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Geochemical Investigation of Arsenic in Drinking Water Sources in Proximity of Gold Mining Areas within the Lake Victoria Basin, in Northern Tanzania

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Summary

Access to safe drinking water is a challenge for rural communities in many developing countries. Drinking contaminated water endangers human health and impairs social and economic development. Arsenic

The natural occurrence of arsenic (As) in surface and groundwater is a worldwide environmental problem, posing a severe risk for human health due to the high toxicity of the metalloid. Considering that arsenic sulphide minerals are a significant component of gold deposits, gold mining activities have been pointed out as a cause of As pollution of surface drainage and groundwater in several countries. The problem of As in drinking water has been brought to attention in Tanzania only few years ago and further investigation are therefore needed to enable an early detection of harmful exposures.

This study aims to assess occurrence, source and mobilization mechanisms of As in some drinking water sources within the Lake Victoria Basin, in Northern Tanzania. Rural communities living in areas known for artisanal and large-scale gold mining activities were the target of the present study.

Fifty-four water samples were collected from a variety of drinking water sources (spring, borehole, river and shallow well) in Mara and Geita region during October 2016. pH, electrical conductivity (EC), Redox potential (Eh) and As were measured in situ. Major ions, dissolved organic carbon (DOC) and trace elements, including As, were analysed in the sampled water at KTH-Royal Institute of Technology, in Sweden.

53% of the sampled water do not comply with the WHO recommended limit of 10 µg/L , representing a serious health risk for some rural communities within the Lake Victoria Basin. The spatial distribution of As in the area under investigation is highly heterogeneous and it is mainly influenced by local geology and proximity to the mining sites (approx. < 5 km). Lower As levels in boreholes than in rivers and shallow wells indicates contamination of surface drainage by mining activities and suggest that deep groundwater (> 40 m) generally represent a source of safer drinking water.

The field-measured Redox potential indicates oxidising conditions, suggesting that oxidation-dissolution of arsenic sulphide minerals is a major mechanism of arsenic mobilization in groundwater. However, this study reveals that several geochemical processes control fate and mobility of As, once it has been released into the aquatic environment. Large discrepancies between field and laboratory measurements of As indicates a strong partition of the metalloid into the

particulate fraction. As revealed by the geochemical modelling, co-precipitation with iron /aluminium hydroxides and adsorption on clay minerals are presumed to be the major sinks for dissolved As. Moreover, a good match between peaks in As and dissolved organic carbon concentrations suggests that complexation by humic acids is responsible for enhanced As mobility.