Pollution detection in mining environments using airborne geophysical and other remotely sensed data

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1 Introduction

Remote sensing and geophysics are often seen as two separate disciplines within the earth sciences. However both are based on the remote detection of variations in the physical properties of earth materials and can be seen to play a complementary role in earth observation. Within mining environments, a definite need exists for the direct detection of pollution streams, with airborne and space-borne sensors proving ideal as they are able to provide full coverage of relatively large areas within a short enough timeframe to allow periodic routine coverage as well as providing the capacity for emergency coverage (International Atomic Energy Agency 2003).

Two major categories of information can be deduced from these remotely sensed earth observation data types:

- Direct detection of pollution streams.
- Mapping of environmental features which will have an impact on pollution migration or other processes.

2 The electromagnetic spectrum

Most remote sensing methods rely on a portion of the electromagnetic spectrum, generally using external illumination in the form of solar radiation or radar illumination. Geophysical methods commonly applied to pollution detection use different parts of the electromagnetic spectrum, typically much longer wavelengths than those used in radar and optical remote sensing in the case of electromagnetic surveying and very high photon energies in the case of gamma ray surveying (Sherriff 1974).

3 Methods

This paper will discuss the use of various airborne geophysical methods for pollution detection in mining environments. In particular case studies using the airborne radiometric method in the Witwatersrand Goldfields will be presented. Additional methods with direct application in mining environments are the airborne electromagnetic method, which allows the

direct detection of saline groundwater plumes and the airborne magnetic method, which allows the detection and mapping of subsurface geological structures.

The airborne radiometric method (Cook 1952; Grasty 1975) detects and characterises gamma rays emitted by certain radionuclides on the earth's surface. This allows the detection of pollution plumes, characterization of pollution sources and, under certain conditions, the quantification of radiation levels at the earth's surface. The elevated uranium levels in the Witwatersrand ores (Cole 1998) results in elevated radioactivity levels in the waste streams which are easily detectable using airborne sensors (Coetzee and Szczesniak 1993).

4 Data integration

Successful interpretation of remotely sensed data often requires the integration of other information and data streams. Unfortunately the topologies of geophysical and optically remotely sensed data are often different complicating automated interpretation methods. Combinations using a number of typical GIS operations are however able to produce thematic maps which clearly indicate and characterise environmental impacts (Chevrel and Coetzee 1997).

5 Conclusion

Geophysical and conventional remotely sensed data provide complementary information which can be applied effectively in environmental assessments of mining areas.

6 References

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