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Structural and groundwater mapping using geophysical methods over shear zones in the Namaqua Metamorphic Province

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The Geophysics Competency of the Council for Geoscience was tasked to conduct ground geophysical surveys in Kakamas, Northern Cape Province, South Africa, across five traverses namely: Cnydas, Lerm, Trooilapspan, Neilersdrift and Gifberg. The geology of the surveyed area located in the north eastern part of the Namaqualand Metamorphic Province of late Mokolian age, comprises mainly of granites and gneisses. The aim of the study was to investigate lineaments, geological structures, terrain boundaries and alteration zones to aid in geological mapping and understanding of the hydrogeology of the area. The study involved application of multi-geophysical methods including magnetic, radiometrics, and resistivity. Iris SYSCAL Pro Switch 72 electrical resistivity tomography was used in the dipole-dipole array configuration at 10 m electrode spacing to compliment for resistivity contrast at depth, as well as ability to detect vertically occurring structures. Magnetic data was recorded using Geometrics G859 and Geotron G5 magnetometers. The G859 was used as a rover due to its low noise/high sensitivity (0.008nT/Hz RMS), while G5 as a base station. Radiometric data was acquired using the state-of-the-art hand-held portable RS-125 Gamma Ray Spectrometer.

The resistivity surveys were conducted in Cnydas and Lerm in which the interpreted profile indicates significant lateral resistivity variations and thin sub-vertical NW dipping discontinuities of sharp resistivity contrast that were interpreted as faults. Based on the interpretation of the topography, geology, resistivity profile, the aquifer geometry could be a structurally controlled valley system. Magnetic and radiometric surveys were conducted in all five traverses where a major shear zone in Neilersdrift area shows a drastic drop in the magnetic readings and an increase in Thorium values due to possible destruction of magnetite minerals in the zone. The Trooilapspan shear zone that separate the Kaaine and Areachap terrains was delineated by magnetic and radiometric methods, despite that it is covered by Kalahari sand. These results confirm that geophysical methods can be used as useful non-intrusive tools for aiding in understanding the geological structural complexity of rocks in the study area. Considering this and also the ambiguity and none uniqueness in geophysical interpretation, results need to be consolidated by a local scale geological mapping and/or a shallow exploratory drilling.

References

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