VOLCANIC TUFF

Volcanic tuff is a type of igneous rock, formed from material ejected during an explosive volcanic eruption. In these eruptions, fragments of volcanic material are blasted from the volcano, propelled through the air and then deposited in the surrounding area where they become compacted and cemented into rock, which can be instant if the material is still hot.

Tuffs consist primarily of volcanic ash, however they can contain lapilli (2-64mm volcanic fragments) and volcanic bombs (>64mm lumps of lava that cool into solid fragments before they reach the ground). Closer to the vent, a tuff is likely to contain larger blocks of material catapulted from the volcano in a matrix of ash. Further away from the vent, tuff deposits are more likely to be exclusively made from fine volcanic ash particles, carried by the wind.

This particular tuff comes from the Borrowdale Volcanic Group in Cumbria and is associated with volcanic activity in the late Ordovician period (approximately 450 million years ago). The greenish colour is due to the presence of the mineral chlorite.

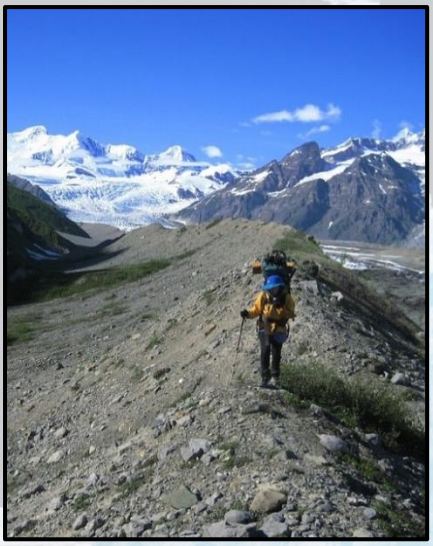
CONGLOMERATE

Conglomerates are coarse grained sedimentary rocks which contain rounded pebbles or clasts. The gaps between these clasts are usually filled in with a mixture of sand, silt and clay or with a mineral cement.

Conglomerates are deposited in settings where the energy is high enough to move large clasts, for example on beaches exposed to wave action or during floods. Floods are a major natural hazard in many parts of the world including the UK. During a flood, rivers have more energy so are able to transport large, heavy clasts. After the flood, the river no longer has this increased energy, and so the large rounded clasts, now too heavy to be transported, are quickly deposited. If these clasts are lithified (turned into rock) they will become a conglomerate.

Conglomerates found in the geological record, together with other features indicative of ancient floodplains, can be used to identify where flooding has occurred in the past, and can help predict areas vulnerable to future flooding.

BOULDER CLAY



Boulder clay, also known as glacial till, is a type of loose sediment deposited by glaciers and ice sheets. As its name would suggest, boulder clay can contain clasts of different sizes ranging from fine clay particles to large boulders. These fragments come from the sandpaper-like erosive action of the base of the glacier on the rocks below (substrate). Rocks are plucked from the substrate and carried by the ice. They are crushed, eroded and abraded as they are transported and are eventually deposited at the glacier margin in huge mounds of glacial till. This boulder clay was deposited in Yorkshire during the Pleistocene period.

Glaciers form when the accumulation of snow and ice is greater than the amount of melting; they therefore 'advance' in cold periods and 'retreat' as the climate warms. Glaciers are one of the most sensitive indicators of climate change and a major cause for variations in sea level. Boulder clays can provide us with insights into past glaciations and climate patterns as well as help us to understand the responses of modern ice sheets, such as those in Antarctica and Greenland, to current climate warming.

GYPSUM

Gypsum is an evaporite mineral, one which is deposited when bodies of water, such as lakes, seas and volcanic springs, evaporate. It is a common mineral in the UK and is used in the manufacture of cement, fertilizer and plaster of Paris.

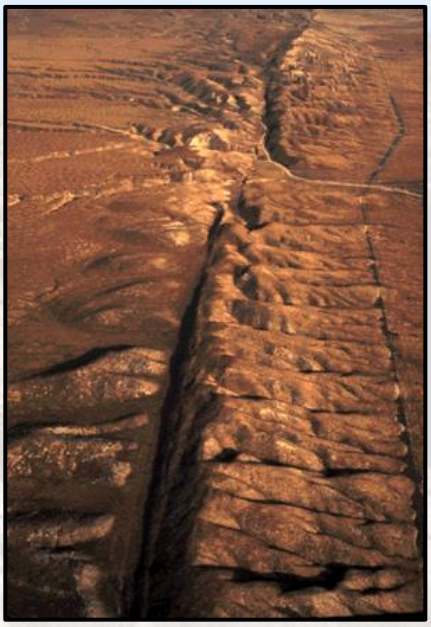
Areas of the UK underlain by deposits of gypsum, such as Ripon in Yorkshire, have a high risk of developing sinkholes. This is because gypsum is extremely soluble in water. Rainwater can percolate though the overlying, less soluble, sediments and rapidly dissolve the gypsum below causing spaces and caverns to open up. These voids eventually become too large to support the land above, and it collapses inwards creating a sinkhole.

PYRITE

Pyrite, commonly known as 'Fools Gold', is an iron sulphide mineral (FeS_2) with a brassy yellow colour and metallic lustre. Pyrite is one of the main causes of acid mine drainage, the outflow of highly acid waters from old mines. This is because metal deposits, such as those containing copper, zinc, and nickel, are often rich in pyrite. When a mine is abandoned it usually floods with water which promotes the breakdown of pyrite into sulfuric acid (H_2SO_4). This increases the acidity of the water and enables it to carry dissolved heavy metals.

Acid mine drainage must be treated at the source to avoid damage to downstream freshwater ecosystems. In 1992 the decommissioned Wheal Jane tin mine in Cornwall had a sudden release of 50 million litres of untreated extremely acidic water into the Carnon Valley and Falmouth Bay. This outburst killed fish, contaminated wild fowl and caused a widespread orange-brown discoloration of the water. The situation was eventually managed but water treatment costs were in excess of £20 million and over 10,000 tonnes of metal had to be removed.

FAULT BRECCIA AND MYLONITE



There is a huge amount of risk and uncertainty associated with earthquakes. While geologists can identify regions likely to be at risk, it is impossible to predict precisely when and where earthquakes will take place. Fault breccias and mylonites form in active fault zones so can be indicators of past tectonic activity.

Fault breccias are composed of large angular rock fragments cemented together with finer grained sand, silt and clay. They form in the upper part of a fault zone where the sudden movement of fault blocks during earthquakes, grinds and crushes the rock between them.

Mylonites form deeper in the crust where pressures and temperatures are higher. Stresses from movements along the fault zone cause the rocks to deform like soft plastic rather than fracture. Minerals in mylonites are sheared parallel to the direction of movement along a fault zone due to the stresses acting upon them.

ACTINOLITE

Actinolite is a dark green, fibrous amphibole mineral which is most commonly found in metamorphosed calcareous sediments. Actinolite is one of six naturally occurring minerals that are classified as "asbestos". These minerals can form long, needle-like, fibrous crystals which readily separate when disturbed.

Asbestos minerals like actinolite are heat resistant, good insulators and have a high a tensile strength. They were mined extensively in the 19th and 20th centuries and widely used in the construction industry for building and electrical insulation. However, it is now recognised that long exposure to asbestos is extremely harmful to human health. Due to their long, fibrous crystal forms, asbestos minerals can be inhaled easily into the lungs where they can cause fibrosis and lung cancer.

The actinolite sample is safe to handle, but please do so carefully and wash your hands afterwards.