Crater Lake, in southwestern Oregon, is not only known for its unequaled beauty and splendor, but is also an area of particularly unusual geologic significance. Crater Lake was once occupied by the summit of Mount Mazama, a composite cone consisting of rocks dacitic to andesitic in composition and towering to an elevation of more than 12,000 feet. This great volcano discharged tremendous volumes of ash and lava which, along with subterranean withdrawals, caused the mountaintop to collapse, creating the caldera that now contains Crater Lake. Subsequent eruptions produced Wizard Island, a dacite dome, and Merriam Cone within the caldera. The former and latter are cinder cones and only the former arises above the lake level. The lake is 6 miles wide, 1,932 feet deep, and has 20 miles of shoreline with the surrounding cliffs rising as much as 1,980 feet to the uneven caldera rim, which ranges from 6,683 to 8,156 feet in elevation.

The purpose of this research was to semi-quantitatively analyze by X-ray diffraction the clay, silt, and sand fractions of sediment samples acquired from selected portions of the bottom of Crater Lake.[1] The sample (numbered), its location and water depth are provided in the following list. (See accompanying map for visual locations)

SAMPLE	LOCATION	DEPTH
60B 60C 60M 60T	Southwest basin Off Eagle Point	1400-1700 ft.
46T 47T 47B	Deepest portion of the lake, west of Skell Head	1900-1932 ft.
61A	Northeast-central basin	1790 ft.
64B	Basin northeast of Wizard Island approaching the west slope of the dacite dome	300 ft.
69	Southeast slope of Merriam Cone	1170 ft.
64	Northeast side of Wizard Island	30 ft.
27	In Cloudcap Bay	1530 ft.

1. The samples were kindly furnished by Hans Nelson, Naturalist, Crater Lake National Park, Oregon.

43	Between Merriam Cone and Cleetwood Cove	960 ft.
39	East of Pumice Point	30 ft.
54	Between Pumice Point and Merriam Cone	700 ft.
11	South end of Grotto Cove	20 ft.
25	South end of Cloudcap Bay	10 ft.

The sand fraction of samples 11, 25, 60T, 54, 61A, 69, 64 was analyzed only, while the remainder of the samples were subjected to clay and silt analysis and, where ample sample permitted, sand analysis.

Prepared and oriented samples were employed in the clay and silt analysis while the sand fractions were powdered and spread on glass slides with acetone added as the cohesive agent before being X-rayed. All samples were run at 1000 Range and 4 S.T.C.*

Results of the analysis are indicated in the following tables. Whewellite, produced during the preparation and treatment of the clay and silt fractions with sodium oxalate, has been omitted from the X-ray data. An attempt to differentiate between feldspar types was made in the sand fraction analysis only below $2\theta = 36$ due to lack of further data. Above $2\theta = 36$ feldspar peaks are denoted simply as plagioclase. Unidentifiable peaks, usually above $2\theta = 50$, are denoted with a question mark.

* Also -

H.R. slit
1° M.R. slit
50 K.Y.
15 M.A.

H.V. units - 6.3
Copper K alpha radiation with nickel filter

CLAY ANALYSIS

SAMPLE	2θ	dA	hkl	I/I	MINERAL
#60B					
	6.4	---	001	100	Montmorillonite
#60M					
	6.3	---	001	100	Montmorillonite
	19.9	4.45	110-020	90	Montmorillonite
	24.2	3.64	$13\bar{1}$	70	Labradorite
	27.9	3.20	040	100	Labradorite
#60C					
	5.8	---	001	100	Montmorillonite
	27.8	3.21	040	100	Andesine
#46T					
	6.3	---	$00\bar{1}$	100	Montmorillonite
	22	4.04	$20\bar{1}$	80	Labrad. or Andes.
	27.9	3.20	040	100	Labradorite
#47T					
	6.3	---	$00\bar{1}$	100	Montmorillonite
	22	4.04	$20\bar{1}$	80	Labrad. or Andes.
	27.9	3.20	040	100	Labradorite
#47B					
	6.2	---	$00\bar{1}$	100	Montmorillonite
	21.9	4.04	$20\bar{1}$	80	Labrad. or Andes.
	27.8	3.21	040	100	Andesine
#64B					
	6.2	---	001	100	Montmorillonite
	22	4.04	$20\bar{1}$	80	Labrad. or Andes.
	27.8	3.21	040	100	Andesine
#27					
	6.2	---	001	100	Montmorillonite
	27.9	3.20	040	100	Labradorite
#43					
	6.2	---	001	100	Montmorillonite
	21.8	4.04	$20\bar{1}$	80	Labrad. or Andes.
	27.5	3.23	$2\bar{2}0$	80	Labradorite
#39					
	22	4.04	$20\bar{1}$	80	Labrad. or Andes.
	23.5	3.76	111	70	Andesine
	27.8	3.21	040	100	Andesine

* Montmorillonite is not apparent in this sample

SILT ANALYSIS

SAMPLE	2θ	dA	hkl	I/I	MINERAL
#60B					
	6.3	---	001	100	Montmorillonite
	19.9	4.45	110-020	90	Montmorillonite
	22	4.04	20$\bar{1}$	80	Labrad. or Andes.
	23.6	3.76	111	70	Andesine
	26.6	3.36	---	30	Hypersthene
	27.8	3.21	040	100	Andesine
	35.5	2.53	24$\bar{1}$	70	Labrad. or Andes.
#60M					
	22	4.04	20$\bar{1}$	80	Labrad. or Andes.
	23.6	3.76	111	70	Andesine
	26.6	3.36	---	30	Hypersthene
	27.8	3.21	040	100	Andesine
	30.4	2.93	04$\bar{1}$	70	Andesine
	35.6	2.53	241	70	Labrad. or Andes.
#60C					
	5.8	---	001	100	Montmorillonite
	21.8	4.04	20$\bar{1}$	80	Labrador. or Andes.
	23.5	3.76	111	70	Andesine
	26.6	3.36	---	30	Hypersthene
	27.6	3.23	220	80	Labradorite
#46T					
	21.9	4.04	20$\bar{1}$	80	Labrad. or Andes.
	23.5	3.76	111	70	Andesine
	26.5	3.36	---	30	Hypersthene
	27.7	3.21	040	100	Andesine
	35.5	2.53	24$\bar{1}$	70	Labrad. or Andes.
#47T					
	21.9	4.04	20$\bar{1}$	80	Labrad. or Andes.
	23.6	3.76	111	70	Andesine
	26.5	3.36	---	30	Hypersthene
	27.7	3.21	040	100	Andesine
	35.5	2.53	24$\bar{1}$	70	Labrad. or Andes.
#47B					
	21.9	4.04	20$\bar{1}$	80	Labrad. or Andes.
	23.6	3.76	111	70	Andesine
	27.7	3.21	040	100	Andesine
	35.5	2.53	24$\bar{1}$	70	Labrad. or Andes.

SAMPLE	2θ	dA	hkl	I/I	MINERAL
#64B					
	22	4.04	20$\bar{1}$	80	Labrad. or Andes.
	23.6	3.76	111	70	Andesine
	27.8	3.21	040	100	Andesine
#27					
	6.0	---	001	100	Montmorillonite
	21.9	4.04	20$\bar{1}$	80	Labrad. or Andes.
	23.6	3.76	111	70	Andesine
	26.6	3.36	---	30	Hypersthene
	27.7	3.21	040	100	Andesine
	35.5	2.53	24$\bar{1}$	70	Labrad. or Andes.
#43					
	22	4.04	20$\bar{1}$	80	Labrad. or Andes.
	23.6	3.76	111	70	Andesine
	27.7	3.21	040	100	Andesine
	35.5	2.53	24$\bar{1}$	70	Labrad. or Andes.
#39					
	22	4.04	20$\bar{1}$	80	Labrad. or Andes.
	23.6	3.76	111	70	Andesine
	27.7	3.21	040	100	Andesine
	35.5	2.53	24$\bar{1}$	100	Labrad. or Andes.

SAND ANALYSIS

SAMPLE	2θ	dA	hkl	I/I	MINERAL
#60C					
	5.5	---	00$\bar{1}$	100	Montmorillonite
	21.9	4.04	20$\bar{1}$	80	Labrad. or Andes.
	23.6	3.76	111	70	Andesine
	24.4	3.65	13$\bar{1}$	70	Andesine
	26.6	3.36	---	30	Hypersthene
	27.7	3.21	040	100	Andesine
	28.4	3.14	220	70	Labrad. or Andes.
	30.3	2.95	0$\bar{4}$1	70	Labradorite
	30.9	2.89	---	80	Hypersthene
	35.5	2.53	24$\bar{1}$	70	Labrad. or Andes.
	42.1				?
#60T					
	5.7	---	001	100	Montmorillonite
	19.8	4.45	110-020	90	Montmorillonite
	20.9	4.26	100	100	Quartz
	22	4.04	20$\bar{1}$	80	Andesine
	22.8	3.89	11$\bar{1}$	50	Labradorite
	23.6	3.76	111	70	Andesine
	24.5	3.65	13$\bar{1}$	70	Andesine
	26.6	3.343	101	100	Quartz
	28	3.18	002	90	Labrad. or Andes.
	30.4	2.93	0$\bar{4}$1	70	Andesine
	31.5	2.84	131	60	Andesine
	33				? Hornblende
	35.5	2.53	24$\bar{1}$	70	Labrad. or Andes.
#46T					
	13.5	6.48	1$\bar{1}$0	40	Labradorite
	21.8	4.04	20$\bar{1}$	80	Labrad. or Andes.
	23.5	3.76	111	70	Andesine
	24.3	3.64	13$\bar{1}$	70	Labrad. or Andes.
	27.6	3.23	2$\bar{2}$0	80	Labradorite
	29.6	3.02	1$\bar{3}$1	50	Labradorite
	30.2	2.95	0$\bar{4}$1	70	Labradorite
	30.8	2.89	---	80	Hypersthene
	33.6	2.66	$\bar{1}$32	60	Labradorite
	35.3	2.53	24$\bar{1}$	70	Labrad. or Andes.
	42.4	2.125	060	7	Plagioclase
	45	2.019	351	10	Hornblende
	51.4	1.776	312	3	Hornblende
	52.3				?
	53.5				?
	55.5	1.653	480	25	Hornblende
	59.8				?

SAMPLE	2θ	dA	hkl	I/I	MINERAL
#47T					
	13.7	6.48	$1\bar{1}0$	40	Labradorite
	18.8	4.68	$02\bar{1}$	40	Labradorite
	21.9	4.04	$20\bar{1}$	80	Labrad. or Andes.
	23.6	3.76	$1\bar{1}1$	70	Andesine
	27.7	3.23	$2\bar{2}0$	80	Labradorite
	28.3	3.14	220	70	Labrad. or Andes.
	30.3	2.95	$0\bar{4}1$	70	Labradorite
	31.4	2.84	$13\bar{1}$	60	Andesine
	35.5	2.53	$24\bar{1}$	70	Labrad. or Andes.
	49.6				?
	53.1				?
	51.5	1.776	312	3	Hornblende
#47B					
	13.7	6.48	$1\bar{1}0$	40	Labradorite
	21.8	4.04	$20\bar{1}$	80	Labradorite
	22.7	3.89	$1\bar{1}1$	50	Labradorite
	23.6	3.76	111	70	Andesine
	28	3.18	002	90	Labrad. or Andes.
	30.3	2.95	$0\bar{4}1$	70	Labradorite
	33.7	2.66	$\bar{1}32$	60	Labradorite
	35.5	2.53	$24\bar{1}$	70	Labrad. or Andes.
	41.3	2.19	042	3	Plagioclase
	42.5	2.125	060	7	Plagioclase
	51.5	1.776	312	3	Hornblende
	53.3				?
#27					
	13.8	6.41	$00\bar{1}$	50	Andesine
	21.8	4.04	$20\bar{1}$	80	Labrad. or Andes.
	23.6	3.76	111	70	Andesine
	24.3	3.65	$13\bar{1}$	70	Labrad. or Andes.
	26.5	3.36	---	30	Hypersthene
	28	3.18	002	90	Labrad. or Andes.
	30.3	2.95	$0\bar{4}1$	70	Labradorite
	31.4	2.84	131	60	Andesine
	35.5	2.53	$24\bar{1}$	70	Andesine
	36.7	2.44	$\bar{2}41$	3	Plagioclase
	42.8	2.11	---	50	Hypersthene
	47	1.93	$42\bar{1}$	1	Plagioclase
	52.7				?
	55.4				? Hornblende

SAMPLE	2θ	dA	hkl	I/I	MINERAL
#43					
	21.8	4.04	$20\bar{1}$	80	Labrad. or Andes.
	23.5	3.76	111	70	Andesine
	24.4	3.65	$13\bar{1}$	70	Andesine
	27.8	3.21	040	100	Andesine
	29.5	3.02	$1\bar{3}1$	50	Labradorite
	30.3	2.95	$0\bar{4}1$	70	Labradorite
	31.3	2.84	131	60	Andesine
	35.5	2.53	$24\bar{1}$	70	Labrad. or Andes.
	42.4	2.125	060	7	Plagioclase
	42.7	2.11	---	50	Hypersthene
	47	1.927	$42\bar{1}$	1	Plagioclase
	51.4	1.776	312	3	Hornblende
	53.1				?
	57.6	1.60	---	60	Hypersthene
#39					
	13.6	6.48	$1\bar{1}0$	40	Labradorite
	21.8	4.04	$20\bar{1}$	80	Labrad. or Andes.
	23.5	3.76	111	70	Andesine
	24.3	3.64	$13\bar{1}$	70	Labradorite
	27.6	3.23	$2\bar{2}0$	80	Labradorite
	28	3.18	002	90	Labrad. or Andes.
	30.2	2.95	$0\bar{4}1$	70	Labradorite
	30.5	2.93	$0\bar{4}1$	70	Andesine
	31.3	2.84	131	60	Andesine
	35.5	2.53	$24\bar{1}$	70	Labrad. or Andes.
	42				? Hornblende
	51.4	1.776	312	3	Hornblende
#54					
	13.6	6.48	$1\bar{1}0$	40	Labradorite
	21.8	4.04	$20\bar{1}$	80	Labrad. or Andes.
	23.6	3.76	111	70	Labrad. or Andes.
	24.4	3.65	$13\bar{1}$	70	Andesine
	27.8	3.21	040	100	Labrad. or Andes.
	30.2	2.95	$0\bar{4}1$	70	Labradorite
	31.3	2.84	131	60	Andesine
	35.5	2.53	$24\bar{1}$	70	Andesine
	36.5				? Plagioclase
	37	2.43	$15\bar{1}$	1	Plagioclase
	42				? Hornblende
	49.6				?
	50.8				?
	51.4	1.776	312	3	Hornblende
	53				?
	54.5	1.68	172	10	Hornblende
	62.3	1.49	---	80	Hypersthene
	68.5				?
	69				?

SAMPLE	2θ	dA	hkl	I/I	MINERAL
#61A					
	21.9	4.04	$20\bar{1}$	80	Labrad. or Andes.
	23.7	3.75	111	80	Labradorite
	27.9	3.20	040	100	Labradorite
	35.5	2.53	241	70	Labrad. or Andes.
	37.8				? Plagioclase
	39				? Plagioclase
	40.6	2.23	$\bar{2}42$	5	Hornblende
	47	1.927	421	1	Plagioclase
	50	1.82	---	3	Hornblende
	52.4				?
#69					
	13.7	6.48	$1\bar{1}0$	40	Labradorite
	22	4.04	201	80	Labrad. or Andes.
	22.8	3.88	$1\bar{1}1$	50	Labrad. or Andes.
	23.6	3.76	$11\bar{1}$	70	Andesine
	24.4	3.65	$13\bar{1}$	70	Andesine
	25.5	3.47	$11\bar{2}$	50	Labrad. or Andes.
	26.5	3.36	---	30	Hypersthene
	28	3.18	002	90	Labrad. or Andes.
	29.5	3.02	$1\bar{3}1$	50	Labradorite
	30.3	2.95	$0\bar{4}1$	70	Labradorite
	31.5	2.84	$\bar{1}31$	60	Andesine
	35.7	2.51	$\bar{2}41$	60	Labradorite
	42.4	2.125	060	7	Plagioclase
	51.4	1.776	312	3	Hornblende
	57.7				? Hypersthene
#11					
	13.6	6.48	$1\bar{1}0$	40	Labradorite
	21.8	4.04	$20\bar{1}$	80	Labrad. or Andes.
	23.6	3.76	111	70	Andesine
	27.6	3.23	$2\bar{2}0$	80	Labradorite
	28.4	3.02	220	70	Labrad. or Andes.
	30.2	2.95	$0\bar{4}1$	70	Labradorite
	31.4	2.84	$\bar{1}31$	60	Andesine
	33.5	2.66	$\bar{1}32$	60	Labradorite
	35.5	2.53	$24\bar{1}$	70	Labrad. or Andes.
	43.2				?
	48.5				?
	49.7				?
	51				?
	59.5				? Hornblende

SAMPLE	2θ	dA	hkl	I/I	MINERAL
#25					
	21.9	4.04	$20\bar{1}$	80	Labrad. or Andes.
	23.5	3.76	111	70	Andesine
	24.3	3.65	$13\bar{1}$	70	Labrad. or Andes.
	28	3.18	002	90	Labrad. or Andes.
	30.3	2.95	$0\bar{4}1$	70	Labradorite
	31	2.89	---	80	Hypersthene
	31.5	2.84	$13\bar{1}$	60	Andesine
	35.5	2.53	$24\bar{1}$	70	Labrad. or Andes.
	36.3				?
	45.5				?
	49.5				?
	51.1				?
	56.5				?
	69.5				?
#64					
	13.6	6.48	$1\bar{1}0$	40	Labradorite
	21.9	4.04	$20\bar{1}$	80	Labrad. or Andes.
	22.7	3.89	$1\bar{1}1$	50	Labradorite
	23.6	3.76	111	70	Andesine
	24.4	3.65	$13\bar{1}$	70	Andesine
	26.4	3.37	$\bar{1}12$	60	Labrad. or Andes.
	28	3.18	002	90	Labrad. or Andes.
	28.3	3.14	220	70	Labrad. or Andes.
	29.5	3.02	$1\bar{3}1$	50	Labradorite
	30.2	2.95	$0\bar{4}1$	70	Labradorite
	31.6	2.84	$13\bar{1}$	60	Andesine
	35.5	2.53	$24\bar{1}$	70	Labrad. or Andes.
	40.5				? Hornblende
	43				?
	50.8				?
	62				?
	65.9				?
	67.6				?

In general, the X-ray analysis did not show a particularly varied mineralogy from locale to locale. All samples, except #39, contained montmorillonite in varied amounts. The silt analysis displayed labradorite and andesine feldspar in mixed proportions as did the sand fractions with the exception that hypersthene and hornblende made their appearance in varied amounts. However, a point of interest which might be conducive to further study is the fact that the samples from the southwest basin off Eagle Point (those having the number 60) contained an abundance of montmorillonite. Montmorillonite was detected not only in the clay fraction but also in the silt and sand fractions. Andesine dominated over labradorite in these samples and one sample, 60T, contained quartz. On the other hand, the samples from the deepest portion of the lake (those having the numbers 46 and 47) contained very little montmorillonite and labradorite dominated over andesine.

Another future possibility might be an attempt to place relative dates (sequence of eruption) on Wizard Island, Merriam Cone, and the dacite dome by use of a parameter such as the feldspar-clay ratio.

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Miami University
1961