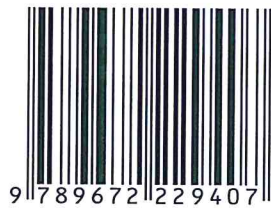


ISBN 978-967-2229-40-7



9 789672 229407



UNIVERSITI  
MALAYSIA  
KELANTAN

**FACULTY OF EARTH SCIENCE  
UNIVERSITY MALAYSIA KELANTAN**

**Kampus Jeli**

**Beg Berkunci (Locked Bag) No. 100  
17600 JELI, KELANTAN, MALAYSIA**





UNIVERSITI  
MALAYSIA  
KELANTAN

# MANUAL OF FIELD GEOLOGY

**Arham Bahar  
Nor Shahida Shafie  
Wani Sofia**

# **MANUAL OF FIELD GEOLOGY**

Arham Muchtar Achmad Bahar  
Wani Sofia Udin  
Nor Shahida bt Shafiee

Copyright UMK PRESS, 2019

All rights reserved. No part of this publication may be reproduced, stored in production transmitted in any form, whether electronic, mechanical, photocopying, recording or otherwise, without having permission from the **UMK Press**.

Book title: Manual of Field Geology

ISBN No.:

Graphic:

Arham Muchtar Achmad Bahar

Published by:

UMK Press Universiti Malaysia Kelantan

Office of Library and Knowledge Management

Locked Bag 36, Pengkalan Chepa,

16100 Kota Bharu, Kelantan

In Collaboration:

Faculty of Earth Science

Universiti Malaysia Kelantan

# TABLE OF CONTENT

---

LIST OF FIGURES	7
LIST OF TABLES	9
ACKNOWLEDGEMENT	10
PREFACE	11
CHAPTER 1 INTRODUCTION	12
1.1 Educational Goals:	12
1.2 Why Should Students "Do Geology" in the Field?	13
CHAPTER 2 GEOLOGICAL MAPPING GUIDANCE	15
2.1 Working Steps	15
CHAPTER 3 GENERAL PROCEDURES AND GUIDELINES IN FIELD GEOLOGIC MAPPING	16
3.1 Equipment and materials	16
3.2 Safety in the Field	16
3.3 Field Note Book Format & Main Notes	19
CHAPTER 4 GEOLOGICAL MAPS	21
4.1 Types of Geological Map	21
CHAPTER 5 TOPOGRAPHIC MAP	23
5.1 Contour Lines	25
5.2 Reference Datum	26
5.3 Map Projections	28
5.4 Map Projection Distortions	29
5.5 Grid Systems	31
5.6 Geographic Coordinate System	32
5.7 UTM - Universal Transverse Mercator Geographic Coordinate System	35
5.8 Vertical Scale	37
5.9 Creating Topographic Profiles	39
5.10 Vertical Exaggeration	42
5.11 Calculating a Slope	43
5.12 Using a Compass with a Map	45
5.13 Magnetic Declination	46
5.14 Setting Magnetic Declination on Your Compass	47
5.15 Get a Bearing	48

5.16	Measuring A Bearing	49
5.17	Going From Point "A" to "B"	51
5.18	Finding Self on a Map	52
<b>CHAPTER 6 METHODS OF GEOLOGICAL MAPPING</b>		<b>54</b>
6.1	Traversing	54
6.2	Following Contacts	54
6.3	Exposure or Green Line Mapping	55
6.4	Mapping in Poorly Exposed Regions	55
6.5	Superficial Deposits	56
6.6	Drilling	56
6.7	Geophysical Aids to Mapping	56
6.8	Large-scale Maps of Limited Areas	57
6.9	Photogeology	57
6.10	Field Traverse Line & Order Of Information Record	59
6.11	Preliminary (Reconnaissance) Field Work	60
6.12	Outcrop Analysis And Record	60
6.13	Sampling	61
6.14	Field Sketches And Photographs	62
6.15	Compilation of Field Data	62
6.16	Rock-Forming Minerals	63
6.17	Quartz	63
6.18	Potassium Feldspar	64
6.19	Plagioclase feldspar	64
6.20	Olivine	64
6.21	Pyroxene	65
6.22	Amphibole	65
6.23	Mica	65
6.24	Calcite and Aragonite	66
<b>CHAPTER 7 PROCEDURES AND GUIDELINES IN IGNEOUS ROCK TERRAIN MAPPING</b>		<b>68</b>
7.1	Remote sensing studies	68
7.2	Steps Of Outcrop Analysis In Igneous Rock	68
7.3	Textures In Igneous Rocks	69

CHAPTER 8	PROCEDURES AND GUIDELINES IN VOLCANIC ROCK TERRAIN MAPPING	73
8.1	Remote Sensing Studies	73
8.2	Steps of Outcrop Analysis In Volcanic Lava Flows	73
8.3	Steps Of Outcrop Analysis In Pyroclastic Volcanic Rocks	73
CHAPTER 9	PROCEDURES AND GUIDELINES IN SEDIMENTARY ROCK TERRAIN MAPPING	75
9.1	General Field Working Steps & Observation Record	75
9.2	Steps of Outcrop Analysis In Clastic Sedimentary Sequence	76
9.3	Sedimentary Rock Texture:	78
9.3.1	Grain size:	78
9.3.2	Roundness and Sorting:	79
9.4	Steps Of Outcrop Analysis In Calcareous Sedimentary Sequence	81
CHAPTER 10	GUIDELINES FOR FIELD IDENTIFICATION & NAMING OF LITHOSTRATIGRAPHIC UNITS	84
10.1	Procedures For Establishing Lithostratigraphic Unit	84
10.2	Lithostratigraphic Rank Terms	84
10.3	Miscellaneous Lithostratigraphic Ranking Terms	85
10.4	Procedures For Extending Lithostratigraphic Units And Correlation	86
CHAPTER 11	PROCEDURES AND GUIDELINES IN METAMORPHIC ROCK TERRAIN MAPPING	88
11.1	General Field Working Steps & Observation Record	88
11.2	Outcrop analysis and record of lithologic data	88
CHAPTER 12	PROCEDURES AND GUIDELINES IN GEOLOGY STRUCTURE TERRAIN MAPPING	92
12.1	Outcrop Analysis And Record Of High Deformation Zones	92
12.2	Orientation Description	93
12.3	Fold Fracture	95
12.3.1	Fold Geometries and Morphology	95
12.3.2	Fold Scale and Attitude	98
12.3.3	Elements of Fold Style (form description)	99
12.3.4	Scaling and Order of Folds (fractal approach to fold scale)	101
12.3.5	Structural Associations of Folds	101
12.4	Faults Structure	102
12.4.3	Terminology	102



12.4.3	Recognition of Faults	104
12.4.3	Determination of Fault Displacement	107
12.5	Fractures Structure	108
12.5.1	Fractures = Brittle Rupture Of Rock Medium In Response To Stress	108
12.5.2	Terminology	109
12.5.3	Types of Fractures	109
12.5.4	Joints Structure	110
12.5.5	Outcrop Pattern	111
CHAPTER 13	GEOMORPHOLOGICAL MAPPING	113
13.1	Landform Unit	113
13.2	Drainage Pattern	117
CHAPTER 14	FOSSIL IDENTIFICATIONS	119
14.1	Tips on Collecting Fossils	119
14.2	Tools for Collecting Fossils	119
14.3	Where To Look For Fossils?	120
14.4	General Guide To Fossil Identification And Paleoecology	121
14.4.1	Phylum Arthropoda	121
14.4.2	Phylum Brachiopoda	122
14.4.3	Phylum Bryozoa	122
14.4.4	Phylum Cnidaria	123
14.4.5	Phylum Echinodermata	124
14.4.6	Phylum Mollusca	124
14.4.7	Phylum Hemichordata, Class Graptolithina	125
14.4.8	Phylum Porifera, Class Stromatoporoidea	125
14.4.9	Phylum Incertae Sedis, Class Tentaculoidea	126
14.4.10	Fossil Plants	126
CHAPTER 15	GEOLOGIC TIME SCALE	129
CHAPTER 16	INDEX FOSSILS	130
CHAPTER 17	UNIT AND CONVERSION	131
REFERENCES		132

## LIST OF FIGURES

NO.	TITLE	PAGE
2.1	Working steps in conducting geological mapping	15
5.1	Elevation layer on topographic map	23
5.2	Title of topographic map quadrangle	24
5.3	Contour line on topographic map	25
5.4	Illustration of reference datum	26
5.5	Example of datum	27
5.6	A piece of paper to represent earth surface	28
5.7	Types of projection surface	29
5.8	Types of map projections	30
5.9	A simple grid with point of interest	32
5.10	Geographic coordinate system	32
5.11	Map grid with location of point on the map	34
5.12	Transverse Mercator projection	35
5.13	UTM projection system	36
5.14	Contour line symbols	38
5.15	Cross profile line	40
5.16	Corresponding elevation on graph paper	41
5.17	Topographic profile line	42
5.18	Vertical exaggeration	43
5.19	Slope calculation	43
5.20	Parts of Compass	45
5.21	Magnetic declination	46
5.22	Magnetic North	46
5.23	Bearing shown on compass	48
5.24	Compass bearing quadrant	49
5.25	Bearing reading	50
5.26	Bearing between A and B	51
5.27	Point of bearing intersection	53
6.1	Bowen reaction series chart	66
7.1	Methamorphic rock occurrence	69
7.2	Igneous rock	70
7.3	QAP diagram	71
7.4	Sedimentary rock symbol	71
8.1	Classification of volcanoclastic sediment	74
9.1	Roundness and sorting chart	79
9.2	The Pettijohn classification of sandstones, often referred to as a 'Toblerone plot' (Pettijohn 1975)	79
9.3	Sedimentary structure	80

9.4	Folk's carbonate rock classification system (after Folk, 1959).	81
9.5	Bedding thickness terminology	83
11.1	Scheme for metamorphic Rock Identification	90
11.2	Grade of metamorphism	90
11.3	Facies of metamorphism	91
12.1	Strike and dip determination	94
12.2	Plunge of bed	94
12.3	Right hand method	95
12.4	Fold geometric classification diagram	97
12.5	Ramsay's Fold Classification	100
12.6	Structural association of fold	102
12.7	Dynamic interpretation of fault	104
12.8	Slicken sides	105
12.9	Morphological form of fault	106
12.10	V-Rules,V Shape outcrop pattern (Planar layer)	111
12.11	Lithological boundary drawing	112
13.1	Drainage pattern	118
14.1	Phylum Arthropoda	122
14.2	Phylum Brachiopoda	122
14.3	Phylum Bryozoa	123
14.4	Phylum Cnidaria	123
14.5	Phylum Echinodermata	124
14.6	Phylum Mollusca	125
14.7	Phylum Hemichordata Class Graptolitina	125
14.8	Phylum Porifera Class Stromatoporoidea	126
14.9	Phylum Sedia Class Tentaculoidea	126
14.10	Lycopods species	127
14.11	Species of Seed fern	127
14.12	Species of Cycads	127
14.13	Fossil Identification chart	128
16.1	List of index fossils	130

## **LIST OF TABLES**

---

<b>NO.</b>	<b>TITLE</b>	<b>PAGE</b>
6.1	Mohs Hardness Scale	67
7.1	Igneous rock chart	72
9.1	Sedimentary rock identification chart	77
9.2	Grain size chart	78
9.3	Minerals in sedimentary rock	80
9.4	Classification of carbonate rock (Folk, 1959)	82
9.5	Classification of carbonate rock (Dunham, 1962)	82
9.6	Symbols for lithology, sedimentary structures and fossils for use in a graphic log	83
10.1	Form for lithostratigraphic section logging	87
15.1	Geologic time scale	129
17.1	Conversion table	131

## **ACKNOWLEDGEMENT**

---

We wish to acknowledge the contribution and guidance of all academic staffs from the Department of Geoscience, Faculty of Earth Science, Universiti Malaysia Kelantan, Jeli Campus during the preparation of this book. Deepest acknowledgement is also extended to the students of Geoscience Programme, Faculty of Earth Science for giving comments and sharing experience while preparing their geological mapping report that help us to improve the guideline. Lastly, we would also like to express our gratitude to all individual who have involved directly and indirectly in preparation of this book.

## **PREFACE**

---

This document is prepared as a guideline for the writing of the Basic Geological Report which will be conducted by the students of Bachelor of Applied Science (Geoscience) in Semester 4. It is meant to be kept in camp with you and even carried in the field. In addition, because no piece of geological mapping can be considered complete until the geology has been interpreted and explained. A report explaining the geology is an essential part of any field project and a brief chapter on the essentials for writing and illustrating it concludes this book. Some emphasis, too, is given to paleontological reference because many reports lack of those detailed which can often explain complex aspects of the geology that cannot be shown on the scale of the field map being used, and which are difficult to describe in words. It is assumed that readers of this book have already had at least one year of university or equivalent geology, and have already been told what to look for in the field. Geological mapping cannot, however, be taught in lectures and the laboratory: it must be learnt in the field. Unfortunately, only too often, trainee geologists are left largely to their own devices, to sink or swim, and to learn to map for themselves with a minimum of supervision on independent mapping projects. It is hoped that this book will help them in that task.

Arham Muchtar Achmad Bahar  
Wani Sofia Udin  
Nor Shahida bt Shafiee