GEOLOGY AND GEOMORPHOLOGY OF AN AREA CENTRED ON THE LOWER ORANGE AND MOLOPO RIVERS:TOWARDS A REMOTE SENSING - GIS SOLUTION

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The objective of this study is to investigate the evolution of geomorphology, specifically drainage, as a function of lithology, structure, tectonics, stream piracy, and climate change. The study also aims to better model the source and transport of alluvial diamonds.

Even though the Kalahari and Bushmanland region typically receives noless than 120 mm of rainfall per annum, it boasts a highly developed drainage system. Notable rivers include the Molopo, Kuruman, Nossob, Aoub, Bak and Kourop. This paradox has received relatively little attention over the past sixty years, this possibly being due to the lack of effective regional-scale geological and geomorphological mapping and analyzing tools. Literature shows that remote sensing and Geographic Information Systems (GIS) have been successfully applied in various geological mapping and exploration studies.

In this study, satellite images (SPOT XS and LANDSAT Thematic Mapper TM) and geophysics (aeromagnetic and gravity) were processed to enhance the geology and geomorphology. The following techniques were utilised to enhance the satellite images: Principal Component Contrast Stretching (PCS), Kauth-Thomas Vegetation Transformation (KTT) and Fast Fourier Transformations (FFT). The first, applied to both the SPOT and TM data, produced well contrasted false-colour composites (RGB: SPOT 321 & TM 754). These images effectively depict lithology, structure and landform. The second technique involved an intensity-hue-saturation representation of the KTT greenness component written as hue and the PCS TM band 4 written as vegetation in tones of blue, green and red respectively and proved useful in mapping drainage. In the third method,

attempts were made to remove the masking effects of the linear dunes which cover large areas of the region. This technique involved the building of a frequencey domain image using a two-dimensional forward FFT, the placement of a user-defined directional wedge, reducing the frequency components within it, and reconstructing a dune-free image by an inverse FFT. The aeromagnetic data were registered and processed at Anglo American Corporation's Geophysical Division by P.B. Leggatt. The aeromagnetic image depicts broad subsurface geology, and correlates well with that depicted in the satellite images. The images also provided information of hidden structure beneath the Nama, Karoo and Kalahari rocks.

The data sets, once registered and correctly projected, were interpreted interactively on-screen for numerous geological and geomorphological features, including geology, palaeo-drainage and landsurfaces. The integration of image processing, image and map registration, projection and interpretation within a GIS has resulted in a very effective mapping, analytical and cartographic tool, able to manage large regional-scale geological and geomorphological studies.

I would like to thank and acknowledge Dr A.A. de Gasparis, Mr E.O. Kostlin and Mr P.B. Leggatt of Anglo American Corporation, and Mr M.C.J. de Wit and Dr J. Ward of De Beers for providing data, logistical support and guidance.