CHAPTER 9: ECONOMIC POTENTIAL.

A small, abandoned mine is situated at 23°08.30'S; 29°42.70'E. The mine is located approximately where the northern and southern strands of the Melinda Fault merge at the western side of Blouberg mountain. The host rock consists of foliated granitic and locally amphibolitic material that now resembles mylonite. The foliation planes generally have a dip-direction of 75°→053°, which is consistent with the regional (Palala parallel) trend. The foliation planes are locally exploited by wide (50cm-1m) veins containing quartz, baryte and small amounts of galena. The baryte content is between 35 and 50% (Willemse, *et al.*, 1944). The mine was considered uneconomic for either lead or baryte mining, and has closed.

Several rocks in the study area were sampled for hydrothermal or placer gold mineralisation. Sampling including the wide quartz veins associated with the northern strand of the Melinda Fault, where it cuts the Wyllies Poort Formation at 23°02.08'S; 28°59.78'E, and hydrothermally altered jasperitic patches developed between the base of the Blouberg Formation and the breccia of the southern strand of the Melinda Fault at 23°07.39'S; 28°57.46'E and 23°07.81'S; 28°56.74'E. Conglomerates from the Blouberg, Mogalakwena and Wyllies Poort formations were sampled for placer gold deposits by fire assay. Only one pebble conglomerate showed any traces of gold (0.9g/tonne), which was collected from the base of the Mogalakwena Formation at the unconformity with the Blouberg Formation at 23°07.35'S; 28°57.53'E. Other samples of basal Mogalakwena conglomerate were collected from this unconformity in other areas of the study area, but did not indicate further mineralisation. The location of the gold mineralisation (on an angular unconformity adjacent to the southern strand of the Melinda Fault) may rather reflect hydrothermal mineralisation associated with the Fault rather than placer deposition.

The continental, fluvial environment proposed here for the Blouberg Formation suggests that it holds no potential as a target for Sedex-type massive sulphide exploration. No other data of economic importance were encountered during this work.

CHAPTER 10: CONCLUSIONS.

In the preceeding chapters, the geology of the Blouberg Formation, Waterberg and Soutpansberg Groups in the area of Blouberg mountain, Northern Province, South Africa, has been described. From this data, a provisional model for the sedimentary and tectonic evolution of the strata in this area has been proposed.

Of importance to the geology of the Blouberg mountain area is the fact that it appears to straddle the suture between the Southern Marginal Zone (reworked Kaapvaal Craton) and the exotic terrane of the Central Zone of the Limpopo Mobile Belt. This suture is generally regarded as being marked by the Palala Shear Zone, which outcrops 50km W.S.W. of the study area, and it seems that the ductile deformation recorded in the banded gneiss in the basement lithologies of the study area represent a higher-grade (i.e. deeper crustal) equivalent to the rocks of the Palala Shear Zone. Thus the underlying crust of the Blouberg mountain area can be considered to have been assembled during the collisional tectonics of the Limpopo event, which took place at either 2.7Ga (with subsequent reactivation at 2.0; McCourt and Armstrong, 1998) or only at 2.0 Ga (e.g. Kröner *et al.*, 1999).

The oldest basin preserved along this cratonic suture is that of the Blouberg Formation. This work has generally simplified the earlier model proposed by Jansen (1976) for the sedimentation of the Blouberg Formation. Jansen (1976) accounted for the varying sedimentary rocks that he included in the Blouberg Formation as having been laid within an active block-faulted terrain, thus allowing for a range of sediments to have been deposited within small, localised fault-bounded basins at different times. This work has shown that all strata outcropping to the north of the southern strand of the Melinda Fault, which Jansen (1976) had included within the Blouberg Formation (i.e. the Mositone Conglomerate Member, the Semaoko Member and the Varedig Member), correlate well with distal facies of the Mogalakwena Formation (Waterberg Group) and, as such, should not be considered within the stratigraphy of the Blouberg Formation. Similarly the My Darling Trachyandesite Member (Blouberg Formation according to Jansen, 1976), which has been demonstrated to be basaltic, should rather be considered as representing a western eruptive centre of the Sibasa Formation (Soutpansberg Group).

Having motivated for the removal of the upper-most four of Jansen's (1976) Blouberg Members from the Blouberg Stratigraphy, the remaining, lowermost four members of Jansen's stratigraphy can be considered to represent the Blouberg Formation (*sensu stricto*). Using the facies identified within a 1400m-thick provisional type section of the Blouberg Formation as a stratigraphic model, all other outcrops of the Blouberg Formation (*sensu stricto*) appeared to compare at least reasonably well with this Kranskop section. Thus Jansen's (1976) model involving short-lived sedimentation in isolated block-faulted basins need not be applied, and the Blouberg Formation can rather be considered to represent a two-fold cycle of sedimentation (Lower and Upper Members), separated by a period of proximal uplift and tectonism. The same tectonism was likely also responsible for the southward-vergent basin inversion of the Lower Member of the Blouberg Formation. The generally restricted, rapidly deepening nature of the Blouberg basin (indicated by outcrops of the Lower Member), situated along a major fault zone, is consistent with its formation as a pull-apart basin.

The fluvial and aeolian-derived strata of the Waterberg Group in the study area (Setlaole, Makgabeng and Mogalakwena formations), have previously been considered to outcrop only to the south of the southern strand of the Melinda Fault (e.g. Jansen, 1976; Meinster, 1977). This work has shown that this distribution holds only for the Makgabeng Formation. The Setlaole Formation may outcrop 2km S.E. of My Darling, indicating a slight encroachment northwards over the Fault Zone. More convincingly, all strata to the north of the southern strand of the Melinda Fault, formerly mapped as the Blouberg Formation (Jansen, 1976; Meinster, 1977) are interpreted here as Mogalakwena strata, albeit distal facies, related to relatively proximal conglomeratic Moglalakwena strata in adjacent areas immediately to the south. The presence of Mogalakwena strata underlying these more northerly regions suggests that the Waterberg basin onlapped northwards over the cratonic suture, now active as a brittle displacement zone along the southern strand of the Melinda Fault.

The presence of distal (sandstone and granulestone) facies alongside proximal (conglomeratic) facies of the Mogalakwena Formation, separated by crush breccia along the southern strand of the Melinda Fault, suggests that they were juxtaposed by faulting. This was most likely accomplished by a northward-dipping normal fault, as a reactivation of fault planes imposed earlier during the inversion of the lower Blouberg basin. The N-S orientated extensional regime necessary to produce such faulting was likely accompanied by intrusion of dyke swarms into pre-existing basement, Blouberg and Waterberg strata. Upon reaching the surface, the dykes appear to have fed the basaltic lavas of the Sibasa Formation (Soutpansberg Group).

Normal displacement along the southern strand of the Melinda Fault, with the hanging wall to the north, not only juxtaposed contrasting facies of the Mogalakwena Formation, but is also interpreted to have created a southern boundary to a half-graben type basin. Such a basin is envisaged to have acted as a depository for the Soutpansberg Group, as the preserved outcrops of both the Sibasa Formation and the Wyllies Poort Formation are restricted only to the north of the southern strand of the Melinda Fault. Facies characteristics and palaeocurrent directions recorded in the Wyllies Poort Formation are compatible with a fluvial half-graben type depositional setting.

Post-Soutpansberg deformation is represented by the activation of the northern strand of the Melinda Fault, which appears to have displaced the Wyllies Poort Formation by dextral strike-slip movement. Displacement appears to have been accommodated along numerous E.N.E-W.S.W striking splays (flower structure), which occur throughout the northern part of the study area. In the area N.E. of Vivo (in the northeastern part of the study area), these splays appear to have merged and approximately 17km of displacement is indicated here. There is no evidence that this post-Wyllies Poort dextral displacement in any way reactivated the adjacent southern strand of the Melinda Fault.

Thus the sedimentary and tectonic history of the Blouberg Formation, Waterberg and Soutpansberg Groups in the area of Blouberg mountain can be considered in terms of continued reactivation along a cratonic suture. A sedimentary basin appears to have formed as a result of pull-apart tectonics (Lower Member of the Blouberg Formation) caused by strike-slip reactivation along the suture, only to be inverted during a reorientation of the stress field to approximately N-S. Such tectonism lead to renewed, rapid sedimentation during these syn-tectonic times (Upper Member), and restricted the extent of the successor Waterberg basin (Setlaole and Makgabeng Formations) to the south. General tectonic quiescence, following this N-S oriented compression, allowed for the denudation of the uplifted area to the north and, and deposition of the (upper Waterberg) Mogalakwena Formation, derived from now denuding sources to the north and east. As Mogalakwena fluvial sedimentation continued, these deposits onlapped over the southern strand of the Melinda Fault. The deposition of the Blouberg and Waterberg strata can thus be considered as representing flysch (syn-tectonic) and molasse (post-tectonic) style sedimentation, respectively.

After the end of Waterberg deposition, when the uplifted area to the north had been greatly denuded, renewed reactivation along the southern strand of the Melinda Fault appears again to have controlled sedimentation, during a period of N-S orientated extension, which can be considered to be a reversal of the syn-Blouberg tectonic regime. This led to the creation of the Soutpansberg depository in a half-graben environment.

Subsequent, late-stage reactivation along the suture did not reactivate the southern strand of the Melinda Fault, but instead displaced strata further north, but still parallel to the suture, creating the northern strand of the Melinda Fault.

Thus the geology of the Blouberg mountain area can be considered as a model for basin development and inversion within the realm of a zone of any linear fundamental tectonic weakness, such as a suture zone. Along such zones, it is likely that overlying and adjacent areas are prone to reactivation during any subsequent tectonic episodes, leading to complex structural and sedimentological relationships as basins are created, inverted and superimposed along a long-lived zone of tectonic weakness.