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Integrated geological mapping approach and gold mineralization in Buhweju area, Uganda

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ABSTRACT

Deeply dissected mountainous ridges, paucity of exposure, deep weathering, extensive regolith, dense vegetation cover and poor accessibility, are detrimental to conventional field geological mapping. Conditions such as these, characterize our current study area; the Buhweju area in Uganda. The latter is poorly explored and known to host alluvial gold. In this work, an integrated geological mapping approach aiming at updating the geology, building relationships between the lithology and structure and assessing its control on mineralization was tested using Landsat TM, shuttle radar topographic mission (SRTM) and potential filed datasets (radiometrics and magnetics) subsequently validated by field investigations. Several image processing and enhancement techniques were applied that improved the aesthetic quality of the various remotely sensed datasets for visualization and interpretation. Among the image enhancement techniques, image fusion and pan-sharpening of the radiometric composite image with multispectral data and SRTM digital elevation model (DEM) have resulted in better lithological differentiation. In general, the present work, found complementarity in lithology with the legacy geological map. On the basis of similar radiometric signature however, various basement rock units such as pelitic schist, quartzo-feldspathic gneiss and granite were delineated and mapped; some in areas which were not reported before. These were validated during field investigation. Similarly, the aeromagnetic data depicted worthwhile information regarding litho-magnetic domains and tectonics of the Buhweju study area.

Three prominent structures trending NNW, ESE and NNE determine the tectonic grain of the area. These orientations are consistent with the two major and important regional tectonic trends known in the area; the NNE to the western Rift while the NNW attest to the regional Aswan shear zone. The control of the Buhweju gold field was also assessed in terms of the improved geological units and interpreted lineaments of the area. Accordingly, most gold occurrences are localized in preferred orientations and host rock. Density analysis carried out on surface and subsurface lineaments reveals the Buhweju group rocks and the undifferentiated schist and amphibolites are highly affected by surface lineaments whereas the basement rocks are affected mainly by subsurface lineaments. Two major clusters of gold occurrences were identified in the Buhweju gold field. The gold cluster found at Kitaka mine is characterised by a low magnetic anomaly and high lineament density, while the gold occurrences found at Katonga is hosted by mudstone and Lubare quartzite and underlain by a high magnetic anomaly. These gold clusters are spatially controlled by the NNW and NNE trending faults and their intersection determines the localization of most of the Buhweju gold occurrences. The two trends of structures in Buhweju could also be interpreted in terms of the Geita and Twangiza structural corridors (gold trends) known from the work of others. The NNW trending Geita structural corridors control gold mineralization in Tanzania while the NNE trending Twangiza corridor controls gold mineralization in the Democratic Republic of Congo (DRC).

1. Introduction

Geological maps are considered reliable sources of geoscience data. A good geological map provides information not only about the distribution and thickness of individual rock units but also reveals relationship among strata and structures which provide insight into many aspect; for example, an area's mineral potential (Woldai, 1998). Geological maps are essential tools in visualizing spatial 3-D geological relationships and assist in the prediction and location, size, shape and grade of potential ore bodies.

Whereas in the past, the coverage and publication of traditional geological maps was a process of multiple years of fieldwork, the need to timely attract foreign investment in the mineral resource industry, demands an alternative more time-efficient approach (Woldai and

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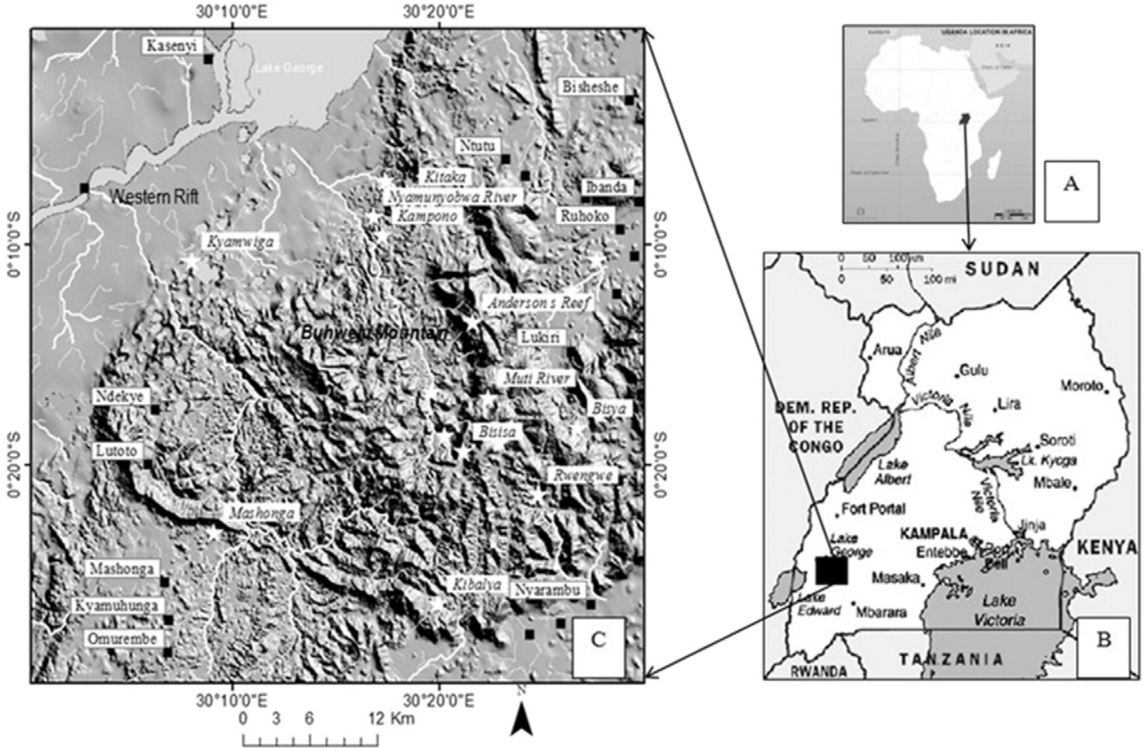

Fig. 1. Location map of the study area. A) showing the location of Uganda on the map of Africa; B) map of Uganda with the dark block corresponding the entire study area as shown in C). An SRTM derived DEM data is used in C) to give the morphological impression of study area (square dark blocks = towns; star = gold mining sites and white lines = major rivers and streams).

Schetselaar, 2002; Schetselaar et al., 2008). As a result, geological interpretations and mapping is greatly assisted by remote sensing data (Schetselaar et al., 2000). The remote sensing data (e.g., optical, microwave and geophysical) often provide information of the spatial distribution of patterns of geologic units, structures and rock properties. Legacy data provides the initial geologic framework (e.g., general geologic setting and rock types and preliminary stratigraphy). Field validation is required when producing geological maps from remote sensing and geophysical datasets. Integration of datasets enables the extraction of subtle variation in geological features otherwise difficult to obtain from one dataset alone. Furthermore, combining data sets in a geographic information system (GIS) to assist with identifying areas of

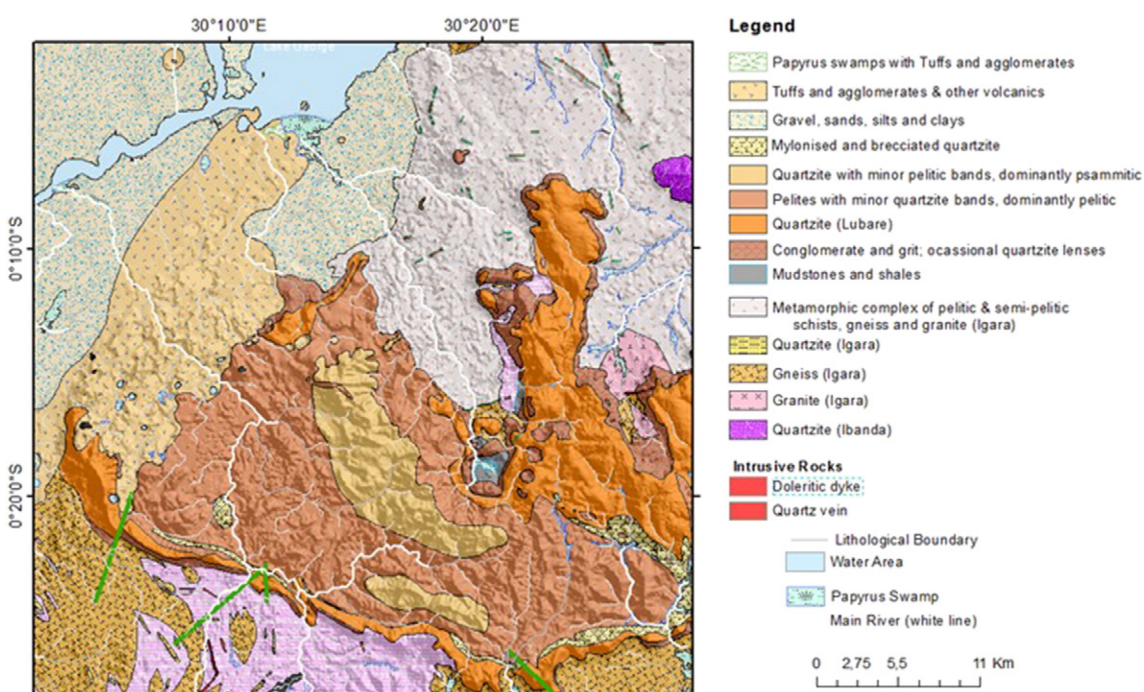

Fig. 2. Geological map of the Buhweju area (modified after Reece (1961)) fused with SRTM data as a background.