

PAN TYPES AND GEOLOGY: SOME OBSERVATIONS FROM BUSHMANLAND, NAMIBIA

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Introduction

Pans are distinctive, mostly Late Cainozoic to contemporary geomorphic elements, that are widespread in the Kalahari environment. Here we draw attention to a variety of pan types in Bushmanland, north-east Namibia, and their apparent association with the underlying geology.

Much of Bushmanland lies on a broad, flat watershed (c. 1150 m above sea level) between the north to north-east draining Nhoma and the south-east draining Daneib watercourses. Pans are well developed in the area north-north-east, south-south-east and south-east of Tsumkwe where the cover of Kalahari sands is thin to absent. This paucity of largely aeolian reworked sands is attributed to the presence of the low but prominent Aha Hills further west which acted as a trap and buffer to the westward movement of Kalahari sands. The variety of pan types in Bushmanland include:

1. Pans underlain by pedogenic hardpan calcrete - notably the large Nyae-Nyae and Khabi systems, Nama Pan, Gautscha Pan and Tjokwe Pan. The pedogenic calcrete, mostly well-cemented and in places jointed, represents a calcereous palaeosol formed in gravels, grits and sands that have been derived largely from the east, i.e. the Aha Hills. These sediments mark the last stage of infilling the c. 300 m deep Cainozoic basin between about Tsumkwe and the western border of Bushmanland. The calcrete not only provides a firm base to these pans but has also contributed to the sand-sized sediment forming lunettes on the western margin of the larger pans, in particular Nyae-Nyae and Khabi. These pans also display palaeo-shorelines reflecting higher water levels, similar to those

recorded elsewhere in the Kalahari. In addition, some pans, e.g. Nama and Gautscha, have minor, cliffed shorelines within their present perimeters, indicating more constant water levels in the recent geological past. Nyae-Nyae and Khabi Pans occupy a large north-south depression, the overall configuration of which may be controlled by structural/neo-tectonic subsidence within the Cainozoic basin.

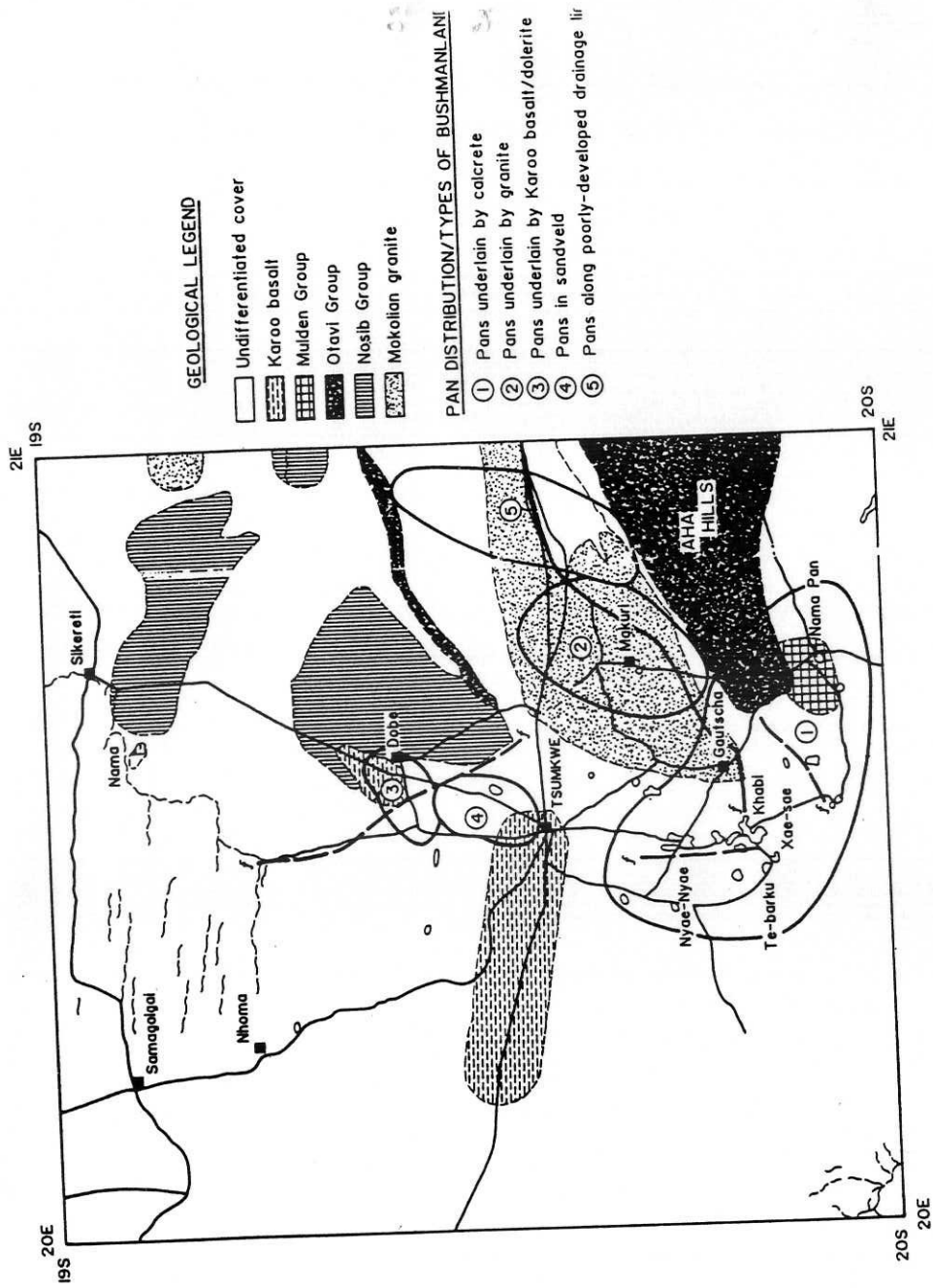
In rare place the calcrete has been affected by local sinkhole formation which has given rise to the almost circular to oval depressions marking the Xae/sae and Te-Barka Pans to the south-west of Khabi.

2. Pans underlain by Mokolian granite - notably Makuri Pan, Gimsa Pan, Kirkii Pan and Halfway Pan. The distribution of these comparatively small pans is governed largely by the intersecting joint patterns in the underlying basement granite. *Acacia kirkii* trees are restricted locally to these pans, pointing to their characteristic high clay content which is probably a consequence of the weathering of feldspars in the granite.

3. Pans underlain by Karoo-age basalt/dolerite sills and dykes - notably the Klein and Groot Dobe Pans. Aeromagnetic survey results of north-eastern Namibia highlight the presence of a dyke swarm of presumed Karoo-age striking roughly south-east to north-west from Botswana into Namibia. Klein and Groot Dobe Pans may represent selective chemical weathering of the basic intrusions and volcanics.

4. Pans in the sandveld north of Tsumkwe. Localised depressions in the pale grey sand country commonly possess a rim of ferricrete. This ferricrete rim represents bog-iron formation as a result of fluctuating water table effecting the leaching of iron oxide coatings from aeolian sand grains, as well as the weathering of heavy mineral grains.

5. Pans along poorly developed drainage lines - notably pans in the Baraka area and in the interdunes of the sand covered area in north-east Bushmanland. Although not strictly correlated with the underlying bed-rock geology, these pans appear to owe their origin to animal activity - initially termitaria, then the resultant browse/trample effect of herbivores, followed by wallowing in the localised



clay-rich are to form a depression that may be modified and/or maintained by aeolian deflation and subsequent wallowing.

The occurrence and distribution of many of the pans can therefore be linked to the underlying geology of the region, an appreciation facilitated by the thin Kalahari sand cover. Furthermore the presence of higher, relict shorelines in the Nyae-Nyae/Khabi system is a potentially important palaeoclimatic indicator in an area situated between and higher than the Etosha and Makgadigadi Pan systems.