英汉对照 地质学中的分类指南 张疆

A GUIDE TO CLASSIFICATION IN GEOLOGY

J. W. MURRAY

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A GUIDE TO CLASSIFICATION IN GEOLOGY

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Author's Preface

Most professional geologists have specialist knowledge of only part of the subject. When they read papers outside their field of specialisation they may encounter problems with unfamiliar terminology. The problem is even greater for students and amateurs who are in the process of building up their knowledge. The majority of modern textbooks concentrate primarily on processes and mechanisms of producing rocks. My aim has therefore been to provide a precis of the classification systems in common use in geology in the hope that this small book will prove a useful source of reference.

I wish to thank Mr Ellis Horwood for encouraging me to write this book and Mrs G. F. Murray for typing the manuscript. Professor D. T. Donovan, Mr P. Grainger and Dr M. Stone kindly offered comment on various chapters.

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Chapter 1

Introduction

To classify is defined as 'to arrange or distribute in classes according to a method or system' (*Shorter Oxford English Dictionary*). Accepting this definition, a classification does three basic things:

- it sets out criteria for distinguishing between the items being classified
- it allows grouping of similar items in an hierarchical scheme of classes
- it establishes a scheme of nomenclature.

In geology, classification plays an important role in the organisation of data. Rocks and structures need to be defined by standard schemes of nomenclature in order to assist communication between geologists. There have been many attempts to standardise nomenclature, but not all classification schemes are universally accepted. This proliferation of systems presents no problems so long as authors state clearly which classification scheme they are using. Moreover, it is doubtful whether it is desirable or necessary to employ a totally standard classification system, as new research inevitably reveals alternative ways of approaching the same problem.

Some geologists believe that the ideal classification is one that is purely descriptive. However, many geological classifications are genetic. For instance, rocks are classified, according to the mode of formation, into igneous, sedimentary, and metamorphic classes. In many cases individual rock names not only describe the rock but also define their chemical composition, texture and grain size, and the environment of formation, for example, quartz arenite, a sedimentary rock composed of detrital grains 0.0625 - 2 mm in diameter, more than 95% of which are quartz.

With so many variables involved it is not surprising that different authors place greatest emphasis on different variables, which in turn leads to disagreement. Thus, the term 'greywacke' fell into disrepute because it meant different things to different people: to some it was a muddy sandstone whereas to others the product of a turbidity current. However, not all muddy sandstones are the product of turbidity currents, and not all turbidity currents deposit muddy sand. The problem can be solved by using 'greywacke' for a muddy sandstone and, for those laid down by turbidity currents, by using the term 'turbiditic greywacke.'

Some classifications, although founded on sound logic, have not been accepted, often because they involve cumbersome terminology. The ideal classification is simple to use, provides a workable system of nomenclature, and is acceptable to those using it. Chapters 2 - 7 represent a compilation of those classifications proposed by international working parties (for example, igneous rocks) and others commonly used. No attempt has been made to include all available classification schemes.

Chapter 2

Sediments and sedimentary rocks

Sediment: an unconsolidated deposit of either detritus derived from pre-existing rock or new minerals formed by chemical or biochemical processes or organically formed materials.

Sedimentary rock: a lithified sediment, including those sediments which have undergone total mineralogical reorganisation under conditions of low temperature and low pressure (but excluding true metamorphism).

2.1 MAJOR GROUPS OF SEDIMENTARY ROCKS

A commonly used subdivision is as follows:

Terrigenous deposits - composed of detrital transported material.

Volcanic sedimentary deposits - composed of fragmented volcanic material extruded penecontemporaneously with sediment deposition. Sometimes this group is termed 'pyroclastic' but this type is only one of several volcanic sedimentary deposits.

Residual deposits - left after chemical weathering of rock, for example laterite.

Organic deposits - composed of the remains of plants or animals (all limestones are conveniently included here even though some contain only a low organic component).

Chemical precipitates - notably evaporite mineral deposits whether primary or secondary (diagenetic) in origin.

An additional category has been added here to cater for process name rock types and deep sea sediments.

2.2 TERRIGENOUS SEDIMENTS AND ROCKS

Terrigenous sediments consists of the detritus of pre-existing rocks which has been produced by weathering (physical and chemical), has been transported by wind, water or ice, has suffered varying degrees of abrasion, and is finally deposited.

The processes of lithification include compaction, cementation, and the chemical and mineralogical alteration of unstable minerals, for example feldspars being altered to clays.

The classification of terrigenous sediments and rocks is based on their composition and grain size.

The principal components are fragments (clasts) of rock, quartz and feldspar, together with clay minerals.

Grain size varies from boulder to clay (Figs. 2.1 and 2.2)

2.2.1 Rudites - conglomerates and breccias

These are made up of clasts >2 mm in diameter.

Gravels and conglomerates

In the majority of cases the clasts are derived from a variety of source rocks separate from the site of deposition (extraformational). However, in some instances penecontemporaneous reworking of a sediment during deposition produces cohesive fragments which are redeposited (intraformational).

Φ	diameter mm	Particle		Size Terms (rock group name)		Common types of terrigenous sediment
- 8	256	Boulder	Gravel	Rudaceous (rudite)	Psephitic (psephite)	Conglomerate or breccia
- 6	64	Cobble				
- 2	4	Pebble				
- 1	2	Granule				
0	1	Very coarse sand		Arenaceous (arenite)	Psammitic (psammite)	Sandstone
1	0.5	Coarse sand				
2	0.25	Medium sand				
3	0.125	Fine sand				
4	0.0625	Very fine sand				
8	0.0039	Silt				Siltstone
		Clay		Argillaceous or Lutaceous (lutite)	Pelitic (pelite)	Mudstone

Fig. 2.1 – Sedimentary size grades and terms. The Φ (phi) scale is a logarithmic transformation of the Wentworth scale: $\Phi = -\log_2 d$, where d is the diameter in mm (Krumbein, 1934, 1936). Particle data after Wentworth (1922).

	Rock types		
Rudite	Conglomerates	Normal, 4 - 64 mm	
Rudite	Conglomerates	Fine, <4 mm	
Rudite	Conglomerates	Sandy, >20% sand	
Rudite	Conglomerates	Clayey, >20% clay	
Arenite	Sandstones	Conglomeratic, >20% pebble	
Arenite	Sandstones	Pebbly, 10 - 20% pebbles	
Arenite	Sandstones	Normal	Very coarse, 1 - 2 mm
Arenite	Sandstones	Normal	Coarse, 0.5 - 1 mm
Arenite	Sandstones	Normal	Medium, 0.25 - 0.5 mm
Arenite	Sandstones	Normal	Fine, 0.125 - 0.25 mm
Arenite	Sandstones	Normal	Very fine, 0.063 - 0.125 mm
Arenite	Sandstones	Silty, >20% silt	
Arenite	Sandstones	Clayey, >20% clay	
Arenite	Fine clastics	Sandy siltstones, >20% sand	
Arenite	Fine clastics	Siltstone	
Lutite	Fine clastics	Silty shale	
Lutite	Fine clastics	Shale	

Fig. 2.2 – Classification of terrigenous rocks based on grade size (after Krynine, 1948).