CHAPTER 6: INTRUSIVE ROCKS.

Intrusive igneous rocks occur only locally in the study area, and predominantly intrude in the area south of the southern strand of the Melinda Fault, where dykes locally cut the strata of the Waterberg Group, and locally rocks of the Blouberg Formation and the basement (Appendix 1). Other intrusive bodies, such as a sill cutting the Setlaole Formation (at 23°11.16'S; 29°01.17'E), and a granitic body, also cutting the Setlaole Formation (at 23°08.93'S; 29°03.75'E) were only encountered rarely.

Generally the intrusive rocks of the dyke swarms cutting the Waterberg, Blouberg and basement strata outcrop poorly, though the dykes can easily be identified from aerial photographs, on which the trend of dykes can be traced for several kilometres by contrasting vegetation patterns and by a slight negative relief caused by enhanced weathering of igneous rocks relative to the neighbouring sedimentary strata. Generally, these dykes seem to have a vertical dip, though rarely dykes with only gently-inclined dips were recorded cutting the Mogalakwena Formation (Figure 6.1). The trend of vertical dykes recorded south of the southern strand of the Melinda Fault is plotted in a rose diagram in Figure 6.2, and shows that the dykes have a dominant trend of E.N.E. to W.S.W.

Samples of three dykes from the field area were analysed by X.R.F and I.C.P.M.S for major and trace elements, respectively. The results of these analyses are shown in Table 6.1. Analysed samples were collected from a dyke cutting the basement at 23°04.52'S; 28°54.00'E (Sample no. 167), from a dyke cutting the Upper Member of the Blouberg Formation (Chapter 3) at 23°08.02'S; 28°55.18'E (Sample no. 227)(Figure 6.2), and from a dyke cutting the Mogalakwena Formation at 23°09.19'S; 28°41.09'E (Sample no. 197). A plot of the weight percent of $Na_2O + K_2O$ against total weight percent of SiO_2 (TAS diagram) for these three samples is shown in Figure 6.3, and shows that all three intrusive rocks are doleritic/dioritic. Incompatible trace element data were used to plot spidergrams (Figure 6.4) for these dolerites. They show relative enrichment in incompatible trace elements and negative anomalies in Nb, P and Ti.

In thin section, the dolerite dykes can be seen to be composed of plagioclase feldspar, augite and minor olivine, locally replaced by serpentine. Generally feldspar laths reach 1.5mm in length and augite crystals are about 1mm in diameter.

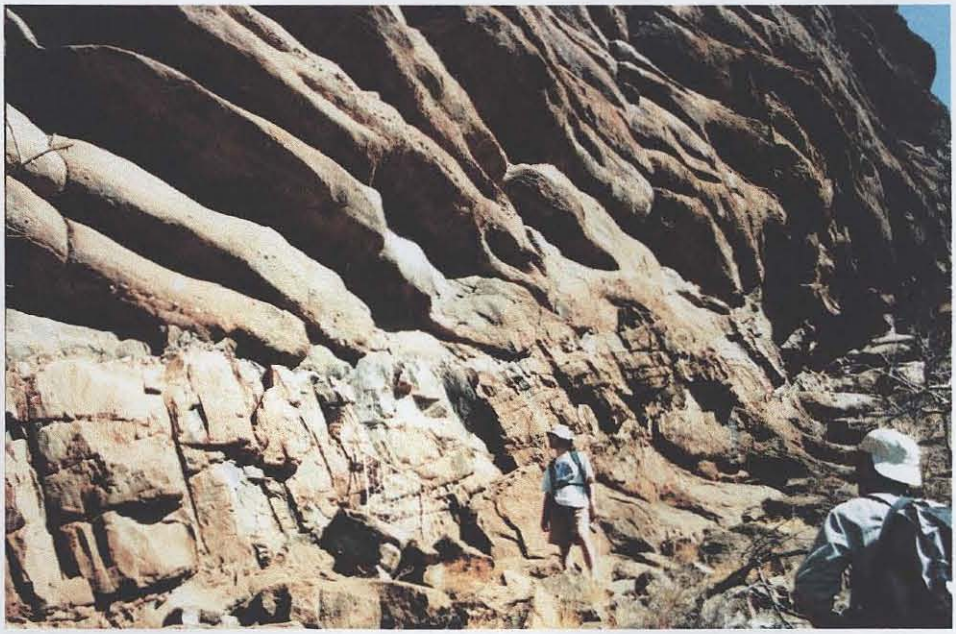

Figure 6.1: Gently dipping dyke cutting the Mogalakwena Formation at 23°16.05'S; 28°50.55'E.

Figure 6.3: Narrow (c. 20cm) E.N.E.-striking, vertically-dipping dyke cutting the Blouberg Formation at 23°09.05'S; 28°41.30'E. Hammer is 30cm long.

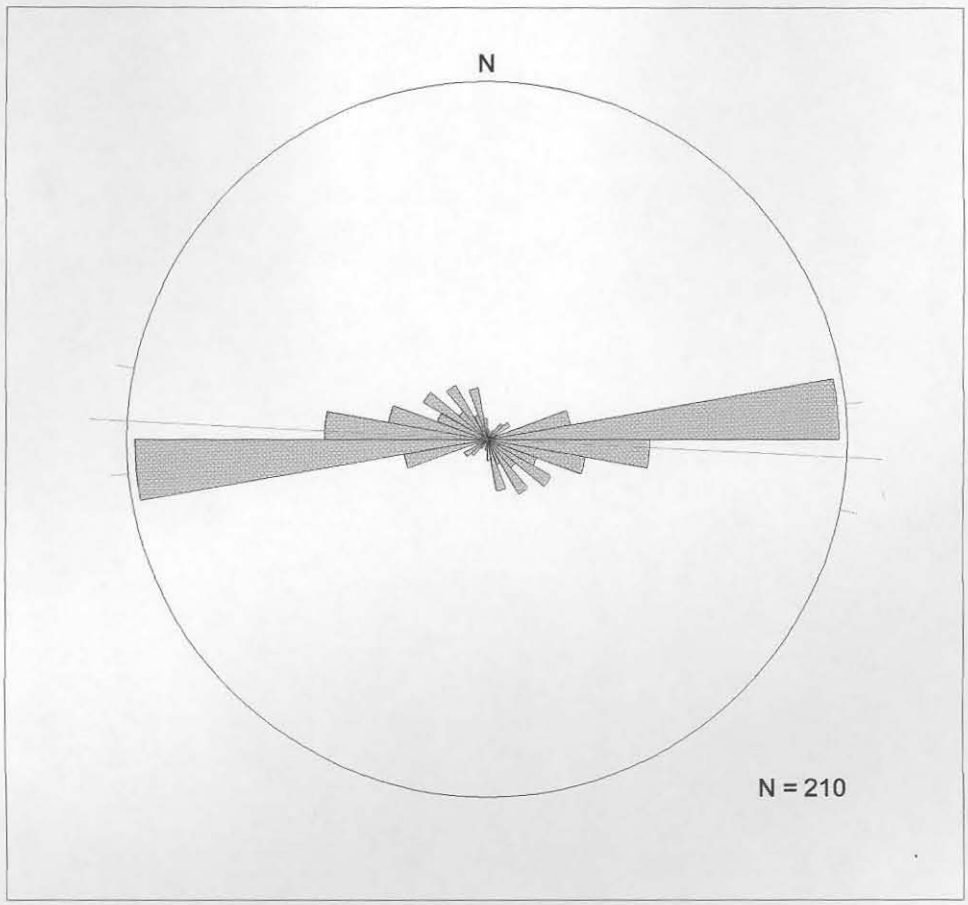

Figure 6.2: Rose diagram showing the orientation of dykes cutting the Waterberg Group strata. Principal trend is shown.

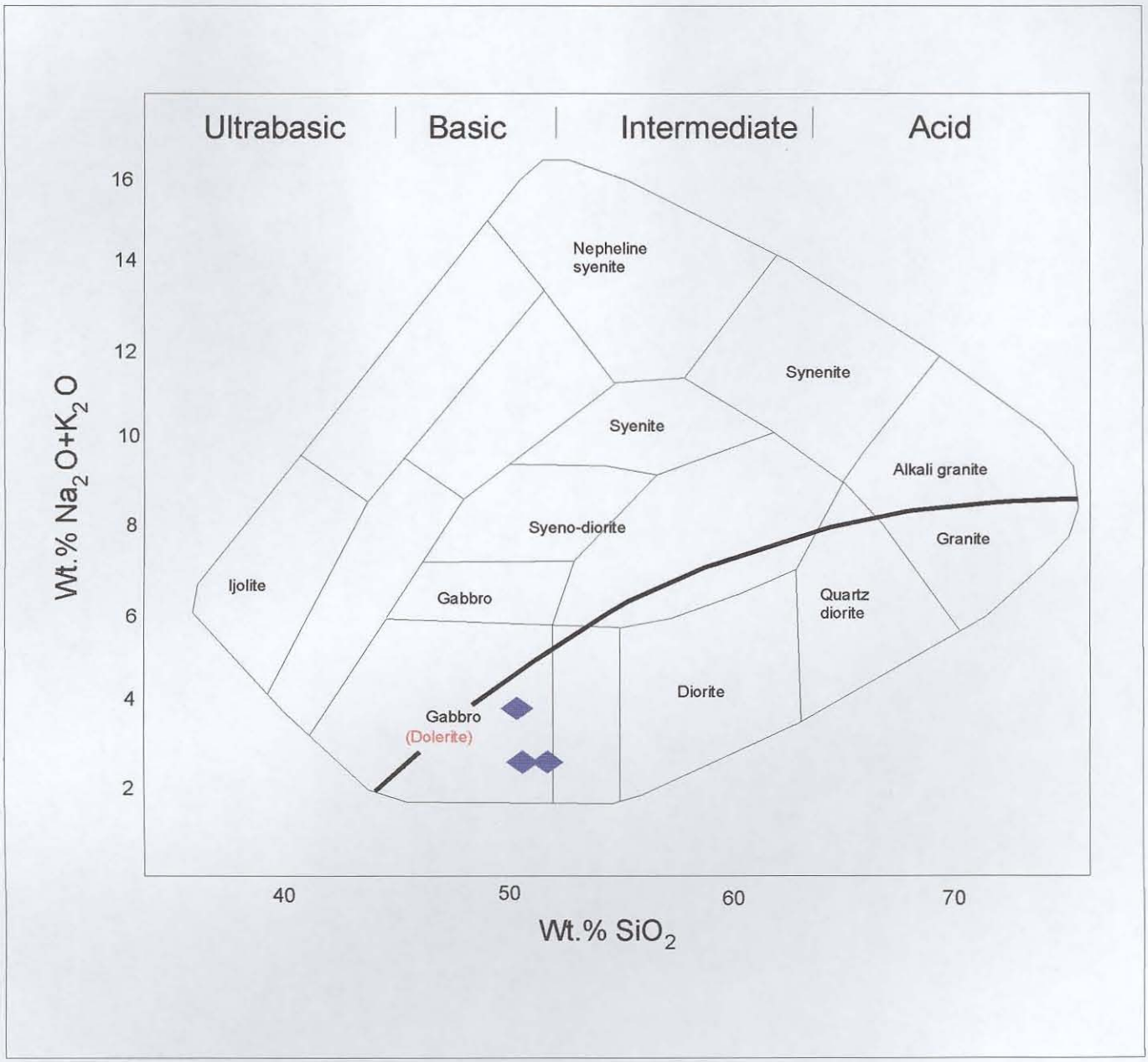

Figure 6.4: Total Alkali/Silica diagram (after Wilson, 1989) to show nomenclature for dykes intruding the basement, Blouberg Formation and Waterberg Group.

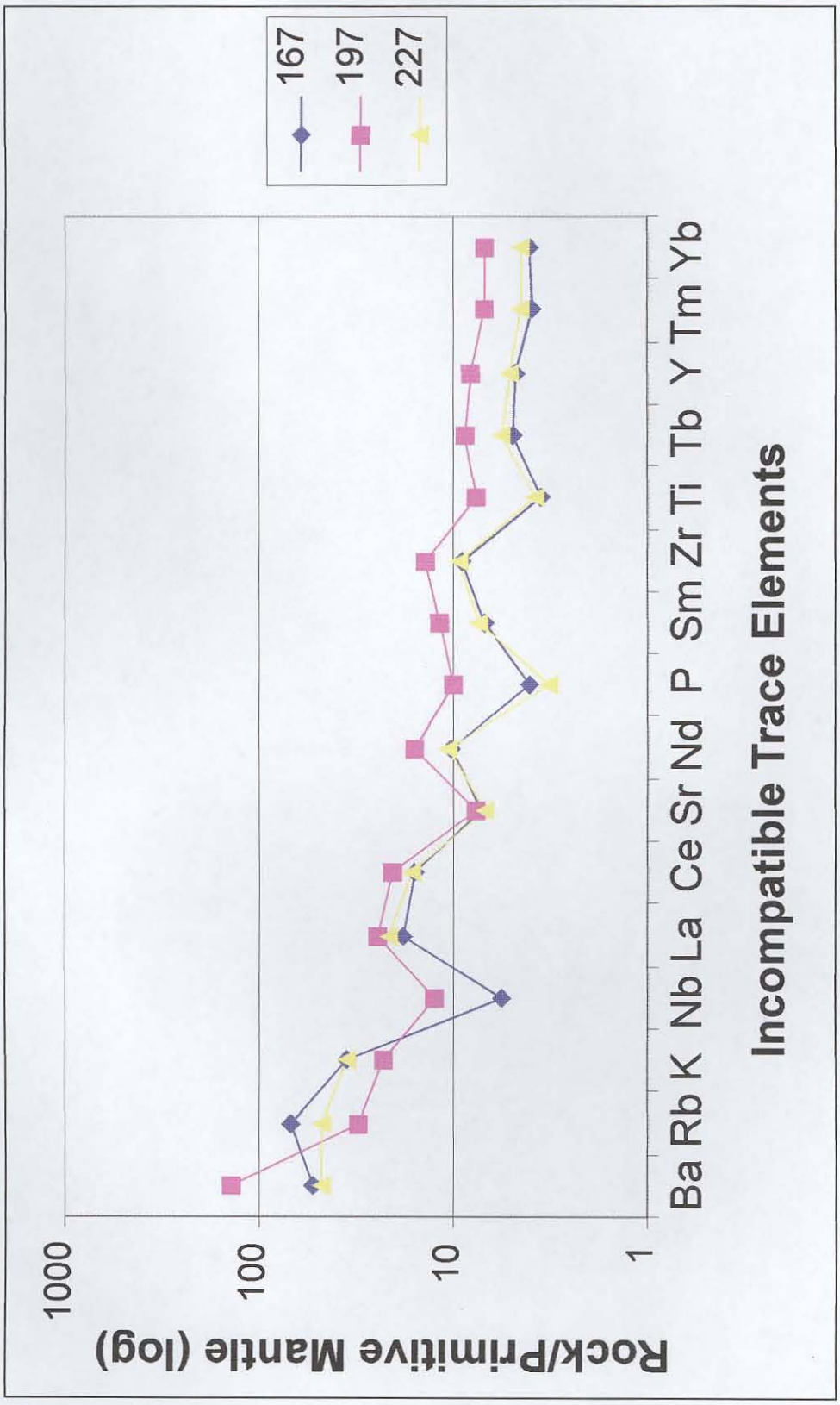

Figure 6.5: Spidergram to show values of normalised incompatible trace elements in the dykes cutting the basement, Blouberg Formation and Waterberg Group strata.

%	167	197	227
SiO2	52.09	51.03	50.82
TiO2	0.78	1.65	0.82
Al2O3	14.17	13.49	15.07
Fe2O3	10.17	14.18	12.02
MnO	0.15	0.21	0.34
MgO	5.53	5.82	5.63
CaO	9.61	10.02	5.63
Na2O	1.58	1.96	2.86
K2O	1.07	0.69	1.06
P2O5	0.09	0.22	0.07
Cr2O3	0.01	0.02	0.02
NiO	0.01	0.01	0.01
LOI	3.93	0.7	4.02
Total	99.23	99.98	98.15
Cu	16	221	71
Ga	14	20	16
Mo	<1	<1	<1
Nb	4	9	<2
Ni	78	77	91
Pb	<2	3	117
Rb	44	20	30
Sr	151	164	146
Th	<5	<5	<5
U	<3	<3	<3
Y	22	37	23
Zn	94	108	393
Zr	103	156	104
Ba	376	969	336
Cl	37	<30	<30
Cr	100	109	135
%S	<0.01	0.02	<0.01
Sc	42	38	40
V	256	325	246

Element	167	179	227
La	12.6	16.8	14.6
Ce	28.1	37.1	29.6
Pr	3.43	4.80	3.44
Nd	14.1	21.4	14.4
Sm	3.07	5.33	3.33
Eu	0.85	1.60	0.95
Gd	3.24	5.58	3.61
Tb	0.54	0.93	0.61
Dy	3.52	6.08	3.90
Ho	0.71	1.28	0.80
Er	2.05	3.70	2.37
Tm	0.29	0.52	0.33
Yb	1.97	3.42	2.18
Lu	0.30	0.51	0.32
Nb	4.0	9.0	2.0

Table 6.1: X.R.F. and I.C.P.M.S. results for major and trace element abundances in the dykes cutting the basement, Blouberg Formation and Waterberg Group.