Assessing aridity and other climatic variables using grass opal phytoliths in subtropical southern Africa

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Résumé

Studies of opal phytoliths in Africa have focused on the variations of morphotypes across latitudinal and altitudinal climatic gradients. This relation has often been expressed through indices (e.g., aridity and climatic indices) and ratios (e.g., dicot-graminoid ratio), and in some cases through multivariate statistics. The aridity and climatic indices use proportions of diagnostic GSSC in C3 (Pooideae) and C4 (Panicoideae and Chorlidoideae) grasses in a phytolith assemblage. The dicot-graminoid ratio uses morphotypes recognized mainly as tree phytoliths, which in the case of tropical Africa includes mainly spherical (globular) morphotypes.

In principle, the use of GSSC protocols and indices across the African continent should be easier because the distribution of vegetation and climatic zones north and south of the equator mirror one another. In practice, however, the application of such protocols and indices in the subtropical and temperate regions of southern Africa faces several problems. One of such problems lies on the fact that the relation between panicoid and chloridoid short cells not always conform to moisture-aridity gradients in parts of Southern Africa. There are several reasons why this unconformable relation exists: (1) in southern Africa the Chloridoideae grasses are abundant even in humid/mesic areas, which make it difficult to always single them out as the drought resistant grass subfamily; (2) some prominent Chloridoideae grasses do not produce the trademark saddles that characterize this subfamily; (3) most arid regions are dominated by *Stipagrostis* (Aristidoideae subfamily), which belittles the Chloridoideae-Panicoideae climatic relationship; and (4) *Stipagrostis* produces a variety of round cells, which are often mistaken as pooid rondels. Additionally, the climatic indices, which are based on the proportions of pooid rondels to other morphotypes do not apply to this region because, as stated above, rondels are produced by a number of C4 grass genera, and because C3 grasses in Southern Africa are not always represented by the Pooideae sufamily, but also by the still poorly studied Danthonioideae and Ehrhartoideae subfamilies, both of which produce a high diversity of short cell morphotypes.

In this paper several indices and ratios are tested on GSSC assemblages from samples collected along a transect extending from the Atlantic to the Indian Ocean coast at approximately latitude 28∘ S, encompassing elevations from near sea level near 2000 m. The transect goes across several moisture gradients in the summer rainfall region (from sub-humid to arid) and part of the winter rainfall region, passing through areas with annual precipitation around 200 mm to areas with more than 1000 mm a year. In other words, from east to west, the transect starts on the Indian Ocean Coastal Belt, across lowland savannas, patches of savannas, grasslands and forest, to the subalpine grasslands of the Drakensberg, then crossing the

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High Veld grasslands of the Free State, mosaics of upper Nama Karoo, Kalahari savanna, Kalahari sandveld, the Bushmanland Karoo, and the winter-rainfall areas of the succulent karoo in Namaqualand.

Mots-Clés: Africa, Southern Africa, Biomes, Transect, Grasses, short cells