
Contents

1	Thermodynamic Model and Techniques	1
1.1	Introduction	1
1.2	Thermodynamic Model	2
1.3	Piston-Cylinder Experiments and Techniques	4
1.4	Multi-Anvil Experiments and Techniques	5
2	System MgO–SiO₂	13
2.1	Introduction	13
2.2	Stability of the Enstatite Polymorphs	13
2.3	Protoenstatite to Orthoenstatite Transition and the Stability of High-T Clinoenstatite	15
2.4	Orthoenstatite to Low Clinoenstatite Boundary	16
2.5	Orthoenstatite to High-P Clinoenstatite Boundary	17
2.6	Reactions in the System MgO–SiO ₂ at Sublithospheric Pressures	19
2.7	Melting Relations in the System MgO–SiO ₂	21
2.8	Stability of the SiO ₂ Polymorphs	23
3	System MgO–Al₂O₃–SiO₂	33
3.1	Introduction	33
3.2	Properties of the Phases in the MAS System	33
3.3	Phase Relations in Spinel and Garnet Peridotites	35
3.4	Other Phase Relations in the MAS System	38
3.5	Comparison with the Thermochemical Measurements	41
3.6	Enstatite–Pyrope Join at Sublithospheric Pressures	42
4	System CaO–MgO–SiO₂	81
4.1	Introduction	81
4.2	Thermodynamic Model for the Enstatite-Diopside Join at 1 Atm	82
4.3	Stability of Protopyroxene	85
4.4	Orthopyroxene–Clinopyroxene Equilibrium at High Pressures	86
4.5	Enstatite-Diopside Join at Sublithospheric Pressures	87
4.6	Melting Relations on the Enstatite-Diopside Join	89
4.7	Melting Curve of Diopside	91
4.8	Phase Relations in the CaSiO ₃ System	92

5	System CaO–MgO–Al₂O₃–SiO₂ Undersaturated with Silica	131
5.1	Introduction	131
5.2	Thermodynamic Approach	131
5.3	Thermodynamic Modeling	133
5.4	Evaluation of the Fit to the Data	135
5.5	Other Phase Relations in the CMAS System Undersaturated with Silica	137
5.6	The CMAS System at Sublithospheric Pressures	138
6	System CaO–MgO–Al₂O₃–SiO₂ Saturated with Silica	173
6.1	Introduction	173
6.2	Phase Relations in the System CaO–Al ₂ O ₃ –SiO ₂	174
6.3	Phase Relations in the Ternary System Di–CaTs–CaEs	176
6.4	Equilibria with Orthopyroxene and Quartz	178
7	Systems with Na and Ca at Lithospheric Pressures	215
7.1	Introduction	215
7.2	System Diopside–Jadeite–SiO ₂	216
7.3	The CaTs–Jadeite Join	218
7.4	Mixing Properties of Plagioclase	219
7.5	Phase Relations in the NCAS System	220
7.6	Phase Relations in the NCMAS System	221
8	System Na₂O–MgO–Al₂O₃–SiO₂	257
8.1	Introduction	257
8.2	Subsolidus Phase Relations in the NMAS System	258
8.3	Melting Relations on the Enstatite–Jadeite Join	260
8.4	Thermodynamic Modeling of the Enstatite–Jadeite Join	262
8.5	Thermodynamic Modeling of the NMAS System	264
8.6	Melting Relations on the Forsterite–Jadeite Join	264
9	System Enstatite–Diopside–Jadeite	315
9.1	Introduction	315
9.2	Phase Relations in the En–Di–Jd System at Pressures up to 17 GPa	315
9.3	Phase Relations in the En–Di–Jd System at 17–22 GPa	316
9.4	Thermodynamic Modeling of the En–Di–Jd System	318
9.5	The Model for the En–Di–Jd System Modified for the Effect of Fe	319
10	Composition and Structure of the Earth’s Interior	375
10.1	Introduction	375
10.2	The 410 km Discontinuity	376
10.3	Evidence from the Majoritic Garnet Inclusions in Diamond	384
10.4	Evidence from the Type III Inclusions in Diamond	393
10.5	Evidence from the NaPx–En Inclusion in Diamond	402

10.6	Evidence from the (Mg,Fe)O Inclusions in Diamond	406
10.7	Relevance of the Inclusions to the Earth's Mantle	413
10.8	The Role of H ₂ O in the Deep Mantle	413
10.9	The Effect of Metasomatism and the Role of CO ₂ in the Deep Mantle	416
10.10	The Composition and Structure of the Earth's Upper Mantle . . .	421
References		429
Author's Articles		429
Other References		432
Subject Index		449