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Using geophysical data to create a 3D conceptual geological model for the Maremane Dome, Northern Cape, South Africa

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Modelling the 3D geology of the Maremane Dome area provides significant insight into the tectonic setting of the Kolomela and Sishen deposits. Importantly, the model provides geological context for the numerous dense sources identified in Falcon Airborne Gravity Gradient (AGG) data, allowing for a more effective discrimination of targets related to high-grade iron mineralisation.

Despite the availability of extensive drillhole databases and geological maps, such datasets are naturally clustered in areas of economic interest, thereby leaving significant gaps in regional data coverage. As a result, drillhole, mapping information and mine-scale 3D models have been integrated and augmented with 3D interpretations of several campaigns of airborne magnetic and electromagnetic (AEM) data.

Geophysical methods respond to physical contrasts in the underlying geology. As physical properties do not always correspond with stratigraphic or lithological boundaries, understanding major physical properties contrasts within the stratigraphy is an essential interpretation step. Downhole wireline logs, combined with available physical properties measurements, have consequently been used to create a 'geophysical stratigraphy' through major geological units of the Maremane Dome area including: Campellrand Subgroup carbonates; Asbesheuwels banded ironstones; Koegas Subgroup banded ironstones; Postmasburg Group Ongeluk lavas; Gamagara Formation shales, Karoo Supergroup glacial tillites and shales; and Karahari Supergroup sediments. The following units may be modelled geophysically: low resistivity, low density, combined Kalahari and Karoo; high resistivity, moderate density, Ongeluk extrusive units; low resistivity, high density Abesheuwels with density related primarily to variations in Fe%; high resistivity, moderate density Campbellrand. Conductive black shales in the upper Campbellrand Subgroup provide additional electrical stratigraphic markers. Variation in susceptibility, resulting from oxidation and haematitisation of the Asbesheuwels ironstones, may be directly mapped with magnetic data.

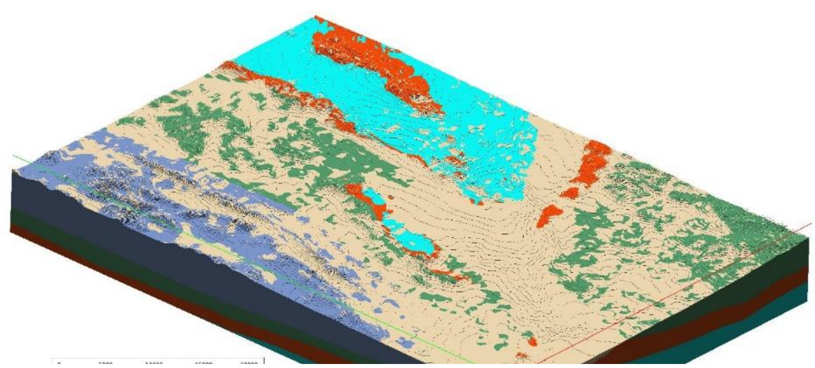

Figure 1: 3D geological model of the southern Maremane Dome, 5x vertical exaggeration, looking northeast.

3D modelling was undertaken on a section-by-section basis, starting in areas with geological mapping and drill data constraints, with inverted magnetic and AEM data providing control for regional interpolation. All model inputs were combined with a 3D structural interpretation to create a conceptual geological model using GoCad SKUA (Figure 1).