

Appendix 1. Major elements compositions of dated samples

Major element contents of the dated samples are reported in Table S1. Their classification is based on the Total Alkali-Silica diagram of Figure S1.

Data have been obtained at the University of Napoli Federico II by means of an Axios X-Ray fluorescence (XRF) spectrometer, with techniques described in Melluso *et al.* (2011). Samples have been prepared as pressed powder pellets. Errors are estimated to be within 1%.

Loss on ignition (LOI) data have been determined at University of Padova by weighting about 1g of sample powder in a ceramic crucible and heating it into a furnace at 100°C overnight, and into a muffle at 1100°C for 4.30 hours, and weighting after each heating; values after 1100°C heating are reported in Table S1.

Appendix 2. Petrography of the dated samples

Gabbros from Phenai Mata are coarse grained rocks and differ in their modal and chemical composition. The alkali gabbro PL3 is very rich in diopsidic clinopyroxene (about 80 vol.%), while plagioclase (An₉₀; about 15 vol.%) and olivine (Fo₆₇₋₇₂; about 5 vol%) are rare. The tholeiitic gabbros PL9 and PL20 trend to anorthosites (60-75 vol.% plagioclase; An₇₃₋₈₀), while olivine (Fo₆₈) augitic clinopyroxene and orthopyroxene mantling olivine are present in similar amounts (10-15 vol.%).

The sample PL2 is a mafic nepheline syenite, mostly constituted by K-feldspar and Fe-pargasitic amphibole, with nepheline and pale green clinopyroxene as minor phases. Apatite and Fe-Ti oxides are early crystallized accessory phases, epidote and zeolites are secondary.

The basalt PL54 presents plagioclase (An₆₂₋₇₆) as main phenocryst phase. Clinopyroxene and olivine are found in the groundmass. The sample PL61 of Pavagadh Fo-rich olivine, Ca-clinopyroxene and An₆₇₋₆₈ plagioclase as phenocryst phases, set in a microcrystalline mesostasis with also Fe-Ti oxides and alkali feldspar.

PL63 is a glassy rhyolite samples at the top of the Pavagadh hill, and with phenocryst of plagioclase (An₄₀₋₅₃), and minor Fe-olivine, clinopyroxene, pigeonite and Fe-Ti oxides set in a rhyolitic glass.

Reference

Melluso, L., le Roex, A.P. & Morra, V. 2011. Petrogenesis and Nd-Pb-Sr- isotope geochemistry of the olivine melilitites and olivine nephelinites (“ankaratrites”) in Madagascar. *Lithos*, **127**, 505-521.

Table S1. Whole rock composition. Major element contents (wt.%) measured by XRF analyses. ne: nepheline-normative; ol/hy: olivine/hyoerstene-normative; qtz: quartz-normative

	PL2	PL3	PL9	PL20	PL36	PL54	PL61	PL63
SiO ₂	55.91	46.89	49.07	49.41	50.78	52.47	47.01	70.01
TiO ₂	0.94	1.24	0.37	0.46	2.05	2.23	2.03	0.68
Al ₂ O ₃	17.47	17.33	20.89	21.12	17.4	14.33	13.71	13.13
Fe ₂ O ₃ ^T	10.39	7.48	5.82	5.38	8.08	14.08	11.73	5.29
MnO	0.30	0.12	0.10	0.08	0.17	0.20	0.17	0.13
MgO	1.42	8.62	6.72	6.34	3.73	3.58	13.41	0.42
CaO	4.22	15.46	14.28	14.30	8.47	8.99	8.66	2.38
Na ₂ O	4.48	1.49	1.79	2.11	4.53	3.06	1.95	4.72
K ₂ O	4.22	0.93	0.76	0.56	3.43	0.65	0.81	2.83
P ₂ O ₅	0.39	0.22	0.07	0.10	0.87	0.27	0.29	0.18
tot	99.74	99.78	99.87	99.86	99.51	99.86	99.77	99.77
LOI	1.50	1.02	0.52	0.65	3.90	1.50	2.13	2.77
norm	ne	ne	ol/hy	ol/hy	ne	qtz	ol/hy	qtz

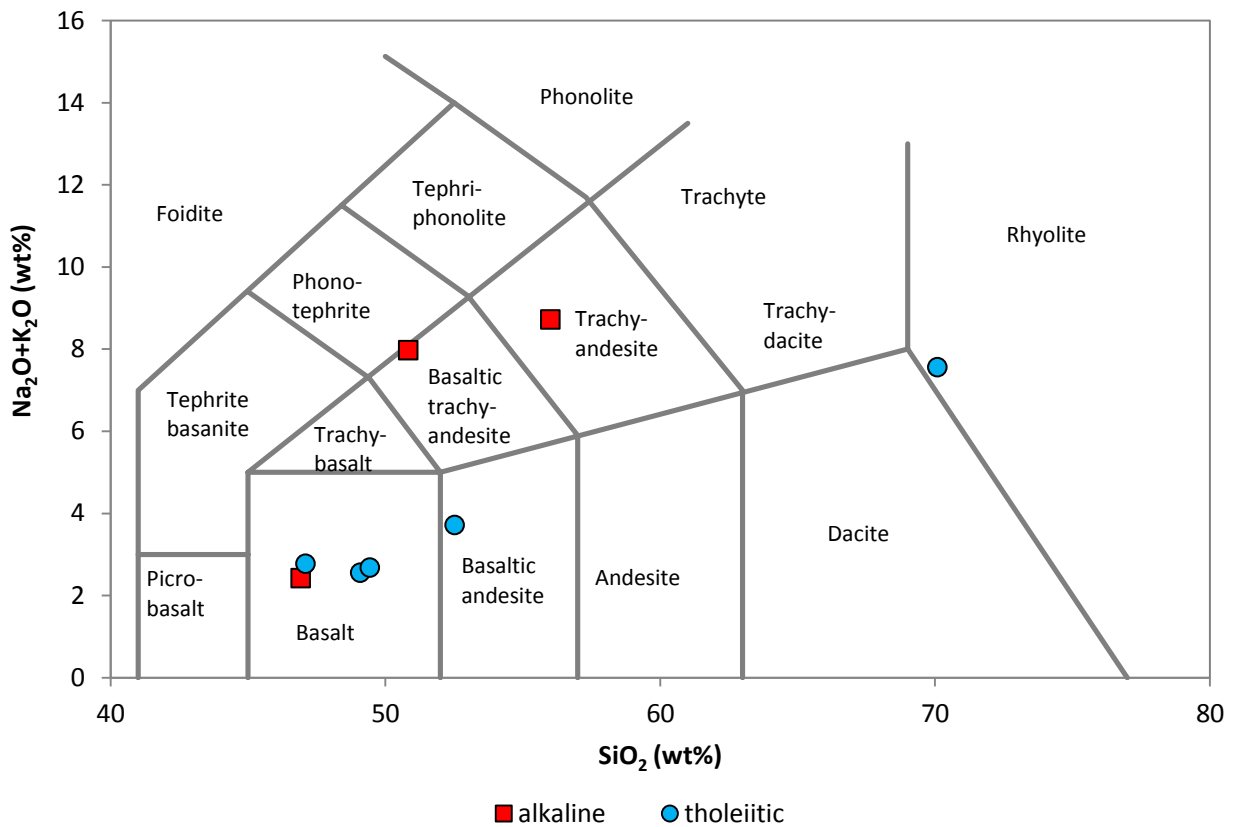


Fig. S1. TAS (total alkali vs. silica) diagram of the analyzed samples.

Table S2. *Plagioclase composition.* Electron microprobe analyses on core-rim traverses on plagioclase. An%: anorthite content. Major elements in wt.%

Label	SiO ₂	TiO ₂	Al ₂ O ₃	FeO ^T	MgO	CaO	Na ₂ O	K ₂ O	tot	K/Ca	Ca	K	An %
PL54-plg1_1	50.06	0.06	30.38	0.64	0.14	14.45	3.20	0.17	99.10	0.014	0.71	0.01	70.70
PL54-plg1_2	49.13	0.05	31.18	0.66	0.13	15.48	2.65	0.09	99.37	0.007	0.77	0.01	75.98
PL54-plg1_3	48.97	0.03	31.24	0.62	0.12	15.46	2.62	0.13	99.19	0.010	0.77	0.01	75.96
PL54-plg1_4	50.23	0.07	29.30	1.21	0.33	13.53	3.38	0.19	98.24	0.017	0.68	0.01	68.10
PL54-plg1_5	50.60	0.07	29.84	0.70	0.18	13.84	3.53	0.18	98.94	0.016	0.68	0.01	67.68
PL54-plg1_6	50.90	0.05	29.79	0.61	0.14	13.81	3.55	0.13	98.98	0.011	0.68	0.01	67.76
PL54-plg1_7	51.31	0.08	29.44	0.60	0.14	13.45	3.79	0.19	99.00	0.017	0.66	0.01	65.48
PL54-plg1_8	51.66	0.08	29.10	0.61	0.16	13.06	3.91	0.23	98.81	0.021	0.64	0.01	63.99
PL54-plg1_9	51.51	0.09	29.28	0.67	0.12	13.17	3.86	0.20	98.90	0.018	0.65	0.01	64.58
PL54-plg1_10	52.34	0.06	29.21	0.72	0.10	12.98	3.97	0.24	99.62	0.022	0.64	0.01	63.44
PL54-plg1_11	52.19	0.11	28.97	0.93	0.11	12.83	3.93	0.24	99.31	0.022	0.63	0.01	63.46
PL54-plg1_12	51.72	0.09	28.87	0.78	0.11	12.88	3.90	0.27	98.62	0.025	0.64	0.02	63.60
PL54-plg2_1	51.75	0.06	29.40	0.56	0.18	13.21	3.84	0.23	99.23	0.020	0.65	0.01	64.67
PL54-plg2_2	51.60	0.05	29.22	0.63	0.18	13.27	3.85	0.16	98.96	0.014	0.65	0.01	64.95
PL54-plg2_3	51.82	0.09	29.07	0.56	0.19	13.26	3.76	0.20	98.95	0.018	0.65	0.01	65.34
PL54-plg2_4	51.73	0.05	29.51	0.58	0.18	13.35	3.76	0.22	99.38	0.020	0.66	0.01	65.39
PL54-plg2_5	52.22	0.10	29.04	0.59	0.16	12.95	4.02	0.20	99.28	0.019	0.64	0.01	63.29
PL54-plg2_6	52.28	0.07	29.12	0.62	0.16	12.99	3.95	0.19	99.38	0.018	0.64	0.01	63.78
PL54-plg2_7	51.27	0.09	29.66	0.58	0.17	13.34	3.75	0.16	99.02	0.014	0.66	0.01	65.64
PL54-plg2_8	51.82	0.06	29.45	0.62	0.17	13.26	3.75	0.16	99.29	0.015	0.65	0.01	65.53
PL54-plg2_9	52.67	0.10	29.15	0.59	0.19	12.63	4.11	0.23	99.67	0.022	0.62	0.01	62.07
PL54-plg2_10	51.81	0.09	29.46	0.65	0.18	13.35	3.73	0.19	99.46	0.017	0.65	0.01	65.71
PL54-plg2_11	50.87	0.10	29.01	0.56	0.15	13.72	3.66	0.19	98.26	0.016	0.68	0.01	66.73
PL54-plg2_12	50.49	0.06	29.55	0.68	0.12	13.97	3.50	0.17	98.54	0.014	0.69	0.01	68.13
PL61-plg1_1	50.72	0.10	30.02	0.69	0.13	13.86	3.45	0.27	99.24	0.023	0.68	0.02	67.84
PL61-plg1_2	50.70	0.10	29.71	0.57	0.16	13.78	3.48	0.27	98.77	0.023	0.68	0.02	67.56
PL61-plg1_3	50.77	0.11	30.01	0.56	0.13	13.96	3.50	0.27	99.31	0.023	0.69	0.02	67.74
PL61-plg1_4	50.56	0.10	29.98	0.62	0.17	13.98	3.43	0.27	99.11	0.023	0.69	0.02	68.15
PL61-plg1_5	50.85	0.11	29.01	0.85	0.95	13.30	3.32	0.27	98.66	0.024	0.66	0.02	67.72
PL61-plg1_6	50.63	0.13	29.85	0.59	0.15	13.78	3.47	0.26	98.86	0.022	0.68	0.02	67.64
PL61-plg1_7	50.77	0.09	29.85	0.68	0.16	13.69	3.51	0.28	99.03	0.024	0.68	0.02	67.19
PL61-plg1_8	50.23	0.10	29.68	0.81	0.46	13.76	3.39	0.28	98.71	0.024	0.68	0.02	68.06
PL61-plg1_9	51.13	0.12	29.52	0.60	0.14	13.55	3.57	0.28	98.91	0.024	0.67	0.02	66.60
PL61-plg1_10	50.25	0.11	29.20	1.35	1.19	13.22	3.30	0.27	98.89	0.025	0.66	0.02	67.71

Table S2. Continued

Label	SiO ₂	TiO ₂	Al ₂ O ₃	FeO ^T	MgO	CaO	Na ₂ O	K ₂ O	tot	K/Ca	Ca	K	An %
PL61-plg3_1	50.70	0.08	29.88	0.56	0.14	13.66	3.45	0.29	98.76	0.025	0.68	0.02	67.49
PL61-plg3_2	50.82	0.13	29.69	0.62	0.15	13.66	3.63	0.30	99.00	0.026	0.68	0.02	66.35
PL61-plg3_3	51.40	0.15	29.32	0.54	0.14	13.36	3.79	0.32	99.02	0.028	0.66	0.02	64.86
PL61-plg3_4	51.14	0.10	29.87	0.64	0.13	13.67	3.55	0.26	99.36	0.022	0.67	0.01	67.04
PL61-plg3_5	50.89	0.09	29.52	0.59	0.16	13.54	3.53	0.30	98.62	0.026	0.67	0.02	66.71
PL61-plg3_6	50.32	0.14	29.85	0.57	0.13	14.01	3.30	0.28	98.6	0.024	0.70	0.02	68.96
PL61-plg3_7	50.93	0.08	29.81	0.58	0.14	13.72	3.45	0.25	98.96	0.022	0.68	0.01	67.69
PL61-plg3_8	51.81	0.10	30.11	0.67	0.31	13.31	3.27	0.27	99.85	0.024	0.65	0.02	68.11
PL61-plg3_9	50.51	0.10	29.81	0.58	0.14	13.73	3.37	0.28	98.52	0.025	0.68	0.02	68.10
PL61-plg3_10	50.69	0.13	29.64	0.63	0.15	13.82	3.56	0.28	98.90	0.024	0.68	0.02	67.10
PL61-plg3_11	50.90	0.15	29.13	0.89	0.66	13.24	3.48	0.29	98.74	0.026	0.66	0.02	66.61
PL61-plg3_12	50.97	0.14	29.51	0.62	0.14	13.49	3.76	0.27	98.90	0.024	0.67	0.02	65.44
PL61-plg3_13	50.91	0.09	29.78	0.62	0.13	13.84	3.62	0.31	99.30	0.027	0.68	0.02	66.64
PL61-plg3_14	50.50	0.13	29.56	0.75	0.36	13.55	3.55	0.29	98.69	0.025	0.67	0.02	66.71
PL61-plg3_15	50.54	0.11	29.86	0.62	0.13	13.74	3.53	0.30	98.83	0.026	0.68	0.02	67.08
PL63-plg4_1	54.32	0.05	26.83	0.41	0.08	11.47	5.25	0.43	98.84	0.045	0.56	0.03	53.41
PL63-plg4_2	55.56	0.06	26.68	0.37	0.01	9.85	5.46	0.52	98.51	0.063	0.48	0.03	48.38
PL63-plg4_3	55.86	0.07	26.72	0.38	0.03	9.59	5.60	0.61	98.86	0.076	0.47	0.04	46.90
PL63-plg4_4	56.18	0.07	26.69	0.36	0.03	9.41	5.64	0.56	98.94	0.071	0.46	0.03	46.40
PL63-plg4_5	55.62	0.04	27.08	0.38	0.04	9.77	5.52	0.53	98.98	0.065	0.48	0.03	47.91
PL63-plg4_6	55.84	0.04	26.66	0.30	0.03	9.58	5.71	0.53	98.69	0.066	0.47	0.03	46.61
PL63-plg4_7	55.89	0.06	26.65	0.35	0.05	9.53	5.59	0.58	98.70	0.073	0.47	0.03	46.87
PL63-plg4_8	55.03	0.05	25.10	2.01	0.27	9.14	5.32	0.54	97.46	0.070	0.46	0.03	47.11
PL63-plg4_9	55.55	0.04	26.29	0.42	0.05	9.55	5.59	0.51	98.00	0.064	0.47	0.03	47.10
PL63-plg4_10	56.13	0.05	26.34	0.40	0.05	9.16	5.84	0.61	98.58	0.079	0.45	0.04	44.77
PL63-plg4_11	56.17	0.05	26.18	0.42	0.03	9.19	5.82	0.58	98.44	0.076	0.45	0.03	45.02
PL63-plg4_12	56.49	0.03	26.09	0.40	0.03	9.19	5.86	0.55	98.64	0.071	0.45	0.03	44.95
PL63-plg4_13	56.36	0.01	26.16	0.40	0.02	9.16	5.78	0.62	98.51	0.081	0.45	0.04	45.00
PL63-plg4_14	56.36	0.05	26.04	0.47	0.02	8.81	5.94	0.59	98.28	0.079	0.43	0.03	43.49
PL63-plg4_15	56.79	0.04	25.44	0.76	0.05	8.54	6.01	0.71	98.34	0.099	0.42	0.04	42.16
PL63-plg5_1	56.63	0.02	26.09	0.48	0.03	8.95	5.87	0.60	98.67	0.080	0.44	0.04	44.10
PL63-plg5_2	56.73	0.02	26.01	0.34	0.06	8.82	5.96	0.69	98.63	0.093	0.43	0.04	43.18
PL63-plg5_3	57.51	0.03	25.72	0.39	0.05	8.50	6.17	0.71	99.08	0.099	0.41	0.04	41.46
PL63-plg5_4	57.70	0.01	25.37	0.42	0.04	8.22	6.28	0.68	98.72	0.099	0.40	0.04	40.29
PL63-plg5_5	57.47	0.06	25.66	0.37	0.05	8.56	6.05	0.71	98.93	0.099	0.42	0.04	42.04
PL63-plg5_6	56.89	0.04	26.25	0.40	0.05	8.97	5.73	0.58	98.91	0.077	0.44	0.03	44.77
PL63-plg5_7	56.95	0.03	25.99	0.40	0.04	8.71	6.00	0.65	98.77	0.088	0.42	0.04	42.83
PL63-plg5_8	55.47	0.06	25.19	0.59	0.08	9.90	5.85	0.64	97.78	0.077	0.49	0.04	46.58
PL63-plg5_9	56.91	0.02	26.15	0.41	0.05	8.91	5.92	0.67	99.04	0.089	0.43	0.04	43.66
PL63-plg5_10	56.66	0.05	26.16	0.36	0.05	8.91	5.80	0.71	98.7	0.095	0.43	0.04	44.01

Table S3. Amphibole composition of sample PL2. Electron microprobe analyses. Major element in wt.%

Label	SiO ₂	TiO ₂	Al ₂ O ₃	FeO ^T	MnO	MgO	CaO	Na ₂ O	K ₂ O	Cr ₂ O ₃	Tot.
PL2-amph2_1	38.94	3.08	11.02	23.71	0.57	5.58	10.90	2.38	1.67	0.04	97.88
PL2-amph2_2	38.84	3.06	11.02	23.76	0.62	5.40	10.86	2.25	1.68	0.00	97.48
PL2-amph2_3	39.01	3.01	11.23	23.99	0.65	5.41	10.77	2.24	1.65	0.05	98.02
PL2-amph2_4	38.77	3.01	10.86	23.70	0.63	5.22	11.04	2.38	1.73	0.00	97.33
PL2-amph2_5	38.68	2.98	10.85	23.83	0.59	5.28	10.90	2.53	1.68	0.03	97.36
PL2-amph2_6	38.44	2.77	10.99	25.42	0.61	4.49	10.80	2.32	1.61	0.05	97.49
PL2-amph2_7	38.42	2.51	10.79	26.93	0.71	3.59	10.61	2.45	1.67	0.02	97.68
PL2-amph2_8	37.98	2.37	10.71	27.47	0.78	3.09	10.63	2.60	1.58	0.01	97.23
PL2-amph2_9	37.11	1.56	10.97	29.51	1.15	1.41	10.31	2.72	1.61	0.01	96.38
PL2-amph2b_1	37.32	1.47	11.09	30.01	1.16	1.42	10.22	2.69	1.58	0.00	96.96
PL2-amph2b_2	37.43	1.34	11.14	30.00	1.21	1.37	10.25	2.69	1.62	0.01	97.05
PL2-amph2b_3	36.90	1.37	11.16	30.41	1.20	1.37	10.06	2.57	1.63	0.00	96.68
PL2-amph2b_4	36.96	1.03	11.16	30.90	1.18	1.23	10.05	2.66	1.68	0.00	96.84
PL2-amph2b_5	37.10	0.87	11.21	30.79	1.27	0.99	10.04	2.69	1.62	0.00	96.58
PL2-amph2b_6	37.32	0.86	11.02	30.85	1.27	0.94	10.00	2.70	1.73	0.01	96.70
PL2-amph2b_7	37.36	0.85	10.76	30.94	1.27	1.00	10.08	2.73	1.72	0.01	96.72
PL2-amph2b_8	40.78	0.84	12.62	29.07	1.31	0.87	9.21	2.27	1.42	0.00	98.40
PL2-amph2b_9	37.24	0.91	10.32	30.05	1.86	1.07	9.88	2.98	1.58	0.00	95.89

Table S4. Biotite composition. Electron microprobe analyses . Major elements in wt.%

Label	SiO ₂	TiO ₂	Al ₂ O ₃	FeO ^T	MnO	MgO	CaO	Na ₂ O	K ₂ O	Cr ₂ O ₃	tot
PL3-bt1_1	33.88	6.56	15.70	12.23	0.09	14.68	0.02	0.64	8.02	0.03	91.86
PL3-bt1_2	33.97	6.40	15.82	12.34	0.07	14.92	0.02	0.73	7.98	0.01	92.27
PL3-bt1_3	33.40	6.86	15.97	12.10	0.06	14.33	0.01	0.67	7.36	0.00	90.76
PL9-bt1_1	37.88	4.48	14.35	10.39	0.04	18.65	0.04	0.20	9.44	0.03	95.49
PL9-bt1_2	36.61	3.92	14.47	12.56	0.13	18.09	0.06	0.19	7.81	0.02	93.86
PL9-bt1_3	37.56	4.84	14.56	10.64	0.05	18.14	0.02	0.19	9.43	0.02	95.47
PL20-bt1	37.03	6.86	13.27	15.41	na	13.48	0.07	0.10	9.64	na	95.86
PL20-bt2	38.92	3.80	14.64	8.49	na	19.06	0.11	0.31	9.73	na	95.05