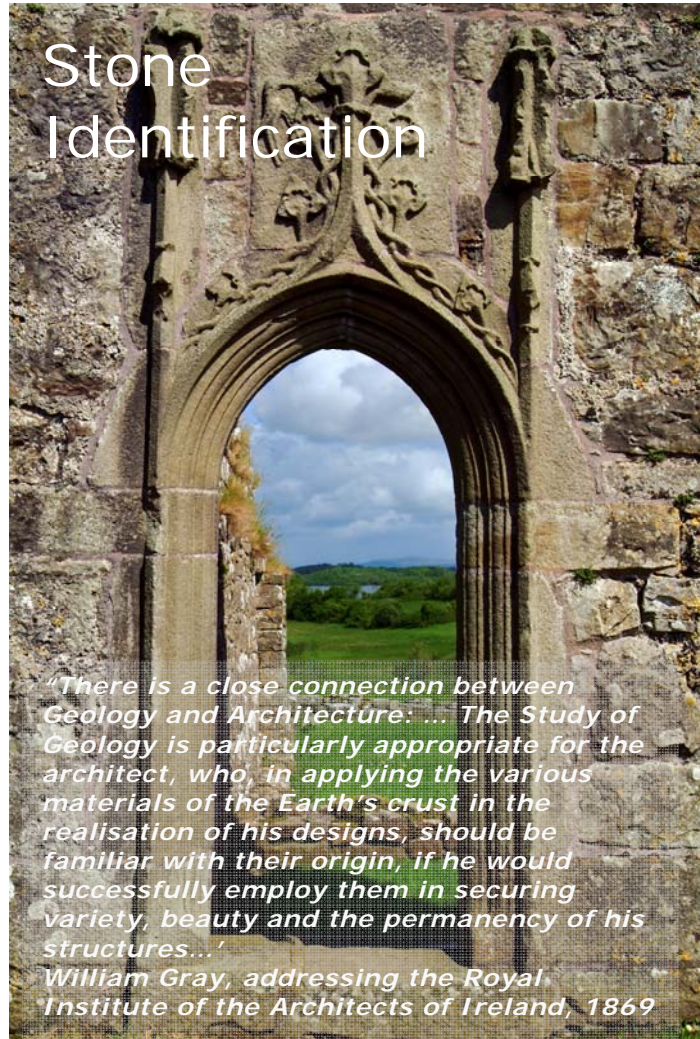


# Stone Identification



Stone is a natural, complex material of almost infinite variety - that's its attraction as a building material but also causes to a variety of failings and problems. Understanding how stone performs in the environment is vital to building, repairing and restoring masonry buildings, be it as a modern thin skin on a steel frame or an ancient solid walled monument.

We have a long history of the use of stone for building in Northern Ireland. Our varied geological foundation has provided a wide variety of stone. It used to be the local availability of a particular rock type that dictated the building stone giving each area and county its own distinctive character of built heritage. The Mourne and Newry granites, the greywacke sandstone of Down and the black basalt of Antrim dominate the random rubble and dressed stonework of buildings and monuments throughout these counties. Scrabo sandstone from Newtownards, with its distinctive pink and yellow hues and sedimentary structures and clay lenses, and the buff sandstones of Dungannon and Ballycastle dominate the dressed and intricately carved stonework on much of our ecclesiastical heritage. In Fermanagh and Armagh the fossil-rich grey and pink Carboniferous limestones are used from both the simplest vernacular building to grandest Cathedral.

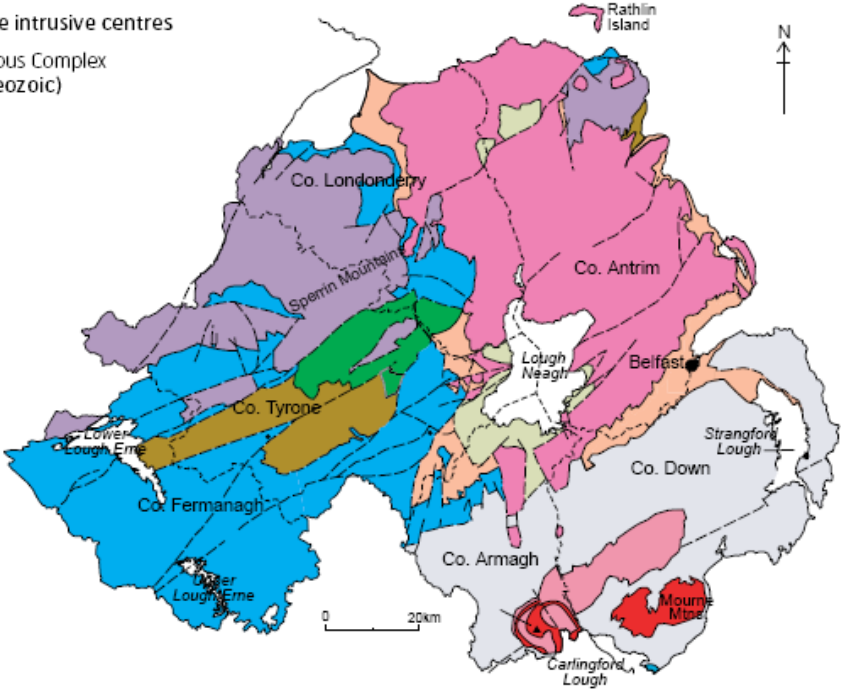
The full range of rock types have been used as building stone since Neolithic times. As transport systems developed in the 19<sup>th</sup> and 20<sup>th</sup> centuries, stone was moved further around the country as well as being shipped in from further a field for construction of the more prestigious buildings such as town halls, churches and banks. Belfast's built heritage has a full range of Scottish Carboniferous sandstones and English Jurassic limestones used from the mid-19<sup>th</sup> Century. Until the railway network was well established the easiest and most economical way to transport stone was via waterways rather than overland. Today we are importing stone from all over the world including India, Portugal and China for cladding and paving.

The Natural Stone Database for Northern Ireland provides information of building stone used for building in Northern Ireland.

Key to Map

- Lough Neagh Group } Palaeogene
- Antrim Lava Group }
- Permian to Cretaceous
- Carboniferous
- Devonian
- Southern Uplands-Down-Longford Terrane (Ordovician-Silurian)
- Midland Valley Terrane (Ordovician-Silurian)
- Central Highland (Grampian) Terrane (Proterozoic)
- Palaeogene intrusive centres
- Newry Igneous Complex (Late Palaeozoic)

Simplified geological map of Northern Ireland



Geological Period	Age (millions of years ago)	General Distribution	Typical Northern Irish Stone Types
Tertiary	65	Counties Antrim and Londonderry, Mourne Mountains, County Down	Antrim Basalt, Tardree Stone and Mourne Granite
Cretaceous	140	County Antrim coastline, Limavady, Moira, and Moneymore	Ulster White Limestone/Antrim Chalk
Jurassic	200	County Antrim	Rare outcrops of mudstone
Triassic	250	Newtownards, Dundonald, Whiteabbey, Dunmurry, & Cookstown	Scrabo Sandstone, Dundonald Sandstone
Permian	300	Belfast Lough (Cultra/Hollywood)	Cultra Limestone
Carboniferous	360	County Tyrone, Fermanagh, Armagh, Londonderry, Antrim, and Down	Dungannon Sandstone, Dungiven Sandstone, Fermanagh Sandstones, Tyrone and Fermanagh Limestones, Armagh Limestone, Castle Espie Limestone, Ballycastle Sandstone
Devonian	410	County Tyrone and County Antrim	Sandstones and conglomerates
Silurian	440	County Down and Armagh	Newry and Slieve Gullion Granodiorite, Greywacke
Ordovician	510	County Londonderry and Tyrone	Granite Greywacke
Cambrian	570	No Outcrops	
Dalradian	850	County Londonderry and Tyrone, North-East Antrim	Derry and Claudy Schist, limestone and psammite, slate

Geological time periods of stone types used in Northern Ireland

## What's in a Name?

A stone can have an assortment of names. Polished gabbros from all over world are often referred to as 'black granite', limestones are called marbles much to the confusion of geologists! The use of industry names such as 'Blue Pearl' and 'Honey Glow' by stone suppliers can cause confusion for architects and specifiers as such names do not relate to the rock type. In an effort to overcome this, a BS EN Standard has been put together for 'Stone Names' of European rock types that are actively quarried. All stone types that have 'CE' mark can be traced to its quarry of origin.

Our local geology also has a variety of names. Sandstones, limestones and granites can be described by their geological formation, stratigraphic age or locality or quarry name. For example, sandstone from County Tyrone was used as a popular dimension stone throughout Northern Ireland. Table 1 shows the three main types of rock groups and the stone types within those groups.

Table 1 Three Main Rock Groups		
Igneous	Sedimentary	Metamorphic
Basalt	Sandstones	Schist
Granite	Limestones	Slate
Gabbro	Shales	Marble
	Mudstones	Gneiss

## Decision making for identifying stone types.

Geologists' categorise rocks into three major groups: Igneous, Sedimentary and Metamorphic (see Table 1) are all represented in the geological record in Northern Ireland and all types have been used as building stone.

Accurate identification of stone types requires some geological knowledge, however, being able to describe the fabric of a stone can go some way towards its recognition.

All rocks can be described by their texture: fine-grained, granular, fragmental, crystalline or foliated.

Fine-grained rock types are extremely difficult to categorise and, out of geological context, are difficult to identify even for the most experienced geologist. The flowchart presents one attempt of a 'structured enquiry' to separate out the main types of fine-grained types common in Northern Ireland. This simple process of elimination, together with a little knowledge of the local geology, can aid recognition of stone types.

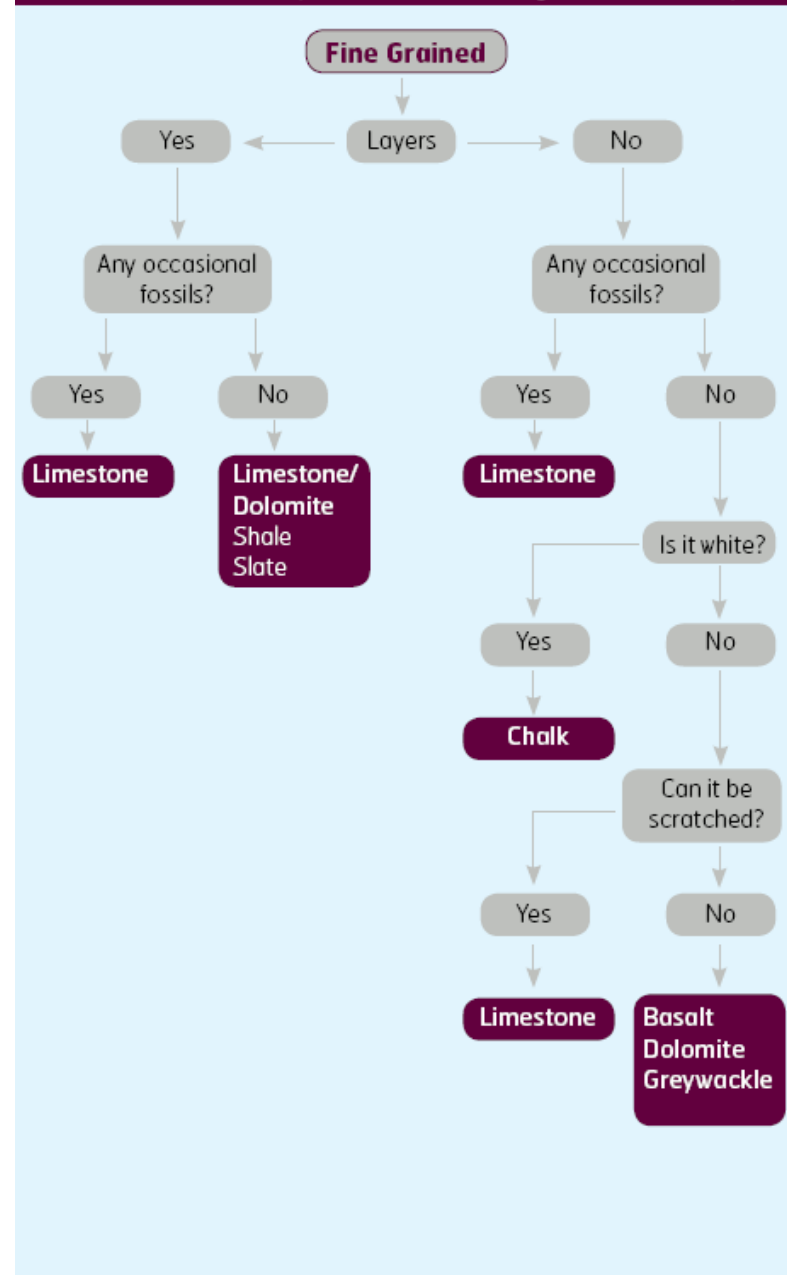


Greywacke: a vein and minor microfractures cross cut the cut face of the stone



Chalk: the very fine lines through the fabric are stylolites – planes of weaknesses in the stone

Figure?? Structured enquiry to identify fine grained stone types

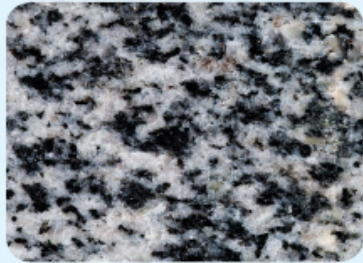




## Figure?? Crystalline Stone Types

The main identifying features of Crystalline stone types are:

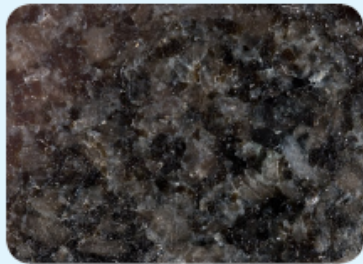
- Visible crystals of different colours forming on interlocking texture
- Stone tends to be very hard



**Granite**

### **Granite**

An igneous rock having crystals or grains of visible size; consists mainly of quartz, feldspar, and mica or other colored minerals.



**Gabbro**

### **Gabbro**

Coarse-grained igneous rock predominantly composed of ferromagnetic minerals with crystals visible to the eye; has the same mineral composition as basalt.



**Marble**

### **Marble**

A metamorphic rock formed by alteration of limestone or dolomite, often irregularly colored by impurities, and used especially in architecture and sculpture.

## **Igneous Rocks**

Igneous rocks are fine to coarse grained crystalline rocks. They are formed when hot, molten rock (called magma) cools and solidifies. There are two main types of igneous rock, depending on where the magma cooled:

- Intrusive igneous rocks form when the magma comes from deep underground and is forced into the upper layers of the Earth's crust, where it cools slowly (Gabbro, Granite);
- Extrusive igneous rocks form when the magma erupts from a volcano and cools quickly on the ground (Basalt, Rhyolite). Granites, gabbros (often called 'Black Granite'), basalt and rhyolite are all examples of igneous rocks.

### Texture

Igneous rocks contain randomly-arranged crystals (crystalline). The crystals are large if the molten rock cooled slowly (Gabbro), and small if it cooled quickly (Basalt).

### Chemistry

Igneous rocks vary in chemical composition as well as texture. 'Basic' igneous rocks such as basalt, dolerite and gabbro are generally dark grey to black in colour and contain magnesium and iron minerals and feldspar with little or no quartz. 'Acid' igneous rocks such as granite and rhyolite are composed of the minerals quartz, feldspar and mica. Granites can vary widely in both texture and colour, with common grey and pale red-orange varieties dependent on their feldspar composition.

### Figure?? Granular Stone Types

The main identifying features of granular stone types are:

- Individual particles/fossils are visible to the naked eye
- Dull lustre on a broken surface
- Can be any colour, but not usually dark gray or black



**Limestone**

#### **Limestone**

Most limestones are formed by the deposition and consolidation of the skeletons of marine invertebrates; a few originate in chemical precipitation from solution



**Sandstone**

#### **Sandstone**

Sedimentary rock composed of sand-sized grains, naturally cemented by mineral materials. In most sandstone used for building, quartz grains predominate; often used for decorative elements in buildings because it is easy to carve.

### **Acid Test for Identification of Limestone**

A reaction with dilute hydrochloric acid is the definitive test for limestones. The mineral calcite (Calcium Carbonate  $\text{CaCO}_3$ ) reacts with  $\text{HCl}$  releasing bubbles of carbon dioxide gas (efflorescence). If the acid fizzes, your rock is limestone.

## **Sedimentary Rocks**

Sedimentary rocks form when particles of minerals, shells or rocks settle through the water or air and form layers or beds (strata). Over millions of years, layers of sediment build up and are buried one on top of the other and the sediment become bonded together to form sedimentary rocks. Sedimentary rocks often have a layered appearance. They may contain fossil remains of animals and plants that were trapped as the rocks formed. Limestone, sandstone, shales and mudstones are examples of sedimentary rocks.

Sandstones are composed of sand-sized grains (usually quartz), naturally cemented by minerals (silica, iron, calcite). Sandstones vary widely in terms of constituent minerals, cement types, grain sizes and pore structures which lead to a wide variety of colours, textures and performances as building stone.

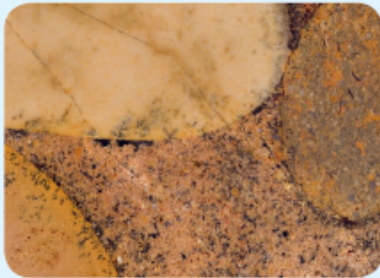
Limestones are wholly or in large part composed of calcium carbonate. Commonly white but may be coloured by impurities, iron oxide making it brown, yellow, or red and carbon making it blue, black, or gray. The texture varies from coarse to fine. Most limestones are formed by the deposition and consolidation of the skeletons of marine invertebrates; a few originate in chemical precipitation from solution

Shales and mudstones are fine-grained, dark grey sedimentary rocks formed from silt and clay. Shales have a layered structure and are easily split along bedding planes. Mudstones have no laminations.

## Figure?? Fragmented Stone Types

The main identifying features of fragmented stone types are:

- Pebbles or angular fragments embedded in fine grained cement/matrix.



**Conglomerate**

### Conglomerate

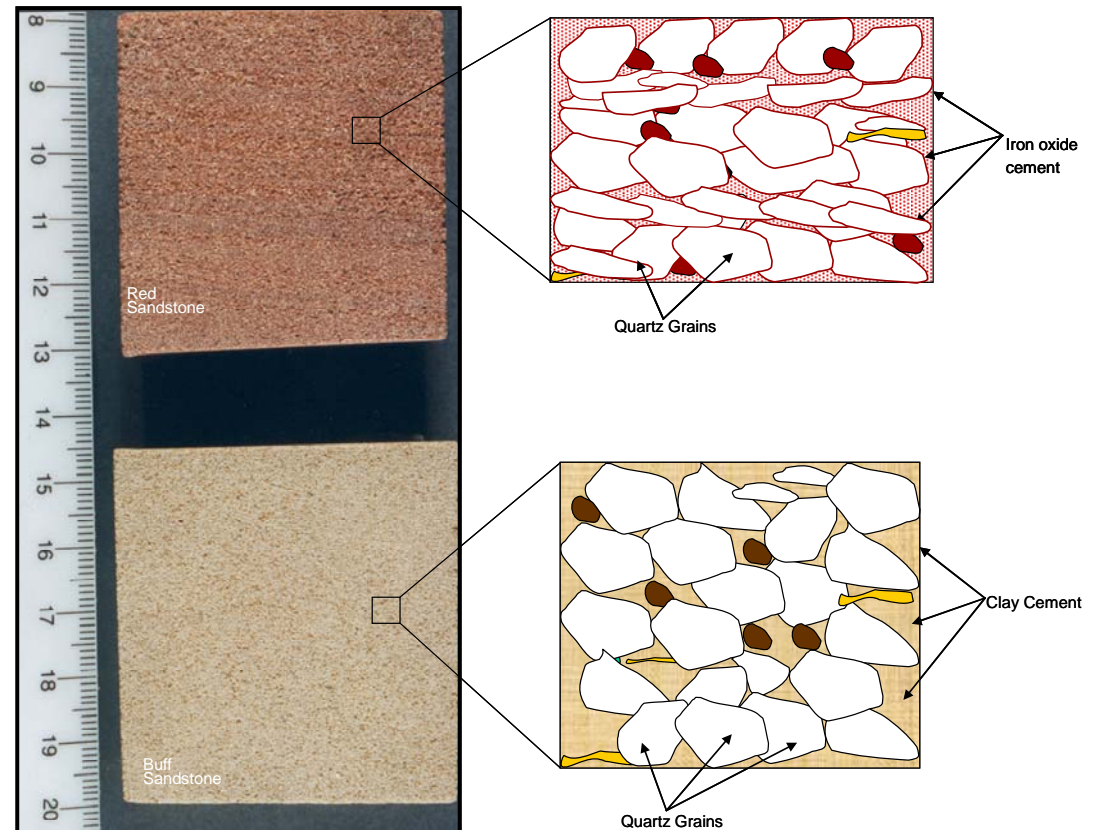
A coarse-grained sedimentary rock (cemented gravel) composed largely of pebbles or other rounded particles whose diameter is larger than 2 mm.



**Breccia**

### Breccia

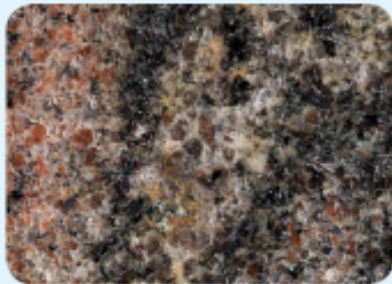
Coarse sedimentary rock consisting of angular or nearly angular fragments larger than 2 mm. Breccia commonly results from processes such as landslides or geologic faulting, in which rocks are fractured.



## Figure?? Foliated Stone Types

The main identifying features of foliated stone types are:

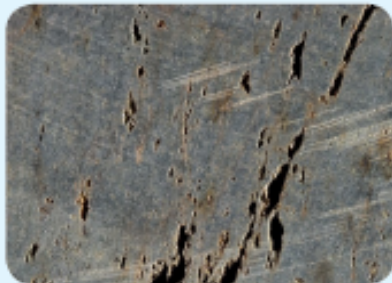
- Alternating dark and light layers that split easily
- Colour: grey-green



**Gneiss**

### **Gneiss**

A banded or foliated coarse-grained metamorphic rock having usually dark and of the same composition as granite.



**Schist**

### **Schist**

Any of various medium-grained to coarse-grained metamorphic rocks composed of laminated, often flaky parallel layers of chiefly micaceous minerals.

## Metamorphic Rocks

These are pre-existing rocks that have been changed by the effects of heat or pressure or both but without melting. Metamorphism ('changed form') of rocks occurs when conditions of heat and pressure change.

These are pre-existing rocks that have been changed by the effects of heat or pressure or both but without melting. These conditions can occur when existing rocks can happen by contact with cooling igneous rocks, or at the edges of tectonic plates, where very high temperatures and pressures occur as mountains are being formed.

Schist, gneiss, slates and marbles are examples of metamorphic rocks.

### Texture

When a rock is metamorphosed the mineral crystals change. Often minerals such as mica become aligned perpendicular to the direction of pressure. When minerals within a metamorphic rock are organized in this way, it is called foliation.

### Chemistry

Metamorphic rocks may have the same chemical composition as other rocks, and this provides evidence for how they were formed. For example, marble is formed from limestone, and both are forms of calcium carbonate.



## Building Stones of Northern Ireland

The main stone types used for building in Northern Ireland are grouped under the following headings:

- Buff-Pink Sandstone
- Red Sandstone
- Conglomerate
- Limestone
- Greywacke
- Basalt
- Granite
- Schist
- Slate
- Marble



Buff Sandstone



Red Sandstone



Conglomerate



Limestone



Greywacke



Basalt



Granite



Schist



Slate



Marble