

TABLE OF CONTENTS

	Page		Page
Preface.....	3	B. Metal Oxide Systems	
Temperature Scales.....	4	I. One Oxide.....	83
General Discussion of Phase Diagrams.....	5	II. Two Oxides.....	86
I. Glossary.....	5	III. Three Oxides.....	145
II. The Phase Rule.....	8	IV. Four Oxides.....	265
(1) Statement.....	8	V. Five Oxides.....	313
(2) Limitations.....	8	C. Systems with Oxygen-Containing Radicals	
III. Interpretation of Diagrams.....	9	I. Carbonates Only	
(1) One-Component Systems.....	9	(a) One Carbonate.....	321
(2) Two-Component Systems.....	9	(b) Two Carbonates.....	322
(A) Binary Systems Without Solid Solutions.....	9	(c) Three Carbonates.....	324
(a) No Compounds Present....	9	II. Perchlorates Only.....	324
(b) Compounds Present.....	11	III. Hydroxides	
(B) Binary Systems With Solid Solutions.....	11	(a) Two Substances.....	325
(a) Mechanics of Crystallization	11	(b) Three Substances.....	327
(b) Types of Systems.....	12	(c) Four Substances.....	328
(C) Binary Systems With Immiscible Liquids.....	12	IV. Nitrates Only	
(D) Binary Systems of a Complex Nature.....	13	(a) Two Nitrates.....	329
(a) Crystallization Paths.....	13	(b) Three Nitrates.....	334
(3) Three-Component Systems.....	14	V. Nitrites Only.....	337
(A) Ternary Systems Without Solid Solutions.....	15	VI. Nitrites-Nitrates, mixed	
(a) Typical Cases.....	15	(a) Two Substances.....	337
(b) Crystallization Paths.....	17	(b) Four Substances.....	338
(c) Summary Relating to Crystallization.....	19	VII. Nitrates-Carbonates, mixed.....	339
(d) Alternate Method for Determining Phase Composition.....	20	VIII. Sulfates Only	
(e) Summary of Alternate Method.....	21	(a) Two Sulfates.....	340
(B) Ternary Systems With Solid Solutions.....	21	(b) Three Sulfates.....	348
(a) The Solid Solution Diagram	21	IX. Sulfates with Metal Oxides	
(b) Mechanics of Crystallization	22	(a) Two Substances.....	351
(c) Determining Three - Phase Boundaries.....	24	(b) Three Substances.....	351
(4) Multicomponent Systems.....	25	(c) Four Substances.....	352
(A) General.....	25	X. Sulfates with Other Oxygen-Containing Radicals	
(B) Graphical Representation.....	28	(a) Two Substances.....	352
(a) Joins.....	28	(b) Three Substances.....	355
(b) Sections.....	28	(c) Four Substances.....	356
(c) Other Specializing Conditions.....	29	D. Systems Containing Halides Only	
IV. Experimental Methods for High-Temperature Heterogeneous Equilibrium.....	29	I. Bromides Only	
V. Selected Bibliography.....	32	(a) Two Bromides.....	361
(1) Theory.....	32	(b) Three Bromides.....	366
(2) Interpretation.....	32	II. Chlorides Only	
(3) Methods and Techniques.....	33	(a) One Chloride.....	367
(A) General.....	33	(b) Two Chlorides.....	368
(B) Optical Mineralogy.....	33	(c) Three Chlorides.....	403
(C) Differential Thermal Analysis....	33	III. Fluorides Only	
(D) X-ray and Crystal Chemistry....	34	(a) One Fluoride.....	413
(E) Hydrothermal.....	34	(b) Two Fluorides.....	413
(F) High Pressure.....	34	(c) Three Fluorides.....	432
(4) Mathematical Treatment.....	35	IV. Iodides Only	
(5) Thermodynamic Calculations.....	35	(a) One Iodide.....	448
(6) Silicate Chemistry.....	35	(b) Two Iodides.....	448
(7) Special Collections of Phase Diagrams	36	(c) Three Iodides.....	451
(8) Phase Diagrams in Related Fields....	36	V. Mixed Halides Only	
Specific Diagrams*		(a) Two Halides.....	451
A. Metal-Oxygen Systems, including those containing valence changes		(b) Three Halides.....	460
I. One Metal with Oxygen.....	37	(c) Four Halides.....	461
II. Two Metals with Oxygen.....	43	E. Systems Containing Halides with Other Substances	
III. Three Metals with Oxygen.....	72	I. Halides with Metals	
		(a) Two Substances.....	467
		(b) Three Substances.....	469
		(c) Four Substances.....	469
		II. Fluorides with Metal Oxides	
		(a) Two Substances.....	470
		(b) Three Substances.....	470
		(c) Four Substances.....	479
		III. Halides with Hydroxides.....	483
		IV. Halides with Nitrates	
		(a) Two Substances.....	485
		(b) Three Substances.....	486
		(c) Four Substances.....	487

Table of Contents

	Page		Page
V. Halides with Sulfates		IV. Sulfides with Metal Oxides	
(a) Two Substances.....	491	(a) Two Substances.....	522
(b) Three Substances.....	492	(b) Three Substances.....	522
(c) Four Substances.....	494	V. Miscellaneous.....	523
VI. Halides with Miscellaneous Oxides		G. Systems Containing Water	
(a) Two Substances.....	500	I. Water.....	525
(b) Three Substances.....	503	II. One Metal Oxide with Water.....	526
(c) Four Substances.....	509	III. Two Metal Oxides with Water.....	532
(d) Six Substances.....	512	IV. Three Metal Oxides with Water.....	554
VII. Halides with Miscellaneous Substances		V. Four Metal Oxides with Water.....	563
(a) Two Substances.....	513	VI. Five Metal Oxides with Water.....	564
(b) Four Substances.....	513	VII. Miscellaneous Substances with Water	
F. Systems Containing Cyanides, Sulfides, etc.		(a) One Substance with Water.....	564
I. Cyanides Only.....	515	(b) Two Substances with Water.....	565
II. Metal with Sulfur		(c) Three Substances with Water...	568
(a) Two Substances.....	516	(d) Four Substances with Water...	568
(b) Three Substances.....	518	Melting Points of the Metal Oxides.....	569
(c) Four Substances.....	519	Molecular Weights of Oxides.....	574
III. Sulfides Only		Author Index.....	575
(a) Two Sulfides.....	519	System Index.....	581
(b) Three Sulfides.....	521		

*System of Arranging Diagrams

A diagram is classified according to one of the listed sections, such as, metal oxides, halides, water containing, etc. Within each section the systems are grouped according to the total number of different oxides (or materials) represented in all the components, such as, two oxides, three fluorides, four materials, etc. Since the systems are not arranged according to the number of components, quaternary, ternary, and binary systems will be grouped together when the same oxides are represented in each. For example the phase diagrams of $\text{CaO}-5\text{CaO}\cdot3\text{Al}_2\text{O}_3-2\text{CaO}\cdot\text{SiO}_2-4\text{CaO}\cdot\text{Al}_2\text{O}_3-\text{Fe}_2\text{O}_3$, $\text{CaO}-\text{CaO}\cdot\text{SiO}_2-4\text{CaO}\cdot\text{Al}_2\text{O}_3-\text{Fe}_2\text{O}_3$, and $2\text{CaO}\cdot\text{SiO}_2-4\text{CaO}\cdot\text{Al}_2\text{O}_3-\text{Fe}_2\text{O}_3$, are all listed together under the heading $\text{CaO}-\text{Al}_2\text{O}_3-\text{Fe}_2\text{O}_3-\text{SiO}_2$, because each contains CaO , Al_2O_3 , Fe_2O_3 , and SiO_2 . These oxide groups are shown in boldface type in the compilation.

The diagrams in all groupings are arranged according to a combination valence, alphabetical, and simplicity order. The order of writing oxides of a compound and the order of writing components of a system follow the same rule. In this method, the oxides are first grouped according to

increasing valence of the cations, the R_2O 's first and the RO 's last, and then arranged in alphabetical order within each valence grouping. In listing compounds of systems containing complex components (compounds of two or more oxides are termed complex), the simplest compounds are given first, followed by the other compounds in order of increasing complexity, each compound being written in the valence-alphabetical order.

The following examples are given for clarification: The $\text{Cs}_2\text{O}-\text{MoO}_3$ category precedes the $\text{Cu}_2\text{O}-\text{SiO}_2$ one; the $\text{CaO}-\text{FeO}-\text{Al}_2\text{O}_3-\text{SiO}_2$ category precedes the $\text{CaO}-\text{MgO}-\text{Al}_2\text{O}_3-\text{Fe}_2\text{O}_3$ one; and the $\text{NaF}-\text{Na}_2\text{O}-\text{SiO}_2$ category precedes the $\text{NaF}-\text{Na}_2\text{O}-\text{CrO}_3$ one. The formula for the mineral diopside is written $\text{CaO}\cdot\text{MgO}\cdot2\text{SiO}_2$ and anorthite is $\text{CaO}\cdot\text{Al}_2\text{O}_3\cdot2\text{SiO}_2$. The phase diagram of albite, diopside, and anorthite is written $\text{Na}_2\text{O}\cdot\text{Al}_2\text{O}_3\cdot6\text{SiO}_2-\text{CaO}\cdot\text{MgO}\cdot2\text{SiO}_2-\text{CaO}\cdot\text{Al}_2\text{O}_3\cdot2\text{SiO}_2$.

In order to conserve space the listing of the title of each diagram according to figure sequence is not given; however, in the alphabetical index at the end of the compilation, a diagram is listed under each of its constituent oxides or materials. An author index has also been included for the convenience of the reader.