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Hydropedological interpretation of arid soilscapes, South Africa

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Hydropedological investigations in arid regions are scarce due to the low the low contribution of these areas to water resources. Infrequent rainfall and few flow events also complicates measurements hydrological studies. Hydropedological studies, relating soil morphological properties and their spatial distribution to hydrological response, have been studied in detail in semi-arid, temperate, and sub-humid regions. In this paper, we investigated the relation between soil morphological properties and selected hydrological properties of soils in an arid landscape. We also studied the spatial distribution of the morphological properties to conceptualise the hydrological behaviour of different soilscapes in the area. A total of 806 soil profiles, covering an area of 4836 ha in the Northern Cape Province of South Africa were described and classified. The geology is dominated by Dwyka tillite overlain by aeolian sands with scattered Dolerite buttes. Thirteen modal profiles, representing the dominant soils types were selected, sampled at horizon level, and analysed for pH, CEC, iron, manganese, carbonate content. In situ measurements of saturated and near saturated (tension) hydraulic conductivity (Ks) were conducted to determine the water conducting macroporosity (WCM). Undisturbed cores were collected on which water retention characteristics were determined under laboratory conditions. Results indicate that dry soil colour, degree of structure development and the presence, absence, and abundance of carbonates as well as the degree of precipitation, are important indicators of hydrological response. For example; grey soils typically have lower Ks with higher storage capacity than soils dominated by red colours, whereas abundant carbonate precipitations in the soil matrix have lower WCM due to clogging of macropores. The dominant soil distribution pattern indicates that rapid vertical flow, through and out of the pedon, might contribute to recharge of an accumulative soil lateral flow at soil/rock interface on upper and midslope positions. Abundant carbonate precipitations decrease in consistency to valley bottom positions, indicating that this area serves as a periodic store of water during and after rain events.