

Petrogenesis of Metamorphic Rocks

Fourth Edition

Helmut G. F. Winkler

B 17 326
Geologisch-Paläontologisches
Institut
T. H. Darmstadt



Springer-Verlag New York Heidelberg Berlin

Stancov Petrologie

Contents

1. Definition and Types of Metamorphism	1
2. From Diagenesis to Metamorphism	9
3. Factors of Metamorphism	15
General Considerations	15
The Composition of the Fluid Phase	19
Directed Pressure	25
4. Mineral Parageneses: The Building Blocks of Metamorphic Rocks .	28
5. Graphical Representation of Metamorphic Mineral Parageneses ...	31
Composition Plotting	31
ACF Diagram	35
A'FK Diagram	41
How Are ACF and A'FK Diagrams Used?	45
AFM Diagrams	48
6. Classification Principles: Metamorphic Facies versus Metamorphic Grade	55
7. The Four Divisions of Metamorphic Grade	64
General Considerations	64
The Terms Isograd and Isoreaction-Grad	66
The Division of Very-Low-Grade Metamorphism	67
The Division of Low-Grade Metamorphism	74
The Change from Low-Grade to Medium-Grade Metamorphism	75
The Change from Medium-Grade to High-Grade Metamorphism	82
Granulite—High Grade; Regional Hypersthene Zone	87
Pressure Divisions of the Metamorphic Grades	88
Problems with the Al_2SiO_5 Species	91
8. General Characteristics of Metamorphic Terrains	96
Metamorphic Zones in Contact Aureoles	96
Metamorphic Zones in Regional Metamorphism	101
Paired Metamorphic Belts	108
9. Metamorphic Reactions in Carbonate Rocks	110
General Considerations	110
Metamorphism of Siliceous Dolomitic Limestones	112
Formation of Wollastonite	128
Metamorphism of Carbonates at Very High Temperature and Very Low Pressure	133

10.	Metamorphism of Marls	139
	Plagioclase & Calcite Assemblages	147
	Vesuvianite	149
11.	Metamorphism of Ultramafic Rocks: Systems	
	MgO-SiO ₂ -CO ₂ -H ₂ O and MgO-CaO-SiO ₂ -H ₂ O	151
12.	Metamorphism of Mafic Rocks	165
	Transformations Except Those of Very-Low-Grade	
	Metamorphism at Low Pressures	165
	Very-Low-Grade Metamorphism at Low Pressures	177
	Evaluation of Metamorphic Changes at Very-Low Grade	185
	The Role of CO ₂ in Very-Low-Grade Metamorphism	196
13.	Very-Low-Grade Metamorphism of Graywackes	200
14.	Metamorphism of Pelites	202
	General Statement	202
	Metamorphism of Pelitic Rocks at Very-Low and Low-Grade	202
	Metamorphism of Pelitic Rocks at Medium- and High-Grade	216
15.	A Key to Determine Metamorphic Grades and Major	
	Isoreaction-Grads or Isograds in Common Rocks	234
	Very-Low-Grade Metamorphism	235
	Low-Grade	237
	Medium- and High-Grade	240
	Geothermometers and Geobarometers	246
	Sequences of Isoreaction-Grads or Isograds	247
16.	Regional Hypersthene Zone (Granolite High Grade)	252
	Nomenclature and Mineralogical Features of "Granulites"	252
	Metamorphism of Granulites and Related Granoblastites	259
	Petrogenetic Considerations	267
17.	Eclogites	271
18.	Anatexis, Formation of Migmatites, and Origin of Granitic	
	Magmas	278
	Anatexis: General Considerations	280
	Experimental Anatexis of Rocks Composed of Alkali Feldspar,	
	Plagioclase, and Quartz	302
	Experimental Anatexis of Rocks Composed of Plagioclase and	
	Quartz but Lacking Alkali Feldspar	308
	Formation of Migmatites	314
	Formation of Granitic Magmas by Anatexis	319
	Appendix: Nomenclature of Common Metamorphic Rocks	325
	Names of Important Rock Groups	325
	Prefixes	327
	Classification	328
	Index	331