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ASPECTS OF PALYNOLOGY IN RHODESIA

by

Rosemary M. S. Falcon

ABSTRACT

This paper is based on a Doctoral Thesis presented to the University of the Witwatersrand, which in whole or part will be published elsewhere at greater length. The essence of the research is presented in three text figures which show the proposed correlations of Karoo strata on opposite sides of the Rhodesian palaeowatershed, correlations with Karoo-equivalent strata in other parts of Gondwanaland, and palaeofloristic trends in Rhodesia during the Permo-Triassic.

In Rhodesia the Karoo Supergroup is found in two major depositional complexes, the Mid-Zambezi and the Sabi-Limpopo Basins. These occur in intercratonic lineament belts floored predominantly by ancient metamorphic sediments and lying peripheral to the stable granitic Rhodesian craton.

The stratigraphic sequence in the Mid-Zambezi Basin is well known, particularly in the major coal-bearing areas. However, detailed correlation between different areas within the main basin is rendered somewhat difficult due to minor lithological facies variations. The Sabi-Limpopo Basin, on the other hand, is stratigraphically and tectonically a far more complex region in which correlation between the often very thick lithological sequences encountered in different sectors of the basin is difficult and relies much on extrapolation. Broadly speaking, comparisons of the sequences in both basins based upon their sedimentology and palaeontology show that similar tectono-sedimentary patterns existed during deposition. Finer resolution of the stratigraphic sequences within each basin is required which will lead to more closely defined comparisons and for this a biostratigraphic zonation is necessary.

Palynology has already been shown to be potentially viable for the defining of biozones in Rhodesia. Furthermore, detailed research on borehole material in the Wankie, Tjolotjo, Insuza and Gokwe areas of the Zambezi Basin, and in the Mid- to Lower-Sabi Valley, Bendezi and Tuli areas of the Sabi-Limpopo Basin has confirmed the generally successful application of palynology in solving stratigraphic problems in Rhodesia.

Differential preservation in some areas and at certain levels, however, has been found to hamper palynological research, as for example in the Wankie and Malilongwe areas. Investigations have shown that conditions during accumulation and deposition and the marked increase in coalification during the subsequent period of diagenesis may well have been predominantly responsible for poor miospore yield in these two cases. In the Wankie area much fragmentation and breakage or total absence of miospores throughout almost the entire coal-shale (K^{2-3}) sequence has been attributed to unfavourable geochemical conditions at the site and time of accumulation. For example, it is generally accepted that a positive redox potential (Eh) and, within certain limits, pH, results in the destruction of spores and pollens by means of aerobic bacterial or geochemical action. Rapid burial and non-aerobic conditions are necessary for ideal preservation. An interesting example of preservational differences to illustrate this point may be seen in two contemporaneous deposits (i.e. Black Shales and Coals) from the Wankie and Lubimbi areas. The low miospore count in the former coals and associated shales is in direct contrast to that in the equivalent strata in the Lubimbi coal-field where miospores (i.e. the exinite components of the coals) are normally much more abundant (Taupitz, pers. comm.). It has been suggested that the answer lies in the low water-table and long stable gradually drying-out (aerobic) conditions that may have prevailed during the formation of the Wankie seam and shales, a fact supported by the presence of a high inertinite content in the coals (i.e. inert decomposed organic material which is generally the end products of decay in aerobic conditions). In contrast, the coals and shales in the Lubimbi coal-field are high in miospore (exinite) components, a fact probably intimately connected with fluctuating swamp conditions as shown by the approximately 60 peatmoor open-lake cycles that have been established by sedimentological means (Taupitz, pers. comm.). The miospores, together with leaf cuticles, waxes and resins, have great bearing on the liquid hydrocarbon production potential (tars and bitumens) of coals and organic shales, and as such are particularly important components of coals in the Lubimbi area.

The lack of miospores in the Malilongwe area (Borehole 66) may in part be related to similar pres-

ervational conditions as proposed for the Wankie area, but these factors are overlain by the imprint of high rank, i.e. destruction of miospore specimens due to heat from increased geothermal gradients and from local igneous intrusions and effusions such as are typical in the nearby Nuanetsi Province. Palynological indications of increased rank are changes in miospore colour from pale yellow to orange, dark brown and finally black opaque forms recognisable only from outlines. The latter sequence of colour changes is very marked in the vicinity of the Lower Sabi (Malilongwe-Mkwasine coalfield), whilst in the major type section at Malilongwe a similar sequence is noted with increased depth. Only the uppermost sequences yield any identifiable specimens and these are very dark orange to brown in colour. The remaining samples at lower levels lack any remnant indication of miospores or possess rare, very black, opaque forms recognisable only in outline. These results correlate well with the evidence of increased rank from coal analyses (Duguid and Bond, pers. comm.).

After detailed analysis of all the palynological results available from Rhodesia, parameters have been selected to show that the gymnospermous floras of the Permian and Lower Triassic in Rhodesia underwent marked successive changes which are ideal in the correlation of the sequences Gondwana-wide. These have been termed macro-correlations. Quantitative fluctuations in the spore-producing lower plant orders (Aletes and Sporites), however, are regarded as indicative of local environmental/ecological/climatic changes. These factors, with typically associated species and genera, are regarded as potentially suitable for the correlation of sequences within restricted geographical areas (within a basin or local coal-field). These have been termed micro-correlations.

Comparisons of quantitative changes and of assemblage associations and ranges of selected genera and species within the major taxonomic groups have resulted in the erection of a biozonation scheme comparable to those used in other parts of Gondwanaland.

The relationship of the macroplant evidence and the palynological record within the Rhodesian sequences illustrates parallel vegetational changes throughout this period of deposition. Microfloral evidence, however, appears capable of finer resolution of the strata into smaller chronostratigraphic units, and this has optimum application in areas and through sequences which are otherwise macropalaeontologically barren. It is, however, always necessary to regard the study of macrofloral evidence as an integral part of microfloral research, both in terms of supporting evidence and as complementary evidence. In many cases within the present research project, plant fossils or compressions have been found in palynologically barren strata, and vice versa.

In terms of the correlation of the coal-bearing strata in the boreholes under investigation, no evidence has yet been found to suggest the presence of any Molteno coals in either the mid-Zambezi or Limpopo Basins. This is contrary to the view of certain earlier authors who believed that some of the coals in the Lower Sabi-Bendezi coal-field were of Molteno age due to their similarity in form and behaviour to South African coals of this age. The major period of coal formation appears to have been during Lower to Upper Ecca equivalent times in both basins, with further minor swamp conditions giving rise to subeconomic coal seams in Beaufort equivalent times (Madumabisa Mudstones), i.e. Upper Permian or Lower Triassic, in the Sabi-Limpopo Basin.

In general, the history of deposition and sedimentation of both basins, as reconstructed by palynofloristic correlation of the strata, indicates that lithological correlations, while superficially useful, are subject to local variations and facies changes resulting in possible misunderstanding of the sequences and their wrong stratigraphic interpretation. Where miospore yield is favourable, correlation by means of palynological methods appears to be superior to other palaeontological methods. It is certainly preferable to direct lithological correlation, although exceptions and refinements to this statement do exist. In order to achieve good palynological correlations, significant parameters must be selected for the purpose and placed in perspective with other factors that may throw light on palaeogeographic, palaeoenvironmental or palaeoclimatic conditions of the times.

Until recently, palynology has been primarily a study from semi-related aspects of dispersed organic objects. It is necessary to attempt to synthesize all these various approaches into an interdisciplinary science of practical application. Critical to the success of this concept is the recognition of the types of data that can be utilized, their applications and their limitations. Some data may be, in the words of Hunter Yarborough, "hard" fact, "soft" fact (subject to interpretation) and "contaminated" fact (based on unsubstantiated hypotheses). Thus the legitimacy and correctness of ideas proposed in the course of this research may best be summarized (also by Hunter Yarborough) as follows:

"We utilize hypotheses which are nothing more than suppositions put forward as a starting point for further investigations by which they may be either proved or disproved. Many of these hypotheses may ultimately be proved valid; however, others may be barren, and cannot be tested or proved. There are many of us who have beliefs that we may consider to be evident truths; others, however, may rate our beliefs as merely barren hypotheses".

In order to verify or modify the hypotheses proposed during the course of this research, the hope is expressed that interdisciplinary research in the fields of palynology and allied sciences will continue well into the future.

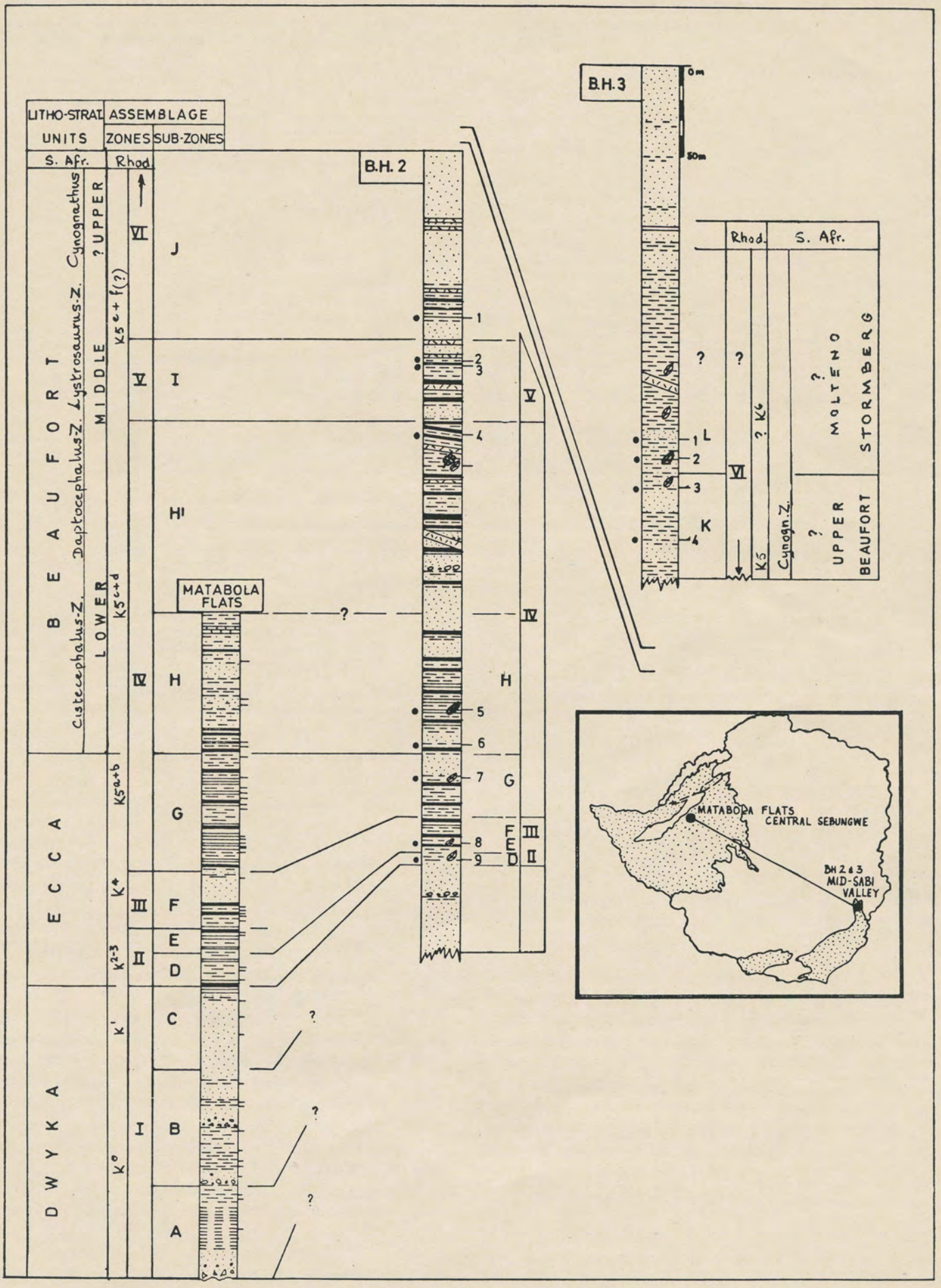


Figure 1. Biostratigraphic correlation of the Mid-Sabi Valley borehole Cores 2 and 3 with the Matabola Flats borehole core.

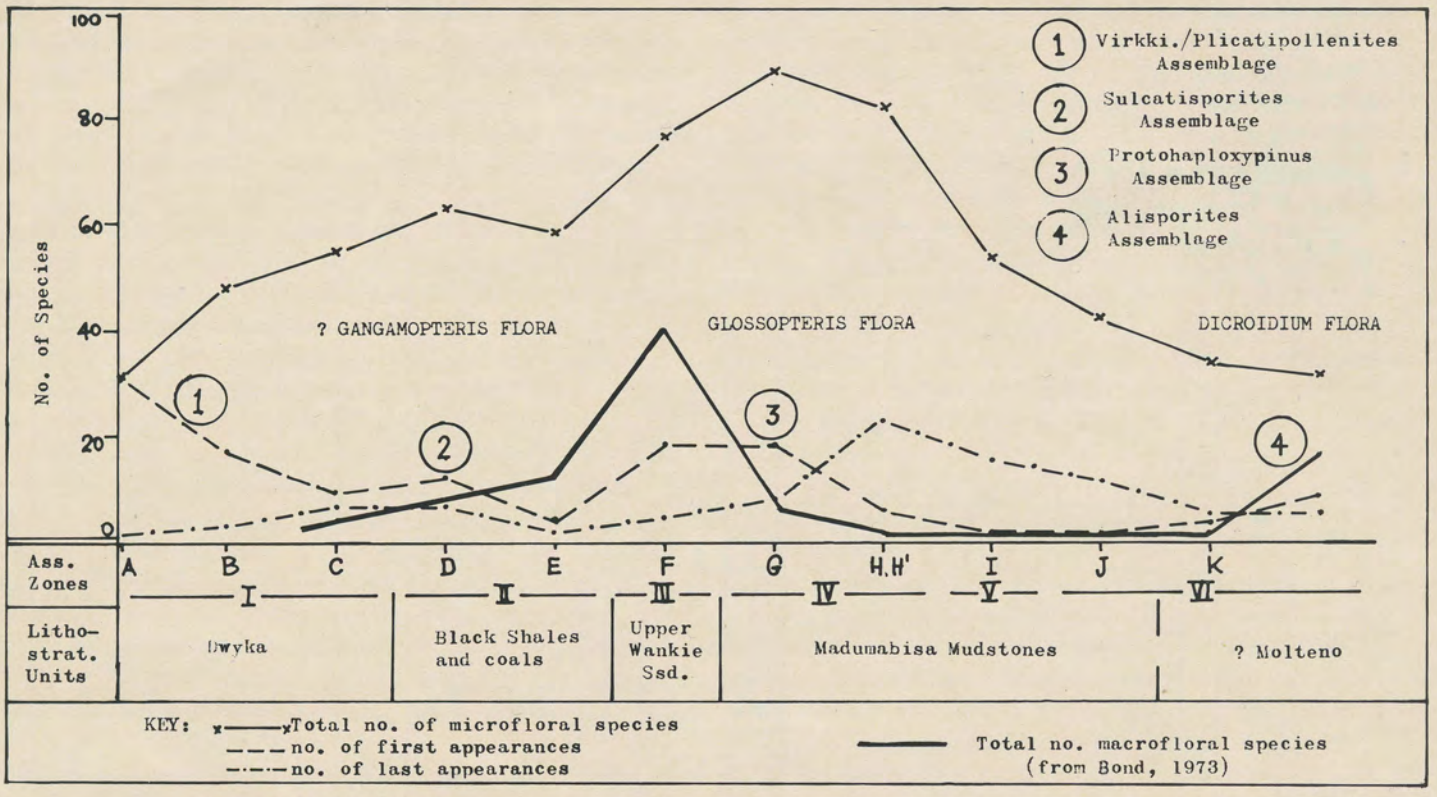


Figure 2. The diversity of the micro- and macrofloras during Permian and early Triassic times in Rhodesia.

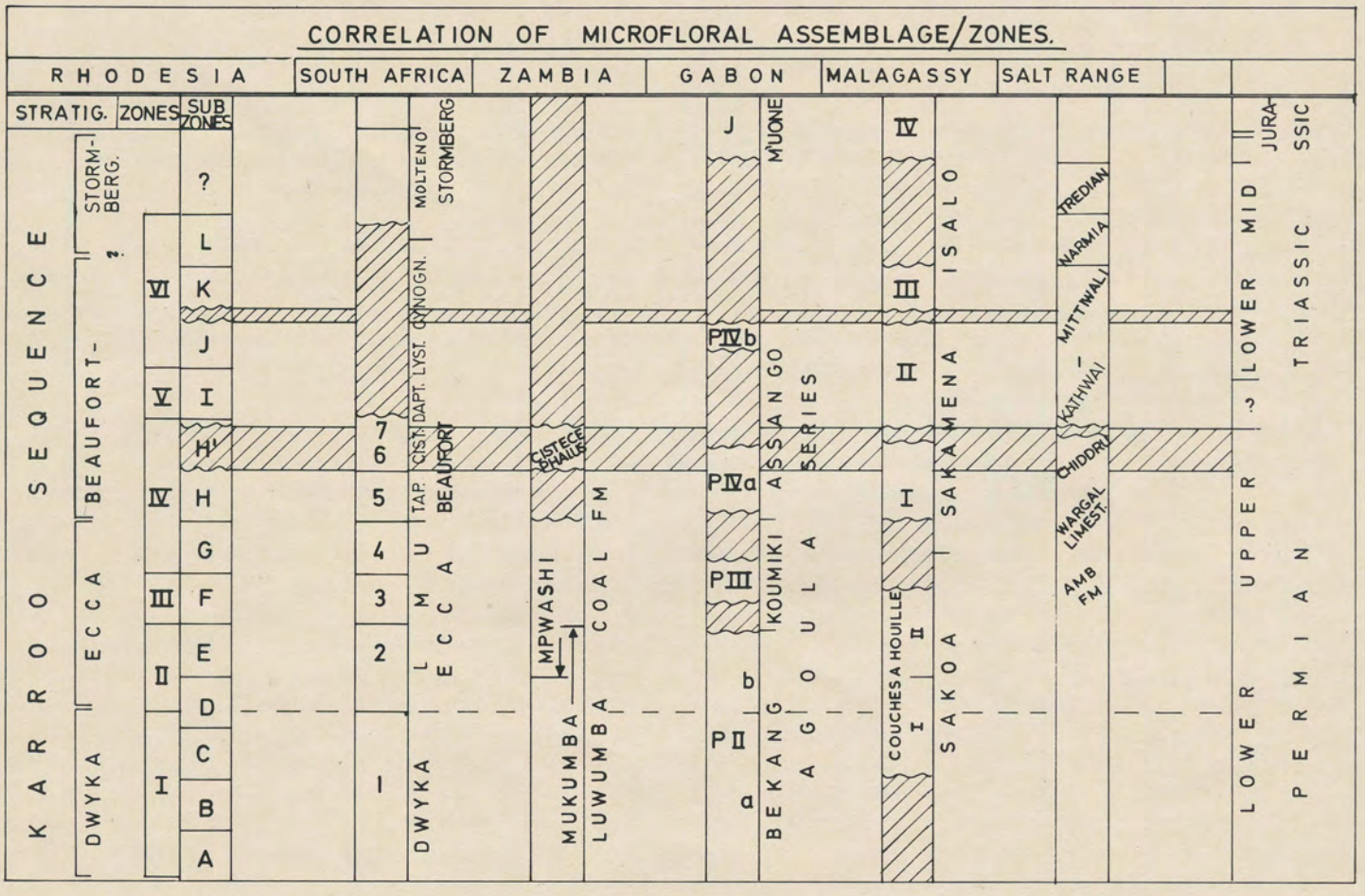


Figure 3.