INVESTIGATING WALL STONE (4)

Categorising Sandstone Minerals

ABSTRACT

A detailed description of the different types of minerals to be found in sandstones and how to go about observing them

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Introduction

This guide is the second of three guides focussing on what may be observed within the Wall stones and how to go about making observations of these different types of rock data. In this guide mineral types will be explored in more detail including how to observe and record these variables.

Categorising Sandstone Minerals

Sandstones have three parts to them. The first part is all the grains (clasts), the sand part of the sandstone. The second is the cement, the bit which holds the grains together and makes sandstone a stone rather than just a clump of grains. The third is the space which is left over – pores.

In this section we will look inside both the grains and the cement that make up sandstone to see what they are made of. We will then look at practical field identification of these minerals.

How these grains came to be in the sandstone and then cemented and what this tells us about rock formation has already been explored.

As with other guidance to collecting data on the Wall stones, we are only looking at sandstones because this is far and away the major type of stone used in constructing the Wall.

Minerals in summary:

Grain types – quartz, feldspar, mica, lithic fragments, mud flakes, metal oxides

Cement – quartz, calcite, iron oxide.

Veins and diagenesis – quartz, calcite, iron oxide

Mineral Grains

Sandstones are so called because they are principally composed of sand grains. The grains are made of hard mineral fragments of which the most common is silica or quartz. This is by virtue of the ubiquity of quartz in rocks such as granites and sandstones which are the primary source of the grains. Quartz is also hard and so able to withstand the forces of physical and chemical erosion better than most other minerals.

Quartz is not the only mineral which can be found in sandstone. Other silicate minerals such as feldspar and mica (commonly) and more rarely garnet, olivine and zircon may be seen. Metal oxides (particularly iron) are not uncommon and native* metals such as copper and gold, unsurprisingly, are rare.

*Native is used geologically to denote metals which are made of a single element e.g. pure gold or pure copper. This is distinct from most ores where the metal is combined to form a mineral oxide (e.g. hematite) carbonate (e.g. malachite) or sulphide (e.g. iron pyrites)

Clay minerals are another group of minerals commonly found between sand grains. The siltier the sandstone the more clay minerals there will be.

Rock fragments, where that rock is exceptionally fine grained, may also make up some of the grains found in sandstone. These may also take the form of mud clasts, where partially consolidated mud or muddy sand is ripped up in a flood and incorporated within the sandstone. These are visible with the naked eye and can be many centimetres across. They are often softer than the surrounding sandstone and will weather out to form pockmarks in the stone.

Carbonates, particularly calcium carbonate in the form of calcite is rare as a grain, though commonly seen as a cement (see below). Sand made from organic calcium carbonate is well known i.e. from shell, coral and other skeletal material. When formed into rocks, however, this sort of material becomes a limestone. Limestones were extremely rarely used as Wall building material and its classification is not considered here.

Recognising Mineral Grains

There are many different mineral types to look out for in the Wall sandstones albeit most of them will be quartz. How can we tell these different mineral types apart? By default, almost all of what you will see will be quartz, so the challenge is identifying those occasional grains which are not. The presence or absence of not-quartz is, however, helpful in classifying the sandstones.

Identifying mineral grains in the field is challenging. Definitive identification is most easily done by making a thin section of the rock and examining it using a polarising microscope. However, there is some identification that can be achieved in the field using the following *properties of the minerals: hardness, colour, lustre, cleavage and fracture.

These properties and how they are used to identify the common minerals found in sandstones are described in summary below. Practical mineralogy is a big subject. Ideally it requires study of hand specimens of individual minerals, looking at sandstones in thin section to see what the grains and cement look like in detail and then comparing them to what is seen in a hand specimen of the same rock. In this way a sense of each mineral is gained – as my old mineralogy tutor would have it in much the same way you get to know your grandmother’s features - and it becomes easier to recognise them.

Hardness is measured on the Moh’s scale of hardness, which runs from 1 (talc) to 10 (diamond). Measuring hardness in the field is challenging as a decent sized grain is required and accurate measurement can only be done using specialist lab-based equipment. Realistically, the only distinction which can be made in the field is between calcite and quartz/feldspar by using a steel point. The steel point is harder that calcite and softer than both quartz and feldspar so will scratch calcite but not quartz or feldspar.

Quartz: Quartz breaks like glass to produce a shiny uneven surface which glints if you catch the sun on it. Grains of quartz appear clear or milky and can look like they have a slightly grey colour, particularly when compared to feldspar or calcite which both have a creamier white colour.

Feldspar: Feldspar has three distinct (rhombic) cleavage planes, which it tends to break along creating flat shiny planes. These planes can be seen by moving the sample around to catch the light and are distinctive. Feldspars commonly form twinned crystals and for some varieties of feldspar (plagioclase) these can be multiple. This twinning causes the cleavage planes to be at a different angle in each twin which makes the plane look striped. This too, is distinctive. Feldspars breakdown chemically more easily that quartz and as well as having a creamier colour than the quartz may have a matt crumbly appearance, particularly if the sandstone has been weathered.

Mica: This is one of the easier minerals to identify. It is a sheet silicate with a single strong cleavage plane so that the mineral is found as tiny flakes with highly reflective surfaces. They glint in the same way that broken quartz does but have a faintly silver/gold colour.

Calcite: this will likely be observed as cement between grains. It is softer than quartz and feldspar and tends to a yellow-cream white colour.

The other minerals mentioned are either too small or too rare to make it useful to complicate this any further and are best identified in thin section.

*Minerals have several other properties, such as density, which are not useful for field identification in sandstones and so not considered here.

Cement

Cementing happens after the grains are laid down as percolating water deposits soluble minerals such as iron, calcium and silica. This process is called diagenesis. Diagenesis causes precipitation (and consequent cementing or staining) of minerals to varying degrees. The degree of cementing and the type of cementing will affect the strength of the sandstone. Sandstones cemented with silica (quartz) tend to be hardest but are less common than those cemented with softer calcite.

Diagenesis is not always even within a given rock. This is manifested as banding in the stone as well as the formation of concretions. Banding is commonly visible in sandstones when formed from iron oxide and produces some beautiful patterns. Concretions are less common and spherical or sub-spherical in form varying in size from a few centimetres to a few metres. Both these phenomena are readily observable without a hand lens.

Cementation is tricky to see in hand specimens particularly if the grains are tightly packed (see categorising sandstone textures).

Pores

Pore space is important to geologists because pores allow the movement and storage of valuable resources such as water, gas and oil. It is also one of the factors that controls how vulnerable a sandstone is to weathering.

It can be measured by looking at thin sections where the cut sandstone is soaked in a blue resin easily observable under the microscope. It can also be ascertained by taking a hand specimen, completely drying it, weighing it, soaking it in water, then weighing it again. The difference will give the weight of water stored by the sandstone from which the volume as a percentage of the hand specimen can be calculated.

For the purposes of the SSD project, field measurements are not possible, so measurement of porosity will be carried out using think section.