

Table of Contents

1	Introduction	1
1.1	Preamble: Potassic Igneous Rocks and Their Importance	1
1.2	Scope of Book	3
2	Definitions and Nomenclature	4
2.1	Historical Perspective of Potassic Igneous Rocks	5
2.2	Potassic Igneous Rocks as an Umbrella Term	6
2.3	Shoshonites	7
2.4	Shoshonitic and Alkaline Lamprophyres	7
2.5	Ultrapotassic Rocks	8
2.5.1	Introduction	8
2.5.2	Lamproites	9
2.5.3	Kamafugites	10
2.5.4	Orogenic Ultrapotassic Rocks	10
2.6	Group II Kimberlites	10
2.7	Potassic Igneous Rocks as Considered in this Book	11
2.8	Field Recognition of Potassic Igneous Rocks	12
3	Tectonic Settings of Potassic Igneous Rocks	13
3.1	Introduction	13
3.2	Tectonic Settings of Potassic Igneous Rocks	13
3.2.1	Continental Arc	13
3.2.2	Postcollisional Arc	18
3.2.3	Oceanic (Island) Arc	18
3.2.4	Within-Plate	18
3.2.5	Problems with Tectonic Classification	19
3.3	History of Discrimination of Tectonic Setting by Geochemical Means	19
3.4	Erection of Databases SHOSH1 and SHOSH2	23

3.5	Discrimination of Tectonic Setting by Multivariate Statistical Methods	30
3.6	Discrimination via Simple Geochemical Diagrams	33
3.7	Theoretical Basis for Discrimination Between Potassic Igneous Rocks in Different Tectonic Settings	37
3.8	Conclusions.	41
4	Selected Type-Localities of Potassic Igneous Rocks from the Five Tectonic Settings	43
4.1	Roman Province (Italy): Example from a Continental Arc Setting	43
4.1.1	Introduction	43
4.1.2	Regional Geology	45
4.1.3	Mineralogy and Petrography of the Potassic Igneous Rocks	45
4.1.4	Geochemistry of the Potassic Igneous Rocks	45
4.2	Kreuzeck Mountains, Eastern Alps (Austria): Example from a Postcollisional Arc Setting	46
4.2.1	Introduction	46
4.2.2	Regional Geology	47
4.2.3	Mineralogy and Petrography of the Lamprophyres	48
4.2.4	Geochemistry of the Lamprophyres	49
4.3	Northern Mariana Arc (West Pacific): Example from an Initial Oceanic Arc Setting	57
4.3.1	Introduction	57
4.3.2	Regional Geology	57
4.3.3	Mineralogy and Petrography of the Potassic Igneous Rocks	58
4.3.4	Geochemistry of the Potassic Igneous Rocks	59
4.4	Vanuatu (Southwest Pacific): Example from a Late Oceanic Arc Setting	59
4.4.1	Introduction	59
4.4.2	Regional Geology	59
4.4.3	Mineralogy and Petrography of the Potassic Igneous Rocks	60
4.4.4	Geochemistry of the Potassic Igneous Rocks	61
4.5	African Rift Valley (Rwanda, Uganda, Zaire): Example from a Within-Plate Setting	63
4.5.1	Introduction	63
4.5.2	Regional Geology	64
4.5.3	Mineralogy and Petrography of the Potassic Igneous Rocks	64
4.5.4	Geochemistry of the Potassic Igneous Rocks	64
5	Primary Enrichment of Precious Metals in Potassic Igneous Rocks	67
5.1	Introduction	67
5.2	Theoretical Discussion	67

5.3	Case Study: Potassic Alkaline Lamprophyres with Elevated Gold Concentrations from the Karinya Syncline, South Australia . . .	71
5.3.1	Introduction	71
5.3.2	Regional Geology and Tectonic Setting	71
5.3.3	Mineralization in the Vicinity of the Lamprophyres	72
5.3.4	Nature of the Lamprophyres	73
5.3.5	Petrology and Geochemistry of the Lamprophyres	75
5.3.6	Precious Metal Abundance and Significance	81
5.4	Comparison of Precious Metal Abundances for Lamprophyres from the Karinya Syncline and Kreuzeck Mountains	83
6	Direct Associations Between Potassic Igneous Rocks and Gold-Copper Deposits	87
6.1	Direct Associations in Specific Tectonic Settings: Introduction . . .	87
6.2	Erection of Database GOLD1	91
6.3	Late Oceanic Arc Associations	93
6.3.1	Ladolam Gold Deposit, Lihir Island, Papua New Guinea	94
6.3.2	Emperor Gold Deposit, Viti Levu, Fiji	98
6.3.3	Dinkidi Copper-Gold Deposit, Didipio, Phillipines	101
6.3.4	Goonumbla Copper-Gold Deposit, New South Wales, Australia . . .	105
6.4	Continental Arc Associations	113
6.4.1	Bajo de la Alumbrera Copper-Gold Deposit, Catamarca Province, Argentina	113
6.4.2	Bingham Copper Deposit, Utah, USA	118
6.4.3	El Indio Gold Deposit, Chile	122
6.4.4	Twin Buttes Copper Deposit, Arizona, USA	127
6.5	Postcollisional Arc Associations	128
6.5.1	Grasberg Copper-Gold Deposit, Indonesia	128
6.5.2	Misima Gold Deposit, Misima Island, Papua New Guinea	132
6.5.3	Porgera Gold Deposit, Papua New Guinea	137
6.6	Synthesis of Direct Genetic Associations	141
7	Indirect Associations Between Lamprophyres and Gold-Copper Deposits	143
7.1	Introduction	143
7.2	Shoshonitic Lamprophyres with Elevated Gold Concentrations from the Goodall Gold Deposit, Northern Territory, Australia (Proterozoic)	143
7.2.1	Introduction	143
7.2.2	Regional Geology	144
7.2.3	Nature of Mesothermal Gold Mineralization	147
7.2.4	Mineralogy of the Lamprophyres	147
7.2.5	Geochemistry of the Lamprophyres	147

7.2.6	Direct or Indirect Link Between Potassic Lamprophyres and Mineralization	151
7.3	Shoshonitic Lamprophyres from the Tom's Gully Gold Deposit, Northern Territory, Australia (Proterozoic)	152
7.3.1	Introduction	152
7.3.2	Regional Geology	152
7.3.3	Nature of Mesothermal Gold Mineralization	152
7.3.4	Petrology and Geochemistry of the Lamprophyres	153
7.3.5	Indirect Link Between Lamprophyres and Gold Mineralization	153
7.4	Shoshonitic Lamprophyres from the Eastern Goldfields, Yilgarn Block, Western Australia (Archaean)	154
7.4.1	Introduction	154
7.4.2	Regional Geology	155
7.4.3	Nature of Mesothermal Gold Mineralization	155
7.4.4	Lamprophyres and Their Association with Mineralization	157
7.4.5	Petrology and Geochemistry of the Lamprophyres	157
7.5	Shoshonitic Lamprophyres from the Superior Province, Canada (Archaean)	160
7.5.1	Introduction	160
7.5.2	Nature of Mesothermal Gold Mineralization	161
7.5.3	Lamprophyres and Their Association with Mineralization	161
7.5.4	Petrology and Geochemistry of the Lamprophyres	163
7.6	Indirect Link Between Lamprophyres and Archaean Gold Mineralization	165
7.7	Synthesis of Indirect Associations	165
8	Halogen Contents of Mineralized Versus Unmineralized Potassic Igneous Rocks	167
8.1	Introduction	167
8.2	Erection of Database MICA1	169
8.3	Discussion	169
8.3.1	Behaviour of Halogens in Magmatic Hydrothermal Systems	169
8.3.2	Halogen Contents of Mica in Potassic Igneous Rocks	171
8.3.3	Significance of Halogen Data	173
9	Implications for Mineral Exploration	181
9.1	Introduction	181
9.2	Area Selection	181
9.2.1	Composition of Host Rocks	181
9.2.2	Tectonic Setting	182
9.3	Prospect Evaluation	182
9.3.1	Favourable Tectonic Elements on the Prospect Scale	182

9.3.2	High Oxidation State of the Magmas	183
9.3.3	Elevated Halogen Contents of the Magmas	184

10	Characteristics of Some Gold-Copper Deposits Associated with Potassic Igneous Rocks	185
10.1	Abbreviations	185
10.2	Tables of Deposit Characteristics	185
10.2.1	Andacollo, Chile	186
10.2.2	Bajo de la Alumbrera, Catamarca Province, Argentina	187
10.2.3	Bingham, Utah, USA	188
10.2.4	Cadia, New South Wales, Australia	189
10.2.5	Choquelimpie, Chile	190
10.2.6	Cripple Creek, Colorado, USA	191
10.2.7	Dinkidi, Didipio, Philippines	192
10.2.8	El Indio, Chile	193
10.2.9	Emperor, Viti Levu, Fiji	194
10.2.10	Goonumbla, New South Wales, Australia	195
10.2.11	Grasberg, Indonesia	196
10.2.12	Kirkland Lake, Superior Province, Canada	197
10.2.13	Ladolam, Lihir Island, Papua New Guinea	198
10.2.14	Maricunga Belt, Chile	199
10.2.15	Misima, Misima Island, Papua New Guinea	200
10.2.16	Mount Kare, Papua New Guinea	201
10.2.17	Mount Morgans, Eastern Goldfields, Western Australia	202
10.2.18	Ok Tedi, Papua New Guinea	203
10.2.19	Porgera, Papua New Guinea	204
10.2.20	Summitville, Colorado, USA	205
10.2.21	Tom's Gully, Northern Territory, Australia	206
10.2.22	Twin Buttes, Arizona, USA	207
10.2.23	Wiluna, Eastern Goldfields, Western Australia	208
10.2.24	Woodlark Island, Papua New Guinea	209

References	211
-----------------------------	------------

Subject Index	239
--------------------------------	------------