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Bathymetric, geophysical and geologic sample data from Medicine Lake, Siskiyou County, northern California

by

Jonathan R. Childs (1), Jacob B. Lowenstern (2) , R. Lawrence Phillips (1), Patrick Hart (1), James J. Rytuba (3), John A. Barron (2), Scott W. Starratt (2), and Sarah Spaulding (4)

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(1) Mail Stop 999, 345 Middlefield Road, Menlo Park, CA 94025 USA
(2) Mail Stop 910, 345 Middlefield Road, Menlo Park, CA 94025 USA
(3) Mail Stop 901, 345 Middlefield Road, Menlo Park, CA 94025 USA

(4) California Academy of Sciences, Dept. of IZ&G, Golden Gate Park, San Francisco, CA 94118 USA

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Figure A1: Location of Medicine Lake Volcano, California.

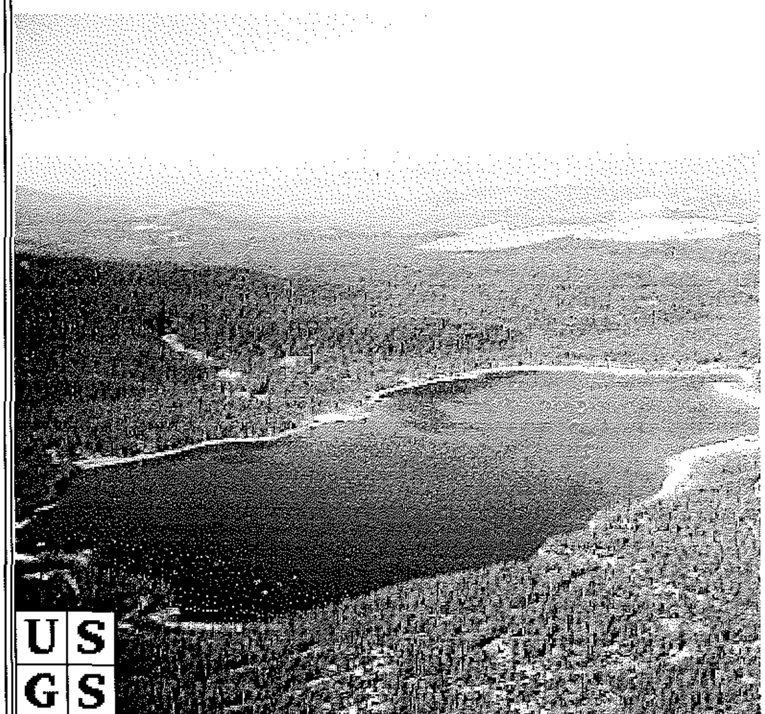

Figure A2: Aerial view of Medicine Lake from the northea
Donnelly-Nolan, USGS

About Medicine Lake in Septemb

Perimeter of Lake	6213 m or 20,380 ft
Area of Lake	1.65 square km = 408 acres
Volume of lake	13,400,000 cubic meters = 3.5 billio feet
Elevation of lake surface	2036m or 6680 feet
Greatest depth	46.4 m or 152.2 feet
Mean depth	7.3m or 23.9 feet
Median depth	4.9m or 16.1 feet

Introduction

In September, 1999, the U.S. Geological Survey acquired high-resolution bathymetry, seismic reflection profiles, and geologic sample data from Medicine Lake, a high altitude (2,036 m) lake located within the summit caldera/basin at Medicine Lake volcano (MLV), a dormant Quaternary shield volcano located in the Cascade Range, 50 km northeast of Mt. Shasta. It last erupted less than 1000 years ago.The purpose of this work was to assess whether sediments in the lake might provide a high-resolution record of the climate, volcanic and geochemical (particularly mercury) history of the region. We are still working with our data to assess whether the sediments are appropriate for further study. This report provides a summary of what we have learned to date.

Selected data products include:

- A bathymetric map of the lake (in meters).
- Another map with depth in feet.
- Forty high-resolution seismic reflection profiles of the lake, including seventeen acquired along east-west tracks, and twenty-three acquired along northeast-southwest tracks (see map with track lines).
- A temperature profile of the lake at its deepest point.
- A perspective-view of the lake bathymetry.
- Descriptions of nine sediment cores, ranging in depth from 10 to 100 cm, from various locations within the lake and surrounding environ.
- Map of sampling/coring locations.
- Mercury analyses of lakewater and sediment samples from the lake bottom.
- Description of diatoms and other microfossils found in lake water and sediments.
- Data for Downloading

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- Table 1. Information on core locations and characteristics.
- Table 2. Mercury and methyl mercury concentration in sediment from cores at Medicine Lake.
- Table 3. Analyses of mercury and methyl mercury in sediment samples from core number 6.
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- Appendix 2. Summary of seismic-reflection profile lines.
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- Figure A2. Photo of Medicine Lake from the northeast.
- Figure A3. Perspective view of the Medicine Lake highland and surrounding region.
- Figure A4. Perspective view of geology and topography around Medicine Lake.
- Figure B1: The Geopulse and Seistec sources towed behind boat.
- Figure B2: The Fast Eddy (Boston Whaler).

- Figure B3: Map 1: Bathymetric map of Medicine Lake contoured at 5-m intervals (also can be downloaded).
- Figure B4: Map 2: Bathymetric map of Medicine Lake contoured at 10-foot intervals (also can be downloaded).
- Figure B5: A 3-D perspective view of the lake bathymetry, as seen from the SW.
- Figure B6: Map 3: Track lines showing locations of seismic profiles.
- Figure B7: Representative seismic line (N-STrackline 210) near deep hole in lake.
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- Figure C1: Stratigraphy summary.
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- Figure C3: Map of sample locations (for sediment cores).
- Figure C4: Photo of hammer core #3.
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- Figure E1: Photo of the planktonic diatom Cyclotella.
- Figure E2: Photo of benthonic diatom Navicula.
- Figure E3: Photos of other planktonic diatoms.
- Figure E4: Photos of other benthonic diatoms.
- Figure E5: Photos of chrysophyte stomatocysts.

Geographic location, geologic setting, and physiographic environment of the Medicine Lake volcanic region are described at:

http://vulcan.wr.usgs.gov/Volcanoes/MedicineLake/framework.html
http://vulcan.wr.usgs.gov/Volcanoes/California/Maps/map_medlake_shasta.html
http://vulcan.wr.usgs.gov/Volcanoes/MedicineLake/Maps/map_lavabeds.html

Contacts

Jon Childs	Jake Lowenstern
U.S. Geological Survey	U.S. Geological Survey
M/S 999	M/S 910
345 Middlefield Rd.	345 Middlefield Rd.
Menlo Park CA 94025	Menlo Park CA 94025
(650) 329-5195	(650) 329-5238
jchilds@usgs.gov	jlwnstrn@usgs.gov

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BATHYMETRIC AND GEOPHYSICAL PROGRAM

Jon Childs and Patrick Hart

In order to determine the optimum location for sampling of lake-floor sediments, we undertook a program of bathymetric and geophysical profiling of the lake bottom. The bathymetric data, in essence, are a topographic map of the lake floor. We also collected seismic reflection profiles to look at the structure and thickness of sediments on the lake floor. The profiles can determine whether the sediments are neatly layered or chaotic and boulder-strewn.

The bathymetric, geophysical, and lake sampling programs were conducted from a 22-foot whaler, R/V Fast Eddie, September 16 through 19, 1999. The field notes for all boat operations are included in Appendix I.

Bathymetry measurements were made with a Lowrance fathometer operating at 192 kilohertz, which also logged surface water temperature. Seismic reflection profiles were acquired using a Geopulse transducer (a "boomer) and two hydrophone receivers: a short 3-element streamer and a line-in-cone Seistec vertical array. The east-west lines were acquired with the streamer only, while the northeast-southwest lines were acquired with both receivers. The Geopulse source creates a wideband (2500-4500 Hz) pulse with a single positive pressure transient of up to 218 dB//1μ Pa @1m. The reflection data were recorded digitally at 16 kHz sampling, 200 msec record length, at a repetition rate twice per second. Vertical resolution of better than 50 cm to a subbottom depth of approximately 25 meters and lateral resolution on the order of 1 meter were achieved. Positioning was accomplished with differential Global Positioning System (GPS). Absolute position accuracy was approximately ± 10 m.

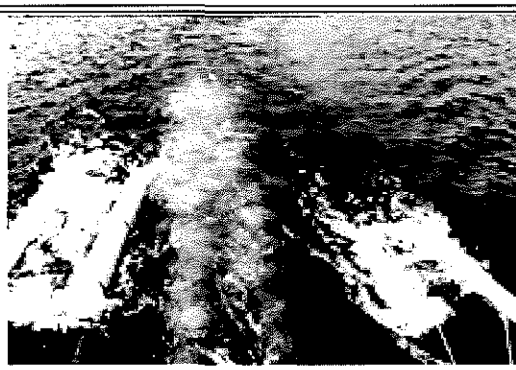


Figure B1: The Geopulse and Seistec Sources towed behind boat.

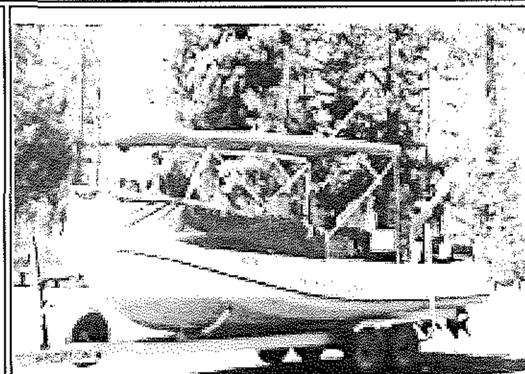
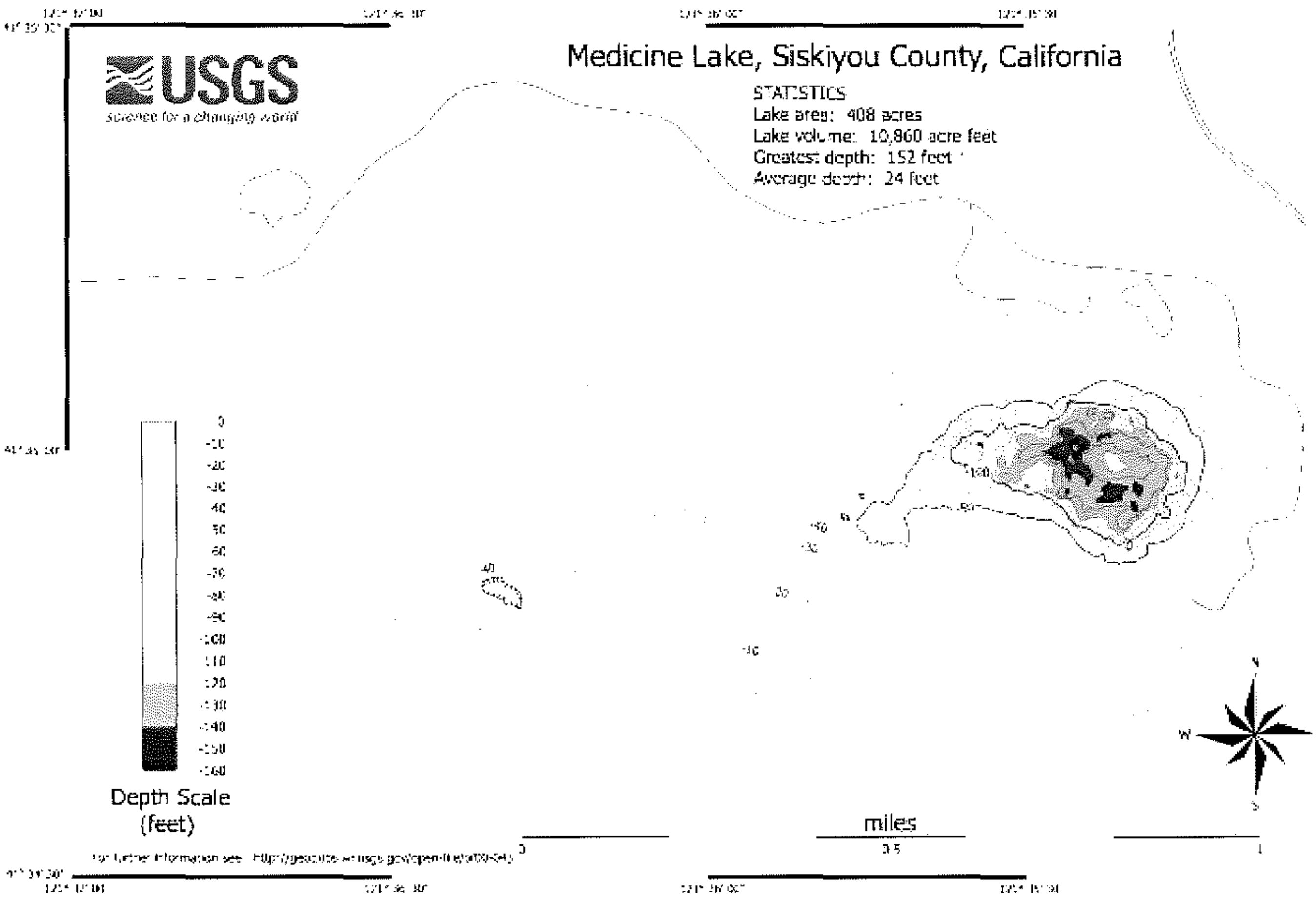


Figure B2: The Fast Eddy

Two bathymetric figures of the lake were generated: Map 1 is contoured at 5-meter intervals; Map 2 is contoured at 10-foot intervals. The bathymetric maps were created by gridding the trackline data at approximately 4-meter grid interval, and fitting the grid with a minimum-curvature surface (Smith and Wessells, 1990). The gridding and contouring was accomplished with the Generic Mapping Tools

(GMT) Package (Wessells and Smith, 1998). Further information regarding this package is available at: http://imina.soest.hawaii.edu/gmt/. The data are available in Appendix III.



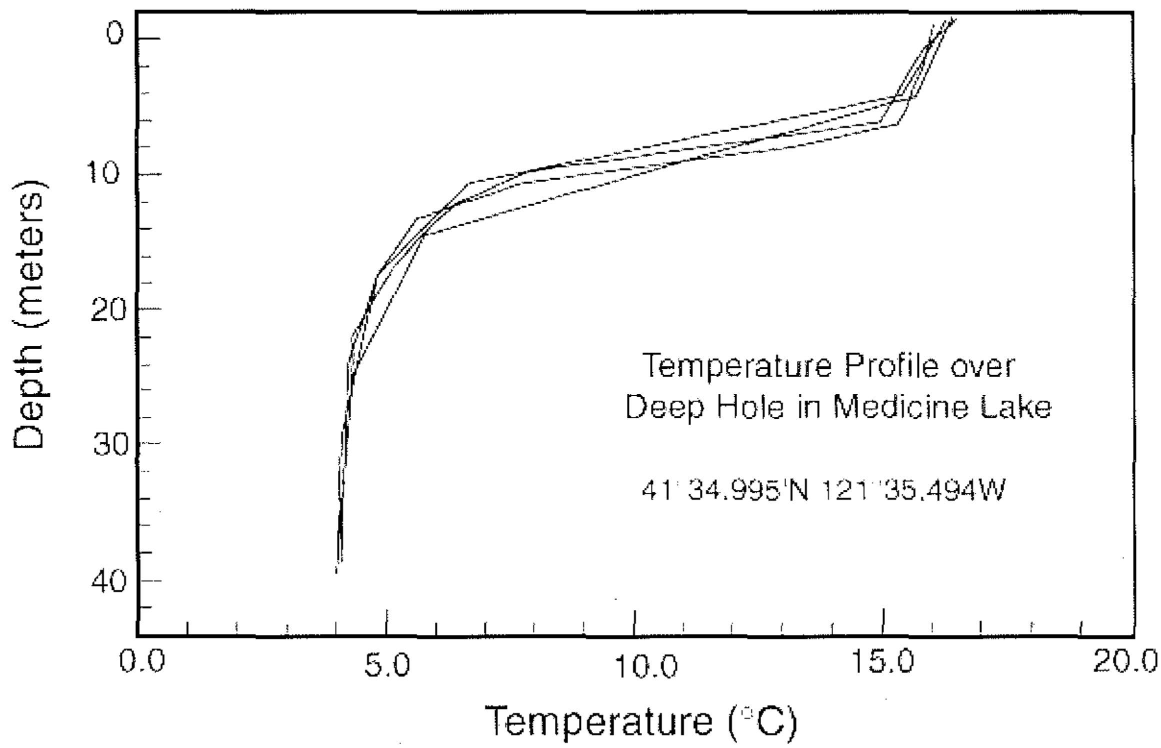
Above image is a small version of Map 2. A higher quality version of the map (JPEG) is available here.

Maps 1, 2 and 3 (layer within Map 1) are also available as Adobe Illustrator® 8.0 files. Click here to see Figure B5: A 3-D perspective view of the lake bathymetry, as would be seen from the southwest .

The locations of the seismic reflection profiles are shown in Map 3 (Figure B6), and a REPRESENTATIVE SEISMIC LINE(Figure B7), with explanatory annotation, is also provided. Information about the acquisition of the track lines is available in Appendices II . The actual bathymetric data are available in Appendix III.

The seismic reflection profile data are available on in SEG-Y exchange format (Barry and others, 1975) via FTP. Click here for more information.

The temperature of the lake as a function of depth to 40 meters was measured with a conductivity-temperature-depth instrument. The temperature profile is shown below in Figure B9.



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SUMMARY OF SEDIMENTOLOGIC INVESTIGATIONS IN MEDICINE LAKE AND BLANCHE LAKE, NORTHERN CALIFORNIA

R. Lawrence Phillips, John A Barron, and Scott W. Starratt

Ten cores, ranging from 18 to 70 cm in length, were obtained in September 1999 in northern California, nine from Medicine Lake and one from Blanche Lake (Figure C3, Table 1). The cores were taken to assess whether Medicine Lake may contain a high-resolution record of the Holocene climate history of the region. The climate history would be inferred through studies of microplankton, pollen and lake & sediment geochemistry.

The most obvious climate cycle that we expect to be present in Medicine Lake sediments is that of lake level. Because Medicine Lake is spring-fed, lake-level variations should correlate with regional precipitation. For example, according to eyewitness accounts, the lake was much smaller during a well-documented period of extended drought during the 1930s. Given the lake's bathymetry, with extensive areas shallower than 10 feet (~ 3m), extended drought would drastically alter the lake area. Preliminary interpretation of the sediments from the shallow-water cores (Cores 2-8) reveals clearly defined cycles of lake level that we hope to date and relate to published climate records. Though the record contained in the shallow-water sediments undoubtedly is interrupted by periods of subaerial exposure or erosion, sediments from the deeper part of the lake (Core 9) are likely to contain an uninterrupted record of lake level. Diatoms and geochemistry have proven to be excellent monitors of lake level, so they will be studied extensively in the deep cores.

This report summarizes the coring methods, lithostratigraphy, texture, and depositional environments identified in the core strata from this inital study.

Summary

Data from the shallow lake cores show that an initial lagoonal/marsh environment was drowned, allowing coarse-grain lake sediments to be deposited. Subsequently, there was a drop in lake level and subaerial soils were developed on the lacustrine strata. A rise of lake level in 1940's(?) again flooded the terrestrial soils and resulted in deposition of the thin modern lake sediments.

- *Sampling and Analytical Methods*
- *Stratigraphy Summary Diagram (Figure C1)*
- *Key to Sedimentary Structures (Figure C2)*
- *Map of Sample Locations (Figure C3)*
-

Table 1. Information on core locations and characteristics.

Core	Depth (cm)	Length (cm)	North Latiitude	West Longitude	Coretype	Area	Strat. Column	Textures
1	0	70	41° 35.3'	121° 36.2'	Hammer	Barrier Island north side Medicine Lake	*Strat. Column*	*Texture Column*
2	100	69	41° 35.6'	121° 35.6'	Hammer	North side Medicine Lake	*Strat. Column*	*Texture Column*
3	130	31	41° 35.2'	121° 36.2'	Hammer	North side Medicine Lake	*Strat. Column*	*Texture Column*
4	50	62.5	41° 34.6'	121° 35.6'	Hammer	Lagoon north side Medicine Lake	*Strat. Column*	*Texture Column*
5	110	31	41° 34.7'	121° 36.5'	Hammer	South side Medicine Lake	*Strat. Column*	*Texture Column*
6	100	18.5	41° 35.6'	121° 35.6'	Boxcore	North side Medicine Lake	*Strat. Column*	*Texture Column*
7	100	18	41° 35.6'	121° 35.6'	Boxcore	North side Medicine Lake	*Strat. Column*	*Texture Column*
8	30	49.5	41° 33.4'	121° 33.2'	Hammer	North side Blanche Lake	*Strat. Column*	*Texture Column*
9	3700	27	41° 34.9'	121° 35.4'	Gravity	East central Medicine Lake	*Strat. Column*	*Texture Column*

Depositional environments of Medicine Lake

Six cores were obtained in the northern part of the Medicine Lake, where a narrow coarse-grained barrier island has built to the east into the lake and now separates a broad, shallow, grass-covered lagoon from the open lake (Figure 2). One core (core 5) was taken along the southern margin of the lake, and the gravity core (core 9) was taken in the deeper, eastern part of the lake.

We identify at least six distinct lithostratigraphic sequences in the lake strata that include the following depositional environments: 1.) Modern shallow lake, 2.) Deep lake, 3.) Barrier island, 4.) Lagoonal and barrier island overwash, 5.) Terrestrial strata, and 6.) Lacustrine/marsh to lagoonal sediments.

Modern shallow lake sediments

Modern sediments within the shallow part of the lake are now being reworked. They overlie consolidated sediments with an erosional contact. Discontinuous patches of grass 2 to 3 cm in height may cover part of the shallow lake where actively migrating ripples are not present. The modern lake sediments form a distinctive unit ranging from 2 to 14 cm thick. Coarse-grained sand and gravel make up to 100 percent of the sediment. Silt and clay are generally lacking or constitute less than 3 percent of the sediment in this upper stratigraphic interval. The sand fraction is composed of a mixture of tephra clasts, consisting of red, black, tan to cream colored vesicular shards and clear bubble wall shards.

Deep lake sediments

The soft dark brown deep lake sediments contain the highest percentage of silt and clay (up to 96 percent) with the sand fraction ranging from 3.6 to 32.7 percent (core 9). Rare gravel clasts (possibly ice-rafted) are also found in the soft mud. Most of the sand-size fraction consists of biologic components consisting of diatoms, fern and conifer spore cases, seed pods, plant material, and insect parts.

Barrier island

The barrier island strata consist of 70 cm of repeated graded beds of gravel and sand (core 1). The gravel fraction ranges from 0.4 to 60 percent while the sand fraction ranges from 42.2 to 99.9 percent. The sand and gravel fractions are composed of a mixture of tephra clast compositions. The strata represent repeated winnowing and deposition of coarse-grain sediments by waves and wave runup on the narrow barrier island beach.

Lagoonal and barrier island overwash

The lagoonal strata, 30 cm thick, comprise two distinct depositional elements, a basal laminated gray and brown sandy-silty clay lacking gravel-sized-clasts overlain abruptly by coarse-grained sandy gravels. The silt and clay fraction makes up to 48 percent of the sediment in the basal beds changing up 10 to 16 percent in the overwash strata. The sand (up to 76 percent) and gravel (up to 20 percent) form a mixture of tephra grains and clast types in the upper depositional unit. The strata represent quiet water deposition for the basal strata with barrier-island overwash introducing the gravelly sands into the lagoon.

Terrestrial strata

The hard, overconsolidated, red to orangish brown sandy mud, which underlies the modern lake and lagoonal sediments, contains iron concretions, silt clasts, and black to brown roots to 10 cm length forming a distinctive unit ranging in thickness from 16 to 22 cm. An abrupt increase in the <0.062 mm size fraction, from 38 to 78 percent, characterizes this sequence. The sand fraction ranges from 22 to 56 percent. Gravel-sized tephra clasts are usually lacking. Most of the sand-size shards are altered. Apparent exposure of originally lacustrine and lagoonal/marsh sediments has resulted in soil development (high silt and clay fraction) and alteration of the sediment. The sequence was deposited in a terrestrial environment.

Lacustrine/marsh to lagoonal sediments

The stratigraphically lowest depositional sequence found in cores 2, 3, and 4 contains two distinct units, a lower marsh/lagoonal sequence up to 26 cm thick overlain by an upper thin lacustrine deposit 4 to 13 cm thick. The lacustrine strata consist of "clean" sand (97 to 100 percent) or gravelly sand (4 to 16 percent gravel, 52 to 75 percent sand) composed of a mixture of tephra compositions. The laminated lagoonal/marsh sediments contain 48 to 71 percent silt and clay and 28 to 51 percent sand indicating deposition in a quiet-water environment.

Blanche Lake

Blanche Lake contains a similar depositional history as recorded in the strata in Medicine Lake with a thin, 6 cm thick, sandy gravel representing the modern lake sediments overlying gravelly, sandy mud from a terrestrial environment with soil development. The gravel clasts are scattered throughout the strata with clasts up to 6.2 cm in length.

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MERCURY AND METHYLMERCURY CONCENTRATION IN SEDIMENT CORES AND SURFACE WATER FROM MEDICINE LAKE, CALIFORNIA

James J. Rytuba

Introduction

Medicine Lake is located within the summit caldera/basin of the Medicine Lake volcano, a Pleistocene and Holocene shield volcano located in northeastern California (Donnelly-Nolan et al., 1990). This study was initiated to establish the record of mercury and methyl mercury deposition in sediment cores from a lake developed within a young volcanic field where an active subsurface geothermal system is present. Numerous studies have been carried out to establish the record of mercury deposition in seepage lakes throughout the world (Porcella, 1996) but no data is presently available for a lake localized within a young volcanic field.

Selected sediment samples from two cores (core 3 and 6) were taken at Medicine Lake on September 16 and 17, 1999, for analysis of mercury and methylmercury. An unfiltered surface water sample in the central part of the lake was taken on September 17, 1999, and analyzed for total mercury and methyl mercury. The pH of the surface water was 4.5. The results of the sediment and water mercury analyses are listed in Table 1.

Sampling for mercury and methylmercury analysis followed ultra-clean sampling and handling protocols (Bloom, 1995, Gill and Fitzgerald, 1987) during the collection of field samples and analysis of samples in order to avoid introduction of mercury. Borosilicate I-CHEMTM glass with teflon-lined caps were used for water sampling. Water samples were preserved in a cooler at 1 to 4 degrees C until maintained under laboratory established conditions to preserve mercury retention and speciation. Sediment core samples were taken in precleaned amber borosilicate glass jars. Transportation to the laboratory was under conditions specified to maintain sample mercury retention.

Analytical Methods

Mercury and methyl mercury concentration in sediment from cores

Mercury and methyl mercury concentration in surface lake water

Conclusions

References

Table 2. Mercury and methyl mercury concentration in sediment from cores at Medicine Lake.

		Methy					

Sample Number	Dry fraction	Mercury wet weight ng/g	Methyl mercury dry weight ng/g	Mercury wet weight ng/g	Mercury dry weight ng/g	Core Interval cm	Depositional Environment
3ML0	0.71	0.034	0.048	25.8	36.3	3.0	Modern Lake
3ML0 replicate	0.0	0.032	0.0	0.0	26.1	0.0	Modern Lake
3ML1	0.69	0.027	0.039	20.3	29.4	0.8	Modern Lake
3ML2	0.7	0.016	0.023	16.9	24.1	4.2	Modern Lake
3ML3	0.66	0.047	0.071	100.0	152.0	2.8	Terrestrial
3ML4	0.59	0.040	0.068	139.0	236.0	4.7	Terrestrial
3ML5	0.61	0.024	0.039	157.0	257.0	4.8	Terrestrial
3ML6	0.6	0.006	0.010	135.0	225.0	3.6	Terrestrial
3ML7	0.66	0.021	0.032	252.0	382.0	3.2	Lacustrine
3ML8	0.65	0.031	0.048	301.0	463.0	2.4	Lacustrine
3ML9	0.64	0.026	0.041	293.0	458.0	1.5	Lacustrine

Table 3. Sediment samples from core number 6

Sample Number	Dry fraction	Methyl Hg wet weight ng/g	Methyl Hg dry weight ng/g	Mercury wet weight ng/g	Mercury dry weight ng/g	Core Interval cm	Depositional Environment
6ML1	0.69	.002	.003	10.5	15.2	1.0	Modern Lake
6ML2	0.69	0.005	0.007	15.7	22.8	1.0	Modern Lake
6ML3	0.57	0.011	0.019	11.8	20.7	1.0	Modern Lake
6ML4	0.64	0.071	0.111	22.4	35.0	3.5	Modern Lake

Table 4. Analysis of water from Medicine Lake

Surface lake water	Methyl mercury ng/L	Mercury ng/L
99ML1W-01	0.024	0.74

Mercury and methyl mercury concentration in sediment from cores

Analysis of the sediment cores indicates that the upper part of the cores consists of modern shallow lake sediments, the central part of the cores consist of terrestrial sediments, and the lower part of the cores consists of lagoon-marsh lacustrine sediments (see section on coring). The lowest mercury concentrations occur in modern shallow lake sediments. Mercury concentrations range from 24.1 to 36.3 ng/g (dry weight basis) in the upper 7 cm in core 3, and from 15.2 to 35.0 ng/g (dry weight basis) in the upper 7 cm of core 6 (Table 1). These mercury concentrations reflect the low level of clay and silt present in modern lake sediments which are primarily composed of coarse sand and gravel derived from pumice (see section on coring). Methyl mercury concentrations are similarly very low in modern lake sediments and range from .023 to .048 ng/g in core 3, and from .003 to .019 in core 6 (dry weight basis) (Table 1 above). The highest concentration of methyl mercury occurs in a fine sand layer at the transition from modern lake sediments to terrestrial sediment in core 6 (Sample 6ML4) where carbonaceous root fragments are present.

The terrestrial sediments in the central part of core 3 have considerably higher mercury concentration than modern lake sediments. Mercury concentrations range from 152 to 257 ng/g (dry weight basis) (Table 1 above). These sediments consist of lacustrine silt and clay that were exposed to the surface weathering during low stands of the lake resulting in soil development (see section on coring). Methyl mercury concentration in terrestrially modified sediments ranges from .01 to .071 ng/g.

Lacustrine environments represented in the lowest part of core 6 consist of shallow lagoon and marsh sediments consisting primarily of clay and silt. Mercury concentrations are the highest in these sediments, 458 to 463 ng/g, and methyl mercury concentration ranges from .041 to .048 ng/g (dry weight basis) (Table 1 above). A layer of more sandy sediment at the top of this section reflects shallow lake deposition and has somewhat lower mercury concentration, 382 ng/g, because of the lower fraction of silt and clay present in this layer.

Mercury and methyl mercury concentration in surface lake water

Mercury concentration in unfiltered surface water of the lake is very low, 0.74 ng/L, and methyl mercury is similarly low, 0.024 ng/L. These concentrations are comparable to other pristine lakes in the world where no mercury point sources of contamination are present. For comparative purposes, Lake Baikal, the largest pristine fresh water body in the world has mercury concentrations that range from 0.14 to 0.77 ng/L, and methyl mercury concentrations that range from .002 to .038 ng/L (Meuleman et al., 1995). Snow melt is the primary source water to Medicine Lake and the low level of mercury in lake water is consistent with this source.

Conclusions

The concentration of mercury in sediment cores from Medicine Lake is dependent on the grain size and depositional environment of the sediment. Modern shallow lake sediments have the lowest mercury concentration because these sediments are composed primarily of coarse sand and gravel with little or no silt or clay. These sediments contain little or no organic material and methyl mercury concentration is relatively low. The highest concentration of mercury occurs in the oldest marsh and lagoon sediments at the bottom of the cores because these sediments are composed primarily of fine silt and clay. Similar lacustrine sediments in the central part of the cores have lower mercury content because these sediments were exposed to the surface during low stands of the lake and mercury was apparently depleted during soil development.

Mercury concentrations in modern lake sediments at Medicine Lake are comparable to concentrations observed in sediments in other fresh water lakes (Lockhart et al. 1995). Lacustrine sediments in the lower part of the Medicine Lake core and in the terrestrially modified lacustrine sediments in the central part of the core are considerably higher than reported for sediments from other fresh water lakes by a factor of about 10 (Lockhart et al., 1995). Sediment cores from fresh water lakes commonly display an increase in mercury concentration from a baseline concentration established in sediments deposited prior to 1850, to higher values in more recently deposited sediments. The progressive increase in mercury concentration in lake sediments since 1850 is attributed to the increase in the global atmospheric flux of mercury resulting from processes associated with industrialization (Porcella, 1996). The sediment cores from Medicine Lake do not display this typical relationship because the highest concentrations of mercury are present in the oldest lacustrine sediments sampled. This inverse relationship and high mercury concentration in the older lacustrine sediments at Medicine Lake may be related to the volcanic setting and caldera environment in which the lake is localized.

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Diatoms and chrysophyte stomatocysts from Medicine Lake.

Samples collected September 15-16, 1999.

John A. Barron, Sarah Spaulding, Scott W.Starratt

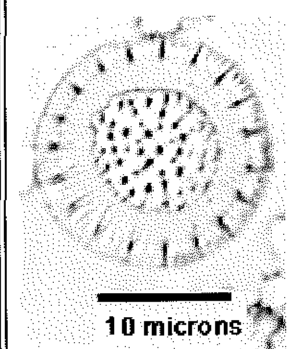
Sediment, rock and wood scraping, and macrophyte samples were collected from several locations around the perimeter of Medicine Lake. In order to document changes in the diatom assemblage over time, 26 samples were taken from Core 2.

Surface samples: All of the samples contain some diatoms. Generic diversity is variable ranging from five to sixteen. Species diversity within each genus has not been evaluated in detail. The following genera are represented:

Planktonic forms:

- *Aulacoseira*
- *Cyclotella*
- *Stephanodiscus* (may be airborne contaminant from local Pleistocene diatomite deposits).

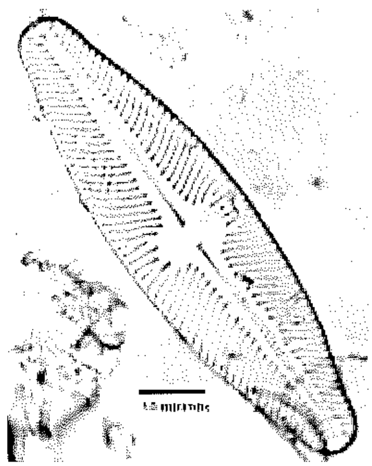
Click here for more images.



Cyclotella

Benthonic forms:

- *Brachysira*
- *Craticula*
- *Cymbella*
- *Epithemia*
- *Eunotia*
- *Fragilaria*
- *Gomphonema*
- *Muelleria*
- *Neidium*
- *Pinnularia*
- *Pseudostauosira*
- *Stauroneis*

• *Staurosira* • *Surirella* • *Tabellaria* Click here for more images.	 *Navicula*

There are at least ten different chrysophyte stomatocysts. None of the cysts observed is known to have an affinity to a vegetative form of chrysophyte. Environmental interpretations using chrysophyte cysts are difficult to make owing to the lack of knowledge of the relationship between each stomatocyst and the physical and chemical parameters favored by its vegetative form.

The diatom taxa present suggest a cold, clear, circumneutral pH (most prefer a pH of around 7), mesotrophic (moderate level of nutrients) lake.

Downcore samples: Diatoms and chrysophyte stomatocysts are present in the upper 2-3 centimeters of sediment. Below 3 cm, the diatoms become increasingly sparse, due to solution in the silica-undersaturated pore water. Chrysophyte stomatocysts are more robust and continue in small numbers to a depth of about 12 cm.

Initial results indicate that there is potential for establishing a calibration data set for both diatoms and chrysophyte stomatocysts. This data set can then be used to evaluate environmental changes in downcore studies. Such studies will require a core collected in the deep center of the lake in order to minimize the silica solution problem inherent with shoreline studies in an environment where subaerial exposure can occur.

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APPENDICES

Appendix I: Bathymetric and geophysical program field notes (observer logs)

F2-99-NC Medicine Lake, California
15 to 19 September, 1999

Overview
A bathymetric and geophysical survey was conducted over Medicine Lake in Siskiyou County, north central California. A concurrent shallow-water sampling program was also conducted.

Equipment included:
R/V Fast Eddie, 22-foot whaler with dual 70 hp outboards
Differential GPS positioning
YoNav survey management software and data logging
Elics two-channel seismic acquisition
Lowrance 1000 fathometer and temperature sensor (hull mounted)
SeaCat CTD (conductivity-temperature-depth) sensor
Geopulse acoustic source
Benthos 12-element, 3-meter streamer
Seistec line-in-cone receiver
Hand gravity corer

Staff (all USGS):
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Jake Lowenstern, geologist (sampling) Volcanic Hazards Team (VHZ)
John Barron, geologist Climate Change Program (VHZ)
Scott Starratt, geologist Climate Change Program (VHZ)
Jim Rytuba, geochemist Western Geologic Mapping

Daily notes:

JD 257 Tuesday, September 15
Travel from Redwood City to Medicine Lake

JD 258 Wednesday, September 16
Morning spent deploying Fast Eddie with bimini top, cowling, and installing electronics. Boat launched about 1245 local (1945 GMT). Weather conditions excellent: v. Light clouds, ~ 70-75° F, sunny, light wind.

SeaCAT CTD instrument started logging approx. 1245 local; in the water 1300 GMT).

First line consisted of a circumnavigation of the lake at 3.5 to 4 knot. Ran into shallow water twice. NW end of the lake very broad and shallow. Returned to the dock at 1400. Deployed Geopulse and back in the water at 2215z. Finished surveying at 259/0000 (1700 PST).

258/1945 Start logging CTD.
258/2000 Leave dock, commence circumnavigation of lake; CTD in water
258/2101 Complete circumnavigation, arrive dock; CTD out of water
258/2241 Leave dock, testing reflection system; CTD back in water
259/0000 Arrive dock; CTD out; end of day

Problems with Geopulse power supply limited reflection profiling. Changed out the power supply at the end of the day for the EG&G unit.

JD 259 Thursday, September 17

Weather conditions remain excellent: v. Light clouds, ~ 70-75° F, sunny, wind slightly greater than Wednesday and gusting 5-10 mph.
Acquiring reflection data with Geopulse and Benthos streamer (one channel). A grid of east-west lines was generated for the survey area at a N-S spacing of ~50 meters. The "A" lines were north of the lake centerline; the "B" lines south. Steering the lines accurately proved problematic because of wind conditions and the filter response of the YoNav line-following algorithm.

259/172800 Start logging CTD
259/173000 Leave dock, commence deploying Geopulse and Benthos streamer
259/173700 CTD in water
259/174600 commence acquisition of EW lines
259/182430 stop acquisition of EW lines
259/183000 CTD out of water
259/183300 CTD in water
259/183700 continue acquisition of EW lines
259/195400 stop acquisition of EW lines
259/195500 CTD out of water
259/200000 arrive dock, break for lunch
259/212500 leave dock, CTD in water
259/214900 continue acquisition of EW lines
260/000400 complete acquisition of EW lines
260/000500 CTD out of water

JD 260 Friday, September 18

Weather conditions remain excellent: v. Light clouds, ~ 70-75° F, sunny, wind calm.

Acquiring reflection data with Geopulse source, Benthos streamer and Seistec receiver (two-channels). Survey lines run approximately NNE-SSW along arbitrary lines chosen by line of sight. Lines at eastern end of lake spaced closer (approx. 25-50 meters), at western end of lake wider (approx. 50-100 meters). CTD data not logged.

260/173000 depart dock, deploying and tuning Seistec at east end of lake
260/181200 commence acquisition of NS lines
260/211400 complete acquisition of NS line
260/212000 arrive dock

JD 261 Saturday, September 19

Weather conditions remain excellent: v. Light clouds, ~ 70-75° F, sunny, wind calm.
Sampling and temperature profiles acquired. Two sampling sites selected based on geophysical profiles:
latitude longitude water depth profile day/time
1. 41° 34.9911' -121° 35.4420' 37 m 259/1846
2. 41°.34.8866' -121° 35.5590' 10 m 259/1916

261/1715:21 41° 34.866' N 121° 35.582' W ---> Dropping Core 1 here
261/1729:03 41° 34.880' N 121° 35.556' W ---> Dropping again here
261/1738:46 41° 34.986' N 121° 35.438' W ---> Core site 2 drop here ~38M
261/1801:34 41° 34.999' N 121° 35.419' W ---> drop long barrel core at 42.1 meter depth
261/1824:55 41° 34.996' N 121° 35.465' W --->site 2 core #10 first try
261/1842:58 41° 34.991' N 121° 35.467' W ---> Site 2 core 10 try 2

261/1853:06 41° 34.971' N 121° 35.503' W ---> CTD drop here
261/1857:42 41° 34.967' N 121° 35.526' W ---> Start to pull up ctd here
261/1858:46 41° 34.962' N 121° 35.526' W ---> CTD at surface
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261/1905:49 41° 34.987' N 121° 35.512' W ---> ctd coming up
261/1906:27 41° 34.985' N 121° 35.513' W ---> ctd at surface
261/1915:53 41° 34.969' N 121° 35.449' W ---> drop core10 try 3

JD 262 Sunday, September 20
Demobilization and travel from Medicine Lake to Redwood City

Appendix II: Summary of seismic-reflection profile lines

F2-99-NC Reflection Profile Start/End Line Times and Field File Numbers

Following table shows the times for each line segment, the line numbers assigned to the segment, the field file ("ping") numbers in the original field recording, and the plotting direction (N - normal, R - reverse) to create reflection images that have west and south to the left. Lines 101 thru 117 were acquired on JD 259; Lines 201 thru 223 on JD 260.

line	JD	start time hhmmss	end time hhmmss	start field file	end field file	Plot
101	259	174600	175600	1	2200	N
102	259	175700	180730	2440	4920	R
103	259	181100	182430	5800	9040	N
104	259	183700	184330	12040	13560	N
105	259	184700	190230	14440	18120	R
106	259	190400	191930	18520	22200	N
107	259	192030	193700	22440	26440	R
108	259	193900	195400	26920	30560	R
109	259	214900	220130	3800	6680	N
110	259	220300	221739	7160	10600	R
111	259	221800	223300	10760	14360	N
112	259	223400	224900	14600	18200	R
113	259	225000	225330	18440	19240	N

114	259	225400	230100	19400	21120	R
115	259	230200	232000	1	4320	N
116	259	232400	234330	5280	9840	R
117	259	234500	000330	10320	14800	N
201	260	181200	182600	1	2520	N
202	260	182630	183130	2600	3800	R
203	260	183230	183800	4080	5400	N
204	260	183830	184500	5520	7080	R
205	260	184530	185230	7200	8840	N
206	260	185300	190100	9000	10920	R
207	260	190130	190900	11000	12840	N
208	260	191000	191730	13080	14840	R
209	260	191800	192530	1	1760	N
210	260	192600	193430	1920	3920	R
211	260	193500	194230	4080	5840	N
212	260	194300	195100	6000	7920	R
213	260	195200	195900	8160	9840	N
214	260	200000	201030	10080	12600	R
215	260	201200	201900	12960	14640	N
216	260	202000	202700	14880	16560	R
217	260	202800	203400	16800	18240	N
218	260	203600	204100	18720	19920	R
219	260	204400	204800	20640	21600	R
220	260	204800	205130	21610	22400	N
221	260	205230	205600	22680	23480	R
222	260	205700	210700	1	2440	N
223	260	210800	211400	2680	4023	N

Appendix III: ASCII Bathymetric Data File

ASCII data file with time, position and depth (**This is a big text file: 2.6 Mbytes!!!!**).

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211	260	193500	194230	4080	5840	N
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213	260	195200	195900	8160	9840	N
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