

III

C O N T E N T S

I. INTRODUCTION AND PRELIMINARY STUDIES

1. Introduction

1.1.	Intention and Concept of the Study	1
1.2.	History and Comprehension of the Concepts on Ophiolites	4
1.3.	The Serpentinization Process; some aspects	9

2. Geological Setting of the Alpine Ophiolites
of the Eastern Central Alps and the Klamath Mountains

2.1.	Geography	17
2.2.	General Perspective	17
2.3.	The Eastern Central Alps	18
2.4.	Outline of the Metamorphic History	21
2.5.	Comparison to the Klamath Mountains	23
2.5.1.	General Aspects	23
2.5.2.	The Klamath Mountains	24

II. EASTERN CENTRAL ALPS, DAVOS TO THE VALMALENCO

1. Sampling

1.1.	Eastern Central Alps, from Davos to the Valmalenco	29
1.2.	Other Regions in the Alps	30

2. Mineralogy of the Silicates in the Serpentinites
related to Metamorphism

2.1.	Introduction	34
2.2.	Arosa-Platta nappe	35
2.3.	Valmalenco	37
2.4.	Microprobe Analyses	41

2.5.	Discussion on the Olivine Genesis and the Contact Metamorphism in the west Valmalenco	45
2.6.	Summary of the Most Important Results	48
3.	Chrome Spinel Variations and their Alteration in the Serpentinites	
3.1.	Introduction	61
3.2.	Sampling; Analytical Methods	62
3.3.	Results	
3.3.1.	Spinel in the Davos region (prehnite-pumpellyite facies)	63
3.3.2	Cr-spinel (I) in the Oberhalbstein (upper prehnite-pumpellyite facies)	64
-	Cr-spinel alteration in serpentinites without carbonate	64
-	Cr-spinel alteration in serpentinites containing small amounts of carbonate	65
3.3.3.	Cr-spinel (I) in the Engadin (greenschist facies)	66
3.3.4.	Cr-spinel (II) in the Oberhalbstein and Engadin (prehnite-pumpellyite to greenschist facies)	66
3.3.5.	Spinel in the Valmalenco	68
3.3.6.	Chlorite as an Alteration Product	70
3.4.	Discussion and Interpretation	
3.4.1.	Alteration Processes of the Spinel -	71
-	Cr-spinel in carbonate-free serpentinite; alteration related to reducing conditions, trend (a)	71
-	Cr-spinel in carbonate-bearing serpentinite; alteration related to locally oxidizing conditions, trend (b)	75
3.4.2.	Primary Magmatic Features	76
3.5.	Summary	78
4A.	Accessory Opaque Minerals in the Serpentinites (without chrome spinel)	
4A.1.	Introduction	113
4A.2.	Sampling, Methods and Problems of Investigation	116
4A.3.	Occurrences of the Arosa-Platta nappe	116
4A.4.	Occurrences of the Valmalenco	121
4A.5.	Interpretation and Discussion	
4A.5.1.	Textural Remarks	123
4A.5.2.	The Fe-Ni[+Co]-S Phases	124
4A.5.3.	The Gersdorffite-Cobaltite Solid Solution Series	134
4A.6.	Summary	138

4B. Small Massive Sulfide Deposits	
4B.1. Introduction	167
4B.2. Occurrences of the Arosa-Platta nappe	
- Tgant Ladrun (OH1)	169
- Tinzen Ochsenalp (OH4)	170
- Gruba (OH5)	171
- Cotschens (OH9 + OH10)	177
- Blaunca, Oberengadin (Bl.)	179
4B.3. Occurrences of the Valmalenco	
- Pass d'Ur (P.d'Ur)	180
- Point 1621m (Prim)	182
- Laghetti di Sassera (Lagh)	182
4B.4. Summary and Discussion	184
5. Bulk Chemistry	205
6. Platinum Group Element (PGE) Analyses of Serpentinites	
6.1. Introduction	217
6.2. Sampling	219
6.3. Analytical Methods and Results	220
6.4. Interpretation and Comparisons	222
6.5. Summary and Conclusions	227
7. Stable Isotope Analyses of Serpentinites; Contrasting Serpentinization Processes	
7.1. Introduction	234
7.2. Analytical Procedure	234
7.3. Results	235
7.4. Water/Rock ratios	236
7.5. The Serpentinization Process	
7.5.1. The Arosa-Platta nappe	240
7.5.2. The Valmalenco	241
7.6. Carbonates	245
7.7. Discussion	247
7.8. Conclusions	248
III. KLAMATH MOUNTAINS (some selected areas)	
1. Introduction	
1.1. The Concept	261

1.2 Sampling	261
2. Results	
2.1. Josephine Peridotite	263
2.2. Trinity Peridotites	270
2.3. Summary of the Observations	271
3. Discussion	273
IV. CONCLUSIONS and COMPARISON	291
Abstract	309
Zusammenfassung	310
References	313
Appendix	
- List of Figures	341
- List of Tables	344
- List of Plates	345