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GRAINSIZE SCALES FOR MACROSCOPIC AND MICROSCOPIC ROCK STUDIES

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CONTENTS

INTRODUCTION

Grainsize is one of the most important characteristics of sedimentary rocks.

Descriptive grainsize terms, e.g. very coarse, coarse, medium, fine, very fine, are adequate for visual examination of sediments, but when it comes to a quantitative study the descriptive terms must be defined in a precise fashion and expressed in units of measurement.

The accompanying Tables 1 and 1a are the result of the author's experience in precise grainsize determination during petrologic and petrographic studies of sediments. The grainsize scales presented in the two tables apply equally well to the mechanical analysis of sediments and to studies by means of stereoscopic and polarizing microscopes. The section on microscopic grainsize scales can also be used in petrologic studies of non-sediments.

GRAINSIZE CLASSIFICATION OF SEDIMENTS

The measurement of grainsize is a precise operation, and the basic requirement is the choice of an appropriate scale. The grainsize scale devised by Udden (1914) is based on the constant ratio of 2 between successive classes. Wentworth (1922) gave specific names to various grainsize classes or intervals, and Krumbein (1938) devised the "ϕ" scale which is a logarithmic transformation of the Wentworth scale; because of simplified mathematical computations the "ϕ" scale has found preference for grainsize expression.

The predominant size of particles of which the rock is composed is the basis for subdivision into three types - GRAVEL, SAND, and MUD. The following grade names which have historical precedence and general authoritative acceptance (Twenhofel & Tyler, 1941; Pettijohn, 1957; and Folk, 1968) are proposed for each rock type:

Cobble is defined as 'a detached rock mases, somewhat rounded or otherwise modified by abrasion in transport with a size between size 64 and 256 mm'.

Pebble is a 'rock fragment larger than a coarse sand grain or granule and smaller than a cobble, which has been rounded or otherwise abraded by the action of water, wind, or glacial ice'. (Pettijohn, 1957) It is between 4 and 64 mm in diameter.

Gravel is an unconsolidated accumulation of pebbles, cobbles, or boulders and may be designated as pebble-gravel, cobble-gravel, etc. The consolidated equivalent is conglomerate, likewise designated pebble-conglomerate, etc.

Sand is the term used to denote an aggregate of mineral or rock grains greater than 1/16 mm and less than 2 mm in diameter. The term arenite may be used instead of sand (as in Pettijohn, 1957, p.16). It is a descriptive term for clastic material of sand size without genetic or mineralogical connotations (Crook, 1960).

Mud comprises silt and/or clay, silt being an aggregate of fine-grained rock material greater than 1/128 mm and less than 1/16 mm in diameter; the clay fraction, being less than 1/16mm, is usually analysed by hydrometer or pipette method.

These terms may require finer distinction, e.g. very coarse sand, coarse sand, medium sand, fine sand. Consolidated equivalents are conglomerate, claystone, sandstone, siltstone.

NOTES ON THE USE OF TABLES 1 AND 1a

- Stereoscopic Microscope "NIKON SMZ" 10X Eyepieces - ZOOM

Example 1. A grain measures 16 graticule spaces under 0.8X objective.

∴ 16 graticule spaces = 2 mm; - 1ϕ.

Example 2. A grain measures 2.5 graticule spaces under 2.0X objective.

∴ 2.5 graticule spaces = $\frac{1}{8}$ mm; 0.125 mm; 125 micrometers; + 3ϕ.

- Polarizong Microscope "Leitz Laborlux" Binocular Head, 10X Eyepieces

Example 1. A grain measures 25 graticule spaces under 10.0X objective.

∴ 25 graticule spaces = $\frac{1}{4}$ mm; 0.25 mm; 250 micrometres; + 2ϕ.

Example 2. A grain measures 30 graticule spaces under 100.0X objective.

∴ 30 graticule spaces = 1/32 mm; 0.031; 31 micrometres; + 5ϕ.

NOTE: Same method as above applies to Table 1a where the polarizing microscope has the 8.0X eyepieces.

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TABLE I

GRAIN SIZE SCALES FOR MACROSCOPIC AND MICROSCOPIC ROCK STUDIES

MODIFIED WENTWORTH SCALE			EQUIV SCALES			SIEVE SIZES		MICROSCOPE CALIBRATIONS									
								Stereoscopic Microscope "Nikon SMZ" No. 38176 c.w. 10x eyepieces "Zoom"					Polarizing Microscope "Leitz Laborlux" No. 562482 c.w. binocular head, 10x eyepieces					
"Type"	Grade Name					B.S.S.	U.S. Stand. (ASTM)	OBJECTIVES					OBJECTIVES					
		mm	mm	micron	phi Ø	mesh	mesh	0·8 x	1·0 x	2·0 x	3·0 x	4·0 x	3·5 x	6·0 x	10·0 x	25·0 x	50·0 x	100·0 x
GRAVEL	Cobble	64	64		-6						Field of View (mm)		4·2	2·5	1·25	0·6	0·3	0·15
	Very Coarse Pebble	32	32		-5													
	Coarse Pebble	16	16		-4													
	Medium Pebble	8	8		-3			64	80									
	Fine Pebble	4	4		-2	5	5	32	40	80								
	Granule	2	2		-1	8	10	16	20	40	60		70					
SAND	Very Coarse Sand	1	1		0	16	18	8	10	20	30	40	35	60	100			
	Coarse Sand	1/2	0·5	500	+1	30	35	4	5	10	15	20	17	30	50			
	Medium Sand	1/4	0·25	250	+2	60	60	2	2·5	5	8	10	8	15	25	65		
	Fine Sand	1/8	0·125	125	+3	120	120	1	1·2	2·5	4	5	4	8	12	32	60	
	Very Fine Sand	1/16	0·062	62·5	+4	240	230	0·5	0·6	1·2	2	2·5	2	4	6	16	30	60
MUD (clay-silt)	Coarse Silt	1/32	0·031	31	+5					0·6	1	1·2	1	2	3	8	15	30
	Medium Silt	1/64	0·015	15	+6						0·5	0·6	0·5	1	1·5	4	8	15
	Fine Silt	1/128	0·008	8	+7							0·3		0·5	0·7	2	4	8
	Very Fine Silt	1/256	0·004	4	+8											1	2	4
	Coarse Clay	1/512	0·005	2	+9											0·5	1	2
	Medium Clay	1/1024	0·001	1	+10												0·5	1
	Fine Clay						ANALYSED BY HYDROMETER OR PIPETTE											

Compiled by S.Ozimic 1975

TABLE 1a

GRAIN SIZE SCALES FOR MACROSCOPIC AND MICROSCOPIC ROCK STUDIES

MODIFIED WENTWORTH SCALE		EQUIV SCALES				SIEVE SIZES		MICROSCOPE CALIBRATIONS									
								Stereoscopic Microscope "Nikon SMZ" No. 38176 c.w. 10x eyepieces "Zoom"					Polarizing Microscope "Leitz Laborlux" No. 562482 c.w. binocular head, 8x eyepieces				
"Type"	Grade Name					B.S.S.	U.S. Stand. (ASTM)	OBJECTIVES					OBJECTIVES				
		mm	mm	micron	phi Ø	mesh	mesh	0·8 x	1·0 x	2·0 x	3·0 x	4·0 x	3·5 x	6·0 x	10·0 x	25·0 x	50·0 x	100·0 x
GRAVEL	Cobble	64	64		-6						Field of View (mm)		3·3	1·75	1·00	0·87	0·43	0·22
	Very Coarse Pebble	32	32		-5													
	Coarse Pebble	16	16		-4													
	Medium Pebble	8	8		-3			64	80									
	Fine Pebble	4	4		-2		5	32	40	80								
	Granule					5												
		2	2		-1	8	10	16	20	40	60		64					
SAND	Very Coarse Sand	1	1		0	16	18	8	10	20	30	40	32	60	100			
	Coarse Sand	1/2	0·5	500	+1	30	35	4	5	10	15	20	16	30	50	120		
	Medium Sand	1/4	0·25	250	+2	60	60	2	2·5	5	8	10	8	15	25	60	120	
	Fine Sand	1/8	0·125	125	+3	120	120	1	1·2	2·5	4	5	4	8	12	30	60	120
	Very Fine Sand	1/16	0·062	62·5	+4	240	230	0·5	0·6	1·2	2	2·5	2	4	6	15	30	60
MUD (clay-silt)	Coarse Silt	1/32	0·031	31	+5					0·6	1	1·2	1	2	3	8	15	30
	Medium Silt	1/64	0·015	15	+6						0·5	0·6	0·5	1	1·5	4	8	15
	Fine Silt	1/128	0·008	8	+7							0·3		0·5	0·7	2	4	8
	Very Fine Silt	1/256	0·004	4	+8											1	2	4
	Coarse Clay	1/512	0·005	2	+9											0·5	1	2
	Medium Clay	1/1024	0·001	1	+10												0·5	1
	Fine Clay						ANALYSED BY HYDROMETER OR PIPETTE											

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