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Title of article Geochemistry of the Cape Verde Islands and Fernando de Noronha

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see GSA Bulletin v. 87, p. 1089 - 1100

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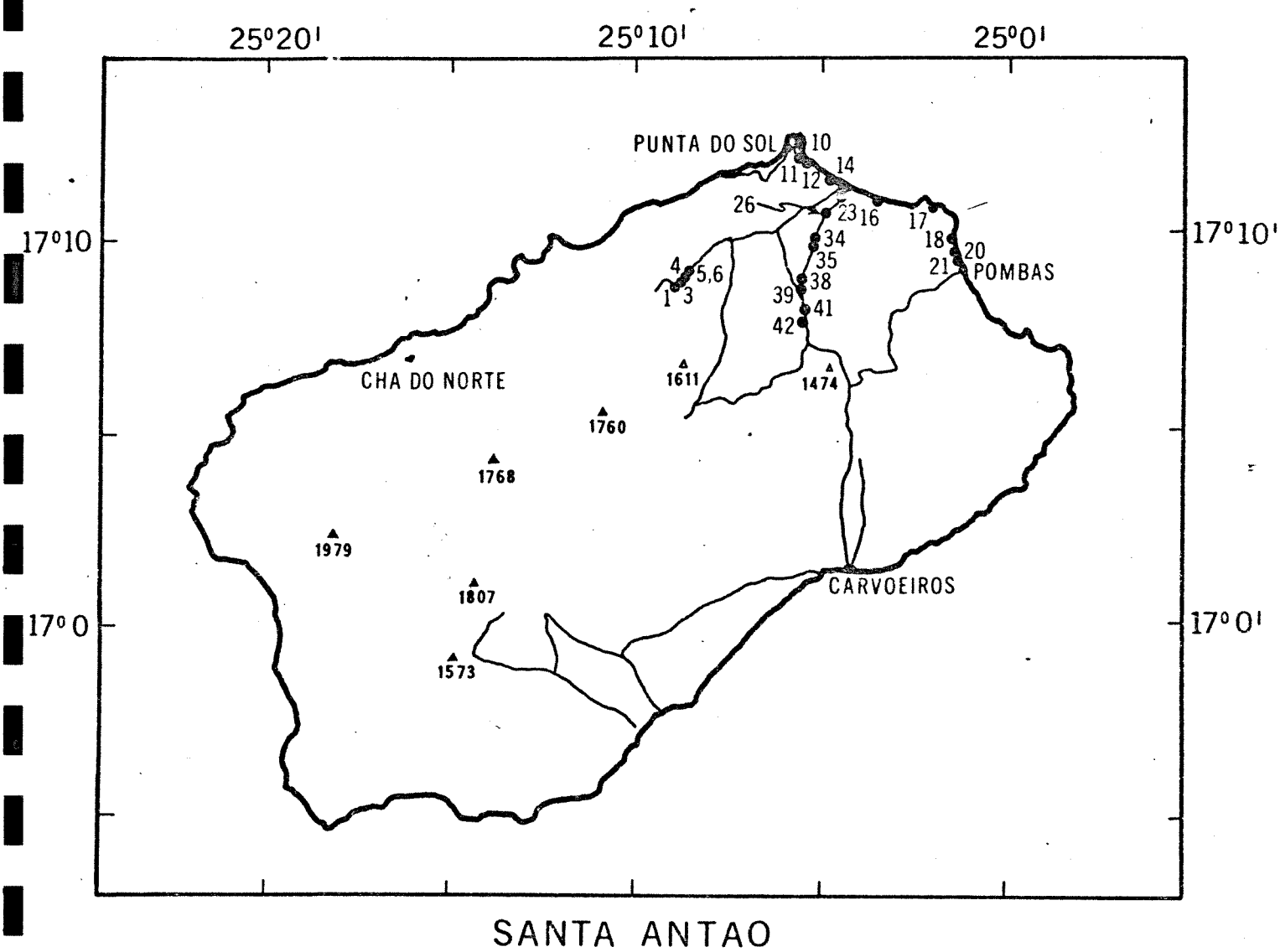

Figure 4. Sample site locations for Sao Antao. Major roads or tracks shown. Major topographic features indicated by solid triangles, with the height given in meters. Sample site numbers are next to site locations. See appendix for exact site locations and descriptions.

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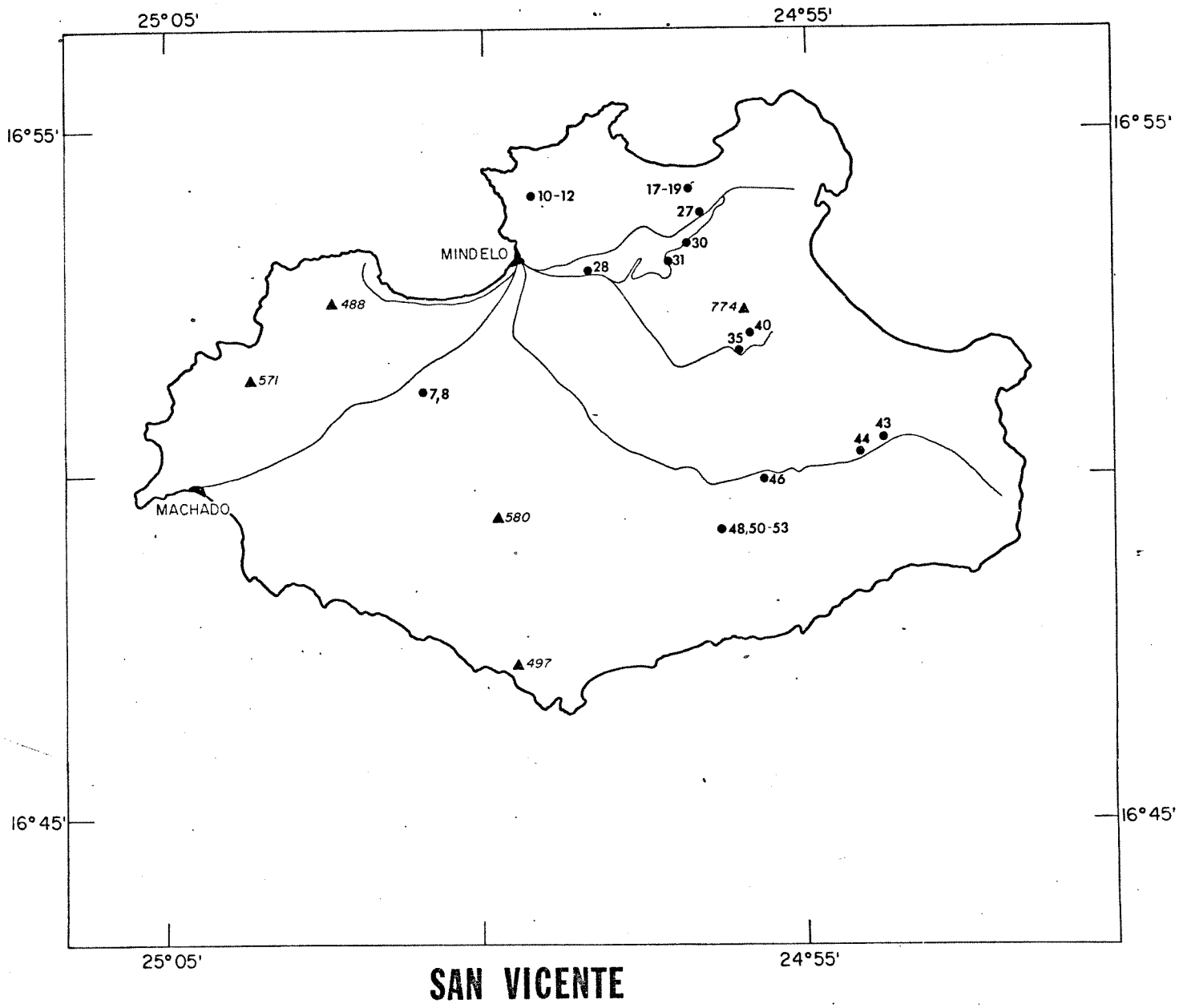

Figure 5. Sample site locations for Sao Vincente. Major roads or tracks shown. Major topographic features indicated by solid triangles, with the height given in meters. Sample site numbers are next to site locations. See appendix for exact site locations and descriptions.

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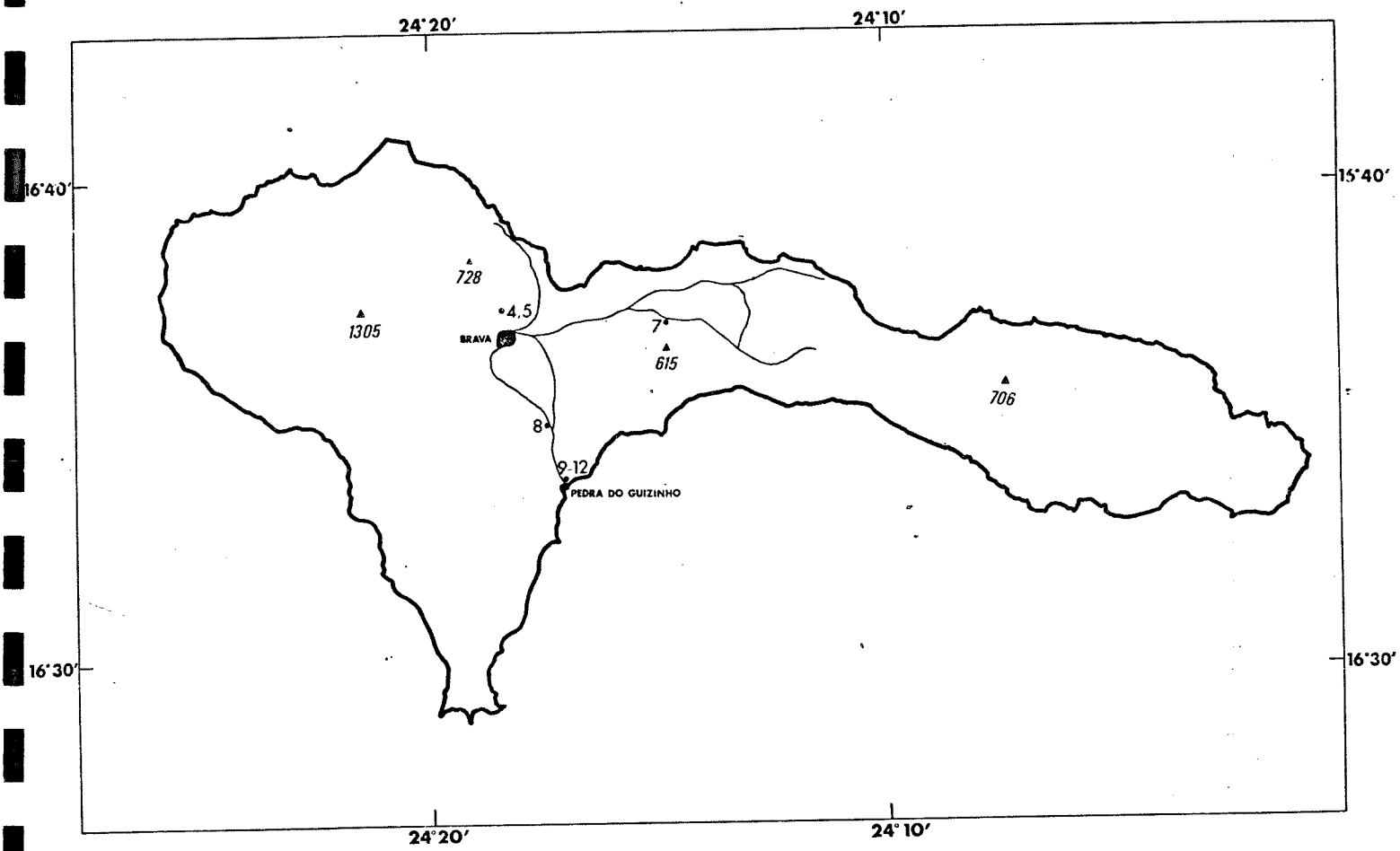

Figure 6. Sample site locations for Sao Nicolau. Major roads or tracks shown. Major topographic features indicated by solid triangles, with the height given in meters. Sample site numbers are next to site locations. See appendix for exact site locations and descriptions.

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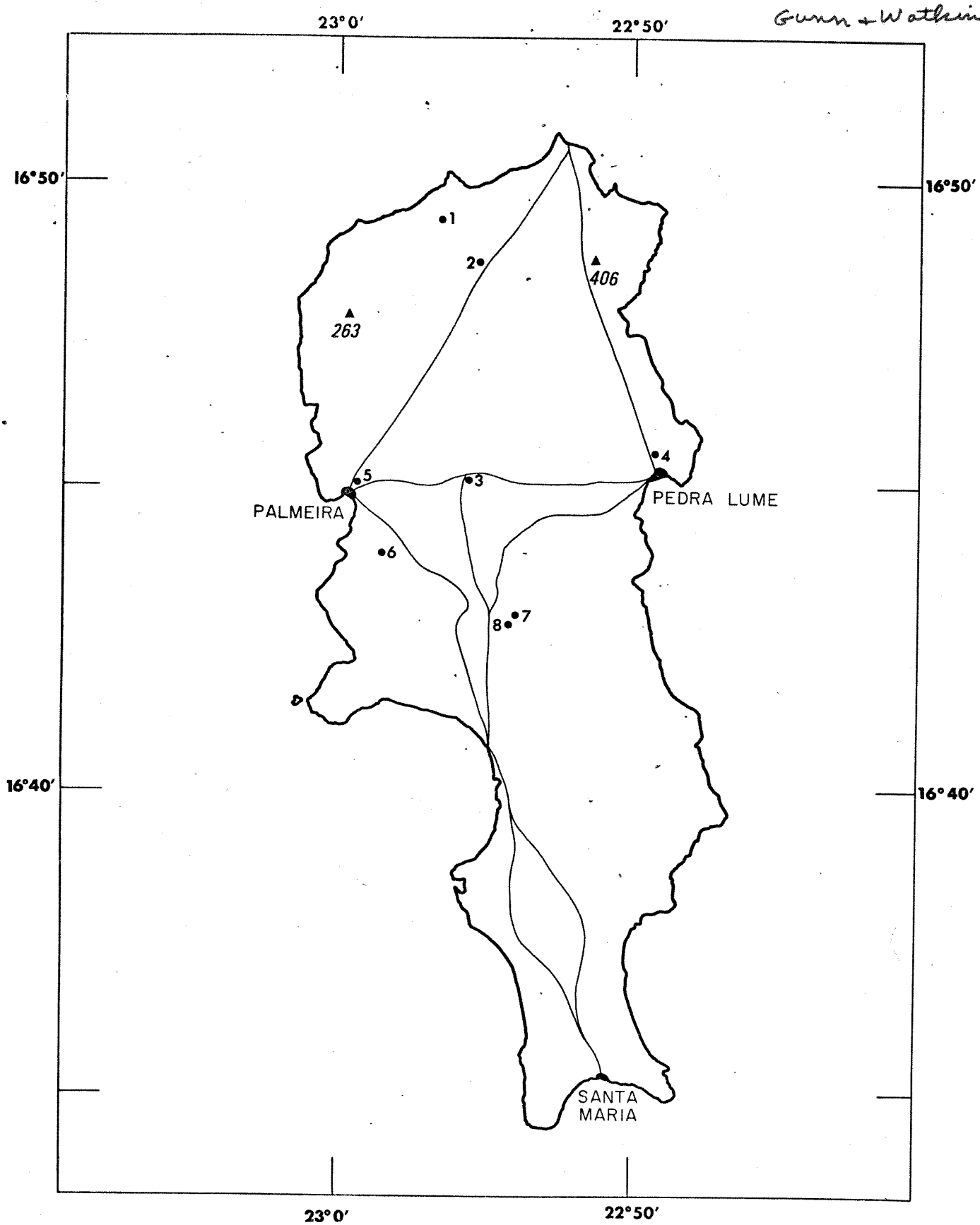

Figure 7. Sample site locations for Sal. Major road or tracks shown. Major topographic features indicated by solid triangles, with the height given in meters. Sample sites numbers are next to site locations. See appendix for exact locations and descriptions.

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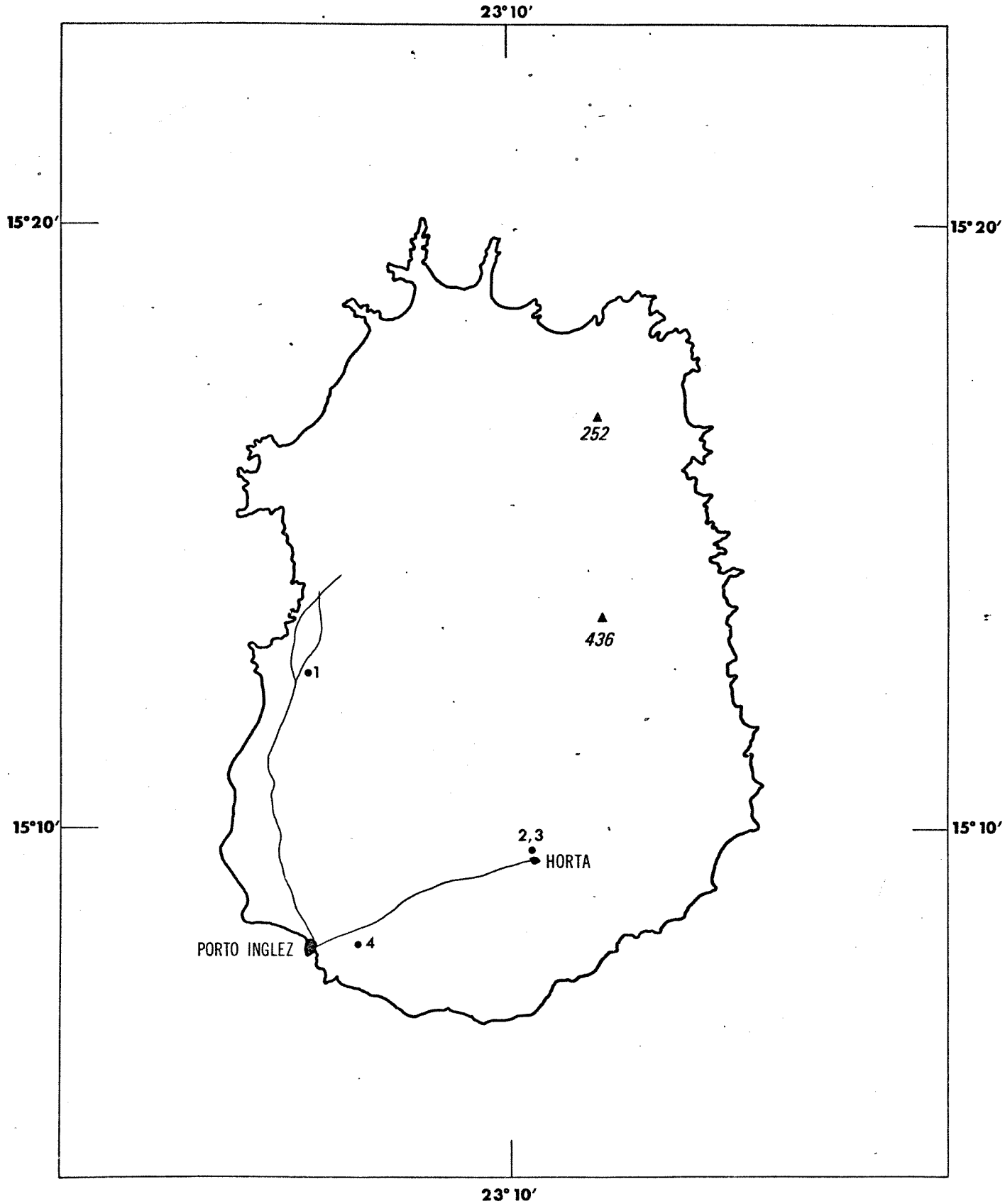

Figure 8. Sample site locations for Maio. Major roads or tracks shown. Major topographic features indicated by solid triangles, with the height given in meters. Sample site numbers are next to site locations. See appendix for exact site locations and descriptions.

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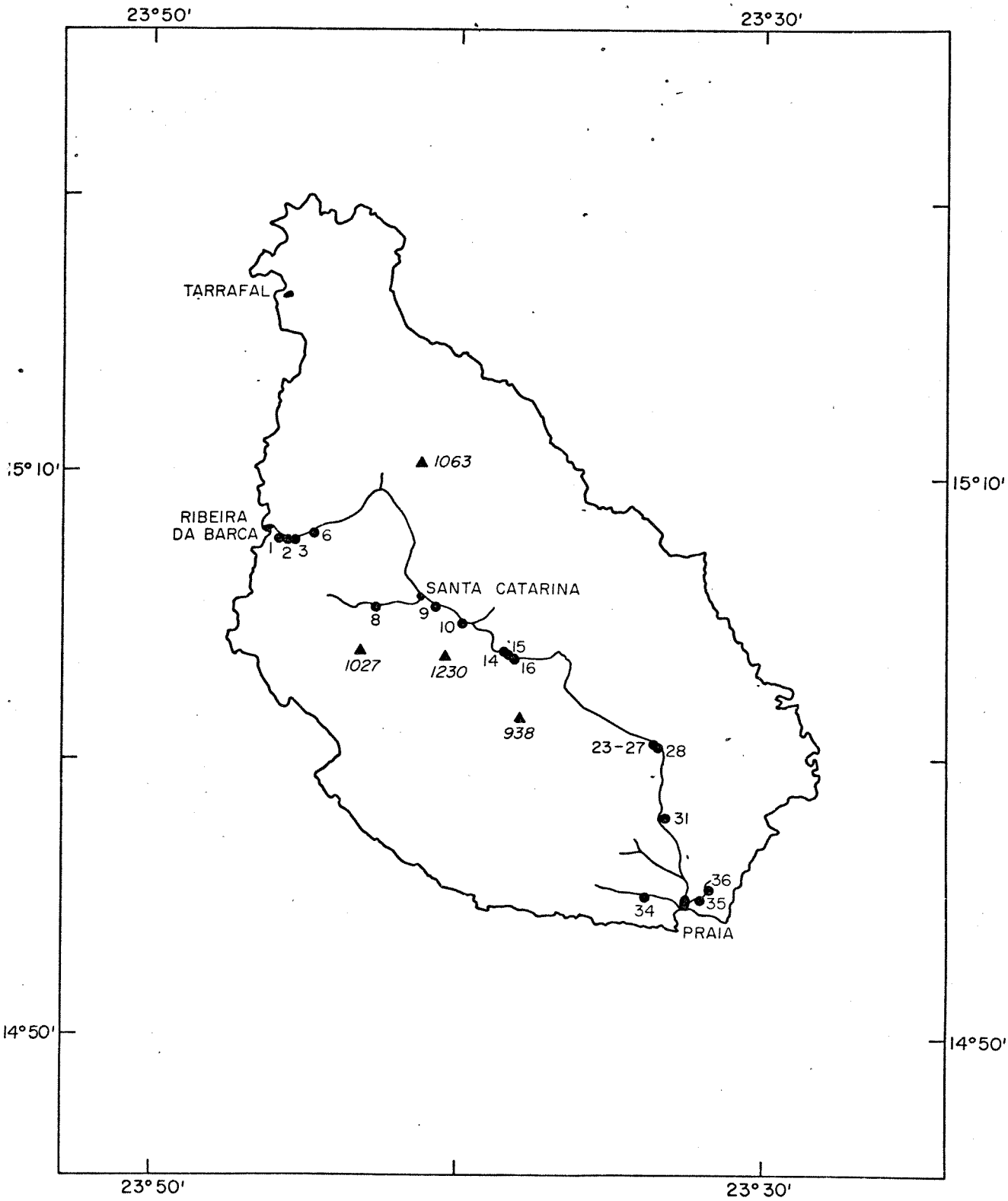

Figure 9. Sample site locations for Sao Tiago. Major roads or tracks shown. Major topographic features indicated by solid triangles, with the height given in meters. Sample site numbers are next to site locations. See appendix for exact site locations and descriptions.

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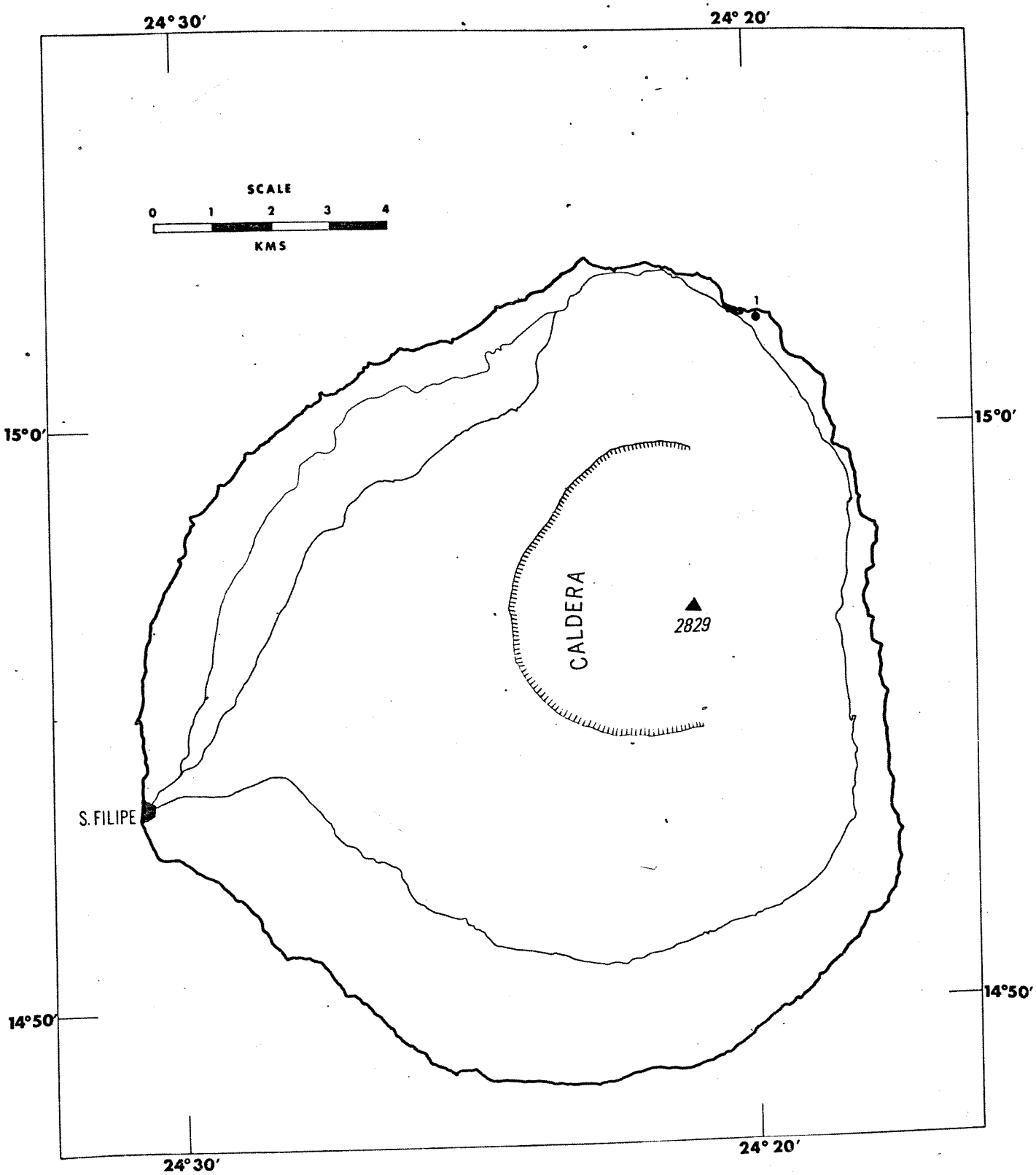

Figure 10. Sample site locations for Fogo. Major roads or tracks shown. Major topographic features indicated by solid triangles, with the height given in meters. Sample site numbers are next to site locations. See appendix for exact site locations and descriptions.

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TABLE 2

Chemical Compositions (Major and Minor Elements) and CIPW Norms of

Cape Verde Islands Igneous Rocks

All arranged by island (Figure 2), in order of decreasing MgO content
Major elements in weight percent; minor elements in parts per million.

(a) SAO ANTAO

Sample No.	VA5-1	VA10-3	VA9-2	VA3-1	VA26-1	VA20-2	VA25-2
Site No. (Fig 4)	33	28	29	35	18	11	19
SiO_2	41.04	41.36	41.05	40.98	41.89	48.09	42.71
Al_2O_3	10.23	10.59	10.56	11.36	11.62	11.18	11.84
TiO_2	4.19	4.71	4.67	4.76	4.70	4.35	4.03
Fe_2O_3	14.48	14.94	14.81	14.16	14.20	12.98	13.39
MnO	0.19	0.17	0.17	0.19	0.19	0.16	0.20
MgO	11.89	11.04	11.02	10.70	10.36	10.32	10.10
CaO	13.24	13.86	13.50	14.12	14.25	14.31	12.41
Na_2O	3.26	2.13	2.98	2.05	1.66	2.55	3.52
K_2O	0.54	0.45	0.48	0.53	0.41	0.40	0.88
P_2O_5	0.94	0.75	0.75	1.14	0.69	0.65	0.94
TOTAL	99.99	100.01	99.99	99.99	99.98	100.00	100.01
Cr	628.1	353.6	373.9	460.2	442.8	459.7	435.8
Co	88.0	89.5	87.0	97.9	59.0	67.7	56.7
Ni	302.8	193.0	209.3	207.5	217.3	218.3	200.5
Cu	80.8	96.9	72.9	80.4	82.2	126.1	84.5
Ga	17.9	17.3	16.1	18.4	18.4	18.1	18.2
Rb	57.6	25.4	17.3	20.6	4.1	10.0	29.0
Sr	1032.6	899.2	881.5	1125.6	950.3	885.9	1102.5
Ba	427.1	339.4	336.2	538.6	476.6	435.9	499.5
Pb	0.0	3.1	0.1	0.0	4.8	0.2	1.5
Th	4.2	5.5	3.9	5.3	6.6	3.0	9.1
Orthoclase	3.19	2.66	2.84	3.16	2.42	2.39	5.18
Plagioclase	12.17	21.70	15.49	24.12	29.13	24.48	20.18
Nepheline	14.68	7.76	12.86	7.28	4.33	8.11	12.75
Diopside	39.06	37.41	39.18	34.74	35.13	39.62	33.97
Olivine	16.74	15.69	14.94	15.04	14.42	11.72	14.20
Magnetite	2.90	2.90	2.90	2.90	2.90	2.90	2.90
Ilmenite	7.96	8.95	8.87	9.05	8.92	8.27	7.65
Apatite	2.05	1.64	1.64	2.49	1.51	1.42	2.05
Total	98.75	98.71	98.71	98.78	98.76	98.90	98.87
AN%	95.8	82.1	90.0	83.0	78.2	71.8	67.7

Sample No.	VA24-3	VA19-2	VA42-1	VA31-3	VA16-3	VA12-3	VA37-1
Site No. (Figure 4)	20	12	42	1	22	26	7
SiO_2	42.27	44.41	41.46	43.75	43.92	42.32	44.17
Al_2O_3	11.78	12.15	11.62	12.26	12.21	12.03	12.91
TiO_2	4.04	3.71	4.97	4.21	3.60	4.68	3.89
Fe_2O_3	13.56	12.66	14.34	13.56	12.82	13.78	13.17
MnO	0.17	0.17	0.19	0.19	0.21	0.18	0.16
MgO	10.06	9.94	9.74	9.19	9.19	8.98	8.42
CaO	12.52	13.55	13.40	12.86	13.03	13.62	13.44
Na_2O	4.21	2.31	2.49	2.77	3.65	2.82	2.74
K_2O	0.85	0.57	0.71	0.54	0.59	0.56	0.57
P_2O_5	0.53	0.53	1.08	0.66	0.77	1.02	0.53
Total	100.001	99.99	100.003	99.98	99.98	99.99	100.00
Cr	412.8	510.9	465.0	346.8	344.9	441.0	370.0
Co	73.4	74.3	85.9	68.1	62.0	67.1	69.2
Ni	224.4	285.3	184.0	214.0	145.7	154.7	170.5
Cu	73.2	98.1	118.9	74.5	57.5	78.4	86.2
Ga	19.9	16.4	17.9	18.0	18.5	18.8	18.5
Rb	30.1	7.4	29.0	38.6	48.4	37.7	27.5
Sr	1228.9	742.2	1177.1	796.5	993.2	1201.8	810.3
Ba	537.8	345.9	400.6	378.1	486.3	465.1	413.0
Pb	0.0	2.2	0.0	0.1	2.0	0.0	0.0
Th	5.8	3.1	0.0	1.8	5.7	4.8	0.0
Orthoclase	5.05	3.40	4.23	3.19	3.49	3.34	3.37
Plagioclase	11.90	31.92	24.29	31.39	24.32	26.52	32.33
Nepheline	18.66	4.72	8.23	6.22	11.78	8.58	6.55
Diopside	38.96	34.65	33.67	32.74	36.31	34.81	34.28
Olivine	12.54	13.15	13.64	12.96	11.58	11.55	10.91
Magnetite	2.90	2.90	2.90	2.90	2.90	2.90	2.90
Ilmenite	7.67	7.04	9.44	7.99	6.84	8.89	7.38
Apatite	1.16	1.16	2.36	1.44	1.68	2.23	1.16
Total	98.84	98.93	98.77	98.83	98.91	98.82	98.88
An %	89.6	64.7	74.7	60.5	61.0	68.5	64.4

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Sample No.	VA35-3	VA36-1	VA31-1	VA27-1	VA14-1	VA23-1	VA33-1
Site No. (Figure 4)	5	6	1	16	23	21	3
SiO_2	43.25	44.09	44.15	42.60	42.21	41.48	44.56
Al_2O_3	12.89	11.60	12.52	13.36	13.72	13.49	13.82
TiO_2	3.72	3.64	4.35	4.39	4.25	4.56	4.06
Fe_2O_3	12.47	13.55	13.58	13.63	13.70	13.33	11.91
MnO	0.13	0.19	0.18	0.17	0.19	0.19	0.19
MgO	8.41	8.28	8.12	7.78	7.72	7.46	7.35
CaO	13.54	15.16	13.49	12.32	12.09	12.61	13.46
Na_2O	3.20	2.53	2.55	3.97	4.47	4.56	2.05
K_2O	1.71	0.50	0.49	1.08	0.93	1.08	1.97
P_2O_5	0.62	0.46	0.54	0.69	0.71	1.23	0.64
Total	99.99	99.99	99.99	100.00	99.99	99.98	100.01
Cr	352.6	763.8	434.8	365.7	195.2	149.7	357.5
Co	78.4	84.8	80.2	75.0	70.9	67.9	64.6
Ni	184.1	291.2	239.2	116.1	110.9	111.0	158.2
Cu	89.6	86.8	78.3	72.6	75.3	71.5	57.5
Ga	18.5	16.6	18.1	20.6	19.8	21.1	18.7
Rb	39.9	25.4	29.0	17.0	43.3	60.5	52.7
Sr	885.2	615.9	783.1	956.7	981.6	1534.7	1007.4
Ba	446.2	331.1	362.8	478.8	507.9	657.1	494.9
Pb	0.0	0.0	0.0	0.0	0.0	0.0	3.1
Th	0.0	0.0	0.6	3.1	5.2	9.5	8.7
Orthoclase	8.75	2.97	2.93	6.41	5.53	6.37	11.62
Plagioclase	15.75	25.12	34.09	20.63	19.08	16.11	28.83
Nepheline	14.67	8.18	4.74	15.38	18.07	19.30	6.08
Diopside	38.61	43.64	34.46	33.80	33.48	34.21	32.56
Olivine	8.77	8.12	10.28	9.87	10.14	8.61	7.92
Magnetite	2.90	2.90	2.90	2.90	2.90	2.90	2.90
Ilmenite	7.07	6.91	8.26	8.34	8.07	8.66	7.72
Apatite	1.35	1.00	1.18	1.51	1.55	2.68	1.40
Total	98.95	98.84	98.83	98.84	98.82	98.85	99.02
An	0.0	73.8	61.0	73.7	75.5	80.7	77.7

Sample No.	VA39-1	VA38-3	VA17-3	VA6-2	VA34-2	VA41-3	VA1-3
Site No. (Figure 4)	39	38	14	31	4	41	37
SiO_2	41.63	42.04	42.63	41.44	46.89	43.74	43.12
Al_2O_3	13.31	13.57	13.34	13.70	14.25	14.83	15.21
TiO_2	4.97	4.70	5.09	5.15	3.44	4.23	4.79
Fe_2O_3	13.87	13.84	14.66	14.27	10.79	12.05	13.07
MnO	0.19	0.20	0.19	0.25	0.17	0.19	0.23
MgO	7.35	7.15	6.76	6.65	6.64	5.50	5.50
CaO	12.48	12.52	12.04	13.47	12.25	10.85	11.76
Na_2O	4.18	4.10	3.38	2.35	2.98	5.67	3.61
K_2O	0.75	0.70	1.03	1.29	2.01	[illegible].87	1.15
P_2O_5	1.260	1.19	0.87	1.42	0.58	1.08	1.55
Total	99.98	100.00	99.99	99.99	100.00	100.00	99.99
Cr	122.5	121.8	158.3	64.8	415.2	64.8	47.5
Co	75.3	79.4	81.4	45.2	163.0	42.3	28.7
Ni	61.0	83.7	82.4	69.8	70.3	56.8	45.8
Cu	19.8	19.7	19.4	21.4	19.4	22.0	22.1
Ga	37.1	64.3	47.4	53.7	41.5	35.2	35.7
Rb	1217.2	1252.1	975.9	1619.9	1095.5	1523.3	2201.3
Sr	481.8	485.8	454.5	619.2	554.4	643.1	300.2
Ba	0.0	0.0	1.3	2.5	0.0	0.0	5.5
Pb	0.0	0.0	0.8	8.4	0.0	0.0	12.5
Th							
Orthoclase	4.46	4.13	6.08	7.65	11.89	11.05	6.80
Plagioclase	23.07	25.40	28.87	29.84	32.77	16.46	37.64
Nepheline	14.97	14.01	9.71	7.07	6.50	22.22	8.02
Diopside	31.82	31.37	29.74	28.92	30.53	30.93	22.32
Olivine	9.40	9.50	9.86	9.49	6.73	5.06	8.72
Magnetite	2.90	2.90	2.90	2.90	2.90	2.90	2.90
Ilmenite	9.44	3.92	9.67	9.78	6.53	8.03	9.10
Apatite	2.75	2.60	1.90	3.10	1.27	2.36	3.38
Total	98.80	98.81	98.73	98.77	99.12	99.00	98.89
An	65.1	63.8	61.6	76.0	58.3	56.2	56.7

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Sample No.	VA4-1	VA43-3	VA22-1	VA11-1	VA7-2	VA26-1	VA8-1	VA26-1
Site No. (Figure 4)	34	43	10	27	32	18	30	17
SiO_2	44.28	42.79	45.94	45.61	46.79	47.59	50.32	57.03
Al_2O_3	15.07	14.77	16.15	16.15	16.84	20.38	19.04	21.51
TiO_2	4.20	4.26	3.99	3.88	3.48	2.32	2.65	0.58
Fe_2O_3	12.26	12.47	10.74	11.03	11.02	7.57	8.13	3.47
MnO	0.21	0.28	0.19	0.20	0.21	0.19	0.20	0.16
MgO	5.31	4.94	4.88	4.39	4.25	3.07	2.51	0.39
CaO	11.12	11.81	11.03	9.99	9.58	6.03	6.69	2.05
Na_2O	4.92	5.53	4.92	5.40	4.77	9.22	6.76	9.20
K_2O	1.47	1.75	1.29	2.26	2.18	3.02	3.21	5.56
P_2O_5	1.17	1.41	0.87	1.08	0.88	0.60	0.50	0.04
TOTAL	100.00	100.00	100.00	99.99	100.00	100.00	100.01	100.00
Cr	73.1	45.1	83.1	30.9	27.2	20.3	25.2	7.4
Co	57.2	37.0	62.0	53.4	45.1	35.4	41.0	22.5
Ni	50.4	21.7	56.3	24.2	26.8	24.1	28.8	21.7
Cu	65.9	50.3	39.8	45.2	36.6	25.7	24.3	6.3
Ga	22.5	22.7	21.8	24.9	22.8	24.9	24.2	26.8
Rb	60.3	51.2	25.0	55.8	26.1	90.9	76.3	184.0
Sr	1555.1	2059.5	1267.1	1687.3	1541.4	2638.8	1683.6	1225.2
Ba	650.6	717.3	620.0	752.1	700.1	949.8	912.8	1189.1
Pb	1.8	5.2	0.0	2.2	1.5	4.6	3.7	5.4
Th	12.0	12.8	5.0	11.8	5.5	18.2	13.5	15.5
Orthoclase	8.70	10.33	7.62	13.34	12.87	17.88	18.98	32.89
Plagioclase	27.62	15.14	36.30	26.60	36.80	17.94	35.97	33.47
Nepheline	15.55	22.74	12.74	17.47	11.74	35.41	18.07	24.56
Diopside	27.43	32.76	25.50	24.53	19.87	17.12	14.83	4.84
Olivine	6.26	3.92	4.59	4.51	6.38	2.48	2.52	0.00
Magnetite	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90
Ilmenite	7.97	8.09	7.58	7.37	6.62	4.41	5.04	1.11
Apatite	2.55	3.08	1.90	2.36	1.92	1.31	1.09	0.09
Total	98.98	98.95	99.13	99.09	99.10	99.44	99.40	99.86
An	51.7	66.9	48.6	48.0	47.7	28.3	32.4	2.7

(b) SAO VICENTE

Sample No.	VV36-1	VV24-2	VV20-3	VV11-2	VV15-3	VV3-1	VV3-3
Site No. (Figure 5)	11	37	27	48	52	35	35
SiO_2	42.60	39.77	38.21	43.69	43.28	38.92	38.64
Al_2O_3	7.14	10.28	10.29	10.44	10.69	10.96	10.18
TiO_2	2.68	3.65	4.23	3.02	3.56	4.06	4.11
Fe_2O_3	13.26	13.94	13.70	13.43	13.42	13.01	13.76
MnO	0.16	0.20	0.20	0.17	0.16	0.19	0.17
MgO	20.71	15.28	15.26	14.48	13.92	13.50	13.47
CaO	11.96	13.71	13.68	11.89	11.39	13.76	15.75
Na_2O	0.71	1.93	2.44	1.59	1.94	3.29	2.01
K_2O	0.49	0.55	1.03	0.85	1.29	1.43	1.12
P_2O_5	0.29	0.67	0.96	0.43	0.35	0.86	0.78
Total	100.01	99.99	100.00	99.99	100.00	100.00	100.00
Cr	1392.3	488.5	459.7	793.1	653.0	442.2	550.0
Co	111.1	75.7	79.4	90.7	89.9	64.7	82.1
Ni	659.7	435.8	301.2	450.7	425.6	243.2	335.4
Cu	44.6	88.0	79.4	75.1	81.5	63.3	53.7
Ga	11.2	14.9	16.1	14.6	16.0	16.4	14.5
Rb	9.9	8.7	20.6	18.8	35.8	31.0	33.6
Sr	297.4	684.8	1640.2	542.5	701.9	765.3	930.2
Ba	181.3	333.7	704.2	254.3	439.2	398.0	334.4
Pb	0.0	3.7	0.0	3.0	0.0	0.9	0.0
Th	0.0	5.7	0.0	2.3	0.0	6.3	0.0
C.I.P.W. NORMS							
Orthoclase	2.92	0.00	0.00	5.05	7.60	0.00	0.00
Plagioclase	16.38	17.76	14.08	26.16	21.32	10.91	15.45
Nepheline	2.42	8.85	11.19	3.32	6.37	15.08	9.21
Leucite	0.00	2.56	4.77	0.00	0.00	6.63	5.18
Diopside	34.08	37.10	38.47	30.19	30.29	41.83	46.57
Olivine	34.45	23.50	22.01	24.56	22.85	17.09	16.20
Magnetite	2.90	2.90	2.90	2.90	2.90	2.90	2.90
Ilmenite	5.10	6.93	8.03	5.73	6.77	7.72	7.82
Apatite	0.63	1.46	2.09	0.94	0.76	1.88	1.70
Total	98.88	101.06	103.54	98.85	98.86	104.03	105.04
An	90.1	0.0	0.0	70.8	77.1	0.0	0.0

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Sample No.	VV17-3	VV39-1	VV44-1	VV21-2	VV52-3	VV50-2	VV7-1
Site No. (Figure 5)	30	12	24	31	19	17	44
SiO_2	40.64	42.75	41.05	44.93	41.36	41.76	41.13
Al_2O_3	11.71	11.33	13.49	14.37	13.81	14.15	13.78
TiO_2	4.81	4.00	4.33	3.04	3.94	4.08	4.11
Fe_2O_3	14.45	13.75	13.38	12.58	13.55	14.20	12.85
MnO	0.17	0.17	0.23	0.16	0.17	0.20	0.21
MgO	12.40	11.83	8.64	8.46	8.19	7.82	7.69
CaO	12.38	12.83	14.65	11.84	14.56	13.80	14.06
Na_2O	2.35	2.04	2.60	3.00	3.08	2.61	4.00
K_2O	0.35	1.04	0.84	1.18	0.61	0.48	1.16
P_2O_5	0.73	0.26	0.80	0.44	0.75	0.92	1.01
Total	100.00	100.00	100.01	100.00	100.02	100.01	100.01
Cr	419.0	539.2	142.8	235.9	129.0	145.2	142.1
Co	61.8	98.9	50.6	66.8	69.2	67.8	68.9
Ni	307.8	291.5	89.6	155.7	112.9	133.1	72.6
Cu	67.7	106.2	90.5	100.2	107.5	80.8	79.0
Ga	15.8	17.3	19.2	18.2	18.3	20.1	17.8
Rb	6.5	21.1	9.1	18.0	5.4	10.1	35.7
Sr	663.8	612.3	974.6	672.0	953.0	864.3	1105.3
Ba	411.5	250.4	613.3	356.9	481.7	543.1	517.0
Pb	0.0	0.0	0.2	0.0	0.0	0.0	0.0
Th	0.0	0.0	7.0	0.0	0.0	0.0	0.0
C.I.P.W. NORMS							
Orthoclase	2.08	6.15	2.74	6.97	3.63	2.81	0.02
Plagioclase	25.20	21.39	22.67	33.54	22.08	32.26	16.21
Nepheline	8.15	7.89	11.92	7.64	14.10	8.30	18.34
Leucite	0.00	0.00	1.73	0.00	0.00	0.00	5.36
Diopside	29.52	34.94	36.65	27.48	37.17	30.61	38.56
Olivine	20.16	17.40	10.28	13.66	9.86	12.16	7.49
Magnetite	2.90	2.90	2.90	2.90	2.90	2.90	2.90
Ilmenite	9.13	7.59	8.23	5.78	7.48	7.74	7.81
Apatite	1.59	0.57	1.75	0.96	1.64	2.01	2.20
Total	98.75	98.82	98.87	98.94	98.86	98.79	98.91
An	79.9	86.7	0.0	65.0	99.8	78.0	0.0

Sample No.	VV37-1	VV51-3	VV47-1	VV14-3	VV1-1	VV40-3	VV13-1
Site No. (Figure 5)	10	18	14	51	40	13	50
SiO_2	42.99	41.86	4.128	45.53	40.53	45.14	44.41
Al_2O_3	14.48	14.27	14.38	14.04	14.17	14.04	14.55
TiO_2	3.81	4.00	3.99	3.81	4.11	4.49	4.28
Fe_2O_3	13.25	14.14	13.66	13.10	12.87	13.59	13.13
MnO	0.17	0.19	0.21	0.15	0.20	0.16	0.16
MgO	7.68	7.59	7.35	6.92	6.67	6.31	6.22
CaO	12.82	14.31	13.58	13.05	14.48	11.69	12.78
Na_2O	2.79	2.94	3.58	1.97	4.84	2.53	2.64
K_2O	1.40	0.50	1.10	0.95	1.23	1.47	1.20
P_2O_5	0.59	0.21	0.86	0.48	0.91	0.58	0.62
Total	100.00	100.01	99.99	100.00	100.01	100.00	99.99
Cr	121.6	135.0	83.4	144.8	78.1	75.6	90.1
Co	61.6	64.1	50.1	61.8	58.2	57.4	65.8
Ni	152.0	109.1	89.6	111.6	75.4	83.3	88.3
Cu	125.5	120.1	101.8	101.7	209.4	106.1	101.9
Ga	20.7	18.2	18.9	19.3	20.7	19.7	20.5
Rb	28.6	14.3	10.8	10.1	13.9	17.8	22.9
Sr	865.7	1213.8	1163.6	601.5	1635.4	828.9	805.4
Ba	440.3	557.2	586.0	309.7	681.2	281.9	366.4
Pb	0.0	0.0	0.6	0.0	0.0	0.0	0.0
Th	0.0	0.0	5.6	0.0	0.0	0.0	0.0
C.I.P.W. NORMS							
Orthoclase	8.30	2.93	5.15	5.64	0.00	8.68	7.09
Plagioclase	27.28	25.62	19.91	43.08	13.31	38.81	36.99
Nepheline	10.38	12.75	16.41	0.13	22.19	2.82	5.23
Leucite	0.00	0.00	1.07	0.00	5.68	0.00	0.00
Diopside	30.32	37.10	34.55	28.74	43.27	26.10	28.91
Olivine	11.15	9.43	9.37	10.12	3.95	9.73	8.27
Magnetite	2.90	2.90	2.90	2.90	2.90	2.90	2.90
Ilmentite	7.25	7.61	7.58	7.23	7.82	8.53	8.13
Apatite	1.29	0.46	1.88	1.05	1.99	1.27	1.35
Total	98.87	98,80	98.82	98.89	101.10	98.84	98.88
An	82.9	94.4	0.0	60.5	0.0	56.8	64.4

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Sample No.	VV6-3	VV30-3	VV46-4	VV16-3	VV2-1	VV9-3	VV45-3	VV45-1
Site No. (Figure 5)	28	1	8	53	36	16	7	7
SiO_2	43.32	44.67	44.08	44.90	44.22	42.99	56.88	57.50
Al_2O_3	14.19	15.61	15.19	16.38	17.75	18.10	19.24	20.03
TiO_2	4.20	4.70	4.22	3.21	3.28	2.50	0.63	0.59
Fe_2O_3	13.72	12.53	13.58	10.92	10.26	12.77	6.41	5.80
MnO	0.18	0.20	0.19	0.21	0.30	0.23	0.24	0.20
MgO	6.21	5.43	4.99	4.87	3.84	3.52	0.62	0.60
CaO	11.82	11.07	10.75	10.56	12.21	9.92	2.36	2.17
Na_2O	4.23	4.02	4.73	5.94	5.01	7.44	8.39	8.01
K_2O	1.48	0.99	1.66	2.26	2.20	1.53	5.10	5.01
P_2O_5	0.64	0.78	0.63	0.76	0.92	1.00	0.11	0.08
Total	100.00	99.99	100.02	100.01	99.99	100.00	99.92	99.99
Cr	68.3	31.6	35.0	72.3	17.8	0.0	4.9	0.0
Co	66.1	44.1	58.9	54.3	26.0	54.8	8.5	52.5
Ni	82.3	34.1	48.0	48.9	12.0	9.5	12.5	11.0
Cu	110.6	62.9	115.7	50.8	16.7	66.8	5.2	6.4
Ga	18.8	21.8	20.9	20.9	24.5	17.3	26.4	24.6
Rb	35.7	14.3	53.3	56.8	80.8	55.1	149.1	152.4
Sr	649.2	969.7	717.7	1258.6	3980.0	1523.2	404.4	347.4
Ba	409.2	399.4	386.2	790.0	1083.5	854.0	947.7	769.4
Pb	0.0	3.4	0.4	2.9	7.2	1.6	9.3	8.6
Th	0.0	7.2	3.8	10.1	6.9	9.2	29.6	24.0
C.I.P.W. NORMS								
Orthoclase	8.76	5.83	9.82	13.38	13.03	9.04	30.13	29.61
Plagioclase	40.19	25.40	16.76	22.95	15.79	34.54	42.47	
Nepheline	16.02	8.37	16.22	24.30	21.06	31.77	19.63	15.82
Leucite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diopside	32.35	23.38	28.27	29.88	29.28	26.67	9.69	5.46
Olivine	7.84	7.63	6.87	4.16	1.72	5.82	1.21	2.04
Magnetite	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90
Ilmentite	7.99	8.92	8.01	6.09	6.22	4.75	1.20	1.14
Apatite	1.40	1.70	1.37	1.66	2.01	2.18	0.24	0.17
Total	98.83	98194	98.86	99.12	99.17	98.93	99.54	99.62
An	69.9	52.4	58.8	66.4	83.9	71.5	0.0	8.7

(c) SAN NICOLAU

Sample No.	VN13-3	VN6-3	VN9-2	VN6-2	VN12-1	VN6-1	VN9-3
Site No. (Figure 6)	6	9	12	9	7	9	12
SiO_2	41.05	42.59	42.78	42.90	41.19	42.49	42.79
Al_2O_3	12.12	11.96	12.17	12.31	11.75	11.82	12.17
TiO_2	2.90	2.97	2.98	2.99	3.86	2.95	2.97
Fe_2O_3	13.10	13.41	13.28	13.33	12.37	13.39	13.02
MnO	0.20	0.18	0.20	0.19	0.18	0.18	0.18
MgO	12.93	12.54	12.35	12.27	12.09	12.06	11.87
CaO	13.40	12.62	12.09	12.33	13.04	13.73	12.58
Na_2O	3.00	2.24	2.61	2.28	4.06	1.94	3.03
K_2O	0.62	0.77	0.87	0.62	0.67	0.76	0.69
P_2O_5	0.69	0.71	0.67	0.76	0.78	0.68	0.71
Total	100.01	99.99	100.00	99.98	100.00	99.99	100.01
Cr	391.9	490.7	411.9	413.5	480.2	474.5	467.6
Co	68.8	73.8	63.6	63.2	75.7	75.8	73.2
Ni	246.7	271.1	234.4	236.5	250.2	278.5	259.2
Cu	74.8	68.9	67.9	74.9	54.0	64.5	66.3
Ga	15.9	15.3	15.9	16.4	15.6	15.3	15.7
Rb	7.7	13.3	9.1	9.1	5.1	17.2	8.0
Sr	675.6	870.2	742.7	890.0	817.3	807.1	716.8
Ba	425.2	416.2	388.1	408.9	503.8	365.8	380.6
Pb	3.0	0.0	4.1	1.1	0.0	0.0	0.0
Th	5.1	0.0	5.6	4.9	0.0	0.0	0.0
C.I.P.W. NORMS							
Orthoclase	0.0	4.57	5.13	3.68	0.00	4.49	4.08
Plagioclase	17.79	24.53	23.65	28.96	11.84	23.23	21.78
Nepheline	13.75	7.97	9.41	6.42	18.61	7.85	11.61
Leucite	2.85	0.00	0.00	0.00	3.12	0.00	0.00
Diopside	35.88	30.71	29.88	28.34	38.62	34.51	32.75
Olivine	19.61	20.97	20.78	21.22	15.12	18.80	18.60
Magnetite	2.90	2.90	2.90	2.90	2.90	2.90	2.90
Ilmentite	5.51	5.64	5.66	5.67	7.34	5.60	5.64
Apatite	1.51	1.55	1.46	1.66	1.70	1.48	1.55
Total	99.80	98.85	98.87	98.85	99.27	98.85	98.90
AN	0.0	31.9	79.1	73.1	0.0	91.2	79.7

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Sample No.	VN7-3	VN8-3	VN1-2	VN4-3	VN5-3	VN4-1	VN11-1
Site No. (Figure 6)	10	11	1	4	5	4	8
SiO_2	42.67	43.16	43.42	43.72	44.36	43.85	45.65
Al_2O_3	12.04	12.40	13.02	13.42	13.00	12.88	14.89
TiO_2	3.04	3.13	3.51	3.61	3.47	3.44	3.04
Fe_2O_3	13.45	13.69	13.32	13.34	12.90	12.98	12.54
MnO	0.18	0.18	0.19	0.19	0.17	0.17	0.20
MgO	11.83	11.40	10.83	10.68	10.37	10.24	7.42
CaO	13.33	12.76	11.32	11.33	11.47	11.33	10.69
Na_2O	2.14	2.05	2.72	2.50	2.84	3.89	4.11
K_2O	0.61	0.47	1.02	0.59	0.80	0.80	0.95
P_2O_5	0.71	0.75	0.62	0.63	0.61	0.46	0.51
Total	99.99	100.00	99.98	100.00	100.00	99.99	100.00
Cr	446.9	433.6	465.9	479.0	600.9	486.1	332.2
Co	85.4	78.3	62.6	61.8	87.4	75.6	66.8
Ni	269.0	274.3	260.4	275.3	267.1	249.6	136.8
Cu	71.3	64.6	57.4	61.8	64.7	62.9	46.9
Ga	16.0	16.3	18.2	18.0	16.8	17.7	20.1
Rb	3.8	3.2	12.4	12.9	35.0	31.2	12.2
Sr	753.9	791.0	763.2	783.7	690.6	699.4	737.4
Ba	372.6	407.6	461.0	472.1	425.2	428.0	410.8
Pb	0.0	0.0	2.3	0.8	0.0	0.0	0.0
Th	0.0	0.0	5.6	6.4	0.0	0.0	0.0
C.I.P.W. NORMS							
Orthoclase	3.59	2.79	6.03	3.50	4.73	4.76	5.59
Plagioclase	26.10	32.78	29.72	37.77	33.66	24.24	36.17
Nepheline	7.29	4.23	7.36	3.81	5.81	12.99	9.75
Diopside	30.65	28.79	25.98	23.27	26.57	30.81	24.95
Olivine	18.99	19.75	18.82	19.39	17.30	15.67	12.70
Magnetite	2.90	2.90	2.90	2.90	2.90	2.90	2.90
Ilmenite	5.78	5.95	6.67	6.85	6.60	6.53	5.77
Apatite	1.55	1.64	1.35	1.37	1.33	1.00	1.11
Total	98.85	98.83	98.85	98.87	98.91	98.90	98.92
An	81.3	69.7	67.0	61.2	59.1	61.8	52.1

(d) SAL

Sample No.	VS2-1	VS2-3	VS3-3	VS3-2	VS4-3	VS1-1
Site No. (Figure 7)	2	2	1	1	4	3
SiO_2	39.35	38.93	39.00	38.96	37.94	36.97
Al_2O_3	7.78	8.33	9.60	9.60	11.31	10.94
TiO_2	3.31	3.32	3.43	3.47	3.48	3.23
Fe_2O_3	13.53	13.33	13.04	13.18	12.97	11.71
MnO	0.18	0.19	0.20	0.18	0.20	0.20
MgO	20.21	19.50	16.35	16.33	13.96	12.54
CaO	12.64	12.71	13.51	13.56	15.02	16.76
Na_2O	1.66	2.04	2.87	2.76	2.91	4.92
K_2O	0.88	1.06	1.23	1.20	0.55	1.67
P_2O_5	0.47	0.57	0.78	0.76	1.56	1.06
Total	100.01	99.98	100.01	100.00	100.01	100.00
Cr	984.0	786.5	554.2	688.0	259.3	216.5
Co	101.9	81.5	70.2	82.9	70.2	78.8
Ni	650.3	538.4	390.1	454.5	244.5	356.5
Cu	50.6	58.4	81.3	74.8	76.1	75.1
Ga	13.1	13.4	14.5	14.3	13.1	12.4
Rb	21.9	25.1	31.0	29.2	22.3	48.8
Sr	579.3	663.9	981.5	904.8	1178.4	946.5
Ba	273.3	323.6	476.2	440.7	538.9	1062.1
Pb	0.0	4.3	1.7	0.0	0.0	0.0
Th	0.0	1.4	7.7	0.0	0.0	0.0
C.I.P.W. NORMS						
Orthoclase	0.00	0.00	0.00	0.00	0.00	0.00
Plagioclase	11.19	10.44	9.67	10.25	16.26	2.84
Nepheline	7.61	9.35	13.16	12.65	13.34	22.55
Leucite	4.06	4.91	5.71	5.57	2.56	7.73
Diopside	38.82	39.23	42.12	41.96	38.90	59.24
Olivine	31.54	29.92	22.86	22.98	19.56	8.87
Magnetite	2.90	2.90	2.90	2.90	2.90	2.90
Ilmentite	6.29	6.31	6.52	6.59	6.62	6.13
Apatite	1.03	1.24	1.70	1.66	3.62	2.31
Total	103.44	104.30	104.64	104.56	103.67	112.56
An	0.0	0.0	0.0	0.0	0.0	0.0

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Sample No.	VS1-2	VS9-3	VS9-1	VS10-3	VS11-3	VS12-4
Site No. (Figure 7)	3	5	5	6	8	7
SiO_2	36.79	45.36	45.11	52.58	54.58	57.44
Al_2O_3	11.01	13.47	13.70	19.35	22.20	22.16
TiO_2	3.21	2.45	2.47	1.68	0.56	0.23
Fe_2O_3	11.47	12.94	13.18	8.01	3.18	2.70
MnO	0.20	0.16	0.19	0.17	0.13	0.21
MgO	12.32	10.09	9.96	1.78	0.40	0.17
CaO	17.77	12.02	11.84	4.82	2.36	1.00
Na_2O	3.61	2.31	2.12	7.40	10.52	10.92
K_2O	1.98	0.91	0.97	3.83	6.06	5.13
P_2O_5	1.64	0.30	0.46	0.38	0.06	0.03
Total	100.00	100.00	100.01	100.01	100.00	99.94
Cr	180.6	327.2	304.3	0.0	5.7	5.8
Co	56.9	76.9	62.9	27.2	38.0	21.4
Ni	221.3	196.6	195.8	8.3	8.8	10.8
Cu	78.0	53.1	53.0	7.1	4.0	0.00
Ga	12.6	15.7	15.4	24.7	27.8	45.0
Rb	60.1	18.4	19.9	92.3	192.6	319.6
Sr	884.4	494.9	579.5	1145.9	1103.4	161.1
Ba	869.2	253.3	859.4	903.7	624.0	80.3
Pb	0.4	0.0	0.0	0.0	5.2	18.9
Th	12.1	0.0	2.0	5.6	12.6	37.2
C.I.P.W. NORMS						
Orthoclase	0.00	5.35	5.76	22.68	35.80	30.31
Plagioclase	7.99	36.14	38.10	36.55	13.58	29.30
Nepheline	16.55	3.85	2.61	18.59	38.41	32.18
Leucite	9.17	0.00	0.00	0.00	0.00	0.00
Diopside	56.37	27.66	25.18	11.22	8.90	6.21
Olivine	9.20	17.69	18.64	3.45	0.00	0.00
Magnetite	2.90	2.90	2.90	2.90	2.22	1.30
Ilmentite	6.09	4.65	4.69	3.19	1.07	0.44
Hematite	0.0	0.00	0.00	0.00	0.47	0.00
Apatite	3.58	0.65	1.00	0.83	0.13	0.07
Total	111.84	98.91	98.89	99.41	100.57	99.82
An	0.0	64.3	64.2	21.5	0.0	

(e) MAIO

(f) FOGO

Sample No.	VM19-6	VM19-5	VM17-1	VM15-3	VM15-2	VM16-1	VF1-7
Site No. (Figure 8)	4	4	3	1	1	2	1 (Figure 10)
SiO_2	38.54	39.06	41.05	44.68	45.85	52.84	42.01
Al_2O_3	10.11	10.13	13.13	14.52	15.12	21.42	14.59
TiO_2	4.27	4.25	4.90	4.27	4.42	1.74	3.95
Fe_2O_3	12.51	12.64	14.63	13.26	11.73	5.08	13.50
MnO	0.19	0.17	0.17	0.14	0.19	0.16	0.20
MgO	14.29	13.74	6.91	5.72	5.65	1.14	6.10
CaO	14.98	15.91	13.38	12.37	11.77	5.08	12.67
Na_2O	2.65	2.10	3.65	3.16	3.26	6.83	3.04
K_2O	1.53	1.04	1.39	1.01	1.17	5.50	2.10
P_2O_5	0.93	0.95	0.80	0.86	0.84	0.31	1.84
Total	100.00	99.99	100.01	100.00	100.00	100.00	100.00
Cr	481.4	526.1	46.7	45.5	28.4	12.1	66.5
Co	61.9	77.7	52.3	54.8	42.5	34.3	56.0
Ni	274.6	301.8	59.0	52.8	41.0	11.6	43.8
Cu	76.9	76.6	107.9	89.2	121.7	4.1	73.4
Ga	16.9	14.7	20.9	21.4	21.8	20.9	20.9
Rb	24.3	16.2	41.5	12.1	15.8	117.3	60.7
Sr	732.4	1716.4	1076.8	1203.4	1213.9	1762.7	1077.4
Ba	446.3	458.9	659.8	704.3	837.1	1209.9	624.6
Pb	2.3	0.0	1.2	0.0	0.2	3.1	0.0
Th	7.1	0.0	4.0	0.0	10.1	13.8	0.0
C.I.P.W. NORMS							
Orthoclase	0.00	0.00	4.80	5.98	6.92	32.51	12.43
Plagioclase	11.17	15.15	15.34	38.67	43.50	30.70	24.22
Nepheline	12.15	9.63	16.73	5.70	3.93	20.93	11.62
Leucite	7.08	4.80	2.67	0.00	0.00	0.00	0.00
Diopside	45.96	46.42	37.83	27.71	24.56	8.89	26.28
Olivine	16.26	15.26	7.42	7.92	6.99	0.00	9.87
Magnetite	2.90	2.90	2.90	2.90	2.90	2.90	2.90
Ilmenite	8.11	8.08	9.30	8.12	8.39	3.30	7.50
Apatite	2.03	2.07	1.75	1.88	1.83	0.46	4.01
Total	105.65	104.32	98.74	98.87	99.03	99.69	98.84
An	0.0	0.0	0.0	56.6	51.8	36.2	81.5

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(g) SAO TIAGO

Sample No.	VT37-3	VT36-3	VT28-3	VT33-1	VT35-2	VT35-1	VT23-1	VT21-1	VT24-3
Site No. (Figure 9)	31	33	28	36	34	34	23	21	28
SiO_2	43.03	40.12	40.84	43.71	43.85	43.15	43.46	44.22	41.43
Al_2O_3	12.14	11.79	11.86	12.91	12.63	11.99	13.08	13.09	13.02
TiO_2	3.36	3.62	3.65	3.14	3.59	3.30	3.20	3.06	3.18
Fe_2O_3	13.01	12.74	14.07	14.03	13.78	12.82	13.63	13.49	13.21
MnO	0.18	0.18	0.17	0.18	0.19	0.17	0.17	0.13	0.16
MgO	12.50	12.31	11.70	10.56	10.44	10.40	10.09	10.07	9.83
CaO	12.00	14.44	12.16	12.81	12.13	14.43	12.17	11.66	11.79
Na_2O	2.66	2.75	3.65	1.61	2.21	2.42	2.96	2.54	2.56
K_2O	0.62	1.22	0.83	0.51	0.65	0.85	0.69	1.19	1.22
P_2O_5	0.50	0.83	1.06	0.54	0.54	0.47	0.56	0.52	0.59
TOTAL	100.01	100.01	99.99	100.01	100.00	100.00	100.01	100.00	99.99
Cr	576.0	341.1	362.3	490.1	494.6	510.3	481.4	411.6	476.2
Co	67.3	66.5	77.4	84.8	63.8	73.2	83.9	62.8	106.6
Ni	296.6	240.9	293.7	270.5	310.4	295.0	214.9	185.5	208.4
Cu	73.2	64.1	46.9	71.1	59.2	63.5	70.9	68.9	67.8
Ga	16.6	15.1	16.0	17.3	17.1	16.4	17.2	16.8	17.2
Rb	10.0	17.3	12.2	4.9	13.5	25.0	3.5	21.1	19.4
Sr	797.7	893.1	1191.8	742.2	1149.4	947.5	668.7	637.8	639.0
Ba	551.0	630.6	650.5	469.1	569.8	500.7	421.4	421.1	411.5
Pb	2.0	1.5	0.0	0.0	2.8	0.0	0.0	1.5	0.0
Th	2.5	5.0	0.0	0.0	6.0	0.0	0.0	0.4	0.0
C.I.P.W. NORMS									
Orthoclase	3.66	0.00	4.91	3.04	3.82	5.04	4.05	7.02	7.21
Plagioclase	26.29	16.21	13.56	38.02	34.88	20.51	29.14	30.32	30.74
Nepheline	8.43	12.61	16.71	1.13	3.50	10.46	8.82	6.49	6.15
Leucite	0.00	5.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diopside	29.90	40.53	32.72	27.46	27.78	39.90	29.72	27.56	27.99
Olivine	20.23	15.58	18.74	19.11	17.96	12.81	16.89	17.61	16.56
Magnetite	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90
Ilmenite	6.39	6.88	6.93	5.97	6.81	6.27	6.09	5.81	6.04
Apatite	1.09	1.81	2.31	1.18	1.18	1.03	1.22	1.11	1.29
Total	98.91	102.19	98.78	98.80	98.82	98.92	98.84	98.85	98.87
An	72.4	0.0	99.7	68.4	63.5	94.0	68.7	67.4	65.1

Sample No.	VT24-3	VT26-3	VT25-1	VT14-1	VT27-1	VT15-3	VT2-1	VT7-3	VT[illegible]-1
Site No. (Figure 9)	24	26	25	9	27	7	2	16	[illegible]
SiO_2	45.17	44.84	44.86	43.60	44.40	43.62	43.75	46.18	43.09
Al_2O_3	13.23	13.25	13.27	14.53	13.43	14.98	14.37	13.96	14.00
TiO_2	3.10	3.11	2.10	2.51	3.19	3.58	3.37	3.17	3.73
Fe_2O_3	13.16	13.04	13.13	13.95	12.91	14.13	12.73	11.86	13.06
MnO	0.16	0.16	0.16	0.18	0.16	0.20	0.18	0.15	0.20
MgO	9.64	9.55	9.49	9.30	9.11	8.48	8.38	7.70	7.32
CaO	12.00	11.76	11.73	11.31	11.86	11.12	10.62	12.45	12.81
Na_2O	2.10	2.84	3.03	2.22	2.96	2.46	3.51	2.75	4.10
K_2O	0.96	0.90	0.70	0.75	1.29	0.77	2.43	1.10	0.63
P_2O_5	0.50	0.55	0.54	0.66	0.69	0.66	0.68	0.67	1.05
TOTAL	100.01	100.00	100.01	100.00	100.00	100.00	100.02	100.00	99.99
Cr	425.4	415.8	411.5	243.4	363.1	209.9	239.1	264.0	138.7
Co	91.2	93.8	71.9	68.3	73.0	63.6	78.1	66.9	52.2
Ni	195.5	183.8	189.2	179.4	167.6	157.5	158.0	131.7	78.1
Cu	73.2	61.9	72.3	50.9	68.6	46.4	65.7	81.4	59.7
Ga	16.3	16.4	17.1	18.1	17.5	19.8	19.4	19.6	18.6
Rb	15.7	12.7	7.8	31.7	23.7	49.6	85.8	40.4	39.5
Sr	859.4	632.2	650.1	1263.2	796.4	1283.9	1073.6	834.8	1146.0
Ba	402.4	399.4	421.0	728.8	487.7	801.5	690.5	483.5	754.0
Pb	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	3.7
Th	0.0	0.0	0.0	0.0	0.0	4.1	0.0	0.0	12.3
C.I.P.W. NORMS									
Orthoclase	5.66	5.34	4.17	4.41	7.65	4.56	14.37	6.51	3.72
Plagioclase	38.28	33.80	34.62	42.20	29.28	42.96	19.32	38.92	27.28
Nepheline	1.81	5.94	6.25	2.20	8.29	2.93	14.44	3.71	13.74
Diopside	26.51	27.82	27.93	20.09	28.54	19.33	26.27	28.62	32.10
Olivine	16.77	15.99	15.96	18.90	14.69	17.86	13.76	10.88	9.78
Magnetite	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90
Ilmenite	5.88	5.90	5.89	6.66	6.06	6.80	6.40	6.01	7.08
Apatite	1.09	1.20	1.18	1.44	1.51	1.44	1.48	1.46	2.29
Total	98.89	98.89	98.90	98.80	98.91	98.78	98.94	99.00	98.88
An	60.9	59.9	57.8	63.8	65.4	62.8	83.4	56.4	64.4

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Sample No.	VT8-1	VT16-1	VT10-1	VT13-1	VT9-3	VT6-1	VT3-3	VT34-3	VT31-1
Site No. (Figure 9)	15	8	13	10	14	6	3	35	32
SiO_2	44.39	41.68	43.28	43.78	44.77	44.55	45.15	55.33	54.43
Al_2O_3	15.51	13.50	14.28	14.79	16.25	15.15	15.34	23.64	22.65
TiO_2	3.89	4.68	3.88	3.99	3.70	2.40	3.27	0.31	0.40
Fe_2O_3	13.09	17.40	15.73	14.92	11.70	13.96	13.69	3.23	3.01
MnO	0.16	0.20	0.25	0.22	0.18	0.21	0.22	0.18	0.17
MgO	6.93	6.89	5.50	5.37	5.27	4.59	4.33	1.24	0.35
CaO	11.70	10.13	10.00	10.86	11.20	9.34	9.19	2.06	2.36
Na_2O	3.13	3.76	4.01	3.68	3.43	4.60	4.44	7.98	9.84
K_2O	0.59	0.79	1.22	0.89	2.37	2.75	2.87	6.02	6.47
P_2O_5	0.60	0.96	1.85	1.50	1.12	1.45	1.50	0.00	0.31
TOTAL	100.00	100.00	100.00	100.01	99.99	100.00	100.00	99.99	100.00
Cr	80.2	23.9	13.4	80.1	29.5	12.7	3.7	0.0	0.0
Co	58.8	61.7	26.2	47.7	50.9	42.7	52.1	23.7	39.2
Ni	78.4	42.0	18.0	45.3	42.7	10.8	12.3	7.7	8.1
Cu	61.5	41.9	14.2	26.1	61.4	14.4	14.0	3.8	7.3
Ga	20.9	19.1	17.7	18.9	23.1	19.7	20.2	26.7	29.6
Rb	32.5	19.4	50.7	48.4	98.9	66.5	72.3	141.5	178.3
Sr	912.1	1211.8	1729.0	1721.1	1732.3	1342.5	1388.1	1132.2	1731.1
Ba	543.7	513.8	826.1	889.4	854.2	798.7	826.5	1431.7	874.9
Pb	0.0	0.0	2.9	0.0	0.0	0.0	1.4	13.4	14.4
Th	0.0	0.0	3.6	0.0	0.0	6.2	2.3	23.9	26.7
C.I.P.W. NORMS									
Orthoclase	3.49	4.67	7.22	5.29	13.98	16.24	16.99	35.59	38.25
Plagioclase	43.91	31.00	36.71	41.38	32.74	23.82	26.67	35.15	15.18
Nepheline	4.93	9.99	7.90	5.94	9.88	15.00	13.18	23.07	36.08
Diopside	22.80	22.30	17.74	19.75	22.05	20.96	19.41	0.00	6.95
Olivine	12.15	16.61	14.75	12.61	7.98	10.27	10.18	2.31	0.00
Magnetite	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.33
Ilmenite	7.40	8.89	7.37	7.57	7.04	6.45	6.22	0.60	0.76
Hematite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39
Apatite	1.31	2.09	4.04	3.27	2.44	3.16	3.27	0.00	0.68
Cordierite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00
TOTAL	98.89	98.45	98.63	98.71	99.02	98.80	98.83	99.87	100.62
AN	59.0	55.4	45.8	49.7	65.8	51.3	48.9	27.9	0.0

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TABLE 3

Chemical Compositions (Major and Minor Elements) and CIPW Norms of Fernando Noronha Igneous Rocks

All data arranged in order of decreasing MgO content

(Major elements in weight percent; minor elements in parts per million)

Sample No.	FN17-2	FN22-0	FN12-0	FN17-2(i)	FN17-0	FN17-4	FN25-1	FN27-1	FN25-4
Site No. (Figure 3)	26	8	12	26	26	26	3	5	3
SiO_2	41.05	39.19	41.06	43.23	43.85	43.71	39.57	39.46	39.22
Al_2O_3	7.89	10.50	10.08	9.88	9.18	10.04	10.12	10.40	10.35
TiO_2	2.67	3.61	2.98	3.29	2.95	3.20	3.63	3.55	3.62
Fe_2O_3	14.44	13.93	12.71	13.10	12.60	12.84	13.89	13.67	13.71
MnO	0.17	0.18	0.16	0.16	0.17	0.17	0.18	0.18	0.18
MgO	20.04	16.22	15.24	14.30	14.01	13.97	13.95	13.81	13.62
CaO	9.80	12.26	12.77	11.39	12.96	11.24	12.54	12.89	12.54
Na_2O	2.38	2.27	3.06	2.76	2.74	2.81	3.41	3.20	3.79
K_2O	1.01	0.92	1.25	1.27	0.96	1.39	1.82	1.81	2.06
P_2O_5	0.54	0.93	0.69	0.60	0.57	0.62	0.89	0.91	0.93
Total	99.99	100.01	100.00	99.98	99.99	99.99	100.00	100.00	100.02
Cr	354.1	319.6	495.1	433.3	688.0	480.7	326.5	306.2	323.2
Ni	658.0	197.7	370.3	385.1	422.9	399.3	157.8	174.2	157.2
Cu	67.1	54.6	59.9	65.4	62.7	66.1	50.1	57.4	52.2
Rb	40.5	29.0	26.1	50.1	39.2	56.3	36.6	47.4	42.9
Sr	713.1	592.8	856.1	824.1	792.8	867.6	878.3	735.9	878.3
Ba	404.7	635.5	492.8	495.0	429.8	409.4	733.7	825.3	794.8
Pb	4.5	3.9	3.1	5.9	5.3	5.2	2.7	3.6	2.5
Th	6.6	11.3	11.9	7.2	6.0	8.2	11.8	9.0	6.6
C.I.P.W. NORMS									
Orthoclase	0.00	0.00	0.00	7.51	5.67	8.22	0.00	0.00	0.00
Plagioclase	7.86	15.74	10.08	13.87	12.17	14.87	6.93	8.13	5.14
Nepheline	10.91	10.41	14.03	11.00	11.34	10.61	15.63	15.22	17.37
Leucite	4.68	4.26	5.79	0.00	0.00	0.00	8.42	8.38	9.54
Diopside	30.04	31.69	39.35	33.77	40.87	33.19	40.17	40.50	41.41
Olivine	36.12	27.04	21.93	22.27	19.13	21.69	20.01	19.48	18.78
Magnetite	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90
Ilmenite	5.07	6.86	5.66	6.25	5.60	6.08	6.89	6.74	6.88
Apatite	1.18	2.03	1.51	1.31	1.24	1.35	1.94	1.99	2.03
Total	98.76	100.92	101.24	98.87	98.93	98.90	102.90	103.33	104.05
AN	0.0	0.0	0.0	77.0	80.6	70.6	0.0	0.0	0.0

Sample No.	FN22-	FN8-1	FN23-5	FN22-1	FN8-4	FN21-0	FN13-0	FN13-3	FN23-1
Site No. (Figure 3)	8	20	1	8	20	7	23	23	1
SiO_2	40.71	39.85	39.76	39.82	40.16	42.93	42.09	41.91	43.99
Al_2O_3	10.46	10.52	10.50	10.73	10.61	11.41	10.63	10.66	11.74
TiO_2	3.67	3.95	4.07	3.87	3.89	3.44	3.68	3.54	3.43
Fe_2O_3	14.06	14.42	14.52	14.28	14.29	13.200	13.78	14.00	12.690
MnO	0.19	0.19	0.20	0.19	0.18	0.16	0.16	0.17	0.16
MgO	13.45	13.05	12.45	12.28	12.12	11.22	11.14	11.1	10.97
CaO	12.42	13.17	13.12	13.78	12.85	11.48	12.37	12.75	10.88
Na_2O	2.85	2.71	2.78	3.03	3.44	3.64	4.26	4.03	3.24
K_2O	1.26	1.18	1.49	0.94	1.48	1.68	0.79	0.70	2.03
P_2O_5	0.93	0.96	1.10	1.08	0.98	0.85	1.10	1.11	0.86
TOTAL	100.00	100.00	99.99	100.00	100.00	100.01	100.00	99.99	99.99
Cr	318.1	342.2	234.4	260.6	334.6	286.6	246.1	238.2	238.1
Ni	209.8	119.3	155.9	172.3	116.0	214.4	206.3	214.1	206.7
Cu	49.3	45.6	41.3	54.5	48.2	57.5	65.3	59.4	60.8
Rb	46.6	18.1	36.3	12.4	21.8	43.4	16.3	11.0	41.1
Sr	623.4	860.5	1052.1	1006.9	902.3	1047.9	1032.5	1025.6	1103.9
Ba	609.9	743.8	974.2	622.1	689.3	523.0	718.1	719.2	540.2
Pb	5.1	2.4	3.7	4.1	1.6	6.7	2.6	4.0	4.4
Th	12.1	7.0	10.0	13.0	9.4	8.0	10.3	11.1	12.4
C.I.P.W. NORMS									
Orthoclase	0.00	0.00	0.00	0.00	0.00	9.93	4.67	4.14	12.00
Plagioclase	12.03	13.06	11.77	12.90	9.14	11.09	10.09	10.91	16.40
Nepheline	13.06	12.42	12.74	13.89	15.77	16.01	18.15	17.40	12.19
Leucite	5.83	5.46	6.90	4.35	6.85	0.00	0.00	0.00	0.00
Diopside	35.46	37.52	37.73	39.56	39.36	33.93	38.19	38.60	30.10
Olivine	20.91	19.58	18.41	17.41	17.17	16.65	15.43	15.69	16.93
Magnetite	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90
Ilmenite	6.97	7.50	7.73	7.35	7.39	6.53	6.99	6.72	6.51
Apatite	2.03	2.09	2.40	2.36	2.14	1.85	2.40	2.42	1.88
Total	99.19	100.53	100.59	100.72	100.71	98.89	98.82	98.79	98.92
An	0.0	0.0	0.0	0.0	0.0	88.1	73.7	80.9	68.8

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Sample No.	FN7-0(i)	FN7-0	FN7-2	FN14-3	FN5-0	FN3-0	FN20-0	FN14-0
Site No. (Figure 3)	18	18	18	22	16	11	6	22
SiO_2	43.93	44.16	43.73	52.44	57.32	58.66	60.55	60.78
Al_2O_3	13.92	14.10	14.17	18.81	20.82	22.84	19.90	20.23
TiO_2	2.74	2.72	2.85	1.43	1.41	0.21	0.46	0.48
Fe_2O_3	11.19	11.10	11.57	6.56	5.39	2.41	2.69	2.97
MnO	0.17	0.17	0.19	0.16	0.08	0.09	0.14	0.15
MgO	9.41	9.33	7.99	3.48	2.61	0.20	0.38	0.91
CaO	11.35	11.17	12.08	5.59	2.92	0.52	2.45	3.20
Na_2O	4.55	4.55	4.59	6.37	3.38	9.17	6.68	5.78
K_2O	2.17	2.12	2.23	4.87	5.78	5.90	6.14	5.41
P_2O_5	0.58	0.58	0.59	0.29	0.29	0.02	0.60	0.07
TOTAL	100.01	100.00	99.99	100.00	100.00	100.02	99.99	99.98
Cr	0.0	293.6	285.5	78.0	14.1	6.3	6.5	2.0
Ni	214.5	226.8	214.8	67.1	27.4	15.8	12.1	10.4
Cu	0.0	47.5	52.7	24.5	18.8	0.0	6.2	7.4
Rb	0.0	79.4	78.7	139.4	196.3	319.9	220.3	190.6
Sr	0.0	1187.2	1208.5	1071.0	1364.4	81.9	806.2	894.0
Ba	0.0	750.6	752.0	647.1	1407.6	6.3	1263.0	1430.3
Pb	0.6	0.6	6.6	10.2	17.9	32.3	16.0	15.9
Th	10.5	10.5	9.7	17.8	32.8	56.5	28.1	25.6
C.I.P.W. NORMS								
Quartz	0.00	0.00	0.00	0.00	5.32	0.00	0.00	0.00
Orthoclase	9.70	12.53	6.58	28.78	34.16	34.87	36.29	31.98
Plagioclase	11.15	11.90	11.48	27.22	41.38	38.84	49.73	59.76
Nepheline	20.86	20.80	21.04	18.97	0.00	22.33	7.03	1.32
Leucite	2.45	0.00	5.17	0.00	0.00	0.00	0.00	0.00
Diopside	33.60	32.36	36.41	14.27	0.00	0.00	2.07	1.80
Hyp.	0.00	0.00	0.00	0.00	8.27	0.00	0.00	0.00
Olivine	11.96	12.17	8.75	4.05	0.00	1.75	1.21	2.44
Magnetite	2.90	2.90	2.90	2.90	2.90	1.16	1.30	1.44
Ilmenite	5.20	5.17	5.41	2.72	2.68	0.40	0.87	0.91
Apatite	1.27	1.27	1.29	0.63	0.63	0.04	1.31	0.15
Cordierite	0.00	0.00	0.00	0.00	4.32	0.47	0.00	0.00
Total	99.09	99.09	99.03	99.54	99.66	99.86	99.81	99.78
AN	0.0	99.0	0.0	29.4	29.6	6.0	11.8	21.2

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APPENDIX

Description of Sample Sites of Analyzed Samples

All sample numbers are given as follows: first is the site location number (according to figures 4 to 10), and second (in brackets) is the chemical analysis and original field number. When given, latitudes and longitudes are accurate to only ± 0.2 minutes, but other locality descriptions facilitate relocating the unit. Topographic maps used are the Portugese Colonial Office Cartegraphic Commission 1929-1932 editions in the Cape Verde Islands, and a Brazilian Military Map of Fernando de Noronha. Scales are up to 1:75,000.

(a) Cape Verde Islands

SAO ANTAO (Figure 4). Samples were collected from four major sequences:

1. Roadcuts South from Ribeira Grande. This section extends from sea level south to the divide of the island. It is composed of a series of interdigitated horizontal basalts, scoriatous zones, thick tuff layers, and irregular phonolite bodies, both extrusive and intrusive. Chemically analyzed units are as follows, in order of decreasing age:

14(VA17-3) 25°04.5'W; 17°11.0'N. Cliff outcrop; 50 meters thick lava, on west side of town of Ribeira Grande.

22(VA16-3). Lowest prominant lava on east side of main road south from town. Six meters thick basalt.

23(VA14-1) 25°04.0'W; 17°11.0'N Two meters thick lava exposed on lowest hairpin bend in road at about 120 meters above sea level, on east side of road.

26(VA12-3) 25°0.45'W; 17°10.5'N. Horizontal basalt 14 meters thick at 490 meters above sea level, at deep roadcut on west side of road.

27(VA11-1) thick basalt, immediately overlying unit 26. Coarse feldspathoid phenocrysts.

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28(VA10-3) 25°05.0'W; 17°10.0'N; Massive ankaramitic basalt flow, overlying unit 27.

29(VA9-2) Irregular ankaramitic lava; three meters thick overlying unit 28.

30(VA8-1) Basalt lava separated from unit 29 by a 3 meter thick scoriatious horizon.

31(VA6-2) Basalt lava separated from the older unit 30 by a prominant red baked zone.

32(VA7-2) Basalt underlying 40 meters thick tuff bed; and above unit 30.

33(VA5-1) Ten meters thick basalt in deep roadcut, overlying prominent red baked zone, above 40 meters thick tuffaceous unit.

34(VA4-1) Twelve meters thick lava, with well developed sub-horizontal jointing. 700 meters above sea level.

35(VA3-1) 25°05.0'W; 17°09.5'N. Ankaramitic basalt with well-developed spheroidal weathering.

37(VA1-3) Eight meters thick basaltic lava about 20 meters above unit 35.

38(VA38-3) 25°05.5'W; 17°08.5'W. Nine meters thick basalt, in deep roadcut, east side of road, at 905 meters above sea level.

39(VA39-1) Eight meters thick extrusive on east side of road, immediately south of junction with track to village of Calculi, at 1005 meters above sea level.

41(VA41-3) 25°05.5'W; 17°08.0'N. Lava 0.7 km south of unit 39, on east side of road. Five meters thick, as exposed.

42(VA42-1) Irregular phonolitic intrusives, eight meters thick, twenty meters wide, as prominantly exposed on major bend in road, at 1205 meters above sea level.

43(VA43-3) Youngest of analyzed units. Highest local outcrop. A large phonolitic capping pod.

2. Section Within the Old Igneous Complex. This section is at the western fork of the head of the very deeply incised valley of Ribeira Grande. Dikes are common, but not dominant. The sequence is mainly from a track or roadcut above and south from the stream called Despenhadeiro. Chemically analyzed units are as follows:

1(VA31-3) 25°09.0'W; 17°08.0'N. Youngest of lavas samples locally. Weathered unit, close to dikes. Five meters thick. 680 meters above sea level, at end of track.

5(VA35-3). A two meters wide dike below a culvert.

6(VA36-1) 25°08.5'W; 17°10.0'N. Top of a series of thin flow units, at confluence of two streams. 230 meters above sea level.

7(VA37-1 and VA37-1i) 25°07.0'W; 17°10.0'N. Probably the oldest of the sampled extrusives. A prominant basalt, on the south side of the river, below a viaduct, at 170 meters above sea level.

3(VA33-1) 25°09.0'W; 17°08.0'N. A two meters wide vertical dike, younger than units, 1, 6, and 7, on east side of track.

4(VA34-2) A 2.5 meters wide vertical dike, 0.1 km north of unit 3. Secondary mineralization well developed.

3. Roadcuts on East Coast. This sequence is from the coastal roadcuts, between the towns of Ribeira Grande and Pombas. The relative stratigraphic ages are not known, although the elevation of each unit differs by only ± 20 meters. The chemically analyzed units are:

16(VA27-1) 20°3.5'W; 17°11.0'N. A prominant sill, 5 meters thick, with an irregular base and some columnar development, at the mouth of Ribeira Mao Para Traz on the east side of the river.

17(VA29-3) 25°02.0'W; 17°11.0'N. An intrusive body, at least 20 meters thick, with phonolitic appearance. Quarried for local road metal. On south side of road.

18(VA26-1) 25°01.5'W; 17°09.5'N. Green columnar extrusive body with phonolitic appearance, at Punta do Paul. 20 meters thick. West side of road.

19(VA25-2) Quarry 200 meters south of unit 18. A probable extrusive, with minimum thickness of 20 meters.

20(VA24-3) Irregular ankaramitic lava, 8 meters thick, overlying unit 18. Well developed augites.

21(VA23-1) 25°01.5'W;17°09.5'N. Basalt flow, 4 meters thick, forming roadcut on north side of beach at Pombas.

4. Roadcuts on North Coast. These two units are from the high roadcuts and cliffs between the town of Riberia Grande and Ponta do Sol:

10(VA25-2) Prominant lava exposed on road directly above shipwreck beneath Ponta do Sol.

11(VA20-2) 25°05.5'W; 17°11.5'N. Eight meters thick basaltic lava, with prominant spherical weathering, and large porphyritic augites, at 50 meters above sea level on Ponta Boca Riberia dos Organos.

12(VA19-2) Immediately above unit 11. A basaltic lava, 3 meters thick, with incipient columnar development towards the base. Unusually large (up to 6 cm long) augites present.

SAO VINCENTE (Figure 5). Samples were taken from nine areas on this island.

1. Machado Settlement. A 5 meters thick lava, 1(VV30-3), outcropping immediately above and to the southwest of the coastal settlement, forming the wall of local domestic animal pens.

2. The Pedro Blanco Monzonite Plug. This body, used for local decorative purposes, has been described by Part (1950). It occurs as a small (20 meters maximum width) unit, with subdued relief (only 4 meters) in a region of aeolian sand, at 25°01.0'W; 16°51.0'N. The analyzed samples are:

7(VV45-3 and VV45-1) The monzonite is massive, light colored, and apparently unweathered, as the result of quarrying operations.

8(VV46-4) A limburgite dike through unit 7. This is very fine, and only 5 cms wide, without any contact metamorphic reaction with the host rocks.

3. Maderal, Above Spring. This sequence is a series of horizontal basaltic lavas at 24°56.0'W; 16°49.0'N, constituting a very steep north-facing scarp, immediately above a fresh water spring which is only periodically productive. The analyzed units are, in order of decreasing age.

52(VV15-3) A one meter thick lava, at the entrance to the spring.

48(VV11-2) A seven meters thick ankaramitic lava, immediately above unit 52.

50(VV13-1) A seven meters thick basaltic lava, above unit 48, an 8 meters thick scoriatious zone; and a 5 meters thick heavily weathered unit.

51(VV14-3) A 1.5 meter thick lava, immediately above unit 50. This is the youngest extrusive sampled in the section.

53(VV16-3) A 3 meters wide vertical dike, which is cutting units 48, 50 51 and 52.

4. Mount Verde. This sequence is part of the highest feature in the island, at 24°56.5'W; 16°52.0'N. The sampled units are in a section at the eastern termination of the road to Mount Verde from Mindelo. The analyzed bodies are:

36(VV2-1) Dike 6 meters wide on north side of eastern terminus of road.

37(VV24-2) Seven meters irregular lava with prominant outcrop on west side of Mount Verde, 20 meters above road.

40(VV1-1) A 9 meter thick massive basalt immediately below unit 27, marking the western wall of the road at its eastern terminus.

5. Northeastern Coast. This section of horizontal basaltic lavas is confined to a single well-rounded range between the coast and major road to the northeast coast at 24°57.0'W; 16°53.0'N. The analyzed units are, in order of decreasing age:

24(VV44-1) A two meters thick irregular lava, outcropping in base of dry river bed.

27(VV20-3) A four meters thick lava, eight meters above dry river bed on the south side of the mountain.

14,17,18, and 19(VV047-1, VV050-2, VV51-3 and VV52-3) Four successive lavas in order of decreasing age, on the north side of the mountain above a prominant scoriatus zone. A calcareous weathering product is well developed between units 18 and 19. The thicknesses are 15, 3, 8, and 1.5 meters, respectively.

6. North-Central Peninsula. This section is confined to a short east-to-west valley, of gentle slopes, immediately north of Mindolo and southeast of a military installation, at 24°59.0'W; 16°54.0'N. The valley is a continuation of the 'Mindelo Complex' (Bebiano, 1932) which is an igneous complex dominated by sills and dikes. The analysed units are, in order of decreasing age:

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10(VV37-1) A vesicular 1 meter thick lava. This is the lowest exposed unit in the valley.

11(VV38-1) An irregular ankaramitic body, immediately above unit 10. The lava is lenticular in form.

13(VV40-3) A 1.5 meter vesicular lava.

12(VV39-1) A 1.4 meter thick sill, between units 38 and 40. The sill has coarse augites developed at the center of the unit.

7. Roadcuts Mt. Verde to Mindelo. The two analyzed units from this road are isolated, and not correlatable. The two analyzed samples are:

28(VV6-3) At 24°58.0'W; 16°53.0'N, this roadmetal quarry is 18 meters high. It is probably an intrusive. Secondary mineralization is common.

35(VV3-3 and VV3-1) At 24°56.0'W; 16°52.0'N, this prominant lava occurs at a local crest in the road, above a small settlement to the north. It is 5 meters thick as exposed.

8. Roadcuts Mindelo to Southeast Coast. The two analyzed units from the eastern end of this road are not correlatable. The two units are:

44(VV7-1) This basaltic body appears to be the remnants of a volcanic neck, or small plug. It is 5 meters high, and 20 meters across. It outcrops 50 meters south of the road at 24°54.0'W; 16°50.0'N.

46(VV9-3) This body is whitish in outcrop. A carbonate development, probably secondary in origin, causes the color. The body is rounded, irregular, and probably intrusive in origin.

9. Roadcuts Mindelo to Northeast Coast. The two isolated bodies sampled on this road are not stratigraphically relatable:

30(VV17-3) This lava forms the roadcut at Cruz de Verde (24°57.0'W; 16°57.0'N). It is 6 meters thick, and is fractured into large blocks.

31(VV21-2) This is a five meter thick vertical basalt dike, trending

southwest to northeast. The dike has weathered into regular polygonal units. It occurs at a 90° bend in the road, immediately beneath and to the northwest of Mount Verde.

SAO NICOLAO (Figure 6). The sampled bodies, were taken from five main areas:

1. Mount de Fora. The units sampled are from the southern very steep scarp of Mount de Fora, above the town of Brava, at 24°19.0'W; 16°37.0'N. The analyzed units are, in terms of decreasing age:

5(VN5-3) This is the oldest lava in basalt sequence overlying a massive tuff unit. It is regular and 1 meter thick.

1(VN1-2 and VV4-1). This is a lava immediately above unit 5; 4 meters thick.

4(VN4-3) This is separated from unit 1 by two lavas. It is very prominant; and 10 meters thick.

2. Pedro do Guizinho. This section is a cliff sequence east of the settlement of Pedro do Guizinho at Ribeira do Porto Vella (24°17.5'W; 16°32.5'N). The horizontal lavas sampled on the west cliff, are, in order of decreasing age:

12(VN9-3 and VN9-2) This lava is 7 meters thick, and is the second basaltic lava from the base of the cliff.

11(VN8-3) An 8 meter thick basaltic lava, immediately above unit 12.

10(VN7-3) A 9 meter thick basaltic lava, immediately above unit 11.

9(VN6-3, VN6-2 and VN6-1) A 3 meter thick basaltic lava, immediately above unit 12.

3. Roadcut North of Pedro do Guizinho. A single lava (8, VN11-1) was sampled at the point where the road from Pedro do Guizinho to Brava separates into two roads. The lava is 1 meter thick, vesicular, and limited in extent.

4. Roadcut East of Brava. A single basaltic lava was sampled below the south side of a prominant farm track at 24°15.0'W; 16°37.0'N. The lava (7, VN12-1) is three meters thick and irregular.

5. River Bed East of Brava. A single lava (6, VN13-3) outcropping in the sand of a dry river bed on the south side of the main track east of Brava, and 600 meters west of unit 7.

SAL (Figure 7). Samples were taken in four groups.

1. Basaltic Necks. At the northern end of the island, two isolated basaltic columnar necks stand out very conspicuously above the older truncated basement. They are both about 30 meters in diameter, and 15 meters or so high. The two units are 1(VV3-2 and VS3-3) at 22°56.5'W; 16°49.0'N; and 2(VS2-3) at 22°55.0'W; 16°47.0'N.

2. Basalt Flows. Three different lavas were sampled:

3(VS1-1 and VS1-2) This lava flow is on the western edge of the settlement associated with the airport at 22°55.0'W; 16°45.0'N and has been removed in part, to make room for buildings. It is massive, and about 5 meters thick.

4(VS4-3) This basaltic flow is on the eastern rim of a large commercially-exploited saline lake, immediately north of Pedra Lume, at 22° 49.5'W; 16°45.5'N. It is 2 meters thick, massive and blocky.

5(VS9-3 and VS9-1) This lava flow is similar to unit 4, and was sampled immediately northeast of Palmeira, on a roadcut, at 22°59.5'W; 16°45.0'N. The lava is 1.5 meters thick.

3. Intrusive Phonolites. Two of the sampled bodies at 22°54.0'W; 16°45.0'N, come under this category:

7(VS12-4) This is the most prominant phonolitic body. It stands up about 12 meters above the flat basement complex. It is irregular and no more

than 30 meters across. The body is a coarsely porphyritic blue phonolite and has been quarried for airport runway metal.

8(VS11-3) This second phonolite body outcrops immediately to the southwest of unit 7. It is far less prominant (being only 2 meters in relief) more irregular, less porphyritic, brown in color, but apparently wider, being up to 40 meters in horizontal extent.

4. An Intrusive Diorite. A coarsely prophyritic greenish white igneous rock 6(VS10-3) was sampled at 22°57.5'W; 16°43.5'N. It outcrops over 50 meters extent, irregularly reaching relief of only 3 meters.

MAIO (Figure 8). Samples from three bodies were analyzed. These are:

1(VM0153 and VM0152) Due north of Porto Inglez at 15°12.5'W; this lava was sampled on the east side of the road, in a dry stream bed. This basaltic lava flow is 5 meters thick, and exhibits spherical weathering.

2(VM16-1) In the north central part of the village of Horta, an isolated outcrop of dolerite was sampled. It is not greater than 2 meters in height, and only 4 meters wide. Fine limburgite dikes are injected through the body.

3(VM17-3) Narrow fine basaltic dike through unit 16.

4(VM19-5 and VM19-6) Two kilometers east of Porto Inglez, a prominant pillow basalt was sampled. It is 10 meters thick, and is overlain by a prominant fossiliferous limestone.

SAO TIAGO (Figure 9). Samples were taken from nine general localities:

1. Canyon of Ribeira da Barca. A sequence of horizontal basaltic lavas is exposed in a vertical cliff on the south side of the Ribeira da Barca (23°48.0'W; 15°08.0'N), 1 km east of the town at the mouth of the river.

The analyzed units are, in order of decreasing age:

2(VT2-1) A 9 meters thick lava, immediately above the oldest lava in the sequence.

3(VT3-3) A 7 meters thick lava, lighter in color than the underlying unit (2).

6(VT6-1) A 5 meters thick basalt, with some columnar development. It is the highest outcrop directly on the canyon roadcut, and overlies a much thinner and more irregular basalt.

2. Isolated Roadcuts Near Santa Catarina. These basalts were sampled from roadcuts on the main roads west and south from Santa Catarina. The relative stratigraphic positions are known for only a few of the units. The sampled bodies are:

7 and 8(VT15-3 and VT16-1) These two horizontal lavas are adjacent to each other, in the steep and narrow roadcuts 3.6 km west of Santa Caterina. Unit 7, which is the oldest, is 6 meters thick. Unit 8 which is of similar thickness, was sampled on the south side of a hairpin bend of the road.

9(VT14-1) This is the closest roadcut lava to the southern edge of Santa Caterina. It is three meters thick, and only poorly exposed.

10(VT13-1) This lava has been quarried. It occurs at the western side of a pronounced sharp bend of the main road 3.2 kms southeast of Santa Caterina. Four meters of outcrop thickness is evidence.

13(VT10-1) This is a very prominant massive basalt, probably extrusive, occuring on the eastern side of a wide bend in the main road 7.5 km southeast of Santa Caterina. It has been used as a road metal source.

14, 15, and 16 (VT9-3, VT8-2 and VT7-3) These three units occur in succession, and are the southernmost fresh outcrops in roadcuts in the central part of the island. Unit 14 is the youngest. The topography south of this becomes subdued, there being few substantial roadcuts between here and Ribeira Chiquero. They are all horizontal basaltic lavas, about five meters thick.

3. The Ribeiro Chiquero Scarp. At 23°34'W; 15°01'N, the Ribeiro Chiquero flows in a narrow flat-bottomed valley, with a prominant vertical scarp occurring as the southwest side of the main road to Santa Caterina. The scarp is a series of alternating flow units (generally only one to two meters thick) and coarse scoriatious two-meters-thick layers. Samples from two units were analyzed. They are in order of decreasing age:

18(VT18-3) A 2.5 meters thick basalt flow unit, outcropping ten meters above the road level.

21(VT21-1) This is very similar to unit 18, from which it is separated by 2 lavas and 3 scoriatious zones. It is the highest locally accessable unit.

4. Roadcut Flow Units North of Praia. At 23°33'W; 15°01'N, the major road from Praia changes direction from south-north to southeast to northwest. A series of flow units are exposed on the west side of the road, as it decends into the Ribeira Chiquero valley. They are easily recognizable, by their orange colored weathering products. Samples from five successive lavas have been analyzed. In order of decreasing age they are:

23(VT23-1) Three meters thick. At base of hill.

24(VT24-3) Two meters thick.

25(VT25-1) Three meters thick.

26(VT25-1) Two meters thick.

27(VT27-1) One meter thick. Youngest outcrop on hill.

5. Phonolite Bodies North of Praia. Between 1 and 2 kms south of area 4, a series of isolated domed phonolitic bodies occur. They are generally not more than 5 meters high in outcrops, but appear to be at least 50 meters in horizontal extent. Samples from one of those units was analyzed.

28(VT28-3) The main road cuts directly through this body, at 15°00.5'N. Only 3 meters of vertical extent is exposed.

6. Ribeiro Sao Jorge Intrusive. 4 km northwest of Praia, a green porphyritic intrusive outcrops in the banks of the Ribeiro Sao Jorge. The petrology has been described by Part (1950). The body does not have a large relief locally, and only 10 to 15 meters vertical extent is exposed. One sample (32, VT31-1) has been analyzed.

7. Outcrops on Southwest Edge of Airport. The roadcut between Praia and the island's airport has provided two fresh outcrops. These have been sampled and analyzed. They are:

36(VT33-1) This is a very prominant lava, 10 meters thick directly underlying the airport runway. It overlies sedimentary layers, one of which was described by Part, 1951. The unit was sampled at the cut on the road going uphill into the airport terminal.

35(VT34-3) At the lowest point on the road from Praia to the airport stream erosion has exposed this small igneous intrusive. It is green, dioritic, massive, only 15 meters in maximum horizontal extent, and 5 meters high.

8. Lavas on Plain West of Praia. West of Praia, an erosional platform is covered by a few extensive lavas. Samples from two of these units have been analyzed:

33(VT36-3) Four kms west of Praia, the main road crosses a stream which has cut through this massive prominant basaltic lava flow. It is ten meters thick. Samples were taken from the west side of the stream.

34(VT35-1 and VT35-2) 1 km east of unit 33, on the main road, a prominant massive lava outcrops above a conglomerate with calcareous components. This may be equivalent to units 36. It is 9 meters thick locally.

FOGO (Figure 10). Only one sample was taken from this island.

1(VF1-7) was from a pillow basalt, on the beach immediately north of the airstrip at Porto dos Mosteiros, at 24°10.9'W; 15°01.5'N.

(b) Fernando de Noronha

This island is so small that the map (Figure 3) provides sufficient means to accurately locate the sample sites.

1 (FN23-1 and FN23-5) Lower lava, at sea level on prominant point. Eight meters thick.

3 (FN25-1 and FN25-4) Third lava above sea level. Eight meters thick. Separated from unit no. 1 by a five meters thick lava.

5 (FN27-1) Fifth lava above sea level. Seven meters thick. Separated from unit 3 by a 17 meters thick prominant lava.

6(FN20-0) Greenish intrusive trachyte, known locally as Morro Branco, outcropping through beach sand. Maximum dimension as exposed 20 meters wide, two meters high.

7(FN2-1, FN2-1(i) Lava, eight meters thick, lowest outcrop in gulley.

8(FN22-0, FN22-1) Lava, eight meters thick, immediately above unit 7.

11(FN3-0) Green massive phonolite dome. Sampled at sea level.

12(FN12-0) One meter wide vertical north-south trending basaltic dike, outcropping prominantly in pink rhyolitic host body, at sea level.

16(FN5-0) Three meters wide greenish colored irregular dike. As illustrated by Almeida (1958, p. 25).

18(FN7-0, FN7-0(i), FN7-2) Thirty cm wide prominant dike 35 meters north of unit 16. Inclined at 15° to vertical.

20(FN8-1, FN8-4) Prominant slightly columnar basaltic lava, ten meters thick.

22(FN14-0, FN14-3) Greenish intrusive trachyte body, at western terminus of local beach, at sea level.

23(FN13-0, FN13-3) Eight meters thick prominant pillow lava, outcropping at sea level.

26(FN17-0, FN17-2, FN17-2(i), FN17-4) Prominant north-south trending fine basaltic dike, cutting most of the other irregular intrusive bodies which form an intrusive complex at sea level, as illustrated by Almeida (1958, p. 28).