



Using Sentinel-2A multispectral imagery to explore for deep groundwater resources in the Ceres-Tankwa Karoo, Western Cape, South Africa: Significance for the ‘water-energy(-food) nexus’ in an arid region

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The Ceres-Tankwa region is an arid region in the south-western part of the main Karoo Basin, underlain by folded and faulted strata of the Cape and lower Karoo Supergroups in the syntaxis zone between the Western and Southern branches of the Cape Fold Belt. Explored for oil in the mid-1960s, with the drilling of the >3000 m deep KL1/65 borehole, the area recently attracted attention as a potential shale-gas prospect with the drilling in 2015 of the 671 m-deep KZF-1 research borehole on the farm Zandfontein (de Kock et al, 2016). KZF-1 encountered no positive indication of methane gas in the carbonaceous shale target but intersected a strong flow of deep groundwater from fractures in the basal Dwyka tillite. The accidental discovery of deep artesian groundwater, probably originating from the underlying Cape Supergroup aquifers and of significantly better quality than the shallow aquifer utilised by local farmers, has important implications for future development here.

Using 13-channel multispectral data from the European Space Agency satellite Sentinel-2A, a false-colour composite image, centred about the KZF-1 location, was assembled by combination of selected spectral band-ratios. Stratigraphic layering and associated folding within the hitherto undivided, pelitic Tierberg Formation (Ecca Group), is revealed in striking new detail, together with narrow lines of stratal offset corresponding to previously unmapped faults. KZF-1 is evidently sited within an anomalous NE/SW-striking belt, unlike the general NNW/SSE strike of Cape-Karoo sequence strata in the north-western part of the image. Associated with a notable strike change of a lower Tierberg marker unit, subparallel to and aligned with a similar trend in the Swartruggens mountain foothills to the SW, a deep-seated, controlling, NE/SW-striking fault structure may continue downwards from the lower Karoo units into the underlying Cape strata, providing hydraulic connection.

With the looming threat of global warming and increasing water scarcity in semi-arid regions, deep artesian groundwater systems provide a long-term solution to future demands for water, food and power. In contrast to shale-gas development, which competes for the scarce water resource and poses a substantial pollution threat, an alternative, synergistic and conjunctive development of solar energy, specifically Concentrating Solar Power plants facilitated by the deep artesian groundwater resource, is envisaged for the Ceres-Tankwa and other parts of the Southern Karoo, in a proposed “Sores-Kamma (Sun-Water) Initiative”. In this effort, Sentinel-2A-based lithological mapping is integrated with a new digital elevation model, providing geomorphometry and morphotectonic interpretations, and with the systematic monitoring of surface- and groundwater fluxes using a conjunction of radar satellite, Global Navigation Satellite Systems and microgravity approaches.

Reference

De Kock, M.O., Beukes, N.J., Götz, A.E., Cole, D., Birch, A., Withers, A. and Van Niekerk, H.S. 2016. Open file progress report on exploration of the southern Karoo Basin through CIMERA-KARIN borehole KZF-1 in the Tankwa Karoo, Witzenberg (Ceres) District. 12 pp. Available online at <http://www.cimera.co.za/index.php/karin-feedback>