



1 Este mapa forma parte de una Tesis Doctoral publicada en "Leidse Geologische Mededelingen" y se ha realizado de acuerdo con la Comisión Nacional de Geología
 2 Topografía tomada de la Cartografía de España Hojas 96 y 122 (Escala 1:25.000). 3 Primera edición autorizada por el Consejo Superior Geográfico en 28-2-1973

a: metabasic rocks, chemical analyses

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	129 080	129 092	129 081	129 082	129 155	129 089	129 093	129 094	129 083	129 084	129 095	129 096	129 085	129 097	129 086	129 087	129 098	129 099	129 090	129 091
SiO ₂	47.73	49.05	45.31	47.68	46.91	47.98	45.58	43.96	46.47	43.83	47.84	46.20	46.89	47.94	43.20	49.52	49.31	47.80	48.29	46.21
TiO ₂	1.20	1.70	2.13	2.10	1.71	1.71	2.64	4.77	1.31	1.41	1.70	1.38	1.48	1.61	1.44	1.42	2.13	1.71	1.31	1.78
Al ₂ O ₃	14.68	14.45	13.37	14.00	14.42	14.13	15.42	12.63	14.02	15.87	14.95	14.97	13.59	13.90	14.74	14.03	15.11	13.50	14.20	13.87
Fe ₂ O ₃	2.54	2.96	5.04	2.57	3.32	3.77	3.40	3.14	3.20	3.40	3.15	2.94	3.56	3.31	7.54	3.16	2.57	4.63	2.65	5.76
FeO	9.04	9.39	8.57	11.26	9.86	9.39	11.47	13.72	9.76	9.93	9.71	9.38	11.30	9.87	9.55	10.41	9.42	9.17	10.17	9.60
MnO	0.26	0.21	0.24	0.26	0.20	0.24	0.23	0.29	0.30	0.26	0.26	0.21	0.29	0.26	0.30	0.29	0.22	0.22	0.21	0.29
MgO	7.27	6.73	6.75	6.57	7.30	6.98	7.08	6.59	8.00	8.00	6.61	8.13	7.80	7.03	8.90	7.23	5.92	6.90	7.28	6.92
CaO	13.00	10.13	14.25	11.48	11.47	11.92	10.82	10.00	12.20	14.65	12.18	12.20	10.79	11.83	11.57	9.78	9.75	11.90	10.35	11.00
Na ₂ O	2.79	2.98	2.63	2.25	2.93	2.60	2.15	2.58	3.23	1.82	2.40	2.13	2.70	2.68	1.50	2.84	3.58	2.20	3.38	2.80
K ₂ O	0.20	0.18	0.30	0.25	0.27	0.15	0.25	0.31	0.33	0.29	0.05	0.07	0.08	0.16	0.08	0.14	0.33	0.26	0.34	0.21
P ₂ O ₅	0.12	0.17	0.26	0.18	0.18	0.17	0.25	0.01	0.11	0.12	0.12	0.11	0.19	0.14	0.12	0.21	0.36	0.16	0.22	0.19
CO ₂	0.24	0.17	0.12	0.10	0.09	0.10	0.11	0.27	0.11	0.11	0.09	0.09	0.14	0.12	0.03	0.19	0.09	0.09	0.25	0.13
H ₂ O ⁺	1.08	0.93	1.00	0.62	1.19	1.30	1.85	1.23	0.62	0.73	0.94	1.48	0.73	0.88	1.52	0.89	1.13	1.40	1.09	1.18
Sum	100.15	99.05	99.97	99.32	99.85	100.44	101.25	99.50	99.66	100.42	100.00	99.29	99.54	99.73	100.49	100.11	99.92	99.94	99.74	99.94
k	0.05	0.04	0.07	0.07	0.06	0.04	0.07	0.07	0.06	0.09	0.01	0.02	0.02	0.04	0.03	0.03	0.06	0.07	0.06	0.05
mg	0.53	0.49	0.47	0.46	0.50	0.49	0.46	0.41	0.52	0.52	0.48	0.54	0.48	0.49	0.49	0.49	0.47	0.48	0.50	0.45
D.I.	-8.08	-4.10	-9.38	-5.63	-6.81	-6.63	-6.31	-5.34	-8.52	-11.88	-6.54	-9.26	-7.07	-6.62	-10.69	-4.31	-2.28	-6.49	-5.09	-6.14

b: metabasic rocks, norms

	9	10	3	12	20	17	6	15	4	16
	129 083	129 084	122 081	129 096	129 091	129 098	129 089	129 086	129 082	129 087
Or	1.97	1.73	1.82	0.43	1.28	2.00	0.90	0.48	1.53	0.85
Ab	18.80	7.34	16.99	19.73	25.98	32.85	23.92	13.93	20.92	26.08
Ne	6.35	5.56	4.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00
An	23.08	34.82	24.50	32.08	25.48	24.72	27.10	34.42	28.33	25.70
Di	30.08	30.64	37.39	23.79	23.82	18.06	25.79	19.42	23.65	18.07
Hy	0.00	0.00	0.00	3.40	6.09	7.04	10.36	13.13	15.83	21.60
Ol	14.28	14.07	5.92	11.77	8.16	6.60	4.92	8.15	3.56	1.82
Ilm	1.84	2.00	3.06	1.98	2.56	3.04	2.44	2.08	3.02	2.02
Mt	3.39	3.61	5.43	3.17	6.22	2.75	4.04	8.16	2.78	3.38
Ap	0.22	0.24	0.52	0.22	0.38	0.72	0.34	0.24	0.37	0.42
norm Ol										
%Fo	75	38	7	50	32	62	40	75	34	62

c: Ca-rich inclusions of the metabasic rocks, chemical analyses and norms

	21	22	23	24	25	26
	129 102	129 104	129 101	129 103	129 105	129 106
SiO ₂	43.1	45.82	40.9	40.95	43.63	46.61
TiO ₂	6.3	1.91	1.3	2.89	2.61	2.39
Al ₂ O ₃	7.2	12.82	21.5	16.55	15.34	16.91
Fe ₂ O ₃	3.2	7.44	4.0	6.28	5.90	3.93
FeO	12.8	5.39	9.7	9.60	8.45	8.13
MnO	0.25	0.20	0.37	0.26	0.26	0.20
MgO	6.2	5.65	3.4	2.89	5.02	3.85
CaO	18.7	17.75	18.1	16.49	14.34	12.12
Na ₂ O	1.7	2.05	0.62	1.53	2.14	3.11
K ₂ O	0.01	0.17	0.05	0.10	0.19	0.35
P ₂ O ₅	0.01	0.22	0.01	0.42	0.40	0.37
CO ₂	0.15	0.13	0.05	0.10	0.07	0.07
H ₂ O ⁺	0.45	1.45	0.83	1.38	1.49	1.88
Sum	100.07	101.00	100.83	99.44	99.84	99.92
k	<0.01	0.05	0.05	0.04	0.06	0.07
mg	0.41	0.45	0.25	0.25	0.39	0.37
Or	0.07	1.03	0.00	0.63	1.18	2.15
Ab	7.7	16.56	0.00	12.39	18.83	29.05
Lc	0.00	0.00	0.24	0.00	0.00	0.00
Ne	5.2	1.49	3.5	1.37	0.79	0.00
An	12.4	26.13	57.7	40.62	33.23	32.42
Di	35.9	32.24	19.4	17.07	23.48	15.40
Wo	7.1	6.55	1.2	4.85	0.00	0.00
Cs	0.00	0.00	0.93	0.00	0.00	0.00
Hy	0.00	0.00	0.00	0.00	0.00	1.25
Ol	14.2	2.70	9.9	8.74	9.48	9.51
Tit	13.9	4.14	2.7	6.45	5.73	5.19
Mt	3.5	8.04	4.3	7.02	6.47	4.27
Ap	0.02	0.45	0.02	0.88	0.82	0.75
Pr	0.06	0.00	0.11	0.00	0.00	0.00
norm Ol						
%Fo	0	0	0	0	22	24

d: paragneisses

	27	28	29	30	31	32	33	34	35	36	37
	129 118	129 119	129 120	129 121	129 122	129 123	129 124	129 125	129 126	129 127	129 128
SiO ₂	64.37	61.90	63.95	58.98	59.06	59.05	68.50	71.17	68.40	69.81	73.14
TiO ₂	1.02	1.07	1.07	1.03	1.05	0.96	0.76	0.56	0.75	0.69	0.26
Al ₂ O ₃	17.22	16.88	16.16	19.90	19.51	20.72	15.95	13.74	14.60	13.68	14.56
Fe ₂ O ₃	3.12	1.79	2.03	0.80	1.47	1.23	0.41	0.76	0.86	1.10	0.62
FeO	3.98	5.91	4.76	7.38	7.09	6.90	5.05	3.54	3.19	3.98	1.64
MnO	0.16	0.16	0.10	0.13	0.23	0.11	0.16	0.10	0.09	0.08	0.05
MgO	1.80	3.19	2.00	2.75	2.95	2.73	2.18	1.26	0.75	1.66	0.64
CaO	1.40	1.70	2.00	1.76	1.31	1.23	1.57	1.18	2.60	1.68	1.70
Na ₂ O	2.38	2.45	2.86	1.90	1.68	1.59	1.83	2.34	3.26	1.97	2.64
K ₂ O	1.94	2.57	2.46	2.58	2.37	2.89	2.30	1.84	3.49	2.20	3.11
P ₂ O ₅	0.13	0.17	0.18	0.09	0.09	0.14	0.10	0.07	0.25	0.06	0.10
CO ₂	0.14	0.22	0.15	0.19	0.05	0.03	0.03	0.04	0.04	0.10	0.10
H ₂ O ⁺	2.21	1.35	2.68	2.03	2.87	1.99	0.79	2.80	1.25	2.44	2.34
Sum	99.87	99.36	100.40	99.52	99.73	99.57	99.63	99.40	99.53	99.45	99.90
k	0.35	0.41	0.36	0.47	0.48	0.54	0.45	0.34	0.41	0.42	0.44
mg	0.32	0.43	0.35	0.37	0.38	0.37	0.41	0.34	0.25	0.37	0.34

e: orthogneisses

	38	39	40	41	42	43	44	45
	129 132	129 133	129 144	129 141	129 135	129 139	129 140	129 143
SiO ₂	70.58	70.42	74.14	73.72	68.99	68.37	67.08	67.76
TiO ₂	0.33	0.36	0.16	0.20	0.64	0.84	0.73	0.62
Al ₂ O ₃	14.86	14.49	13.62	13.71	14.25	14.43	15.74	15.07
Fe ₂ O ₃	1.14	0.47	0.44	0.00	0.48	1.16	0.84	0.58
FeO	1.19	1.80	0.48	1.53	3.23	3.71	3.55	2.92
MnO	0.06	0.06	0.04	0.06	0.09	0.11	0.11	0.08
MgO	0.34	0.93	0.25	0.45	0.88	1.16	1.25	0.88
CaO	1.24	1.44	0.75	1.36	2.64	3.10	3.05	2.65
Na ₂ O	3.17	2.60	2.17	3.15	3.20	3.13	3.30	3.43
K ₂ O	4.55	4.45	4.67	4.38	3.90	2.45	2.73	4.03
P ₂ O ₅	0.24	0.23	0.20	0.05	0.24	0.22	0.15	0.24
CO ₂	0.06	0.25	0.10	0.10	0.11	0.10	0.10	0.10
H ₂ O ⁺	1.95	1.41	1.79	0.82	1.15	0.85	1.05	0.99
Sum	99.71	98.91	98.81	99.53	99.80	99.63	99.68	99.35
k	0.49	0.53	0.59	0.48	0.45	0.34	0.35	0.44
mg	0.21	0.42	0.33	0.34	0.29	0.30	0.34	0.31
D.I.	26.35	25.25	28.72	26.60	22.68	19.95	19.70	22.40

Enclosure II: wet chemical whole-rock analyses

by Mr. L. M. Belfroid

Miss H. Bontje

Miss T. Loosbroek

a: scapolite and epidote

	1	2	3	4	5	6
SiO ₂	47.21	48.83	47.52		47.17	39.05
TiO ₂	n.d.	n.d.	0.00		0.03	0.31
Al ₂ O ₃	26.31	25.08	25.21		26.29	26.88
Fe ₂ O ₃	0.00	0.00	n.d.		0.15 ^Δ	8.76 ^Δ
FeO	0.17 ^Δ	0.18 ^Δ	0.30		0.00	0.00
MnO	n.d.	n.d.	0.02		0.01	0.05
MgO	0.03	0.30	0.14		1.00	0.17
CaO	16.56	15.50	15.48		14.31	23.44
Na ₂ O	4.24	4.50	4.52		3.82	n.d.
K ₂ O	0.06	0.00	0.10		1.01	n.d.
H ₂ O ⁺	n.d.	n.d.	0.22		0.93	n.d.
H ₂ O ⁻	n.d.	n.d.	0.08		0.50	n.d.
CO ₂	n.d.	n.d.	2.16		2.66	n.d.
SO ₃	0.48	2.18	4.17		1.42	n.d.
Cl	0.23	0.07	0.06		0.56	n.d.
Sum	95.52	96.89	100.01		99.90	98.66

numbers of ions on the basis of 12 (Al, Si)

	7.244	7.476	7.384	7.16	7.243	6.051
Si	7.244	7.476	7.384	7.16	7.243	6.051
Al	4.756	4.524	4.616	4.84	4.757	4.906
Ti	n.d.	n.d.	0.000	n.d.	0.004	0.035
Fe	0.018	0.028	0.039	n.d.	0.018	1.021 ^Δ
Mg	0.009	0.074	0.033	n.d.	0.231	0.038
Mn	n.d.	n.d.	0.003	n.d.	0.001	0.007
Ca	2.719	2.538	2.577	2.86	2.362	3.893
Na	1.253	1.333	1.362	n.d.	1.137	n.d.
K	0.009	0.000	0.020	n.d.	0.198	n.d.
H	n.d.	n.d.	0.228	n.d.	0.950	n.d.
C	n.d.	n.d.	0.458	n.d.	0.558	n.d.
Cl	0.065	0.018	0.016	<0.01	0.146	n.d.
S	0.055	0.248	0.486	0.72	0.163	n.d.
%Me	68.5	66.4	65.8	72	66.2	17.2 %Ps

- a: scapolites
- 1: 129102, scapolite-salite granofels (including P₂O₅ = 0.23)
 - 2: 129101, garnet-clinopyroxene-scapolite-epidote-amphibole gneiss (including P₂O₅ = 0.25)
 - 3: garnet-hornblende-pyroxene-scapolite gneiss (including P₂O₅ = 0.03) (von Knorring & Kennedy, 1958)
 - 4: partial analysis, garnet-clinopyroxene-plagioclase-scapolite granulite, R 165 (Lovering & White, 1964)
 - 5: scapolite-calcite-amphibole-diopside rock, Q 85 (including Cl = 0.04) (Haughton, 1971)
- Me: meionite
- epidote
- 6: 129101, garnet-clinopyroxene-scapolite-epidote-amphibole gneiss
- Ps: pistacite

b: clinopyroxene and amphibole

	7	8	9	10	11	12	13
SiO ₂	48.47	51.61	49.60	47.67	39.34	42.13	41.86
TiO ₂	0.68	0.56	0.62	1.37	1.61	1.53	1.90
Al ₂ O ₃	6.83	6.18	6.12	10.70	13.27	14.76	14.31
Fe ₂ O ₃	0.00	0.00	3.80	2.60	0.00	0.00	4.29
FeO	14.09 ^Δ	9.16 ^Δ	5.86	7.06	21.54 ^Δ	15.64 ^Δ	8.79
MnO	0.27	0.18	0.10	0.05	0.21	0.15	0.10
MgO	7.73	10.51	11.26	11.04	7.03	10.25	12.58
CaO	20.16	20.24	20.58	17.26	11.27	10.85	11.14
Na ₂ O	1.90	2.07	1.68	1.80	2.30	2.79	2.47
K ₂ O	0.00	0.00	0.05	0.04	0.82	0.53	0.63
Sum	100.13	100.50	99.97	99.69	97.39	98.63	100.06

numbers of ions on the basis of 60

	1.853	1.910	1.852	1.766	6.112	6.221	6.093
Si	1.853	1.910	1.852	1.766	6.112	6.221	6.093
Al	0.147	0.090	0.148	0.234	1.888	1.779	1.907
Al	0.161	0.159	0.122	0.233	0.542	0.789	0.600
Ti	0.020	0.015	0.017	0.038	0.189	0.169	0.209
Fe ³⁺	0.000	0.000	0.106	0.073	0.000	0.000	0.472
Fe ²⁺	0.450	0.284	0.183	0.219	2.800	1.932	1.075
Mn	0.009	0.006	0.003	0.002	0.028	0.018	0.013
Mg	0.440	0.580	0.626	0.610	1.627	2.254	2.742
Ca	0.826	0.803	0.823	0.685	1.877	1.717	1.744
Na	0.141	0.149	0.122	0.129	0.693	0.798	0.700
K	0.000	0.000	0.002	0.002	0.162	0.101	0.117

- b: clinopyroxenes
- 7: 129102, scapolite-salite granofels
 - 8: 129101, garnet-clinopyroxene-scapolite-epidote-amphibole gneiss
 - 9: garnet-hornblende-pyroxene-scapolite gneiss (including H₂O = 0.30) (von Knorring & Kennedy, 1958)
 - 10: garnet-pyroxene-plagioclase-scapolite granulite R 130 (including Cr₂O₃ = 0.029 and P₂O₅ = 0.07) (Lovering & White, 1964)
- amphiboles
- 11: magnesian hastingsite, 129102, scapolite-salite granofels
 - 12: ferroan pargasite, 129101, garnet-clinopyroxene-scapolite-epidote-amphibole gneiss
 - 13: hornblende, garnet-pyroxene-hornblende-scapolite gneiss (including H₂O = 1.92 and Cl = 0.07) (von Knorring & Kennedy, 1958)

Enclosure III:
 chemical mineral analyses
 The new chemical analyses presented in this enclosure are microprobe electron analyses, carried out at the Free University, Amsterdam. Oxyde wt% may include a maximum error of ± 2%.
 Garnet and biotite from 129121 analyzed by Dr. C. Kieft, other minerals by the author
 n.d.: not determined
 Δ: total Fe calculated as Fe²⁺
 ▲: total Fe calculated as Fe³⁺

c: garnet

	14	15	16
SiO ₂	39.51	39.50	40.33
TiO ₂	0.15	0.16	0.26
Al ₂ O ₃	21.25	21.53	20.74
Fe ₂ O ₃	0.00	1.05	2.28
FeO	21.65 ^Δ	20.91	17.66
MnO	0.87	0.66	0.43
MgO	4.35	7.85	10.89
CaO	13.62	8.34	7.08
Sum	101.41	100.00	99.88

numbers of ions on the basis of 12 O

	3.026	3.016	3.036
Si	3.026	3.016	3.036
Al	1.917	1.938	1.840
Ti	0.008	0.018	0.015
Fe ³⁺	0.000	0.060	0.129
Fe ²⁺	1.387	1.335	1.112
Mn	0.056	0.042	0.028
Mg	0.497	0.894	1.222
Ca	1.118	0.683	0.571

mol% end-members

	45.5	45.2	37.9
Al	45.5	45.2	37.9
Sp	2.0	1.4	1.0
Py	16.0	30.3	41.7
Gr	36.5	19.1	12.8
An	0.0	4.0	6.6

- c: garnets
- 14: 129101, garnet-clinopyroxene-scapolite-epidote-amphibole gneiss
 - 15: garnet-hornblende-pyroxene-scapolite gneiss (von Knorring & Kennedy, 1958)
 - 16: garnet-clinopyroxene-plagioclase-scapolite granulite R 130 (including Na₂O = 0.08, K₂O = 0.05 and P₂O₅ = 0.04) (Lovering & White, 1964)

d: biotite

	17	18	19	20
SiO ₂	n.d.	35.47	35.72	37.11
TiO ₂	2.82	1.80	3.18	3.40
Al ₂ O ₃	17.98	18.80	19.97	17.99
FeO	19.79	15.00	17.85	13.42
MnO	0.07	0.07	0.05	0.01
MgO	9.62	13.48	8.87	13.04
CaO	n.d.	0.03	0.07	n.d.
Na ₂ O	n.d.	0.00	0.13	n.d.
K ₂ O	n.d.	9.64	8.97	9.38
Sum		94.29	94.81	94.35

numbers of ions on the basis of 22 O

	5.354	5.397	5.524
Si	5.354	5.397	5.524
Al	2.646	2.603	2.476
Al	0.698	0.951	0.681
Ti	0.204	0.361	0.381
Fe ²⁺	1.895	2.256	1.672
Mn	0.008	0.007	0.002
Mg	3.033	1.997	2.893
Ca	0.005	0.011	n.d.
Na	0.000	0.038	n.d.
K	1.856	1.728	1.782

- d: biotites
- 17: 129121
 - 18: 129122
 - 19: 129123
 - 20: 129124
- kyanite-garnet-biotite gneisses

e: garnet

	21	22	23	24
SiO ₂	37.47	38.21	38.00	38.54
TiO ₂	n.d.	0.04	0.05	0.07
Al ₂ O ₃	21.15	21.32	21.18	21.74
FeO	34.81	32.77	33.60	29.93
MnO	1.15	1.36	1.67	1.48
MgO	3.64	4.74	3.18	5.21
CaO	2.05	2.65	2.30	4.31
Sum	100.27	101.09	99.98	101.28

numbers of ions on the basis of 12 O

	2.998	3.005	3.036	2.998
Si	2.998	3.005	3.036	2.998
Al	0.002	0.000	0.000	0.002
Al	1.992	1.976	1.994	1.990
Ti	n.d.	0.002	0.003	0.004
Fe ²⁺	2.330	2.156	2.246	1.948
Mn	0.078	0.090	0.113	0.098
Mg	0.434	0.556	0.378	0.604
Ca	0.176	0.223	0.197	0.359

mol% end-members

	66.1	71.2	76.5	64.7
Al	66.1	71.2	76.5	64.7
Sp	2.6	2.9	3.8	3.3
Py	14.4	18.4	12.9	20.1
Gr	5.8	7.4	6.7	11.9

- e: garnets
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