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Structural Setting and Geometry of the Kapstevél North and South Deposits, Kolomela Mine, South Africa

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The Kapstevél deposits are situated on the southern extent of the Maremane Dome and the western edge of the Kaapvaal Craton. The geological history of the area comprises several major tectonostratigraphic events, from development of the ca. 2.78-2.64 Ga Ventersdorp rift basin, to the east-verging Kalahari (ca. 2.35-2.25 Ga) and Kheis (ca. 1.83-1.73 Ga) Orogenies, and finally the ca. 1.15-1.0 Ga NNW-directed Lomanian (Namaqua-Natal) Orogeny. Due to the protracted geological history of the region, as well as the proximity of the deposit to the front of the Kheis orogeny, several major structural features formed within the broader Kolomela area: 1) Relict, primary sub-basins/graben/half-graben geometries with preserved, partially inverted normal faults, filled with high-energy sediments from adjacent uplifted blocks (conglomerate, hematite-rich conglomerate and intercalated shale); 2) Low-angle, thin-skinned thrusting, with mesoscale to microscale kinematic indicators; 3) A local, SW-directed tectonic transport direction or vergence, exhibited by the asymmetry of meso-scale and small-scale folds; 4) Blind thrusts and breached folds; 5) Tectonic “removal” or displacement of ore and other horizons, as well as duplication, inversion and lensing of units; 6) NNE-SSW trending folds, with varying amplitudes; 7) Broad folding of bedding-sub-parallel thrust planes; and 8) NW-SE and/or NE-SW trending, subvertical strike-slip faults that transect the entire Kapstevél area and which offset or displace the relict or primary sub-basin/half-graben geometries. These features, some of which are identifiable at Kapstevél, locally contribute to selective ore preservation and/or reworking.

Kapstevél North lies along the south-eastern side of a mesoscale, NNE-trending, doubly-plunging anticlinal dome, similar to the Maremane and Wolhaarkop Domes, wherein chert and dolomite are centrally exposed. Strata in the model, created from a dense set of drillhole data, dip predominantly towards the ESE, deepening abruptly due to two factors: a) The presence of the very steep limb of the adjacent Welgevonden Syncline, wherein almost vertical (-85° to -90°) strata occur and b) downfaulting of units due to a laterally-continuous, albeit fragmented, normal fault. This NNE- to NE-trending fault runs closely parallel to the northern edge of the pit and is associated with a graben or half-graben, which shows considerable development of conglomeritic material and ore preservation. This fault is offset and segmented by NW-trending faults.

The Kapstevél South Prospect lies to the south of the Kapstevél North Pit. Ore is preserved in a NE-trending “trough”, which is bounded by two NE-trending normal faults, possibly comprising a faulted synclinal or graben-like structure in which ore and conglomeritic material are preferentially preserved. This structure affects all lithologies, up to Gamagara shale, and is truncated on either end by two NW-trending, strike-slip faults (parallel to the Griekwastad Fault), the northernmost of which is responsible for the sinistral offset of KSS ore from KSN ore.

Gabbro occurs in the KSS area as two distinct sills, which have intruded both BIF and HEM. The lower gabbro sill is more laterally continuous and possibly connects to a handful of gabbro intervals in KSN. The gabbro sill is folded and undulates across the model limit, becoming much deeper to the southwest of the KSS orebody. Ore occurs predominantly between, and overlapping with, BIF and Gamagara shale. Within the ore-bearing, down-faulted graben, ore has been intruded by the lower gabbro sill, although the majority of ore lies above gabbro. The other major ore body overlies the SW edge of the upper gabbro sill. This ore appears somewhat laterally offset from the main, graben-bound ore, although this may be the result of low-angle thrusting.

