

Electronic supplement 25-2-01

to the paper

Heterogeneous magmas of the Quaternary Sierra Chichinautzin
volcanic field (central Mexico): the role of an amphibole-bearing mantle
and magmatic evolution processes

by

Lorenzo Meriggi, José Luis Macías, Simone Tommasini, Lucia Capra, and Sandro Conticelli

published in

Revista Mexicana de Ciencias Geológicas, 2008, 25(2), 197-216

Tables

- A1: Modal mineralogical analyses**
- A2: Selected analyses of olivine**
- A3: Selected analyses of clinopyroxene**
- A4: Representative analyses of plagioclase**
- A5: Representative analyses of oxide**
- A6: Major and trace element composition**

This electronic supplement contains 10 pages.

Table A1. Modal mineralogical analyses (vol. %) of representative samples from the Sierra Chichinautzin volcanic field. More than 750 point counted.

Sample:	d-37	MX15	MX01	MX44	d-25	TEB	MX42	MX51	MX36	MX39.2	MX07	d-10
Locality:	Tezoyuca	Cuaul	Chapultepec	Esperanza	Pelagatos	Tenango	Lagunilla	Lama	Capulhuac	Cuate Grande	Villa Metepec	Sta. Cruz
Latitude N:	18°48'40"	19°09'55"	19°12'27"	19°05'35"	19°06'00"	19°06'41.9"	19°04'31"	19°05'31"	19°11'52"	19°11'23"	19°14'58"	19°10'18"
Longitude W:	99°12'36"	99°25'30"	99°33'14"	99°26'02"	99°50'00"	99°37'49.4"	99°23'56"	99°31'46"	99°27'21"	99°26'20"	99°46'30"	99°29'44"
Altitude (m):	1,225	2,880	2,590	2,880	1,243	2,640	2,820	2,630	2,710	2,730	2,690	2,612
Affinity:	H-TiO ₂	H-TiO ₂	H-TiO ₂	H-TiO ₂	L-TiO ₂	L-TiO ₂	L-TiO ₂	L-TiO ₂	Transitional	Transitional	Transitional	H-K ₂ O
Rock type:	B	A	A	D	BA	A	A	A	BA	B	A	BTA
Ol Ph	7.1	6.0	2.0	-	12.8	0.1	0.7	0.7	8.4	7.9	3.5	-
Ol MPh	0.8	-	0.1	-	1.0	tr	-	-	0.9	-	1.1	-
Cpx Ph	-	1.9	6.1	2.2	1.0	tr	3.1	0.2	0.7	2.5	-	12.1
Cpx Mph	-	0.2	-	0.4	0.1	-	0.2	tr	0.2	-	-	1.5
Opx Ph	0.4	0.3	1.9	0.7	-	0.1	2.0	1.4	-	-	-	-
Opx Mph	-	-	0.5	0.2	-	-	0.1	-	-	-	-	-
Xeno Qz	-	-	-	-	-	3.7	-	5.4	-	-	1.5	-
Xeno Plg	-	0.6	-	-	-	1.3	-	1.8	-	-	-	-
Xeno Cpx/Anp	-	-	-	-	-	2.8	-	2.9	-	-	-	-
Plg MPh	13.2	12.5	17.0	1.9	13.6	21.1	4.4	11.0	8.6	13.1	4.7	-
Gdm	78.5	78.5	72.3	94.6	71.5	70.9	89.5	76.6	81.2	76.6	89.2	86.4
Tot	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Vesicles	9.0	33.0	13.2	7.4	1.4	11.3	9.6	11.2	9.0	26.6	10.2	8.4

Ph = phenocryst (>0.3 mm), MPh = microphenocrysts (>0.03 mm), Gdm = groundmass (<0.03 mm). Qz: quartz, Plg: plagioclase, Amp: amphibole. A: andesite, B: basalt, BA: basaltic andesite, BTA = basaltic trachy-andesite, D: dacite, Ol: olivine, Cpx: clinopyroxene, Opx: orthopyroxene.

Table A2. Selected analyses of olivine (Ol) in samples from the western Sierra Chichinautzin volcanic field plus Pelagatos and Tezoyuca cinder cones.

Sample: Locality: Affinity Texture Mineral	d-37 Tezoyuca		d-37 Tezoyuca		d-25 Pelagatos		d-25 Pelagatos		d-25 Pelagatos		Sc08 Tenango		Sc08 Tenango		Ms84 Tepexingo		Ms84 Tepexingo		d-53 Capulhuac		d-53 Capulhuac	
	H-TiO ₂ Ph Core Ol	H-TiO ₂ Ph Rim Ol	L-TiO ₂ Ph Core Ol	L-TiO ₂ Ph Rim Ol	L-TiO ₂ Ph Core Ol	L-TiO ₂ Ph Rim Ol	L-TiO ₂ Gdm Ol	L-TiO ₂ Ph Core Ol	L-TiO ₂ Ph Core Ol	L-TiO ₂ Ph Core Ol	L-TiO ₂ Ph Core Ol	L-TiO ₂ Gdm Ol	L-TiO ₂ Ph Core Ol	L-TiO ₂ Ph Core Ol	L-TiO ₂ Ph Core Ol	L-TiO ₂ Ph Core Ol	L-TiO ₂ Ph Core Ol	L-TiO ₂ Ph Core Ol	L-TiO ₂ Ph Core Ol	L-TiO ₂ Ph Core Ol	L-TiO ₂ Ph Core Ol	L-TiO ₂ Ph Core Ol
SiO ₂	40.1	40.7	40.7	40.9	41.2	41.2	42.1	40.2	39.6	37.5	40.2	40.4	40.2	40.2	40.2	40.2	40.2	40.2	39.6	39.0	39.6	39.0
TiO ₂	0.01	bdl	bdl	bdl	0.03	0.03	bdl	bdl	bdl	0.01	0.02	0.03	0.03	0.04	0.04	0.04	0.04	0.04	bdl	bdl	bdl	0.09
Al ₂ O ₃	0.26	bdl	0.04	0.03	bdl	bdl	0.03	bdl	0.04	bdl	bdl	0.04	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.06
Cr ₂ O ₃	0.18	0.04	0.02	0.01	0.04	0.04	0.02	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
FeO	12.3	12.9	14.2	13.3	13.3	13.3	15.1	13.2	16.6	30.2	15.3	13.1	13.1	12.1	12.1	12.1	12.1	12.1	17.5	19.2	17.5	19.2
MnO	0.18	0.14	0.21	0.20	0.23	0.23	0.20	0.16	0.22	0.44	0.20	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.26	0.41	0.26	0.41
NiO	0.40	0.42	0.18	0.19	0.16	0.16	0.10	0.34	0.11	0.12	0.09	0.08	0.08	0.44	0.09	0.08	0.44	0.08	0.31	0.09	0.31	0.09
MgO	46.9	46.8	45.5	47.5	44.5	44.5	44.2	47.42	44.6	32.7	45.3	46.6	46.6	48.1	44.4	48.1	44.4	44.4	44.4	42.0	44.4	42.0
CaO	0.16	0.16	0.20	0.15	0.13	0.13	0.11	0.10	0.14	0.18	0.12	0.08	0.08	0.12	0.15	0.12	0.15	0.15	0.15	0.29	0.15	0.29
Forsterite	86.8	86.3	84.6	86.1	85.3	85.3	83.6	86.2	82.5	65.4	83.7	86.1	86.1	87.4	81.5	87.4	81.5	81.5	81.5	78.9	81.5	78.9
Fayalite	12.8	13.4	14.9	13.5	14.3	14.3	16.0	13.5	17.1	33.9	15.9	13.6	13.6	12.3	18.0	12.3	18.0	18.0	18.0	20.2	18.0	20.2
Larnite	0.20	0.20	0.30	0.20	0.20	0.20	0.10	0.13	0.18	0.26	0.16	0.11	0.11	0.20	0.20	0.16	0.20	0.20	0.20	0.40	0.20	0.40
Tephroite	0.20	0.10	0.20	0.20	0.30	0.30	0.20	0.17	0.22	0.50	0.21	0.18	0.18	0.20	0.30	0.21	0.20	0.20	0.30	0.40	0.30	0.40
Mg# (bulk rock)	67.1	67.1	67.1	73.7	73.7	73.7	73.7	65.6	65.6	65.6	62.5	62.5	62.5	70.9	70.9	62.5	70.9	70.9	70.9	70.9	70.9	70.9

Trans.: Transitional; Ph: phenocryst; Gdm: groundmass; bdl: below detection limit.

Table A.3. Selected analyses of clinopyroxene (Cpx) and orthopyroxene (Opx) in samples from the Sierra Chichinautzin volcanic field.

Sample Locality:	d-37 Tezoyuca		d-37 Tezoyuca		TEB Tenango		TEB Tenango		TEB Tenango		Mx53 Tenango		Sc02 Tenango		Sc05 Tenango		Mx39.2 Los Cuates		Mx39.2 Los Cuates		Mx39.2 Los Cuates		d-10 Sta. Cruz		d-10 Sta. Cruz		L2 Lama dome		L2 Lama dome	
	H-TiO ₂ Cpx Ph core	H-TiO ₂ Cpx Ph rim	L-TiO ₂ Cpx Ph core	L-TiO ₂ Cpx Ph core	L-TiO ₂ Cpx Qz rim	L-TiO ₂ Cpx Qz rim	L-TiO ₂ Cpx Ph core	L-TiO ₂ Cpx Ph core	L-TiO ₂ Cpx Ph core	L-TiO ₂ Cpx Ph core	L-TiO ₂ Cpx Ph core	L-TiO ₂ Cpx Ph core	L-TiO ₂ Cpx Ph core	L-TiO ₂ Cpx Ph core	L-TiO ₂ Cpx Ph core	L-TiO ₂ Cpx Ph core	L-TiO ₂ Cpx Ph core	L-TiO ₂ Cpx Ph core	L-TiO ₂ Cpx Ph core	L-TiO ₂ Cpx Ph core	L-TiO ₂ Cpx Ph core	L-TiO ₂ Cpx Ph core	L-TiO ₂ Cpx Ph core	L-TiO ₂ Cpx Ph rim	L-TiO ₂ Cpx Ph rim	L-TiO ₂ Cpx Ph core	L-TiO ₂ Cpx Ph core	L-TiO ₂ Cpx Ph core	L-TiO ₂ Cpx Ph core	
SiO ₂	48.03	49.29	46.70	53.6	53.4	53.8	53.8	52.7	55.5	52.3	51.8	50.8	49.9	53.4	49.3	48.3	53.1													
TiO ₂	2.89	1.82	3.10	0.26	0.71	0.17	0.41	0.41	0.16	0.59	0.75	1.10	1.34	0.27	1.20	0.50	0.26													
Al ₂ O ₃	3.77	4.02	5.11	1.59	3.03	0.41	0.46	0.02	1.82	0.87	2.81	3.19	3.93	1.29	5.02	7.83	0.71													
Cr ₂ O ₃	0.17	0.13	0.30	bdl	0.08	bdl	0.02	0.56	0.56	bdl	0.16	0.43	0.05	0.07	bdl	bdl	bdl													
FeO	9.91	11.09	9.85	7.76	10.5	8.36	10.4	8.41	8.41	19.4	6.26	7.55	7.93	5.29	8.44	20.0	12.0													
MnO	0.22	0.32	0.24	0.21	0.22	0.16	0.31	0.18	0.18	0.56	0.15	0.18	0.13	0.09	0.16	0.63	0.38													
MgO	13.11	15.59	13.04	18.28	13.5	16.56	14.8	31.5	31.5	22.4	16.9	15.4	15.1	17.7	13.9	22.7	14.8													
CaO	21.14	16.41	20.24	17.22	17.88	19.4	20.0	1.40	1.40	3.32	20.7	21.16	21.0	20.9	21.3	0.58	18.9													
Na ₂ O	0.39	0.61	0.52	0.25	0.64	0.39	0.42	0.42	0.12	0.03	0.25	0.43	0.48	0.28	0.42	bdl	0.37													
K ₂ O	bdl	0.08	0.02	bdl	0.36	0.03	0.04	0.04	0.02	bdl	bdl	0.03	0.20	bdl	0.04	0.30	0.03													
Enstatite	38.6	46.2	39.2	52.0	41.8	47.0	42.0	84.4	84.4	62.2	47.8	44.0	43.5	49.5	40.9	65.5	42.0													
Ferrosilite	16.7	19.0	17.0	12.7	18.5	13.6	17.1	12.9	12.9	31.2	10.2	12.4	13.0	8.40	14.2	33.3	19.6													
Wollastonite	44.7	34.9	43.8	35.2	39.7	39.5	40.9	2.70	2.70	6.64	42.0	43.6	43.5	42.1	44.9	1.20	38.4													
Mg#	0.70	0.71	0.70	0.80	0.69	0.80	0.78	0.87	0.87	0.67	0.80	0.78	0.80	0.85	0.70	0.70	0.70													

Trans.: Transitional, Ph: phenocryst, Qz: quartz, bdl: below detection limit.

Table A4. Representative analyses of plagioclase (Plg) in samples from the western Sierra Chichinautzin volcanic field.

Sample	Mx39.2	Mx39.2	Sc05	Mx84	Mx84	Mx84	Sc08	L2	L2
Locality	Los Cuates	Los Cuates	Tenango	Tepexingo	Tepexingo	Tepexingo	Tenango	Lama dome	Lama dome
Affinity	Transitional	Transitional	L-TiO ₂	L-TiO ₂	L-TiO ₂	L-TiO ₂	Xenocryst	Xenocryst	Xenocryst
Mineral	Plg	Plg	Plg	Plg	Plg	Plg	Plg	Plg	Plg
Texture	Gdm (core)	Gdm (core)	Gdm (core)	Gdm (core)	Gdm (rim)	Gdm (rim)	Ph core	Ph core	Ph core
SiO ₂	51.7	52.1	53.6	53.7	54.3	55.8	61.2	60.0	59.2
Al ₂ O ₃	30.0	29.4	30.4	28.3	29.1	27.6	25.3	25.1	25.4
Fe ₂ O ₃	1.00	1.20	0.87	0.72	0.72	1.27	0.74	0.13	0.60
MgO	0.17	0.11	0.09	0.00	0.07	nd	0.00	0.04	0.07
CaO	12.8	12.1	12.4	11.7	10.7	10.0	6.09	6.71	6.79
Na ₂ O	3.99	4.39	4.24	4.79	4.95	5.61	7.91	7.67	6.91
K ₂ O	0.25	0.36	0.27	0.24	0.26	0.36	0.46	0.43	1.19
SrO	0.25	0.17	0.23	nd	nd	nd	0.08	0.10	0.09
BaO	0.03	bdl	0.03	nd	nd	nd	0.07	bdl	0.04
Albite	35.6	38.9	37.6	42.0	44.86	49.3	68.3	65.8	60.4
Anorthite	62.9	59.0	60.7	56.7	53.59	48.6	29.1	31.8	32.8
Orthoclase	1.50	2.10	1.58	1.38	1.55	2.06	2.66	2.40	6.8

Ph: phenocryst, Gdm: groundmass, bdl: below detection limit, nd: not determined.

Table A5. Representative analyses of oxide in samples from the western Sierra Chichinautzin volcanic field.

Sample	Mx39.2	Mx39.2	d-37	d-37	d-25	d-25	Sc05	Sc05	L2	L2
Locality:	Los Cuates	Los Cuates	Tezoyuca	Tezoyuca	Pelagatos	Pelagatos	Tenango	Tenango	Lama dome	Lama dome
Affinity	Trans.	Trans.	H-TiO ₂	H-TiO ₂	L-TiO ₂	L-TiO ₂	L-TiO ₂	L-TiO ₂	Xenolith	Xenolith
Mineral	Mg-Chr	Mg-Chr	Mg-Chr	Mg-Chr	Mg-Chr	Mg-Chr	Ilm	Mt	Sp	Sp
Texture	In Olv	In Olv	In Olv	In Olv	In Olv	In Olv	Gdm	Gdm	Gdm	Gdm
SiO ₂	0.16	0.03	0.19	0.07	0.07	0.06	0.03	0.14	0.09	0.13
TiO ₂	1.36	0.97	1.19	1.24	0.57	0.55	44.9	13.2	0.49	0.26
Al ₂ O ₃	15.5	19.4	23.4	26.4	15.2	17.6	0.25	1.19	58.4	60.21
Cr ₂ O ₃	35.0	38.5	32.9	32.5	45.4	43.8	0.05	0.08	0.04	0.10
FeO	34.7	23.4	23.9	24.2	25.9	21.6	50.2	80.4	26.3	27.9
MnO	0.28	0.20	0.17	0.17	0.27	0.35	0.41	0.40	0.34	0.20
NiO	0.15	0.05	0.26	0.29	nd	nd	nd	nd	bdl	0.05
MgO	11.8	15.3	14.15	13.7	11.1	12.8	2.73	0.89	12.7	10.7
CaO	0.19	bdl	0.02	bdl	bdl	0.03	0.14	0.19	0.03	0.04
ZnO	0.10	0.30	bdl	bdl	bdl	0.12	0.15	bdl	bdl	0.68
Sum	99.31	98.15	96.15	95.53	98.57	96.84	98.86	96.44	94.41	100.38
Fe ₂ O ₃	19.4	12.9	11.1	9.34	9.34	7.79	-	42.8	5.18	3.52
Cr#	0.60	0.57	0.49	0.45	0.67	0.63	0.12	-	-	-
ILM'	-	-	-	-	-	-	83.7	-	-	-
HEM'	-	-	-	-	-	-	16.3	-	-	-
USP'	-	-	-	-	-	-	-	37.6	-	-
MT'	-	-	-	-	-	-	-	62.4	-	-

Trans.: Transitional; Gdm: groundmass, bdl: below detection limit, nd: not determined, Mg-Chr: Mg-chromite, Ilm: ilmenite, HEM: hematite, USP: ulvöspinel, Mt: magnetite, Sp: spinel.

Table A.6. Major (wt.%) and trace element (ppm) composition of samples from the western Sierra Chichinautzin volcanic field.

Sample Locality	MX01 Chapultepec	MX02 Chapultepec	MX03 Chapultepec	MX05 Chapultepec	MX07 Villa Metepc	MX09 Villa Metepc	MX09a Villa Metepc	MX11 Sta. Cruz	MX15 Cuautl	MX17 Tomasquillo	MX18 Negro	MX22 Negro	MX23 Negro	MX24 La Mesa
Lat N	19°12'27"	19°12'29"	19°12'19"	19°12'20"	19°14'58"	19°14'58"	19°14'58"	19°10'18"	19°09'55"	19°10'05"	19°09'32"	19°09'47"	19°10'12"	19°09'58"
Long W	99°33'14"	99°33'40"	99°33'34"	99°33'14"	99°46'30"	99°36'10"	99°36'10"	99°29'44"	99°25'30"	99°23'30"	99°23'50"	99°22'36"	99°22'56"	99°24'27"
Altitude (m)	2590	2580	2640	2600	2690	2710	2710	2610	2880	3050	2870	3040	3010	2810
Rock type	A	A	A	BA	A	BA	BA	BTA	A	BA	BA	BTA	BTA	BA
Affinity	H-TiO ₂	H-TiO ₂	H-TiO ₂	H-TiO ₂	Trans.	Trans.	Trans.	H-K ₂ O	H-TiO ₂	H-TiO ₂	H-TiO ₂	H-TiO ₂	H-TiO ₂	H-TiO ₂
SiO ₂	60.3	61.8	59.9	54.9	56.8	56.1	55.9	55.1	60.8	53.1	54.9	53.3	54.0	52.5
TiO ₂	0.87	0.90	0.89	1.34	1.10	1.10	1.08	1.05	0.85	1.54	1.33	1.58	1.56	1.53
Al ₂ O ₃	16.1	15.9	16.8	16.4	16.0	16.1	16.1	14.3	16.1	16.3	16.9	16.2	16.2	16.5
Fe ₂ O ₃	2.14	2.28	2.32	2.89	6.52	3.06	2.36	3.60	1.48	4.71	1.76	3.68	3.22	8.65
FeO	3.60	3.12	3.40	5.12	1.20	4.76	4.92	2.68	3.88	4.72	5.44	5.08	5.20	1.01
MnO	0.10	0.09	0.10	0.14	0.12	0.13	0.12	0.11	0.09	0.15	0.13	0.15	0.14	0.15
MgO	4.47	3.66	3.76	5.97	5.80	6.08	6.57	6.01	4.28	5.91	5.63	6.24	6.11	6.04
CaO	5.79	5.75	6.37	7.13	6.95	6.77	6.79	9.12	5.68	7.82	6.99	7.55	7.48	7.81
Na ₂ O	3.50	3.90	3.57	4.11	3.76	3.70	4.04	3.50	3.42	3.97	4.11	4.04	4.10	3.90
K ₂ O	1.97	1.96	2.12	1.19	1.36	1.43	1.40	3.21	2.16	1.07	1.34	1.34	1.40	0.97
P ₂ O ₅	0.15	0.20	0.18	0.25	0.18	0.18	0.17	0.81	0.16	0.27	0.40	0.42	0.41	0.28
LOI	1.03	0.48	0.56	0.57	0.19	0.64	0.57	0.50	1.09	0.50	1.00	0.48	0.16	0.66
Mg #	62.9	59.8	59.0	61.9	63.2	62.9	66.2	68.0	63.3	58.0	62.7	60.9	61.3	59.0
V	116	128	132	135	127	130	132	152	118	153	145	150	144	137
Cr	182	101	101	269	316	343	315	192	176	289	198	310	287	259
Co	19	18	17	32	31	34	34	24	21	37	29	32	31	39
Ni	89	51	48	87	158	157	146	123	91	80	72	131	109	82
Cu	27	31	26	44	31	40	40	48	27	44	32	30	34	43
Zn	77	71	74	86	80	79	79	101	76	92	80	94	91	92
Rb	56	44	47	25	42	44	44	60	55	20	23	24	26	16
Sr	608	715	723	638	559	562	555	1807	595	702	662	780	771	685
Y	15	15	14	25	22	23	22	30	17	28	26	32	26	27
Zr	181	164	167	184	169	171	168	216	180	176	193	238	230	173
Nb	7	7	8	13	8	8	8	10	7	16	14	20	17	14
Ba	462	445	413	414	377	354	373	2690	468	397	514	612	607	424
La	22	20	24	22	17	21	14	104	29	24	28	35	33	23
Ce	49	56	44	47	46	44	50	251	50	62	59	84	85	56
Nd	25	28	23	26	23	23	27	146	24	31	36	46	48	31
Pb	6	5	9	5	<5	6	5	26	6	6	5	5	5	<5
Th	6	7	8	4	7	6	6	14	8	2	5	6	3	4
CIPW calculation														
Q	12.7	13.8	11.5	1.76	5.92	4.48	2.26	-	13.5	-	2.35	-	0.31	-
Ne	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H ₂ O	14.4	11.1	11.9	18.44	17.2	19.5	19.5	8.31	13.8	18.1	17.8	16.9	17.5	18.6
O ₁	-	-	-	-	-	-	-	1.51	-	0.22	-	0.95	-	0.41

Table A6 (continued). Major (wt.%) and trace element (ppm) composition of samples from the western Sierra Chichinautzin volcanic field.

Sample	d-56	d-42	d-47	d-53	d-45	d-37	d-25	XTN	L2
Locality	Villa Meteppec	Texontepec (proximal)	Texontepec (distal)	Cuate Grande	Capulhuac	Tezoyuca	Pelagatos	Tenango	Lama
Lat N	19°06'44.9"	19°14'22.6"	19°15'00.3"	19°11'27.2"	19°11'50.0"	18°48'40"	19°06'00"	19°05'22.4"	19°07'00.3"
Long W	99°25'35.1"	99°24'43.5"	99°27'36.3"	99°26'18.0"	99°27'26.4"	99°12'36"	99°50'00"	99°37'35.3"	99°33'15.6"
Altitude (m)	2732	2846	2587	2742	2686	1225	1243	3087	2622
Affinity	L-TiO ₂	L-TiO ₂	L-TiO ₂	Trans.	Trans.	H-TiO ₂	L-TiO ₂		
Rock type	A	A	A	BA	B	B	BA		
SiO ₂	59.6	61.6	61.9	52.4	51.3	51.6	54.0	49.1	58.3
TiO ₂	0.88	0.80	0.73	1.25	1.34	1.61	0.81	1.38	0.97
Al ₂ O ₃	16.7	15.7	15.8	15.3	15.5	15.6	15.42	13.7	18.8
FeO _{tot}	5.21	4.97	4.82	7.34	7.40	8.47	6.91	7.01	5.79
MnO	0.09	0.09	0.08	0.12	0.12	0.14	0.12	0.13	0.09
MgO	4.32	4.30	4.54	8.51	8.59	8.24	9.24	9.93	2.49
CaO	5.46	5.44	5.12	8.12	8.38	7.93	7.51	14.3	5.92
Na ₂ O	4.19	4.31	4.33	3.59	3.57	3.43	3.35	2.61	4.47
K ₂ O	1.48	1.74	1.63	1.32	1.19	1.20	0.96	0.21	1.20
P ₂ O ₅	0.21	0.26	0.18	0.37	0.31	0.46	0.15	0.34	0.21
LOI	1.06	-0.05	0.19	0.19	0.32	0.41	0.34	0.21	0.18
Mg #	63.5	64.47	66.4	70.9	70.9	67.1	73.7	74.8	47.4
Sc	14	12	13	22	23	26	23	20	14
V	90	90	93	159	148	169	154	101	98
Cr	198	241	253	377	379	374	514	219	43
Co	21.8	18.7	19.5	39.3	41.4	38	41	31	15
Ni	97	117	120	220	229	184	255	91	30
Cu	28	41	27	46	44	36	46	42	11
Zn	73	82	72	67	63	74	67	61	68
Ga	19	17	19	17	17	15	18	16	21
Rb	25	31	34	26	16	19	20	2	26
Sr	527	598	457	823	808	490	402	612	704
Y	18	18	17	26	25	30	18	22	15
Zr	158	144	144	181	174	179	117	146	139
Nb	7.7	4.9	5.2	8.5	9.4	13.9	3.6	12.2	7.2
Cs	1.06	1.4	1.4	0.7	0.4	0.7	1.0	bdl	0.8
Ba	409	612	438	440	423	359	243	276	354
La	17	22	16	27	25	20	11	19	13
Ce	35	46	34	62	56	42	25	41	30
Pr	4.7	6.6	4.5	8.6	7.5	5.6	3.5	5.5	3.8
Nd	20	27	19	37	33	24	15	23	16
Sm	4.4	5.8	4.3	7.9	6.8	5.4	3.6	5.4	4.1
Eu	1.41	1.68	1.29	2.33	2.07	1.78	1.16	1.66	1.38
Gd	3.97	4.68	3.76	6.72	5.90	5.20	3.51	5.02	3.84
Tb	0.60	0.63	0.58	0.99	0.89	0.81	0.55	0.80	0.62
Dy	3.28	3.18	3.08	5.00	4.64	4.78	3.30	4.37	3.45
Ho	0.62	0.56	0.58	0.91	0.89	0.93	0.64	0.83	0.64
Er	1.81	1.51	1.66	2.64	2.59	2.64	1.85	2.39	1.86
Tm	0.27	0.21	0.24	0.38	0.38	0.38	0.27	0.34	0.28
Yb	1.67	1.29	1.51	2.38	2.34	2.37	1.71	2.11	1.79
Lu	0.24	0.18	0.22	0.33	0.32	0.34	0.25	0.31	0.27
Hf	4.31	3.90	4.20	4.74	4.57	4.18	3.07	3.99	4.33
Ta	0.6	0.4	0.4	0.6	0.6	1.1	0.2	0.8	0.4
Pb	6	6	<5	<5	<5	<5	<5	<5	7
Th	2.7	3.3	3.0	3.2	2.9	2.2	1.9	2.4	3.5
U	1.1	1.4	1.3	1.2	0.9	0.8	0.7	0.9	1.7
CIPW calculation									
Q	10.7	11.9	12.4	-	-	-	0.63		
Ne	-	-	-	-	-	-	-		
Hy	10.1	8.90	9.90	10.2	-	12.1	19.8		
Ol	-	-	-	6.50	9.52	5.10	-		

Trans.: Transitional; Mg#: $100 \times \text{Mg} / [\text{Mg}^{2+} + \text{Fe}^{2+}]$ with $\text{Fe} = 0.85 \times \text{FeO}_{\text{tot}}$ (Frey *et al.*, 1978). A: andesite, B: basalt, BA: basaltic andesite, BTA: basaltic trachy-andesite, D: dacite. bdl: below detection limit. CIPW calculated by using SINCLAS software of Verma *et al.* (2002).