Table 1. Chemical and isotopic analyses of spring water from Ugashik caldera and locally derived meteoric water (LDMW) Analyst, R. Barnes, U.S. Geological Survey, 1973.

	Spring LDMW 1031B73	
Field No.	(in parts per million)	1031B73M
SiO_2	56	14
Rb	0.1	--
Ca	18	3.4
Mg	8.5	0.6
Na	28	<0.01
K	2.6	24
Li	0.07	2.8
HCO_3	164.2	24
SO_4	<0.2	2.8
Cl	17	2.7
F	0.1	<0.1
B	0.31	<0.02
pH	5.22	6.9
0^{18}	-12.67	-12.36
D	-90.8	-88.8
Temp $10^{O}C$		--

Table 2. Analytical data for potassium-argon age measurement on Ugashik caldera dacite.

Sample No.	Material Dated	K_2O^* (wt%)	Wt. (gm)	Ar $^{40}100_{rad}$ (mol/gm)	$^{40}Ar_{rad}$ / ^{40}Ar	Calculated age (ka)
75ALe36	Dacite	1.60 ± 0.04	14.504 15.439	0.4284 0.3855	4.8 6.7	171 ± 22

Petrographic Description of Analyzed Samples.

Ugashik caldera

1) Dense fine-grained hornblende dacite porphyry.
2) Porphyritic plagioclase-orthopyroxene dacite. Glassy groundmass with phenocrysts of weakly zoned plagioclase (An64-68) and orthopyroxene.
3) Pale-red vesicular, porphyritic dacite. Oscillatory-zoned plagioclase (An60-72), orthopyroxene, and rare clinopyroxene in fine-grained groundmass of glass and plagioclase microlites.
4) Vitric clast. Porphyritic plagioclase-pyroxene-hornblende dacite. Glassy groundmass contains abundant randomly oriented phenocrysts of plagioclase (An70), clinopyroxene, hornblende (altered), and biotite (altered).
5) Porphyritic hornblende dacite. Phenocrysts of normal and oscillatory-zoned plagioclase (26%), hornblende (4%), orthopyroxene (0.7%), clinopyroxene (0.5%), biotite (0.5%), and metallics (2.2%) in a fine-grained felsic groundmass (74%). Scarce olivine; less than 2% vesicles.
6) Hornblende-clinopyroxene-orthopyroxene-biotite porphyritic dacite. Phenocrysts of normal and oscillatory zoned plagioclase (27%), hornblende (3%), clinopyroxene (2%), orthopyroxene (1%), and biotite (2%) in fine-grained groundmass (59%) of felsic material and pale-brown glass. Trace of olivine and metallic oxides.
7) Light-gray vesicular biotite-plagioclase dacite porphyry. Plagioclase, biotite, quartz, hornblende, and orthopyroxene phenocrysts in a glassy groundmass.
8) Porphyritic hornblende-biotite dacite. Flow-foliated glassy groundmass contains rounded phenocrysts of plagioclase and quartz . Phenocrysts are plagioclase (19%; An54), quartz (4%), dark-green hornblende (3%), lesser biotite, and scarce orthopyroxene.
9) Porphyritic hornblende dacite. Phenocrysts of plagioclase (21%), quartz (6%), hornblende (3%), and trace amounts of biotite and orthopyroxene in a slightly vesiculated (6%) felsic groundmass (60%) with minor glass.
10) Fine-grained hornblende dacite. Phenocrysts (13%) of plagioclase (10%), hornblende (2%), and trace quartz and biotite in a fine-grained felsic groundmass (85%).
11) Fine-grained hornblende dacite.
12) Fine-grained dacite. Phenocrysts of plagioclase (9%) with trace hornblende, biotite, orthopyroxene, and metallic oxides in a fine-grained felsic groundmass (80%).
13) Fine-grained hornblende dacite.
14) Fine-grained hornblende dacite. Phenocrysts of plagioclase (5%), hornblende (2%), and trace biotite and metallic oxides in a fine-grained felsic groundmass.
15) Light-colored very fine-grained hornblende-biotite dacite. Phenocrysts (15%) of plagioclase (14%) and minor biotite and hornblende with trace quartz in a cryptocrystalline felsic groundmass.

Mount Peulik volcano

16) Porphyritic basalt. Phenocrysts of plagioclase (An65; 39%), olivine (4%), and clinopyroxene (1%) in a microlitic felspar groundmass.
17) Porphyritic andesitic basalt. Phenocrysts of plagioclase (An60; 30%), olivine, and trace clinopyroxene and metallic oxides in a groundmass of clear-brown glass and plagioclase microlites.
18) Two-pyroxene vesicular andesite. Phenocrysts of plagioclase (19%), hornblende (2%), and trace clinopyroxene, orthopyroxene, olivine, and quartz in a microlite-rich groundmass (60%).
19) Porphyritic andesite. Phenocrysts of plagioclase (23%) and orthopyroxene (11%) with trace biotite olivine and metallic oxides in a groundmass (40%) of pale brown glass.
20) Porphyritic two-pyroxene andesite. Phenocrysts of plagioclase (28%), orthopyroxene (7%), clinopyroxene (2%), and trace olivine in a groundmass (40%) of pale-brown glass.
21) Porphyritic two-pyroxene andesite. Phenocrysts of plagioclase (37%), orthopyroxene (6%), and clinopyroxene (3%) with trace olivine in a groundmass of pale-brown glass.
22) Porphyritic two-pyroxene andesite. Phenocrysts of plagioclase (21%), orthopyroxene (7%), and clinopyroxene (6%) in a groundmass of pale-brown glass.
23) Porphyritic two-pyroxene vesicular andesite. Phenocrysts of plagioclase (35%), orthopyroxene (6%), and clinopyroxene (4%) in a groundmass of pale-brown glass (50%).
24) Porphyritic orthopyroxene andesite. Phenocrysts of plagioclase (36%) and orthopyroxene (9%) with trace clinopyroxene and olivine in a groundmass of pale-brown glass.

Summit dome

25) Porphyritic hornblende-biotite dacite. Phenocrysts of hornblende (with altered opaque rims), plagioclase, and rare quartz in a cryptocrystalline groundmass.
26) Porphyritic hornblende-biotite dacite. Phenocrysts of hornblende (with altered opaque rims), plagioclase, and rare quartz in a felsic cryptocrystalline groundmass.
27) Porphyritic hornblende-biotite dacite. Phenocrysts chiefly plagioclase with hornblende and biotite in a vesiculated cryptocrystalline felsic groundmass.
28) Dome material from debris-avalanche deposit. Porphyritic hornblende-biotite dacite. Phenocrysts of plagioclase, brown hornblende, red biotite, and scarce quartz and orthopyroxene in a fine-grained felsic groundmass.

Debris-avalanche deposits from east dome

29) Glassy porphyritic hornblende-biotite dacite. Phenocrysts of plagioclase, brown hornblende, red biotite, and scarce quartz in a dense glass groundmass.
30) Porphyritic hornblende-biotite dacite vitrophyre.

Table 3. Major element (in weight percent, nd = not determind) and trace element (in parts per million) composition of Ugashik and Mount Peulik Volcanic rocks.

	Pre-caldera rocks						Intracaldera Dome Complex								
							Dome 1				Dome 2			Dome 3	
Map No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Field No.	75AM60	81AR11A	81AW269	81AR11B7	9AM43	79AM44	81AW271	81AR13	79AM55	79AM54A	79AM54B	79AM54C	73AM45	73AM28B	74AM51C
Unit	Quf	Quf	Quf	Qub	Qub	Qub	Qud	Qud	Qud	Qud	Qud	Qud	Qud	Qud	Qud
Major Elements															
SiO_2	58.6	59.4	60.1	61.4	61.5	61.4	65.5	66.4	66.5	66.9	67.7	64.2	66.5	66.1	71.9
Al_2O	17.5	17.3	17.5	17.4	16.8	16.7	16.6	16.3	16.1	16.3	16.0	16.6	16	16.3	15
FeO	3.48	4.78	5.15	3.35	0.19	2.30	1.96	1.78	2.50	2.20	1.80	1.90	2.20	2.10	1.00
Fe_2O_3	3.09	1.20	1.07	1.67	5.10	3.00	2.36	2.14	1.80	1.9	1.90	2.80	1.60	2.10	1.40
MgO	3.80	2.75	3.15	2.68	2.70	2.70	1.71	1.49	1.80	1.5	1.40	1.80	1.40	1.60	0.70
CaO	7.34	6.63	6.97	6.29	6.10	6.00	4.79	4.44	4.60	4.50	4.10	4.90	4.30	4.40	2.90
Na_2O	3.40	3.31	3.42	3.30	3.50	3.60	3.74	3.75	3.80	4.00	4.00	3.70	4.00	3.30	4.30
K_2O	1.27	1.36	1.32	1.43	1.60	1.60	1.77	2.79	1.70	1.80	1.90	1.70	1.80	1.80	2.10
H_2O+	0.40	nd	0.09	nd	0.29	0.55	0.28	nd	0.52	0.55	0.39	0.73	0.25	1.10	0.43
H_2O-	0.12	nd	0.02	nd	0.22	0.43	0.10	nd	0.13	0.12	0.24	0.41	0.23	0.29	0.56
TiO_2	0.64	0.59	0.56	0.58	0.56	0.54	0.42	0.39	0.40	0.34	0.30	0.38	0.32	0.39	0.15
P_2O_5	0.10	0.16	0.17	0.14	0.12	0.11	0.13	0.12	0.10	0.18	0.19	0.23	0.20	0.19	0.11
MnO	0.14	0.13	0.15	0.12	0.13	0.14	0.13	0.12	0.16	0.16	0.17	0.16	0.16	0.16	0.12
CO_2	0.36	nd	0.08	nd	0.69	0.76	0.72	nd	0.08	0.27	0.33	0.63	0.27	0.01	0.01
Cl_2	nd	nd	nd	nd	0.00	0.01	nd	nd	0.05	0.02	0.02	0.03	0.01	nd	nd
F	nd	nd	nd	nd	0.02	0.03	nd	nd	0.02	0.03	0.03	0.04	0.02	nd	nd
SiO_2 (vol.free)	59.1	60.9	60.4	62.4	62.6	62.6	66.1	67.3	66.9	67.0	68.1	65.3	67.5	67.2	72.1
Trace Elements															
Rb	32	nd	30	nd	42	48	nd	nd	45	51	48	48	nd	35	54
Sr	417	nd	400	nd	393	407	nd	nd	345	439	396	436	nd	302	301
Ba	455	nd	530	nd	564	589	nd	nd	647	765	765	731	nd	562	758
Zr	123	nd	130	nd	142	153	nd	nd	117	135	131	128	nd	103	118
Nb	<10	nd	<10	nd	<10	11	nd	nd	15	11	11	<10	nd	<10	<10
La	11	nd	30	nd	22	22	nd	nd	22	31	25	10	nd	13	15
Ce	24	nd	42	nd	26	38	nd	nd	39	52	50	38	nd	38	35
Y	16	nd	16	nd	16	18	nd	nd	20	24	17	20	nd	13	16
Cr	47	nd	20	nd	28	31	nd	nd	<20	<20	<20	<20	nd	<20	<20
Ni	22	nd	14	nd	11	10	nd	nd	<10	<10	11	<10	nd	<10	<10
Cu	38	nd	40	nd	24	20	nd	nd	12	<10	12	<10	nd	186	<10
Zn	64	nd	60	nd	61	58	nd	nd	59	59	69	81	nd	75	40

	Cone-Building Lava Flows									Summit Dome		Pyroclastic Flow Deposits	Debris Avalanche	East Dome Debris Avalanche	
Map No.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Field No.	79AM36	79AM50	73AM31	73AM30	79AM41	79AM75	79AM47	79AM40	79AM52	75AM75A	74AM53	74AM54	79AM31	79AM46	79AM46A
Unit	Qpc	Qpoc	Qb	Qpc	Qpc	Qpc	Qpff	Qpc	Qpc	Qpds	Qpds	Qpda	Qpda	Qpda	Qpda
Major Elements															
SiO_2	58.6	52.6	53.3	53.4	53.6	54.4	54.5	55.2	56.8	65.4	66.2	65.9	67.1	67.1	68.6
Al_2O	17.5	20	18.9	18.4	18.5	18.7	18.41	8.3	18.5	16.9	16.5	16.6	15.9	15.9	15.4
FeO	3.48	2.14	3.30	2.30	6.20	2.80	3.20	2.70	2.70	3.20	1.50	1.50	3.70	3.70	1.30
Fe_2O_3	3.09	6.29	6.00	6.00	2.50	5.30	5.20	5.30	4.80	0.84	2.40	2.40	0.22	0.22	1.90
MgO	3.80	4.30	4.10	5.30	5.10	4.80	4.70	4.20	4.00	1.40	1.20	1.20	1.50	1.50	1.20
CaO	7.34	10.30	8.10	8.80	8.90	8.80	8.70	8.20	8.20	4.60	4.60	9.80	4.10	4.10	3.80
Na_2O	3.40	2.60	2.70	2.60	3.10	3.10	3.10	3.10	3.20	4.30	4.40	4.20	4.10	4.10	4.00
K_2O	1.27	0.90	1.00	0.91	0.88	1.00	0.96	1.10	0.92	1.70	1.60	1.60	1.80	1.80	1.90
H_2O+	0.40	0.48	0.56	0.49	0.24	0.21	0.52	0.17	0.26	0.40	0.73	0.90	0.10	0.10	0.32
H_2O-	0.12	0.18	0.20	0.12	0.16	0.31	0.17	0.17	0.13	0.23	0.27	0.40	0.16	0.16	0.08
TiO_2	0.64	0.96	0.94	0.81	0.82	0.80	0.83	0.81	0.71	0.38	0.37	0.33	0.40	0.40	0.31
P_2O_5	0.10	0.20	0.22	0.18	0.15	0.15	0.14	0.17	0.14	0.18	0.22	0.22	0.11	0.11	<10
MnO	0.14	0.14	0.20	0.20	0.17	0.15	0.16	0.16	0.15	0.14	0.14	0.15	0.13	0.13	0.13
CO_2	0.36	0.22	<0.05	<0.05	0.13	0.11	0.12	0.10	0.17	0.53	0.02	0.01	0.22	0.22	0.22
Cl_2	nd	0.05	nd	nd	0.03	0.04	0.06	0.06	0.04	0.02	nd	nd	0.00	0.00	0.00
F	nd	0.04	nd	nd	0.03	0.03	0.03	0.03	0.03	0.03	nd	nd	0.02	0.02	0.02
SiO_2 (vol.free)	59.1	52.2	54.0	54.0	54.0	54.4	54.5	55.6	56.7	66.0	66.8	66.6	67.7	67.7	69.5
Trace Elements															
Rb	19	14	28	23	18	30	19	26	16	44	38	38	45	nd	53
Sr	447	401	412	371	374	439	355	458	372	421	395	405	319	nd	314
Ba	340	350	276	277	364	365	371	399	421	596	534	523	697	nd	752
Zr	85	73	107	91	100	111	94	115	101	165	159	161	132	nd	131
Nb	<10	<10	<10	<10	<10	11	<10	<10	<10	<10	<10	<10	10	nd	11
La	14	16	<10	<10	20	20	23	21	20	29	16	15	23	nd	32
Ce	10	26	29	23	19	26	21	26	22	46	37	39	26	nd	47
Y	19	16	19	17	21	20	17	17	17	22	17	19	18	nd	17
Cr	57	56	<20	56	63	45	71	40	41	<20	<20	<20	<20	nd	<20
Ni	15	16	<10	30	37	15	30	16	16	<10	<10	<10	<10	nd	<10
Cu	50	69	11	29	30	26	42	38	33	<10	<10	<10	16	nd	11
Zn	64	84	81	70	78	72	74	78	71	66	72	72	56	nd	55

Major element analysis by USGS X-ray spectrscopy methods (XRF), analysts: J.S. Wahlberg, J. Taggart, J. Baker, and by rapid rock methods (FeO, H_2O+, H_2O-, CO_2), analyst: B. Lai.
Trace element analysis by USGS Energy Dispersive XRF methods, analyst: Zone Ann Brown and John Evans. Samples 2, 3, 4, 7, and 8 are from Wilson and Shew (1992).

GEOLOGY OF THE UGASHIK-MOUNT PEULIK VOLCANIC CENTER, ALASKA

by
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