

A multi-element baseline geochemical database from the western extension of the Central Africa Copperbelt in north-western Zambia

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A stream sediment geochemical survey was undertaken in the extreme north-west of Zambia with three primary objectives: (i) to provide a baseline environmental database for an area uncontaminated by heavy industry, mining and intensive farming; (ii) to detect metal anomalies that may indicate potentially economic mineral deposits; and (iii) to provide a tightly controlled geochemical database that can be used as a standard for future mineral exploration programmes throughout central Africa. Three major geological domains underlie the studied area. These are crystalline Neoproterozoic to Palaeoproterozoic basement, an overlying sequence of Neoproterozoic Katanga strata within the western part of the Lufilian Arc (a Pan African orogenic belt that hosts major copper-cobalt deposits in the Central African Copperbelt of northern Zambia and the Democratic Republic of Congo [DRC]), and extensive Cenozoic Kalahari Group sediments. Stream sediments collected from each of the three geological domains have distinctive geochemical signatures. Relatively high values for a range of elements including uranium, thorium and yttrium were found in stream sediments within the pre-Katanga basement domain. Enhanced values of a larger number of elements are present in the stream sediments underlain by Katanga strata including significant, previously unknown, copper anomalies that warrant detailed follow-up work.

The high metal values in sediments derived from Katanga strata contrasts sharply with sediment samples collected from drainage channels in areas of thick Kalahari sand, which mostly have very low values of all analysed elements. Our results suggest that it will be difficult to detect contamination of streams in the Copperbelt areas of Zambia and the Democratic Republic of Congo due to their naturally high metal concentrations. By contrast, it will be relatively easy to monitor pollution of areas underlain by Kalahari sands as these have naturally very low values of all elements.

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INTRODUCTION

A stream sediment survey was undertaken of an area of about 13 500 km² in the extreme north-west of Zambia (to cover the 1:250 000 Mwinilunga Sheet, SC-35-13; Fig. 1) between 1998 and 2000 as part of a World Bank-funded geological mapping project by BGS and the Zambian Geological Survey. The stream sediment survey had three primary objectives: (i) to provide a baseline geochemical database that can be used to monitor pollution due to mining and agriculture in the region; (ii) as an exploration tool for uranium, base and precious metals; and (iii) to provide a tightly controlled multi-element geochemical data base that can be used as a standard for future geochemical exploration elsewhere in central Africa.

The extreme north-western part of Zambia is an unspoiled rural area with no history of mining or of modern intensive agriculture. It is sparsely populated and local people have maintained a traditional lifestyle with small fruit and vegetable gardens and small stocks of animals. A well-developed drainage

network forms the headwaters of the upper Zambezi River and provides an abundant supply of clean water for the local people. Collected stream sediments are, therefore, uncontaminated.

Three major geological domains underlie the studied area. These are a crystalline Neoproterozoic to Palaeoproterozoic basement, overlying Neoproterozoic Katanga strata within the western part of the Lufilian Arc orogen and extensive Cenozoic Kalahari Group sediments. A total of 3024 stream sediment samples were collected and analysed by ICP-MS for 40 elements. The samples were also analysed for gold, platinum and palladium by Fire Assay, and for uranium by XRF. Samples were wet sieved in the field and the $-100\mu\text{m}$ fraction was bagged for analysis.

The geology of the mapped area is described in a series of Zambian Geological Survey reports^{21,22,24,28,29} that accompany geological maps of the five component 1:100 000 sheets. An overview of the geology is given in a memoir²⁵ of the Zambian Geological Survey and is also summarised in Key *et al.*²⁶