ELEMENT DILUTION FACTORS FOR DETECTING AMD-RELATED METAL CONTAMINATION

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Introduction

Long histories of mining in many countries around the world have led to extensive AMD in surface waters.

AMD is an acidic, metal-enriched discharge formed as a result of pyrite oxidation and is largely associated with mine tailings and slimes.

While the impact of AMD on the environment is well documented, no previous work has made use of element dilution factors to study AMD-related metal contamination in streams.

This study proposes a novel way to address this research gap by using iron (Fe) and aluminium (Al) dilution factors to trace AMD-related metal contamination. The proposition is demonstrated for Zn in the study area.

Study Area

The Blesbokspruit River (fig. 1), forms part of the Olifants' River catchment in South Africa, and is located approx. 5 km north west of the coal-mining town of Emalahleni, Mpumalanga.

Methodology

Stream water- and overbank sediment samples were collected along an approx. 8 km stretch of the Blesbokspruit River (fig. 1), towards an acid pool contamination source and analyzed for Fe, Al, Co, Ni, Cu, Zn, Pb, As, Cr and Cd by ICP-OES/MS.

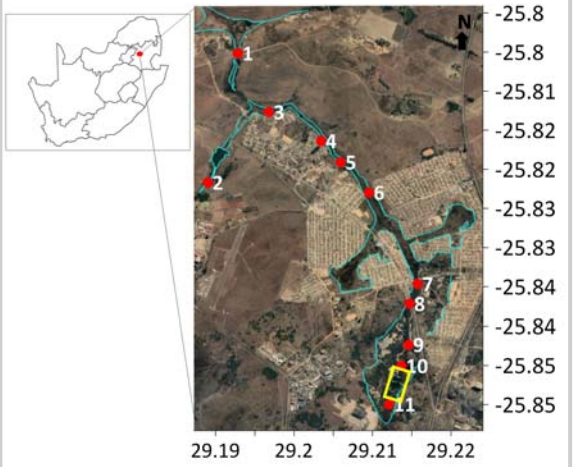

Fig. 1: Sample locations (red dots) and contamination source (yellow rectangle) along the Blesbokspruit River, Mpumalanga, South Africa.

Al and Fe dilution factors (fig. 2) were calculated by dividing aqueous concentrations of Al and Fe by their respective sediment concentrations, and mapped using Surfer® software

Results

Increased Zn concentrations generally correlate with increased Al and Fe dilution factors (fig. 2). Similarly, lower Al and Fe dilution factors generally correlate with subdued Zn concentrations.

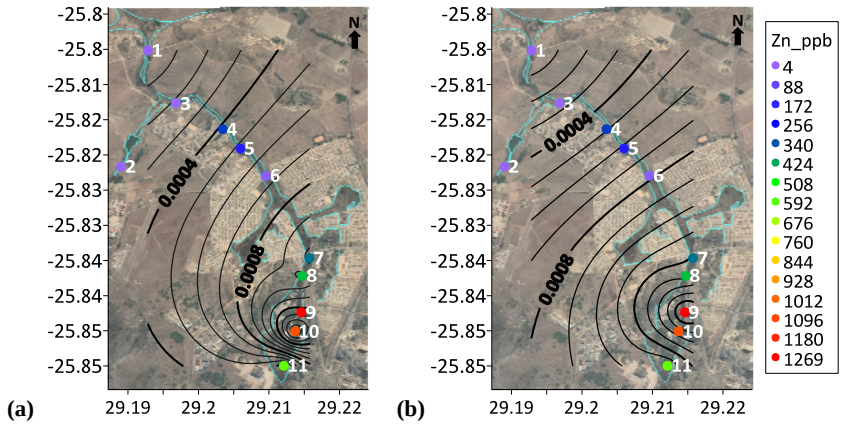

Fig. 2: Distribution of Zn (ppb) along the Blesbokspruit River relative to dilution factor contours of (a) Al and (b) Fe.

Discussion

Fe and Al are typical components of AMD and were used in this work to detect AMD-related Zn contamination.

Al and Fe dilution factors show strong correlation and can be used to group samples into four general divisions according to the probability of Zn contamination: low probability (< 0.0004), moderate probability (0.0004 – 0.0008), high probability (0.0008 – 0.0012) and very high probability (> 0.0012).

Conclusion

Al and Fe dilution factors show good potential as proxies for tracing high probability zones of metal contamination in AMD-affected streams. Thus, proving useful for long-term metal contamination studies. The advantage of using Al and Fe to trace AMD-related contamination is that they are major elements and easier to analyze compared to trace elements such as Zn.