

Man's Dependence on the Earth

The Role of the Geosciences in the Environment

Edited by

A. A. ARCHER, G. W. LÜTTIG and I. I. SNEZHKO

Authors:

A. ARCHER, U.K., Chapter 3; J. BOUMA, Netherlands, Chapter 8; H. COLENBRANDER, Netherlands, Chapter 7; G. J. GONI, France, Chapter 11; G. LÜTTIG, F.R.G., Chapters 5, 6 and 12; B. MOLDAN, CSSR, Chapter 9; V. ŠIBRAVA, UNESCO, Chapter 13; I. SNEZHKO, UNESCO, Chapters 1, 2, 4 and 10.

Based on papers of the Working Group: "Lithosphere: economic development and the environment"

with contributions from O. GORBATYUK, K. P. KAVOUN, G. KULIKOV, O. KUZNETSOV, E. MILANOVSKY, A. OPALOVSKY, M. POLKANOV, L. RASTSVETAEV, A. A. SCHPACK, A. SECH-
EVITSA, A. SHEKO, G. S. VARTANYAN, Z. S. YAZVIN, I. S. ZEKSTER (USSR); J. BIGNON, R.
BISCALDI, R. BLOISE, G. DUFOR, A. GAUDICHET, G. MARGAT, G. MONCHAUX (France); M.
LANGER (FRG).

Project FP/1107-79-04 "Protection of the Lithosphere as a component of the Environment"



Unep, Nairobi



Unesco, Paris

Schweizerbart'sche Verlagsbuchhandlung
(Nägele u. Obermiller) Stuttgart



Contents

Preface

Introduction

1. Introducing the Earth	1
Basic Facts	2
The Lithosphere	3
The Composition of the Crust	3
Igneous Rocks	5
Sedimentary Rocks	6
Metamorphic Rocks	7
Structure and Distribution of Continental and Oceanic Rocks	7
The Natural Geological Processes	9
The Atmosphere and the Hydrosphere	13
The Biosphere	17
References	18
2. The Natural Systems of the Environment	19
Rock and Water Cycles	20
Major Geochemical Cycles	23
Geophysical Fields	25
Radiation	26
Energy Systems	27
Natural Systems and the Environment	28
References	30
3. The Pursuit of Geology	31
The Geological Map	32
The Roles of Geophysics	35
The Roles of Geochemistry	38
The Earth Science Laboratories	41
The Conclusion	41
4. Man's Impact on the Geosphere	43
Population Growth and Development Needs	44
The Impact of Towns	47
Man's Effects	49
The Impact of the Minerals Industry	50
Impact of Water Use	53
Impact of the Use of Energy	54
The Effect of Chemicals	60
A Synoptic View and the Future	61
References	62
5. Mineral Resources	63
Introduction	64
Consumption and Production	69
Resources and Reserves	71
Accessibility, Lifetime	73
The Geography of Mineral Production	75
Integrated Use of Raw Materials	79

Future Trends	80
References.....	81
6. Energy Resources	83
Introduction.....	84
The Non-Renewable Resources.....	85
The Renewable Resources.....	88
Fuel Consumption.....	93
The Resources	94
Resources in Developing Countries	96
Future Strategy	97
Oil and Natural Gas.....	98
Tar Sands and Bituminous Shale.....	98
Hard Coal.....	98
Lignite.....	99
Peat	99
Uranium	99
Thorium	99
Geothermal Energy	99
Solar Energy	100
Wind Power.....	100
Water Power.....	100
Biomass.....	100
References.....	101
7. Groundwater Resources	103
The Groundwater Regime	104
Groundwater and the Hydrological Cycle.....	106
Groundwater and its Significance	109
Groundwater Quality.....	111
The Assessment and Management of Groundwater Resources.....	113
References.....	115
8. Soil Resources	117
The Background	118
Some Basic Soil Properties	119
Some Major Soil Types	122
Production of Crops.....	123
Soil Improvement: Fertility.....	125
Soil Improvement: Drainage.....	126
Soil Improvement: Irrigation	128
Soil Deterioration: Erosion.....	129
Soil Deterioration: Desertification	130
Soil Deterioration: Salinization	131
Soil Deterioration: Compaction	131
Urbanization.....	132
Soil Pollution.....	133
Conclusions	134
References.....	134
9. Geochemical Aspects	137
The Geochemical Environment.....	138
Basic Processes.....	140
The Carbon Cycle.....	143
The Nitrogen Cycle	144
The Sulphur Cycle	145
The Free Oxygen Cycle.....	145
The Phosphorus Cycle.....	146

The Calcium Cycle	147
Minor Chemical Elements and Toxic Substances.....	147
Organic Chemicals	150
Ionizing Radiation	151
Pollution: The Disturbance of Geochemical Balances.....	152
Acidification.....	152
References.....	154
10. The Use of Underground Space	157
Underground Storage.....	158
Underground Waste Disposal.....	159
Radioactive Waste.....	161
References.....	167
11. Human Health	169
Introduction.....	170
Pathological Effects of Mineral Dusts.....	173
Analytical Methods.....	178
Practical Applications of Analytical Methods	183
Regulation	183
Conclusion	184
References.....	185
12. Geology and Land-Use Planning	187
Some Problems of Land-Use Planning.....	188
Geological Maps, the Land-Use Planner's Pre-Requisite	190
What the Land-Use Planner Needs to Know	191
The Role of the Geologist	193
References.....	199
13. Future Changes, Natural and Man-Made	201
The Minimization of Man's Adverse Impact	205
Protection Against Natural Disasters	209
Environmental Protection and Land-Use Planning.....	209
The Role of the United Nations	210
References.....	211