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Coal geology and quality of the Springbok Flats Basin, South Africa

Nxumalo, V.[1&2], Wagner, N.[2], Cairncross, B.[2]Kramers, J.[2], Vorster, C.[2] , Przybylowicz, W.[3&4] and Setladi, C.[1]

[1] Council for Geoscience, Pretoria, South Africa, vnxumalo@geoscience.org.za
[2] University of Johannesburg, South Africa
[3] iThemba LABS, National Research Foundation, P.O. Box 722, Somerset West 7129, South Africa
[4] AGH University of Science and Technology, Faculty of Physics & Applied Computer Science, al. A. Mickiewicza 30, 30-059 Kraków, Poland

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Coal geology and quality of the Springbok Flats Basin in South Africa have been recently studied using five recently drilled boreholes. The coal zones of the Springbok Flats Basin occur in two stratigraphic horizons: the lower coal zone occurs above and below a succession composed of fining-upward channel deposits, in the lower part of the Vryheid Formation, whereas the upper coal zone occurs above a coarsening upward deltaic succession of the Vryheid Formation, and below a thick (± 50 m) mudstone succession of the Volksrust Formation. Both lower and upper coal zones are characterised by intercalations of mudstones, carbonaceous mudstones (making up to 60%) and bright coals (±30%). The lower coal zone is well developed in the south-western part of the basin and has thickness up to 9.39 m. The upper coal zone varies in thickness between 3.5 and 5.92 m in the studied boreholes, and can be subdivided into three coal seams (upper, middle and lower coal seam), which are separated by carbonaceous mudstones and mudstones. The middle seam in the upper coal zone is well-developed, with a comparatively thick coal sequence up to 1 m, and it is present throughout the basin. The bright coals are rich in vitrinite (> 80% by volume), and are dominated by collotelinite, pseudovitrinite, collodetrinite, corpogelinite, and telinite. The inertinite maceral group is present, but in relatively low amounts, consisting of fusinite (some extremely oxidised), semifusinite, and inertodetrinite, which are much common than the reactive semifusinite, macrinite, and secretinite macerals. Sporinite and cutinite of the liptinite maceral group were identified, but were not common. Mineral matter in the coal samples averages up to 5% as determined by XRD techniques. Quartz is the dominant mineral, followed by kaolinite, calcite, and pyrite. Carbonate minerals present include calcite and siderite. Pyrite occurs as framboids, euhedral particles, cell fillings (i.e. in fusinite), cleat fillings, and lenses. The overall depositional environment of the coals of the Springbok Flats Basin points to waterlogged (high water table) swamps with anaerobic conditions, except for the coal zones in the south western part of the basin, which are slightly enriched in inertinite macerals. This indicates fluctuations of the water table during peat accumulation. Mean random vitrinite reflectance of the studied samples ranges between 0.61 and 0.72%, indicating a medium-rank high volatile bituminous C coal. The coal samples show average moisture contents between 1.68 and 3.03%, ash contents of 19.4 to 39.6%, and volatile matter average values of between 6.2 and 33.9 % (air dried basis). The average gross calorific value of these coal samples is medium to high, ranging from 17.18 MJ/Kg to 25.05 MJ/Kg (dry basis). The coals are slightly enriched with sulphur (> 2%) and can be interpreted to have been deposited in brackish water

environments. The upper and middle seams are also enriched with uranium (average values range between 15.60 and 593 ppm). Uranium is associated with the carbonaceous matter of the coals and a syngenetic mode of mineralisation is proposed. The lower coal zone in the south western part of the basin shows potential for coal bed methane extraction (CBM) due to the presence of gas bubbles that were observed during the drilling programme. The upper coal zones of the Springbok Flats Basin could potentially be mined for combustion or metallurgical purposes; provided that the coals are beneficiated, and that the uranium can be extracted.