# Contents

Preface to the Second Edition ix  
Preface to the First Edition xi  
List of Mineral Abbreviations xii  

1 Background 1  
1.1 Introduction 1  
1.2 History of the Examination of Rocks with the Microscope 1  
1.3 How Relevant Is the Microscope Today? 1  
1.4 Mineral Identification 2  
1.5 The Concept of a Section 2  
1.6 Newer Techniques 2  
1.7 Quantitative Approaches 4  
1.8 Some Terms 4  
1.9 Traditional Rock Groupings 4  
1.10 Importance of Evidence 5  
1.11 Kinds of Evidence Used 5  
1.12 Complexity 6  

2 Microstructures of Sedimentary Rocks 7  
2.1 Introduction 7  
2.2 Epiclastic (‘Terrigenous’) Sedimentary Rocks 7  
2.3 Pyroclastic Sedimentary Rocks 17  
2.4 Organic and Bioclastic Sedimentary Rocks 19  
2.5 Chemical Sedimentary Rocks 24  

3 Microstructures of Igneous Rocks 28  
3.1 Introduction 28  
3.2 Structure of Silicate Melts and Glasses 28  
3.3 Crystallization of Magma: Nucleation and Growth 29  
3.4 Grain Shapes in Igneous Rocks 39  
3.5 Grain Size in Igneous Rocks 65  
3.6 Order of Crystallization in Igneous Rocks 78  
3.7 Magmatic Reactions and Antecrysts 82  
3.8 Distribution of Minerals in Igneous Rocks 89  
3.9 Mineral Intergrowths in Igneous Rocks 93  
3.10 Magmatic Flow 98  
3.11 Enclaves in Igneous Rocks 102  
3.12 Compositional Zoning in Igneous Minerals 109  
3.13 Growth Twinning in Crystals in Igneous Rocks 120  
3.14 Embayments 123  
3.15 Microstructures Formed by Boiling (Vesiculation) of Magma 126  
3.16 Liquid Unmixing in Magma 132  

4 Microstructures of Metamorphic Rocks 135  
4.1 Introduction 135  
4.2 Processes Controlling Grain Shapes in Metamorphic Rocks 136
# CONTENTS

4.3 Grain Size and Porphyroblasts 153  
4.4 Effect of Fluids on Crystal Faces in Metamorphic Rocks 166  
4.5 Elongate and Dendritic Crystals in Metamorphic Rocks 172  
4.6 Solid-State Grain Shapes in Slowly Cooled Igneous Rocks 173  
4.7 Growth Twinning Formed in Metamorphic Minerals 178  
4.8 Transformation Twinning 180  
4.9 Exsolution 181  
4.10 Symplectic Intergrowths 185  
4.11 Modification of Deformation Twins, Exsolution Lamellae and Other Intergrowths 198  
4.12 Compositional Zoning in Metamorphic Minerals 201  
4.13 Criteria for Inferring Metamorphic Reactions 207  
4.14 Distribution of Minerals in Metamorphic Rocks 212  
4.15 Residual Microstructures in Metamorphic Rocks 214  
4.16 Microstructures Formed by Melting of Solid Rocks 219  

5 Microstructures of Deformed Rocks 228  
5.1 Introduction 228  
5.2 Experimental Evidence 228  
5.3 Deformation Mechanisms 229  
5.4 Recovery and Recrystallization 247  
5.5 Deformation of Polymineral Aggregates 264  
5.6 Metamorphic Reactions during Deformation 266  
5.7 Deformation Partitioning 269  
5.8 Tectonic Foliations in Metamorphic Rocks 290  
5.9 Fluid and Mass Transfer in Deforming Rocks 298  
5.10 Porphyroblast-Matrix Microstructural Relationships during Deformation 307  
5.11 Deformation of Partly Melted Rocks 337  
5.12 Deformation of Peridotite in Earth’s Mantle 345  
5.13 Deformation of Eclogites and Blueschists 351  

Glossary of Microstructural and Other Terms 353  
References 365  
Index 422