

---

# DESCHUTES NATIONAL FOREST

---



Pacific Northwest Region  
United States Department of Agriculture  
Forest Service

---

## Briefing Book

December, 1991



## **Newberry National Volcanic Monument**

---

**NEWBERRY NATIONAL  
VOLCANIC MONUMENT  
BRIEFING BOOK**

Photos by Sherri Lee

Prepared by Deschutes National Forest Staff

# TABLE OF CONTENTS

	Page
I. INTRODUCTION	
<i>A new National Monument</i>	1
<i>Monument Map</i>	1A
<i>Recreation and Tourism in Central Oregon</i>	2
<i>History and Citizen's Committee Involvement</i>	3
II. MONUMENT RESOURCES	
<i>Interpretation</i>	4
<i>Geology</i>	5
<i>Map of Geologic Provinces of Oregon</i>	5A
<i>Map of Selected Cascade Range Peaks</i>	8A
<i>History and Prehistory</i>	11
<i>Recreation Opportunities</i>	17
<i>Lakes and Fisheries</i>	17
<i>Wild &amp; Scenic Rivers</i>	19
<i>Vegetation</i>	19
<i>Wildlife</i>	20
<i>Roads</i>	20
III. ENERGY	
<i>Geothermal</i>	22
<i>Pacific Gas Pipeline</i>	23
IV. NEXT STEPS	
<i>Planning</i>	25
<i>Monument Management Plan</i>	25
V. APPENDICES	
<i>A. Origins of Names/Facts</i>	26
<i>B. Glossary of Geologic Terms</i>	34
<i>C. Public Law 101-522</i>	38

**NEWBERRY NATIONAL  
VOLCANIC MONUMENT**

**EVENING MEAL AT PAULINA LAKE**



*Newberry*

## **A NEW NATIONAL MONUMENT: A SPECIAL PLACE FOR 10,000 YEARS**

The citizens of central Oregon requested that the 101st Congress create a national monument out of 50,000-plus unique acres. Those of us who are now just catching up to the reality of Newberry as a National Monument might ask ourselves, "Why a national monument? What is its purpose?" Monument designations are reserved for the nation's true "jewels". In the hierarchy of special designations, National Monuments rank at the top recognizing areas like Newberry for its unique and special values.

President Bush responded to central Oregon's request on November 5, 1990 when he signed Public Law 101-522 which established Newberry National Volcanic Monument **"To preserve and protect for present and future generations its remarkable geologic landforms and for the purposes of providing for the conservation, protection, interpretation, and enhancement of its ecological, botanical, scientific, scenic, recreational, cultural, and fish and wildlife resources."**

Public Law 101-522 also directed that the Forest Service prepare a management plan and establish priorities for development. The Forest Service is responsible for stewardship of the Monument and, consequently, must ensure that any development in the Monument is carefully considered and consistent with Monument legislation.

Newberry National Volcanic Monument, located on the Deschutes National Forest, encompasses an outstanding volcanic landscape of considerable diversity, showcasing over 95% of all known geological features. Plants, animals, and humans have uniquely adapted to the land and climate of this remarkable area. At a glance, some of the features of the Monument include:

- Newberry Crater** - a caldera with two scenic lakes and spectacular lava flows of black glass,
- Lava Butte** - a classic volcanic cinder cone and rugged lava flow,
- Lava Cast Forest** - a frozen forest of tree molds in a lava flow, and
- Lava River Cave** - a 6000-foot-long lava tube cave.
- Volcanic products and landforms** - pumice, ash, cinders, obsidian, lava flows, cinder cones, pumice cones, tuff rings, and many more.
- Pre-historic occupation by native Americans** - major sources of obsidian and 7,000 to 10,000 years of occupation.

The rest of this briefing book will include information on recreation in central Oregon, history and resources of the Monument, related energy issues, planning for the future, and some fun facts and trivia.

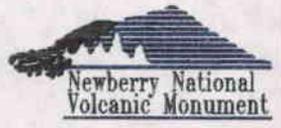
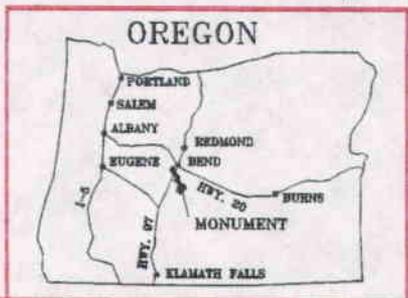
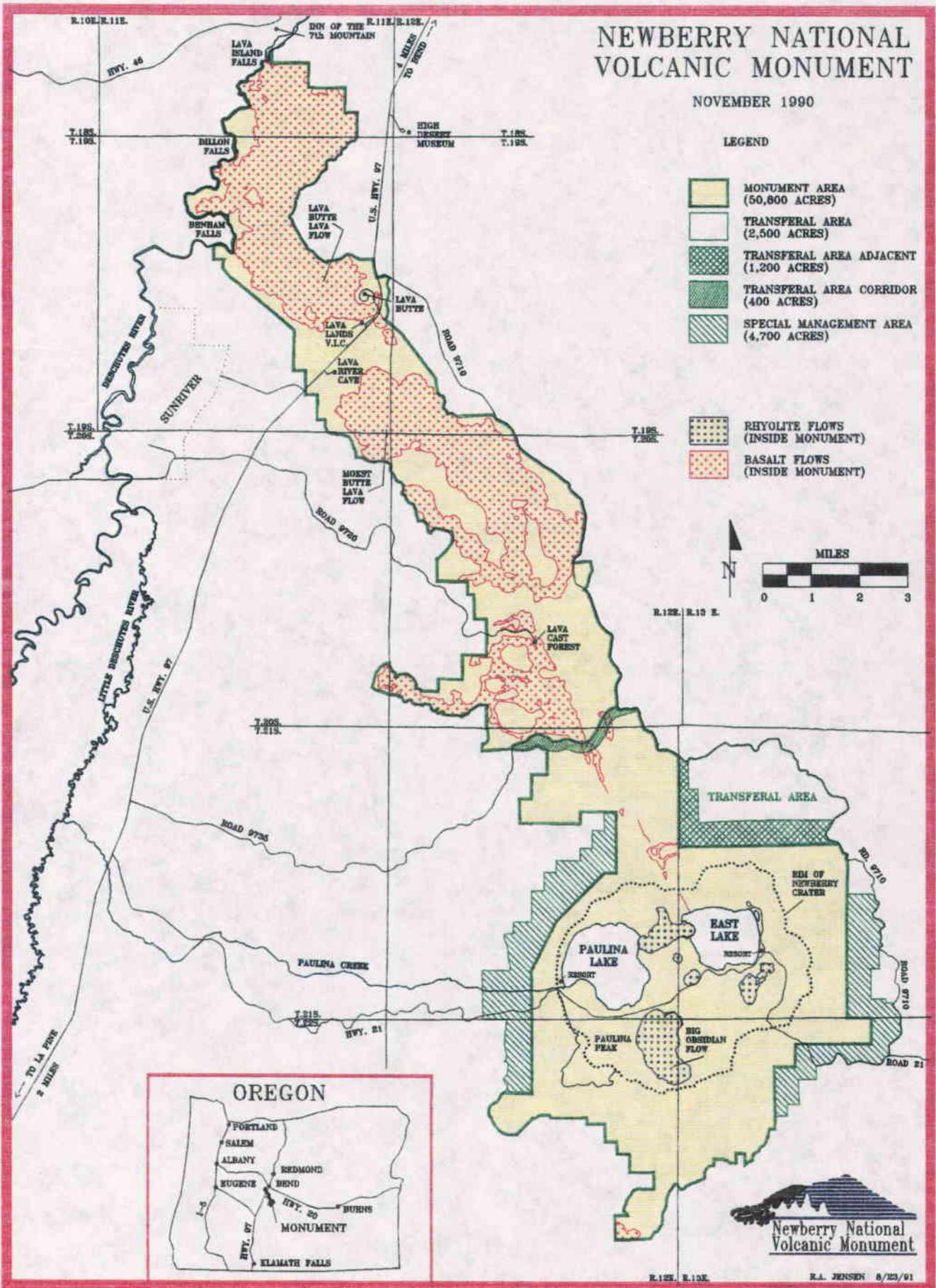
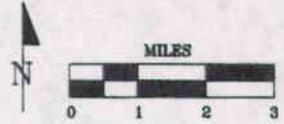
# NEWBERRY NATIONAL VOLCANIC MONUMENT

NOVEMBER 1990

## LEGEND

-  MONUMENT AREA (50,800 ACRES)
-  TRANSFERAL AREA (2,500 ACRES)
-  TRANSFERAL AREA ADJACENT (1,200 ACRES)
-  TRANSFERAL AREA CORRIDOR (400 ACRES)
-  SPECIAL MANAGEMENT AREA (4,700 ACRES)

-  RHYOLITE FLOWS (INSIDE MONUMENT)
-  BASALT FLOWS (INSIDE MONUMENT)



R. 12E, R. 13E R.A. JENSEN 8/23/91



**FALL MORNING PAULINA PEAK**

## RECREATION AND TOURISM IN CENTRAL OREGON

Statistics verify that Central Oregon is a primary destination on the itineraries of legions of tourists. Visits to Lava Lands Visitor Center (the current interpretive facility at the Monument) and Newberry Crater have jumped 10 and 30 percent respectively, since the area was designated a National Monument. The overall population of Deschutes County has grown 20% in the past decade and the rate of growth is accelerating. Room tax collections in the county have grown 15% per year for the past five years. Employment in the hotel/motel trade has quadrupled since 1980. These trends are expected to continue.

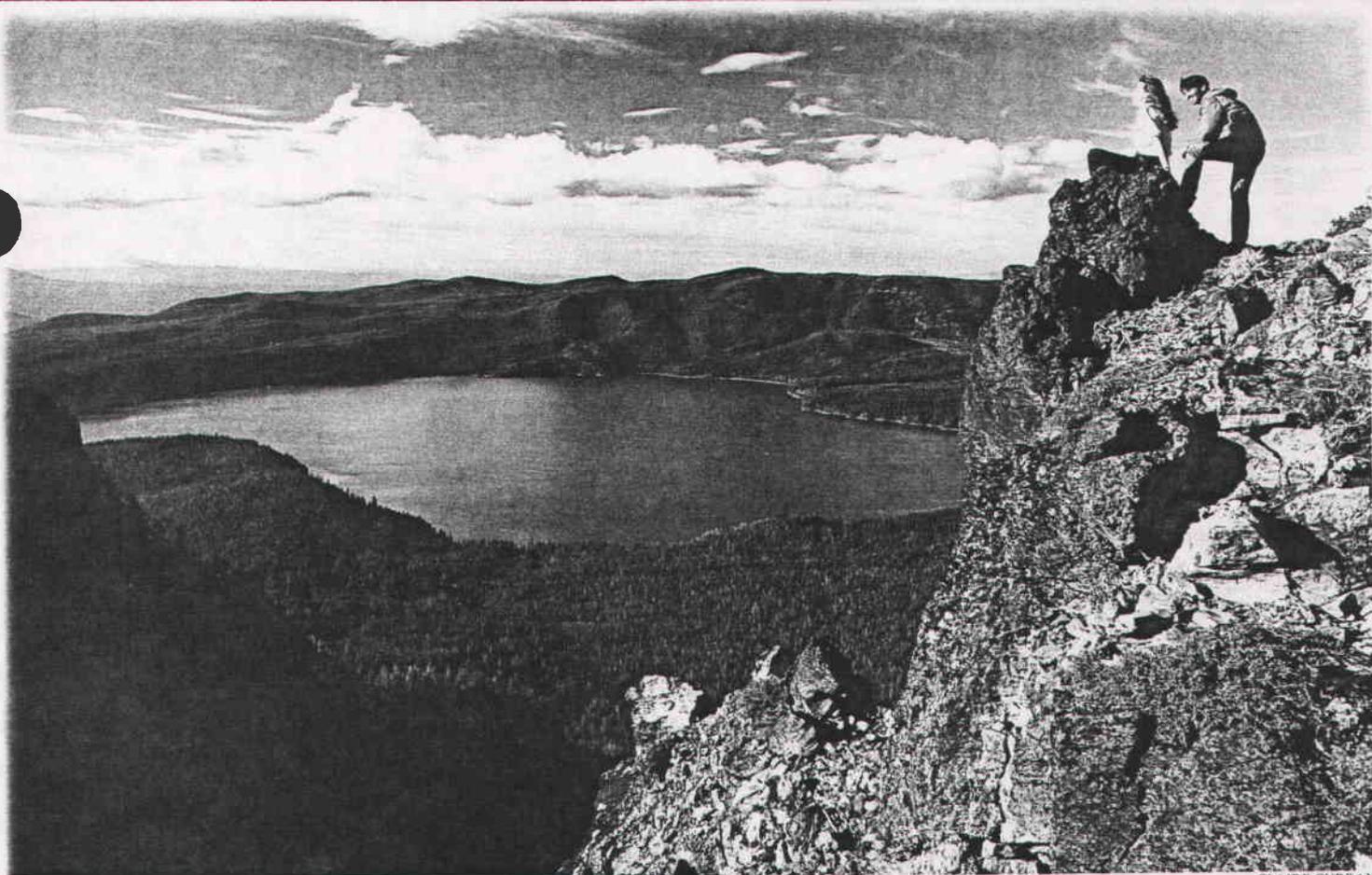
The Deschutes National Forest and central Oregon are unique. Few places in the world can boast a more varied, pristine, active, and expansive volcanic landscape. Few places can demonstrate such great antiquity of human association with that landscape. *It is world class.*

Increasing numbers of travelers arrive here as eco-tourists interested in learning as much as they can about the science and history of the area. These people are well educated and have extremely high expectations of the facilities and enhancements found on the Forest including trails, campgrounds, buildings, exhibits, displays, and presentations.

Central Oregon is also a mecca for people who covet quality outdoor recreation. Thousands of skiers flock to Mt. Bachelor in the winter. The Three Sisters Wilderness area is extremely popular with hikers, horseback riders, and photographers. The high Cascade lakes of central Oregon draw sailboat enthusiasts, windsurfers and fishermen.

The Monument is economically and philosophically in the center of the area that is experiencing rapid growth in population, recreation, and tourism. The communities of Bend, Sunriver, and La Pine have joined forces to aggressively encourage tourism and promote the scenic beauty of the region. Forest Service partnerships and cooperative efforts with local communities are vital. Even though this aggressive marketing of the Forest's scenic and scientific wonders is being done by the community, **the destination is the Forest.**

Ready or not, **people are coming.** The Forest Service will ultimately be responsible for the impression these people leave with. Are we prepared for the realities of our community partnerships? This question and others must be addressed clearly in the Monument Management Plan.



CLAIRE CURRAN

*No place for vertigo, 7,985-foot Paulina Peak offers dizzying views of Paulina Lake, with Mount Bachelor in distance*

## Not Crater Lake, it's Newberry . . . the West's newest national monument



*Glass-sharp chunks of obsidian are easily studied; all sizes, from chips to boulders, are scattered along Big Obsidian Flow*

In the heart of Oregon's lava country, the West's newest national monument adds a midstate vacation destination between Bend and Crater Lake. Designated last November and slated for dedication on June 30, 56,000-acre Newberry National Volcanic Monument stretches from Newberry Crater, near the small town of La Pine, north 28 miles to Bend, with its many resorts, dude ranches, and recreational opportunities.

The landscape comprises obsidian fields, deep mountain lakes, lava formations, and waterfalls. Though the monument's centerpiece, 18-square-mile Newberry Crater, may lack Crater Lake's startling first impression, its wilderness lakes, campgrounds, and trails are more accessible and less crowded.

A visit to Newberry—administered by the Forest Service—can take as little as a few hours to drive into the caldera, see Paulina and East lakes, and enjoy views from Paulina Peak. Or take three or four days to camp, hike, fish, and explore. While the monument has many attractions, we've chosen to focus on outdoor activities in its southern area, around the crater.

Warmer midsummer weather makes camping appealing, but be prepared for wide temperature swings: July and August daytime temperatures range from 70° to over 100°, and drop as low as 30° to 50° at night.

### **Camp, fish, and hike inside a caldera**

From La Pine, it's a 6-mile drive north along U.S. 97 to County Road 21 (Newberry Crater Road), which leads to the monument. (Through summer, Road 21 may have 30-minute delays for construction.) The crater lies well hidden as Road 21 climbs the 13 miles eastward along its sloping pine-forested shoulder. In about ½ hour, you cross the rim and emerge at the west end of Paulina Lake.

Newberry Crater was formed by volcanic events that began about 500,000 years ago. Its most recent eruption, about 1,300 years ago, sent lava tumbling down the southern rim, leaving a wide swath of obsidian as it cooled.

Cupped in the caldera lie two of the best fishing lakes in Oregon—Paulina and East—as well as two rustic resorts, seven campgrounds, numerous surrounding hik-



*Predawn mist hovers above Paulina Lake as early-morning rower waits for the sun to break over the lake's eastern edge*

ing trails, and view points.

**Where to stay.** Paulina Lake Resort, built in 1929 on the west shore, is the lake's fishing hub. Its dozen one- to three-bedroom modernized log cabins cost \$50 to \$105 per night. For reservations, call (503) 536-2240 well in advance.

The resort serves hearty lunches and dinners (\$3 to \$13) in its small log-beamed dining room or out on a deck; the homemade pie à la mode is irresistible. A general store sells snacks and beverages along with fishing licenses and tackle. You can rent canoes (\$12 to \$19), motorboats (\$8 to \$30), rowboats (\$5 to \$19), or moorage (\$6). Motorists will find a convenient but expensive fuel pump here.

Five miles beyond Paulina lies quiet East Lake Resort. Rows of green-roofed red cabins (11 in all; \$48 to \$74 per night) have small kitchens and face west across the lake. The resort's simple restaurant serves breakfast and lunch (\$2 to \$7), dinner on request. East Lake also offers a general store with boat rentals (\$12 to \$30), pay telephones, and the area's only RV park (\$10; public showers and laundry). As at Paulina, cabin reservations should be made early; call 536-2230.

If you prefer to camp, five individual campgrounds, one group area, and a horse campground—315 sites in all—are within the caldera. Along Newberry Crater Road beside Paulina Creek are two individual campgrounds, Prairie and McKay Crossing, and a group camp, Ogden.

Reserve Ogden and the caldera group and horse camps ahead; call 388-5664. Other camps (free to \$8) are first come, first served, and with the exception of Hot Springs (near East Lake) are along the creek or one of the lakes.

**Fishing.** Trout limit reductions and the practice of catch-and-release fishing by conservation-minded anglers have meant bigger and better catches each season in

both Paulina and East lakes. No streams feed these trophy trout lakes, which are regularly stocked with brown, rainbow, and brook trout. Paulina is also stocked with kokanee, a landlocked salmon; in 1990, East was experimentally stocked with Atlantic salmon.

There's a five-fish limit, and an Oregon fishing license is required. Boats' speed must be kept under 10 mph.

**Hiking.** Newberry Crater's six main trails vary from easy 7/8-mile Big Obsidian Flow to steep 2.1-mile Paulina Peak. The longest is 22-mile Crater Rim Trail, a one- to two-day route. The 3 1/2-mile Little Crater Trail loops around the small hill between Paulina and East lakes; 7 1/2-mile Paulina Lake Loop follows the shoreline.

The 8 1/2-mile Peter Skene Ogden Trail, named for the trapper who discovered the lakes in 1826, begins at Ogden Group Camp off County Road 21 and climbs

along the lake's outlet, Paulina Creek, before passing 100-foot-high Paulina Falls about 1/2 mile from trail's end near the resort.

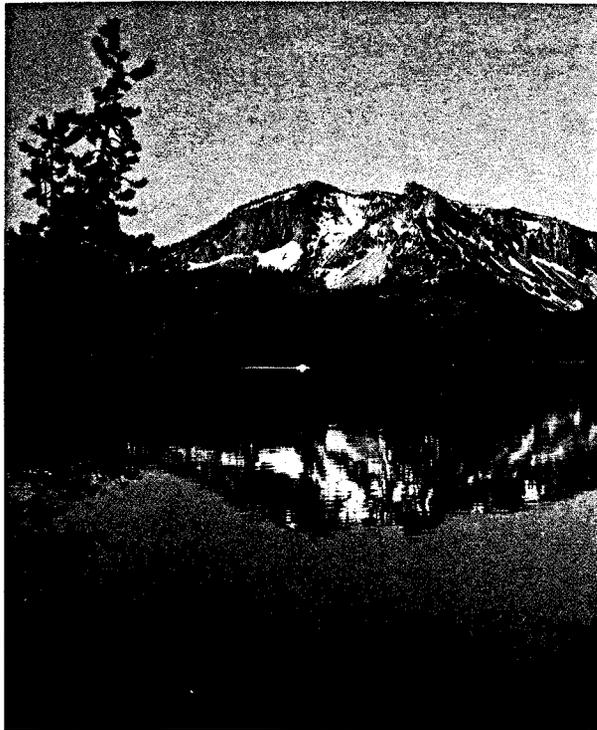
For a one-way trip, you may want to hike down from the resort and arrange for a shuttle pickup at Ogden Group. You can also hike just the lower 2 3/4-mile section from Ogden to McKay Crossing Campground, or the upper 5 3/4 miles from McKay Crossing to the lake. Horses are permitted on most trails; mountain bikes are discouraged (policy still pending).

**Interpretive programs.** Throughout summer, activities include naturalist-led walks, flintknapping or arrowhead manufacture, and campfire programs at a small outdoor amphitheater. Ask at the information center (open through September 2), on County Road 21 just inside the rim, about upcoming talks. Maps and displays of the area can also be viewed here. □

# Newberry: The West's Newest

## GEOLOGY

Volcanoes from eruptions at least 45 million years ago dominate the Central Oregon landscape. The remnants of this cataclysmic activity create natural wonders and recreation attractions throughout the region. The prime volcanic area to begin exploration is Newberry Crater, the West's newest National Monument. Dedicated June 30, 1990, the 56,000-acre Newberry National Volcanic Monument stretches from Newberry Crater, near the town of LaPine, north 28 miles to Bend.



*Paulina Peak reflecting in the pristine waters of Paulina Lake.*

The landscape comprises obsidian fields, deep mountain lakes, lava formations and waterfalls. The monument's centerpiece, 18-square-mile Newberry Crater, features wilderness lakes, campgrounds, and accessible, uncrowded trails.

A visit to Newberry — administered by the Forest Service — can take as little as a few hours to drive into the caldera, see Paulina and East lakes, and enjoy the startling views from Paulina Peak. Or take three or four days to camp, hike, fish and explore.



MICHAEL CLAPP

# ● *National Monument*



*Paulina Lake lies nestled in the gentle slopes of Newberry Crater.*



*Volcanic reflections in the Crooked River at Smith Rock.*

Warm midsummer weather makes camping appealing: July and August daytime temperatures range from 70 degrees to over 100 degrees, and drop as low as 30 degrees to 50 degrees at night.

From LaPine, drive north six miles along U.S. 97 to Country Road 21 (Newberry Crater Road), which leads to the monument. The crater lies well hidden as Road 21 climbs the 13 miles eastward along its sloping pine-forested shoulder. In about a half-hour, you cross the rim and emerge at the west end of Paulina Lake.

Cupped in the caldera lie two of the best fishing lakes in Oregon — Paulina and East — as well as two rustic resorts, seven campgrounds, numerous surrounding hiking trails, and viewpoints.



*Central Oregon's powerful geological history is told through the impressive folds and contours of the regional landscape.*

Throughout summer, activities include naturalist-led walks, flintknapping or arrowhead manufacture, and campfire programs at a small outdoor

amphitheater. Ask at the information center (open summers), on Country Road 21 just inside the rim, about upcoming talks. Maps and displays of the area can also be viewed here.

(Excerpted by Permission from Sunset Magazine, July 1991)

THE POWERFUL GEOLOGIC HISTORY OF CENTRAL OREGON IS EVIDENT IN THE REGION'S RICH VARIETY OF LANDSCAPES. REGIONAL VOLCANOES GREW UP TOGETHER IN LONG CHAINS, SUCH AS MT. BACHELOR AND THE PEAKS AND CONES TO ITS SOUTH, WHICH ERUPTED FROM AN 8-MILE NORTH-SOUTH CRACK, OR SERIES OF CRACKS, 14,000 YEARS AGO. LAVA FROM THE ERUPTIONS BLOCKED OLD RIVERS AND CREATED BASINS, BEHIND WHICH FORMED THE MANY AND BEAUTIFUL BODIES OF WATER ALONG THE CASCADE LAKES HIGHWAY.

REMARKABLE LAVA CAVES AND TUBES WERE ALSO FORMED, WHEN NARROW RIVERS OF LAVA CRUSTED OVER WHILE LAVA CONTINUED TO FLOW BENEATH THE SURFACE. MANY EXAMPLES ARE IN THE LAVA ARMOR ON THE SIDES OF NEWBERRY VOLCANO. LAVA RIVER CAVE AND OTHER TUBES SOUTHEAST OF BEND ARE AMONG DOZENS OF OTHER EXAMPLES.

SOUTH OF NEWBERRY VOLCANO, FORT ROCK BASIN, WHICH BEGAN TO FORM 13 MILLION YEARS AGO, IS ANOTHER FASCINATING FEATURE. DURING THE ICE AGE, THIS AREA FILLED WITH WATER. FISH FOSSILS REVEAL THAT THE RESULTING LAKE SPILLED OVER INTO WHAT WAS PROBABLY THE DESCHUTES OR CROOKED RIVER. AND CARBON-DATED SANDALS INDICATE THAT EARLY AMERICANS INHABITED THIS AREA 9,000 YEARS AGO.

FOR A CLOSE-IN LOOK AT THE REGION'S VOLCANIC ACTIVITY, DRIVE THE ROAD THAT SPIRALS TO THE TOP OF PILOT BUTTE RIGHT IN BEND, WHERE AN OVERLOOK REVEALS THE ENTIRE CENTRAL OREGON VOLCANIC SKYLINE.

LAVA LANDS VISITOR CENTER AND LAVA CAST FOREST, OPERATED SEASONALLY BY THE FOREST SERVICE ON HIGHWAY 97 BETWEEN BEND AND SUNRIVER, SHOWCASE EXAMPLES OF THE REGION'S GEOLOGY AND OFFER INTERPRETIVE PROGRAMS TO VISITORS.

## HISTORY AND CITIZENS COMMITTEE INVOLVEMENT

*"We had a vision of what could be; through a remarkable series of events, we've held that vision together and made it reality."--Stu Garrett, 1990*

Newberry Crater was considered, along with Crater Lake, for National Park status in 1903. Professor Crosby recommended park or Monument status for Newberry again in 1920. In the 1940's the local Chamber of Commerce proposed monument status and tried again in the 1970's.

Late in the fall of 1987, Stu Garrett, local Bend physician and chairman of the Monument Citizens Committee, banded together a dedicated group of about 25 individuals to re-create a vision of making Newberry a National Monument. Through a process of consensus and many long meetings, these people developed a proposal that encourages winter recreation, development of geothermal resources, natural processes of ecological succession, and the interpretation and protection of extraordinary volcanic features. Committee interests included geothermal energy, timber, and tourism industries as well as environmental groups, snowmobiling clubs, local business communities, state and federal agencies, and county commissioners.

The committee formed after geothermal drilling proposals for deep production-sized wells became public. Citizens feared that such drilling would destroy the unique geologic and scenic values of Newberry Crater, and they proposed the creation of the Monument. Negotiations with the Forest Service resulted in the formation of the Monument Citizens Committee that would represent all interests.

While the monument process was originally aimed at stopping geothermal activity in Newberry Crater and nearby areas, the committee found ways to satisfy the needs of the local community, environmentalists, and the geothermal industry. The consensus process created most of the unique sections in the legislation. Existing leases located within the boundaries of the Monument were traded for areas of comparable heat values on areas adjacent to the Monument. If commercial sources of geothermal resources are not located within 30 years, these areas will be withdrawn from further entry and the lands would become part of the Monument. In addition, the legislation requires Forest Service approval for surface-disturbing activities on leases.

The Monument was formally dedicated in June, 1991, with a ceremony at Lava Lands Visitor Center and public tours of the entire Monument. James Overbay, Deputy Chief of the Forest Service, who grew up in Bend, was on hand to help with the dedication. Hundreds of local business and volunteers donated their time, energy and money to assist with the two-day community celebration. Over 5,000 people attended the event, which marked the official opening of the nation's newest National Monument.

A copy of Public Law 101-522 can be referenced in Appendix C.

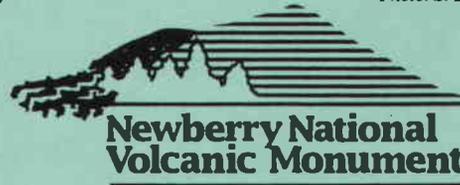


Paulina Lake from Paulina Peak, October, 1990

Photo: S. Lee DNF

Established November 5, 1990

Dedicated June 30, 1991



The Monument Citizens Committee and the Deschutes National Forest extend warmest appreciation to all the volunteers, Forest Service employees, contributors and communities who made the Dedication Celebration of the Newberry National Volcanic Monument a wonderful success! Community spirit created and dedicated this "gift to the nation" and this spirit will protect and preserve this unique "gift."

The Celebration provided an opportunity for people to enjoy the Monument and increase their understanding of the resource values which elevated the Newberry area to Monument status. Nearly 5,000 people took advantage of that opportunity and came to explore America's newest National Monument.

## Thank You All!

Action Typesetting & Printing - Larry & Mike Lancaster  
 Loreln Aegen  
 Air Life of Oregon  
 All Seasons R.V. & Marine - John Richey  
 Steve Alley  
 Tom Andrade  
 Kimberly Arnold  
 Albert Arguello  
 Aubry's 4 Seasons Florist  
 Beaver Coaches Sales of Oregon - Scott Keele  
 Mark Beighley  
 Bend Chamber of Commerce - Ambassador Club  
 Bend/Lapine School District - Denise Sporslasky  
 Bend Metro Parks & Recreation - Carrie Whittiker  
 Ben Benhower  
 Dean Bihles  
 Bob Thomas Chevrolet, Cadillac - Bob Thomas  
 Maria Borja  
 Boy Scout Troop 21 - Tim & Henry Albritton, Lee & Eric Campbell, Adam, Gary & Matt Clausen, Gregg Conaway, Brian Hoblit, Scott & Sean Jones, Jessie & Stu Laird, Scott McClelland, Betty Leo & Kevin Renk, Joel Ronnigen, Kevin Wilson  
 Bohemian Brass  
 Bend Bulletin  
 Rico Burgess  
 Karen Bushnell  
 Alvin Cade  
 Cafe N.E.W.S. - Mark Flowikowski  
 Caprine Express, Inc. - Pat Cutting  
 Todd Cardin  
 Carmin Marimba Band - Greg Burke  
 Jack Carpenter  
 Bill Carter  
 Mary Jane Carver  
 Paul Chan  
 Sandra Chandler  
 George Chesley  
 Larry Chitwood  
 Shelly Christopher  
 Linda Clark  
 Jenne Clayton  
 C.O.C.A. Meals on Wheels - Mary Tinker  
 COCC - Erika Fitzgerald  
 C.O.M.A.C. - Bob Greenstreet  
 Linda Collier  
 Sally Collins  
 Crescent, LaPine, Sunriver Rural Fire Departments  
 Willie Crippen  
 Roger Crisafi  
 Jose Cruz  
 Karen Curtis  
 Deschutes County Public Works - Bonnie McGillvray  
 Deschutes County Sheriff  
 Alice Doremus  
 Andy Eglitis  
 Frank Ellis  
 Max Elkins  
 Frank Erickson  
 Steve Easelstyn  
 Federal Highway Admin. - Ken Welborn  
 Meg Fellerath  
 Gert Ferguson  
 Dick Ferraro  
 Michelle Finck  
 Evelyn Findley

Steven Fischer  
 Robert Fujimoto  
 Peggy Gaines  
 John Gayle  
 Wendy Gersher  
 Girl Scouts of America Troop #150 - Stella Maekey  
 Linda Goodman  
 Kay Goodmanson  
 Good Sams - Cliff & Vi Anderson, George & Sydney Anderson, Ober & Louise Hall, Mr. & Mrs. A. Malstrom  
 Mike Hanemann  
 Denise Hann  
 Diane Hutton  
 Karri Heap  
 Leonard & Sharon Herzstein  
 Tom Hittlet  
 Harry Hoogesteger  
 Patricia Hudspeth  
 Allison Hull  
 Marlene Hunt  
 Bob & Carol Jensen  
 Suzanne Johannaen  
 Bill Johnson  
 Kim Johnson  
 Laurie Johnson  
 Bill Jones  
 Pat & Lee Joslin  
 Connie Kahler  
 Ed Kraehmer  
 Karla Kaenzulak  
 KTVZ-21 - John Larkin  
 Kerry Laekey  
 LaPine Chamber of Commerce - Peggy Spigler  
 Phyllis Larmay  
 Lava Lands Visitor Center - Judy Bever, Vicki English, Paul Findley, Leo Gaston, Bob & Louise Gerlach, Perry Graven, Joan Haekett, Gail Hakola, Lisa Hoffman, Lloyd Holt, Al & Janet Kruse, Jerry Larson, John Masterson, Bob Potter, Jean Wayman  
 Mara Lehman  
 Jeff Le Claire  
 Sherri Lee  
 Michelle Liberty  
 Lodge Pole Dodgers - Tom Sly  
 Marlene Loshbaugh  
 Erin Maekey  
 Rusty Marcum  
 John Marker  
 Bill & Virginia Martin  
 Steve Mats  
 Jim McCauley  
 Cez & Jennifer McClarren  
 Dennette McComb  
 Sandi McDonald  
 McDonald's Portable Toilets - Bill McDonald  
 Lee Means  
 Thomas Means  
 Bill Mergal  
 Ken Meyer  
 Ken Meyer Sr.  
 Mike's Carpet Warehouse - Mike Plaia  
 Miller Lumber Company - John Miller  
 Monument Citizens Committee  
 Moon Country Snowmobilers - Marilyn & Ray Peterson  
 Gena Meyer  
 Mt. Bachelor Corp. - Kathy DeGree

Jeanie Mullens  
 Dr. John Strong Newberry  
 Newberry Crater Visitor Center - Frank & Mary Cheney, Phyllis Cheney, Mildred Crites, C.A. & Eleanor Hockett, Suzi Lewis, Don Sargent  
 Bruce Olson  
 Oregon National Guard - 1st Battalion 82nd Cavalry  
 Oregon State Police  
 Oregon State Snowmobile Assn. - Howard Gieger  
 Jim Overbay  
 Donna Owens  
 Kay Lynne Pagel  
 Martha Pagel  
 Don Pearson  
 Pepsi-Cola 7 Up Bottling Company - Pat DuVoll  
 Orde Pinekney  
 Ponderosa Printing & Typesetting - Jeanette Boorman,  
 Mark Frielee & Sharon Swift  
 Ginger Porter  
 Prineville Bank - Valarie De Folio  
 Bill Queen  
 Sarah Riley  
 Kim Rivard  
 Tammy Ronceray  
 Tom Russeil  
 Safeway Stores, Inc. - Dave Vernon  
 Carrie Sammons  
 David Savage  
 Ron Schiltz  
 Liz Sinclair  
 Shirt Circuit - Dan Leneh  
 Honorable Bob Smith  
 John Smith  
 Jami Snelson  
 Sound Advice - Cliff Wyland  
 Susan Strauss  
 David Summer  
 Sunriver Properties - Sheridan Atkinson  
 Jennifer Tatum  
 Deb Taylor  
 Telephone Pioneers of America - Susie & Malcolm Campbell, Bob & Marlene Funk, Sharon & Wally Hoblit, Dick & Carolyn Nelson, Jerry Rice  
 The High Desert Museum - Ron & Trudy Bellot, Diana Daniel, Ben Francey, Virginia & Bill Fuller,  
 Dana McCarty  
 Stoa Thompson  
 Tom Throop  
 June Tillman  
 David T.J. Tjomsland  
 U.S. Postal Service - Steve Apling, Jerry Campbell  
 Mari Van Dyke  
 John Van Patten  
 Holly Van Ronk  
 Veterans of Foreign Wars #1643 - Alleine Scanzand  
 Sherry Wagner  
 Wagners Supermarket - John Overbay  
 Al Waibel  
 Christine Walsh  
 Danny Weinrich  
 Bob White  
 Mark Wilson  
 Patricia Wilson  
 Roberts Wilson  
 Ruth Yazzie

Bend, Ore., for Sunday, July 21, 1991

## MONUMENT RESOURCES

### INTERPRETATION

Located 11 miles south of Bend on Highway 97, Lava Lands Visitor Center serves as the interpretive hub of the Monument. The Visitor Center has welcomed over two million visitors to central Oregon since it opened in 1975. The Center features dioramas, small interpretive displays on volcanism and geothermal energy, and educational books and materials. The facility, however, is outdated, in need of repair, and too small to handle the increase in visitorship. During the summer, about 1,700 people per day pour into the small facility, seeking education, entertainment, and restrooms. Yearly visitation exceeds 100,000 and the center is only open half the year. Annual visitations are expected to rise to 275,000 by the end of this decade.

The creation of a new interpretive center to replace the small, outdated Lava Lands Visitor Center has been identified as the highest recreation priority on the Deschutes National Forest. We envision a major educational, interpretive, and research facility with active and evolving displays and exhibits, field trips, talks and lectures, demonstrations, interaction with researchers and curators, and works of art. The Interpretive Center will be the link between the Monument, central Oregon, and the world.

A feasibility study was recently completed for this proposed expansion, and citizens who worked together to create Newberry National Volcanic Monument are excited about the possibilities for the new Center. Visitors to the National Monument do not distinguish between the National Park Service, which manages almost all monuments, and the Forest Service, which manages only four national monuments. People expect a high standard of quality for interpretive facilities at national parks and monuments.

Central Oregon is a region of international significance in the fields of geology and archaeology. The great expanse of Newberry Volcano may be thought of as one archaeological site and from the Cascade crest eastward, a truly astounding array of geologic and volcanic features shape the landscape. The most important aspects of this outstanding area are quality, diversity, and accessibility. Nowhere in the world do such scientific treasures occur in such close proximity with such easy access for so many. We believe it would be difficult to find a Forest in the nation with more potential for the development of comprehensive, leading edge educational and interpretive programs. The Monument will be the magnet drawing people in and, through the vision of this new interpretive center, we will send them out into the world to view and learn more about the surrounding volcanic landscape.

Although the new interpretive center would be physically located in the Monument, the interpretive vision extends far beyond Monument boundaries. An integrated interpretive plan would be developed to include the Monument but the question remains - Should this interpretive plan be included in the Monument Management Plan meant to guide the development of a specific 50,000+ acres?

Lines are drawn on maps; these are usually political boundaries but these lines often become walls which limit our thinking. Nature recognizes no such boundaries. While the Monument is unique and remarkable, focusing attention on an isolated geographic feature is akin to describing one tree in the vast continuum of an ecosystem. This restricted view does not begin to portray all the remarkable aspects of that tree. In the same way, the Monument is part of an enormous volcanic complex located in central Oregon, which in turn is part of a dynamic global system known as plate tectonics. The same can be said for cultural and biological features that derive from this unique landscape. When Newberry Volcano is seen in this context, its significance is increased one thousand fold.

## GEOLOGY

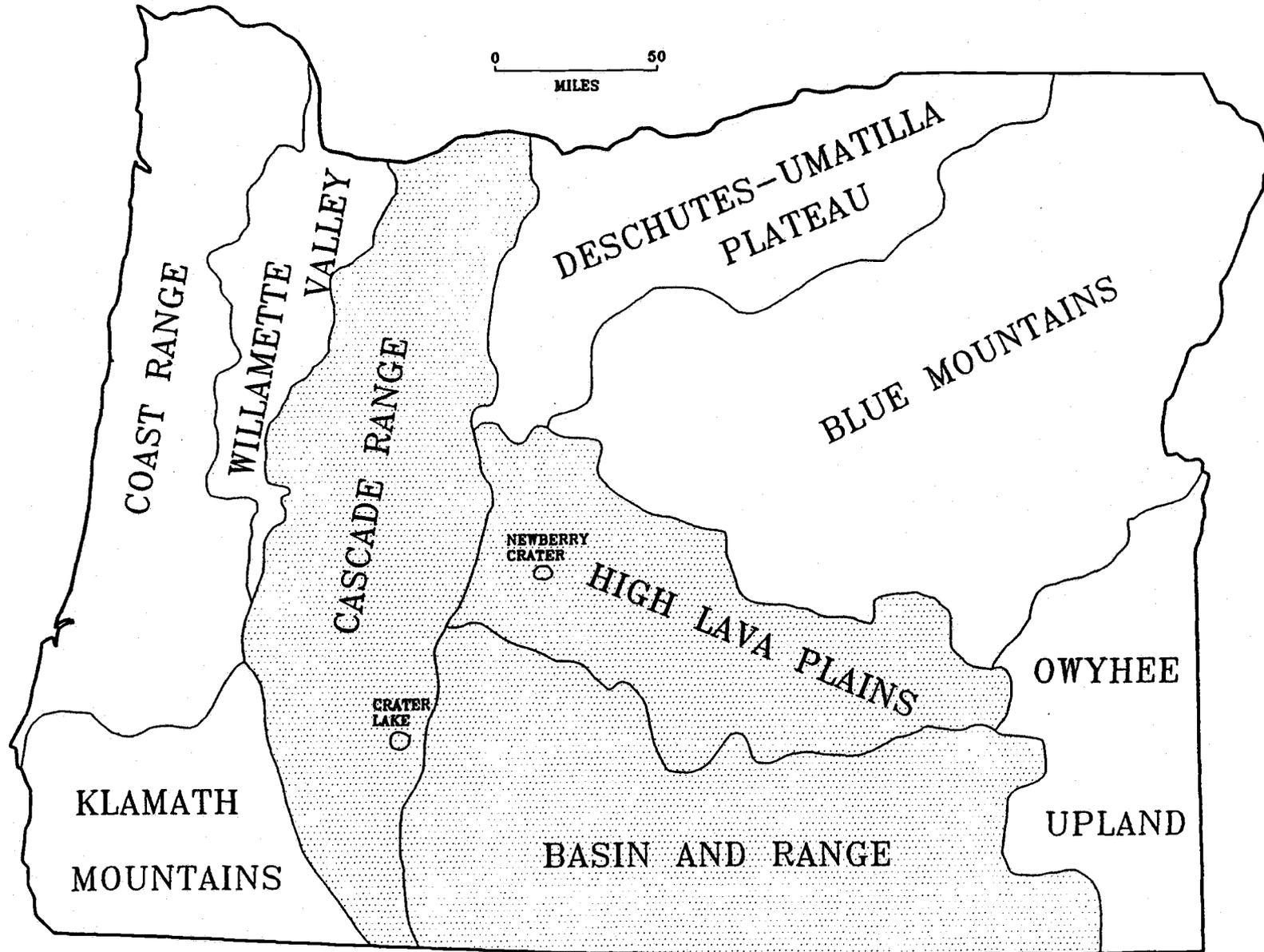
### *General Setting*

Newberry Volcano's location is no accident; it lies at the intersection of three geologic provinces (see map on page 5A). The intersection of fault zones related to these provinces localized volcanism and produced the large size of Newberry. The crest of the Cascade Range runs north to south, approximately 25 miles to the west of Newberry. The High Cascades are a range of young volcanoes (less than 2,000,000 years old) and are a product of subduction of the Juan de Fuca plate under the North American plate. South and southeast of Newberry lies the Basin and Range province of North America, which extends south through Nevada, Arizona, New Mexico and well into Mexico. This province consists of block faulted mountains separated by alluvial basins. Walker Rim (south of Newberry) represents the most northwesterly extent of the Basin and Range province in Oregon. East of Newberry lies the High Lava Plains province, which includes the Brothers Fault Zone which marks the northern boundary of the Basin and Range province in Oregon. (See "Glossary of Geologic Terms" in Appendix B to enhance your knowledge and understanding.)

### *Newberry Volcano*

Newberry Volcano is among the largest Quaternary volcanoes in the lower 48 states. It covers an oval area (20 miles east-west by 30 miles north-south) in excess of 500 square miles, and lavas from it extend northward many tens of miles beyond the volcano. Evidence suggests that the geologic history of Newberry is complex and includes multiple episodes of caldera formation. There is evidence that volcanic activity has occurred at the site of Newberry for at least a million years. None of the rocks on Newberry have yet been dated at more than 700,000 years but intracanyon flows at Cove Palisades State Park (dated at 1.2 million years old) are chemically similar and disappear beneath Newberry flows when traced to the south. On the northeast flank of the volcano are the unusual rock formations of Tepee Draw. The Tepee Draw welded tuff has been radiometrically dated at somewhat over 500,000 years old and is a deposit from the earliest recognized caldera forming event at Newberry. At least 3 more deposits from probable caldera forming events are known on Newberry. Geologists currently believe that Newberry has never been much higher than it is today and that a caldera has been present for much of its geologic history. Today's caldera (4 by 5 miles wide) is the result of voluminous tephra eruptions of silicic composition from one or more magma chambers below the former summit resulting in multiple overlapping collapses that have gradually enlarged the caldera to its present size. The caldera, which contains East and Paulina Lakes, has been the site of numerous Holocene eruptions, the most recent of which occurred about 1300 years ago. Most of the caldera floor is formed of rhyolitic rocks including domes, flows, and pumiceous tephra deposits (ash flows, pumice falls, and explosion breccias), but basaltic andesite and andesite flows and plagioclase tuff rings occur in several places. These floor rocks represent the top of a 1600-foot thick caldera fill.

The gently sloping flanks of Newberry consist of basalt and basaltic andesite flows, andesitic to rhyolitic ash flow and air fall tuffs and other types of pyroclastic deposits, dacite to rhyolite domes and flows, and alluvial sediments produced during periods of erosion of the volcano. The slopes are dotted with over 400 cinder and spatter cones and a few silicic domes. Some of these are probably more than a half million years old but some such as Lava Butte are only about 6000 years old. The Monument includes many of the youngest cinder and spatter cones and their associated lava flows. Many of these young vents are located along the Northwest Rift Zone of Newberry which extends from the caldera to the Deschutes River. The rift zone is a series of northwest trending fault segments that create a zone of weakness along which volcanic activity has occurred for a long period of time. About 6,100 C14 years ago three to five short eruptive episodes occurred from vents along this zone producing 11 basaltic lava flows.



GEOLOGIC PROVINCES OF OREGON



**SUMMER DAY AT LAVA BUTTE**

### *Lava Butte Area*

As magma rises, gases begin to come out of solution and rise toward the top of the magma body so that the first magma to reach the surface is gas rich. About 6100 years ago a highly gas charged and very fluid basaltic magma reached the surface along fractures within the Northwest Rift Zone. As the magma reached the surface it erupted along a 1.5 mile long fissure as a curtain of fire like many eruptions in Hawaii. These early eruptions probably lasted from a few hours to a few days and formed a series of spatter cones and thin pahoehoe flows along much of the length of the fissure. Today, evidence of these initial eruptions can be found east of U.S. Hwy. 97 in what are known as the Gas Line Flows, but have been buried by Lava Butte west of the highway.

As the eruption continued, most of the fissure sealed off and eruptive activity was concentrated at the site of Lava Butte. The magma was becoming less fluid, so escaping gases carried larger quantities of foamy lava fragments (cinders) into the air. Blown by the prevailing southwest winds the cinders fell back to the ground to build a cone. Due to the wind, over two-thirds of the cone's volume is north of the crater and the cone's northeast rim is higher. In addition a deposit of finer cinders was spread mainly to the northeast and is exposed in the highway cuts north of Lava Butte. Charcoal from beneath these fine cinders was used to obtain a C14 date of 6160 years.

As the highly gas charged magma was depleted, magma began to rise up into the cone. The thin south side was not strong enough to contain the fluid magma which broke through the cone to form lava flows. The early flows were still quite fluid and spread over five miles to the west and north. During the following months numerous overlapping flows spread out and covered more than 9 square miles. It has been estimated that of the total amount of lava erupted from Lava Butte; 90 percent of it is found in the lava flows, 9 percent in the butte itself, and 1 percent in the air fall material to the north.

To the west the flows entered the channel of the Deschutes River at several places. In an area from above Benham Falls to Dillon Falls, the flows filled the river's channel with over 50 feet of lava. A lake was formed which extended upstream through the Sunriver area. When the lake filled it found an outlet across a low divide in an ancient lava dome over a million years old. The river today continues to cut into this dome at Benham Falls.

When Newberry is viewed from the top of Lava Butte it is easy to see the shield-shaped profile of the volcano. The shield shape is classically seen in the basaltic volcanos of the Hawaiian Islands, however, Newberry is not a true shield volcano. It is actually made up of low and high silica rock types. The low silica (basaltic) rocks form fluid lava flows that spread out on low gradients. The high silica (rhyolites) when erupted in large volumes typically form ashflows which also spread out over low gradients. Andesite and basaltic andesite are of a more intermediate composition and tend to form the steeper sided cones common in the High Cascades.

In the summer, shuttle buses run to the top of the Butte, and visitors can talk with the Forest Service fire lookout there, and watch him performing his duties. It is a major draw, and for many people, the only chance they have to observe the first line of fire fighting up close. There is also a small interpretive display and map at the top of the Butte.

### *Lava River Cave*

Lava River Cave was discovered by Leander Dillman, about 1889, and was known as Dillman's Cave until 1921. The Shevlin-Hixon Lumber Co. deeded 22.5 acres of land surrounding the entrance, to the State of Oregon in 1926 for a state park. The area was a state park until 1981 when it was acquired by the Deschutes National Forest in a land exchange. The main northwestern portion of the cave is 6,180 feet long and drops 170 feet in elevation. The southeastern (undeveloped) portion of the cave is 1600 feet long.



PHOTO: MIKE HANEMANN

**LAVA RIVER CAVE, DEDICATION DAY**

Lava tubes form only in basaltic lava flows. The most important factor in tube formation is low viscosity, which is a function of temperature, chemistry, and the amount of gas dissolved in the lava. The lava flow is more fluid and less viscous at higher temperatures and/or with a higher gas content. Basalt is the only volcanic material fluid enough to permit development of tubes, but even some basalt flows are too viscous for tube formation. Basalt occurs as pahoehoe flows, aa flows, and block flows. There is a complete gradational series between pahoehoe, aa, and block flows relative to increasing viscosity. Lava tubes form only in pahoehoe flows and are so common that they are evidently the primary means of flow advance. Small distributary tubes branch from the main lava tube to feed the flow front.

In general there are two types of tubes (minor and major) and each type forms differently. Minor tubes are the distributary tubes which directly feed advancing flow fronts and are typically active for a relatively short period of time. They are typically a few feet wide but occasionally may be up to 30 feet wide and rarely extend more than a 1000 feet in length. On smaller tubes the roof may be less than a foot thick while on larger ones no more than a few feet thick. They form in small single flow units and often occupy nearly the entire flow unit. Major tubes are roofed over sections of the major channels that transport the lava from the vent to the distributary tubes. Depending on the length of eruption these major channels may be active for months. During periods of high flow they overflow the channel banks so that the channels are deepened from the ground up by successive overflows. During periods of uniform flow the channel may roof over by a crust growing from the edges to the center of the channel. If the flow rate remains constant for long enough, the crust will thicken enough to support its own weight, when the flow rate is reduced. Higher rates of flow may destroy the roof or strengthen it by adding layers inside or outside (from overflows). A roofed over lava channel conserves the heat of the flow so that the channel can continue to increase in length. When the eruption stops the channel may partly drain to form a major lava tube. A lava tube system is a meandering series of lava ponds, open channels, collapsed trenches, and lava tubes.

Lava River Cave, located one mile south of Lava Lands Visitor Center off Highway 97 can be toured, with a nominal entrance fee charge. Lanterns can be rented on-site and visitors should be careful of ice and always carry two light sources when descending into caves.

The Monument contains several other caves formed by volcanic action over the past centuries.

#### *Lava Cast Forest Area*

The Lava Cast area was discovered in 1925 by Walter Perry of the Forest Service and was set aside as a Geological Area in 1942. The name of the area is based on the many lava trees and tree molds in the area, but is incorrect because a mold is formed around an object whereas a cast fills a mold, so the area should actually be the Lava Mold Forest.

Lava trees and tree molds are formed when fluid lava enters a forested area. As fluid pahoehoe surrounds a living tree a crust of solidified lava forms about the tree due to the moisture in the tree quickly cooling the lava surface. The tree will either be burned to ash or converted to charcoal depending on the availability of oxygen. If the level of the flow drops, a collar of lava may project above the final surface to indicate the high stand of the flow.

The area includes portions of three lava flows: Forest Road Flow, Lava Cast Forest Flow, and Lava Cascade Flow. Based on C14 dates that range from 5800 to 6400 years before present and the contacts between flows, it had previously been assumed that each flow dated from a separate eruption. Based on work on the tephra deposits related to the flows it can now be shown that all three flows are from the same short eruptive episode. The vents for this eruptive phase are located on a 7 mile long series of fissures which stretch from East Lake nearly to Mokst Butte. The best C14 dates indicate an age of 5900 years for this eruption. The lavas here flowed into a forest of mature Ponderosa pine trees, enveloped the tree trunks and solidified before the heat was able to burn out the wood resulting in a lava mold. The eruption probably lasted for only a few days to few weeks.

The landscape now includes the "casts" or molds, of these ancient trees. Colonizing plants, such as delicate penstemon flowers and Indian Paintbrush, have taken root in the ash soil. Ponderosa Pine trees have re-established themselves and flourished as well, so that the landscape now includes a blend of the past and the present. A one-mile paved trail loops through the area.

### *Paulina Creek Falls*

Just prior to entering Newberry Crater from the west is Paulina Falls. Two trails lead to two viewpoints of these 80-foot falls. Paulina Creek drains Paulina Lake which is less than a half mile to the east. The rocks that make up the cliffs over which the falls drop are pyroclastic deposits erupted from a ring fracture bordering the west side of the caldera. As water from the falls erodes the weak units below the cliff, the cliff becomes undercut and sections fall resulting in upstream migration of the falls. Geologic processes are ongoing even if infrequent. In 1983 a large section of the cliff between the two falls fell exposing fresh rock. Given sufficient time the creek will continue to cut headward and will eventually drain Paulina Lake.

### *Paulina Peak*

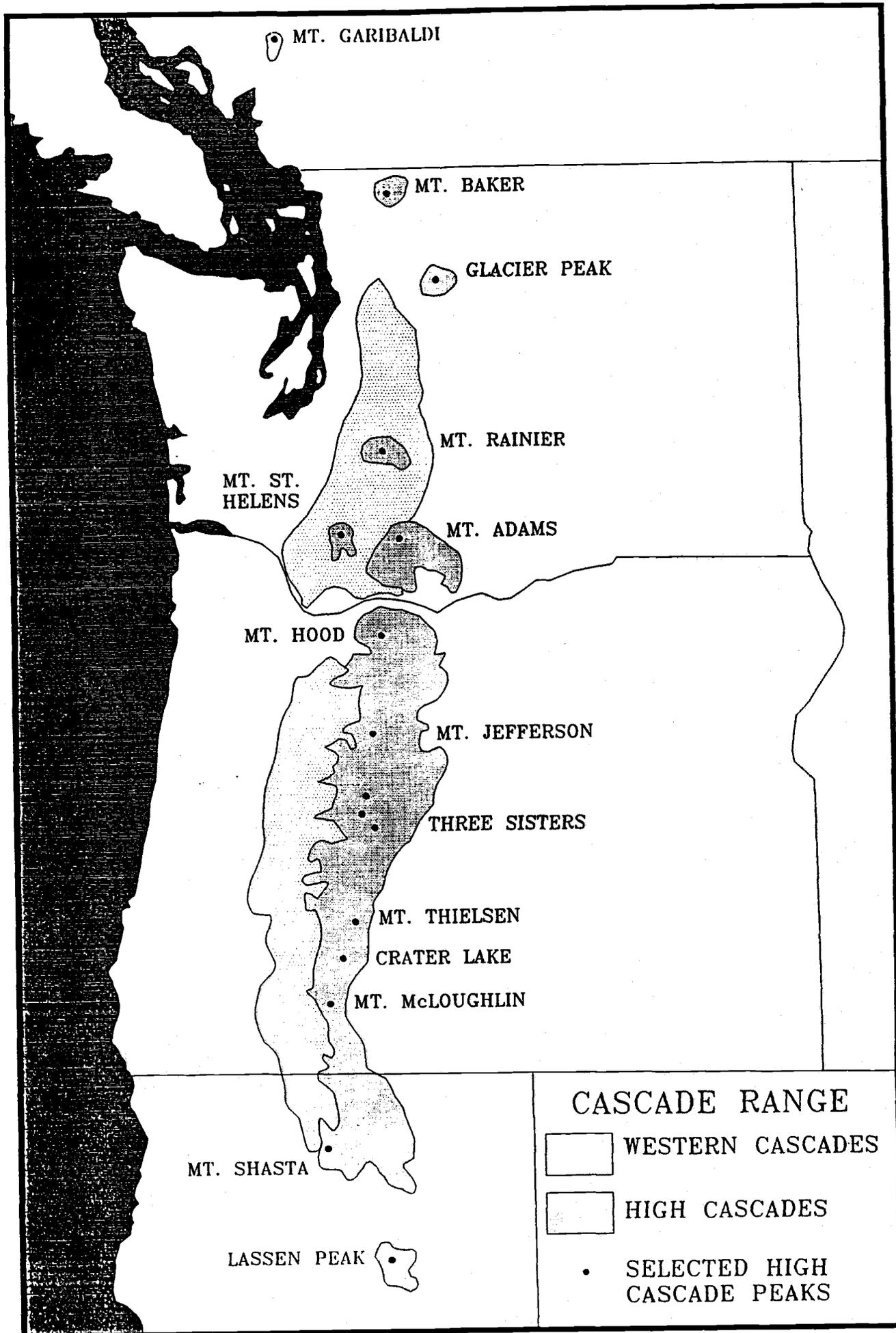
Paulina Peak (the current high point of Newberry Volcano) is a large rhyolite dome located on the southwest rim of Newberry Crater on a fracture along which caldera collapse later occurred. From the 7,984 foot summit a view of much of Central Oregon is possible. Paulina Peak is the third highest spot that one can drive to in the state of Oregon. It is one of the best views in the entire state. From the summit of Paulina Peak, everything that one sees is volcanically derived. All the mountain peaks on the western horizon are volcanos. All the buttes, plains, and hills in any direction are made up of the products of volcanos. Even the alluvial basins such as the Fort Rock basin and the La Pine basin are filled with products erupted or eroded from volcanos.

Looking to the west one sees the entire Cascade Range from Mount Adams in Washington to Mount Shasta in California (see map on page 8A). Not only do you see the dozen or so majestic snow capped peaks but there are hundreds of smaller cinder cones, shields and composite cones. To the immediate west is the La Pine basin which contains volcanic sedimentary deposits at least 1300 feet deep. Some of the near surface units are lakebeds formed when flows from Lava Butte dammed the Deschutes River near Benham Falls. This dam backed up the river forming a shallow lake which covered much of the Sunriver area.

To the south are Walker Mountain and Bald Mountain. Walker Mountain is the northwestern most expression of the Basin and Range province. Faults of the Walker Rim Fault Zone extend to Newberry's lower south flank. Some of the older rocks, such as the dacite flows on Indian and Amota Buttes, are offset several hundred feet by faulting but younger basalts which surround Indian and Amota Buttes are only offset a few tens of feet. Bald Mountain is a rhyolite dome on the south side of a poorly preserved 4 to 5 million year old caldera which erupted widespread ash-flow tuffs that crop out from Fort Rock Valley to Walker Mountain.

To the east and southeast lies Oregon's high desert and on an extremely clear day the escarpment of Hart Mountain and Steens Mountain can be observed with binoculars. To the southeast is the basin of ancient Fort Rock Lake, which most recently held a 300-foot deep lake about 20,000 years ago. The lake has probably been dry the majority of the last 10,000 years. The basin has no outlet to the ocean and is indeed a part of the Great Basin. Any precipitation flowing into this area can only leave by evaporation. Due east lie China Hat and East Butte which are rhyolite domes 800,000 and 900,000 years old respectively.

To the northeast lie the Ochoco Mountains which are Clarno and John Day age volcanoes and their deposits. To the north is the Deschutes Basin which preserves the deposits of the early High Cascades.





**PAULINA FALLS, SEPTEMBER**

### *Newberry Caldera Features*

Within the caldera one's attention is drawn to the two lakes, East and Paulina. Paulina Lake covers an area of approximately 1530 acres and has a maximum depth of 250 feet, while East Lake covers an area of approximately 1050 acres and has a maximum depth of 180 feet. The lakes are the surface expression of ground water trapped within the bounding faults of the caldera. There are no surface inlets to either lake as most water comes from precipitation (rain and snow) within the caldera. Paulina Lake does discharge into Paulina Creek. Both lakes have drowned hot springs in them, which provide a minor input of water to the lakes. On the southeastern shore of East Lake there is a particularly active area of springs where the smell of sulphur can be detected. During the early 20th century, the East Lake Health Resort was located in this area, but little can be seen of the resort now. Similar hot springs occur in the northeastern part of Paulina Lake.

The caldera of Newberry Volcano is a geologic wonderland of lava flows, ash flows, pumice cones, and tuff cones. The most prominent flow in the caldera is the Big Obsidian Flow, which also happens to be the youngest dated flow in the state of Oregon. It erupted approximately 1300 years ago and not only produced the magnificent obsidian and rhyolite flow that is visible, but also spread an ash flow into Paulina Lake and spewed out a large amount of pumice that covers the southern part of the caldera and extends for over 40 miles to the east.

Another prominent feature of the caldera is the Central Pumice Cone. This 6700 year old cone contained a lava lake which drained to form the Game Hut Obsidian Flow on the south side of the cone. The Interlake Obsidian Flow is also about 6700 years old and is located north of the Central Pumice Cone. Southeast of East Lake are two 3500 year obsidian flows.

South of the Central Pumice Cone and East of the Big Obsidian Flow is the location of the U.S. Geological Survey Newberry Well No. 2. This well was drilled in 1981 to a depth of 3,058 feet and yielded temperatures of 509 degrees Fahrenheit. Geologists learned from this well that Newberry caldera was once deeper than it is today. The first 1640 feet of drilling consisted of caldera fill deposits made up of sediments and caldera eruptive products. Below 1640 feet the rocks are similar to the flows on the flanks of the volcano and may be the former upper part of the volcano that collapsed to form the caldera.

Basaltic vents and flows occur on the north wall near Paulina Lake (Red Slide), East Lake (East Lake Fissure and Sheeps Rump), and a long fissure vent occurs near the top of the east wall. All of these vents and associated flows are pre-Mazama in age, except the East Lake Fissure, which is the southernmost vent of the Northwest Rift Zone.

One of the more interesting and unusual types of volcanoes that occur in association with Newberry Volcano is the tuff ring or maar. Maar is the German term for this type of volcano. The chemical composition of the palagonite tuff making up these volcanos is the same as that of basaltic cinder cones. The difference comes from the fact that these types of volcanos are formed when rising basaltic magma comes into contact with abundant ground water as it rises. The resulting contact generates violent steam explosions which drive muddy slurries of fractured rock away from the vent producing low ring like structures. These volcanos occur in only two areas on the volcano where ground water is abundant. The first is within the caldera and Little Crater along the southeast shore of Paulina lake is an excellent example. The second area is along the southeast flank of Newberry at the margin of the Fort Rock Basin where Fort Rock and Hole-in-the-Ground are examples.

### *Big Obsidian Flow*

Although the flows within the caldera are called obsidian they are a complex mixture of obsidian, pumice and rhyolite. Chemically they are rhyolitic in composition and the name applied to a particular piece of



**BIG OBSIDIAN FLOW**

**L. CHITWOOD AND GROUP OF MANAGERS FROM EL SALVADOR**

rock depends on its cooling history and gas content at time of eruption. As with basaltic eruptions the early part of a rhyolitic eruption is typically highly gas charged but because rhyolite is so sticky the resulting eruption is extremely violent and can produce large deposits of air fall and ashflow pumice (like Mt. St. Helens). Later in the eruption, as degassed magma reaches the surface, thick massive flows of rhyolite occur. Under conditions that are not well understood portions of these flows may form obsidian.

Obsidian is a natural glass erupted from a volcano. It forms mainly in lava flows and welded tuffs. In lava flows, molten rock rising to the surface probably foams while losing gases, then the foam compacts into rhyolite or dense obsidian which flows onto the land surface. In ash flow deposits, the glassy ash in the center of the deposits may weld together to make obsidian if the deposit is thick and hot enough.

Obsidian is not the result of rapid cooling as is commonly believed. Instead, the highly viscous nature of the liquid makes it very difficult for chemical elements to move around, combine, and crystallize. Obsidian has a chemistry that is rich in silica (silicon dioxide) and poor in metals (calcium, sodium, magnesium, and iron). Lacking metals, the silica joins together in long strands that greatly increase the viscosity of the liquid rock. Since crystals have difficulty forming, a glass forms with little or no crystalline structure.

Obsidian would be clear except that microscopic crystals give it a variety of colors, most commonly black and red. The black color comes from extremely tiny crystals of magnetite (oxides of iron) scattered through the glass like dust in the sky giving beautiful colors to a sunset. Thin pieces of obsidian seem almost clear. A red color comes from highly oxidized minerals of iron. In this case, the iron becomes highly oxidized in the oxygen of our atmosphere, not under the ground.

The eruption that created the Big Obsidian Flow happened in three phases about 1300 years old, the youngest known eruption on Newberry Volcano. The eruption began explosively with a towering column of pumice and ash. Wind carried the pumice and ash eastward where it slowly fell to the ground covering over 250 square miles of the eastern flank of Newberry. At 5.5 miles from the vent the pumice fall is about 12 feet thick, while at 40 miles it decreases to about 10 inches. During the next phase, the height of the eruption decreased and the eruptive column acted like a giant water fountain. That is, pumice and ash continued to shoot up out of the ground but the mixture fell back around the outside of the rising column at great speed producing a hot and violent ash flow that raced over the land and across Paulina Lake covering 2 to 3 square miles. The first two phases probably lasted a few hours to a few days. After the initial venting of gases by the eruption column the final phase was the relatively quiet extrusion of the Big Obsidian Flow and the dome that marks its vent. The Big Obsidian Flow covers about one square mile and ranges from 100 to 300 feet thick over most of its area. The total volume of the eruptions was 0.06 cubic miles of which the flow is slightly more than half.

-Geology write-up prepared by Robert A. Jensen...

## **HISTORY and PREHISTORY**

First, many folks often confuse the terms "history" and "archaeology". History is an account of events or records which have been documented over time. Historians study existing documents and records and may also interview people or their descendents (oral history). On the other hand, archaeology is the study of the physical remains from all people who have lived before us.

Therefore, archaeologists study the remains of people that lived both before and after written records were kept. The time prior to written records is referred to as "prehistory". Native American Indians have lived in central Oregon during both periods, while homesteaders, railroad logging companies, and early Forest Service and Civilian Conservation Corp employees fall into the "historic" period. Archaeological studies may involve documentary research, field survey, site excavation, or all of the above.

Both the prehistory and history of Newberry National Volcanic Monument is intimately joined with the geologic environment. The prehistoric plants, animals, and people have adapted to the many volcanic eruptions in central Oregon. The great thickness of volcanic ash has created a landscape that is too dry for many of the root crops that Native American Indians depended upon to grow, so they had to travel to or trade for these resources. As well, lava flows have created falls which block salmon from reaching the boundaries of the Monument and therefore, people had to travel to the lower Deschutes River to fish for these resources. Since little or no water flows east of the Deschutes River, partly due to the mantle of lava and volcanic ash that covers the region, places where water is available drew both people and animals.

However, the geologic story is not all bad news for ancient Native Americans. Water can usually be found in pockets associated with lava flow edges, lava tubes, and lava tube collapses. The numerous obsidian flows provide abundant stone for making tools. As well, the pattern of vegetation that grew upon this volcanic landscape provided excellent hunting and sufficient plant foods for Native American survival.

In the late 1800s and into the 1900s, the white settlers of the area found little agricultural land that was worth working, however, they did find other resources. The timber companies found large stands of ponderosa pine timber growing on the ash that covered the lava flows. Developers and recreationists found wonderful volcanic vistas and hot springs to soak their aching bodies. This same pattern can be seen in the area today, and the past holds lessons for the future.

The result of this geologic pattern is that people who lived in and around the Monument developed their own way of life that was tied to and dependant upon these geologic features. Without these features the prehistory and history of the Monument as described below would be vastly different.

### *Prehistory of the Monument*

From archaeological excavations within central Oregon we know that people have lived here for almost 13,000 years. The earliest people, referred to as "Paleo-Indians" or the oldest Native Americans, may have hunted now extinct animals, such as mammoths and mastodons, with thrusting spears. Today all we see are the stone points that tipped those spears. By about 10,000 years ago the land was drier and hotter than it had been and "Archaic" or ancient Native Americans were hunting and collecting much of the same animals and plants as we find today. They used an "atlatl" or spear thrower to hunt animals and various stone, bone, and wooden tools to collect and process the plant and animal foods that they used. Food might be collected or carried in baskets made of plant fibers. They lived in small shelters made of willow branches that were covered by sagebrush, pine boughs, or woven mats and lined with furs and mats. By as early as 2500 years ago people started using the bow and arrow, but otherwise their lives were changed very little from previous generations. By the time "Euro-Americans" came to central Oregon, many of the Native peoples lives had been dramatically changed by the introduction of disease,

trade goods such as metal, cloth, and glass, and by the horse. Illustrations of various artifacts are shown on the following pages.

There are no known "Paleo-Indian" sites within the Monument, however, it is likely these people hunted within the area and crossed the area on their travels. While only an occasional spear point has been found in the area surrounding the Monument, there is ample evidence that they lived along the shores of ancient Fort Rock Lake to the south and east of the Monument. These people may have hunted and collected obsidian from the flanks of Newberry Crater and traveled along the Deschutes River to and from the Columbia River.

The "Archaic" peoples left evidence of their camps and travels across all of the Monument. There are over 60 known "Archaic" sites within or immediately adjacent to the Monument, with many more yet to be found. Like Native Americans that were here when Euro-Americans arrived, these people probably lived on the banks of the Deschutes River during the winter and moved up into the surrounding mountains during the summer. Wherever they went they depended on the geologic landforms and resources.

While not a geologic resource, the Deschutes River has been shaped by geologic forces and has thus shaped the lives of the ancient Native Americans. The Deschutes provides water, food, and a warmer area to camp in the winter for the people who lived on the terraces and in the caves along its banks. There are numerous prehistoric camp sites along the banks of the river, including Lava Island Rockshelter. Here we have an excellent example of people using local geologic resources to their full potential.

This site was excavated by archaeologists in 1981 and contained the remains of a hunters camp that was situated within a small rock overhang on the west bank of the Deschutes River. A majority of the stone artifacts were made from obsidian, of which 52 percent of the identified material came from Newberry volcano, the next highest percentage from a known source totaled only eight percent. Artifacts recovered from the site consisted of arrow and atlatl points for killing game, knives for butchering the kill, scrapers for preparing animal hides for clothing, a piece of red stone that could be ground into paint, and a piece of bone that has incised lines on it that may have been used for decoration. Also found were a series of 33 obsidian tools shaped like willow leaves that may have been either spear points or trade items. It is believed that these artifacts were cached by the owner for later retrieval, it is not known why they were never recovered. Also found was a bark lined storage pit, that may have contained food at one time.

During the spring and summer the "Archaic" peoples of the area would have left the edge of the river to go in search of plant and animal foods in the surrounding uplands. People then would have searched out areas that contained water to camp around. Some of the best areas east of the Deschutes River are the lava flows that can be found along the flanks of Newberry volcano, Paulina Creek, and along the lakes within Newberry Crater.

At geologic phenomena, such as Lava River Cave, people might have found seasonal water sources and cool areas for food storage. It is possible that seasonal ice may have formed in these caves and in large cracks in the ground. The ice would be useful to melt as drinking water and to keep meat and plant foods from spoiling. There are also various plant foods that people may have been able to use such as rose hips, willow, and Great Basin wild rye that are seldom found on the drier east side of the Deschutes River.

In Newberry Crater geologic phenomenon such as lakes, hot springs, and obsidian flows acted like a magnet to bring "Archaic" people to the area for over 8000 years. The lakes provided various plant foods along their shores, although it is believed that there were no fish in the lake, due to Paulina Falls. The hot springs probably brought therapeutic relief to tired, aching muscles and may have had mystic properties as well. The obsidian makes wonderful arrow and dart points and cutting instruments. There is ample evidence that people made stone tools from the obsidian for use locally and carried or traded the material to the Willamette Valley, to the Fort Rock area, to Washington, and further into eastern Oregon. The hunting

was probably also very good and this, coupled with the other resources and its centralized position, probably made Newberry Crater an excellent base of operations for people throughout time.

As winter approached, "Archaic" peoples would have begun to hunt in earnest. Dried meat was a staple for people that needed to get through the long winter. The lava flows presented an excellent chance to use the geologic environment to get that meat.

As archaeological evidence suggests "Archaic" peoples built rock cairns and walls along one of the lava flows on Newberry Volcano's flanks. The site consists of rock cairns stationed on top of the edge of the lava flow. There is a long clearing along the edge of the flow and rock walls just inside the tree line opposite the rock cairns and lava flow edge. Arrow points, knives, scrapers, and burnt, broken animal bone can be found on the surface of the ground.

One possible scenario for the use of the site involves driving deer to waiting hunters. Hunters spread out in the forest and drove a herd of deer toward and along the edge of the lava flow. The steep lava flow front and rock walls, that appeared to be hunters, kept the deer within the long clearing. As the deer approached the rock walls, waiting hunters began firing arrows, killing many of the rushing animals. Using obsidian knives the deer were butchered. The hides scraped clean and staked out to dry. The meat dried on wooden racks. The bone broken up and placed into shallow pits filled with water and cooked by fire heated rocks. From this a rich broth could be made and the marrow from the bones scooped into containers and used like butter.

Not only did the geology of the local area affect "Archaic" people of the area, but geologic occurrences centered many miles away also shaped their lives. At the edge of Paulina Lake atlatl dart points and other artifacts have been found beneath a blanket of Mazama ash. The ash fell about 6800 years ago when Crater Lake was formed and covered all of central Oregon with several feet of ash. The people who had been hunting and collecting obsidian in Newberry Crater were forced to flee from the area, because plant and animal life would have been devastated and food would have been scarce. Not only did the plants and animals disappear for a time, but the major obsidian source in the Crater was also buried from view. Soon after the Mazama ash-fall, local geologic occurrences within the Crater itself would reshape human use of the area.

After the Mazama ash-fall a series of obsidian flows were formed in Newberry Crater that provided an unusually rich source of tool stone. At around 6000 years ago major obsidian flows were formed in the center of the Crater. Prior to 1300 years ago but after the 6000 years old flows, more obsidian was formed in the area south and east of East Lake, and by 1300 years ago the Big Obsidian Flow was formed. Newberry Crater became a veritable treasury of obsidian to make tools from.

During each eruptive episode people probably left the area of Newberry Crater, but eventually returned to quarry the precious stone. Once they collected the material they would break it down into pieces archaeologists called "flakes". These pieces could be further formed by striking the edges to create "cores", "flake blanks", and "tool blanks". The cores are similar to our tool boxes, they are shaped to give the utmost in raw material for making tools and are small enough that they can be transported away from the obsidian flow. A flake can be struck from the core and further reduced through steps into a flake blank, and then into a tool blank. The tool blank is shaped into a "preform" and finally into the finished tool by using a piece of antler to push smaller flakes off the edge. This procedure and some of the artifacts are illustrated on the following page.

Examples of the types of artifacts found in these sites can be viewed at Lava Lands Visitor's Center, the High Desert Museum, and The Des Chutes Historical Society in Bend. **If you find the remains of ancient Native American tools lying on the ground, please feel free to pick them up and look at them, but put them back so that others may have the same experience.**

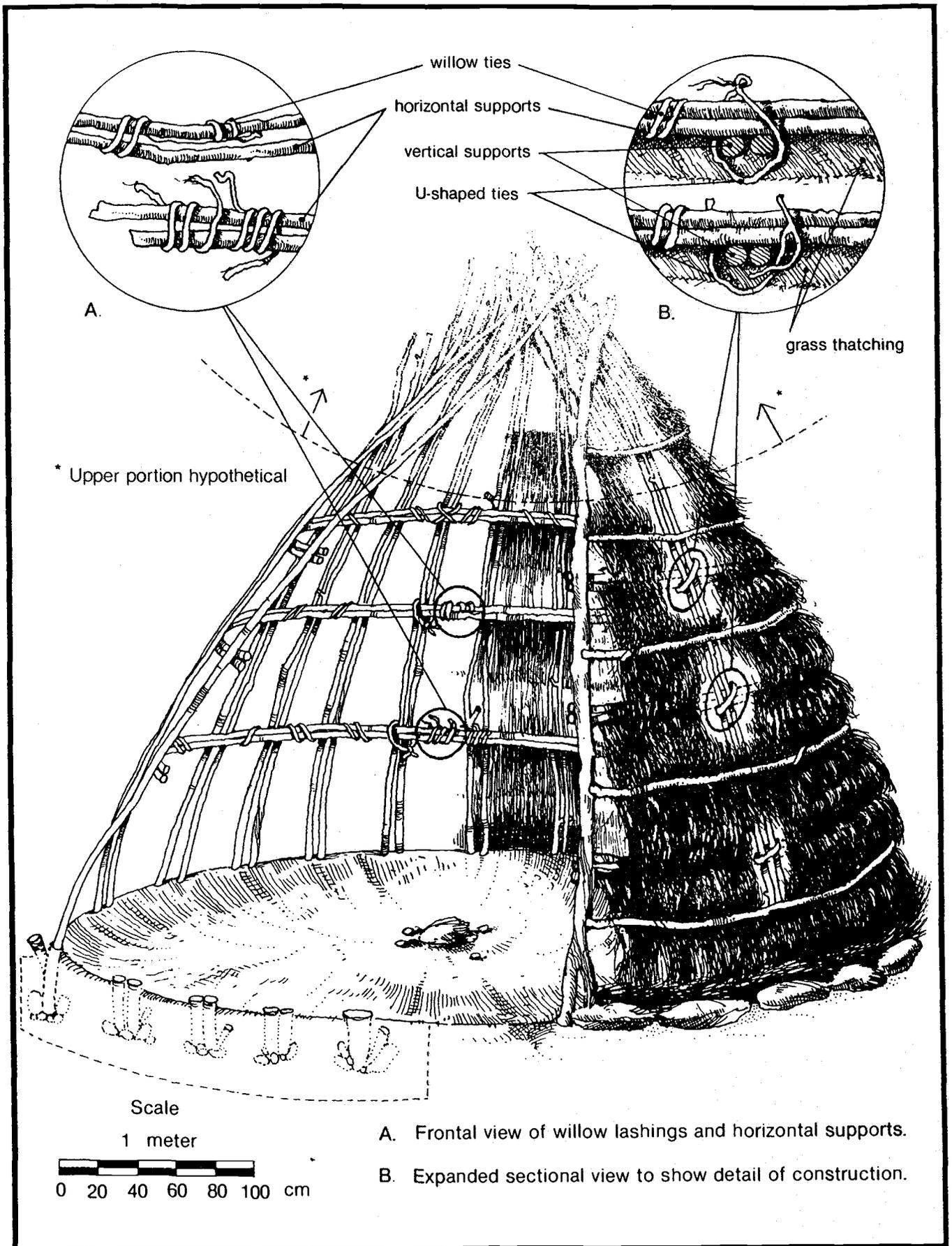


Fig. 2.10 Reconstruction drawing of pole-and-thatch wickiup from Dirty Shame Rockshelter, based on data from excavation.

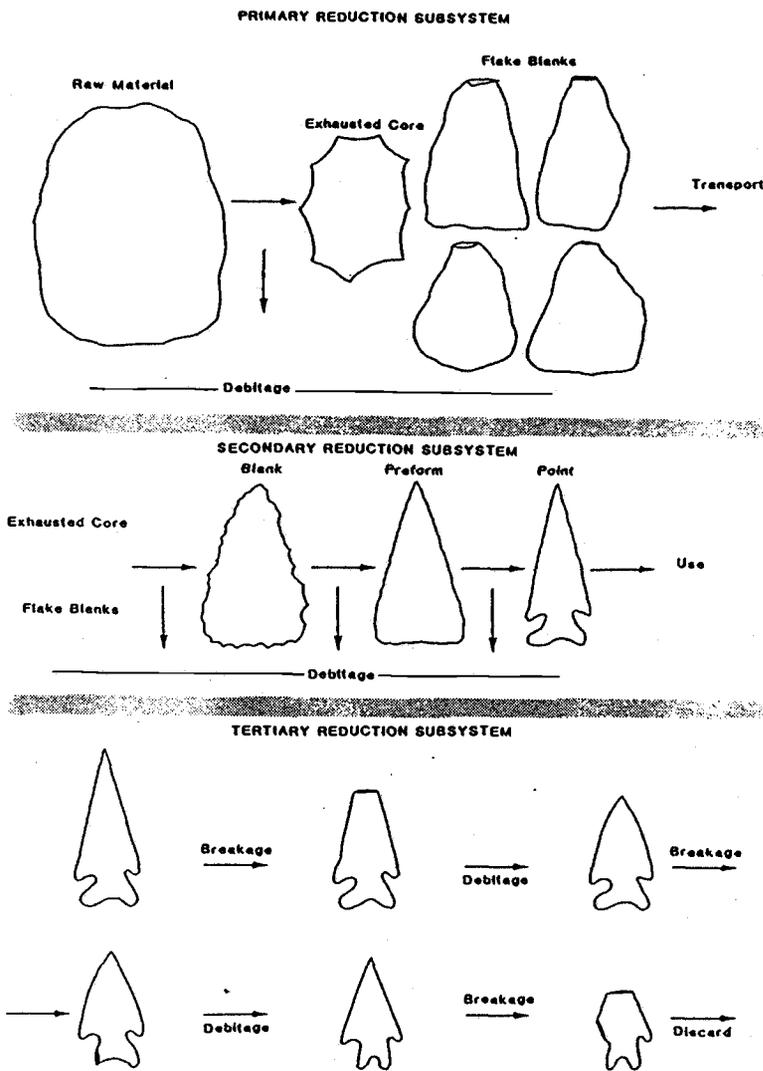
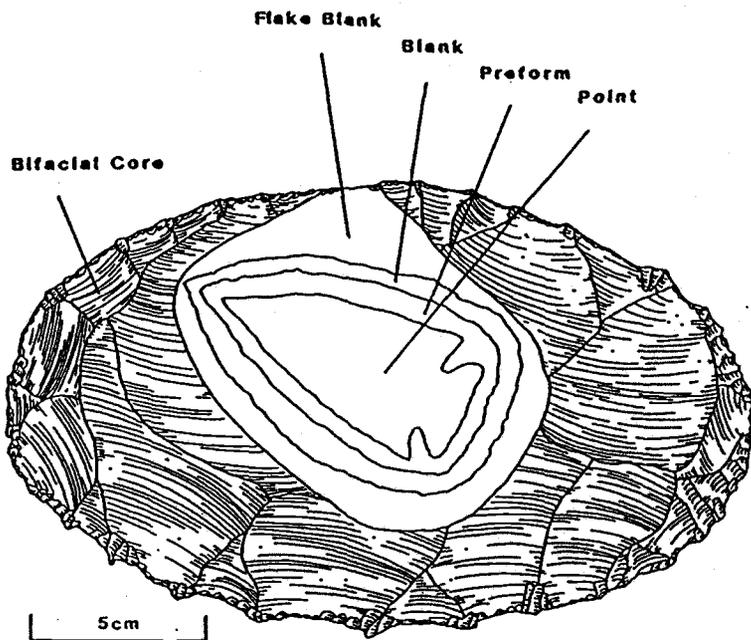


Figure 29. Technological model for Newberry Crater lithic reduction. After Flenniken and Ozbun (1988).

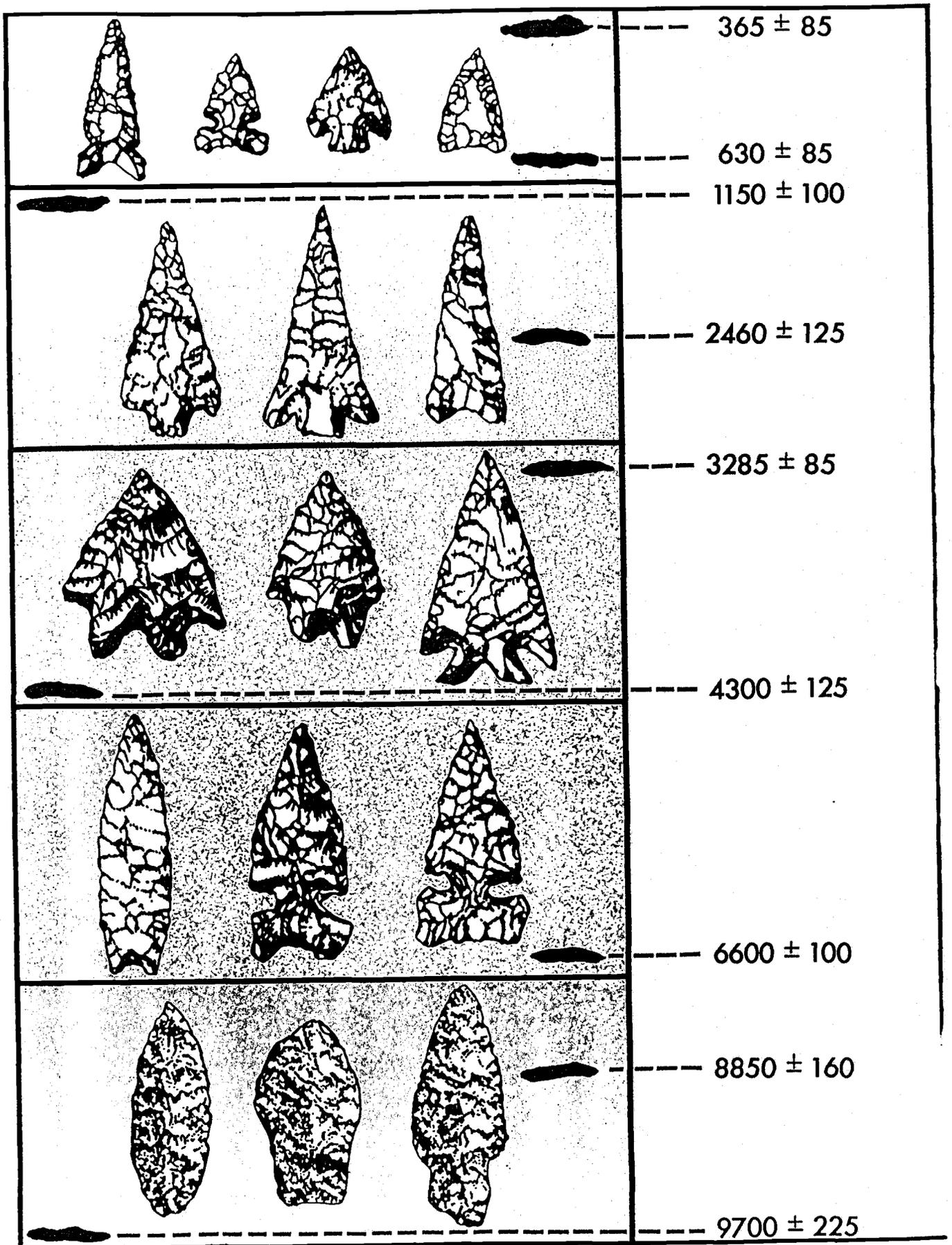
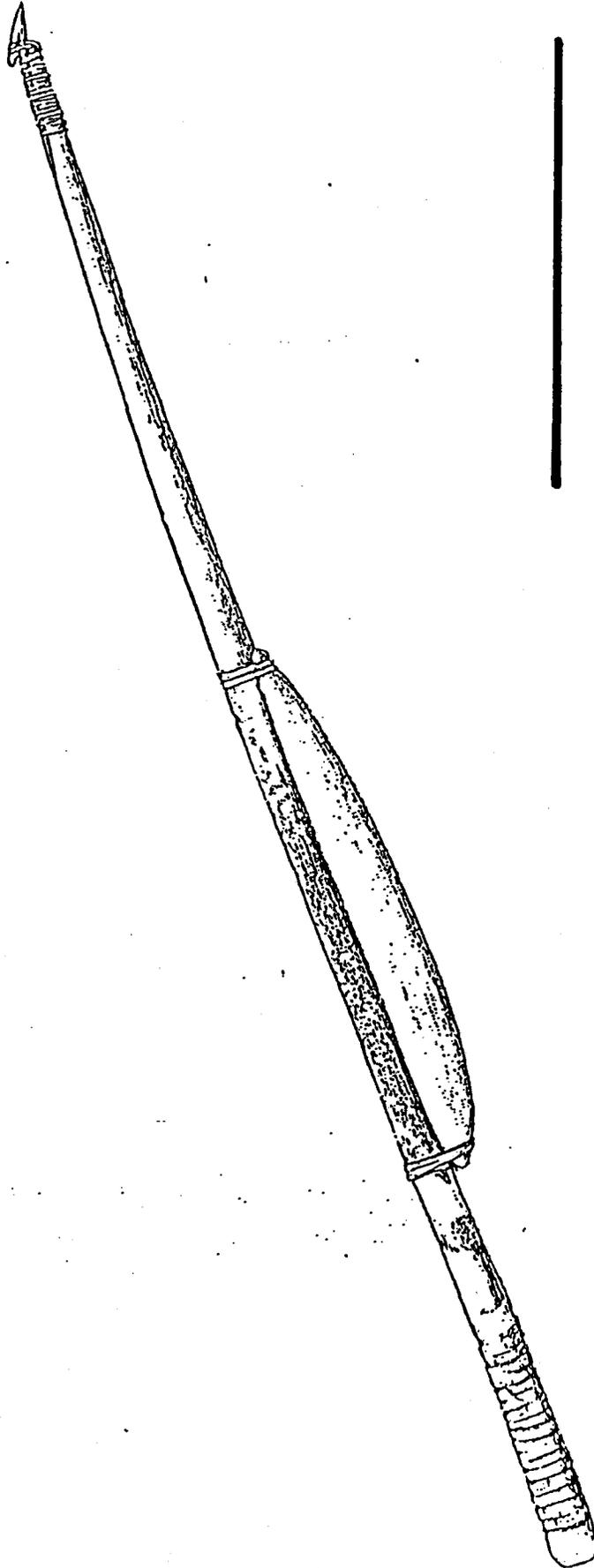


Fig. 1.1 Hypothetical stratified site with projectile points and  $^{14}\text{C}$  dates.

VIII Archaic site from Mel Aikens Oregon Archaeology



CITATIONS:

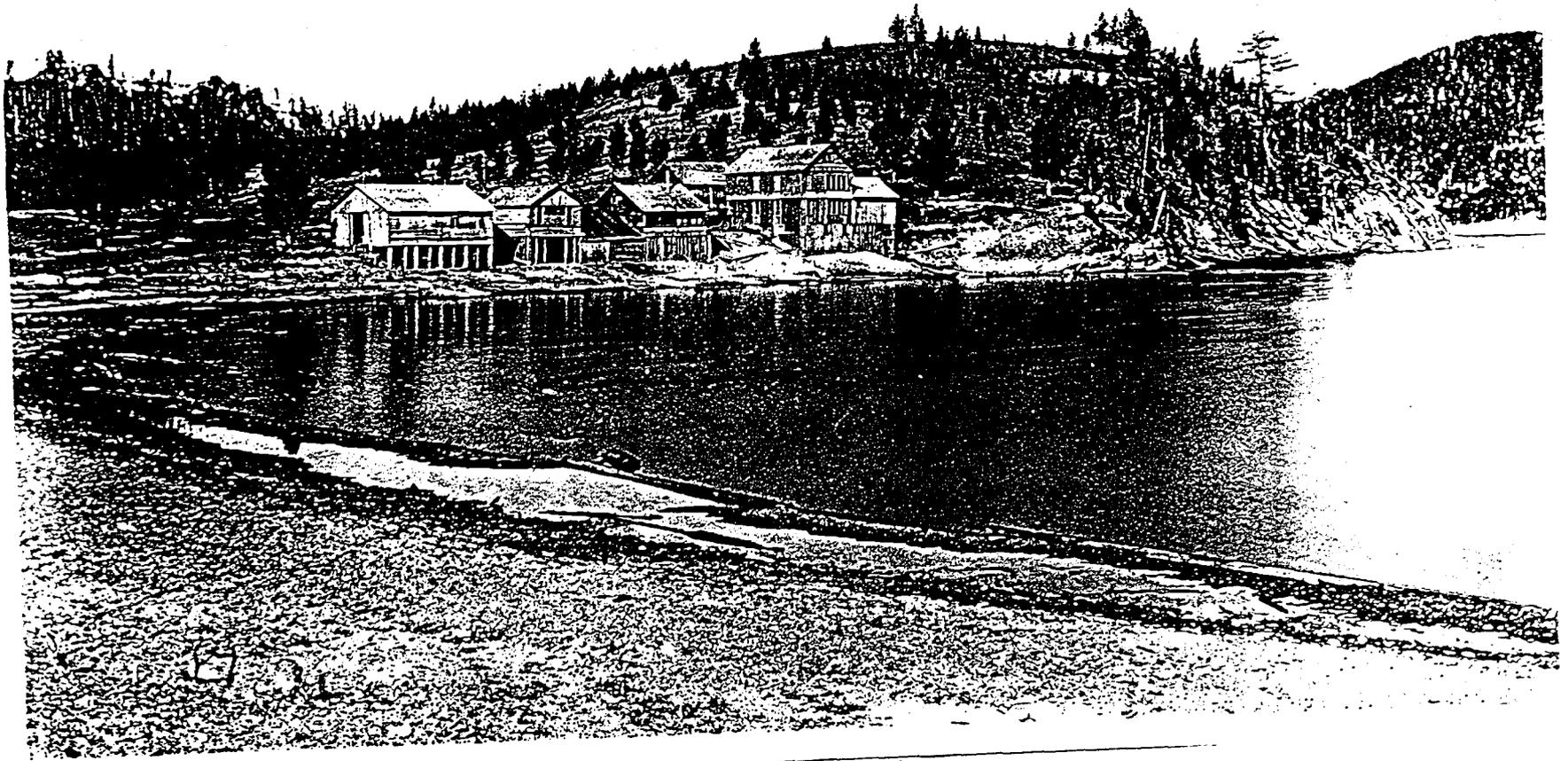
Wickiup and Projectile Points:

Aikens, C. Melvin  
*Archaeology of Oregon*  
1984

Core reduction drawing:

Flenniken, Jeffrey and  
Ozbun, Terry  
*Archaeological Investigations  
of Newberry Crater*  
1988

Figure 13. Atlatl from NV-Wa-197 (From Hester 1974).



Hot Springs Resort

East Lake

Circa 1921

### *Recent Native American Use of the Monument*

The Monument may have been used by many Native American bands or tribes: Klamath, Tenino, Northern Paiute, Mollala, Cayuse, Nez Pierce, and Umatilla, although it appears that the Northern Paiute were the predominant users of the area when the pioneers arrived. The Northern Paiute camped on the Deschutes River during the winter, while the other groups visited this portion of the Deschutes River valley for hunting in the autumn or as they passed through on trading or raiding parties.

Both the Northern Paiute and the other Native American groups had similar lifeways centered on a "seasonal round", or scheduled seasonal travel route through the forest to gather a wide variety of plant and animal resources. During the winter they camped along the rivers and lakes in the region. During the Spring they collected young plants along the rivers, lakes, and springs near their winter camps and fished or hunted for water fowl. During the summer they moved into the uplands around their winter camps and collected roots and berries. During the autumn Native Americans from far and wide would come to this area to hunt deer or fish along the lower Deschutes for salmon for food to eat during the long winter.

The Northern Paiute, like many of the Native American groups, used bone and horn spoons, dippers, stirrers, knives, knife handles, awls, drill tips, and arrowheads. Wooden implements were used for cooking, drill shafts, arrowshafts, and bows. Willows and tules were used for winnowing baskets and seed beaters. Watertight bottles for carrying water were woven and covered with pitch. Watertight baskets without pitch were used for cooking and heated by hot stones. Shredded sagebrush bark was used for sandals, bags, and blankets. Obsidian was used for knives, scrapers, and arrow points. Stone metates were used for preparation of plant foods.

Newberry Crater was an important summer camp for native American people. They traveled into Newberry Crater to hunt, collect obsidian from the flows, and to bathe in the hot springs. These people still hold a special reverence for Newberry Crater, although they do not feel welcome in the new Monument because current recreation uses conflict with the traditional uses of the Tribe's ancestors. Today, tribal members gather food and material from the forests, but do not camp for recreation, so Newberry National Volcanic Monument provides little incentive to visit.

### *History within the Monument*

The history of the Monument has mainly been centered on recreational activities, however, early trails, wagon roads, homesteads, and logging camps are found within or near its boundaries. This leads to a fascinating and diverse history that people can learn more about at the Lava Lands Visitor's Center, at the Des Chutes Historical Society, and at the High Desert Museum.

The earliest exploration was conducted for future exploitation of the region by fur trappers, the military, and settlers looking for transportation routes into the Willamette Valley. In each case the numerous lava flows presented especially difficult obstacles to their passage. Peter Skene Ogden and Nathaniel Wyeth passed through the area in 1826 and the mid 1830s, respectively. Ogden traveled the Deschutes and Little Deschutes Rivers and discovered Newberry Crater, while Wyeth passed through the site of Bend and traveled up the Deschutes past Dillion, Pringle, and Benham Falls. Neither Ogden nor Wyeth found the area worth trapping and decided not to stay. The John Fremont and Robert Williamson parties were part of U.S. Army expeditions traveling to explore the area for development in the mid 1840s and 1850s, respectively. Fremont mapped the country from above the site of Bend, past Benham Falls to the Klamath country, while Williamson scouted a railroad route along the Deschutes River and determined that construction of a railroad through the area was not practical. Dr. John Newberry was Williamson's geologist, the man Newberry Crater is named after. During the 1840s and 1850s three wagon trains traveled through Bend area on their way to the Willamette Valley, the Stephen Meek train in 1845, the Thomas Clark train in 1851, and the Elijah Elliot train in 1853.

Early transportation in the area was by foot, horse, wagon, car, and railroad. The earliest routes were scouted by Ogden, Fremont, Wyeth, and Elliot although these routes do not actually exist today. Both the broken lava flows and deep ash presented difficulties to transportation. It was almost impossible to travel over fresh lava flows and "corduroy road" of logs were constructed to keep vehicles from becoming mired in the soft ash. One attempt at trying to recreate Ogden's route is found along Paulina Creek, west of Newberry Crater, and is called the "Peter Skeene Ogden Trail over Newberry Crater". The first of the established roads that exist on the District is near the route of Highway 97. It was called the Huntington Road and was constructed in 1867 by J. W. Perrit Huntington and lead from The Dalles to the Klamath Indian reservation along the Deschutes River.

The original settlements within the Monument area were located along the Deschutes River near Big Meadows in the late 1800s. A brief expansion of homesteading in the period between 1906 to 1916 occurred within the Fort Rock area. For the most part the extensive lavas and deep ash made agricultural homesteading impractical and a drought in the early 1900s drove out all but those people that had permanent water sources.

In all cases on the early Forest Reserves, Forest Service personnel were charged with determining whether a land claim was valid. To complete an evaluation of the claim, a special agent was dispatched to interview the owners and describe the homestead so that a decision could be made as to whether the parcel could be returned to the Forest Reserve. In many cases the land was already abandoned, as in John McPherson's case. It seems that he was wanted for a crime and had left for California in 1909. Others never did a proper job of improving the land or they did not live continuously on the land for the specified time period. In these cases the land was returned to the Forest Service and became a part of the Deschutes National Forest.

Prior to the turn of the century, subsistence logging was the main use of timber in the area, however by 1916 Brooks-Scanlon and Shevlon-Hixon had opened mills in Bend and began the full scale railroad logging that would characterize timber utilization for the next half century. The earliest timber sales on the Deschutes National Forest used selective logging practices to remove the best timber and it was not until after World War II that Forest Service lands were clearcut. Many of the slopes of Newberry Volcano were logged by these companies using railroad grades to move loggers out to the trees and the trees back to the mills. Once the lands were logged, the timber companies traded the harvested land to the Forest Service for virgin stands elsewhere. This early exploitation of the timber has left dense stands of young pines, instead of the large old growth ponderosa pine stands that are mentioned in early Forest Service reports.

Railroad logging of the 1930s through the 1950s consisted of pushing rail into an area of virgin timber, setting up mobile camps with tents and/or buildings on sleds, logging the timber and moving it back to the mills by railroad. This pattern left a series of railroad grades that connected Bend with the logging camps and the logging camps with the harvest sites. Today a series of grades exist across the Forest with few or no ties and no rails. Ravines were filled with pumice scraped from the surrounding area to form a berm on which the tracks were laid and so trestles were not needed or used. The logging camps were mobile and so the only features that remain are trash dumps and in the earliest camps, before refrigerator cars were used, a series of excavated and timber reinforced cellars which have since collapsed.

Many of the structures within the Monument were built in the 1930s. The original lookout that stood on top of Lava Butte was built in the 1930s, but was later replaced by the lookout you see today. One of the first four lookouts on the Forest was situated on Paulina Peak, however, it was removed decades ago. The Paulina Lake Resort consists of a lodge and cabins on the west side of Paulina Lake that were built in the late 1920s. The first use of the East Lake hot springs may have been as early as 1898, however, a permit for building and operation of the original East Lake Hot Springs Resort was not issued until 1912. The resort burned several times and was rebuilt each time until 1940 when the site was abandoned. The present East Lake Resort was moved to its present site to escape the rotten egg smell of sulphur that

comes from the hot springs. It consists of a lodge and cabins built in the late 1930s or early 1940s. The Paulina Lake Guard Station, which is located at the entrance to the Crater, was built in 1938 as a Civilian Conservation Corps (CCC) project. In the Newberry Group Camp are four cabins that were part of a private resort built by the International Order of Odd Fellows (I.O.O.F.) in the 1930s. These cabins now belong to the Forest Service. Both the Paulina Lake Guard Station and the I.O.O.F. cabins are on the National Register of Historic Places. There are six private residences located at the southern edge of Paulina Lake which are under permit by the Forest Service. The cabins are thought to have been built in the 1920s when most of the other resort facilities were constructed.

### *Conclusions*

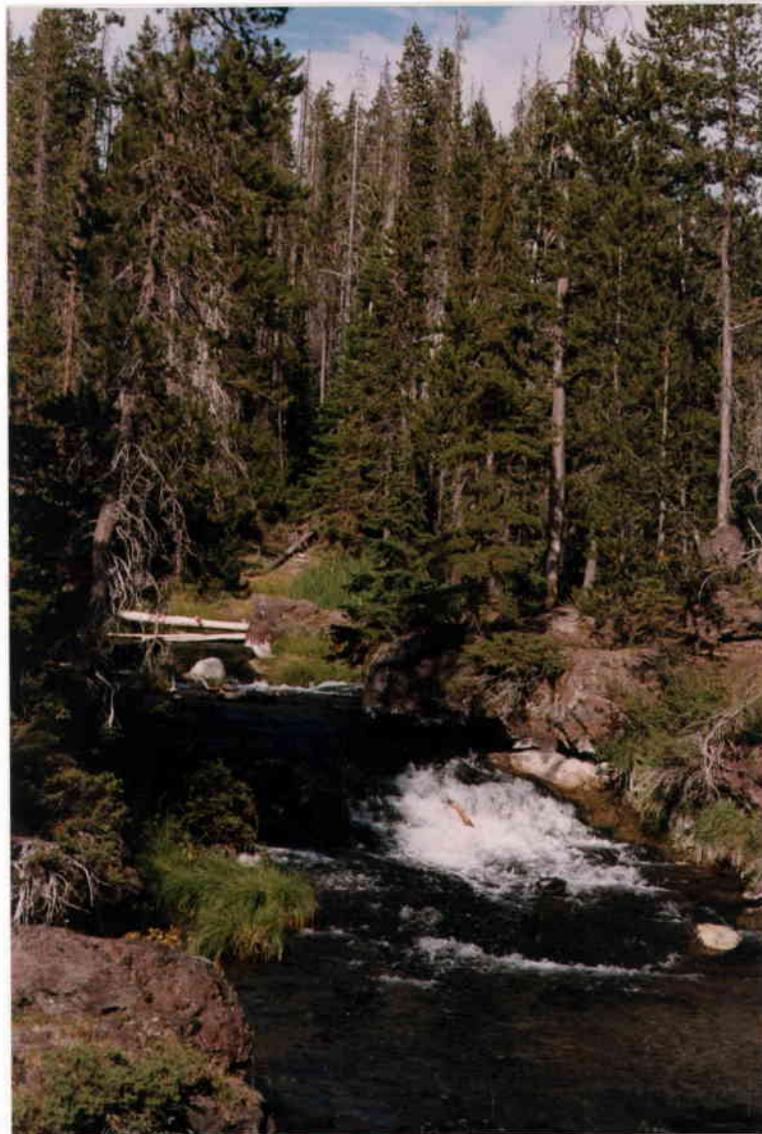
The prehistory and history of Newberry National Volcanic Monument is a shining jewel for interpretation and research into the interactions between people and the geologic environment. There are few other places in the world which have the equivalent potential to educate people about these interactions. Interpretation and research can center on how people have solved the many problems and how they exploited the opportunities that the geologic environment presented.

We still have much to learn about the early Native American use of the area. Important research on the types of plants and animals that they collected and hunted has not been completed. We have begun to understand how they quarried the local obsidian resources and made their stone tools, but many questions remain unanswered. There is probably no better place to study how people were affected by the various volcanic eruptions that have occurred. While these questions may seem esoteric they can provide insight into how we may better interact with our environment during a period of increased used and decreased resources.

The study of history within the Monument is also critical to understanding how we can better manage the environment. Failed attempts at colonization and exploitation give us clues to potential problems that we will face in the future. The success stories can be used to formulate strategies to make sure future resources will be available.

As well, people are fascinated by the past. As we move into the 21st century we can not loose as an agency if we interpret what we learn to the public. This can be accomplished through museum displays, books such as this, pamphlets and brochures, tours, participatory excavations, and the news media. We only have to make it happen.

Whether through original records or through plant and animal remains found in archaeological sites we can use this information to determine long range resource trends and public education opportunities. Thus, Newberry National Volcanic Monument is an unprecedented location for learning how people and geology interact. While this interaction has been both positive and negative for the local inhabitants for over 8000 years, without the geologic resources found in the Monument, the human history of this area would have been vastly different.



**PAULINA CREEK, SEPTEMBER**



## **RECREATIONAL OPPORTUNITIES**

### *Trails:*

Over 150 miles of hiking trails explore the Monument's backcountry areas. There is a trail around Paulina Lake (8 miles); one that takes visitors around the entire rim (21 miles); and numerous shorter trails to points of interest, such as Paulina Falls, just below the Entrance Station. The Peter Skene Ogden Trail (8.6 miles) parallels Paulina Creek as it descends from Paulina Lake down to Ogden Group Camp. Many of these trails are used by snowmobilers and cross-country skiers during the popular winter recreation season.

### *Campgrounds:*

Campground facilities are located at both lakes, and all sites include drinking water, a picnic table, fireplace, toilets, and access to boat ramps. Paulina Lake Campground (69 spaces) and Little Crater (50) are located at Paulina Lake. East Lake Campground (29 spaces) and Cinder Hill (110) overlook East Lake. Hot Springs Campground (52 spaces) is near East Lake and adjoins another recent obsidian flow. Newberry Group Camp and Chief Paulina Horse Camp offer special accommodations for larger groups or those with horses. Paulina Lake Lodge and East Lake Resort supplement the accommodations available in the rim. Both full-service resorts have showers, cabins, and supplies, while East Lake Resort also has a 38-space RV park.

### *Big Obsidian Flow:*

The newest recreational trail on the Monument is a one-mile loop trail threading through the Big Obsidian Flow. This trail was completed in 1991. Still to come are interpretive signs for the trail and a new trailhead. The trail allows people to walk through one of the largest obsidian flows in North America, a site where Indians have quarried obsidian for over a thousand years.

## **EAST and PAULINA LAKES HYDROLOGY and FISHERY**

East Lake and Paulina Lake are the two lakes occupying Newberry Crater, a volcanic caldera nearly five miles in diameter. East Lake is slightly smaller and is about 48 feet higher in elevation than its neighbor to the west, Paulina Lake.

Paulina Lake is one of many geographic features in Oregon which carries the name of a well-known, nineteenth century Snake Indian. Chief Paulina is believed to have been responsible for a number of conflicts between Indians and white settlers in eastern Oregon during the 1860s. He was killed in the summer of 1867 after raiding several ranches in the John Day country. Appropriate or not, the name is commonly used in this area: e.g., Paulina Lake in the Paulina Mountains is surrounded by the rim of the caldera whose high point is Paulina Peak. Paulina Creek is the outlet for the lake and joins the Deschutes River 15 miles downstream in Paulina Prairie.

The rim of Newberry Crater rises steeply for several hundred feet around the lakes to a high point of 7,984 feet at Paulina Peak, and it has been breached only on the west side to form a perennial outlet to the Deschutes River by way of Paulina Creek. The steep slopes support a scattered forest of lodgepole pine and ponderosa pine, interspersed with some hemlocks and alders; however, much of the drainage basin is covered with bare rock.

The entire area of Newberry Crater, including East Lake and its drainage basin is topographically tributary to Paulina Lake. Phillips and Van Denburgh (1968) have described the hydrologic characteristics of the two lakes. East Lake has no surface outlet and loses water entirely by evaporation from the surface and by subsurface seepage. A portion, but not all, of this seepage makes its way into Paulina Lake through the volcanic obstruction between the two lakes. Thus, surface inflow to Paulina Lake is only from an eight square mile area. There are no perennial streams, but considerable runoff during the snowmelt season. Water is lost from the lake by surface evaporation and by discharge through Paulina Creek.

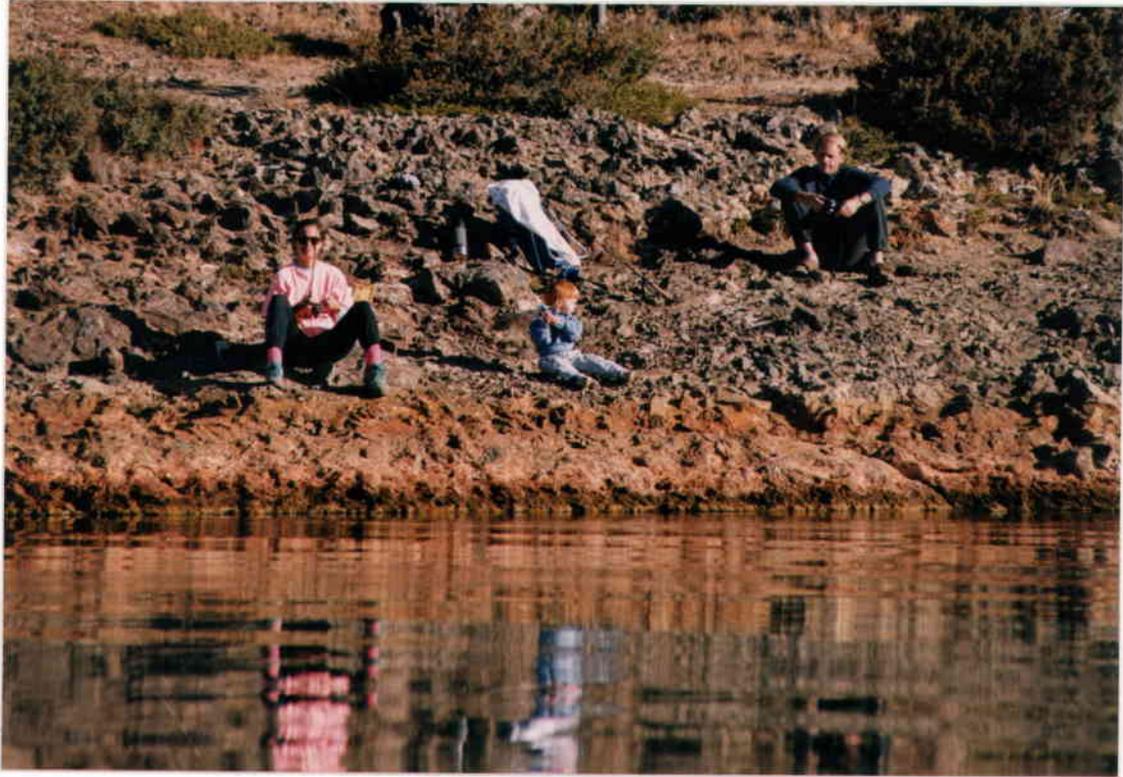
Although East and Paulina Lakes are favorites with fishermen, both were devoid of fish until a Central Oregon sportsman packed in trout late in the nineteenth century. Since then, they have been stocked by the Oregon Department of Fish and Wildlife. It is estimated now that over 60,000 anglers visit the lakes each year, although they are among the last lakes to open in the spring because of road blockage by heavy snows. Record German brown trout taken from East Lake have enhanced its reputation over Paulina Lake, but the larger lake has been a consistent producer from year to year, with good catches of rainbow trout and occasional eastern brook trout. The kokanee in Paulina Lake range from 10 to 12 inches. The brown trout in both lakes range from 12 to 30 inches. In 1990, the Oregon Department of Fish and Wildlife stocked Atlantic salmon for the first time in East Lake. These salmon are currently about 8 inches in length (John Hoffer; personal communication, East Lake Resort).

The best angling method for brown trout is to troll or cast rapalas, sea-bees, or minnow imitation lures. Successful kokanee angling is accomplished by trolling with flashers and assorted lures tipped with corn. Similarly rainbow trout are caught by trolling flashers, worms, and flat fish. Fishing from the shore is promising with Velvet cheese, salmon eggs, and Burkley Paver bait. Flyfishing and jigging are most successful in spring and fall.

Currently Oregon Department of Fish and Wildlife stock approximately 20,000 kokanee fingerling, 65,000 rainbow trout fingerling, and 10-20,000 brown trout fingerling each spring into Paulina Lake and 115,000 rainbow trout, 20,000 brown trout, and 50,000 brook trout into East Lake. In 1990, 10,000 fingerling Atlantic salmon were stocked into East Lake and an additional 4,000 yearling salmon (10 to 12 inches) were stocked this spring as an experimental population (Ted Fies; personal communication, Oregon Department of Fish and Wildlife).

The fingerling are generally 3 to 4 inches when planted and will grow to 10 to 12 inches by the following spring. This phenomenal growth rate is unique to the caldera. The hot mineral springs support a tremendous and varied food base for the fish. The fingerling feed on zooplankton, aquatic insects, fresh water shrimp, and crawfish during their first year. By the following spring, they are large enough to prey on the chubs which concentrate around the springs. The hot mineralized water provides a unique, varied, and plentiful food base for this high elevation, deep lake.

Paulina Lake is one of the deeper lakes in Oregon, with a mean depth of 163 feet and a maximum depth of over 250 feet. The walls of the caldera are steep, and only a very small proportion of the lake (three percent) is shallower than 10 feet, thereby, restricting the growth of macrophytes (plants growing in an aquatic environment large enough to be seen with the naked eye) to a narrow fringe around the shoreline. *Myriophyllum* and *Elodea* are common macrophytes. The lake develops a distinct thermal stratification in the summer, around the fourth of July, with a thermocline at a depth of 50 to 60 feet (15 to 18 meters). Deep water remains very cold (39 degrees Fahrenheit, 4 degrees Celsius, below 200 feet) all year and in the winter the surface frequently ices over. Because of the high elevation of the lake and its large volume, surface water also remains cool during the summer. Maximum summer temperature of surface water is about 64 degrees Fahrenheit (18 degrees Celsius).



**YOUNG FISHERMAN AND FAMILY**

## **WILD AND SCENIC RIVERS**

The Monument borders several miles of the Deschutes River, which is a part of the National Wild and Scenic Rivers System. Within the Monument boundaries is a portion of Paulina Creek (about 1/2 mile), which has been identified by the Forest Service as "eligible" for designation as a part of the National system.

The three potential classifications as a Wild and Scenic River include:

**Wild** -- Rivers that are free of impoundments and generally inaccessible by trail. Most of these wild river segments are located on public land.

**Scenic** -- Rivers that are free of impoundments, with shorelines or watersheds largely primitive and shorelines largely undeveloped, but accessible in places by roads.

**Recreational** -- Rivers that are readily accessible by road, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past.

The section of the Deschutes River bordering the Monument is classified as "scenic". The outstandingly remarkable values in this segment are scenic, recreation, geologic/hydrologic and wildlife.

In the eligibility determination for Paulina Creek, it was found to have outstandingly remarkable hydrologic/geologic and scenic resources. Therefore, Paulina Creek would qualify as a "recreational" river if found to be "suitable" for inclusion in the National Wild and Scenic River System. The Deschutes National Forest needs to proceed with a suitability study in 1992 to determine if Paulina Creek is suitable to be recommended for addition to the National system. The timing of this study is critical to the development of the Monument Management Plan and timely analysis related to potential geothermal activities adjacent to Paulina Creek.

It is the responsibility of the Deschutes National Forest to assure that the values for which the river was designated are protected and made available for the public to enjoy.

## **VEGETATION**

The Monument spans an approximate elevational gradient of 4000', from 3960' at its southwest end on the Deschutes River to 7984' at the summit of Paulina Peak. This gradient provides for a diverse array of forest vegetation zones including: ponderosa pine, lodgepole pine, mixed conifer, mountain hemlock and whitebark pine. Alpine plant communities are found on the rim of the crater above 7000'. Here the rare pumice grape-fern, *Botrychium pumicola*, can be found on barren pumice talus slopes. The pumice grape-fern is endemic to central Oregon, restricted to pumice deposits of Newberry Crater, Mazama and Broken Top.

The Mokst Butte RNA (Research Natural Area) lies within the monument designation. The Mokst Butte RNA contains geologic substrates from three different geologic time periods: Cinder cone deposits dating 6600 years, exposed Mazama ash dating 6600 years, Mokst Butte ash and lava deposits dating about 6000 years. Associated with these closely positioned substrates are differing forest community types unique to this area. The addition of the monument lands offer further protection for adjoining forest communities and will provide very interesting opportunities for research on plant succession in forested lavas, ash and cinder.

The Monument includes seven old growth areas for ponderosa pine, lodgepole pine and mixed conifer forest types.

-Prepared by Cindi McAllister.

## **WILDLIFE**

In 1957, a wildlife refuge was created in Newberry Crater in cooperation with the Oregon Department of Fish and Wildlife. The initial effort was to provide a refuge for wild birds and animals in their natural habitat. Public safety was greatly enhanced by elimination of firearms within the confines of the Newberry Crater area. Wildlife and waterfowl viewing opportunities near the lakes and lava flows can best be experienced on a clear quiet day during a lull in busy activities.

Some of the least known animals are the many nocturnal varieties, such as the pine marten which lives in the deep dark woods, or the marauding raccoons who have been fed by humans and are getting used to helping themselves. Several species of bats and insect-eating birds literally catch POUNDS of bugs as they fly by night.

Watch your step as you travel around in the forest or on trails for the underground population of various chipmunks and squirrels. Near the waters of Paulina Creek and Paulina and East Lakes, long-toed salamanders, western toads, and spotted frogs can be viewed as they hop and crawl near the waterline.

There are some seldom seen animals which pop up when you least expect them, like the flighty pikas (rock rabbits) which live on the lava flows and rock piles scattered around the Monument area. A pair of bald eagles is also known to nest near the shores of East Lake.

Migrating through in the fall are common loons, canada geese, pintails, northern shovelers and golden crowned sparrows. Winter visitors may glimpse water pipits or rufus-sided towhees. The song of mourning dove and the yellow rumped warbler can also be heard echoing throughout the summer. Also listen for the drilling and drumming of white-headed woodpeckers, and for the yellow-bellied sapsucker making linear rows of holes while foraging after its favorite prey.

Ever-popular visitors to trail sides and picnic sites include the Stellar's Jay and black capped chickadees; look quickly for the tiny pygmy nuthatches on the undersides of the tree branches. Open areas are homes to western meadowlarks and mountain bluebirds.

For serious wildlife viewing in the newest National Monument, remember your field glasses, and a good field guide (either Audubon's or Peterson's have a full range of species guides).

## **ROADS**

The primary road into Newberry Crater, the center-piece of the new Monument, is currently under reconstruction (Road 21). The Federal Highway Works Administration (FHWA), in cooperation with the Forest Service and the Oregon Department of Transportation, is administering this project. When completed, this new, paved, well-landscaped road will lead from Highway 97 into the heart of the Monument. This will bring more visitors, more motorhomes, and more demands on the existing facilities.

Part of the Paulina Peak access road (Road 2100-500) will be reconstructed at the same time as the FHWA constructs Segment IV of Road 21 (Paulina Lake to East Lake) in 1993-1994. However, reconstruction of this highly important access road will only include the relocation of the junction with Road 21 and the paving of the first 0.4 miles. The disposition of the remaining 3.5 miles must wait until the Monument Management Plan is completed.



"GOODNIGHT DUCKS."

"GOODNIGHT FAWNS."



***LAST CATCH OF THE DAY***

fills. For the areas that must be disturbed, the FS developed an extensive revegetation plan to return these roadside areas to a more natural condition as soon as possible. In addition to seeding, mulching, and fertilizing all disturbed areas, the contract includes planting the following plants:

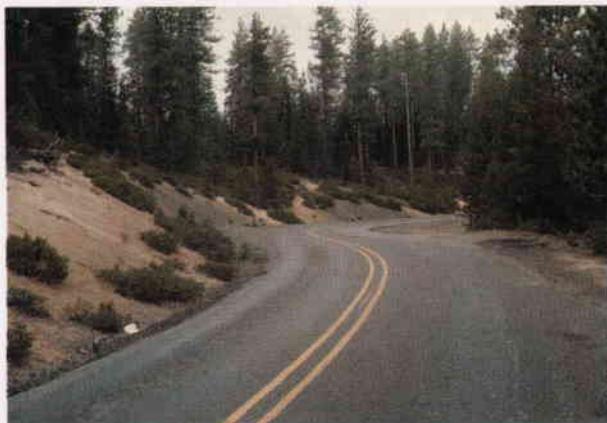
- 210 Mountain Hemlock Trees, 2 years old
- 460 Ponderosa Pine Trees, 2 years old
- 300 White Fir Trees, 2 years old
- 410 Green Leaf Manzanita bushes, 8 to 12 in.
- 2,880 Antelope Bitterbrush bushes, 1 year old
- 410 Snowbrush bushes, 8 to 12 in.
- 770 Kinnikinnick bushes, 1 year old

The contract also calls for selective clearing at various locations along the roadside, and for stripping and salvaging the surface soils for replacement on the new cut and fill slopes. Slopes have been designed as flat as possible to minimize the potential for erosion, and the steeper roadside drainage ditches are being lined with rock to prevent erosion. While all of the above measures are not uncommon to road reconstruction projects, special care and effort is being expended to blend the disturbed roadside into the adjacent landscape to return it to a more natural condition as soon as possible.

## CONSTRUCTION ACTIVITIES

Construction of the current project is being performed by ELTE, INC. of Boring, Oregon. The contract was awarded on June 19, 1990, and has a fixed completion date of November 15, 1991.

The road remains open to public traffic, subject to short delays to facilitate construction. Please watch for flaggers and other traffic control devices as you drive through the project. Have a safe and enjoyable trip.



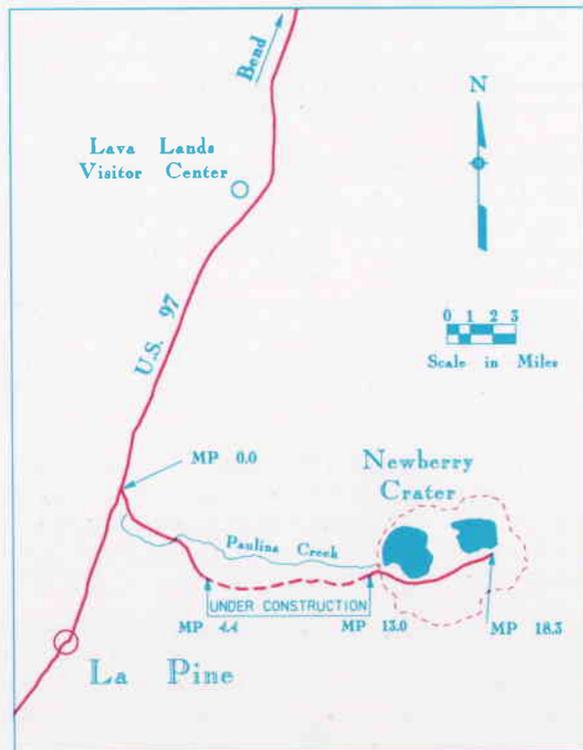
For further information about the Forest Highway Program or reconstruction of the Paulina Lake Road, contact:

Allan Stockman, Location/Environmental Engineer  
(206) 696-7752, Vancouver, WA

Mike Odom, Area Design Engineer  
(206) 696-7740, Vancouver, WA

Gene Stager, Construction Operations Engineer  
(206) 696-7744, Vancouver, WA

Ken Welborn, Project Engineer  
(503) 536-3794, La Pine, OR



Location Map

Printed on Recycled Paper

# PAULINA LAKE ROAD RECONSTRUCTION



US Department of Transportation  
Federal Highway Administration  
Western Federal Lands Highway Division  
610 East Fifth Street  
Vancouver, Washington 98661-3893



## FOREST HIGHWAY PROGRAM

Reconstruction of the Paulina Lake Road (Oregon Forest Highway 93) is funded under the Forest Highway Program, a Federal program that returns a portion of the Federal gas tax revenue to the States for use on specific Forest Highway routes. These highways are selected public roads which serve a substantial amount of national forest related traffic and resources. In Oregon, the program is jointly administered by the Federal Highway Administration (FHWA), the USDA Forest Service (FS), and the Oregon State Department of Transportation (ODOT) which also represents the interests of the Counties. Deschutes County is responsible for the operation and maintenance of the Paulina Lake Road.

Oregon's annual share of the Forest Highway funds is currently \$7,247,000 out of a total nationwide program amount of \$55,000,000. Of this amount, \$4,232,685 has been committed to the first Paulina Lake Road reconstruction project which is currently in progress. A second reconstruction project in the amount of approximately \$3,400,000 will be required to complete the route. This last project is currently planned for the summers of 1993 and 1994.

Matching funds from the County or ODOT are not required for the Forest Highway Program. However, Deschutes County is providing the funding for the first 5.8 miles of the route. The segment from Mile Post (MP) 3.0 to MP 4.4 was completed during 1990, and the remainder from MP 0.0 to MP 3.0 will be constructed at the same time as the next Forest Highway project. The County has also funded the part of the route from MP 4.4 to MP 5.8 which is included in the current construction contract.

## WESTERN FEDERAL LANDS HIGHWAY DIVISION

Forest Highway projects in Oregon are typically engineered and administered by the Western Federal Lands Highway Division (WFLHD) of the Federal Highway Administration, located in Vancouver, Washington. Land surveys, location studies, environmental clearance, geotechnical investigations, materials testing, roadway design, construction supervision, and contract administration are services provided by WFLHD under the Forest Highway Program.

Actual construction of Forest Highway projects is performed by private contractors. Projects are most often publicly advertised for bids, and are awarded to the lowest responsive bidder. WFLHD provides a Project Engineer at the construction site to administer the construction contract and inspect the construction operations. WFLHD does not maintain roads, and when construction of a project is complete, it is returned to the owner to resume maintenance responsibility.



## THE PROJECT

**NEED** - Initial planning for improvement of the Paulina Lake Road began early in the 1980's. Increasing traffic volumes and steady deterioration of the existing road's surface dictated the need for major repair work. Increased pavement width and safety improvements necessary to accommodate the projected traffic volumes, including realignment of hazardous curves, determined the need for total reconstruction. The newly reconstructed road will provide the Newberry National Volcanic Monument with an excellent access and will safely accommodate the increased traffic volumes that will occur.

**SCOPE OF THE PROJECT** - The work planned for the Paulina Lake Road includes complete reconstruction from its junction with US 97 to its end at the junction with the China Hat Road near the East Lake Lodge. The total length of reconstruction is 18.3 miles.

The reconstructed road alignment will closely follow the existing road, although alignment revisions will straighten some of the sharper curves. A new asphalt pavement will provide a uniform driving surface 28 feet wide, and slow-moving vehicle turnouts will be provided to create some passing opportunities. New roadside pull-off parking areas are planned for at least two locations to allow the road users a chance to stop and view the spectacular scenery.

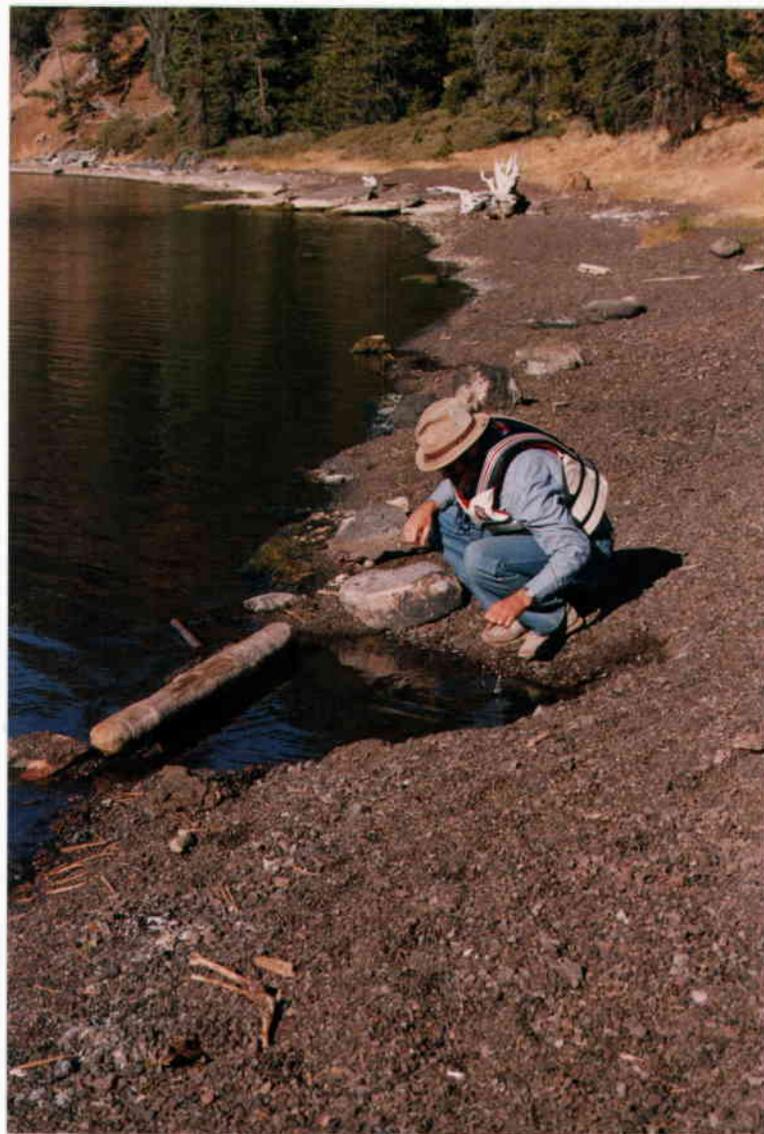
## SPECIAL PROJECT FEATURES

**CULTURAL RESOURCES** - In 1986 and 1987, the FS conducted an extensive reconnaissance survey along the proposed road corridor to locate any possible archaeological sites as required by the National Historic Preservation Act. Nine sites were identified, and a more intensive evaluation of these sites is currently underway by the University of Oregon, under contract to ODOT through WFLHD. This evaluation is showing that some of these sites contain significant, intact cultural deposits that may be valuable for interpreting prehistoric cultural patterns in the region. Plans are underway to excavate and salvage the significant sites during the summer of 1992 in advance of the road reconstruction. The cost of this salvage work is estimated to be in excess of \$250,000, a significant expense to the Forest Highway Program. The FS will contribute \$100,000 to the mitigation effort.

Prehistoric use of the Newberry Crater as a source of obsidian has long been known, and nearly 30 archaeological sites are presently recorded within the crater. At least one of the sites which will be disturbed by reconstruction of the road has been dated between 11,000 and 7,000 years ago. That was prior to the eruption of Mt. Mazama which formed Crater Lake some 60 miles to the southwest. The opportunity for further evaluation of these sites as a result of the road reconstruction promises to add significantly to the knowledge of prehistoric activities in the region.



**ROADSIDE AESTHETICS** - Location and design of the road included special effort to provide a project that will blend with the scenic nature of the area. A curvilinear alignment was carefully developed to avoid disturbing well vegetated slopes where possible, and to blend into the terrain without large cuts or



**TOO HOT! SPRINGS ON PAULINA LAKE**

## RELATED ENERGY (GEOTHERMAL AND GAS) ACTIVITIES

### GEOTHERMAL

The Northwest Power Planning Council, a four-state board created by Congress to set policy on regional energy issues, has determined that conservation and renewable energy resources need to be a top priority for the 1990's. The Council has predicted that the energy surplus enjoyed by the northwest is now a thing of the past, and that alternative sources of energy need to be actively pursued to meet energy demands of the future. Geothermal energy has been identified as a promising resource to meet these energy needs.

As a major objective in its 1991 power plan, the Northwest Power Planning Council calls for a series of pilot projects to better determine the cost and availability of geothermal resources in the region. To meet this objective and encourage new development of geothermal resources, the Bonneville Power Administration (BPA) has initiated a demonstration program in the northwest. Earlier this year, BPA solicited proposals for projects. To be considered, each project must be within the northwest, must be on a currently undeveloped site, and each developer must have a local utility as a partner.

The Bonneville Power Administration will purchase a total of 30 megawatts of power from up to three projects in separate locations in the northwest. With BPA's assistance, the high cost of initial development can be off-set, encouraging new development in the region. In response to BPA's program, seven proposals have been submitted, two of which are for sites located on the west slope of Newberry Crater, on National Forest Land, outside of the Newberry National Volcanic Monument. One of these proposals has been submitted by California Energy Company, Inc., of Omaha, Nebraska, in partnership with the Eugene Water and Electric Board. The other proposal has been submitted by Vulcan Power Company, based in Bend, Oregon, but they have not yet announced their utility partner. BPA is currently reviewing and evaluating the proposals, and they expect to make the selections in January, 1992.

At this point in time, no formal proposal for development at west Newberry has been approved or presented to the Forest Service. It is extremely likely, however, that one of the proposals for the Newberry site will be among the three selected by the Bonneville Power Administration for the pilot program. This would result in the planning and development of a 30-megawatt electrical generating power plant, transmission lines, and maintenance facilities in the very near future, as both companies have indicated they would like to begin drilling in 1993.

Estimates have indicated that the full potential of the site may be between 100 to 200 megawatts. It is obvious that there could be major implications on the management of the Monument, central Oregon, the State, the entire Northwest, and potentially, the nation, when you consider that one megawatt serves about 1,000 people per year.

Tax revenues for the local Deschutes County would be large, but there are important questions about safety, noise, and environmental and social impacts which must be answered. As you can see, planning and implementation of this type of project would indeed be a formidable and exciting undertaking for the Deschutes National Forest!

## **PACIFIC GAS TRANSMISSION PIPELINE EXPANSION**

### *Background:*

Pacific Gas Transmission (PGT) and Pacific Gas and Electric (PG&E) own and operate a natural gas pipeline system between the Canada-U.S. border and southern California. PGT's facilities are in Idaho, Washington, and Oregon; PG&E's facilities are in California. PGT and PG&E propose to expand their facilities and service areas by building a 42-inch pipeline parallel to their existing 36-inch pipeline. The PGT/PG&E pipeline expansion would provide a long-term natural gas supply of 755 million cubic feet per day to southern California and 148 million cubic feet per day to the Pacific Northwest. About 30 miles of the pipeline would cross the Deschutes National Forest (Deschutes N.F.), with about 2 miles of the total crossing the Monument near Lava River Cave and Lava Butte.

Under Section 7 of the Natural Gas Act, the Federal Energy Regulatory Commission (FERC) must determine that interstate natural gas transportation facilities are in the public interest. If FERC determines a present or future need for a proposed service, it issues a Certificate of Public Convenience and Necessity authorizing the construction and operation of a proposed project. Environmental impacts are also an important part of the overall determination. In addition, FERC is the lead decision-making agency for this project, and is thus responsible for preparing the Environmental Impact Statement and deciding which alternative will be implemented. FERC will also ensure that implementation measures are met. Agencies cooperating with FERC include the Bureau of Land Management (BLM) and the Forest Service.

BLM is the lead agency responsible for granting the right-of-way easement on federal lands. This grant would allow for construction as decided in the selected alternative, and would include plans for construction, operation, and maintenance of the pipeline. In 1985 PGT was granted a permanent right-of-way adjacent to the existing pipeline. In order to build the proposed 42-inch pipeline, PGT is applying for an amended grant and is requesting a working strip, as well as consent to construct, operate, and maintain the proposed pipeline. BLM issues the amended right-of-way grant for any Federal lands.

The Forest Service must ensure that laws, policies, and regulations are met on National Forest System Lands. Forest Service officials must determine consistency with Forest Land and Resource Management Plans and other plans governing management on National Forests. The Forest Service advises both FERC and the BLM on appropriate mitigation measures for pipeline construction on National Forest System lands. The Forest Service must also consent to the project prior to BLM granting the right-of-way easement.

It is important to note that the Forest Service is not making a decision on route selection; only FERC has that authority when it issues the certificates to the pipeline companies. The Forest Service decision space is whether to consent to the BLM amending PGT/PG&E's right-of-way grant to allow construction, operation and maintenance of a natural gas pipeline across the Deschutes National Forest.

Congressional intent documented in the Congressional Record accompanying the Monument legislation, noted that the intent was to allow the FERC EIS to provide the basis for deciding how to manage the pipeline where it crosses the Monument. The pipeline was thus exempted from the Monument planning process. Further advice from the Office of General Counsel advised the Deschutes that in the absence of other direction, the Land and Resource Management Plan for the Deschutes N.F.'s standards and guidelines should govern, as long as the standards and guidelines meet or exceed the intent to protect Monument values as defined in the Monument legislation.

### *Current status:*

The Deschutes N.F. adopted FERC's FEIS for the PGT/PG&E Altamont Natural Gas Pipeline projects as the analytic basis for the decision to consent to the project. This was done after an independent analysis

of FERC's EIS. This also led the way for Forest Supervisor Joe Cruz to recently sign its Record of Decision (ROD) approving the pipeline expansion and granting of the easement. The ROD highlights the needed mitigation measures needed to achieve acceptable environmental results in the Monument. The area of the pipeline project within the Monument considered most environmentally sensitive, because of direct viewing from Lava Butte, will be largely unaltered with the expansion, since PGT officials feel confident that activities can be confined within the existing right-of-way corridor.

Pipeline expansion construction and associated activities in Oregon are planned over a two-year period, beginning in early 1992.

## THE NEXT STEPS...

### **PLANNING**

The importance of letting the resource dictate the direction of development cannot be over-emphasized. It is, after all, the resource that will ultimately enjoy or suffer the effects of human activities. What can the resource bear? Where we recreate today, ancient humans lived in the past. We must not put development in conflict with natural and cultural resources.

As we prepare to welcome all who are intending to make Newberry National Volcanic Monument and the Deschutes National Forest their destination, our focus is on providing opportunities for memorable, quality experiences, rich in education. To create meaningful opportunities for visitors, we must carefully plan our facilities and give serious thought to the kinds of activities that are appropriate for us to encourage.

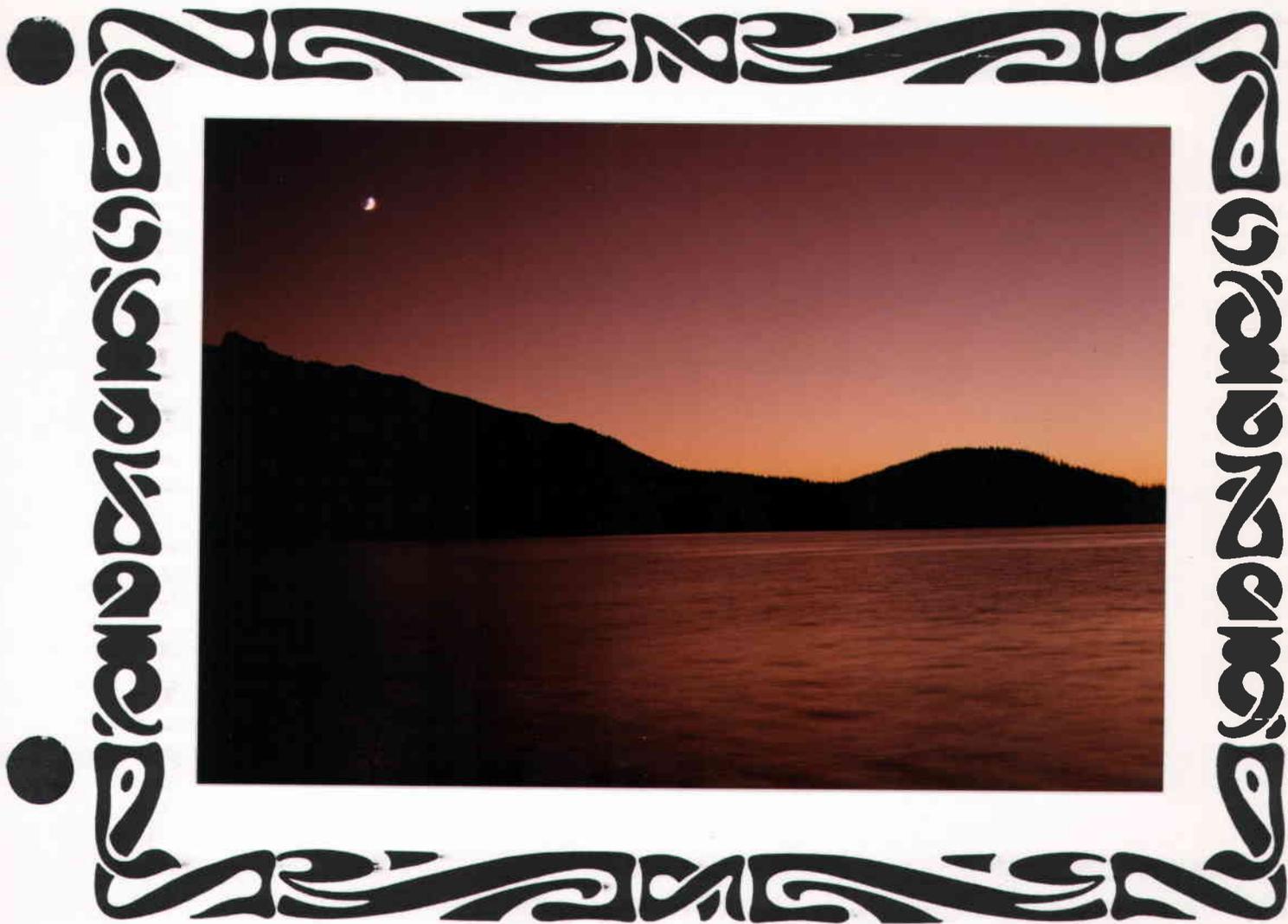
The old adage "If it's worth doing, it's worth doing right" is very appropriate here. To produce and implement a state-of-the-art management plan for the Monument we need talented, enthusiastic people and money. However, all the talent in the West will not meet the expectations of the agency and the owners if we are unable to secure appropriate funding.

### **MONUMENT MANAGEMENT PLAN**

Public Law 101-522 requires that "within three fiscal years beginning after the date of enactment of this Act, the Secretary shall develop a management plan...." for Newberry National Volcanic Monument. Issues to be addressed by the plan include recreation, vegetation, roads and facilities, fire, wildlife, research, monitoring, and conflicts.

Many projects were anticipated and planned long before the Monument was proposed. Naturally they were proposed because of some critical needs at the time. The designation of the Monument has only escalated the importance of renewing important sites that are now deteriorating in the wake of relentlessly increasing usage. However, while the need to improve the condition of these sites is real, there is a greater need to consider the whole condition and potential of the Monument before proceeding piecemeal with projects even though many have already been proposed for funding. What can the resource bear?

Final disposition of natural areas, roads, trails, campgrounds, and buildings, even though they may currently exist, will be identified in the forthcoming Monument Management Plan.



**SUNSET, MOON SET, PAULINA PEAK**

## **APPENDIX A NEWBERRY FACTS AND TRIVIA**

### ***THE ORIGIN OF NAMES WITHIN NEWBERRY NATIONAL VOLCANIC MONUMENT***

**NEWBERRY CRATER:** Named for Dr. John Strong Newberry who explored Central Oregon for the Pacific Railroad Surveys in 1855.

**PAULINA PEAK, LAKE, & CREEK:** A number of Oregon geographic locations are named for Chief Paulina, an infamous member of the Walpapi tribe of the Snake Indians. Chief Paulina was thought to be responsible for a number of atrocities committed against scores of miners, trappers, and settlers between 1866-68. After raiding several ranches in John Day country, Chief Paulina was pursued and shot down in Paulina Basin.

**OGDEN GROUP CAMP:** (Rd 21 and Paulina Creek) Named for Peter Skeen Ogden, a trapper and explorer with the Hudson Bay Company who made four trips through the Snake, Malheur, Klamath, and Deschutes country between the years 1825 - 1827.

**IKT BUTTE:** (N. of Lava Cast Forest) The first of a series of buttes named by the U.S.F.S. using chinook Indian jargon words for numbers. Ikt means one.

**MOKST BUTTE:** (N. of Lava Cast Forest) Named with the chinook jargon word for two.

**KLONE BUTTE:** (E. of Lava Cast Forest) Named with the chinook jargon word for three.

**KAWAK BUTTE:** (N. of Paulina Lake) Named for the chinook jargon word meaning to fly.

**LOWULLO BUTTE:** (N.E. of Paulina Lake) Named for the chinook jargon word meaning round.

**KWEO BUTTE:** ( S. of Paulina Peak) Named for the chinook jargon word meaning ring or circle.

**DEVILS HORN:** (S. of Paulina Peak) a peculiar butte of red lava whose shape suggested the name.

**DESCHUTES RIVER:** During fur trading years, the river was known as Riviere des Chutes, meaning River of the Falls, and referring to the fact that the river flowed into the Columbia near the falls in the Coloumbia. Several fur traders' journals (including Peter Skene Ogden's) refer to the Deschutes as the River in the Falls in the Columbia.

**BENHAM FALLS:** Named for J.R. Benham who filed on nearby land about 1885. He was born in Oregon and lived in Prineville for awhile before moving to Deschutes County.

**DILLON FALLS:** Named for Leander Dillon who homesteaded nearby in the 1890's.

**CAMP ABBOT:** Now called Sunriver, this area was an Army Engineer replacement and training center during WWII. It was named after Brigadier-General Henry Abbot, a military engineer attached to the Pacific Railroad Surveys, who camped on the site in 1855.

## 101 NEWBERRY FACTS

(Information provided by various Deschutes National Forest employees. Their names are in parentheses.)

1. In 1903 Dr. I.C. Russell examined central Oregon for the U.S. Geological Survey and attempted to use the name Mount Newberry for the Paulina Mountains and Paulina Peak. Dr. John Strong Newberry was a geologist with the Pacific Railroad Surveys in 1855 when they surveyed the central Oregon area. The name Mount Newberry never found acceptance but the caldera at the summit has become known as Newberry Crater. (Bob Jensen) (Linda A. Clark)
2. The volume of rock in the Lava Butte Lava Flow is 380,000,000 cubic yards. Assuming a paved road 24 feet wide and 6 inches thick, there is enough rock in the flow to pave 160,000 miles of road which is equivalent to a paved road circling the world six and a half times. (Bob Jensen)
3. Two miles of railroad grade across the Lava Butte lava flow were constructed in late 1931 during a two month period. The first train used the new section of railroad on April 7, 1932. Burlington Northern continues to use this railroad today. (Bob Jensen)
4. In 1929 approximately 2000 cubic yards of cinders from the east side of Lava Butte were trucked to Bend where they were loaded into railcars for shipment to Longview, Washington. The cinders were used in light weight concrete for the bridge deck on the Longview bridge across the Columbia River. (Bob Jensen)
5. The volume of rock in the flows of the Northwest Rift Zone is 850,000,000 cubic yards. Assuming a paved road 24 feet wide and 6 inches thick, there is enough rock in the flow to pave 360,000 miles of road which is equivalent to a paved road circling the world fourteen and a half times. (Bob Jensen)
6. In 1903, Dr. I.C. Russell, Geologist for the U.S. Geological Survey, estimated the Lava Butte eruption to have occurred 100 to 150 years ago. In 1977 the eruption was radiocarbon dated at 6150 years old. (Bob Jensen)
7. The road to the top of Lava Butte was completed in early 1933. (Bob Jensen)
8. Peter Skene Ogden (1794-1854), while leading a fur trapping expedition, first entered Newberry Crater and discovered East and Paulina Lakes on a stormy Nov. 16, 1826 (brrr!). (Bob Jensen) (Suzi Lewis)
9. The volume of rock in the Big Obsidian Lava Flow is 170,000,000 cubic yards. Assuming a paved road 24 feet wide and 6 inches thick, there is enough rock in the flow to pave 70,000 miles of road which is equivalent to a paved road circling the world three times. (Bob Jensen)
10. Astronaut R. Walter Cunningham tested the mobility of a moon-suit on the Big Obsidian Flow on August 27, 1964. (Bob Jensen)
11. Nathaniel J. Wyeth (another early explorer) passed through the Benham Falls area in Dec. 1834. (Bob Jensen)
12. The volume of airfall pumice erupted from the Big Obsidian vent is at least 416,000,000 cubic yards. Assuming a 10 cubic yard dump truck arriving every minute it would take 80

- years for the trucks to haul all the pumice that the volcano was able to erupt in a few days at most. (Bob Jensen)
13. The U.S. Geological Survey drilled an exploratory well east of the Big Obsidian Flow in 1981. This well reached a depth of 3,058 feet and a temperature of 509 degrees F. was recorded at the bottom. (Bob Jensen)
  14. The Lunar Geological Field Conference was held in Bend during August 1965. One of the major field trips during this conference was to Newberry Volcano. (Bob Jensen)
  15. Of the total Big Obsidian eruption volume 45% was erupted into the air to form pumice, while 55% was erupted as a lava flow. (Bob Jensen)
  16. During 1939 the Wickiup basin was cleared for the Wickiup Reservoir project. The timber (26,000,000 board feet) was floated down the Deschutes River to Benham Falls where it was loaded on rail cars and sent to the Shevlin-Hixon mill in Bend. (Bob Jensen)
  17. Paulina Peak, Paulina Creek, Paulina Lake, and North Paulina Peak are a few of the many features in Central Oregon named for an Indian, Chief Paulina. Chief Paulina was blamed for the deaths of many miners, trappers, and settlers during 1866 and 1867. After raiding several ranches in the John Day country he was pursued by a group of ranchers and shot by Howard Maupin (town of Maupin named for him). (Bob Jensen) (Bill Ham)
  18. Benham Falls was named for J.R. Benham who filed on land nearby in 1885. The falls were named by a Mr. Hutchinson who was promoting central Oregon irrigation projects. (Bob Jensen)
  19. Of the total Lava Butte eruption volume 10% was erupted into the air to form cinders, while 90% was erupted as a lava flow. (Bob Jensen)
  20. During the early 1920's to aid in forest fire location the Deschutes National Forest named many buttes with Chinook jargon words. Buttes with these names within the Monument include: Kawak (to fly), Ikt (one), Mokst (two), and Klone (three). (Bob Jensen)
  21. In December 1929 the Forest Service proposed a 12 mile drive around the rim of Newberry Crater for fire control purposes. The road was never built. (Bob Jensen)
  22. The first fish were carried in a bucket and planted in East and Paulina Lakes about 1912. (Bob Jensen)
  23. The earliest auto access to Newberry Crater was over the east rim to East Lake. In 1933 the CCC's built a road to Paulina Lake from the west. This road was rebuilt in 1952 and is again being improved and rebuilt this year. (Bob Jensen)
  24. East and Paulina Lakes and Paulina Creek are the only surface water on the entire Newberry Volcano. (Bob Jensen) (John R. Young)
  25. Newberry Volcano is a large shield-shaped composite volcano approximately 25 miles in diameter and covers 500 square miles. (Bob Jensen)
  26. Newberry Volcano is made up of ash, pumice, lava, cinders and mudflows and contains about 100 cubic miles of volcanic material. (Bob Jensen)

27. The Andesite Conference was held in Eugene and Bend during July 1968. One of the major field trips during this conference was to Newberry Volcano. (Bob Jensen)
28. Other eruptions of Newberry have been relatively passive outpourings of lava such as the eruptions in Hawaii for the past 8 years. (Bob Jensen)
29. The age of volcanic deposits on Newberry Volcano ranges from 700,000 to 1,300 years ago. The youngest feature is the Big Obsidian Flow (1,300 years old, about 650 A.D.) which is the youngest volcanic feature in central Oregon. (Bob Jensen)
30. Newberry Volcano is not an extinct volcano. It will erupt again both passively (lava flows) and explosively (ash and pumice). (Bob Jensen)
31. The average elevation of the base of Newberry Volcano is 4,400 feet. The highest point is Paulina Peak at 7,984 feet. (Bob Jensen)
32. The slopes of Newberry Volcano are covered with about 400 cinder cones. Lava Butte and Mokst Butte within the Monument are two excellent examples. (Bob Jensen)
33. At the summit of Newberry Volcano is Newberry Crater which is about 4 miles in diameter and covers about 17 square miles. (Bob Jensen)
34. Newberry Crater is a caldera formed from several enormous violent eruptions of ash and pumice. The summit of Newberry Volcano collapse during a series of eruptions over a period of a half million years. By contrast the top of Mt. Mazama (Crater Lake) collapsed in one vast eruption. (Bob Jensen)
35. Within Newberry Crater are two lakes: Paulina (250 feet deep) and East (170 feet deep). Paulina Lake is one of the deeper lakes in Oregon. (Bob Jensen) (Suzi Lewis)
36. The last major caldera forming eruption probably occurred about 200,000 years ago. Since then the caldera has filled with ash, pumice and lava from eruptions on its floor. (Bob Jensen)
37. At times in the past the caldera may have contained a single large lake as much as 1600 feet deep much like Crater Lake today. (Bob Jensen)
38. The East Lake Hot Springs are drowned hot springs which emerge in the cold water of East Lake. The highest measured temperature is 175 degrees F. Gas bubbles smell of hydrogen sulfide (rotten eggs). (Bob Jensen)
39. The first detailed study of the geology of Newberry Volcano was published in 1935 by Dr. Howel William. (Bob Jensen)
40. Native Americans have used the Newberry Crater area for at least 8,000 years. (Bob Jensen) (Linda A. Clark)
41. In 1903 when Dr. I.C. Russel visited Newberry Crater there were no fish in either lake but there were crayfish in Paulina Lake. Paulina Creek Falls were an impassable barrier to fish (abundant below the falls) but crayfish were able to crawl up the nearly vertical rocks adjacent around the falls to reach the lake. (Bob Jensen)

42. Obsidian was a favorite material of the local native Americans in their weapons production industry. A big pile of obsidian may actually have been an ammunition dump for one or more tribes. (Bill Ham)
43. After the Paulina fire in 1988, a person could pick up a good sized piece of the pumice that had been heated up, throw it into the air and it would float down in a manner similar to styrofoam. (Bill Ham)
44. The Nationwide campaign "Animal Inn" began here on the Deschutes in an effort to provide habitat and protection for cavity nesting birds and animals. (Patricia Hudspeth)
45. One of only 4 known populations in THE WORLD (or for that matter THE UNIVERSE) of Botrychium pumicola "pumice grape-fern" is found within the boundaries of the Newberry National Volcanic Monument. (Patricia Hudspeth)
46. No, we do not have spotted owls on the monument. But there are eagles, osprey, and Big-eared bats, and the mythical "lava bears." (Patricia Hudspeth)
47. Every August the Obsidian Flow is crawls with thousands of frogs. At times, it's hard to walk without stepping on one. They may migrate UP the flow, from Lost Lake. Really strange, like the flight of the Lemmings. (Dick Dufourd)
48. The road to Paulina Peak was built in the early 1960's by the military to bring equipment up for a large radar installation (part of the D.E.W. Line system). The installation only lasted one or two winters due to the heavy buildup of rime ice on the tower and violent winds which destroyed the tower which was never replaced. The cement equipment storage room remained until 1987 when the National Guard removed it as a summer camp project. (Mahlon R. Hale) (Bob Jensen) (Larry Chitwood)
49. There is an upwelling from the hot springs in both Paulina and East Lakes that keeps the water moving and circulating. Certain small micro-organisms seem to thrive in this warm, nutrient-rich environment, and they provide food for the many fish in both lakes. (Harry Hoogesteger)
50. In the 1920's there was a flourishing hot springs resort at East Lake. Patrons came from all over the country to bask in the warm (120 degree), soothing, medicinal waters. (Harry Hoogesteger) (Suzi Lewis)
51. There is a population of albion golden mantle ground squirrels in Newberry Crater. (Carol J. Guthrie) (Bob Jensen)
52. Paulina Creek has been determined to be eligible as a Wild and Scenic River based upon the outstanding geologic and scenic values located near Paulina Lake outlet. Paulina Creek would qualify as a recreation river. (Carrie K. Sammons)
53. A portion of the Monument is adjacent to the Deschutes River which is a federally designated Wild and Scenic River. (Carrie K. Sammons)
54. The eruption of the Big Obsidian Flow was like opening a very cold soda pop that was shaken up. When you pop the top the soda explodes, flows over the top of the bottle, and ice forms as it supercools. (Suzi Lewis)

55. Surgical blades made from obsidian are sharper than those of steel. (Suzi Lewis)
56. Technical minds and skilled hands designed and shaped raw rock (obsidian) into specialized instruments that clothed, fed, and sheltered the people that used them. (Suzi Lewis)
57. The Big Obsidian Flow is home to symphonic tree frogs, darting pine martens, purple monkey flowers, old growth trees, and the soft wind. (Suzi Lewis)
58. The green ribbons alongside Paulina Creek are like a giant wet sponge of vitamins, soil, roots, and water. They clutch roots, sprout plants, and slowly squeeze water and nutrients into the flowing creek. (Suzi Lewis)
59. Minerals from hot springs, raindrops, and snowflakes feed the rich food chains of Paulina and East Lakes, making the fishing some of the best in the West! (Suzi Lewis)
60. Newberry Crater has a natural brand of insect repellent; bats. Finding their dinner the same way as dolphins, they can snatch up to 600 mosquitoes per hour! (Suzi Lewis)
61. At about 1/3 the way into Lava River Cave, there is as much sand below your feet as there is air above (your feet)! (Suzi Lewis)
62. Dillon Falls was named for Leander Dillon who homesteaded nearby in 1890. (Bob Jensen)
63. Some eruptions of Newberry have been extremely explosive producing hot, glowing avalanches of ash and pumice such as the eruptions in Japan and the Phillipines the last few weeks. (Bob Jensen)
64. The 1979 Pacific Northwest American Geophysical Union meeting was held in Bend during September 1979. One of the major field trips during this conference was to Newberry Volcano. (Bob Jensen)
65. The first issue of the Ore Bin (now Oregon Geology) in January 1939, published by the Oregon State Department of Geology and Mineral Industries contained an article entitled "Fissure Eruptions Near Bend" and dealt with the Northwest Rift Zone of Newberry Volcano. (Bob Jensen)
66. In 1919 Professor W.O. Crosby studied the area around Benham Falls for a proposed reservoir site. In his report on the area he stated, "We feel that Newberry Crater is comparable in scenic and geologic interest with Crater Lake and recommend its designation as a national park or monument." (Bob Jensen)
67. The Dalles-California Hwy. (U.S. Hwy. 97) was completed through central Oregon in 1926. (Bob Jensen)
68. In 1940 Dr. R.L. Nichols of Tufts College proposed including the Lava Cast Forest, Lava Butte, and the Lava River Caves as part of a national park on Newberry. (Bob Jensen)
69. The bald eagle nesting pair at East Lake is the highest-elevation active bald eagle nest site in Oregon. (Edward W. Styskel)
70. At the point where Lava River Cave crosses beneath U.S. Hwy. 97 the roof of the cave is 50 feet thick. (Bob Jensen)

71. Lava Butte rises 500 feet above U.S. Hwy. 97 and the crater is 180 feet deep measured from the high point on the rim. (Bob Jensen) (Lava Lands Staff)
72. East Lake has no surface outlet and acts like a giant rain gauge for the indication of climate. Within the 20th century the level of East Lake has fluctuated over a range of about 16 feet, from 6,366 to 6382.5 feet elevation. (Bob Jensen)
73. The first small bath house was built at East Lake hot springs in 1915. The first resort with overnight facilities was built in 1918 and burned in Nov. 1923. Another resort was built in 1924 and it burned in Nov. 1941. (Bob Jensen)
74. On July 8, 1938 an alien space craft was seen descending into the crater by local residence on a Pilgrimage to Christmas Valley. (Clinton W. Holly)
75. The Paulina Lake Guard Station is on the National Register of Historic Places. The Guard Station was built in the early 1930's by the CCC's. (Linda A. Clark) (Steve Matz)
76. John Strong Newberry (1822-1892) grew up in Ohio, but came to know much of the geology and botany of the West. (Suzi Lewis)
77. The toilet on Paulina Peak is the highest public toilet in Oregon. (Dick Dufourd)
78. The old hand pump well (no longer works) at camp site 49 in Little Crater Campground produced water at a temperature of 86 to 97 degrees F., while most other wells in Newberry Crater produce water at temperatures of 36 to 50 degrees F. (Bob Jensen)
79. The lizard commonly seen on the Lava Butte lava flow is the Blue Tailed Lizard. (Lava Lands Staff)
80. The lava flow from Lava Butte is 30 to 100 feet thick and covers over 9 square miles. (Lava Lands Staff)
81. The Pandora Moth has a two year life cycle. Hatch from eggs first year and feed on needles of Ponderosa Pine as caterpillars. They winter over in the ground and return as moths the second year to lay eggs for the next generation. The moths will be coming out in July this year. (Lava Lands Staff)
82. Lava Lands receives more than 100,000 visitors a year. (Lava Lands Staff)
83. Lava River Cave is about 6200 feet long, as wide as 50 feet in places, and the ceiling is as much as 60 feet high in places. (Lava Lands Staff)
84. The Lava River Cave area has three ecosystems: the warm dry climate surrounding the entrance; the warm moist microclimate at the entrance; and the cool, moist, dark environment of the cave. (Lava Lands Staff)
85. In the mid-60's, NASA tested the chemistry of rocks from the Big Obsidian Flow from 70 sites. The chemistry at all sites was identical. (Larry Chitwood)
86. Based of geologic and geophysical information molten rock probably lies 2 to 3 miles below the floor of Newberry Crater. (Larry Chitwood)

87. The Northwest Rift Zone is a set of deep fractures that opened about 6000 years ago. Molten rock rose to the surface through these fractures and created several lava flows and cinder cones such as Lava Butte, Mokst Butte, and the Lava Cast Forest Flow. (Larry Chitwood)
88. In central Oregon, the next volcanic eruption will most likely be near South Sister or Newberry Crater. (Larry Chitwood)
89. Paulina Creek Falls continues to change. In the mid 1980's another large block of rock fell. Thousands of years from now the falls will be at Paulina Lake causing it to drop 20 or more feet. (Larry Chitwood)
90. When the flows from Lava Butte reached the Deschutes River they filled the existing canyon from the Benham Falls area to Dillon Falls with more than 100 feet of lava and formed a dam. The river backed up to form a lake which extended south through the Sunriver Area. When the lake reached its maximum depth it began spilling over a low saddle on Benham Buttes and began to cut the channel that today is known as Benham Falls. (Bob Jensen)  
(Larry Chitwood)
91. Railroad logging in central Oregon consisted of pushing rails into areas of virgin timber, setting up mobile camps or towns, logging the timber and moving it back to the mills in Bend. Many of the roads on the Deschutes N.F. and within the monument follow the old railroad grades. The foot bridge at Benham Falls is built on the remains of a bridge on the Shevlin-Hixon mainline to Bend. (Bob Jensen)
92. At Cinder Hill Campground on the east side of East Lake, in the early 80s, many of the Lodgepole pine trees were being attacked and threatened by the mountain pine beetle. The District put up a salvage sale and successfully removed a lot of trees. The operator did a very good job and wound up in October. Other than a little slash work for us to do, we all expected the campsite to look pretty good for the next season. BUT—low and behold, in November the area experienced a very bad windstorm (about 100 MPH gusts). It blew most of the leave trees over. It wreaked havoc on the site and it looked terrible. The District did well to re-salvage and cleanup slash the next early summer. Planted trees, etc. So, if one detects an absence of shade in this campground—it is not by USFS design! (Edward A. Coray)
93. The Paulina Lake Resort was built in the late 1920's. (Bob Jensen)
94. It is estimated that over 60,000 anglers visit East and Paulina Lakes each year, although they are among the last lakes to open in the spring due to heavy snow. (Denise Hann)
95. In 1990, the Oregon Department of Fish and Wildlife stocked Atlantic salmon for the first time in East Lake. (Denise Hann)
96. Oregon Department of Fish and Wildlife stock approximately 20,000 kokanee fingerling, 65,000 rainbow trout fingerling, and 10-20,000 brown trout fingerling each spring into Paulina Lake. (Denise Hann)
97. Oregon Department of Fish and Wildlife stock approximately 115,000 rainbow trout, 20,000 brown trout, and 50,000 brook trout into East Lake. (Denise Hann)
98. Fingerlings are generally 3 to 4 inches when planted and will grow to 10 to 12 inches by the following spring. This phenomenal growth rate is unique to the Crater. The hot mineral springs support a tremendous and varied food base for the fish. (Denise Hann)

99. J. H. Haner located a mining claim on Lava Butte in 1931. The claim was for volcanic rock, ash, and cinders suitable for ballast. The material was to be used in the construction of the railroad that passes through the Monument. The Railroad Company elected to get their material from another source and no material was removed from the site. The claimant lost his rights to the claim when he did not file a verified statement, as required under the 1955 mining law, to protect his rights to common variety materials. (Ken Meyer)
100. The 22.5 acre Lava Rivers Cave site was acquired by the Forest Service through an exchange of land with the State of Oregon in 1981. (Ken Meyer)
101. Not all of the Monument is within the Deschutes National Forest Boundary. The State of Oregon owns 80 acres outside the forest boundary in sec. 36, T. 18 S., R. 11 E. (Ken Meyer)

## APPENDIX B GLOSSARY OF GEOLOGIC TERMS

- AA Flow** (pronounced ah-ah)--A sluggish lava flow with a clinkery, rough, fragmental surface. Aa is a Hawaiian term for what you would say when you walk barefooted across it. Temperature and gas content are intermediate.
- Andesite** A fine grained igneous rock with an intermediate silica content of 57 to 62%.
- Ashflow** A turbulent mixture of gas and pyroclastic materials of high temperature, ejected explosively from a vent, that travels swiftly down the slopes of a volcano or along the ground surface.
- B.P.** Before present.
- Basalt** A dark fine grained igneous rock with a low silica content of less than 52%, and rich in iron and magnesium.
- Basaltic-andesite** A fine grained igneous rock with a low silica content of 52 to 57%.
- Block Flow** A sluggish lava with a surface made of blocks or large chunks of lava. Temperature and gas content are on the low side.
- Breccia** Angular broken rock.
- C14 Years** Age as dated by the carbon 14 method. Zero year is 1950 A.D. Due to pre-historic variations in C14 in the atmosphere C14 years and calendar years do not match exactly.
- Caldera** A large circular depression resulting from collapse of the land over a large emptying chamber of magma. Often the magma is erupted violently from the top of a volcano showering the area with ash and pumice. During the eruption the top of the volcano sinks into the chamber below.

<b><i>Cinders or Scoria</i></b>	Dark colored pieces (usually black to red) of volcanic rock full of vesicles. Cinders are thrown out of a volcano by expanding gases and pile up in a cone around the vent.
<b><i>Cinder Cone</i></b>	Cone shape pile of tephra erupted from a central vent. During eruptions cinder cones several hundred feet high are often built within weeks.
<b><i>Composite volcano</i></b>	Usually a steep sided cone made of numerous layers of lava, ash, pumice, and cinders strengthened by numerous dikes and sills.
<b><i>Crater</i></b>	A bowl or funnel shaped depression usually at the top of a volcanic cone formed during explosive eruptions.
<b><i>Dacite</i></b>	A glassy to fine grained igneous rock with an intermediate silica content of 62 to 67%.
<b><i>Dike</i></b>	A sheet like body of formerly molten rock that intruded steeply into bedded rock.
<b><i>Dike Swarm</i></b>	Large number of dikes in a relatively small area.
<b><i>Dome</i></b>	A mound of formerly molten rock with so little fluidity that it did not move away from the vent. The surface of the dome is very rough and made up of large blocks.
<b><i>Eocene Epoch</i></b>	Geologic time interval from 36,600,000 to 57,800,000 years B.P.
<b><i>Feeder Dike</i></b>	Dike along which magma reached the surface to feed a volcano.
<b><i>Fire Foundations</i></b>	Jets of incandescent lava that shoots into the air as lava is forced up to the surface by hydrostatic pressure and the expansion of gas bubbles.
<b><i>Fissure Eruption</i></b>	Volcanic eruption resulting from magma rising along an elongate fissure in the earth's crust.
<b><i>Holocene Epoch</i></b>	Geologic time interval from present to 10,000 years B.P.
<b><i>Hornito</i></b>	A small cone of spatter built on the surface of a lava flow by the escape of gas and clots of molten lava through cracks in the crust of the flow.
<b><i>Kipuka</i></b>	Hawaiian word for an island of older land surrounded by later lava flows.
<b><i>Lava Tube</i></b>	A roofed over channel that develops within a fluid lava flow (pahoehoe) through which lava travels to feed the advancing front of the flow. When lava ceases to pour out of the vent, the lava in the channel may flow out the end leaving a hollow winding cave.
<b><i>Maars</i></b>	A type of volcanic crater blasted out of existing rock by single or short lived steam eruptions. Steam is generated when molten rock encounters a large supply of ground water. The crater is surrounded by a low to negligible rims of ejecta.

<b>Mafic</b>	Includes rocks classified as basalt, basaltic-andesite, and andesite.
<b>Miocene Epoch</b>	Geologic time interval from 5,300,000 to 23,700,000 years B.P.
<b>Normal fault</b>	Fault resulting from extension of the earth's crust.
<b>Obsidian</b>	Black to clear volcanic glass from a lava flow or dome with a high silica content. The black color is due to abundant microscopic crystals of magnetite (a dark iron oxide).
<b>Oligocene Epoch</b>	Geologic time interval from 23,700,000 to 36,600,000 years B.P.
<b>Pahoehoe flow</b>	A very fluid lava with a ropy, smooth, billowy, or undulating surface. Pahoehoe is a Hawaiian term meaning smooth. Temperature and gas content are on the high side.
<b>Palagonite tuff</b>	A sandstone like brown tuff of angular grains, rock fragments and altered basaltic glass (palagonite).
<b>Paleocene Epoch</b>	Geologic time interval from 57,800,000 to 66,400,000 years B.P.
<b>Pleistocene Epoch</b>	Geologic time interval from 10,000 to 1,600,000 years B.P.
<b>Pliocene Epoch</b>	Geologic time interval from 1,600,000 to 5,300,000 years B.P.
<b>Pluvial lake</b>	A lake formed during a period of time characterized by abundant rainfall; such as a glacial period.
<b>Pumice</b>	Light colored pieces of volcanic rock so full of vesicles that they will often float on water. Most pumice is violently thrown out of volcanoes by expanding gases. Composition ranges from dacite to rhyolite.
<b>Quaternary Period</b>	Geologic time interval from present to 1,600,000 years B.P., and is divided into the Holocene and Pleistocene Epochs.
<b>Rhyodacite</b>	A glassy to fine grained igneous rock with a high silica content of 67 to 72%.
<b>Rhyolite</b>	A glassy to fine grained igneous rock with a high silica content of more than 72%.
<b>Rift Zone</b>	Zone of fractures along which volcanic activity has occurred.
<b>Shield Volcano</b>	A gently sloping volcano in the shape of a flattened dome, built by flows of very fluid basaltic lava.
<b>Silicic</b>	Includes rocks classified as dacite, rhyodacite, and rhyolite.
<b>Spatter cone</b>	A mound of welded clots of lava and cinders that were thrown a few feet into the air but were still molten when they landed.

**Spatter rampart**

A rim of welded clots of lava and cinders along a fissure.

**Tephra**

All rock fragments, molten or solid, thrown out of a volcano by expanding gases.

**Tertiary Period**

Geologic time interval from 1,600,000 to 66,400,000 years B.P., and is divided into the Pliocene, Miocene, Oligocene, Eocene, and Paleocene Epochs.

**Tree Molds (Lava casts)**

A mold which forms when lava surrounds the trunk of a living tree. A lava cast is an incorrect term for the same feature.

**Tuff**

A type of igneous rock resulting from the solidification of volcanic ash and pumice.

**Tuff cone or ring**

A broad, low volcanic cone with a wide flat bottomed crater. Tuff cones and rings result when magma encounters abundant ground water and huge amounts of steam are generated which drive a violent eruption of steam, water, and rock fragments. Difference between ring and cone relates to width of crater to height of cone.

**Vent**

The opening at the Earth's surface through which volcanic materials issue.

**APPENDIX C  
PUBLIC LAW 101-522  
NOVEMBER 5, 1990**

**ENJOY THE MONUMENT!**

PUBLIC LAW 101-522—NOV. 5, 1990

NEWBERRY NATIONAL VOLCANIC  
MONUMENT

Public Law 101-522  
101st Congress

An Act

Nov. 5, 1990  
(H.R. 3840)

To establish the Newberry National Volcanic Monument in the State of Oregon, and for other purposes.

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,*

SECTION 1. ESTABLISHMENT.

(a) IN GENERAL.—There is hereby established the Newberry National Volcanic Monument in the State of Oregon as a component of the National Forest System in order to preserve and protect for present and future generations its remarkable geologic landforms and for the purposes of providing for the conservation, protection, interpretation, and enhancement of its ecological, botanical, scientific, scenic, recreational, cultural, and fish and wildlife resources.

(b) AREA INCLUDED.—(1) The Monument shall comprise those lands generally depicted on the map entitled "Newberry National Volcanic Monument" and dated September 1990, which shall be on file and available for public inspection in the Office of the Chief, Forest Service, Department of Agriculture, Washington, District of Columbia.

(2) The Newberry Special Management Area, the Transferal Area, the Transferal Area Adjacent, and the Transferal Corridor shall comprise those lands generally depicted as such on the map referred to in paragraph (1).

(3) The Secretary may, by publication of a notice of availability of a revised map and after public comment, make corrections or minor changes to the boundary of the Monument or Special Management Area if such changes are—

(A) necessary to facilitate management of the Monument, Special Management Area and the immediately surrounding area;

(B) consistent with the purposes of this Act, and

(C) noncontroversial.

Any proposed boundary change shall be made pursuant to the National Environmental Policy Act of 1969.

SEC. 2. ADMINISTRATION.

(a) IN GENERAL.—Subject to valid existing rights, the Secretary shall administer the Monument and Special Management Area in accordance with the laws, rules, and regulations pertaining to the National Forest System and this Act as part of the Deschutes National Forest.

(b) TRANSFERAL AREA.—(1) Upon termination, cancellation, or relinquishment of all Federal geothermal leases (numbered OR-12008, OR-11612, and OR-11613), the lands and mineral rights encompassed by such leases, and other Federal land identified as the Transferal Area on the map referred to in section 1(b)(1), shall become part of the Monument and shall be administered under this Act.

(2) The Transferal Corridor is a part of the Transferal Area and shall be managed as such, except as otherwise provided in section 4.

(3) Prior to the termination, cancellation, or relinquishment of such geothermal leases, the Secretary of the Interior and the Secretary of Agriculture shall, to the extent practicable and consistent with the Geothermal Steam Act of 1970 and rights under such leases, manage the Transferal Area under the laws, rules, and regulations pertaining to the National Forest System in such a manner so as to preserve the natural values of the area which would qualify it for designation as a national monument.

(4) Upon discovery of commercial quantities of geothermal resources, paragraphs (1), (2), and (3) shall no longer apply.

(c) NEWBERRY SPECIAL MANAGEMENT AREA.—The area identified on the map referred to in section 1(b)(1) as the Newberry Special Management Area shall be managed as if it were part of the Monument, except as otherwise provided in section 4.

(d) TRANSFERAL AREA ADJACENT.—The area identified on the map referred to in section 1(b)(1) as the Transferal Area Adjacent is a part of the Special Management Area, except as otherwise provided in section 4.

(e) MANAGEMENT REQUIREMENTS.—The Monument and Special Management Area shall be administered in accordance with the following management requirements:

(1) Land management activities shall allow natural ecological succession of vegetation to continue to the maximum extent practical, as determined by the Secretary. Timber removal shall be permitted only to the extent the Secretary determines necessary to achieve the purposes of this Act and to protect health and safety. Timber within the Monument and Special Management Area shall not be considered part of the allowable sale quantity for the Deschutes National Forest.

(2) Recreation uses and interpretive facilities shall be provided, including (but not limited to) trails, campgrounds, resorts, and visitor centers, as identified in the management plan.

(3) Roads shall be permitted in the Monument and Special Management Area consistent with the purposes of this Act and in accordance with the management plan.

(f) SCIENTIFIC RESEARCH.—Scientific research shall be allowed consistent with the purposes for which the Monument was established.

(g) DISEASE, INSECT INFESTATION, AND FIRE HAZARD.—The Secretary is authorized to take action to the extent practicable to ensure that tree diseases, insect infestations, fire hazards, and fires within the Monument and Special Management Area do not seriously threaten resources outside the Monument and Special Management Area boundaries.

SEC. 3. EXCHANGES OF GEOTHERMAL LEASE RIGHTS.

(a) IN GENERAL.—Those holders of all Federal geothermal leases within the Monument as of the date of enactment of this Act and who are listed in subsection (c) of this section are authorized, without penalty, to relinquish all rights to such leases on the terms and conditions provided in this section and section 10 of the Geothermal Steam Act of 1970. Such leases are depicted on the map entitled "Geothermal Lease Compensation" which is a part of the Surface Resource Analysis of Newberry Volcano.

Historic  
preservation.  
16 USC 431 note.

(b) **GEOTHERMAL LEASE EXCHANGE.**—Upon the acceptance by the Secretary of the Interior of a lease relinquished pursuant to subsection (a), the Secretary of the Interior shall immediately issue, in lieu thereof and in full compensation for such relinquishment, geothermal leases of like value as described in subsection (c). The leases issued in lieu of relinquished leases shall contain the terms and conditions prescribed in the Surface Resource Analysis of Newberry Volcano and the Land and Resource Management Plan for the Deschutes National Forest, dated August 1990. Consistent with such terms and conditions, such in-lieu leases shall be administered under the Geothermal Steam Act of 1970.

(c) **DESCRIPTIONS.**—(1) The parties (including their successors, or assignees), and lands referred to in subsection (a), are those specified on the map referred to in subsection (a).

(2) The leases to be issued pursuant to subsection (b) and the interests in lands subject to such leases are as follows:

(A) Within the Newberry Caldera Known Geothermal Resource Area, lease area 1, leases shall be issued with an undivided fractional interest distributed as follows:

- (i) 62.87 percent to California Energy Co., Inc.
- (ii) 35.09 percent to Christian F. Murer.
- (iii) 2.54 percent to Delta Funds, Inc.

(B) Within the Newberry Caldera Known Geothermal Resource Area, lease area 2, leases shall be issued with an undivided fractional interest distributed as follows:

- 0.84 percent to L.H. Armour, Jr.
- 5.49 percent to Frances B. Bunn.
- 1.73 percent to Robert B. Bunn.
- 8.52 percent to Geo-Newberry Crater, Inc.
- 15.10 percent to Hawthorn Oil Co.
- 3.42 percent to Terry Allen Kramer.
- 64.90 percent to George W. Waters.

(C) Outside the Newberry Caldera Known Geothermal Resource Area, leases shall be issued for the approximate acreage noted:

- (i) Lease Area 3—Robert B. Bunn—1,280.00 acres.
- (ii) Lease Area 4—Frances B. Bunn—1,240.00 acres.
- (iii) Lease Area 5—Geo-Newberry Crater, Inc.—2,928 acres.

(d) **AVAILABILITY OF CERTAIN LANDS FOR GEOTHERMAL LEASING UNDER THE GEOTHERMAL STEAM ACT.**—Following the expiration, relinquishment, or termination of any geothermal lease issued for lands identified in subsection (c), except for lands situated within the Special Management Area, such lands may be offered for lease under the Geothermal Steam Act of 1970.

(e) **AVAILABILITY OF CERTAIN LANDS FOR GEOTHERMAL LEASING UNDER THIS ACT.**—Following expiration, relinquishment, or termination of a geothermal lease on lands identified in subsection (c), within the Special Management Area, lands shall be offered for lease as provided in section 4(a)(5) of this Act.

(f) **NONAPPLICABLE PROVISIONS.**—The provisions of subsection (g) of section 6 of the Geothermal Steam Act of 1970 (30 U.S.C. 1005 (c) and (g)) shall not apply to any geothermal lease within the Monument existing on the date of enactment of this Act.

#### SEC. 4. SUBSURFACE RIGHTS.

##### (a) WITHDRAWAL.—

(1) **MONUMENT.**—Subject to valid existing rights, Federal lands within the Monument are hereby withdrawn from all forms of entry, appropriation, or disposal under the public land laws, from location, entry, or patent under the mining laws, and from disposition under all mineral and geothermal leasing laws.

(2) **TRANSFERAL AREA.**—Subject to valid existing rights, Federal lands within the Transferal Area are hereby withdrawn from all forms of entry, appropriation, or disposal under the public land laws, from location, entry, or patent under the mining laws, and from disposition under all mineral and geothermal leasing laws. Upon completion of a well capable of producing geothermal steam in commercial quantities, as defined in section 6(d) of the Geothermal Steam Act of 1970 (30 U.S.C. 1005(d)) on valid existing leases within the Transferal Area, as determined by the Secretary of the Interior, the withdrawal made by this subsection shall be revoked, and such lands shall be restored to the operation of the public land laws, mining laws, and mineral and geothermal leasing laws.

(3) **TRANSFERAL CORRIDOR.**—Subject to valid existing rights, Federal lands within the Transferal Corridor are hereby withdrawn from all forms of entry, appropriation, or disposal under the public land laws, from location, entry or patent under the mining laws, and from disposition under all mineral and geothermal leasing laws.

(4) **TRANSFERAL AREA ADJACENT.**—Subject to valid existing rights, Federal lands within the Transferal Area Adjacent are hereby withdrawn from all forms of entry, appropriation, or disposal under the public land laws, from location, entry, or patent under the mining laws, and from disposition under all mineral leasing laws except the Geothermal Steam Act of 1970. Upon completion of a well capable of producing geothermal steam in commercial quantities, as defined in section 6(d) of the Geothermal Steam Act of 1970 (30 U.S.C. 1005(d)) within the Transferal Area, as determined by the Secretary of the Interior, this area will be managed as part of the Special Management Area and be governed by provisions in section 4(a)(5). Geothermal leases issued in this area shall contain stipulations that prohibit surface occupancy and no plans of operation will be approved by the Secretary until commercial quantities of geothermal resources are found within the Transferal Area.

(5) **SPECIAL MANAGEMENT AREA.**—Subject to valid existing rights, Federal lands within the Special Management Area are hereby withdrawn from all forms of entry, appropriation, or disposal under the public land laws, from location, entry, or patent under the mining laws, and under all mineral leasing laws except the Geothermal Steam Act of 1970. Geothermal leases issued in this area shall contain stipulations that prohibit surface occupancy and shall require that the Special Management Area be entered only by directional drilling from outside the Special Management Area boundaries. In the event that no commercial quantities of geothermal resources are developed under leases within 30 years after the date of enactment of this Act, the Secretary of the Interior is authorized and directed to withdraw such areas in perpetuity from all further leasing under the Geothermal Steam Act of 1970. Upon such withdrawal, the Special Management Area designations shall terminate and such areas shall become part of the Monument. All or

portions of the Special Management Area may be withdrawn from the Geothermal Steam Act of 1970 and made a part of the Monument earlier at the joint discretion of the Secretaries of Interior and Agriculture. This provision shall in no way restrict the Secretary's authority to acquire by purchase, donation or exchange any lease within the Special Management Area prior to the expiration of the term of years set forth in this paragraph.

(b) **GEOTHERMAL LEASE SALES.**—(1) Within one year after the date of the enactment of this Act, pursuant to the Geothermal Steam Act of 1970, the Secretary of the Interior shall offer for lease by competitive bid the lands depicted on the map entitled "Geothermal Lease Sale Parcels," which is part of the Surface Resource Analysis of Newberry Volcano, with stipulations as provided therein.

(2) Any of the lands described in paragraph (1) of this subsection which are not leased as a result of the first competitive bid offering, or any of the initial leases which are relinquished, terminated, or otherwise canceled, may be reoffered by the Secretary of the Interior for lease by competitive bid under the Geothermal Steam Act of 1970, except that all lands within the Special Management Area shall be subject to the leasing provisions of subsection (a)(5) of this Act.

(c) **AUTHORITY FOR PLANS OF OPERATION.**—The Secretary of Agriculture shall regulate all surface disturbing activities conducted pursuant to any lease issued under this section and section 3 and shall determine reclamation and all other actions as required in the interest of conservation of these resources. No permit to drill on a geothermal lease for areas covered under this Act may be granted without the analysis and approval by the Secretary of Agriculture of a plan of operations covering proposed surface disturbing activities within the lease area. In making such determination, the Secretary shall consider the effects of the proposed operations on the values for which the Monument and Special Management Area were established.

#### SEC. 5. FISH AND WILDLIFE.

Nothing in this Act shall be construed to affect the jurisdiction or responsibilities of the State of Oregon with respect to fish and wildlife, including the regulation of hunting, fishing, and trapping, except that the Secretary may designate zones where, and establish periods when, no hunting, fishing, or trapping shall be permitted for reasons of public safety, administration, or public use and enjoyment. Except in emergencies, any regulations of the Secretary pursuant to this section shall be put into effect only after consultation with the Department of Fish and Wildlife of the State of Oregon or its successor agency.

#### SEC. 6. MANAGEMENT PLAN.

(a) **IN GENERAL.**—(1) Within three fiscal years beginning after the date of enactment of this Act, the Secretary shall develop a management plan which shall address the lands established in section 1. The management plan shall be developed in consultation with the Council (established by section 7), interested Federal, State, and local government agencies, and the public.

(2) The management plan shall be periodically updated, amended, or revised as necessary and, at the discretion of the Secretary, such updates, amendments, or revisions may be done separately or in

conjunction with land management planning for other adjacent areas of the Deschutes National Forest.

(3) No actions taken under the authority of this Act shall require the reconsideration, amendment, or revision of the Deschutes National Forest Land and Resource Management Plan prepared pursuant to section 6 of the Forest and Rangeland Renewable Resources Planning Act of 1974 (16 U.S.C. 1604). The management plan required by paragraph (1) shall be incorporated into the Deschutes National Forest Land and Resource Management Plan upon the regular revision of the the Deschutes National Forest Land and Resource Management Plan.

(b) **ISSUES TO BE ADDRESSED BY MANAGEMENT PLAN.**—Consistent with the purposes for which the Monument and Special Management Area were established, the Management Plan shall address at least the following management issues:

(1) Recreation, including consideration of a full range of existing and appropriate new facilities and programs for recreation during all seasons of the year.

(2) Vegetation, including consideration of a full range of management options, and a program to reestablish old growth ponderosa pine ecosystems.

(3) Roads and facilities, including—

(A) consideration of the general location, design, construction, and maintenance criteria;

(B) standards for motorized vehicle use;

(C) traffic management; and

(D) criteria for the closing and obliteration of roads.

(4) Fire and fuel management prescriptions, including consideration of a full range of management options for fuel hazard reduction and prescribed fire and fire control strategies to minimize the risk of catastrophic wildfire and to meet other resource objectives.

(5) Wildlife management, including general prescriptions for wildlife habitat improvements.

(6) Research, including identification and prioritization of research opportunities.

(7) Monitoring, including monitoring needs for air, water, wildlife, soil, and other resources. The Secretary, in cooperation with the Secretary of the Interior, shall maintain a research and monitoring program for geothermal resources for the purpose of identifying and assessing the impact that present and proposed geothermal development in the vicinity of the Monument and Special Management Area may have on the values for which such Monument and Special Management Area were established.

(8) Conflicts, including consideration of potential conflicts among uses and resources.

#### SEC. 7. ADVISORY COUNCIL.

(a) **ESTABLISHMENT.**—There is hereby established the Newberry National Volcanic Monument Advisory Council for the purpose of advising the Secretary on the preparation of the initial management plan required by section 6(a) and on other matters at the Secretary's request.

(b) **MEMBERSHIP.**—The Council shall be composed of 11 members, appointed by the Secretary, as follows:

(1) One member who represents the scientific community.

- (2) One member who represents organized recreational interests.
- (3) One member who represents organized timber industry interests.
- (4) One member who represents organized geothermal industry interests.
- (5) One member who represents organized tourism interests.
- (6) One member of the Deschutes County Board of Commissioners.
- (7) One member who represents organized environmental interests.
- (8) One member who represents organized wildlife and fish interests.
- (9) One at-large member from nominations submitted to the Secretary by the Governor of Oregon.
- (10) The Forest Supervisor, Deschutes National Forest, and the District Manager, Prineville District, Bureau of Land Management, who shall serve as nonvoting, ex officio members.
- (c) **VACANCY.**—A vacancy on the Council shall be filled in the same manner as the original appointment.
- (d) **QUORUM.**—A quorum shall be 6 appointed members of the Council. The operations of the Council shall not be impaired by the fact that a member has not been appointed as long as a quorum has been attained.
- (e) **CHAIRPERSON AND PROCEDURES.**—The Council shall elect a chairperson and establish such rules and procedures as it deems necessary or desirable.
- (f) **CONSULTATION.**—The Secretary shall consult with the Council on a periodic and regular basis with respect to the management plan.
- (g) **PAY.**—Members of the Council who are not full-time officers or employees of the United States shall serve without pay. Members who are full-time officers or employees of the United States shall receive no additional pay by reason of their service on the Council.
- (h) **SCIENTIFIC ADVISORY SUBCOMMITTEE.**—The Council may appoint a Scientific Advisory Subcommittee, to be chaired by the Council member who represents the scientific community, for the purposes of advising the Council on matters related to the management plan. Subcommittee members shall be appointed for their expertise and need not be members of the Council.
- (i) **TERMINATION.**—The Council and the Scientific Advisory Subcommittee, if any, shall cease to exist on the date upon which the management plan is officially adopted by the Secretary, or later at the discretion of the Secretary, except in no event shall the Council exist later than 5 years after the date of enactment of this Act.

#### SEC. 8. SAVINGS PROVISIONS.

(a) **MANAGEMENT OUTSIDE BOUNDARIES OF MONUMENT.**—Nothing in this Act shall be construed as authorizing or directing the establishment of protective perimeters or buffer zones around the Monument or Special Management Area for the purpose of precluding activities outside the Monument and Special Management Area boundary which would otherwise be permitted under applicable law. Nothing in this Act shall be construed as limiting the existing authority of the Secretary to take actions on Federal lands adjacent to the Monument and Special Management Area necessary to protect public health and safety in emergencies. The fact that activities

or uses outside the Monument and Special Management Area can be seen, heard, measured, or otherwise perceived within the Monument and Special Management Area shall not, of themselves, limit, restrict, or preclude such activities or uses up to the boundary of the Monument and the Special Management Area.

(b) **CONTRACTS.**—Nothing in this Act shall limit, restrict, or preclude the implementation of valid timber sale contracts or other contracts or agreements executed by the Secretary or the Secretary of the Interior prior to the date of enactment of this Act.

(c) **ADMINISTRATION OF GEOTHERMAL STEAM ACT OF 1970.**—Except as specifically provided in sections 3 and 4, nothing in this Act shall be construed to affect the authority of the Secretary of the Interior to administer the Geothermal Steam Act of 1970 (30 U.S.C. 1001 et seq.).

#### SEC. 9. DEFINITIONS.

As used in this Act:

- (1) the term "allowable sale quantity" has the same meaning as such term has in section 13 of the Forest and Rangeland Renewable Resources Planning Act of 1974 (16 U.S.C. 1611).
- (2) The term "Council" means the Newberry National Volcanic Monument Advisory Council established by section 7.
- (3) The term "Management Plan" means the plan developed under section 6.
- (4) The term "Monument" means the Newberry National Volcanic Monument established by section 1.
- (5) The term "Newberry Caldera Known Geothermal Resource Area" refers to the area established by the United States Geological Survey in 1974 and identified on the map referred to in section 3(a).
- (6) The term "Special Management Area" means the Newberry Special Management Area established by section 1.
- (7) The term "Secretary" means the Secretary of Agriculture.
- (8) The term "Surface Resource Analysis of Newberry Volcano" means the document dated September 1990, prepared by the Forest Service and the Bureau of Land Management, and available for public inspection in the Office of the Chief, United States Forest Service, United States Department of Agriculture, Washington, District of Columbia.
- (9) The terms "Transferral Area", "Transferral Corridor" and "Transferral Area Adjacent" mean the areas established by section 1.

**SEC. 10. AUTHORIZATION OF APPROPRIATIONS.**

There are authorized to be appropriated such sums as may be necessary to carry out this Act.

Approved November 5, 1990.

---

**LEGISLATIVE HISTORY—H.R. 3840:**

**HOUSE REPORTS:** No. 101-827 (Comm. on Interior and Insular Affairs).  
**CONGRESSIONAL RECORD, Vol. 136 (1990):**

Oct. 10, considered and passed House.  
Oct. 22, considered and passed Senate.

