Contents

	Energetic basis	
	General relations	
	Equations of state and chemical potential of	
	pure gases, liquids, and solids	
	Phases of variable composition	
	Reactions and equations of equilibrium	
	The Gibbs phase rule	
	Effect of gravitational field	
	Kinetics	
	Equilibrium of mineral systems	1
	One-component transitions	1
	Univariant transformations of solids	1
	Univariant reactions involving gases	1
	The system CaO-MgO-CO ₂	J
	Exchange equilibria	l
	The distribution of minor elements	2
	Coupled equilibria involving solid solutions	
	and gases	2
	Intrinsic and extrinsic stability	2
	Ionic processes	2
	Crystal-melt equilibria	4
ŀ	Kinetics of mineral systems	3
	General	-
1	Quasiequilibrium processes in a temperature	-
- 1		

Cont	ents	
Qua	siequilibrium processes under isothermal conditions	37
-	tal kinetics	39
	etics of dissociation	42 43
	etics of complex heterogeneous reactions etics of rock deformation	45
Clas	sifications of rocks	49
Che	mical classification	49
	eral facies classification	52
	tion between bulk chemistry and mineral composition	56
Che	mical and petrogenetic processes in space	62
	ds in space	62
	problem of the origin of the solar system	63
	densation from a gas of solar composition	63
	effect of nonequilibrium ionization	69 70
Syst	em O-Si-Mg-Fe-Ni-P	70
Me	teorites	74
Gen	eral characteristics	74
The	dating of events in meteorite history	75
	sification schemes	77
	eralogy	77
	ography of the chondrites c chemical characteristics	83 86
	r's rules	87
	dation and hydration states of meteorites	90
Car	bon reactions in meteorites	92
	ctions involving sulfur and phosphorus compounds in meteorites	93
	nent distributions in meteorites	94
	chanisms of liquidus crystallization for the chondrites gin of the metallic components of chondrites	95 98
	sure of formation of meteorites	90 99
	gin of meteorites: a critique of theories and hypotheses	100
The	e terrestrial planets	105
	ss physical and chemical characteristics	105
	gin and evolution	105
	mistry and petrology of Venus	110
	atmosphere and surface of Mercury	117
Ma	rs	118
	Moon	121
	nparative planetology	124

	ntents	
M	etamorphism and metamorphic mechanisms	12
Int	roduction	12
	igin of microstructures and textures	13
	netic aspects of crystallization	13
	ites of metamorphic reactions	14
	igin of macrostructures	14: 14:
	igin of compositional variations	14
	mmary	154
м	etamorphic minerals	15
Fr	perimental appraisal of the stability of minerals	15:
	eoretical analysis of stabilities of crystalline solutions	17
M	etamorphic mineral facies	18
	agenesis and metamorphism; the zeolite and lawsonite facies	182
	eenschist facies	18
An	nphibolite facies	19
Gr	anulite facies	19
Ex	perimental and theoretical study of metamorphic systems	199
Ge	ometric analysis of phase equilibria	199
	ethod of interpreting metamorphic assemblages	201
Γh	e system $K_2O-MgO-Al_2O_3-SiO_2-H_2O$	200
	semblages with staurolite	201
As	a system SiO K O Al O Eq. MaO H O in transition from amphibalita	
As: Th	e system SiO_2 - K_2O - Al_2O_3 -FeO-MgO- H_2O in transition from amphibolite granulite facies	216
Ass The	granulite facies	
Ass The to g An		210 222 223
As The to An The As	granulite facies thophyllite-gedrite pelitic rocks e system CaO-Al ₂ O ₃ -SiO ₂ -H ₂ O semblages with cordierite in the granulite facies	222 223 224
As: The to g An The As: The	granulite facies thophyllite-gedrite pelitic rocks e system CaO-Al ₂ O ₃ -SiO ₂ -H ₂ O semblages with cordierite in the granulite facies e charnockite assemblage	222 223 224 224
As: The to An The As: The Ma	granulite facies thophyllite-gedrite pelitic rocks e system CaO-Al ₂ O ₃ -SiO ₂ -H ₂ O semblages with cordierite in the granulite facies e charnockite assemblage agnesian, calcic, and carbonate rocks	222 223 224 225 225
Ass The to p An The Ass The Ma	granulite facies thophyllite-gedrite pelitic rocks e system CaO-Al ₂ O ₃ -SiO ₂ -H ₂ O semblages with cordierite in the granulite facies e charnockite assemblage agnesian, calcic, and carbonate rocks etamorphism of ultramafic rocks	222 222 224 225 225 225 239
Ass The to An The Ma Ma Ma	granulite facies thophyllite-gedrite pelitic rocks e system CaO-Al ₂ O ₃ -SiO ₂ -H ₂ O semblages with cordierite in the granulite facies e charnockite assemblage agnesian, calcic, and carbonate rocks	222 222 224 225 227 239 240
Ass The to p An The Ass The Ma Ma Ro	granulite facies thophyllite-gedrite pelitic rocks e system CaO-Al ₂ O ₃ -SiO ₂ -H ₂ O semblages with cordierite in the granulite facies e charnockite assemblage agnesian, calcic, and carbonate rocks etamorphism of ultramafic rocks e iron formations cks of high pressure and controversial origin	22: 22: 22: 22: 22: 22: 23: 24(24:
Ass The to p An The Ass The Ma Ma Ro Pr e	granulite facies thophyllite-gedrite pelitic rocks e system CaO-Al ₂ O ₃ -SiO ₂ -H ₂ O semblages with cordierite in the granulite facies e charnockite assemblage agnesian, calcic, and carbonate rocks etamorphism of ultramafic rocks e iron formations cks of high pressure and controversial origin operties, origin, and environment of magmas	222 222 222 222 223 239 240 243 243
Ass The to p An The Ass The Ma Ma Ro The Ro Pr Str	granulite facies thophyllite-gedrite pelitic rocks e system CaO-Al ₂ O ₃ -SiO ₂ -H ₂ O semblages with cordierite in the granulite facies e charnockite assemblage agnesian, calcic, and carbonate rocks etamorphism of ultramafic rocks e iron formations cks of high pressure and controversial origin operties, origin, and environment of magmas uctures of silicate melts	22: 22: 22: 22: 22: 23: 24: 24: 24: 24: 24: 25:
Ass The to g An The Ass The Ma Ma Ma Ro The Ro The Ro	granulite facies thophyllite-gedrite pelitic rocks e system CaO-Al ₂ O ₃ -SiO ₂ -H ₂ O semblages with cordierite in the granulite facies e charnockite assemblage agnesian, calcic, and carbonate rocks etamorphism of ultramafic rocks e iron formations cks of high pressure and controversial origin operties, origin, and environment of magmas uctures of silicate melts lubilities of volatile components	222 222 222 239 244 243 244 243 25 25 25
As: The An The As: The Ma Ma The Ro The Ro Pre Str Sol	granulite facies thophyllite-gedrite pelitic rocks e system CaO-Al ₂ O ₃ -SiO ₂ -H ₂ O semblages with cordierite in the granulite facies e charnockite assemblage agnesian, calcic, and carbonate rocks etamorphism of ultramafic rocks e iron formations cks of high pressure and controversial origin operties, origin, and environment of magmas uctures of silicate melts lubilities of volatile components nsities of magmas	222 224 225 239 240 241 251 255 255
As: The to : An The As: The Ma Ma Ma Ma Ro The Ro Str Sol De Vis	granulite facies thophyllite-gedrite pelitic rocks e system CaO-Al ₂ O ₃ -SiO ₂ -H ₂ O semblages with cordierite in the granulite facies e charnockite assemblage agnesian, calcic, and carbonate rocks etamorphism of ultramafic rocks e iron formations cks of high pressure and controversial origin operties, origin, and environment of magmas uctures of silicate melts lubilities of volatile components	222 223 224 225 225
As: The to f An The As: The Ma Ro The Ro The Ro Str Sol De Vis Lice Ori	granulite facies thophyllite-gedrite pelitic rocks e system CaO-Al ₂ O ₃ -SiO ₂ -H ₂ O semblages with cordierite in the granulite facies e charnockite assemblage agnesian, calcic, and carbonate rocks etamorphism of ultramafic rocks e iron formations cks of high pressure and controversial origin operties, origin, and environment of magmas uctures of silicate melts lubilities of volatile components nsities of magmas acosities of magmas	222 224 225 239 240 243 251 255 256 255

Differentiation and	d crystallization of magmas	
	k series and their meaning	
Homogeneous diffe		
	rentiation by separation of a fluid phase	
	d phase in a crystallizing magma heterogeneous differentiation in magmas	
Subtraction and var		
Igneous plutons: 7	Their physical chemistry and mode of occurence	
The compositional	fields of igneous rocks	
	he differentiation of basaltic magmas	
Differentiated gabb		
Large calc-alkali plu The physical chemis	stry of calc-alkaline-type differentiation	
Origin of calc-alkali		
Alkaline rocks		
	teration of inclusions nent and mode of emplacement of igneous plutons	
Plutonic rocks of co		
Volcanism and vo	Icanic fluids	
Introduction		
Volcanic and hypat		
Volcanoes and volc Volcanic fluids	anic deposits	
References		
Subject Index		
Author Index		