Environmental Geophysical Analysis of Portion of the Muddy and Roaring Creek Watersheds, West Virginian

by

Fouzan Ali Al-Fouzan

BS, King Saud University, 1994

Submitted to the Graduate Faculty of

Arts and Sciences in partial fulfillment

of the requirements for the degree of

Master of Science

University of Pittsburgh

2002

UNIVERSITY OF PITTSBURGH

FACULTY OF ARTS AND SCIENCES

This thesis was presented

By

Fouzan Ali Alfouzan

It was defended on

August 6, 2002

And approved by

Dr. Michal Ramsey

Dr. Chen Zhu

Dr. William Harbert

Committee chairperson

Advisor: Dr. William Harbert

Environmental Geophysical Analysis of Portion of the Muddy and Roaring Creek Watersheds, West Virginia

Fouzan Ali Al-Fouzan, MS

University of Pittsburgh, 2002

Abstract

This thesis presents a new environmental geophysical analysis derived from airborne and ground measurements of electromagnetics and total magnetic field collected from the Muddy and Roaring Creek watersheds located in northeastern Preston County, West Virginia. This region is referred to as the T&T mine area. In the simplest representation, with respect to subsurface Acid Mine Drainage (AMD) impacted water systems, the subsurface regions can be thought of as containing three pools of AMD contaminated water. The objectives of this project were to determine the location of these subsurface pools, the lateral extent of a contaminated mine pool located at a depth of about 300 feet, and to determine areas of groundwater recharge to the mine pool. Geophysical data analyzed included frequency-domain electromagnetic (EM) conductivity (380, 1400, 6200, 25k and 102k Hz), VLF (VLF1I from Cutler station, VLF2I from Seattle station), and total field magnetics. In order to check the airborne data, ground measurements were collected using EM34 and EM47 instruments. These data were collected for the National Energy Technology Laboratory of the U.S. Department of Energy as part of their active and ongoing environmental geophysical program. Cultural noise was removed from some of the conductivity dataset using ER MAPPER software and applying a variety of

spatial frequency filters. ER MAPPER, ERDAS Imagine, ERDAS Virtual GIS, ESIR Arc/Info, and ESRI ArcView software package were then used to display and interpret the data. The geometry of the high-conductivity pools were imaged using a variety of techniques including Hue Saturation and Intensity (HSI) algorithms and unsupervised classification using ER MAPPER and Arc/Info software. After the pool geometry was determined, a series of geophysical profiles were extracted from the edges of the three pools. I interpret these data as showing the geometry of the mine pools and regions of contrasting groundwater conductivity related to discharge.

Acknowledgments

I would like to take this opportunity to thank every one who assisted me in finishing this thesis. First and foremost I would like to think my advisor, William Harbert for his continuous support, guidance, encouragement, and his unlimited patience along his wide and deep knowledge made it possible for me to accomplish this work. I would like also to thank Michal Ramsey and Chen Zhu for as committee members for their helpful comments and suggestions regarding this thesis and their invaluable cooperation.

My greatest thanks go to my parents for their support and encouragement from childhood, on, and to my wife Munirah for her endless support, encouragement, and patience, and of course to my daughters Reem and Noura for their enormous help.

Also, I would like to thank King Abdulaziz City for Science and Technology for financial support. I would like to express my gratitude to the National Energy Technology Laboratory (NETL) of the U.S. Department of Energy (DOE) for their helpful, cooperation, and allowing me to use their data, special thanks to Terry Ackman, Richard Hammack, Garret Veloski, Jennifer Shogren, Jim sams, and Bob.

To my parents and my family

Contents

List of Figures

List of Tables