CHAPTER 9

SUMMARY AND CONCLUSION

The samples used in this research were obtained from the Petroleum Agency, SA and consist of 326 already processed microscope slides from Offshore Sites O-A1 and C-B1 located off the west coast of South Africa. Sampling intervals varied considerably in both wells, and depended on the presence of carbonaceous shale lithologies and the state of preservation of the sedimentary strata. Not all the slides studied yielded microfossils and this is possibly due to either bad preservation or barren lithologies being sampled. The bulk of the sediments deposited into the Cape Basin are continent-derived and are generally assumed to have been transported into the Cape Basin mainly via the palaeo-Orange River.

All microscope work was done on a Zeiss Axioskop Petrographic Microscope located at the Bernard Price Institute for Palaeontology. A minimum of three slides were studied for each of the 70 samples taken from Offshore Site C-B1 and a minimum of two slides were studied for each of the 189 samples taken from Offshore Site O-A1. This study yielded 133 distinct sporomorphs that included 41 pollen grain, 85 trilete spores, 2 monolete spores, 4 algal cysts and 1 fungal spore types. Thirty one of the 126 sporomorphs identified are considered new species however formal descriptions have not been attempted. The distribution and abundances of the pollen grains and spores identified as well as palynodebris present in each sample was recorded.

Photographs were taken of representative specimens and these were compared with specimens found in published literature for identification purposes. The identification database used included literature from every continent and from the Permian Period onwards.

The stratigraphic ranges of the various pollen grain and spore groups affected by the punctuated rise and drop in sea level, have been used to create zones for both Offshore Sites. These zones are new and five zones have been designated for each Offshore Site. They represent major and minor changes in the microflora and are possibly of an evolutionary nature. They will hopefully act as a template against which other sites may be compared to see if they truly represent the temporal ranges of species and hence have biostratigraphic significance (See below for further discussion). The distribution of these sporomorphs in these zones have divided both Offshore Sites into successions representing the Early and Late Cretaceous periods. The microflora of these two sites are similar but not identical and could therefore not be used to support the possibility of the two sites reflecting the same microfloral province.

The distribution of the microflora within these two Offshore Sites have aided in the division of both pollen diagrams into zones that in turn represent the Early Cretaceous and Late Cretaceous periods. The Early Cretaceous Period is represented in Offshore Site C-B1 by Zone CI and Subzones CI – A and CI - B and the first half of Zone CII. Offshore Site O-A1's Early Creataceous Period is represented by Zones OI and OII. The Late Cretaceous Period is contained in the second half of Zone CII, Zones CIII, CIV, CV and Subzones CV - A and CV - B of Offshore Site C-B1 as well as Zones OIII, OIV and OV of Offshore Site O-A1. The microflora of these two Offshore Sites are similar only during the Early Cretaceous Period, thereafter the palaeoflora at both Offshore Sites takes on a different character. This suggests a possible divergence of a single microfloral province during the Early Cretaceous Period into two separate microfloral provinces during the Late Cretaceous Period. This separation coincides with the appearance and infiltration of angiosperm vegetation that in some instances appeared to be Tertiary in origin.

Gymnosperms and ferns dominate the palaeoflora during the Early and Late Cretaceous periods of both Offshore Sites. Angiosperms only really became a part of the vegetation during the Late Cretaceous period. Gymnosperms found in both Offshore Sites include *Classopollis, Podocarpaceae, Zonalapollenites, Balmeiopsis* and *Exesipollenites.* Spores of *Cyathedites*, *Gleicheniidites* and other schizeaceous types dominated the spore population.

The most noticeable change in the palaeoflora started during the Turonian Stage (Late Cretaceous) with the replacement of the gymnosperm flora with angiosperms and the slow replacement of Cretaceous with Tertiary palaeoflora. By the close of the Late Cretaceous Period, environmental conditions had reverted back to warm, wet and humid.

The age ranges of the palynomorphs present have provided an Early Cretaceous / Late Cretaceous general age bracket for each of these two Offshore Sites, supporting the Petroleum Agency, SA's findings. Only a few specimens tentatively age-defined the depth they were found at. On more than one occasion Tertiary palynomorphs were located in the early part of the Cretaceous Period. As mentioned earlier, these Tertiary-based palynomorphs were probably contaminants.

The reconstruction of the palaeoflora has been based on the known botanical affinities of the palynomorphs present. The forests that existed during the Cretaceous were probably cool and temperature and located in the higher regions of the newly developing rift valley. The dominant trees in these forests shed pollen grains that included *Podocarpaceae, Microcachryidites* and *Exesipollenites.* At the lower latitudes woodlands consisting mainly of *Classopollis* hugged the coastline. The undergrowth included varieties of ferns (*Cyathedites* and other shizeaceous plants) and mosses.

The palaeoflora as reflected by the palynomorphs present adapted and flourished in response to the changing climatic conditions that prevailed at the time, with the most noticeable change in the palaeoflora being the slow replacement of the gymnosperms, by the more adaptable angiosperms. Tertiary-based pollen grains and trilete spores were noticeably conspicuous by their presence throughout the Late Cretaceous Period, however by the Campanian Stage the palaeoflora of the Tertiary Period in my opinion, was, if not starting to replace Cretaceous flora then, becoming far more dominant.

The palynodebris results illustate a terrigenous accumulation over time for each Offshore Site from the Early Cretaceous Rift Valley accumulation phase in the littoral and shallowest regions of the inner neritic zone, to the Late Cretaceous late drift accumulation phase in the deepest regions of the inner neritic zone.

The palynodebris component for both Offshore Sites supports the origin of the sediments deposited into the Cape Basin as continent-derived and transported into the Cape Basin via fresh water sources. The presence of sporomorphs and resins in the palynodebris reflects a great diversity of hinterland vegetation. Plant and cuticle palynodebris found at both Offshore Sites suggest stable dry conditions terrestrially and near shore deposition. Amorphous organic material and the presence of green algae throughout both Offshore Sites indicate a terrigenous source associated with shallow fresh to brackish water of lagoons and swamps. The presence of marine palynomorphs supports deposition in a marine or saline esturine marsh environment.

The environment of the Early Cretaceous of Offshore Site C-B1 was probably humid and tropically warm, with climatic conditions starting to shift towards being semi-arid and warm to hot by the Early / Late Cretaceous transition. Most of the Late Cretaceous succession of these Offshore Sites accumulated under warm, semi-arid and humid conditions. By the close of the Late Cretaceous Period climatic conditions had reverted back to warm, wet and humid.

This detailed description of the palynomorphs from these two Offshore Sites have increased our knowledge of Cretaceous systematic palynology for this region of the southern hemisphere, and have provided information on the Cretaceous palaeoenvironments that prevailed along and off the west coast of southern Africa.