APPENDIX C
RESULTS OF OBSIDIAN STUDIES

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This appendix presents the results of various obsidian studies performed in conjuction with the PGT-PG&E Pipeline Expansion Project (PEP) and is divided into five sections. PEP obisidian characterization and hydration studies are discussed in Chapters 4 and 5.

Obsidian sourcing and provenience information for all characterized samples from the Northwest are presented in Section C.1 and all characterized samples from California are presented in Section C.2. These tables provide a record of all trace element (XRF) and visual obsidian characterization studies. They also show trace element concentrations, analytical uncertainties, and the identified geologic source of the sample.

Sections C.3 and C.4 provide summary results of all obsidian hydration and characterization studies for PEP samples from the Northwest and California respectively. These tables includes the mean values of measurable hydration rims, sample provenience information, and brief comments. Also included is geological source of the artifact. In contrast to the source attributions presented in Sections C.1 and C.2, Sections C.3 and C.4 identify the Grasshopper Flat/Lost Iron Wells/Red Switchback and East Medicine Lake sources based on their zirconium value (see Chapter 4), refining the all inclusive "Grasshopper Group" attributions.

Obsidian sources identified during the x-ray fluorescence (XRF) characterization studies conducted for the PEP are presented in Section C.5.

Categories of information used in Sections C.1, C.2, C.3, and C.4 are defined below.

Site. Site trinomial or PEP site number, if no trinomial was assigned.

Specimen. Lot number, specimen number, and item number.

Artifact Source/Chemical Type. In most cases, the chemical group or source to which the sample was assigned is based on the trace element composition of the item. Because of the limited space available, some sources occasionally were abbreviated when only undifferentiated chemical source groups (e.g., Little Bear Cr./Whitewater R./Juniper Sp. 1) were identifiable:

Juniper Sp. 1 = Juniper Spring 1
Juniper Sp. 2 = Juniper Spring 2

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Little Bear Cr. = Little Bear Creek
Whitewater R. = Whitewater Ridge

A "?" immediately following a source indicates a provisional source assignment (e.g., Newberry Volcano?); for these samples, trace element values fell very close to the known range of geochemical values determined for the geologic source. Any sample whose source was visually assigned without trace element data is noted in the Artifact Source/Chemical Type column—the source ascription of the artifact is immediately followed in the column by a (V) or (MV) notation. Samples characterized on the basis of megascopic visual characteristics received the (V) designation; these were all from California sites investigated by BioSystems Analysis (n=352). Artifacts characterized on the basis of microscopic petrographic attributes are followed by (MV); these were all from the Oregon Site 35-JE-49 (n=49).

Unknown Sources. Chemical groups for which no known geologic source could be identified are denoted by a letter immediately following the unknown designation (e.g., Unknown A, Unknown B, etc.). *The letter suffixes following the Unknown designations have no significance other than temporarily differentiating among unknown obsidian sources* and are assigned simply on the basis of the order of the catalog number of the artifact. These unknown group designations are *specific to every site*, that is, Unknown A at one site has no genetic relationship with an Unknown A source at any other site.

The following category appears only in Sections C.1 and C.2:

Trace Element Concentrations. Trace element abundances (Zn, Ga, Rb, Sr, Y, Zr, Nb, Ti, Mn, and Ba) and analytical uncertainties ($\pm$) are reported in parts per million (ppm). Fe_2O_3 concentrations are reported as weight percent oxide; uncertainty is reported in percent. The iron-manganese ratio is reported by Richard Hughes as a standard ratio; the ratios are presented by BioSystems Analysis only as uncorrected counts.

These categories are pertinent to Sections C.3 and C.4 only:

Unit. Test or excavation unit type and location.

Depth. Top and bottom of unit (cm below surface).

CLA. Classification of sample:

BIF	Biface
COR	Core
DEB	Debitage
EXS	Exotic Stone
FLB	Flaked Blank (BioSystems 1991 only)
PFT	Patterned Flaked Tool
PPT	Projectile Point
UFT	Unpatterned Flaked Tool
UNF	Unifacial Tool (BioSystems 1991 only)

Hydration Rims. Average obsidian hydration rim. The uncertainty ($\pm$) presented after each measurement represent one standard deviation of the multiple rim measurements. Standard deviations of less than 0.049 are reported as 0.0.

DH = Diffuse hydration (hydration rim not measurable)
NVB = No visible band found after preparation
NM = Not measured; sample was not prepared for obsidian hydration measurement
NO = Not obsidian
NR = Not readable; sample was prepared but rim could not be measured
VW = Variable width band

Comments. Brief comments regarding the individual sample. OH is used as an abbreviation for obsidian hydration.

C.5 OBSIDIAN SOURCES IDENTIFIED DURING PEP STUDIES

Fifty-nine different potential chemical sources or types of obsidian were identified during the x-ray fluorescence (XRF) characterization studies associated with the PGT-PG&E Pipeline Expansion Project (Table C.5-1, Figures C.5-1 and C.5-2). Although many sources in addition to those identified during these investigations are known, particularly in Oregon and California, only those found during trace element studies of PEP samples are described here. These chemical types represent almost all major sources of glass known to exist within direct procurement range of sites within the Project corridor. Sources of glass are also known from Washington (McClure 1989; Weld 1962) and Idaho (Sappington 1981a, 1981b), though none were identified during the course of PEP XRF studies.

C.5.1 Oregon Obsidian Sources

More sources of natural glass are found in Oregon than in any other comparable geographic area of the world. With field research still in its early stages, well over 100 geochemically distinct sources have been identified. These sources are found primarily in the central High Cascades, the Newberry Volcano region, north-central Oregon, the Klamath Basin, and scattered throughout the northwestern Great Basin. Although obsidian characterization studies have appeared with increasing frequency in contract and graduate archaeological research in recent years, the systematic geoarchaeological studies of Oregon obsidian sources are still rare. Geologic investigations of Oregon obsidian are incomplete and widely dispersed throughout the literature; the Newberry Volcano and Glass Buttes areas have received the most attention because of their high geothermal or mineral potential and their spectacular geologic features (Berri 1982; Higgins 1968, 1973; Johnson 1984; MacLeod et al. 1982; Roche 1987; Williams 1935). Obsidian source compilations have appeared in Hughes (1986a) and Skinner (1983); many additional references to archaeological and geological obsidian studies in Oregon are found in Skinner and Tremaine (1993).

C.5.2 California Obsidian Sources

The first attempt to assemble descriptions of California obsidian sources was made as part of an ambitious compilation of prehistoric mines and quarries by Heizer and Treganza (1944). Although this initial effort contained numerous factual errors, including several nonexistent sources (Jackson 1974:33–51), it provided an important platform for later studies. Since then, several contributions to California obsidian source compilations have been made, most notably by Ericson (1977, 1981), Ericson et al. (1976), Hughes (1986a), and Jackson (1974, 1986). Other major contributions to California obsidian studies include edited volumes by Hughes (1984, 1989) and Taylor (1976). Contract and graduate-level archaeological investigations, particularly those reported since about 1975, have produced more obsidian characterization and hydration studies for California than perhaps any other similar geographic area in the world except New Zealand. In addition, areas of recent volcanism, potential volcanic hazards, and geothermal activity such as the Medicine Lake Highlands, the Long Valley Caldera-Mono Lake Basin, and the North Coast Range have received considerable geologic attention (Bailey 1989; Bailey et al. 1976; Donnelly-Nolan et al. 1981; Donnelly-Nolan et al. 1990). Many geologic studies of associated obsidian sources in these and other areas are available. Specific references related to archaeological and geological investigations are listed in Skinner and Tremaine (1993).

C.5.3 Wyoming Obsidian Sources

Obsidian sources in the Teton-Yellowstone area are briefly described by Frison (1974). Obsidian Cliff, a well-known source located within Yellowstone National Park, was the subject of the first major geologic study of any obsidian source (Iddings 1888). Glass from that source was extensively utilized and has been identified at prehistoric sites in Montana, Idaho, Wyoming, Ohio, Illinois, Wisconsin, Michigan, Alberta, Saskatchewan, and Ontario (Davis 1972; Frison 1974; Griffin et al. 1969; Hatch et al. 1990).

Table C.5-1 Obsidian Sources Identified During Obsidian Characterization Studies of PEP Obsidian Artifacts.

Chemical Group	Location	Comments
		OREGON OBSIDIAN SOURCES
Bald Butte	T23S R26E	Source located southeast of Wagontire Mountain about 10 km northwest of the town of Wagontire.
Beatys Butte	T37S R28E	Dense concentrations of surface obsidian nodules are found on the northern slopes of Beatys Butte and are common in the lacustrine deposits of Pluvial Lake Catlow to the north and east of the Butte. Obsidian from this source was widely used in the southeastern part of the state. References: Ericson et al. 1976; Hughes 1986a:317–318; Skinner 1983:9-10.
Big Obsidian Flow	T21S R12E	This chemical group includes the Big Obsidian Flow and Buried Obsidian Flow, both located within the summit caldera of Newberry Caldera. Trace element studies by Linneman (1990:277) indicate that both flows are chemically similar, resolving a problem of anomalously thick obsidian hydration rims found on artifacts thought to be from the geologically recent Big Obsidian Flow. Preliminary XRF analyses of samples from the two flows by Richard Hughes, however, suggests that the two units may be eventually prove to be geochemically separable. The age of the Buried Obsidian Flow is estimated by Linneman (1990:87) to be about 10,000 years. Radiocarbon dates from charcoal associated with the ashfall or ashflow that immediately preceded the eruption of the Big Obsidian Flow has yielded ages of: 1270 ± 60 B.P. (Tx-245; Pearson et al. 1966); 1330 ± 60 B.P. (IVIC-200; Tamers 1969); 1340 ± 60 B.P. (USGS-755; Robinson and Trimble 1983); 1390 ± 200 B.P. (W-277; Kelley et al. 1978); 1550 ± 120 B.P. (USGS-755; Robinson and Trimble 1983); 1720 ± 250 B.P. (W-2168; Spiker et al. 1978); 2054 ± 230 B.P. (C-657; Libby 1952). References: Higgins 1968, 1973; Linneman 1990; Skinner 1983:110–112, 236–237; Williams 1935.
Brooks Canyon	T23S R20E	Located north of Benjamin Lake and just south of the Lake County line. The obsidian is found in a canyon that opens onto Brooks Lake (dry).
Chickahominy	T23S R26E	Nodules of obsidian are found on the surface in the vicinity of Chickahominy Reservoir.
Coglan Buttes	T33S R20E	Nodules of glass up to about 10 cm in diameter are found in a sagebrush flat immediately west of Hope Well in the Coglan Buttes. References: Hughes 1986a:316–317; Skinner 1983:241.
Cougar Mountain	T25S R15E	A rhyolite-obsidian dome located on the northwest edge of the Fort Rock Valley, central Oregon. High-quality glass from this source is widespread in lacustrine deposits associated with the former Pluvial Fort Rock Lake. References: Hughes 1986a:317; Skinner 1983:114–118, 242–244.

Table C.5-1 (continued)

Chemical Group	Location	Comments
Deer Creek	T27S R7E	A locally-utilized source of obsidian found in the drainage of Deer Creek a few kilometers west of Chemult, central Oregon. The source was first mentioned in a description of PEP Site 35-KL-811 in Moratto et al. 1991. Reference: Moratto et al. 1991.
Delintment Creek	T19S R25-26E	Obsidian is found in association with ash-flow deposits at several locations in the Delintment Lake area, Ochoco National Forest. Numerous widespread secondary outcrops of glass in this chemical group have been located. The secondary distribution of obsidian is currently poorly-known although trace element studies by Richard Hughes are underway.
Drews Creek/Butcher Flat	T38S R16E	Obsidian in the Drews Reservoir area co-occurs with commercial quantities of perlite and has been described by Peterson (1961). References: Hughes 1986a:314; Peterson 1961; Skinner 1983:247.
Glass Buttes	T23S R22E	Oregon's most well-known source of obsidian. High-quality obsidian from this complex of flows and domes is spread over a large area in the vicinity of Glass Buttes. A long-standing rumor that glass from this source was found in the Hopewell mounds of the Midwest was discounted by trace element studies of Hopewell artifacts (Griffin et al. 1969). References: Berri 1982; Godfrey-Smith et al. 1993; Hughes 1986a:318; Johnson 1984; Mack 1975; Roche 1987; Skinner 1983:118–123, 251–253.
Horse Mountain	T28S R22E	Obsidian nodules from the Horse Mountain chemical group are widely distributed in the region surrounding this large dome. References: Hughes 1986a:319–320; Skinner 1983:254–255.
Inman Creek/ Salt Creek A	T18S T17S R5W T22S R5E	Widely distributed throughout northwest Oregon, glass from this source is found in secondary geologic contexts in the Willamette Valley, the central Oregon Coast, and the Western Cascades. The primary source appears to lie near Salt Creek in the Upper Middle Fork Willamette drainage at the southern base of Mount David Douglas. The type locality for this source is located at Inman Creek, a tributary to Fern Ridge Reservoir in the southwestern Willamette Valley. A geochemically-distinct Inman/Salt Creek B chemical group co-occurs with Inman A glass at most geologic localities. References: Skinner 1983:304–320; Skinner 1993; Woller and Black 1983.
Juniper Spring 1 and 2	—	Located about 30 miles north northeast of Glass Buttes north of Buck Creek and south of Twelvemile Creek. Obsidian from two geochemically distinguishable chemical groups, Juniper Spring 1 and 2, occurs together at this location.
Little Bear Creek	T16S R33E	Located east of Seneca and northeast of Whitewater Spring. This source is geochemically very similar to the Whitewater Ridge glass and further geochemical studies may show that the two sources represent chemical variability of a single chemical group. This source was first mentioned briefly in the literature by Ericson 1977:316.

Table C.5-1 (continued)

Chemical Group	Location	Comments
McComb Butte	T34S R18E	Source of obsidian nodules along the southwestern flank of McComb Butte; shows evidence of prehistoric use. Reference: Hughes 1986a:315.
McKay Butte	T21S R11E	An obsidian-rhyolite dome situated on the lower western flanks of Newberry Volcano, central Oregon. Glass from this localized source is typically a distinctive gray to bluish-gray and was extensively used prior to the eruption of Newberry Caldera obsidian flows during the mid-Holocene. References: MacLeod et al. 1982; Skinner 1983:261–262.
Newberry Volcano	T21S R12–13E	A chemical group consisting of the geochemically indistinguishable Central Pumice Cone, East Lake, Game Hut, and Interlake obsidian flows. These flows were all extruded not long after tephra from Mount Mazama covered the region. References: Higgins 1968 and 1973; MacLeod et al. 1981; MacLeod et al. 1982; Skinner 1983:105–114; Williams 1935.
Obsidian Cliffs	T16S R7–8E	Extensive obsidian quarry source located near the Three Sisters, central High Cascades. Characterized glass from this source has been was found at many archaeological sites in both western and central Oregon. References: Hughes 1993d; Skinner 1983:98–102, 265–266; Skinnner 1986; Skinner and Winkler 1991.
Potato Hills	T23S R24E	Located about 14 miles east northeast from Glass Buttes. This source is currently under investigation by Richard Hughes.
Quartz Mountain	T22S R15E	A complex of rhyolite dome and flows located immediately east-southeast of Newberry Volcano. References: Hughes 1986a:320; Skinner 1983:267–268.
Riley	T24S R26E	Surface nodules of high quality glass located a few kilometers south of Riley in central Oregon. References: Atherton 1966; Hughes 1986a:319; Skinner 1983:123–125, 269.
Round Top Butte	T24S R23E	A silicic complex located just south of Glass Buttes, Round Butte consists of rhyolitic flows and domes of glass overlain by basalts. References: Cummings 1984; Skinner 1983:270.
Sawmill Creek	T20S R25E	Ash-flow source located at several locations near Sawmill Creek, Ochoco National Forest. This source is currently under investigation by Richard Hughes.
Silver Lake/Sycan Marsh	T30/31S R13E	Obsidian from this chemical group is found spread over a large area in the Sycan Marsh and Sycan River region. Silver Lake is located some distance to the north of the source; the name was adopted because of an early reference to a Silver Lake source by Atherton (1966). References: Atherton 1966:30–33; Hughes 1986a:313–314; Hughes and Mikkelsen 1985; Skinner 1983:271.

Table C.5-1 (continued)

Chemical Group	Location	Comments
Spodue Mountain	T34/36–37S R10–13E	Obsidian from the Spodue Mountain chemical group is widely distributed in the Spodue Mountain area and in secondary deposits in the Sprague and Williamson River valleys. References: Hughes and Mikkelsen 1985; Hughes 1986a:311–312.
Tucker Hill	T34S R19E	Obsidian associated with commercial deposits of perlite are found at this alignment of rhyolitic domes at the southern margin of Pluvial Lake Chewaukan. References: Hughes 1986a:315, Skinner 1983:274–275; Wilson and Emmons 1985.
Whitewater Ridge	T17S R32–33E	Obsidian is found in numerous locations east of Seneca in the vicinity of Whitewater Spring, Bear Valley, central Oregon. Also called the Whitewater Spring or Foster Spring source. Glass from this source is found in the Bear Creek Valley, Silvies River, and west in Antelope Valley. Currently under investigation by Richard Hughes.
Witham Creek	T34S R16–17E	Emerald-colored glass found at locations south of Summer Lake, central Oregon. Reference: Hughes 1986a:320–321.
Wolf Creek	T17S R33E	Obsidian found at several outcrops near Bear Creek Valley east of Seneca. The obsidian may originate from a primary source in the Glass Mountain area. Currently under investigation by Richard Hughes.
Yreka Butte	T22S R20E	A rhyolite-obsidian dome complex located about 15 miles west northwest from Glass Buttes.
		CALIFORNIA OBSIDIAN SOURCES
Annadel	T7N R6W	Obsidian quarry located near Santa Rosa in present day Annadel State Park. References: Ericson et al. 1976, Jackson 1986:51–52; Jackson 1989.
Blue Mountain	T46N R9E	Source of nodules found in an area of prehistoric quarrying activity located west of Goose Lake. Referred to as the Steel Swamp source by Ericson et al. 1976. References: Ericson et al. 1976; Hughes 1986a:309; Van de Hoek 1990.
Blue Spring	T46N R14–15E	Glass from this chemical group can be found at several localities in the Warner Mountains east of Goose Lake, northern California. Reference: Hughes 1986a:296–297.
Bodie Hills	T5N R26E	Surface nodules are found over a large area in the Bodie Hills, eastern California. References: Ericson et al. 1976; Ericson 1977.
Borax Lake	T13N R7W	Large pieces of obsidian found at Borax Lake near Clear Lake. This is one of the most well-known California obsidian sources. References: Ericson et al. 1976; Jackson 1986:59.

Table C.5-1 (continued)

Chemical Group	Location	Comments
Buck Mountain	T44–45N R14–15E	Glass from this chemical group can be found at a few localities in the Warner Mountains east of Goose Lake, northern California. References: Ericson et al. 1976; Hughes 1986a:291–295.
Casa Diablo	T2–3S R27–28E	Obsidian found at many different locations within the Long Valley Caldera has long been collectively referred to as the Casa Diablo source. Many of the sources are associated with a resurgent dome located in the western portion of the caldera (Bailey et al. 1976). Although the Casa Diablo source has been generally considered as a single geochemical group, recent research by Hughes (1992) has indicated that three geochemically distinguishable chemical groups are identifiable within the Casa Diablo source area. Hughes has provisionally termed these varieties, based primarily on Sr, Ti, and Ba composition, as the Lookout Mountain, Sawmill Ridge, and Hot Creek varieties. References: Bailey et al. 1976; Ericson et al. 1976; Hughes 1992.
Cougar Butte	T44N 5E	A prehistoric quarry area found near Cougar Butte, Medicine Lake Highlands. References: Ericson et al. 1976; Hughes 1986a:303.
Cowhead Lake	T47N R16–17E	Obsidian nodules from the chemical group are found at locations in the vicinity of Cowhead Lake, Surprise Valley. References: Ericson et al. 1976; Hughes 1986a:308–309.
East Glass Mt.	T43N R4E	Source located near Glass Mountain, Medicine Lake Highlands. Reference: Hughes 1986a:304–305.
East Medicine Lake	T44N R5E	Obsidian from this chemical group is found at two locations near Glass Mountain, Medicine Lake Highlands. Iron-manganese ratios are typically used to distinguish this source from the chemically similar GF/LIW/RS glass. Reference: Hughes 1986a:301–302.
GF/LIW/RS	—	Grasshopper Flat (GF), Red Switchback (RS), and Lost Iron Well (LIW) chemical group distinguished by Richard Hughes. These three geochemically indistinguishable sources are located in the Medicine Lake Highlands of northern California. High quality glass from this chemical source was prehistorically extensively utilized. Reference: Hughes 1986a:300–301.

Table C.5-1 (continued)

Chemical Group	Location	Comments
Glass Mountain	T44N R5E	The age of this spectacular and well-studied flow of obsidian, found on the upper eastern slopes of the Medicine Lake Highlands, has been a subject of archaeological and geologic discussion for some time. Based on radiocarbon dates and paleomagnetic evidence, Donnelly-Nolan et al. (1990) places the age of the flow at somewhere between about 850 and 1050 years B.P., providing a well-defined time frame for its procurement and prehistoric use. Ethnographic accounts point to the use of glass from this source by the Achomawi and several northern California groups to the west of the source (Kniffen 1928). The source was extensively utilized during the late prehistoric period—Hardesty and Fox (1974) recorded 594 archaeological sites along the margin of the flow. References: Anderson 1933; Donnelly-Nolan et al. 1990; Ericson et al. 1976; Hardesty and Fox 1974; Hughes 1986a:302–303; Kniffen 1928.
Grasshopper Flat	T43N R2E	One of the geochemically indistinguishable source outcrops in Hughes' GF/LIW/RS chemical source group. References: Ericson et al. 1976; Hughes 1986a:300.
Grasshopper Group	—	Geochemical group identified by BioSystems Analysis as consisting of the Grasshopper Flat, Red Switchback, Lost Iron Well, and East Medicine Lake chemical groups.
Kelly Mountain	T29–30N R5–6E	Chemical group consisting of small nodules of glass available at a few scattered locations. Reference: Hughes 1986a:309–310.
Lost Iron Well	T42N R2E	One of the geochemically indistinguishable source outcrops in Hughes' GF/LIW/RS chemical source group. Reference: Hughes 1986a:301.
Mono Glass Mountain	T1–2S R30E	This extensive Pliocene-Pleistocene complex of rhyolitic domes, flow, and pyroclastic deposits is located along the northeastern boundaries of the Long Valley Caldera. Glass Mountain obsidian is widely available at Glass Mountain and in the lacustrine deposits of Pleistocene Long Valley Lake (Bailey et al. 1976). References: Bailey et al. 1976; Ericson et al. 1976.
Mt. Konocti	T13N R8W	Widely used and widespread source of obsidian located on the south side of Mt Konocti near Clear Lake. Glass from this area is of poorer quality than many other North Coast Range sources. References: Ericson et al. 1976; Jackson 1986:58–59; Jackson 1989.
Napa Valley	T8N R6W	Extensively used prehistoric quarry site located in northern Napa Valley near the town of St. Helena. Also known as Napa Glass Mountain. References: Ericson et al. 1976; Jackson 1986:54–57; Jackson, 1989.
Rainbow Mines	T46N R14E	Large nodules of glass associated with a modern rockhound collecting area. Reference: Hughes 1986a:298–299.

Table C.5-1 (continued)

Chemical Group	Location	Comments
Red Switchback	T45N R3E	One of the geochemically indistinguishable source outcrops in Hughes' GF/LIW/RS chemical source group. Reference: Hughes 1986a:301.
South Warners	T36–38N R16E	Nodules of glass are found at several locales in the Dodge Reservoir Area, Surprise Valley. Reference: Hughes 1986a:297–298.
Sugar Hill	T45–45N R14E	The source lies within the ethnographic boundaries of the Achomawi and Sugar Hill was reported as sacred by Kniffen (1928). References: Ericson et al. 1976; Hughes 1986a:295–296; Kniffen 1928.
Tuscan	T31–34N R1–3W	Obsidian associated with the Tuscan Formation, a widespread laharic deposit, is found in numerous localities in the area east of Redding, California. Recent geochemical studies of Tuscan source material indicate that three chemical subgroups may be distinguished from among glass recovered from the Tuscan Formation (Hamusek 1993). References: Hamusek 1993; Hughes 1986a:305–308.
		NEVADA OBSIDIAN SOURCES
Mosquito Lake	T46N R19E	Nodules up to about 10 cm in diameter are found immediately north of Mosquito Lake, Washoe County, northwestern Nevada. Location is not shown in Figure 4-13. Reference: Hughes 1986a:327.
Bordwell Spring	T36–37N R19/21E T39N T20E	Several discrete source localities of obsidian nodules located in northwestern Nevada are included in the Bordwell Spring chemical group. Evidence of prehistoric utilization has been reported from all known source locations. This source has previously been called Homecamp A by Hughes and appears to be the same chemical group reported as Duck Flat by Ericson et al. (1976:33). Reference: Hughes 1986a:325, 328–329.
		WYOMING OBSIDIAN SOURCES
Obsidian Cliff	—	Located in Yellowstone National Park, this obsidian flow was extensively prehistorically used, most notably as a component of the Hopewell Interaction Sphere. Artifacts from this source have been found in sites in southern Canada and throughout the northern United States. References: Davis 1972; Frison 1974; Griffin et al. 1969; Hatch et al. 1990; Iddings 1888.

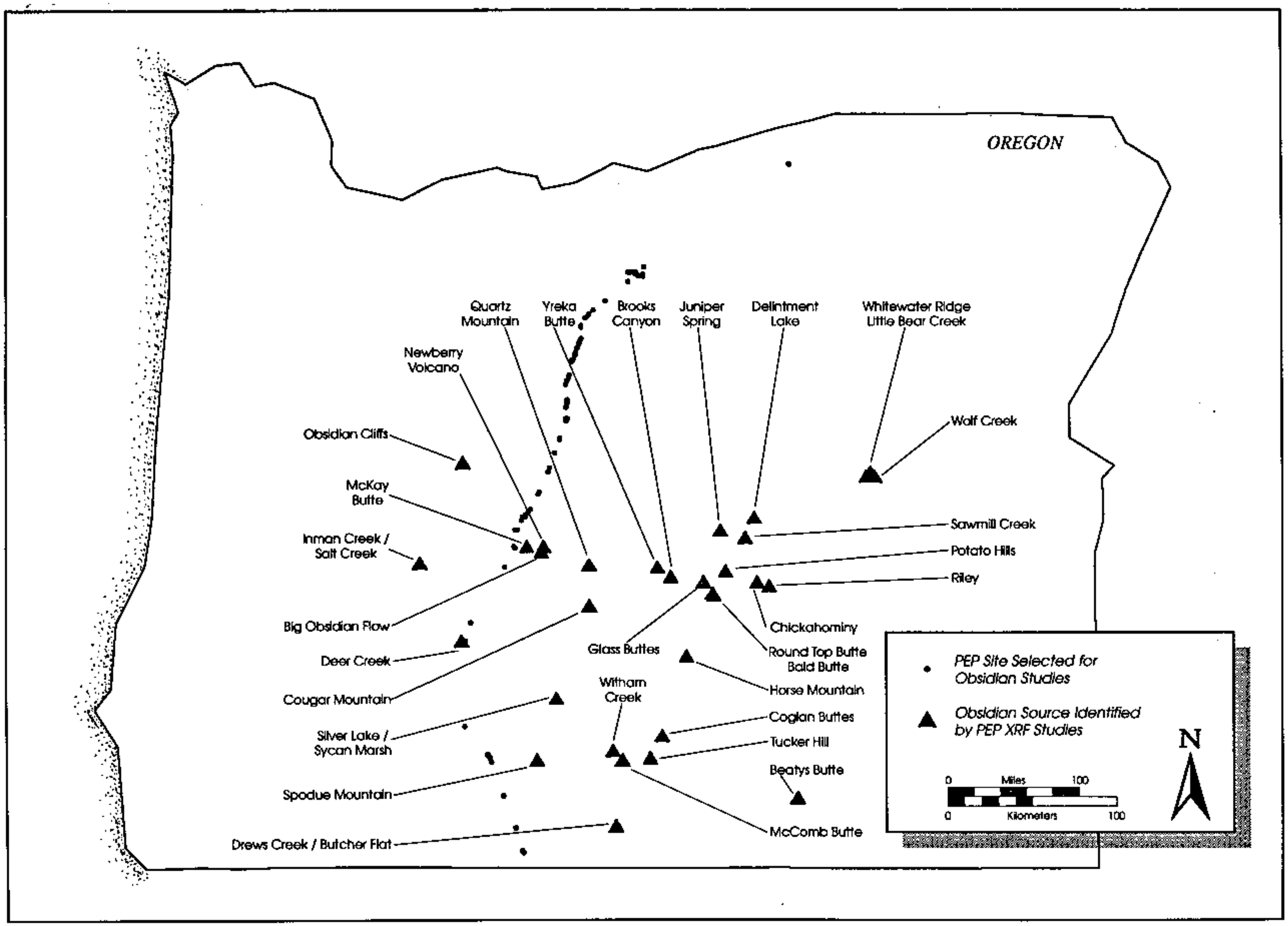

Figure C.5-1 Location of all Oregon obsidian sources identified during trace element studies of PEP artifacts. Source locations are from Hughes (1986a) and Skinner (1983).

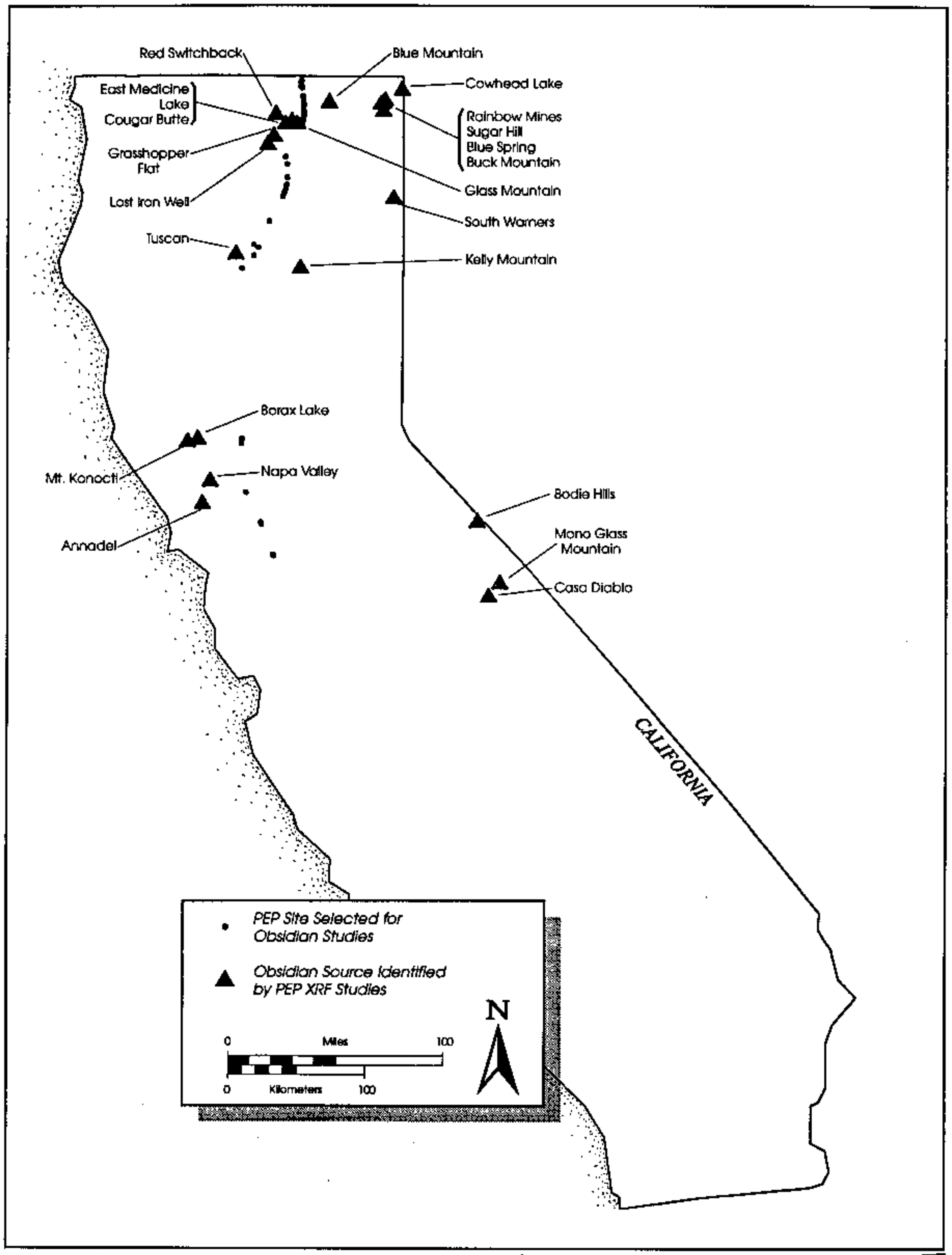

Figure C.5-2 Location of all California obsidian sources identified during trace element studies of PEP artifacts. Source locations are from Ericson et al. (1976), Hughes (1986a), and Jackson (1986).