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Mining hydrogeological data from existing AEM datasets for mineral Mining

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Large amount of existing Airborne Electromagnetic (AEM) data are potentially available all over the World. Originally acquired for mining purposes, AEM data traditionally do not get processed in detail and inverted: most of the orebodies can be easily detected by analyzing just the peak anomaly directly evidenced by voltage values (the so-called "bump detection"). However, the AEM acquisitions can be accurately re-processed and inverted to provide detailed 3D models of resistivity: a first step towards hydrogeological studies and modelling. This is a great opportunity especially for the African continent, where the detection of exploitable groundwater resources is a crucial issue. In many cases, a while after AEM data have been acquired by the mining company, Governments become owners of those datasets and have the opportunity to develop detailed hydrogeological characterizations at very low costs. We report the case in which existing VTEM (Versatile Time Domain Electromagnetic - Geotech Ltd) data, originally acquired to detect gold deposits, are used to improve the hydrogeological knowledge of a roughly 50 km2 pilot-test area in Sierra Leone. Thanks to an accurate processing workflow and an advanced data inversion, based on the Spatially Constrained Inversion (SCI) algorithm, we have been able to resolve the thickness of the regolith aquifer and the top of the granitic-gneiss or greenstone belt bedrock. Moreover, the occurrence of different lithological units (more or less conductive) directly related to groundwater flow, sometimes having also a high chargeability (e.g. in the case of lateritic units), has been detailed within the regolith. The most promising areas to drill new productive wells have been recognized where the bedrock is deeper and the regolith thickness is larger. A further info that was considered in hydrogeological mapping is the resistivity of the regolith, provided that the most permeable layers coincide with the most resistive units. The resistivity model thus produced has allowed us to detect some alignments of conductive dykes, perforating the greenstone belt (made by volcanic Mafic and Ultramafic rocks or Metasedimentary formations), and correlated with the gold mineralization. Moreover, the conductive response of the basal serpentine-chloritized Ultramafic volcanic rocks, has allowed reconstructing the deeper structural features of the area. Therefore, the advantage in re-processing existing AEM data has been twofold, i.e. for both hydrogeological and geological-structural (hence mining) purposes. Concluding, we advocate for re-using of existing AEM datasets covering wide areas in underdeveloped and developing countries in to improve the hydrogeological characterizations of these nations where groundwater resources could cope with need of providing fresh / safe water to the population.