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Environmental-geochemical Atlas of the Central-northern Part of the Copperbelt Province of Zambia

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FOREWORD

This Environmental-geochemical Atlas of the Central-northern Part of the Copperbelt Province of Zambia is published to assist the Government and people of Zambia in understanding the impacts of ore mining and processing on the environment.

Significant geological exploration and mining in Zambia started during the 1920s when the British South African Company (BSAC) offered prospecting rights to large multinational companies. This resulted in the discovery and development of various mines such as Luanshya and Nkana Mines (1931), Mufulira (1933) and Nchanga (1936), Konkola and Nchanga (1957), Chibuluma Mine (1964) Chambeshi Open pit (1965), Bwana Mkubwa (1971) and Chambeshi underground mine (1972) under the main companies of Anglo American Corporation (AAC) and Roan Selection Trust (RST). Annual Zambian copper production peaked at over 755,000 in 1969. In the same year, the Zambian government nationalised the industry by acquiring a 51% stake in all mining utilities and reorganised them into Nchanga Consolidated Copper Mines Limited (NCCM) and Roan Copper Mines Limited (RCM). In 1979, this stake was further increased to 60.3%. In 1982, in an attempt to redress falling production trends, NCCM and RCM were merged into the Zambia Consolidated Copper Mines Limited (ZCCM). By 2000, the ZCCM mines were all privatised.

Considering that in all these years, mining has been centered on profit making, the huge tonnes of copper and cobalt produced over a span of 75 years of mining on the Copperbelt produced enormous amounts of waste due to mining and processing. No baseline studies on the natural backgrounds and what effect mining and processing would be to the environment and the ecosystem including human health during mining and after, this project implemented within a framework of the Development Cooperation Programme of the Czech Republic to the Republic of Zambia in years 2002, and 2004 to 2006 was therefore set-up to determine the extent of industrial contamination, and in some respects the "first of its kind" in that it also determined the natural background on the Copperbelt before mining by sampling sub-surface soils up to 90 cm depth as well as mining impacts on agricultural plants.

The results of this project carried out by the Czech Geological Survey in cooperation with the Geological Survey Department of the Ministry of Mines and Mineral Development of Zambia, the Geology Department, School of Mines at the University of Zambia, and the Geological Institute of the Academy of Sciences of the Czech Republic are contained in the four reports (Kříbek and Nyambe, 2002, 2004, 2005, 2006) and are summarized in this book, here called "Environmental-geochemical Atlas of the Central-northern part of the Zambian Copperbelt".

These maps show up-to-date regional geochemical data for both unpolluted and polluted areas of the Central-northern part of Zambian Copperbelt including heavy metals and sulphur in stream sediments, soils and agricultural plants. More importantly, some of the maps show the extent of industrial pollution on the Copperbelt, affecting agricultural plants, soils and stream sediments.

The Ministry of Mines and Mineral Development, on behalf of Government of Zambia strongly recommends this Atlas for use by government administrative units (for example Environmental Council of Zambia and Mine Safety Department) to accentuate their efforts in coordinating environmental management, promotion of public awareness and minimisation of environmental deterioration in areas affected by mining and processing of raw materials. The mining companies will find it useful in their formulation and implementation of their Environmental Management Plans during mining and after closure. Local administrative authorities such as city and municipal councils on the Copperbelt are also encouraged to use the Atlas as a foundation for an improved decision making at all levels beginning with allocating of land-use zones in town planning to the sustainable development in the use of raw materials. The Atlas can also be of use as reference material for basic courses in environmental and earth sciences at universities in Zambia. It can be a starting point for formulation of environmental-geochemical research on the Zambian Copperbelt and elsewhere in Zambia.

The Ministry is grateful to the Czech Republic for this support and wish for a continued support in this area. Indeed, based on this Atlas, the Ministry believes that more efficient environmental impact assessment and reclamation of tailing impoundments spoil banks and waste deposits can be carried out by various agencies, enabling them to immediately deal with the most critical issues of land and environmental management.

Dr. Kalombo Mwansa
Minister
Ministry of Mines and Mineral Development

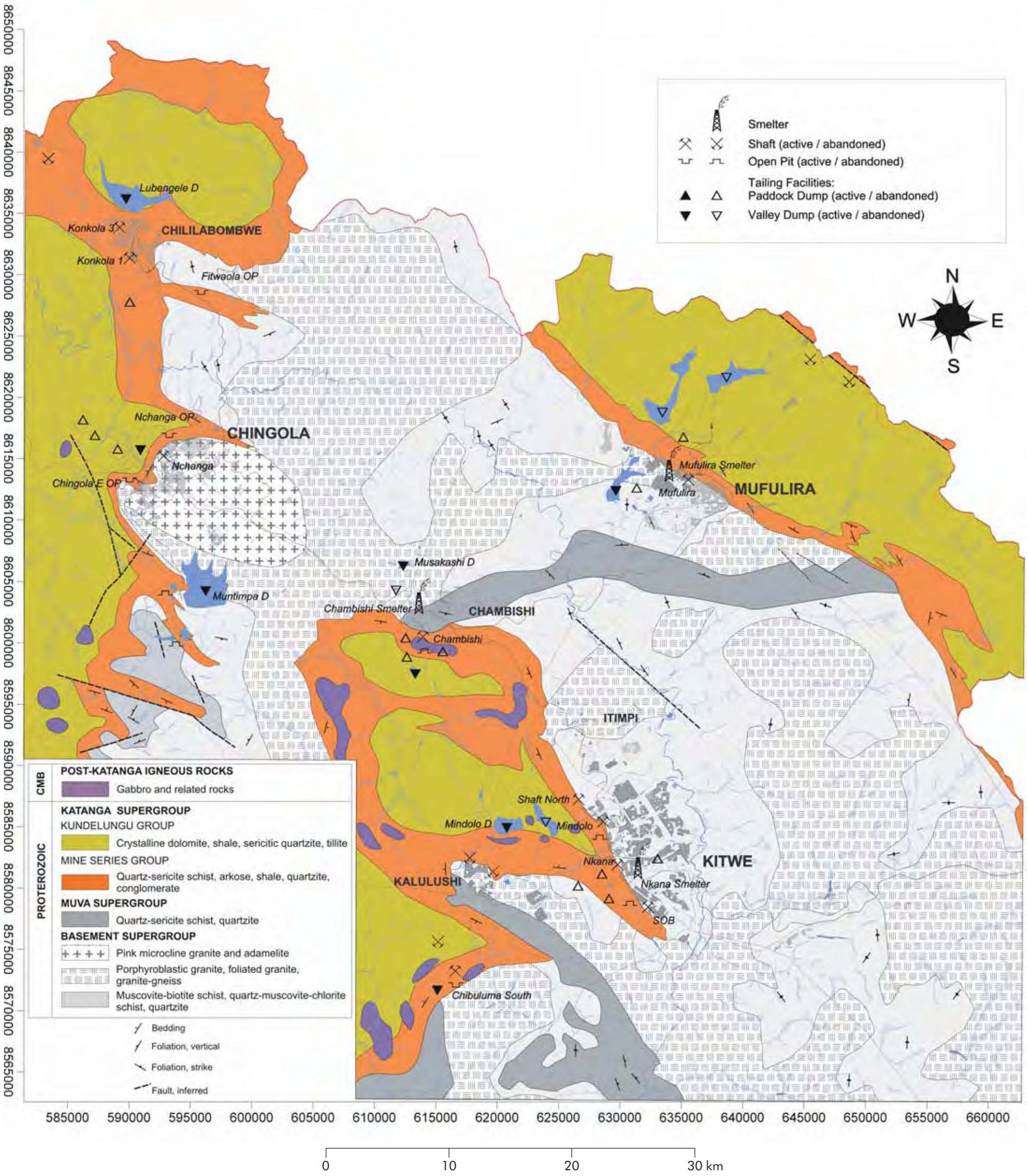
INTRODUCTION

The environmental degradation in the Zambian part of the Copperbelt is poorly quantified in spatial terms since the availability of accurate and up-to-date regional geochemical data for both unpolluted and polluted areas are limited. Moreover, a high natural background of heavy metals and sulphur in many stream sediments and in soils makes the evaluation of the degree of industrial pollution difficult. To determine the extent of industrial contamination, an environmental-geochemical survey of soils, agricultural plants and stream sediments was implemented within a framework of the Development Cooperation Programme of the Czech Republic to the Republic of Zambia in years 2002, and 2004 to 2006 (Kříbek and Nyambe, 2002, 2004, 2005, 2006). Field work was carried out by the Czech Geological Survey in cooperation with the Geological Survey Department of the Ministry of Mines and Mineral Development of Zambia, the Geology Department, School of Mines at the University of Zambia, and the Geological Institute of the Academy of Sciences of the Czech Republic. In field work and interpretation of results, a number of people participated and have been authors to project reports over the years (Kříbek and Nyambe, 2002, 2004, 2005, 2006) including Jiří Adamovič, Petr Bezuško, Francis Chibesakunda, Alphed Dokowe, Josef Godány, Ilja Knésl, Mabvuto Mwale, Kelvin Mwamba, Bohdan Kříbek, Vladimír Majer, Imasiku Nyambe, Jan Pašava, Vratislav Pecina, Petr Rambousek and Simasiku Simasiku.

The main results of the project contained in the four reports (Kříbek and Nyambe, 2002, 2004, 2005, 2006) are summarized in set of maps, here called "Environmental-geochemical Atlas of the Central-northern part of the Copperbelt Province of Zambia". These maps show up-to-date regional geochemical data for both unpolluted and polluted areas of the Central-northern part of the Zambian Copperbelt including heavy metals and sulphur in stream sediments, soils and agricultural plants. More importantly, some of the maps show the extent of industrial pollution on the Copperbelt, affecting agricultural plants, soils and stream sediments. This Atlas is strongly recommended for use by government administrative units (for example Environmental Council of Zambia and Mine Safety Department) to accentuate their efforts in coordinating environmental management, promotion of public awareness and minimisation of environmental deterioration in areas affected by mining and processing of raw materials. Local administrative authorities such as city and municipal councils on the Copperbelt are also encouraged to use the Atlas as a foundation for an improved decision making at all levels beginning with allocating of land-use zones in town planning to the sustainable development in the use of raw materials. The Atlas can also be of use as reference material for basic courses in environmental and earth sciences at universities in Zambia. It can be a starting point for formulation of environmental-geochemical research on the Zambian Copperbelt and elsewhere in Zambia.

Based on the Atlas, more efficient environmental impact assessment and reclamation of tailing impoundments, spoil banks and waste deposits can be carried out by various agencies, enabling them to immediately deal with the most critical issues of land and environmental management.

The authors wish to thank Mr. Kennedy Liyungu, Director of the Geological Survey Department, Ministry of Mines and Mineral Development, Zambia for his support during the fieldwork. Dr. Sixtus Mulenga (Vice President, Safety, Health and Environmental Quality, Konkola Copper Mines Plc.), and Mr. Tim Williams, Mineral Resources Manager at Nchanga are thanked for the logistical support. Special thanks are due to Mr. Tim Henderson (Chief Executive, Mopani Copper Mines, Plc.), and Mr. Wellington Mukumba (Chief Geologist, Mopani Copper Mines, Plc.), for their effective cooperation and sponsorship. Without their help this study would not have been possible. Dr. Francis Tembo, Dean, School of Mines, is thanked for logistic support, particularly to the use of the School of Mines Research House in Kitwe on the Copperbelt.



Map No. 1. Geological map of the Central-northern part of the Copperbelt Province of Zambia. Compiled and simplified from Garrard (1994), Marjonen (2000), and Mukwila (2002).
Abbreviations: D – Dam, OP – Open Pit, E OP – "E" Open Pit, SOB – South Ore Body.