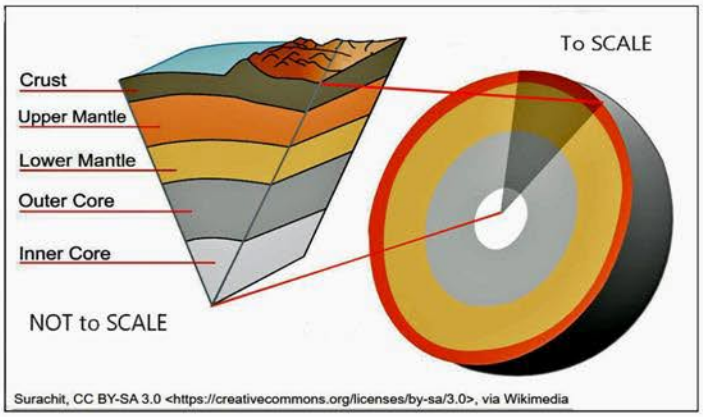
Bill's rocks and Minerals.
Breccia

The lithosphere is composed of the solid uppermost layers of the earth. These layers are the crust and the upper mantle which are composed of solid rock. The lower mantle tends to be semi - fluid because of an increase in pressure and temperature. The breccias that are the subject of this article are derived mainly from the crust, and partially from the upper mantle.



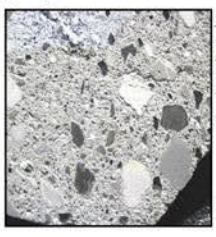
There are two components to the diagram. The first vector diagram is not to scale, and is for illustrative purposes only. The cross section diagram is to scale, and it can be seen that the crust and upper mantle are small compared to the Earth as a whole The continental crust is between 25 to 70 Km. thick, and the upper mantle is about 640Km thick, compared to the Earths diameter of 12,756 Km.

The rocks around us appear to be solid and stable, but over geological time, as long as several hundred million years, the rocks around us have been moving, grinding against each other, uplifting, subsiding, and fracturing, For instance the bulk of the British Isles began life near the South pole, and tectonic plate movement moved it to it's present location, which created a lot of turmoil in the rocks. This turmoil, which also included a great deal of volcanic activity, created conditions in which many types of breccia were formed. The rocks around us are still moving, as demonstrated by frequent earthquakes, volcanic eruptions, and landslides, so brecciated rocks are still being formed.

The definition of breccia is

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

Breccia composed of more than one rock type is termed *polymictic*



Impact Breccia Devon Isl. Canada

James St. John Wikipedia C.C. 2.0

Breccia composed of a single rock type is termed *monomictic*

Impact Breccia Pyranees S. France

James St. John Wikipedia C.C. 2.0

There are two main classes of breccia as far as their construction is concerned

Clast supported — Where the clasts touch each other, and the matrix fills the voids.

Matrix supported — Where the clasts are not in contact and the matrix surrounds each clast.

A review of the terminology which has so far been used in this article.

Breccia Fragments of rock / minerals cemented together by a fine grained matrix.

Polymitic breccia. Breccia which contains more than one type of rock / mineral.

Monomictic breccia. Breccia which contains only one type of rock / mineral.

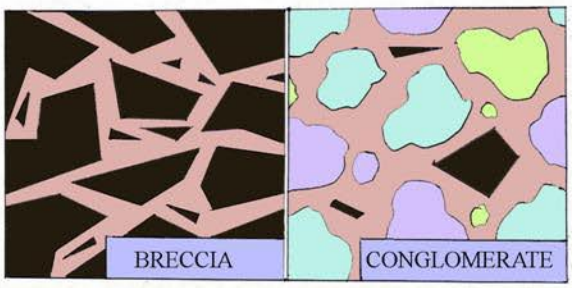
Clasts. Clasts is the name given to pieces of rocks / Minerals in the breccia.

Matrix. The name given to the cement which bonds the clasts together. An alternative name for matrix is groundmass

Clast supported breccia. Breccia where most of the clasts are touching each other.

Matrix supported breccia. Breccia in which the clasts do not touch each other, and are surrounded by the matrix.

BRECCIA versus CONGLOMERATE



A word of caution. Breccia can be confused with Conglomerate. Both are composed of peices of rock set in a cement matrix. Breccia however is composed entirely of shattered angular clasts, whereas Conglomerate is composed mainly of rounded clasts with occasional angular clasts. The angular clasts are created locally, but rounded clasts are created by transport and friction over a long distance

Breccia
Dolomite cemented Dolostone Breccia

Conglomerate
Sandy Polymictic Conglomerate

Types of breccia

Sedimentary	Igneous	Hydrothermal
Tectonic	Impact	Collapse .

These are the basic types of breccia. However there are many variations of each type, very often named after the locality where they are found. There are literally dozens of breccias named after their locality, each one having it's own distinctive appearance

SEDIMENTARY BRECCIA

Of all the different types of breccia, sedimentary breccia is probably the most common. There is so much erosion of surface rocks that this is hardly surprising. All types of rock, including the harder igneous rocks are subject to erosion from wind ice and rain. Just about every exposed hillside has some scree slopes. The steeper the hillside the more scree there is.

Very large accumulations of scree can occur as the result of debris flows. which are produced when a storm washes loose scree into swollen streams and rivers. The scree in the debris flow will be deposited on lower ground where the river widens, especially so in estuaries.

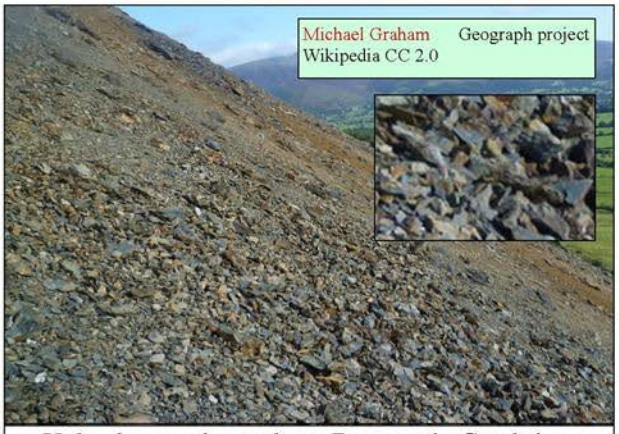
Coastal rocks are especially subject to erosion, mostly by wave and storm action. Most cliffs have freshly formed scree at their bases.

It is the accumulated scree from whichever source which will eventually, after a very long period of time become cemented to form breccia.

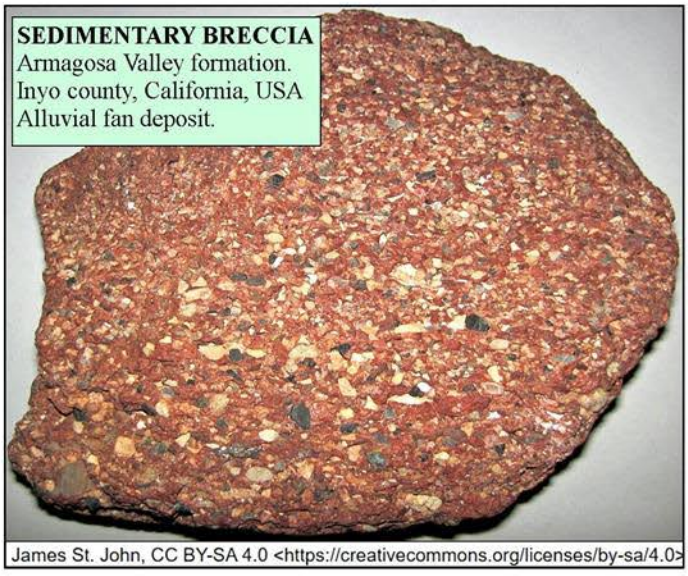
The rounded pebbles and pieces of rock in a conglomerate are rounded from the grinding action of long distance transportation, either by rivers or glaciers, which differentiates them from the angular pieces in a breccia.

Sources of scree.

August, 2013, Debris flow in Badger Gulch, Idaho triggered by heavy rainfall following the Beaver Creek wildfire.



Upland scree slope, above Derwent in Cumbria

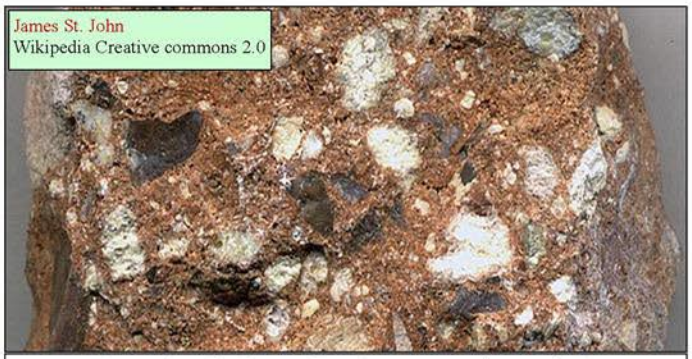


Igneous breccia

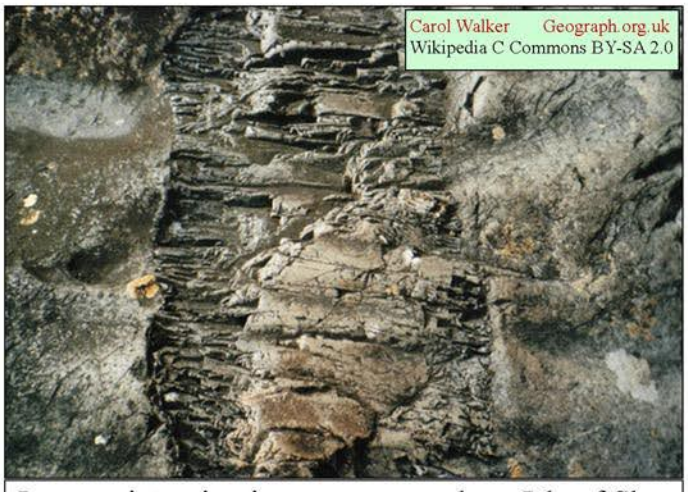
Igneous breccia can be formed from rocks coming from two different origins, volcanic eruptions, or igneous intrusions, for this reason Igneous breccia is commonly referred to as volcanic breccia. The volcanic breccias are the result of violent eruptions causing pyroclastic flows of fractured pieces of rock plucked from the wall of the magma conduit, mixed with a smaller amount of pieces of rock picked up by the lava as it flows down the volcano slopes. The resulting breccia is uniform in rock type

Volcanos eject molten lava to the surface, whereas igneous intrusions occur when magma cools and solidifies before it reaches the surface. Igneous intrusions are often the result of more than one episode of intrusion into the same fault and when new hot magma intrudes into previously cooled magma, fracturing occurs, especially around the outer edges of the intrusion, and it is this outer fractured rock which later becomes brecciated.

Cooled pyroclastic flow at Mount St. Helens Volcano



Pyroclastic breccia (Igneous breccia)



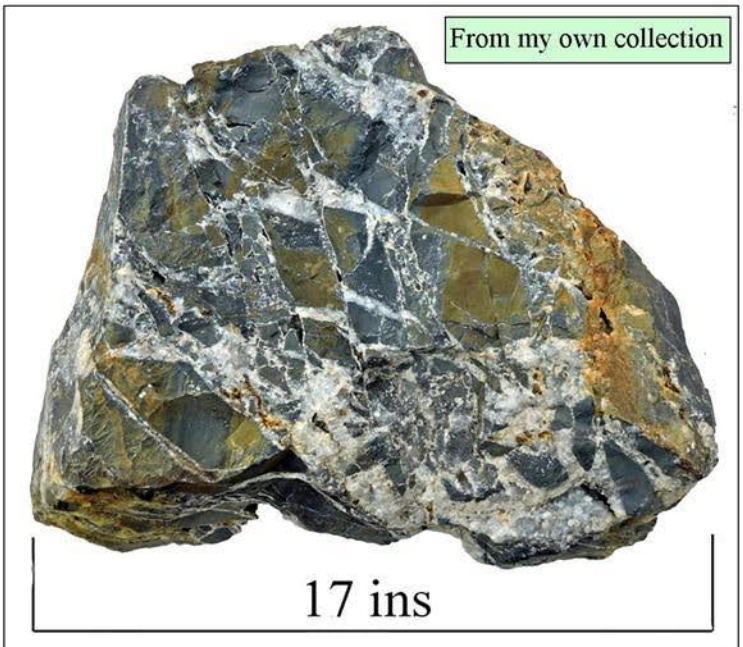
Igneous intrusion into country rock Isle of Skye

Note that in this intrusion that the outer margins are very fractured compared with the inner core

Hydrothermal breccia

Hydrothermal breccias occur at relatively shallow depths in the Earths crust, at temperatures between 150° C and 350° C. Fractures in the rock are home to circulating hot fluids, very often mineralised. As with any hot or boiling fluid, expansion occurs, which causes extreme pressure to be exerted on the walls of the fracture by the fluid. If the extreme pressure exerted by the fluid is suddenly decreased, due to the fluid finding an escape route, the hydrofracturing process is triggered. The instantaneous decrease in pressure causes the fracture walls to shatter and implode rock fragments into the hot circulating fluid. The fluid, now carrying rock fragments will eventually cool and solidify, and a breccia is created.

In ore bodies the circulating fluid is usually rich in silica or calcite, but the fluid also carries other dissolved minerals, such as galena, copper, sphalerite, etc. which upon cooling crystallise, and become incorporated into the breccia.

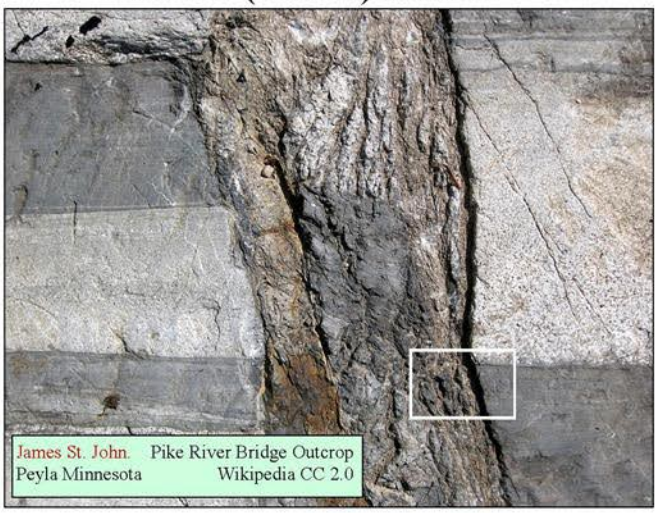


This specimen of Hydrothermal breccia was collected from Dylife mine in Powys. It is composed of silica rich circulating fluid and shards of wall rock, but only very small amounts of minerals for which the mine is famous

Tectonic or Fault breccia

Tectonic or fault breccia is formed by the action of the opposing walls of a fault grinding against each other. The cement may be the result of mineral matter introduced into ground water.

Tectonic (Fault) breccia



Note that the breccia filled fault is sandwiched between beds which have moved against each other. The misalignment of the beds is obvious.

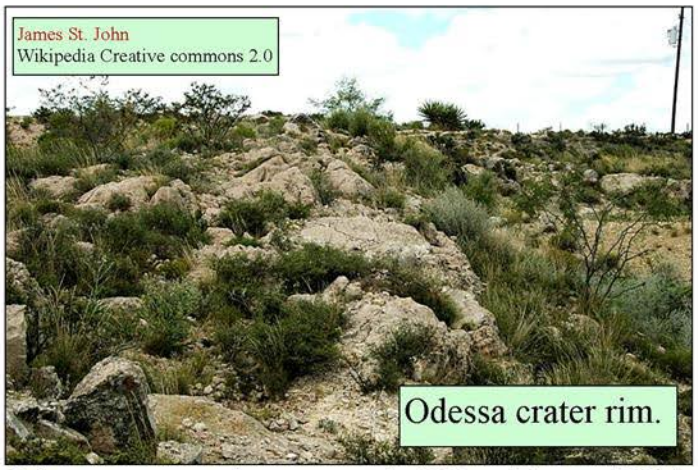
The next two types of breccia mentioned in this article are very different in the manner that they are formed. Impact breccia forms as the result of a very violent occurrence, In complete contrast collapse breccia simply relies on gravity.

Impact breccia

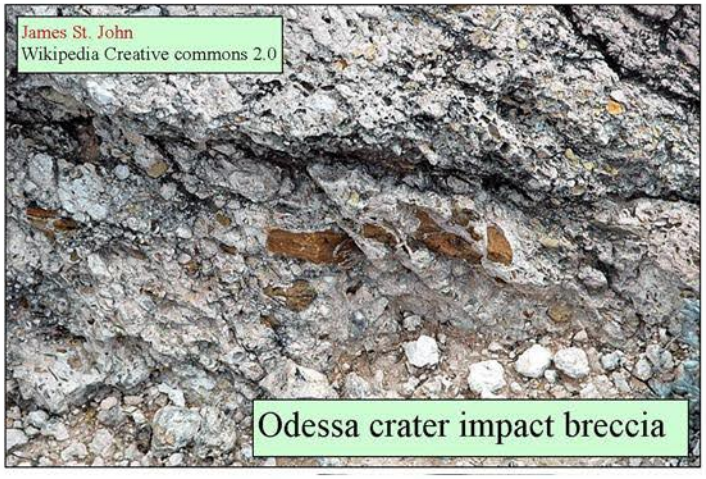
Impact breccia is not a common type of breccia because it is the product of immense heat and pressure generated by an asteroid strike, which fortunately does not happen very often.

Impact breccia is composed of shattered fragments of rock set in a crystalline matrix of melted rock, the composition of which can vary widely, dependant of the type of rock at the asteroid impact site.

71% of the Earths surface is covered by water, so it is inevitable that many asteroid strikes have been in the oceans which makes them much more difficult to observe

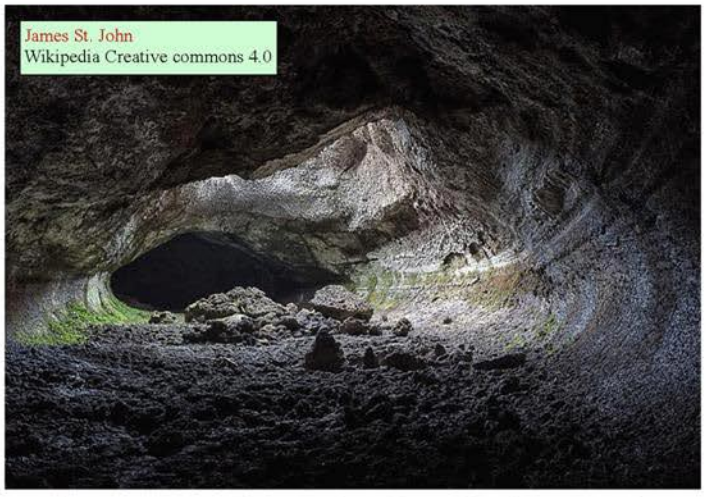


Odessa meteorite crater in West Texas USA 160m. in diameter, created by a nickel iron meteorite that fragmented in the atmosphere

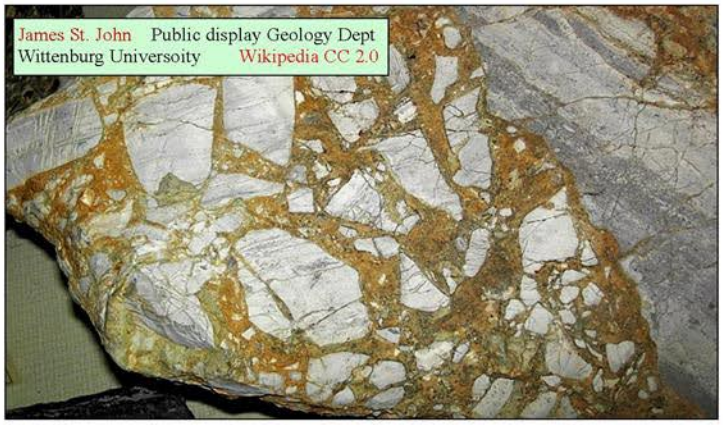


Collapse breccia

There are several ways in which collapse breccia is formed. Most commonly it is formed from the debri in roof or wall collapse of a cavern or tunnel. A more complicated process takes place in limestone formations.



In the Grotto of Raspberries, the longest lava flow tube at Mount St. Etna, part of the roof has collapsed. The debris on the floor will eventually become cemented and transformed into collapse breccia.

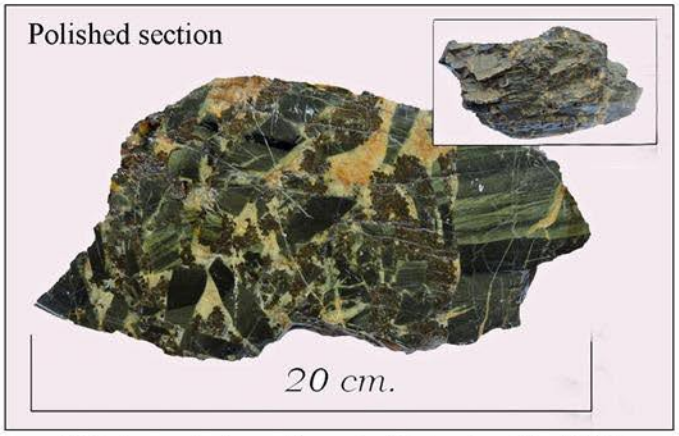


Collapse breccia from the Everton formation, Middle Ordivician, Rush creek district, Marion county, Arkansas, USA.

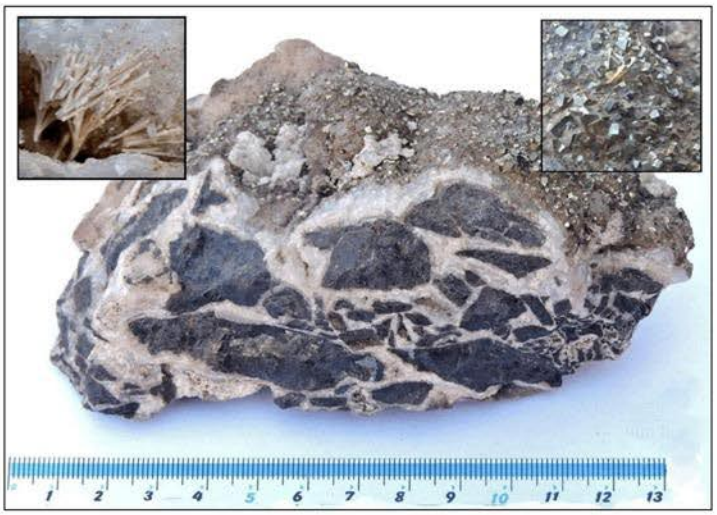
Ferroan dolomite in Hydrothermal Breccia. W. Wales

Miscellaneous Breccia from my collection

Hydrothermal breccia from Bryn-y- Rafr mine W .Wales

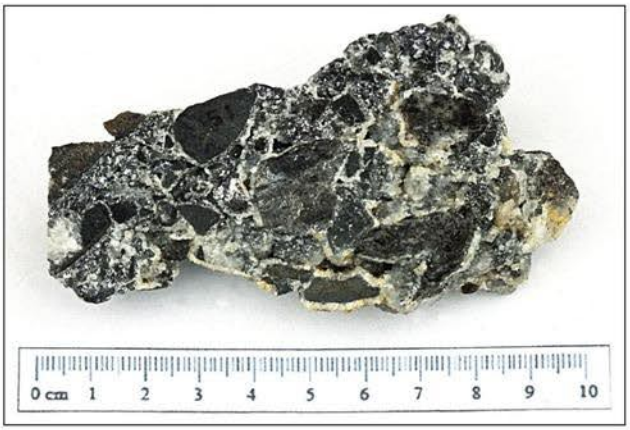


Vein breccia from Cwmrheidol mine West.Wales



Rhodochrosite in Hydrothermal Breccia. S.Australia

Hematite shards in Hydrothermal Breccia S. Wales



Hydrothermal breccia from Dylife mine Central.Wales

Postscript

When I started to compile this article on breccia, I had not realised just how complex the subject would be. Breccia is far more complicated than any single mineral or rock. However, having started I was determined to continue. I do not profess to being an expert on the subject, I am an amateur, and the content of this article is the result of many hours of research, both from books and the internet. For that reason there may be mistakes, and if so, I apologise.