Table 3.1 The four principal categories of sedimentary rock (1–4) together with the broad lithological groups

1 *terrigenous clastics*	2 *biochemical-biogenic -organic deposits*	3 *chemical precipitates*	4 *volcaniclastics*
sandstones, conglomerates and breccias, mudrocks	limestones + dolomites, chert, phosphates, coal	ironstones, evaporites	tuffs, agglomerates

Terrigenous clastic sediments

Terrigenous clastic sediments arc made up of transported fragments Tabl e I. Grain-size clas sification of sediments derived from the weathering of pre-existing igneous, sedimentary or metamorphic rocks. These rocks are classified initially according to grain size, using the Udden Wentworth scale

Table 1. Grain-size classification of sediments

Size in mm of class boundary	Class term	Grain size terms for rock	
256	boulders	rudite rudaceous rock conglomerate breccia	
64	cobbles		
4	pebbles		
2	granules		
1	very coarse sand	arenite arenaceous rock sandstone	
0.5 ($\frac{1}{2}$)	coarse sand		
0.25 ($\frac{1}{4}$)	medium sand		
0.125 ($\frac{1}{8}$)	fine sand		
0.0625 ($\frac{1}{16}$)	very fine sand		
0.0312 ($\frac{1}{32}$)	coarse silt	siltstone	argillite argillaceous rock mudstone mudrock shale
0.0156 ($\frac{1}{64}$)	medium silt		
0.0078 ($\frac{1}{128}$)	fine silt		
0.0039 ($\frac{1}{256}$)	very fine silt		
	clay	claystone	

Gravels and conglomerates

- **A gravel and conglomerates are unconsolidated accumulation of angular and rounded fragments larger than sand (more than 2mm in size).**
- **The term conglomerate is applied to rounded**
- **indurated gravels in the size of pebble, boulder and cobbles**
- **The term breccia applied to an accumulation of angular rock fragments**

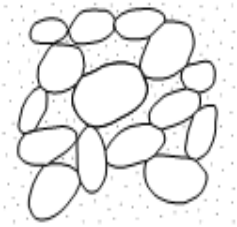

LEADERART

Shape of gravel bodies

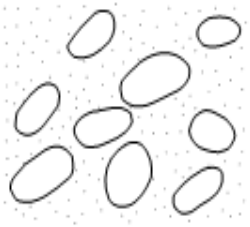
- **They are wedges or wedge shaped deposits deposited as aprons or fans**
- **They occur as sheets or blanket deposits**
- **Their clasts vary from pebbles, cobbles and boulders in sizes**

Texture and structure

(f) Preferred orientation of grains



(g) Grain-supported fabric



(h) Matrix-supported fabric

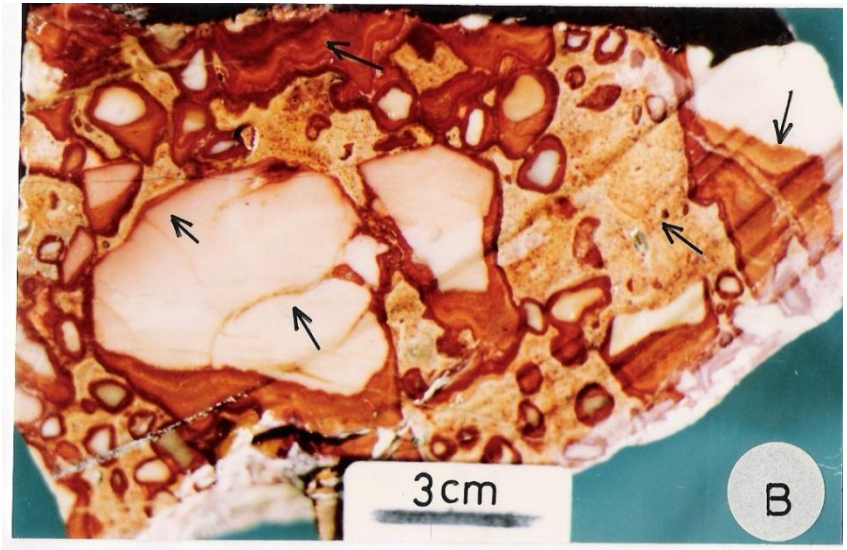
Clast-support fabric; pebbles, mainly quartzite, are in contact and were deposited on a fan delta

They include voids empty or filled with sand materials

Conglomerates are divided into clast-supported and matrix-supported

- **Clast supported are dominanantly clasts with reduced fine materials , produced from rapid erosion and high relief**
- **Matrix-supported are dominated by mud, produced from low-relief and slow erosion**

Difference Between Conglomerate and Breccia



- **Breccia is a name given to clastic sedimentary rocks that are formed by clinging تشبث together of a large number of angular fragments, with the space between the fragments either filled by smaller fragments or mineral cement, which is responsible for holding the rock together**
- **Breccias formed when host rocks break and their debris is not transported to any far off place. This means that these rocks form when original rocks break and re-accumulate to make pieces that are angular in texture. Situations that often lead to formation of breccias are landslides, impact craters, fault zones. Formation of breccias also takes place when meteors strike earth and rocks are sent flying into air. When these rocks fall back on earth, they join together to make breccias**

conglomerates

- **Conglomerate is also a type of clastic sedimentary rock that is formed by rounded fragments having joined together with the help of smaller such particles or with mineral cement that binds the minerals and fragments together.**
- **Conglomerates form when pebbles cling together in a matrix bind together by mineral cement. However, the major difference between breccias and conglomerates lies in roundness of grains.**
- **In conglomerates, the pebbles or grains are more rounded than in breccias, which indicates that their pieces have transported to a longer distance and have been impacted by transporting material (such as water).**

Distinguish between breccias and conglomerates

- **It is easy to distinguish between breccias and conglomerates with naked eyes as grains are much large to be seen with naked eyes. When the grain size is less than 2mm, it becomes difficult to see them with naked eyes, and then the rock is simply categorized as sandstone.**
- **Near the outcrop where breakage of rocks takes place, the pieces or fragments are angular, the breakage having resulted from mechanical weathering. However, the sharp edges of angular fragments get rounded when they are transported by water to large distances. These fragments are carried away from the outcrop and get cemented together after having been rounded because of the action of water.**

Economuic importance of conglomerates and breccias

- **Cementing materials in breccias are normally calcite, quartz, gypsum, and clays. Even after formation, there are many pores or open spaces in breccias, which is why they are said to be a good rock to act as a reservoir of gases, ground water, and even petroleum. Breccias are angular in texture and are considered very good building material (ornamental). They are used for graves, making tiles, also for many other ornamental uses. Some breccias are considered precious and used in jewelry.**

- **Conglomerates, on the other hand, because of their irregular grain size have less durability, and thus, used less often as a building material. They are beautiful, and thus, used in an ornamental fashion in buildings.**

Summary
the difference between Conglomerates and Breccias?

- **Breccias have angular fragments inside, while fragments are much more rounded in conglomerates.**
- **This difference in grains is due to transportation of fragments, also because of the impact of transporting material (water).**
- **· Breccias have greater strength than conglomerates, and are thus used more often as building material.**
- **· However, both breccias and conglomerates are used as ornamental material in buildings.**

Breccias

What is Breccia, How Does it Form and What is its Composition?

Breccias

Chert Breccia: The angular clasts in this breccia are chert fragments. The matrix is an iron-stained mix of clay through sand-size particles

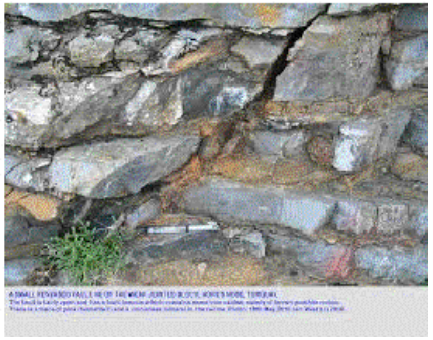
- **What is Breccia?**
- **Breccia is a term most often used for clastic sedimentary rocks that are composed of large angular fragments (over two millimeters in diameter). The spaces between the large angular fragments can be filled with a matrix of smaller particles or a mineral cement that binds the rock together.**

How Does Breccia Form?

Debris Flow Breccia: Outcrop of a breccia thought to have formed from debris flow deposits

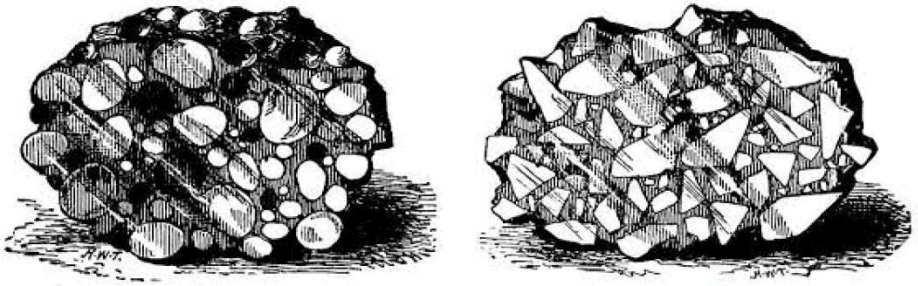
Breccia forms where broken, angular fragments of rock or mineral debris accumulate. One possible location for breccia formation is at the base of an outcrop where mechanical weathering debris accumulates. Another would be in stream deposits near the outcrop such as an alluvial fan. Some breccias form as debris flow deposits. The angular particle shape reveals that they have not been transported very far (transport wears the sharp points and edges of angular particles into rounded shapes). After deposition the fragments are bound together by a mineral cement or by a matrix of smaller particles that fills the spaces between the fragments.

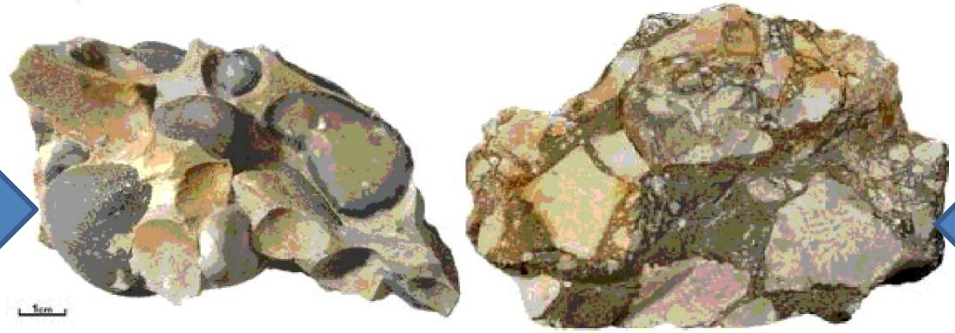
How Does Breccia Differ From Conglomerate?



- **Breccia and conglomerate are very similar rocks. They are both clastic sedimentary rocks composed of particles larger than two millimeters in diameter. The difference is in the shape of the large particles. In breccia the large particles are angular in shape but in conglomerate the particles are rounded. This reveals a difference in how far the particles were transported. Near the outcrop where the fragments were produced by mechanical weathering the shape is angular. However, during transport by water away from the outcrop the sharp points and edges of those angular fragments are rounded. The rounded particles would form a conglomerate.**

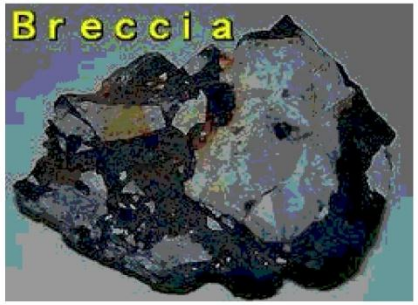
Difference Between Conglomerate and Breccia



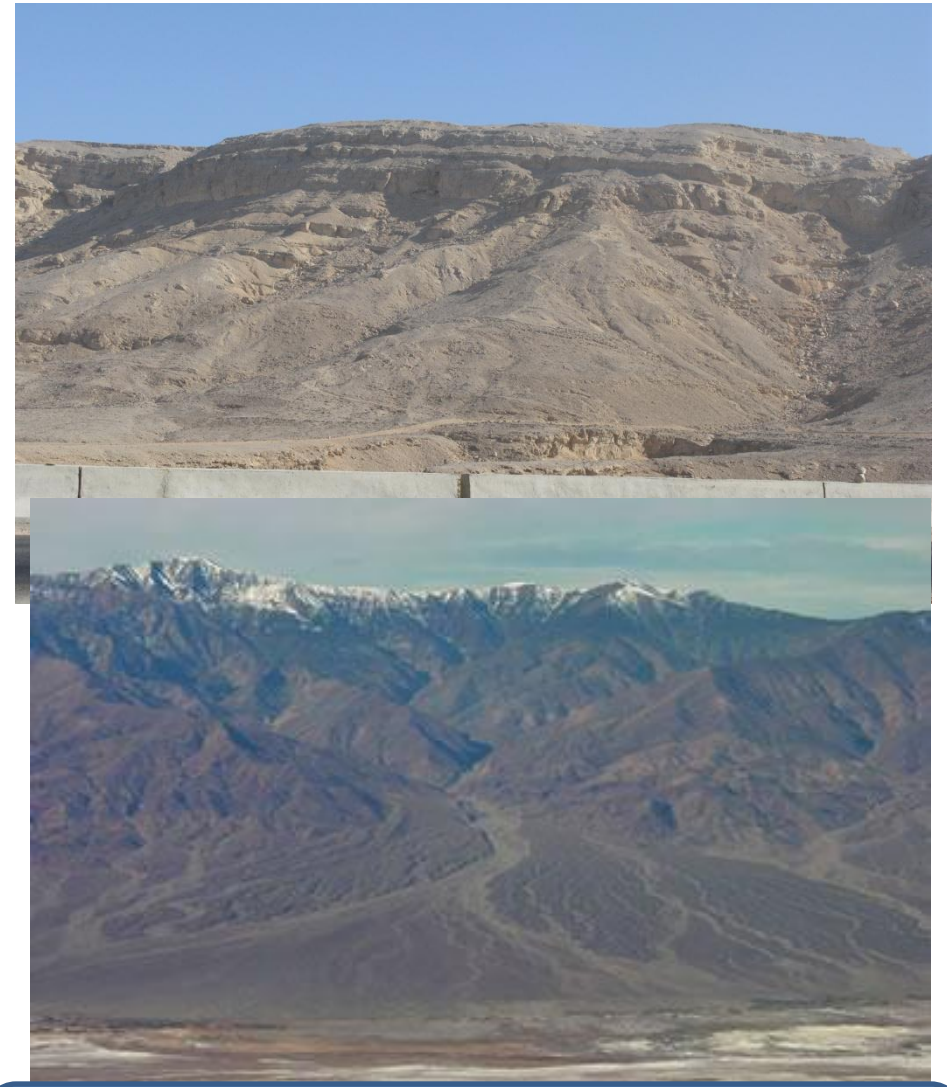


conglomerates

Breccias



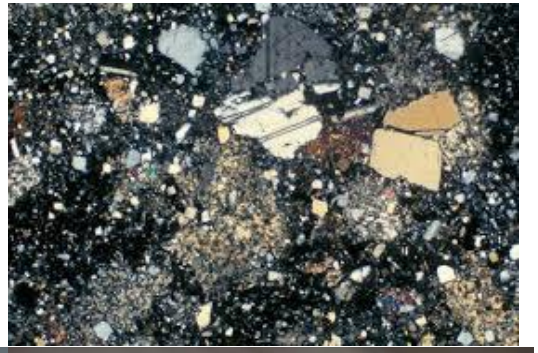
How Does Breccia Differ From Conglomerate?



Alluvial Fan:Material on the fan was weathered from the mountains in the background and transported a very short distance.

Breccia and conglomerate are very similar rocks. They are both clastic sedimentary rocks composed of particles larger than two millimeters in diameter. The difference is in the shape of the large particles. In breccia the large particles are angular in shape but in conglomerate the particles are rounded. This reveals a difference in how far the particles were transported. Near the outcrop where the fragments were produced by mechanical weathering the shape is angular. However, during transport by water away from the outcrop the sharp points and edges of those angular fragments are rounded. The rounded particles would form a conglomerate.

What is Breccia's Composition?



Limestone Breccia: A breccia that contains clasts of multiple types of limestone.

Breccia has many compositions. Its composition is mainly determined by the rock and mineral material that the angular fragments were produced from. The climate of the source area can also influence composition. Most breccias are a mix of rock fragments and mineral grains. The type of rock that the fragments were produced from is often used as an adjective when referring to the rock. Some examples: sandstone breccia, limestone breccia, granite breccia, chert breccia, basalt breccia and others. Often a breccia will contain many types of angular rock fragments. These are known as polymict breccias or polymictic breccias.

What Color is Breccia?

- **Breccia can be any color. The color of the matrix or cement along with the color of the angular rock fragments determine its color. Breccia can be a very colorful rock as shown in the photo at the top-right of this page**

Types of breccias

- **Igneous Breccia:** A term used for a rock composed angular fragments of igneous rocks. "Flow breccia" and "pyroclastic breccia" could be called "igneous breccia".

  Impact Breccia: A deposit of angular rock debris produced by the impact of an asteroid or other cosmic body. See an article about "impactites".

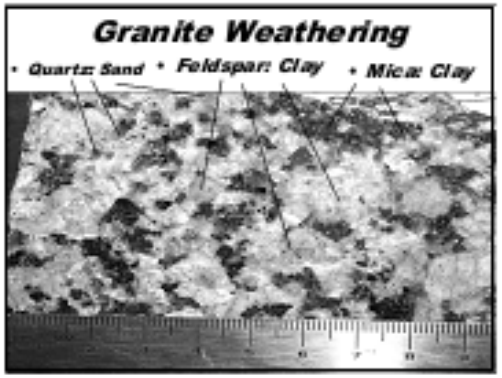
  Pyroclastic Breccia: A term used for a deposit of igneous rock debris that was ejected by a volcanic blast or pyroclastic flow.

- **Geologists have been very generous in their use of the word "breccia." It is common to hear the term used when referring to a rock or rock debris made up of angular fragments. Although it is mainly used for rocks of sedimentary origin it can be used for other types of rocks. A few more uses of the word are given below.**
- **Collapse Breccia: Broken rock that originates from a cavern or magma chamber collapse.**

  Fault Breccia: Broken rock found in the contact area between two fault blocks and produced by movement of the fault.

  Flow Breccia: A lava texture produced when the crust of a lava flow is broken and jumbled during movement.

Granite Weathering

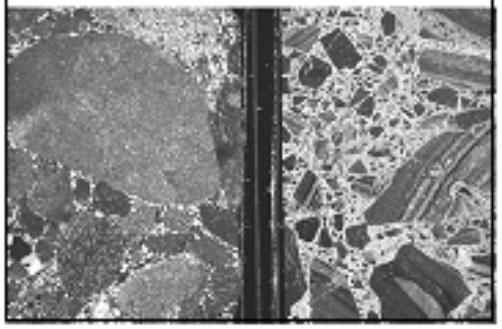


Conglomerates and Breccias

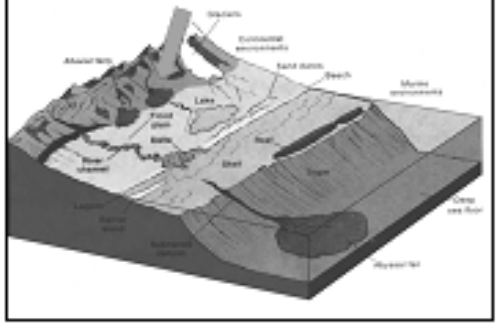
- Breccias are composed of coarse, angular fragments.
  - Breccia fragments have not traveled far.
- Conglomerates are composed of coarse, rounded fragments
  - Conglomerate fragments have traveled further
- Conglomerates and Breccias are typical of continental alluvial fans

Environment of deposition

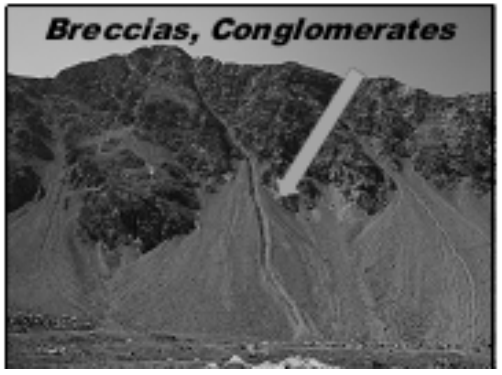
Conglomerate - Breccia



Breccias, Conglomerates

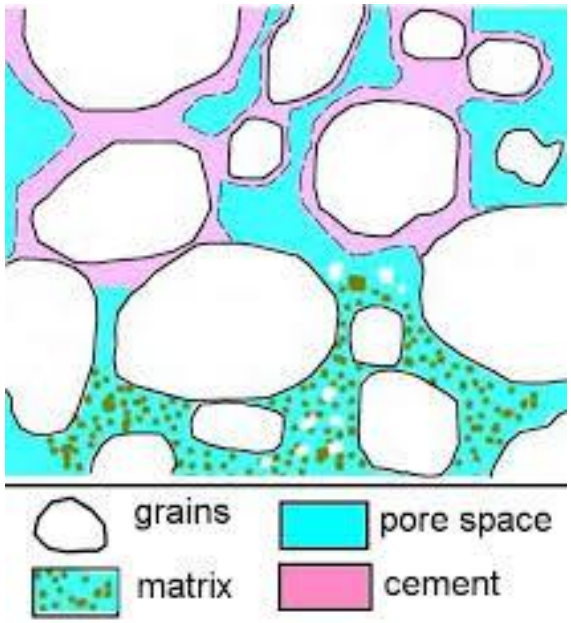


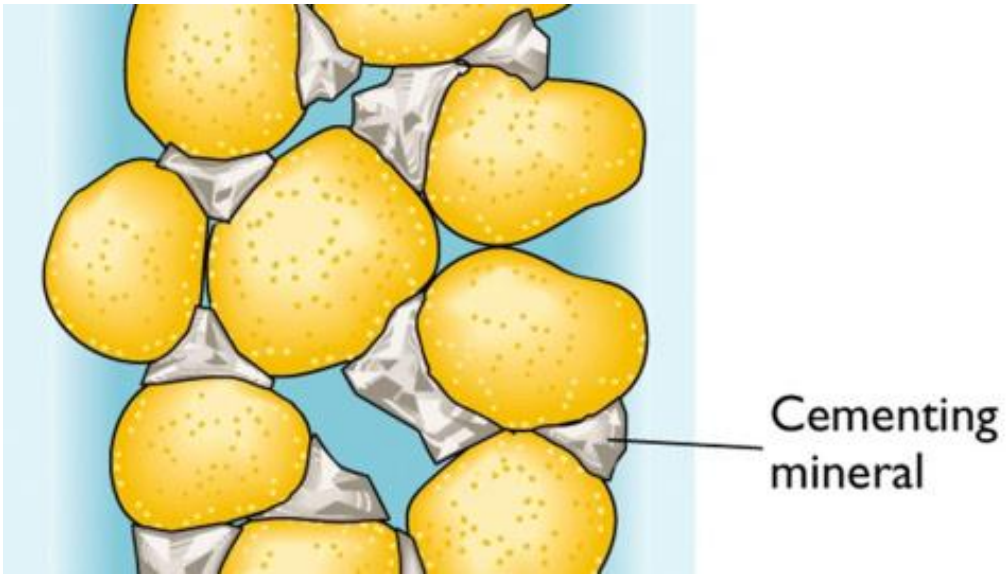
Breccias, Conglomerates

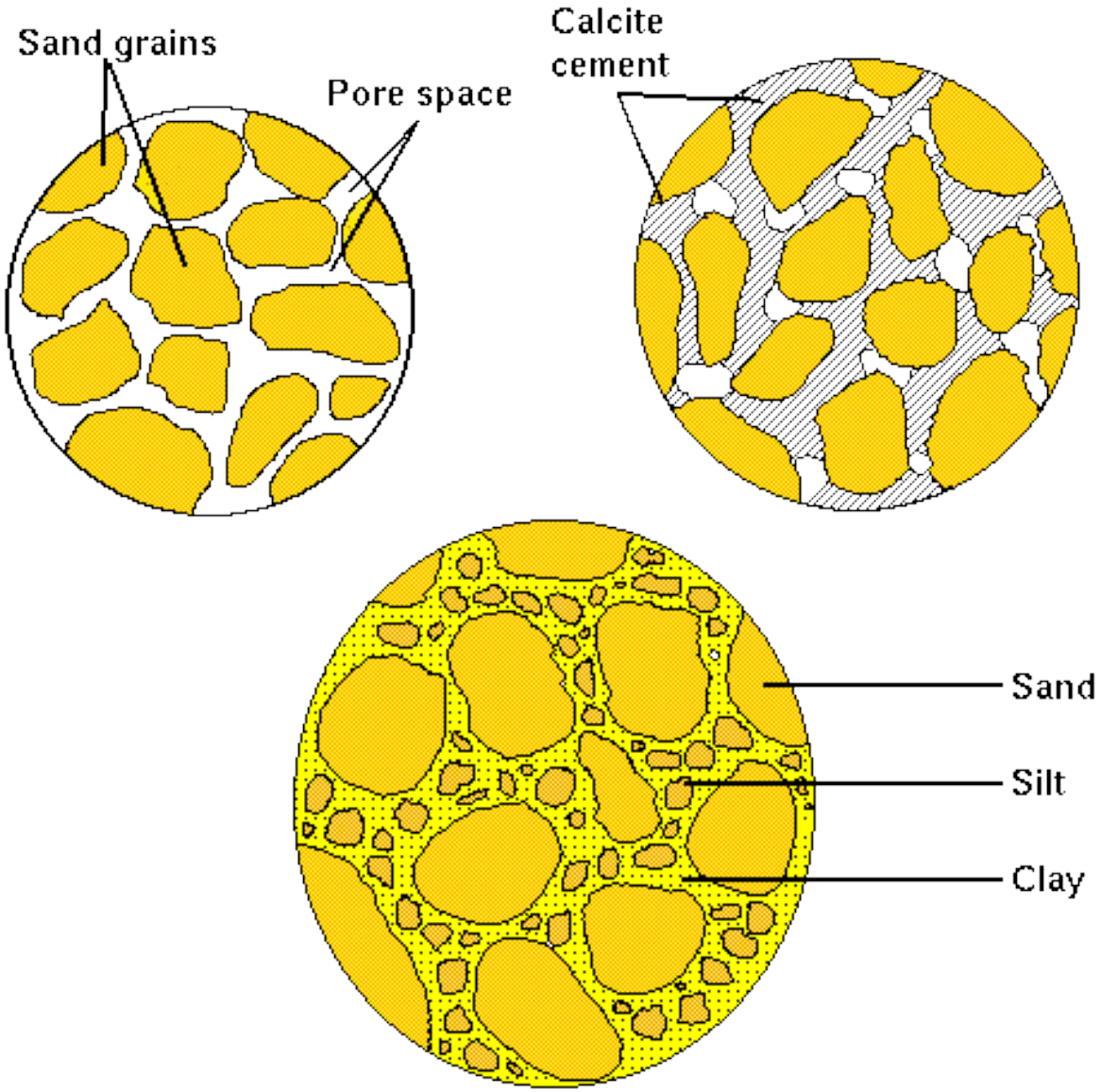


Sandstones

- Arkose contains feldspar and is near source
  - Fountain Formation (Flatirons) is made of arkose and conglomerates
- Eolian sandstones are desert (wind) deposits
  - Commonly show cross-bedding
- Fluvial sandstones are stream deposits
  - Commonly have asymmetric ripples and channels.


grains
pore space
matrix
cement


Cementing mineral


Sand grains
Pore space
Calcite
cement
Sand
Silt
Clay

- **Cementation**
- A diagenetic process, where the particles that make up a sedimentary rock are cemented together by new minerals after deposition. Cements are precipitated from mineral rich water moving through any cavities or pore spaces between the grains of sediment
- **Clast, clastic rocks**
- A clast is a fragement of rock or mineral produced by the disintegration of a larger rock or rock mass. Clastic rocks are sedimentary rocks composed primarily of clasts derived from erosion of older rocks.
- **Colluvium**
- Loose and unconsolidated deposits that have not been transported by wind or water. Usually applied to material lying at the base of a slope that has been transported there by gravity.
- **Calcrete**
- A hard layer of soil, sand or gravel formed by precipitation of calcite from ground or surface waters into pore spaces. Frequently occurs in arid or semi arid regions where evaporation increases salt concentrations in waters and promotes precipitation. Such hard layers are also called duricrusts or caliche. Nodules form first and then layers develop.

Conglomerate

- **Conglomerate**
- A clastic sedimentary rock where the majority of clasts are larger than 2 mm in diameter (granules, pebbles, cobbles, boulders) and rounded or subrounded. Clasts are set in a finer grained matrix, and can be supported by the matrix or by clast to clast contact. Conglomerates are the lithified equivalents of gravel

conglomerates

a thin section of a conglomerate in

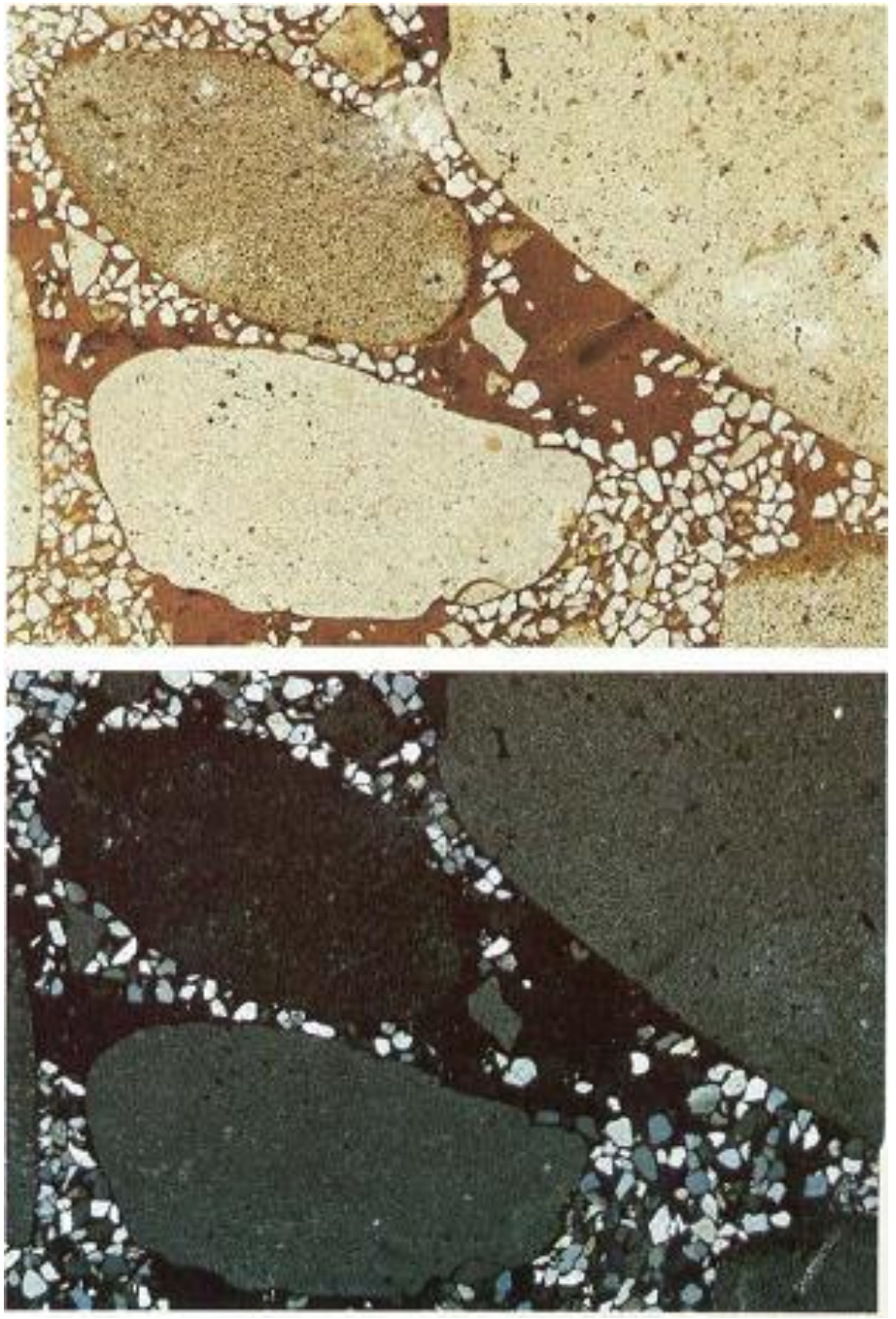
which the largl: rounded fragments arc chert. Under cross polars shows that the fragments are

made up of very fine-grained quart; (micro-quartz

the matnix comains subangular to suhrounded quartz

grains and and mall chert fr agments set in an iron oxide-rich

cement



Sediment maturity

There are two types of sediment maturity – mineralogical and textural. Mineralogically mature sediments are those containing a high proportion of the most chemically stable and most physically resistant minerals such as quartz, chert and ultrastable heavy minerals, such as zircon and tourmaline. Mineralogically immature sediments contain the less stable grains, such as feldspars, and those rock fragments not consisting principally of quartz.

The textural maturity of a sediment depends on the content of fine-grained material, the sorting and the roundness of the grains. A scale of textural maturity proposed by Folk (1951) is presented below.

Immature stage – Sediment contains > 5% clay matrix. Grains poorly-sorted and not well-rounded.

Submature stage – sediment contains < 5% clay matrix. Grains poorly-sorted and not well-rounded.

Mature stage – sediment contains little or no clay. Grains well-sorted, but not well-rounded.

Supermature stage – sediment contains no clay. Grains well-sorted and well-rounded.