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Geoscience Integration - A Prospect for Gold Exploration Beyond 2021 in Ghana, West African Craton

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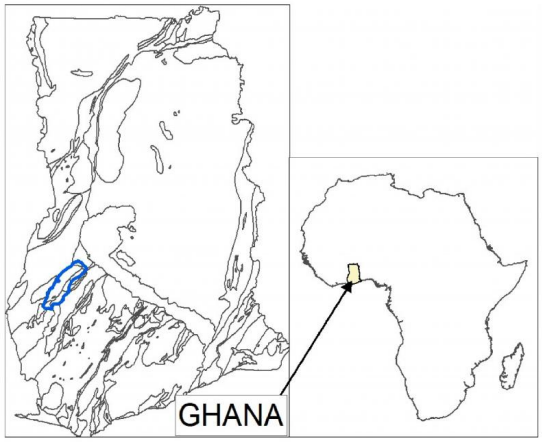
Orogenic gold deposits preserved in Precambrian greenstone belts such as Superior Province (Canada), the Dharwar Craton (India), and the West African craton (Ghana) contribute a share of 10-200 Moz of the world's gold resource. South-western Ghana is regarded as one of the most prolific regions for gold exploration, with gold making up 90% of the total mineral exports of the country. Currently, Ghana is the leading producer of gold (4.8 Moz) on the African continent, ahead of South Africa (4.2 Moz), with a volume reserve of 8.74 metric tonnes from 2015 to 2020. The geological structure complexity hosting this gold boom is linked to the Eburnean orogeny (ca. 2.1-1.9 Ga). The gold mineralisation on regional and local scale is controlled by major deformational structures (D1-D6), with imprints extending from shallower (~5km) to deeper (>15 km) depth on the cratonic scale. Deeper structures, such as faults and shear zones, acted as conduits for auriferous mineralised fluids with high gold concentrations to advect upward to form gold deposits in second- and third-order structures or fractured rock units in basins and belts. Traditional methods (stream sediments analyses, soil sampling, conventional geological mapping, drilling) of mineral exploration have dominated exploration in Ghana for decades, even though some of them are less successful in areas where bedrock geology is obscured by tropical vegetation, laterite, and thick saprolite soils. Adopting modern geophysical mapping (e.g., gravity, magnetic, seismic tomography, and magnetotelluric) will suffice for a thorough assessment of deeper subsurface structural architecture. To meet gold demand and production beyond 2021, a continuous search for new potential gold targets is required. The advanced development in GIS allows for a more reliable and cost-effective method of combining geoscience data sets to map new potential zones. The use of GIS-based geoscience integration to predict possible mineralized zones in Ghana is still in its early stages. However, in the areas where it has been implemented, the approach has been successful. In this presentation, the Ahafo Gold District of the Sefwi greenstone belt, southwest Ghana, was investigated to delineate potential zones for lode gold mineralisation. GIS-based weighted overlay, fuzzy overlay, and weight-of-evidence techniques were used to integrate evidential layers deduced from digital elevation, geological, and geophysical datasets. The approaches were successful in delineating potential zones for lode gold mineralization that can serve as a guide for further exploration in the study area. Adopting and implementing cost-effective GIS geoscience integration in Ghana will be critical in mapping prospective zones for exploration purposes, allowing basins and belts to fully exploit their mineral potential. The advent of efficient and cost-effective exploration, continuous mining production, and government support will not only increase gold production levels but will also make it a long-term sustainable endeavour.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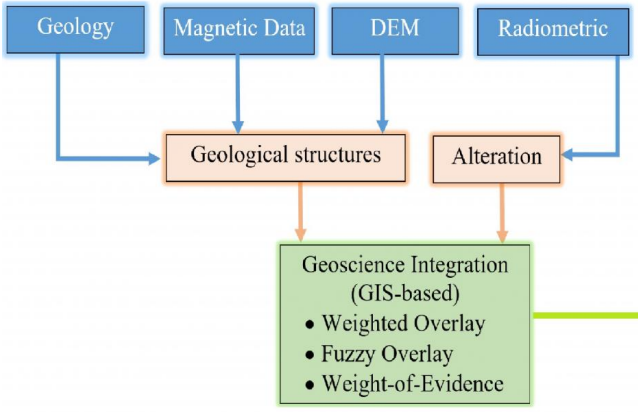
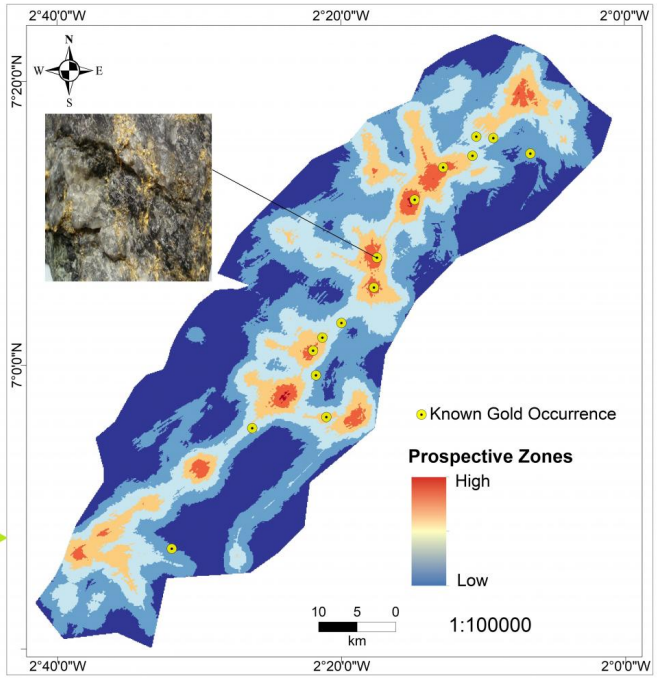

Geology
Magnetic Data
DEM
Radiometric
Geological structures
Alteration
Geoscience Integration
(GIS-based)
• Weighted Overlay
• Fuzzy Overlay
• Weight-of-Evidence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2°20'0"W
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7°0'0"N
N
W
E
S
Known Gold Occurrence
Prospective Zones
High
Low
10 5 0
km
1:100000