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Structural framework of the Maremane Dome: Selective iron ore preservation

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A compilation of regional airborne magnetic, electromagnetic, radiometric and remote sensing data allows for a revised structural interpretation of the Maremane Dome area, encompassing Sishen and Kolomela Mines. Dominant major structures comprise strike-extensive, N-S trending, steep, predominantly W-dipping (listric-at-depth), normal and inverted normal faults, notably prevalent within the western half of the Maremane Dome. Normal faulting probably initiated prior to the deposition of the Ghaap Group or deposition of Koegas Subgroup units at c. ~2.43-2.35 Ga, although these structures underwent numerous phases of reactivation. Fault drag occurred mainly during the superimposed Kheis Orogeny, wherein N-S trending normal faults were inverted by a second phase of eastward tectonic vergence at *c*. 1.4 to 1.25 Ga. This resulted in mine-scale, N-S trending synclines to the west of these faults, typified by the Sloep Fault and "Sloep Syncline" at Sishen Mine. NE/ENE- and SE/ESE-trending, subvertical faults cross-cut and offset N-S trending faults. Typical spacing of these faults, recorded at Sishen Mine, is 100-500m or "prospect- or sub-pit-scale". ENE- and NE-trending faults may have originated with the development of the Ventersdorp Rift Basin at *c*. 2.6 Ga to 2.5 Ga. Reactivated between *c*. 1.73 Ga and 1.4 Ga, ESE- and ENE-trending faults also underwent a degree of transpression, possibly during *c*. 1.4-1.25 Ga inversion. Thick diabase dykes exploited major, N-S trending structures, which are at least similar in offset and extent to the Sloep Fault. Such dykes are distributed across the entire area of interest, although they are locally clustered in a wedge-shaped zone immediately to the west of Sishen Mine.

Previous conceptual models and cross-sections, which depict thick-skinned thrusting with moderately-dipping thrusts with overlying, breached anticlines, may apply only in the extreme west of the area of interest, within the Kheis Orogeny. In contrast, there is no support for widespread, eastward-climbing thrusts that regionally duplicated or inverted the stratigraphy over the bulk of the Maremane Dome. Rather, very local, flat-lying thrusts such as the "Blackridge Thrust", a handful of thin thrust outliers or klippe, selectively tectonized shale units and very gentle dips around the Maremane Dome (5°-7°) support a thin-skinned thrust model, which has been successfully adopted in geophysical data interpretation. The consequences of adopting such a model are profound, not least of all due to the variable removal of ore along regional tectonic unconformities. The interpretation suggests that Fe ore preservation occurs at several scales or orders: 1) A first-order (large-scale) control is the position, thickness and proximity to surface of ore-bearing intervals, especially that between the top of dolomite and base of andesitic basalt. Other first-order controls comprise primary, N-S trending graben or half-graben, which sub-domain ore (and ore types) and non-ore sediments; 2) Second-order controls comprise the rims or flanks of broad domes at all scales and their complimentary, adjacent depressions which may show local back-propagating thrust stacks; 3) Third-order controls include i) N-S trending, predominantly steeply W-dipping, normal and/or partially-inverted normal faults that bound small graben or half-graben, wherein ore, BIF, conglomerate and Gamagara shale are preserved and "monoclines" or inversion-related synclines to the west of inverted normal faults and ii) downthrown blocks to the north of reactivated E-W, SE/ESE- or NE/ENE-trending conjugate faults. Upthrow to the south of these structures may be attributed to the 1.15-1.0 Ga NNW-directed Lomanian (Namaqua-Natal) Orogeny; 4) Deep, conical depressions with anomalous thicknesses of chert, chert breccia and hematite, which accord well with longstanding models on palaeo-sinkhole development, comprise a very local fourth-order control on ore preservation.