CONTENTS

1

12

Preface, ix

1 Introduction

Safety Considerations, 1 Laboratory Work, 2 Fieldwork, 2 **Utilizing Personal Computers, 3** Hardware, 3 Software, 4 Integrated Software, 5 Word-Processing Software, 5 Spreadsheets, Statistical and Graphing Programs, 6 Database and Bibliographic Programs, 6 Graphics Programs, 7 Modeling: Simulation and Expert Programs, 7 Specialist Sedimentological Programs, 8 **Project Design**, 9 Analyses Carried Out by Others, 9 Ethics, 10 Selected Bibliography, 10

2 Aerial Photographs and Maps

Aerial Photographs and Satellite Imagery, 12 Maps, 15

Guidelines in Map Preparation, 15 Contour Maps, 15 Varieties of Contour Maps, 19 Other Geological Maps, 21 Selected Bibliography, 22 3 Fieldwork

Field Equipment, 24 Field Mapping, 24 Traverses, 27 Selection of Units, 27 Description of Units, 28 Age of Units, 28 **Tectonic Features**, 28 Description of Coals, 29 Measurement of Geological Sections, 30 Use of the Compass, 30 Measurements with the Compass, 33 Surveying, 36 Photography, 37 **Base Work—Evenings and Impossible Weather, 38** Field Report Preparation, 39 **Chemical Field Analyses, 39** pH, 41 Redox (Eh), 41 Dissolved Oxygen, 42 Salinity, 44 Analyses for Elements and Compounds, 46 Selected Bibliography, 47

4 Sampling

Sampling Strategies, 48 Sample Collection, 51 Coring, 52 Grab Sampling, 53 Explosives, 54 Sediment Traps (and Rising Stage Samplers), 56 Turbidity and Suspended Solids, 56 **4**8

Sampling Coal, 57 Sample Storage and Transport, 57 Peel Samples, 57 Selected Bibliography, 58

5 Sample Treatment in the Laboratory

Sample Splitting, 61 Water Content and Bulk Density, 61 Sediment Disaggregation and **Dispersion**, 61 Physical Disaggregation, 62 Dispersion of Clays, 62 **Removal of Salts, 65 Removal of Sediment Components** by Chemical Means, 65 **Cleaning Solid Residues after** Chemical Treatment of Samples, 67 Drying, 68 **Extraction of Microfossils, 68** General, 68 Pollen, 70 **Mounting Loose Grains for** Microscopy, 71 **Impregnation Procedures**, 72 **Embedding Procedures**, 72 **Thin-Section Preparation**, 72 **Polished-Section Preparation**, 73 Polished Sections of Coal, 74 Pore Stains, 75 Streak Prints, 75 Acetate Peels, 76 **Rock Crushing and Grinding**, 77 **Preparation for Chemical** Analysis, 77 Preparation of Samples for X-Ray Fluorescence Analysis, 77 Whole Rock Digestions, 78 Selective Extractions, 78 Liquid and Plastic Limits, 81 Selected Bibliography, 82

6 Analysis of Sedimentary Structures 85

Enhancement of Original Structures, 85 Surface Replicas, 85 Sand-Blasting, 85 Photographic Enhancement, 86 X-Ray Radiography, 86 Collection of Paleocurrent Data, 87 Correction of Directional Data for Tectonic Deformation, 87 Field Correction, 87 Laboratory Correction, 88 Evaluation of Directional Data, 89 Presentation of Results, 89 Selected Bibliography, 90

7 Textures

61

Shape, 92 Sphericity, 92 Roundness, 93 Pivotability, 93 Methods for Determining the Size of **Detrital Sediments**, 93 Sample Parameters, 94 Rapid Analysis for (Gravel)/ Sand/Silt/Clay Ratio, 94 Individual Particle Analysis, 94 Sieve Analysis, 101 Settling Tubes, 101 Pipette Analysis of Mud, 103 Hydrometer Analysis of Mud, 109 Size Analysis of Indurated Sandstones, 114 Treatment of Size Data, 115 Method of Moments, 116 Graphical Analysis, 116 Interpretation, 118 **Texture of Carbonate Sediments**, 122 **Grain Surface Textures**, 122 Scanning Electron Microscopy (SEM), 122 Phase and Differential Interference Contrast Microscopy, 123

92

Fabric Studies, 123 Porosity and Permeability, 125 Selected Bibliography, 125

8 Mineralogy

130

Common Rock-Forming Minerals of Sand Size, 130 Detrital Minerals, 130 Carbonate Minerals, 130 **Optical Microscopy**, 131 **Transmitted Light** Microscopy, 131 Spindle Stage Technique, 132 Oil Immersion Microscope Study, 132 Universal Stage, 132 **Cathodoluminescence**, 133 **Reflected Light Microscopy**, 133 Coal Microscopy, 134 Heavy Minerals, 135 Initial Preparation, 135 Heavy Liquid Separation, 135 **Electromagnetic Separation**, 138 Miner's Pan and Superpanner, 140 Hand Panning, 140 Shaking Tables, 140 **Mineral Staining Methods**, 140 Staining for Feldspars, 140 Staining for Carbonate Minerals, 140 **Evaporite Minerals**, 140 Staining for Bioturbation, 142 **Modal Analysis of Thin and Polished Sections and** Grain Mounts, 142 X-Ray Diffraction, 144 Principles of Operation, 144 Instrumentation and Operation, 144 Sample Preparation, 145 Data Interpretation, 145 Advantages and Limitations, 147 **Differential Thermal Analysis** and Thermogravimetric Analysis, 147

Principle, 147 Instrumentation, 149 Heat Source, 149 Temperature Controller, 150 Sample Holder, 150 Thermocouples, 150 Temperature Recorder, 150 Conditions, Sample Preparation, and Standards, 150 Interpretations, 150 Advantages Over Other Methods of Analysis for Fine Grained Samples, 151 Limitations, 151 Thermogravimetric Analysis, 151 **Infrared Spectrophotometry**, 151 Principles, 151 Equipment, 152 Sample Preparation, 153 Identification and Characterization of Minerals, 153 Raman Spectroscopy, 154 Mössbauer Spectroscopy, 154 Principles, 154 Equipment, 155 Sample Preparation, 155 Data Processing, 155 The Measured Parameters, 156 Isomer Shift, 156 Quadrupole Splitting, 156 Half-Height Line Width, 157 Peak Intensity, 157 Magnetic Splitting, 157 The Effect of Temperature, 158 Geological Applications, 158 Fe²⁺/Fe³⁺ Determination, 158 Crystallographic Site Determination, 158 **Fingerprint Mineral** Description, 158 Provenance Studies, 158 Laterite Dating, 159 Selected Bibliography, 159

9 Chemical Composition

General Considerations, 164

164

Choice of Analytical Technique, 164 Standards and Blanks, 165 Loss on Ignition, 166 **Organic and Inorganic Carbon**, 167 Total Carbon, 167 Total Organic Carbon, 167 Inorganic Carbon, 168 **Total Sulfur, 168 Total Kieldahl Nitrogen, 168 Oils and Grease, 169** Ion Chromatography, 170 Principles, 170 Applications, 171 **Electrochemical Methods**, 171 Principles, 171 Applications, 173 X-Ray Fluorescence, 173 Principles, 173 Applications, 174 **Electron Microprobe and** EDAX, 174 Principles, 174 Applications, 175 **Atomic Absorption**, 175 Principles, 175 Applications, 176 Flame Photometry, 176 Principles, 176 Applications, 177 ICP and ICP-MS, 177 Principles, 177 Applications, 178

Spectrophotometry, 178 Principles, 178 Applications, 178 Selected Bibliography, 180 10 Borehole Sedimentology The Borehole Environment, 182 Lithological Drilling Logs, 183 Sample Gathering and Preparation of Well Cuttings, 183 Examination and Description, 185 Lithologic Log Preparation and Interpretation, 185 **Geophysical Logs**, 185 The Caliper Log, 185 The Spontaneous Potential (SP) Log, 187 The Gamma-Ray Log, 187 **Resistivity Logs**, 188 Sonic Logs, 189 The Formation Density (FD) Log, 190 Neutron Logs, 191 **Correlation Using Geophysical** Logs, 191 Selection of Units, 191 Correlating Logs, 192 Interpretation of Depositional Environment, 194 Selected Bibliography, 196