a city.

Granite is also well-known from its many world-famous natural exposures. These include: Stone Mountain, Georgia; Yosemite Valley, California, Mount Rushmore, South Dakota; Pike's Peak, Colorado; and White Mountains, New Hampshire.

Granite is a light-coloured igneous rock with grains large enough to be visible with the unaided eye. It forms from the slow crystallization of magma below Earth's surface. Granite is composed mainly of quartz and feldspar with minor amounts of micas, amphiboles and other minerals. This mineral composition usually gives granite a red, pink, grey or white colour with dark mineral grains visible throughout the rock.



This chart illustrates the generalized mineral composition of igneous rocks. Granites and rhyolites (compositionally equivalent to granite but of a fine grain size) are composed mainly of orthoclase feldspar, quartz, plagioclase feldspar, mica and amphibole.

Composition:

A worldwide average of the chemical composition of granite, by weight percent:

- SiO_2 — 72.04% (silica)
- Al_2O_3 — 14.42% (alumina)
- K_2O — 4.12%
- Na_2O — 3.69%
- CaO — 1.82%
- FeO — 1.68%
- Fe_2O_3 — 1.22%
- MgO — 0.71%
- TiO_2 — 0.30%
- P_2O_5 — 0.12%
- MnO — 0.05%

The average density of granite is between 2.65and 2.75 g/cm^3, its compressive strength usually lies above 200 MPa, and its viscosity near STP is 3-6 • 10^{19} Pa·s. Melting temperature is 1215 - 1260 °C.

Uses:

Granite is the rock most often quarried as a "dimension stone" (a natural rock material that has been cut into blocks or slabs of specific length, width and thickness). Granite is hard enough to resist most abrasion, strong enough to bear significant weight, inert enough to resist weathering and it accepts a brilliant polish. These characteristics make it a very desirable and useful dimension stone.

Granite has been used for thousands of years in both interior and exterior applications. Rough-cut and polished granite is used in buildings, bridges, paving, monuments and many other exterior projects. Indoors, polished granite slabs and tiles are used in countertops, tile floors, stair treads and many other practical and decorative features.

High price often reduces the popularity of a construction material and granite often costs significantly more than man-made materials in most projects. However, granite is frequently selected because it is a prestige material, used in projects to produce impressions of elegance, durability and lasting quality.

India is endowed with one of the best granite deposits in the world, having excellent varieties comprising over 200 shades. India accounts for over 20% of the world resources in granite. Granite reserves in India have now been estimated by the Indian Bureau of Mines at over 42,916 million cubic metres. Splendid black and multicolour varieties of granite are available in the states of Karnataka, Andhra Pradesh, Tamil Nadu and Uttar Pradesh. Granite deposits are also widespread over the provinces of Rajasthan, Bihar, West Bengal, and Gujarat. India is the largest exporter of granite and granite products in the world.

Diorite

Diorite is a grey to dark grey intermediate intrusive igneous rock composed principally of plagioclase feldspar (typically andesine), biotite, hornblende, and/or pyroxene. It may contain small amounts of quartz, microcline and olivine. Zircon, apatite, sphene, magnetite, ilmenite and sulfides occur as accessory minerals. It can also be black or bluish-grey, and frequently has a greenish cast.

Varieties deficient in hornblende and other dark minerals are called leucodiorite. When olivine and more iron-rich augite, are present, the rock grades into ferrodiorite, which is transitional to gabbro. The presence of significant quartz makes the rock type quartz-diorite (>5% quartz) or tonalite (>20% quartz), and if orthoclase (potassium feldspar) is present at greater than ten percent the rock type grades into monzodiorite or granodiorite. Diorite has a medium grain size texture, occasionally with porphyry.

Diorites may be associated with either granite or gabbro intrusions, into which they may subtly merge. Diorite results from partial melting of a mafic rock above a subduction zone. It is commonly produced in volcanic arcs, and in cordilleran mountain building.

Use:
Diorite is an extremely hard rock, making it difficult to carve and work with. It is so hard that ancient civilizations (such as Ancient Egypt) used diorite balls to work granite. Its hardness, however, also allows it to be worked finely and take a high polish, and to provide a durable finished work.

Although one can find diorite art from later periods, it became more popular as a structural stone and was frequently used as pavement due to its durability. Diorite was used by both the Inca and Mayan civilizations, but mostly for fortress walls, weaponry, etc. It was especially popular with medieval Islamic builders. In later times, diorite was commonly used as cobblestone; today many diorite cobblestone streets can be found in England, Guernsey and Scotland, and scattered throughout the world in such places as Ecuador and China

Gabbro
Gabbro refers to a large group of dark, coarse-grained, intrusive mafic igneous rocks chemically equivalent to basalt. The rocks are plutonic, formed when molten magma is trapped beneath the Earth's surface and cools into a crystalline mass. The vast majority of the Earth's surface is underlain by gabbro within the oceanic crust, produced by basalt magmatism at mid-ocean ridges.

Gabbro is dense, greenish or dark-colored and contains pyroxene, plagioclase, amphibole, and olivine (olivine gabbro when olivine is present in a large amount).

The pyroxene is mostly clinopyroxene; small amounts of orthopyroxene may be present. If the amount of orthopyroxene is substantially greater than the amount of clinopyroxene, the rock is then a norite. Quartz gabbros are also known to occur and are probably derived from magma that was over-saturated with silica. Essexites represent gabbros whose parent magma was under-saturated with silica, resulting in the formation of the feldspathoid mineral nepheline. (Silica saturation of a rock can be evaluated by normative mineralogy). Gabbros contain minor amounts, typically a few percent, of iron-titanium oxides such as magnetite, ilmenite, and ulvospinel.

Gabbro is generally coarse grained, with crystals in the size range of 1 mm or greater. Finer grained equivalents of gabbro are called diabase, although the vernacular term microgabbro is often used when extra descriptiveness is desired. Gabbro may be extremely coarse grained to pegmatitic, and some pyroxene-plagioclase cumulates are essentially coarse grained gabbro, although these may exhibit acicular crystal habits.

Gabbro is usually equigranular in texture, although it may be porphyritic at times, especially when plagioclase oikocrysts have grown earlier than the groundmass minerals.

Gabbro is an essential part of the oceanic crust, and can be found in many ophiolite complexes as parts of zones III and IV (sheeted dyke zone to massive gabbro zone). Long belts of gabbroic intrusions are typically formed at proto-rift zones and around ancient rift zone margins, intruding into the rift flanks. Mantle plume hypotheses may rely on identifying mafic and ultramafic intrusions and coeval basalt volcanism.

Uses:
Gabbro often contains valuable amounts of chromium, nickel, cobalt, gold, silver, platinum, and copper sulfides.

Ocellar varieties of gabbro can be used as ornamental facing stones, paving stones and it is also known by the trade name of 'black granite', which is a popular type of graveyard headstone used in funerary rites. It is also used in kitchens and their countertops, also under the misnomer of 'black granite'.

Peridotite
A peridotite is a dense, coarse-grained igneous rock, consisting mostly of the minerals olivine and pyroxene. Peridotite is ultramafic, as the rock contains less than 45% silica. It is high in magnesium, reflecting the high proportions of magnesium-rich olivine, with appreciable iron. Peridotite is derived from the Earth's mantle, either as solid blocks and fragments, or as crystals accumulated from magmas that formed in the mantle. The compositions of peridotites from these layered igneous complexes vary widely, reflecting the relative proportions of pyroxenes, chromite, plagioclase, and amphibole.

Peridotite is the dominant rock of the upper part of the Earth's mantle. The compositions of peridotite nodules found in certain basalts and diamond pipes (kimberlites) are of special interest, because they provide samples of the Earth's mantle brought up from depths from about 30 km or so to depths at least as great as 200 km. Some of the nodules preserve isotope ratios of osmium and other elements that record processes to when the earth was formed, and so they are of special interest to paleogeologists because they provide clues to the composition of the Earth's early mantle and the complexities of the processes that were involved.

The word peridotite comes from the gemstone peridot, which consists of pale green olivine.

Peridotites are rich in magnesium, reflecting the high proportions of magnesium-rich olivine. The compositions of peridotites from layered igneous complexes vary widely, reflecting the relative proportions of pyroxenes, chromite, plagioclase, and amphibole. Minor minerals

and mineral groups in peridotite include plagioclase, spinel (commonly the mineral chromite), garnet (especially the mineral pyrope), amphibole, and phlogopite. In peridotite, plagioclase is stable at relatively low pressures (crustal depths), aluminous spinel at higher pressures (to depths of 60 km or so), and garnet at yet higher pressures.

Pyroxenites are related ultramafic rocks, which are composed largely of orthopyroxene and/or clinopyroxene; minerals that may be present in lesser abundance include olivine, garnet, plagioclase, amphibole, and spinel.

Texture:
Some peridotites are layered or are themselves layers; others are massive. Many layered peridotites occur near the base of bodies of stratified gabbroic complexes. Other layered peridotites occur isolated, but possibly once composed part of major gabbroic complexes. Both layered and massive peridotites can have any of three principal textures: (1) rather well formed crystals of olivine separated by other minerals. This probably reflects the original deposition of olivine sediment from magma. (2) Equigranular crystals with straight grain boundaries intersecting at about 120°. This may result from slow cooling whereby recrystallization leads to a minimization of surface energy. (3) Long crystals with ragged curvilinear boundaries. This probably results from internal deformation.

Many peridotite occurrences have characteristic textures. For example, peridotites with well-formed olivine crystals occur mainly as layers in gabbroic complexes. "Alpine" peridotites generally have irregular crystals that occur as more or less serpentinized lenses bounded by faults in belts of folded mountains such as the Alpines, the Pacific coast ranges, and in the Appalachian piedmont. Peridotite nodules with irregular equigranular textures are often found in alkaline basalts and in kimberlite pipes. Some peridotites rich in amphibole have a concentric layered structure and form parts of plutons called Alaskan-type zoned ultramafic complexes.

Types:

- Dunite: more than 90% olivine, typically with Mg/Fe ratio of about 9:1.
- Wehrlite: mostly composed of olivine plus clinopyroxene.
- Harzburgite: mostly composed of olivine plus orthopyroxene, and relatively low proportions of basaltic ingredients (because garnet and clinopyroxene are minor).
- Lherzolite: mostly composed of olivine, orthopyroxene (commonly enstatite), and clinopyroxene (diopside), and have relatively high proportions of basaltic ingredients (garnet and clinopyroxene). Partial fusion of lherzolite and extraction of the melt fraction can leave a solid residue of harzburgite.

Uses:

1. Peridotite may have potential economic value as a low-cost, safe and permanent method to capture and store atmospheric CO_2 as part of climate change-related greenhouse gas sequestration. While it was already known that peridotite reacts with CO_2 to form a solid carbonate-like limestone or marble mineral, the study concludes that this process can be sped up a million times or more with simple drilling and hydraulic fracturing to allow injection of the CO_2 into the subsurface peridotite formation.
2. Some peridotite is mined for ornamental stone.
3. Layered intrusions with cumulate peridotite are typically associated with sulfide or chromite ores. Sulfides associated with peridotites form nickel ores and platinoid metals; most of the platinum used in the world today is mined from the Bushveld Igneous Complex in South Africa and the Great Dyke of Zimbabwe. The chromite bands commonly associated with peridotites are the world's major ores of chromium.

Fine Igneous Rocks:

Rhyolite

Rhyolite is an igneous, volcanic (extrusive) rock, of felsic (silica-rich) composition (typically > 69% SiO2 — see the TAS classification). It may have any texture from glassy to aphanitic to porphyritic. The mineral assemblage is usually quartz, alkali feldspar and plagioclase (in a ratio > 1:2 — see the QAPF diagram). Biotite and hornblende are common accessory minerals.

Rhyolite can be considered as the extrusive equivalent to the plutonic granite rock, and consequently, outcrops of rhyolite may bear a resemblance to granite. Due to their high content of silica and low iron and magnesium contents, rhyolite melts are highly polymerized and form highly viscous lavas. They can also occur as breccias or in volcanic plugs and dikes. Rhyolites that cool too quickly to grow crystals form a natural glass or vitrophyre, also called obsidian. Slower cooling forms microscopic crystals in the lava and results in textures such as flow foliations, spherulitic, nodular, and lithophysal structures. Some rhyolite is highly vesicular pumice. Many eruptions of rhyolite are highly explosive and the deposits may consist of fallout tephra/tuff or of ignimbrites

Uses:

It can be used as aggregate, fill etc. in the construction and roading industries (often not ideal for concrete aggregate because of high silica content); obsidian was used by pre-European Maori as a cutting tool, and can be carved into jewellery; pumice is used as an abrasive (especially in the cosmetic industry), and can also be incorporated into lightweight building materials.

Andesite

Andesite is an extrusive igneous, volcanic rock, of intermediate composition, with aphanitic to porphyritic texture. In a general sense, it is the intermediate type between basalt and

dacite, and ranges from 57 to 63% silicon dioxide (SiO_2). The mineral assemblage is typically dominated by plagioclase plus pyroxene and/or hornblende. Magnetite, zircon, apatite, ilmenite, biotite, and garnet are common accessory minerals. Alkali feldspar may be present in minor amounts. The quartz-feldspar abundances in andesite and other volcanic rocks.

Classification of andesites may be refined according to the most abundant phenocryst. Example: hornblende-phyric andesite, if hornblende is the principal accessory mineral.

Andesite can be considered as the extrusive equivalent of plutonic diorite. Characteristic of subduction zones, andesite represents the dominant rock type in island arcs, such as the Aleutian Arc in Alaska. The average composition of the continental crust is andesitic.[2] Along with basalts they are a major component of the Martian crust.[3] The name andesite is derived from the Andes mountain range.

Basalt

Uses:

It can be used as aggregate, fill etc. in the construction and roading industries (often not ideal for concrete aggregate because of high silica content).

Vesicular Igneous Rocks:

Pumice

Pumice is a volcanic rock that consists of highly vesicular volcanic glass, which may or may not contain crystals. It is typically light coloured. Scoria is another vesicular volcanic rock that differs from pumice in having larger vesicles and thicker vesicle walls and being dark coloured and denser. Pumice is typically created when super-heated, highly pressurized rock is violently ejected from a volcano. Alternatively it can be formed when lava and water are mixed. Most pumice is light enough to float on water.

The unusual foamy configuration of pumice happens because of simultaneous rapid cooling and rapid depressurization. The depressurization creates bubbles by lowering the solubility of gases (including water and CO_2) that are dissolved in the lava, causing the gases to rapidly exsolve (like the bubbles of CO_2 that appear when a carbonated drink is opened). The simultaneous cooling and depressurization freezes the bubbles in the matrix.

Pumice is composed of highly microvesicular glass pyroclastic with very thin, translucent bubble walls of extrusive igneous rock. It is commonly, but not exclusively of silicic or felsic to intermediate in composition (e.g., rhyolitic, dacitic, andesite, pantellerite, phonolite, trachyte), but basaltic and other compositions are known. Pumice is commonly pale in color, ranging from white, cream, blue or grey, to green-brown or black. It forms when volcanic gases exsolving from viscous magma nucleate bubbles which cannot readily decouple from the viscous magma prior to chilling to glass. Pumice is a common product of explosive

eruptions (plinian and ignimbrite-forming) and commonly forms zones in upper parts of silicic lavas. Pumice has an average porosity of 90%, and initially floats on water.

Scoria differs from pumice in being denser. With larger vesicles and thicker vesicle walls, it sinks rapidly. The difference is the result of the lower viscosity of the magma that forms scoria. When larger amounts of gas are present, the result is a finer-grained variety of pumice known as pumicite. Pumice is considered a glass because it has no crystal structure. Pumice varies in density according to the thickness of the solid material between the bubbles; many samples float in water. After the explosion of Krakatoa, rafts of pumice drifted through the Pacific Ocean for up to 20 years, with tree trunks floating among them. In fact, pumice rafts disperse and support several marine species. In 1979, 1984 and 2006, underwater volcanic eruptions near Tonga created large pumice rafts, some as large as 30 km that floated hundreds of kilometres to Fiji.

There are two main forms of vesicles. Most pumice contains tubular microvesicles that can impart a silky or fibrous fabric. The elongation of the microvesicles occurs due to ductile elongation in the volcanic conduit or, in the case of pumiceous lavas, during flow. The other form of vesicles is sub spherical to spherical and results from high vapor pressure during eruption.

Uses:
Pumice is widely used to make lightweight concrete or insulative low-density breeze blocks. When used as an additive for cement, a fine-grained version of pumice called pozzolan is mixed with lime to form a light-weight, smooth, plaster-like concrete. This form of concrete was used as far back as Roman times. Roman engineers used it to build the huge dome of the Pantheon and as construction material for many aqueducts.

It is also used as an abrasive, especially in polishes, pencil erasers, cosmetic exfoliants, and the production of stone-washed jeans. "Pumice stones" are often used in beauty salons during the pedicure process to remove dry and excess skin from the bottom of the foot as well as calluses. It was also used in ancient Greek and Roman times to remove excess hair. Finely ground pumice is added to some toothpastes and heavy-duty hand cleaners (such as Lava soap) as a mild abrasive. Pumice is also used as a growing substrate for growing horticultural crops. Some brands of chinchilla dust bath are made of powdered pumice.

Scoria
Scoria is a highly vesicular, dark colored volcanic rock that may or may not contain crystals (phenocrysts). It is typically dark in color (generally dark brown, black or purplish red), and basaltic or andesitic in composition. Scoria is relatively low in mass as a result of its numerous macroscopic ellipsoidal vesicles, but in contrast to pumice, all scoria has a specific gravity greater than 1, and sinks in water. The holes or vesicles form when gases that were

dissolved in the magma come out of solution as it erupts, creating bubbles in the molten rock, some of which are frozen in place as the rock cools and solidifies. Scoria may form as part of a lava flow, typically near its surface, or as fragmental ejecta (lapilli, blocks and bombs), for instance in Strombolian eruptions that form steep-sided scoria cones. Most scoria is composed of glassy fragments, and may contain phenocrysts. The word scoria comes from the Greek mean rust. An old name for scoria is cinder.

Scoria differs from pumice, another vesicular volcanic rock, in having larger vesicles and thicker vesicle walls, and hence is denser. The difference is probably the result of lower magma viscosity, allowing rapid volatile diffusion, bubble growth, coalescence, and bursting.

Uses:
Scoria has several useful characteristics that influence how it is used. It is somewhat porous, has high surface area and strength for its weight, and often has striking colours. Scoria is often used in landscaping and drainage works. It is also commonly used in gas barbecue grills.
Scoria can be used for high-temperature insulation.
Scoria is used on oil well sites to limit mud issues with heavy truck traffic.
It is also used as a traction aid on ice and snow covered roads.

Glassy Igneous Rocks:
Obsidian
Obsidian is a naturally occurring volcanic glass formed as an extrusive igneous rock.
It is produced when felsic lava extruded from a volcano cools rapidly with minimum crystal growth. Obsidian is commonly found within the margins of rhyolitic lava flows known as obsidian flows, where the chemical composition (high silica content) induces a high viscosity and polymerization degree of the lava. The inhibition of atomic diffusion through this highly viscous and polymerized lava explains the lack of crystal growth. Obsidian is hard and brittle; it therefore fractures with very sharp edges, which had been used in the past in cutting and piercing tools, and has been used experimentally as surgical scalpel blades.

Obsidian is the rock formed as a result of cooled magma, which is the parent material. Having a low water content when newly formed typically less than 1% water by weight, becomes progressively hydrated when exposed to groundwater, forming perlite. Tektites were once thought by many to be obsidian produced by lunar volcanic eruptions, though few scientists now adhere to this hypothesis.

Obsidian is mineral-like, but not a true mineral because as a glass it is not crystalline; in addition, its composition is too complex to comprise a single mineral. It is sometimes classified as a mineraloid. Though obsidian is usually dark in colour similar to mafic rocks such as basalt, obsidian's composition is extremely felsic. Obsidian consists mainly of SiO_2

(silicon dioxide), usually 70% or more. Crystalline rocks with obsidian's composition include granite and rhyolite. Because obsidian is metastable at the Earth's surface (over time the glass becomes fine-grained mineral crystals), no obsidian has been found that is older than Cretaceous age. This breakdown of obsidian is accelerated by the presence of water.

Pure obsidian is usually dark in appearance, though the colour varies depending on the presence of impurities. Iron and magnesium typically give the obsidian a dark brown to black colour. Very few samples are nearly colourless. In some stones, the inclusion of small, white, radially clustered crystals of cristobalite in the black glass produce a blotchy or snowflake pattern (snowflake obsidian). It may contain patterns of gas bubbles remaining from the lava flow, aligned along layers created as the molten rock was flowing before being cooled. These bubbles can produce interesting effects such as a golden sheen (sheen obsidian) or an iridescent, rainbow-like sheen (rainbow obsidian).

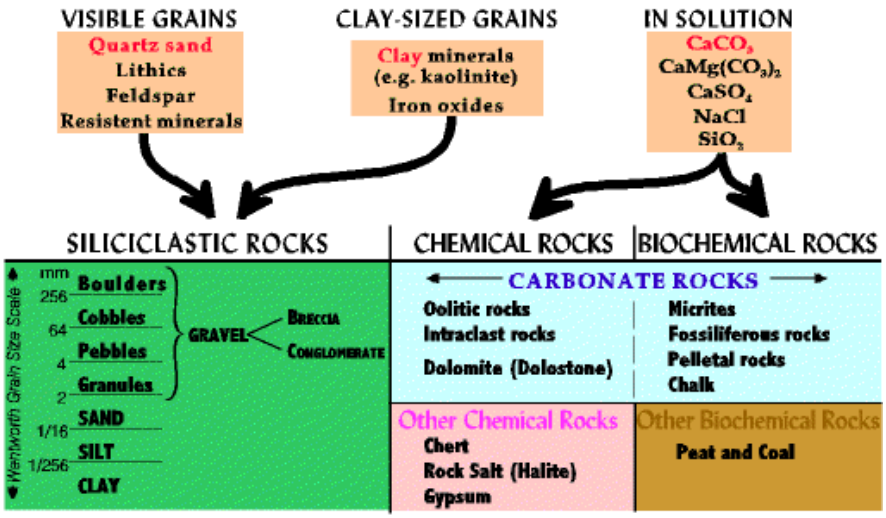
Uses:

Obsidian has been used experimentally for blades in surgery, as well-crafted obsidian blades have a cutting edge many times sharper than high-quality steel surgical scalpels, the cutting edge of the blade being only about 3 nanometers thick. Even the sharpest metal knife has a jagged, irregular blade when viewed under a strong enough microscope; when examined even under an electron microscope an obsidian blade is still smooth and even. One study found that obsidian incisions produced narrower scars, fewer inflammatory cells, and less granulation tissue in a group of rats. Don Crabtree produced obsidian blades for surgery and other purposes, and has written articles on the subject.

Obsidian is also used for ornamental purposes and as a gemstone. It possesses the property of presenting a different appearance according to the manner in which it is cut: when cut in one direction it is jet black; in another it is glistening gray. "Apache tears" are small rounded obsidian nuggets embedded within a grayish-white perlite matrix

Sedimentary Rocks:

Classification



Sedimentary Rock Classification

Clastic & Bioclastic textures

Texture	Size		Clast Composition	Rounding	Sorting	Rock Name	Comments	Depositional Environment
Clastic	>2 mm	gravel	variable	angular	poor	**sedimentary breccia**	large angular clasts - less transport	alluvial fan
	>2 mm	gravel	variable	rounded	poor	**conglomerate**	large rounded clasts - more transport	alluvial fan, stream, beach
	2-1/16 mm	sand	quartz	rounded	well	**quartz sandstone**	"clean" sandstone - more transport	dunes, stream
	2-1/16 mm	sand	feldspar, quartz, etc.	angular	mod-poor	**arkose**	"dirty" sandstone - less transport	alluvial fan, stream
	<1/16 mm	mud	-	-	well	**mudstone**	may split apart along bedding; may or may not "fizz"; easily scratched	floodplain, delta, shallow & deep marine
Bioclastic	>2 mm	gravel	shells	poor	poor	**coquina**	poorly-cemented shell fragments	beach
	<1/16 mm	mud	shells	-	well	**chalk**	microscopic shells; "earthy"	shallow-deep marine

Chemical & Biochemical textures

Texture	Composition	Hardness	Color	Rock Name	Comments	Depositional Environment
Chemical	calcite / $CaCO_3$	H=3	variable	**limestone**	will "fizz"; can be scratched by a nail	shallow marine, lake
	dolomite / $CaMg(CO_3)_2$	H=3	variable	**dolomite**	will not "fizz" unless scratched; can be scratched by a nail	nearshore marine
	silica / SiO_2	H=7	variable	**chert**	will not "fizz"; not scratched by a nail	deep sea
	halite / NaCl gypsum / CaSO4*2H2O	H=2.5 H=2	clear-variable white-variable	**evaporites**	soft, non-metallic minerals; halite is "salty"	playa
Bio	altered organic remains	soft	brown-black	**coal**	light in weight	swamp

Conglomerates:

A conglomerate is a rock consisting of individual clasts within a finer-grained matrix that have become cemented together. Conglomerates are sedimentary rocks consisting of rounded fragments and are thus differentiated from breccias, which consist of angular clasts. Both conglomerates and breccias are characterized by clasts larger than sand (>2 mm).

Use:

Conglomerate has very few commercial uses. Its inability to break cleanly makes it a poor candidate for dimension stone and its variable composition makes it a rock of unreliable physical strength and durability. Conglomerate can be crushed to make a fine aggregate that can be used where a low-performance material is suitable. Many conglomerates are colorful and attractive rocks that are rarely used as an ornamental stone for interior use.

Analysis of conglomerate can sometimes be used as a prospecting tool. For example: most diamond deposits are hosted in kimberlite. If a conglomerate contains clasts of kimberlite then the source of that kimberlite must be somewhere upstream.

Breccia:

Breccia is a rock composed of broken fragments of minerals or rock cemented together by a fine-grained matrix, that can be either similar to or different from the composition of the fragments.

The word is taken from Italian, and in that language indicates either loose gravel or stone made by cemented gravel. A breccia may have a variety of different origins, as indicated by the named types including sedimentary breccia, tectonic breccia, igneous breccia, impact breccia and hydrothermal breccia.

Uses:

The striking visual appearance of breccias has for millennia made them a popular sculptural and architectural material. Breccia was employed for column bases in the Minoan palace of Knossos on Crete in about 1800 BC. Breccia was used on a limited scale by the ancient Egyptians — one of the best-known examples is the statue of the goddess Tawaret in the British Museum. It was regarded by the Romans as an especially precious stone and was often used in high-profile public buildings. Many types of marble are brecciated, such as Breccia Oniciata or Breche Nouvelle.

It is most often used as an ornamental or facing material in walls and columns. A particularly striking example can be seen in the Pantheon in Rome, which features two gigantic columns of pavonazzetto, a breccia coming from Phrygia (in modern Turkey). Pavonazzetto obtains its name from its extremely colourful appearance, which is reminiscent of a peacock's feathers.

Sandstone:

Sandstone (sometimes known as arenite) is a clastic sedimentary rock composed mainly of sand-sized minerals or rock grains.

Most sandstone is composed of quartz and/or feldspar because these are the most common minerals in the Earth's crust. Like sand, sandstone may be any colour, but the most common colours are tan, brown, yellow, red, gray, pink, white and black. Since sandstone beds often form highly visible cliffs and other topographic features, certain colours of sandstone have been strongly identified with certain regions.

Rock formations that are primarily composed of sandstone usually allow percolation of water and other fluids and are porous enough to store large quantities, making them valuable aquifers and petroleum reservoirs. Fine-grained aquifers, such as sandstones, are more apt to filter out pollutants from the surface than are rocks with cracks and crevices, such as limestone or other rocks fractured by seismic activity.

Uses:

Sandstone has been used for domestic construction and housewares since prehistoric times, and continues to be used.

Sandstone was a popular building material from ancient times. It is relatively soft, making it easy to carve. It has been widely used around the world in constructing temples, cathedrals, homes, and other buildings. It has also been used for artistic purposes to create ornamental fountains and statues.

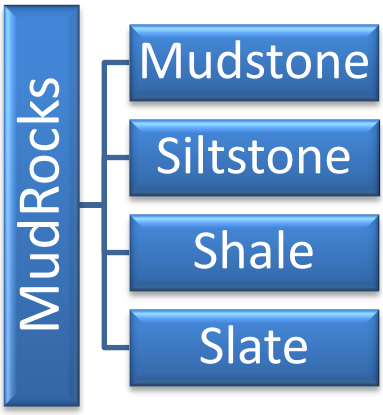
Some sandstones are resistant to weathering, yet are easy to work. This makes sandstone a common building and paving material. However, some that have been used in the past, such as the Collyhurst sandstone used in North West England, have been found less resistant, necessitating repair and replacement in older buildings. Because of the hardness of individual grains, uniformity of grain size and friability of their structure, some types of sandstone are excellent materials from which to make grindstones, for sharpening blades and other implements. Non-friable sandstone can be used to make grindstones for grinding grain, e.g., gritstone.

Mudrocks:

Mudrocks are a class of fine grained siliciclastic sedimentary rocks. The varying types of mudrocks include: siltstone, claystone, mudstone, slate, and shale. Most of the particles are less than 0.0625 mm (1/16th mm or 0.0025 inches) and are too small to study readily in the field.

Mudrocks make up fifty percent of the sedimentary rocks in the geologic record, and are easily the most widespread deposits on Earth. Fine sediment is the most abundant product of erosion, and these sediments contribute to the overall omnipresence of mudrocks. With increased pressure over time the platey clay minerals may become aligned, with the appearance of fissility or parallel layering. This finely bedded material that splits readily into thin layers is called shale, as distinct from mudstone. The lack of fissility or layering in

mudstone may be due either to original texture or to the disruption of layering by burrowing organisms in the sediment prior to lithification.



Mudstone

A mudstone is a siliciclastic sedimentary rock that contains a mixture of silt- and clay-sized particles (at least 1/3 of each).

The terminology of "mudstone" is not to be confused with the Dunham classification scheme for limestones. In Dunham's classification, a mudstone is any limestone containing less than ten percent carbonate grains. Note, a siliciclastic mudstone does not deal with carbonate grains. Friedman, Sanders, and Kopaska-Merkel (1992) suggest the use of "lime mudstone" to avoid confusion with siliciclastic rocks.

The siliciclastic mudstone, which includes shales, has many uses:

Industrial usage:

1. Heavy and light clay for brick and ceramics
2. Fillers and extenders for many things including food and cosmetics
3. Bleaching agents
4. Pigments in paint
5. Sealants
6. Suspending agents such as used in drilling
7. Absorbents
8. Some shales are used as building stones and flagstones for sidewalks and patios

Geologic uses:

1. Shales and mudstones are the most common source rocks for petroleum and natural gas.
2. Indicators of paleo-oxygen levels, paleoecology, and often sources of paleontology data since fossils are often well preserved in shales and mudstone
3. Closely associated with coals
4. Organic-rich shales are sometimes the source rocks for stratiform ores of metals

Engineers use mudstone for:

1. Prediction of landslides and control

2. Understanding ground swelling and shrinkage
3. Understanding subsidence and compaction

The other "mudstone" also known as limestone or carbonate mudstones are also quite useful:

1. These are often polished and used in the building trade as "marble" even though a geologist defines marble as a metamorphosed limestone
2. Some very pure carbonate mudstones are quarried for use in industrial processes to make calcium oxide, used in the manufacture of steel, glass and other processes, and lime used in building construction to make mortar.

Siltstone

A siltstone is a lithified, non-fissile mudrock. In order for a rock to be named a siltstone, it must contain over fifty percent silt-sized material. Silt is any particle smaller than sand, 1/16 of a millimeter, and larger than clay, 1/256 of millimeter. Silt is believed to be the product of physical weathering, which can involve freezing and thawing, thermal expansion, and release of pressure. Physical weathering does not involve any chemical changes in the rock, and it may be best surmised as the physical breaking apart of a rock.

One of the highest proportions of silt found on Earth is in the Himalayas, where phylites are exposed to rainfall of up to five to ten meters (16 to 33 feet) a year. Quartz and feldspar are the biggest contributors to the silt realm, and silt tends to be non-cohesive, non-plastic, but can liquefy easily.

There is a simple test that can be done in the field to determine whether a rock is a siltstone or not, and that is to put the rock to one's teeth. If the rock feels "gritty" against one's teeth, then it is a siltstone.

Uses:

Siltstone does not have many uses other than in soil. There are many particles of siltstone in soil and dirt. It is mainly uses as tiles, cladding, sculptural blocks.

Shale:

Shale is a fine grained, hard, laminated mudrock, consisting of clay minerals, and quartz and feldspar silt. Shale is lithified and fissile. It must have at least 50-percent of its particles measure less than 0.062 mm. This term is confined to argillaceous, or clay-bearing, rock.

There are many varieties of shale, including calcareous and organic-rich; however, black shale, or organic-rich shale, deserves further evaluation. In order for a shale to be a black shale, it must contain more than one percent organic carbon. A good source rock for hydrocarbons can contain up to twenty percent organic carbon. Generally, black shale receives its influx of carbon from algae, which decays and forms an ooze known as sapropel. When this ooze is cooked at desired pressure, three to six kilometers (1.8 - 3.7 miles) depth,

and temperature, 90-120 degrees Celsius (194-248 degrees Fahrenheit), it will form kerogen. Kerogen can be heated, and yield up to 10-150 gallons of product per ton of rock.

Uses:

Some shales have special properties that make them important resources. Black shales contain organic material that sometimes breaks down to form natural gas or oil. Other shales can be crushed and mixed with water to produce clays and cement that can be made into a variety of useful objects.

Shale is used as filler in paint, plastic, roofing cement; as raw material for bricks; as landscaping and driveway material, and in some cases as a source of oil.

Slate

Slate is a hard mudstone that has undergone metamorphosis, and has well-developed cleavage. It has gone through metamorphism at temperatures between 200-250 degrees Celsius (392-482 degrees Fahrenheit), or extreme deformation. Since slate is formed in the lower realm of metamorphism, based on pressure and temperature, slate retains its stratification and can be defined as a hard, fine-grained rock.

Slate is often used for roofing, flooring, or old-fashioned stone walls. It has an attractive appearance, and its ideal cleavage and smooth texture are desirable.

Uses:

Most of the slate mined throughout the world is used to produce roofing slates. Slate performs well in this application because it can be cut into thin sheets, absorbs minimal moisture and stands up well in contact with freezing water. A disadvantage is the cost of the slate and its installation in comparison with other roofing materials. As a result, in new construction slate is mainly confined to high end projects and prestige architecture.

Slate is also used for interior flooring, exterior paving, dimension stone and decorative aggregate. Small pieces of slate are also used to make turkey calls. The photos and video on this page document several uses of slate. Historically slate has been used for chalkboards, student writing slates, billiard tables, cemetery markers, whetstones and table tops. Because it is a good electrical insulator it was also used for early electric panels and switch boxes.

Arkose:

Arkose is a detrital sedimentary rock, specifically a type of sandstone containing at least 25% feldspar. Arkosic sand is sand that is similarly rich in feldspar, and thus the potential precursor of arkose.

Quartz is commonly the dominant mineral component, and some mica is often present. Apart from the mineral content, rock fragments may also be a significant component. Arkose usually contains small amounts of calcite cement, which causes it to 'fizz' slightly in dilute hydrochloric acid; sometimes the cement also contains iron oxide. Arkose is typically grey to reddish in colour. The sand grains making up an arkose may range from fine to very

coarse, but tends toward the coarser end of the scale. Fossils are rare in arkose, due to the depositional processes that form it, although bedding is frequently visible.
Arkose is generally formed from the weathering of feldspar-rich igneous or metamorphic, most commonly granitic rocks, which are primarily composed of quartz and feldspar (called 'grus' as a sand). These sediments must be deposited rapidly and/or in a cold or arid environment such that the feldspar does not undergo significant chemical weathering and decomposition; therefore arkose is designated a texturally immature sedimentary rock. Arkose is often associated with conglomerate deposits sourced from granitic terrain and is often found above unconformities over such granitic terrain.

Uses:
It is a building material.

Coquina:
Coquina is a sedimentary rock that is composed either wholly or almost entirely of the transported, abraded, and mechanically sorted fragments of the shells of either molluscs, trilobites, brachiopods, or other invertebrates. For a sediment to be considered to be a coquina, the average size of the particles composing it should be 2 mm or greater in size. Coquina can vary in hardness from poorly to moderately-cemented. The term "coquina" is derived from the Spanish word for cockleshells or shellfish. Incompletely consolidated and poorly cemented coquinas are considered grainstones in the Dunham classification system for carbonate sedimentary rocks. Well-cemented coquinas are classified as biosparites according to the Folk classification of sedimentary rocks.
Coquinas accumulate in high-energy marine and lacustrine environments where currents and waves result in the vigorous winnowing, abrasion, fracturing, and sorting of the shells, which compose them. As a result, they typically exhibit well-developed bedding or cross-bedding, close packing, and good orientation of the shell fragments composing them. The high-energy marine or lacustrine associated with coquinas include beaches, shallow submarine raised banks, swift tidal channels, and barrier bars.
Uses:
The stone makes a very good material for forts, particularly those built during the period of heavy cannon use. It can be a building material if extremely dried for long time (2-3 years).
Coquina has also been used as a source of paving material. It is usually poorly cemented and easily breaks into component shell or coral fragments, which can be substituted for gravel or crushed harder rocks. Large pieces of coquina of unusual shape are sometimes used as landscape decoration. Because coquina often includes a component of phosphate, it is sometimes mined for use as fertilizer.

Chalk:
Chalk is a soft, white, porous sedimentary rock, a form of limestone composed of the mineral calcite. Calcite is calcium carbonate or $CaCO_3$. It forms under reasonably deep

marine conditions from the gradual accumulation of minute calcite plates (coccoliths) shed from micro-organisms called coccolithophores. It is common to find chert or flint nodules embedded in chalk. Chalk can also refer to other compounds including magnesium silicate and calcium sulfate.

Chalk has greater resistance to weathering and slumping than the clays with which it is usually associated, thus forming tall steep cliffs where chalk ridges meet the sea. Chalk hills, known as chalk downland, usually form where bands of chalk reach the surface at an angle, so forming a scarp slope. Because chalk is porous it can hold a large volume of ground water, providing a natural reservoir that releases water slowly through dry seasons.

Uses:
Chalk is used to make quicklime and slaked lime, mainly used as lime mortar in buildings. In southeast England, Deneholes are a notable example of ancient chalk pits. Such bell pits may also mark the sites of ancient flint mines, where the prime object was to remove flint nodules for stone tool manufacture. The surface remains at Cissbury are one such example, but perhaps the most famous is the extensive complex at Grimes Graves in Norfolk.

The traditional uses of chalk have in some cases been replaced by other substances, although the word "chalk" is often still applied to the usual replacements.

- Blackboard chalk is a substance used for drawing on rough surfaces, as it readily crumbles leaving particles that stick loosely to these surfaces. Although traditionally composed of natural chalk, modern blackboard chalk is generally made from the mineral gypsum (calcium sulfate), often supplied in sticks of compressed powder about 4 in (10 cm) long.
- Sidewalk chalk is similar to blackboard chalk, except that it is formed into larger sticks and often colored. It is used to draw on sidewalks, streets, and driveways, mostly by children, but also by adult artists.
- In agriculture chalk is used for raising pH in soils with high acidity. The most common forms are CaCO3 (calcium carbonate) and CaO (calcium oxide).
- In field sports, including grass tennis courts, powdered chalk was used to mark the boundary lines of the playing field or court. This gives the advantage that, if the ball hits the line, a cloud of chalk or pigment dust can be seen. Nowadays the substance used is mostly titanium dioxide.
- In gymnastics, rock-climbing, weight-lifting and tug of war, chalk — now usually magnesium carbonate — is applied to the hands to remove perspiration and reduce slipping.
- Tailor's chalk is traditionally a hard chalk used to make temporary markings on cloth, mainly by tailors. Nowadays it is usually made from talc (magnesium silicate).
- Toothpaste also commonly contains small amounts of chalk, to serve as a mild abrasive.

- Polishing chalk is chalk prepared with a carefully controlled grain size, for very fine polishing of metals.
- Chalk is a source of quicklime by thermal decomposition, or slaked lime following quenching with water.
- Builder's putty also mainly contains chalk as filler in linseed oil.
- Woodworking joints may be fitted by chalking one of the mating surfaces. A trial fit will leave a chalk mark on the high spots of the corresponding surface. Chalk transferring to cover the complete surface indicates a good fit.
- Fingerprint powder
- Taken orally, in small doses, as an antacid.

Limestone:

Limestone is a sedimentary rock composed largely of the minerals calcite and aragonite, which are different crystal forms of calcium carbonate ($CaCO_3$). Many limestones are composed from skeletal fragments of marine organisms such as coral or foraminifera.

Limestone makes up about 10% of the total volume of all sedimentary rocks. The solubility of limestone in water and weak acid solutions leads to karst landscapes, in which water erodes the limestone over thousands to millions of years. Most cave systems are through limestone bedrock.

Limestone has numerous uses: as a building material, as aggregate for the base of roads, as white pigment or filler in products such as toothpaste or paints and as a chemical feedstock.

The first who distinguished limestone from dolomite was Belsazar Hacquet in 1778.

Uses:

1. It is the raw material for the manufacture of quicklime (calcium oxide), slaked lime (calcium hydroxide), cement and mortar.
2. Pulverized limestone is used as a soil conditioner to neutralize acidic soils.
3. It is crushed for use as aggregate—the solid base for many roads.
4. Geological formations of limestone are among the best petroleum reservoirs;
5. As a reagent in flue-gas desulfurization, it reacts with sulfur dioxide for air pollution control.
6. Glass making, in some circumstances, uses limestone.
7. It is added to toothpaste, paper, plastics, paint, tiles, and other materials as both white pigment and cheap filler.
8. It can suppress methane explosions in underground coal mines.
9. Purified, it is added to bread and cereals as a source of calcium.
10. Calcium levels in livestock feed are supplemented with it, such as for poultry (when ground up).
11. It can be used for remineralizing and increasing the alkalinity of purified water to prevent pipe corrosion and to restore essential nutrient levels.
12. Used in blast furnaces, limestone extracts iron from its ore.

13. It is often found in medicines and cosmetics.
14. It is used in sculptures because of its suitability for carving.

The Great Pyramid of Giza, one of the Seven Wonders of the Ancient World; its outside cover is made entirely from limestone

Dolomite

Dolomite is a carbonate mineral composed of calcium magnesium carbonate $CaMg(CO_3)_2$. The term is also used to describe the sedimentary carbonate rock dolostone.

Dolostone (dolomite rock) is composed predominantly of the mineral dolomite with a stoichiometric ratio of 50% or greater content of magnesium replacing calcium, often as a result of diagenesis. Limestone that is partially replaced by dolomite is referred to as dolomitic limestone, or in old U.S. geologic literature as magnesian limestone.

Uses:

Dolomite is used as an ornamental stone, a concrete aggregate, a source of magnesium oxide and in the Pidgeon process for the production of magnesium. It is an important petroleum reservoir rock, and serves as the host rock for large strata-bound Mississippi Valley-Type (MVT) ore deposits of base metals such as lead, zinc, and copper. Where calcite limestone is uncommon or too costly, dolomite is sometimes used in its place as a flux for the smelting of iron and steel. Large quantities of processed dolomite are used in the production of float glass.

In horticulture, dolomite and dolomitic limestone are added to soils and soilless potting mixes to lower their acidity and as a magnesium source. Home and container gardening are common examples of this use.

Dolomite is also used as the substrate in marine (saltwater) aquariums to help buffer changes in pH of the water.

Particle physics researchers prefer to build particle detectors under layers of dolomite to enable the detectors to detect the highest possible number of exotic particles. Because dolomite contains relatively minor quantities of radioactive materials, it can insulate against interference from cosmic rays without adding to background radiation levels.

Chert

Chert is a fine-grained silica-rich microcrystalline, cryptocrystalline or microfibrous sedimentary rock that may contain small fossils. It varies greatly in colour (from white to black), but most often manifests as gray, brown, grayish brown and light green to rusty red; its colour is an expression of trace elements present in the rock, and both red and green are most often related to traces of iron (in its oxidized and reduced forms respectively).

The banded iron formations of Precambrian age are composed of alternating layers of chert and iron oxides. Chert also occurs in diatomaceous deposits and is known as diatomaceous

chert. Diatomaceous chert consists of beds and lenses of diatomite which were converted during diagenesis into dense, hard chert.

Uses:

Chert has very few uses today; however, it was a very important tool-making material in the past. Chert has two properties that made it especially useful: 1) it breaks with a conchoidal fracture to form very sharp edges, and, 2) it is very hard (7 on the Mohs Scale). The edges of broken chert are sharp and tend to retain their sharpness because chert is a very hard and very durable rock. Thousands of years ago people discovered these properties of chert and learned how to intentionally break it to produce cutting tools such as knife blades, arrowheads, scrapers, and ax heads. Tons of chert fragments have been found at locations where these objects were produced in what was one of the earliest manufacturing activities of people.

Chert is a very hard material that produces a spark when it is struck against steel. The heat from this spark can be used to start fires. A "flint lock" is an early firearm in which a charge of gunpowder is ignited by a flint hammer striking a metal plate.

Evaporite:

Evaporite is a name for a water-soluble mineral sediment that result from concentration and crystallization by evaporation from an aqueous solution. There are two types of evaporate deposits: marine, which can also be described as ocean deposits, and non-marine, which are found in standing bodies of water such as lakes. Evaporites are considered sedimentary rocks.

Major groups of evaporite.

Mineral class	Mineral name	Chemical Composition
Chlorides	Halite	NaCl
	Sylvite	KCl
	Carnallite	$KMgCl_3 * 6H_2O$
	Langbeinite	$K_2Mg_2(SO_4)_3$
	Polyhalite	$K_2Ca_2Mg(SO_4)_6 * H_2O$
	Kainite	$KMg(SO^4)Cl * 3H_2O$
Sulfates	Anhydrate	$CaSO_4$
	Gypsum	$CaSO_4 * 2H_2O$
	Kieserite	$MgSO_4 * H_2O$
Carbonates	Dolomite	$CaMg(CO_3)_2$
	Calcite	$CaCO_3$
	Magnesite	$MgCO_3$

Coal:

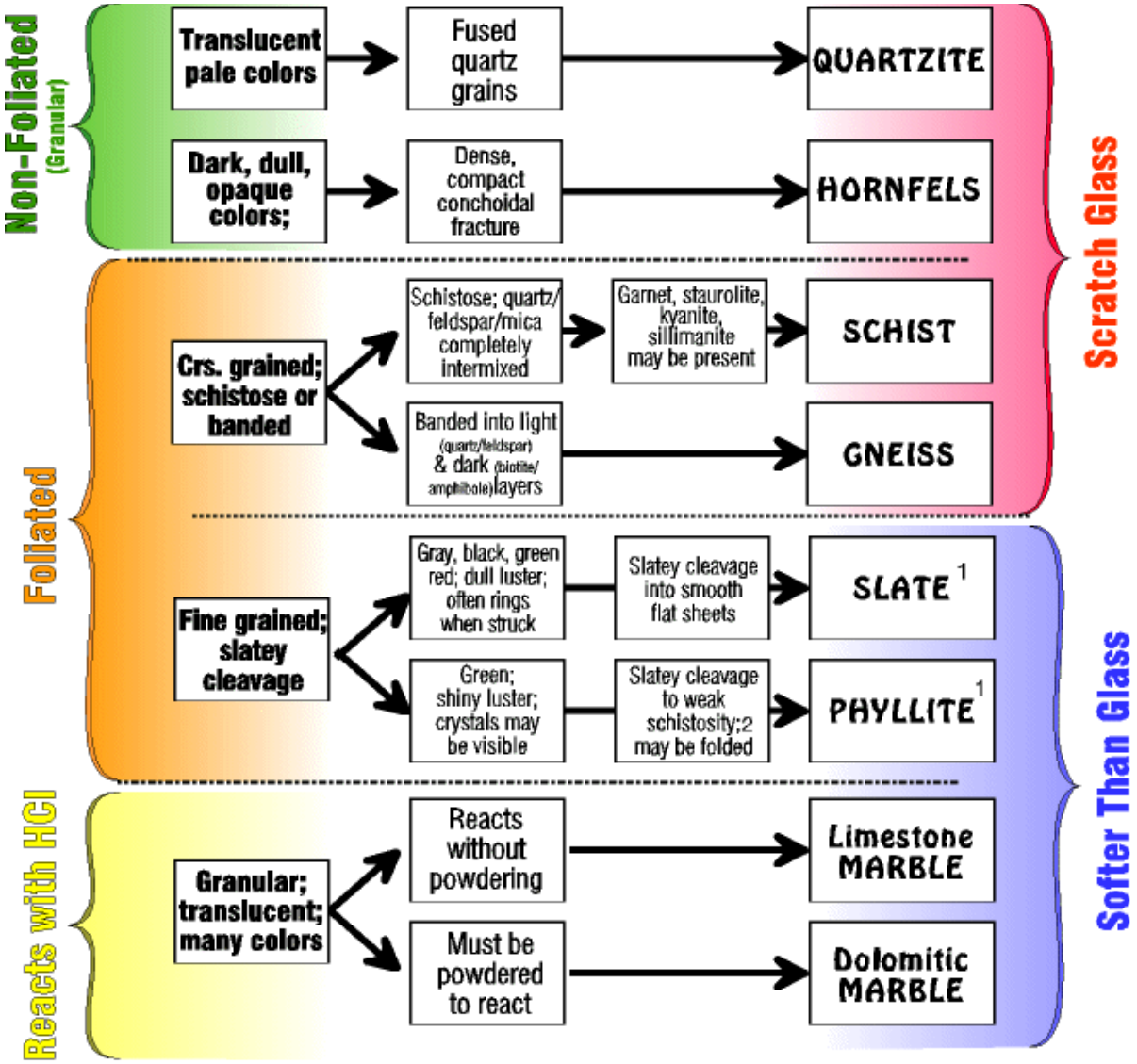
Coal is a combustible black or brownish-black sedimentary rock usually occurring in rock strata in layers or veins called coal beds or coal seams. The harder forms, such as anthracite coal, can be regarded as metamorphic rock because of later exposure to elevated temperature and pressure. Coal is composed primarily of carbon along with variable quantities of other elements, chiefly hydrogen, sulfur, oxygen, and nitrogen.

A fossil fuel, coal forms when dead plant matter is converted into peat, which in turn is converted into lignite, then sub-bituminous coal, then bituminous coal, and lastly anthracite. This involves biological and geological processes that take place over a long period.

Uses:

- Coal is primarily used as a solid fuel to produce electricity and heat through combustion.
- Coke is a solid carbonaceous residue derived from low-ash, low-sulfur bituminous coal from which the volatile constituents are driven off by baking in an oven without oxygen at temperatures as high as 1,000 °C (1,832 °F) so that the fixed carbon and residual ash are fused together. Metallurgical coke is used as a fuel and as a reducing agent in smelting iron ore in a blast furnace.
- Coal gasification can be used to produce syngas, a mixture of carbon monoxide (CO) and hydrogen (H_2) gas. This syngas can then be converted into transportation fuels like gasoline and diesel through the Fischer-Tropsch process.
- Coal can also be converted into liquid fuels such as gasoline or diesel by several different processes.
- Refined coal is the product of a coal-upgrading technology that removes moisture and certain pollutants from lower-rank coals such as sub-bituminous and lignite (brown) coals.
- Finely ground bituminous coal, known in this application as sea coal, is a constituent of foundry sand. While the molten metal is in the mould the coal burns slowly, releasing reducing gases at pressure and so preventing the metal from penetrating the pores of the sand.

Metamorphic Rocks:



1 (Shale), slate, and phyllite complete intergrade with each other. Distinctions may be difficult.

Quartzite:

Quartzite is a hard, non-foliated metamorphic rock which was originally sandstone. Sandstone is converted into quartzite through heating and pressure usually related to tectonic compression within orogenic belts. Pure quartzite is usually white to gray, though quartzites often occur in various shades of pink and red due to varying amounts of iron oxide (Fe_2O_3). Other colors, such as yellow and orange, are due to other mineral impurities.

When sandstone is metamorphosed to quartzite, the individual quartz grains recrystallize along with the former cementing material to form an interlocking mosaic of quartz crystals. Most or all of the original texture and sedimentary structures of the sandstone are erased by the metamorphism. Minor amounts of former cementing materials, iron oxide, silica, carbonate and clay, often migrate during recrystallization and metamorphosis. This causes streaks and lenses to form within the quartzite.

Orthoquartzite is avery pure quartz sandstone composed of usually well rounded quartz grains cemented by silica. Orthoquartzite is often 99% SiO_2 with only very minor amounts of iron oxide and trace resistant minerals such as zircon, rutile and magnetite. Although few fossils are normally present, the original texture and sedimentary structures are preserved. The term is often misused, and should be used for only tightly-cemented metamorphic quartzites, not quartz-cemented quartz arenites. The typical distinction between the two (since each is a gradation into the other) is a proper quartzite is so highly cemented, diagentically altered, and metamorphosed so that it will fracture and break across grain boundaries, not around them. Quartzite is very resistant to chemical weathering and often forms ridges and resistant hilltops. The nearly pure silica content of the rock provides little for soil, therefore, the quartzite ridges are often bare or covered only with a very thin layer of soil and (if any) little vegetation.

Uses:

Because of its hardness and angular shape, crushed quartzite is often used as railway ballast. Quartzite is a decorative stone and may be used to cover walls, as roofing tiles, as flooring, and stair steps. Crushed quartzite is sometimes used in road construction. High purity quartzite is used to produce ferrosilicon, industrial silica sand, silicon and silicon carbide. During the Stone Age quartzite was used as an inferior alternative to flint.

Hornfels:

Hornfels is the group designation for a series of contact metamorphic rocks that have been baked and indurated by the heat of intrusive igneous masses and have been rendered massive, hard, splintery, and in some cases exceedingly tough and durable.

Most hornfels are fine-grained, and while the original rocks (such as sandstone, shale, slate, limestone and diabase) may have been more or less fissile owing to the presence of bedding or cleavage planes, this structure is effaced or rendered inoperative in the hornfels. Though they may show banding, due to bedding, etc., they break across this as readily as along it; in fact, they tend to separate into cubical fragments rather than into thin plates.

The most common hornfels (the biotite hornfelses) are dark-brown to black with a somewhat velvety luster owing to the abundance of small crystals of shining black mica. The lime hornfels are often white, yellow, pale-green, brown and other colors. Green and dark-green are the prevalent tints of the hornfels produced by the alteration of igneous rocks. Although for the most part the constituent grains are too small to be determined by the unaided eye, there are often larger crystals of cordierite, garnet or andalusite scattered through the fine matrix, and these may become very prominent on the weathered faces of the rock.

Uses:

- As aggregate in the construction and roading industries.
- Decorative stone.

Schist:

The schists constitute a group of medium-grade metamorphic rocks, chiefly notable for the preponderance of lamellar minerals such as micas, chlorite, talc, hornblende, graphite, and others. Quartz often occurs in drawn-out grains to such an extent that a particular form called quartz schist is produced. By definition, schist contains more than 50% platy and elongated minerals, often finely interleaved with quartz and feldspar. Schist is often garnetiferous.

The individual mineral grains in schist, drawn out into flaky scales by heat and pressure, can be seen by the naked eye. Schist is characteristically foliated, meaning the individual mineral grains split off easily into flakes or slabs.

Most schists have been derived from clays and muds which have passed through a series of metamorphic processes involving the production of shales, slates and phyllites as intermediate steps. Certain schists have been derived from fine-grained igneous rocks such as basalts and tuffs. Most schists are mica schists, but graphite and chlorite schists are also common.

Uses:

Schists are frequently used as dimension stone. Dimension stone is stone that has been selected and fabricated to specific shapes or sizes.

In geotechnical engineering a schistosity plane often forms a discontinuity that may have a large influence on the mechanical behavior (strength, deformation, etc.) of rock masses in, for example, tunnel, foundation, or slope construction.

Gneiss:

Gneiss is a common and widely distributed type of rock formed by high-grade regional metamorphic processes from pre-existing formations that were originally either igneous or sedimentary rocks.

The etymology of the word "gneiss" is disputed. Some sources say it comes from the Middle High German verb gneist (to spark; so called because the rock glitters). It has occurred in English since at least 1757.

Uses:

Gneiss has many uses as a building material such as flooring, ornamental stones, gravestones, facing stones on buildings and work surfaces.

Slate:

Slate is a fine-grained, foliated, homogeneous metamorphic rock derived from an original shale-type sedimentary rock composed of clay or volcanic ash through low-grade regional metamorphism.

The result is a foliated rock in which the foliation may not correspond to the original sedimentary layering. When expertly "cut" by striking with a specialized tool in the quarry, many slates will form smooth flat sheets of stone which have long been used for roofing and floor tiles and other purposes. Slate is frequently grey in colour, especially when seen, en

masse, covering roofs. However, slate occurs in a variety of colours even from a single locality; for example, slate from North Wales can be found in many shades of grey, from pale to dark, and may also be purple, green or cyan. Slate is not to be confused with shale, from which it may be formed, or schist. Ninety percent of Europe's natural slate used for roofing originates from Spain.

The word "slate" is also used for some objects made from slate. It may mean a single roofing slate, or a writing slate, traditionally a small piece of slate, often framed in wood, used with chalk as a notepad or noticeboard etc., and especially for recording charges in pubs and inns. The phrase "clean slate" or "blank slate" comes from this use.

Uses:

- Slate can be made into roofing slates, which are installed by a slater and are a type of roof shingle, or more specifically a type of roof tile.
- Slate is particularly suitable as a roofing material as it has an extremely low water absorption index of less than 0.4%. Its low tendency to absorb water also makes it very resistant to frost damage and breakage due to freezing.
- Slate tiles are often used for interior and exterior flooring, stairs, walkways and wall cladding.
- Because it is a good electrical insulator and fireproof, it was used to construct early-20th century electric switchboards and relay controls for large electric motors.
- Fine slate can also be used as a whetstone to hone knives.
- Due to its thermal stability and chemical inertness, slate has been used for laboratory bench tops and for billiard table tops.
- In areas where it is available, high-quality slate is used for tombstones and commemorative tablets.

Phyllite:

Phyllite is a type of foliated metamorphic rock primarily composed of quartz, sericite mica, and chlorite; the rock represents a gradation in the degree of metamorphism between slate and mica schist. Minute crystals of graphite, sericite, or chlorite impart a silky, sometimes golden sheen to the surfaces of cleavage (or schistosity). Phyllite is formed from the continued metamorphism of slate.

The protolith (or parent rock) for a phyllite is a shale or pelite. Its constituent platy minerals are larger than those in slate but are not visible with the naked eye. Phyllites are said to have a "phyllitic texture" and are usually classified as having a low grade in the regional metamorphic facies.

Phyllite has a good fissility (a tendency to split into sheets) and will form under low grade metamorphic conditions. Phyllites are usually black to gray or light greenish gray in color. The foliation is commonly crinkled or wavy in appearance.

Uses:

It's a metamorphic rock squished between slate and schist as far as its degree of change from its parent rock. It's flat like slate, but has a significant mica content, which makes it ideal for its primary use -- decorative stone, like counter-tops, sides of buildings, even patios, if you can afford it.

Marble:

Marble is a non-foliated metamorphic rock composed of recrystallized carbonate minerals, most commonly calcite or dolomite.

Geologists use the term "marble" to refer to metamorphosed limestone; however stonemasons use the term more broadly to encompass unmetamorphosed limestone.

Pure white marble is the result of metamorphism of a very pure (silicate-poor) limestone or dolomite protolith. The characteristic swirls and veins of many colored marble varieties are usually due to various mineral impurities such as clay, silt, sand, iron oxides, or chert which were originally present as grains or layers in the limestone.

Green coloration is often due to serpentine resulting from originally high magnesium limestone or dolostone with silica impurities. These various impurities have been mobilized and recrystallized by the intense pressure and heat of the metamorphism.

Uses:

- Marble is commonly used for sculpture and as a building material. This preference has to do with its softness, relative isotropy and homogeneity, and a relative resistance to shattering. Also, the low index of refraction of calcite allows light to penetrate several millimeters into the stone before being scattered out, resulting in the characteristic waxy look which gives "life" to marble sculptures of the human body.
- Construction marble is a stone which is composed of calcite, dolomite or serpentine which is capable of taking a polish.[8] More generally in construction, specifically the dimension stone trade, the term "marble" is used for any crystalline calcitic rock (and some non-calcitic rocks) useful as building stone.