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Sedimentology, Stratigraphy and Depositional Environments of the 3.2 Ga Mapepe Formation in the BARB5 drill core, Barberton Greenstone Belt, South Africa

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Limited preservation of Paleoarchean rocks poses a challenge for studies of the early Earth. However, the rocks of the Barberton Greenstone Belt (South Africa and Swaziland) provide a unique opportunity to study Paleoarchean surface conditions and processes due to their exceptional preservation, regional exposure, and low-grade metamorphism. The recent Barberton Drilling Project cored two sites from the sedimentary rocks of the 3,225-3,260 Ma Mapepe Formation of the Fig Tree Group which records the first significant uplift after almost 300 Ma of tectonic quiescence during deposition of the underlying Onverwacht Group. This study examines 760 m of variable clastic, chemical, and volcanic deposits recovered by the BARB5 drill core and correlates them to mapped units of the Barite Valley structural belt with the objective to constrain the spatial and temporal changes in the Mapepe depositional environment.

While earliest Mapepe sediments in core reflect deep-water sedimentation, middle Mapepe sediments record regional deformation which uplifted segments of the greenstone belt. These regions served as source of siliciclastic sediments which were deposited in a range of progressively shoaling-upward environments [1]. At the base of the sequence, sediments were deposited through density currents and suspension settling in relatively quite water on a slope characterized by frequent failures of soft-sediment. At 512 m core depth, the core penetrated iron-rich shales, jasper and the meteorite impact-generated S3 spherule bed [2]. Jasper is not restricted to a specific environmental setting but occurs interbedded with both deep-water siliciclastic sediments as well as shallow-water silici- and volcaniclastic deposits. Higher up, during middle Mapepe time, sediments coarsen upward to chertarenites deposited in a tidal setting indicated by heterolithic strata, flaser/wavy/lenticular bedding, reactivation surfaces and mud cracks. Shallow tidal channels eroded into a mixed sand and mud tidal flat environment to the north. The angularity of detrital chert grains and the very limited range of detrital zircon ages indicate a short transport distance after erosion from the immediately underlying cherts of the Mendon Formation [3]. A pale green litharenite at 260 m to 95 m core depth marks an abrupt influx of recrystallized dacitic volcaniclastic sand and chert plate conglomerates. Deposition occurred through volcanic ash-falls and possibly surges with subsequent current reworking. This sequence marks the local initiation of Fig Tree dacitic volcanism. Beds of sedimentary barite, well known from the upper Mapepe Fm., were likely narrowly missed near this depth but can be mapped nearby in reworked dacitic shallow water sediments. The volcaniclastic sequence is capped by an abrupt return to deposition of reworked volcaniclastic sediments by turbidity currents and debris flows under deep-water conditions.

Overall, the Mapepe Formation in well BARB5 reflects the complex association of sedimentary lithofacies and depositional environments that accompanied the abrupt transition of the developing

Barberton belt from a mafic and ultramafic volcanic terrane to an orogenic tectonic setting dominated by siliciclastic and felsic volcaniclastic rocks.

References:

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