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The distribution of some potentially harmful elements (PHEs) in the Krugersdorp Game Reserve, Gauteng, South Africa: Implications for wildlife health

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Krugersdorp is the locus of an important wildlife game reserve, the Krugersdorp Game Reserve (KGR) situated (< 1,000 m) down-gradient of the large-scale gold mining outfits of Mintails Mogale Gold (MMG) and Rand Uranium (RU). In this study, we attempt to explain in a broad context, the migration characteristics in the soil of potentially harmful elements (PHEs) derived from the MMG and RU mine effluents largely in the form of acid mine drainage (AMD), and collate these with available data on wildlife health in the KGR.

A total of 36 georeferenced soil samples were collected (in duplicate) from the MMG, RU and KGR, as well as from farmlands and waterways adjacent to the mining sites. All samples were prepared using standard laboratory procedures and analysed for a range of PHEs and some micronutrients by both Inductively Coupled Plasma Emission Spectrometry (ICP-ES) and Inductively Coupled Plasma Mass Spectroscopy (ICP-MS) following an *aqua regia* decomposition procedure. In this study, significant variations in As, Co, Cu, Hg and Pb in terms of acceptable levels in soil for safe wildlife nutrition were identified by applying the 'integrated pollution index' (IPI) measure, using established reference values for maximum acceptable concentration (MAC) levels of PHEs in agricultural soils worldwide.

The geochemical landscape at the KGR is shown to be in flux. Changes in both micronutrient and PHE composition as well as their bioavailability and bioaccessibility vary markedly at relatively short timescales, dependent largely on the quality of mine effluents and decant from the adjacent MMG and

RU gold mines. We put elemental abundances in perspective, and illustrate that soil values at KGR, controlled by the bedrock geology (largely carbonate) and/or water-rock interaction, are variable in both space and time. We attempt to determine the extent to which PHEs could influence the health of the wildlife population in the KGR.

It is hoped that results from this study would help in the formulation of intervention measures such as mitigation (AMD neutralisation), rehabilitation and soil amendment.