



International Course on Stone Conservation SC13

SESSION: Geology and mineralogy of building stone / microscopy, petrography & stone identification

INSTRUCTOR: Graham Lott

TIME: Monday, 22nd April / all day (9:30 - 18:00)

SESSION OUTLINE

ABSTRACT

The session will introduce cause and effect in the weathering and deterioration of building stones at both macro- and micro- levels. The presentation and walking tour will create a general awareness of the issues involved and their inter-relationships so that subsequent presentations will elucidate the issues in more detail.

OBJECTIVES

A wide range of natural stones have been used in historic and modern buildings. We will look at why it is important to understand the principal geological characteristics of the major stone groups – igneous, metamorphic and sedimentary – and consider how they differ one from another. Understanding the geological environments in which natural stones are formed can also give us an insight into their likely strength/durability (how they might weather!) and their natural weaknesses when used in a building or structure. The impact of the natural geological characteristics of the major stone groups will be discussed by following their progress from outcrop/quarry to the building.

CONTENT OUTLINE

Principal rock types – igneous, sedimentary and metamorphic will be discussed and their main characteristics (genesis, mineralogy, bedding styles, jointing, etc) described.

Igneous rock types –

- Intrusives – slow cooling, coarsely crystalline rocks e.g. granites, gabbros, andesites, etc.
- Extrusives – fast cooling, volcanic flows - finely crystalline e.g. basalts, dolerites etc. and violent explosive eruptions - fragmental rocks e.g. volcanic breccias, ignimbrites etc.

Sedimentary rock types -

- Sandstones – non-marine and marine, typical bed forms
- Limestone – marine and non-marine, typical bed forms - calcitic and dolomitic limestones, tufas and travertines, fossiliferous varieties
- Mudrocks - an unlikely building stone?

Metamorphic rock types –

- Slates – cleavage
- Marbles – limestones altered by heat and pressure (metamorphosed)
- Other rock types



SESSION OUTLINE CONT'D

Quarrying of stones – igneous, metamorphic and sedimentary rocks – how do the natural geological features of rocks impact on methods of quarrying, block size, etc and general usage in a structure.

Petrographic characteristics of representative stones

Examples using thin section images of typical sandstones, limestones and igneous rocks.
How are modern thin sections made – use of stains and dyes to identify different mineral phases.
Fully illustrated discussion of their rock framework mineralogy, cementation / porosity patterns, matrix content etc. and other features which can influence their suitability as a building stone.

Porosity and permeability of some typical building stones – Thin section and Scanning Electron Microscopy (SEM Imagery)

Chemical composition of some representative stones – X-ray Diffraction, Electron Microprobe etc.
General discussion of techniques available and the uses to which they can be put in the building stone field.

Practical Laboratory work (Hand Lens required, dilute HCl acid needed to test limestone required).

Using hand specimens from the local collections describe a selection of specimens from each of the main rock groups:

Igneous - granite, basalt

Sedimentary – sandstones and limestones (calcitic and dolomitic varieties)

Metamorphic – slates and marbles

Systematically record their main petrographic features – colour, grain-size, texture, sedimentary structures, cleavage etc

READINGS

 = Essential reading material

 = Available online

Adams, A.E., MacKenzie, W.S. & Guilford. 1984. *Atlas of Sedimentary Rocks under the microscope*. Prentice Hall.

Adams, A.E. and Mackenzie, W.S. A Colour Atlas of Carbonate Sediments and Rocks under the Microscope. Manson Publishing.

Flügel, E. A. 2010. *Microfacies of Carbonate Rocks*. Springer.

Grotzinger, J., Jordan, T.H., Press, F. & Siever, R. 2006. *Understanding Earth*. (5th Edition). Freeman and Co. Ltd.

MacKenzie, W.S., Donaldson, C.H. & Guilford, C. 1982. *Atlas of Igneous Rocks and their textures under the microscope*. Prentice Hall.

MacKenzie, W.S. & Guilford, C. 1980. *Atlas of Rock Forming Minerals in Thin Section*. Prentice Hall.

Tucker, M.E. 2009. *Sedimentary petrography: An introduction to the Origin of Sedimentary Rocks*. John Wiley & Sons.



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