

Contents

Versicherung..... I

Acknowledgements..... III

Abstract V

Kurzfassung VII

Contents IX

List of Figures..... XIII

List of Tables..... XIX

List of Acronyms XXI

1 Introduction 1

2 Geology of the study area 4

2.1 Kupferschiefer – Definition 4

2.2 Regional Geological Setting..... 5

2.3 Local Geological Setting - The Mulkwitz-anticline..... 6

2.4 Distribution of significant mineralization in the Kupferschiefer 8

2.5 Genetic Theories 13

2.5.1 Syn-sedimentary model..... 14

2.5.2 Early-diagenetic model..... 14

2.5.3 Late-diagenetic model..... 14

2.5.4 Post-diagenetic (epigenetic) model 15

2.5.5 New holistic model of Borg et al. (2012)..... 15

2.6 Mineralogy and Geochemistry of the copper ores in the Kupferschiefer..... 15

3 Geometallurgy 17

3.1 Geometallurgical domains 18

3.2 Geometallurgical mapping 19

3.3 Sampling in geometallurgical domain definition 20

4 Methodology 21

4.1 Mineral Liberation Analyzer (MLA) 21

4.2	QEMSCAN.....	23
5	Preparation of a polished reference block for the identification of Cu- and Cu-Fe-sulfides.....	25
5.1	Introduction.....	25
5.2	Methodology.....	26
5.2.1	Preparation of the Polished Reference Block.....	27
5.2.2	Reflected Light Microscopy.....	27
5.2.3	Electron Probe Microanalysis.....	27
5.2.4	Mineral Liberation Analysis.....	29
5.3	Results.....	30
5.3.1	Reflected Light Microscopy.....	30
5.3.2	Electron Probe Microanalysis.....	33
5.3.3	Mineral Liberation Analysis.....	37
5.4	Discussion.....	38
5.4.1	Criteria for a polished reference block for SEM-based image analysis.....	38
5.4.2	Digenite - high standard deviations of Cu and S measured by EPMA.....	39
5.4.3	Mineral Liberation Analysis – limits of differentiation between minerals of similar MAN	40
5.5	Conclusion.....	41
6	Proposals for standardization of automated mineralogy analyses.....	43
6.1	Introduction.....	43
6.2	Samples and Methods.....	43
6.2.1	QEMSCAN and MLA.....	44
6.2.2	Quantitative X-Ray Powder Diffraction (QXRD).....	46
6.2.3	Geochemical Assay Data.....	47
6.2.4	Sample Preparation.....	47
6.2.5	Reproducibility of MLA Data.....	48
6.3	Results.....	49
6.3.1	Reproducibility of MLA Data.....	49
6.3.2	Qualitative and Quantitative Mineralogy.....	52

6.3.3	Mineral Association	56
6.3.4	Mineral Grain Size Distribution	59
6.3.5	Validation of Data	60
6.4	Discussion	64
6.4.1	Summary of major discrepancies between the MLA and QEMSCAN data sets	64
6.4.2	Identification of possible sources of error	65
6.5	Conclusion	71
7	Quantitative mineralogical and textural studies on mineralized lithotypes intersected by exploration drill core CuSp 131/09 and CuSp 136/09, Spremberg	72
7.1	Methodology	72
7.1.1	Drill Core Logging and Sampling	74
7.1.2	Transmitted and Reflected Light Microscopy	74
7.1.3	Quantitative X-Ray Powder Diffraction (QXRD)	74
7.1.4	Mineral Liberation Analysis	75
7.1.5	Geochemical Data	76
7.2	Results of drill core CuSp 131/09	76
7.2.1	Qualitative Mineralogy	77
7.2.2	Quantitative Mineralogy	84
7.2.3	Comparison of mineralogical results between MLA and QXRD	95
7.2.4	Geochemical Assay Data	99
7.2.5	Grain size distribution	102
7.2.6	Mineral Association	109
7.3	Results of drill core CuSp 136/09	114
7.3.1	Qualitative Mineralogy	114
7.3.2	Quantitative Mineralogy	119
7.3.3	Comparison of mineralogical results between MLA and QXRD	130
7.3.4	Geochemical Assay Data	134
7.3.5	Grain size distribution	137
7.3.6	Mineral Association	142

7.4	Discussion	147
7.4.1	Differences and similarities concerning the gangue mineralogy	147
7.4.2	Differences and similarities concerning the ore mineralogy	151
7.4.3	Grain Size Distribution and Mineral Association Data of the Cu- and Cu-Fe sulfides	151
7.5	Conclusion	152
8	Conclusions and Recommendations.....	153
8.1	Analytical problems and possible solutions concerning the MLA.....	153
8.1.1	Sampling and sample preparation	153
8.1.2	Measurement	154
8.1.3	Interpretation of Data	154
8.2	Analytical problems and possible solutions regarding the Kupferschiefer and adjacent lithotypes	153
8.3	Suggestions for further work.....	156
9	References	157
10	Appendices	DVD