STABLE ISOTOPES OF HYDROGEN AND OXYGEN IN SURFACE WATER AND GROUND WATER AT SELECTED SITES ON OR NEAR THE IDAHO NATIONAL ENGINEERING LABORATORY, IDAHO

By Douglas S. Ott, L. DeWayne Cecil, and LeRoy L. Knobel

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CONVERSION FACTORS, VERTICAL DATUM, AND ABBREVIATED UNITS

Multiply	By	To Obtain
inch (in.)	25.4	millimeter
foot (ft)	0.3048	meter
foot per mile (ft/mi)	0.1894	meter per kilometer
mile (mi)	1.609	kilometer
square mile (mi^2)	2.590	square kilometer
acre-foot (acre-ft)	0.001233	cubic hectometer
cubic foot per second (ft^3/s)	0.02832	cubic meter per second

Sea Level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929—a geodetic datum derived from a general adjustment of the first-order level nets of the United States an Canada, formerly called Sea Level Datum of 1929.

Abbreviated units used in report: milliliter (mL).

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Abstract

Relative stable isotopic ratios for hydrogen and oxygen compared to standard mean ocean water are presented for water from 4 surface-water sites and 38 ground-water sites on or near the Idaho National Engineering Laboratory (INEL). The surface-water samples were collected monthly from March 1991 through April 1992 and after a storm event on June 18, 1992. The ground-water samples either were collected during 1991 or 1992. These data were collected as part of the U.S. Geological Survey's continuing hydrogeological investigations at the INEL.

The relative isotopic ratios of hydrogen and oxygen are reported as delta ^{2}H (δ^2H) and as delta ^{18}O (δ^{18}O), respectively. The values of δ^2H and δ^{18}O in water from the four surface-water sites ranged from -143.0 to -122 and from -18.75 to -15.55, respectively. The values of δ^2H and δ^{18}O in water from the 38 ground-water sites ranged from -141.0 to -120.0 and from -18.55 to -14.95, respectively.

INTRODUCTION

The Idaho National Engineering Laboratory (INEL), encompassing about 890 mi^2 of the eastern Snake River Plain in southeastern Idaho (fig. 1), is operated by the U.S. Department of Energy. INEL facilities are used in the development of peacetime atomic-energy applications, nuclear safety research, defense programs, and advanced energy concepts. Wastewater containing radionuclide and chemical constituents generated at these facilities has been discharged to onsite infiltration ponds and disposal wells since 1952. Wastewater disposal has resulted in detectable concentrations of several constituents in water from the Snake River Plain aquifer underlying the INEL.

The U.S. Department of Energy requires information about the mobility of dilute radionuclide- and chemical-waste constituents in water in the Snake River Plain aquifer. Waste-constituent mobility is, in part, determined by (1) the rate and direction of ground-water flow; (2) the locations, quantities, and methods of waste disposal; (3) waste-constituent chemistry; and (4) the geochemical processes taking place in the aquifer (Orr and Cecil, 1991, p. 2). This study was conducted by the U.S. Geological Survey (USGS) in cooperation with the U.S. Department of Energy's Idaho Operations Office.

Purpose and Scope

In 1949, the U.S. Atomic Energy Commission, later to become the U.S. Department of Energy, requested that the USGS describe the water

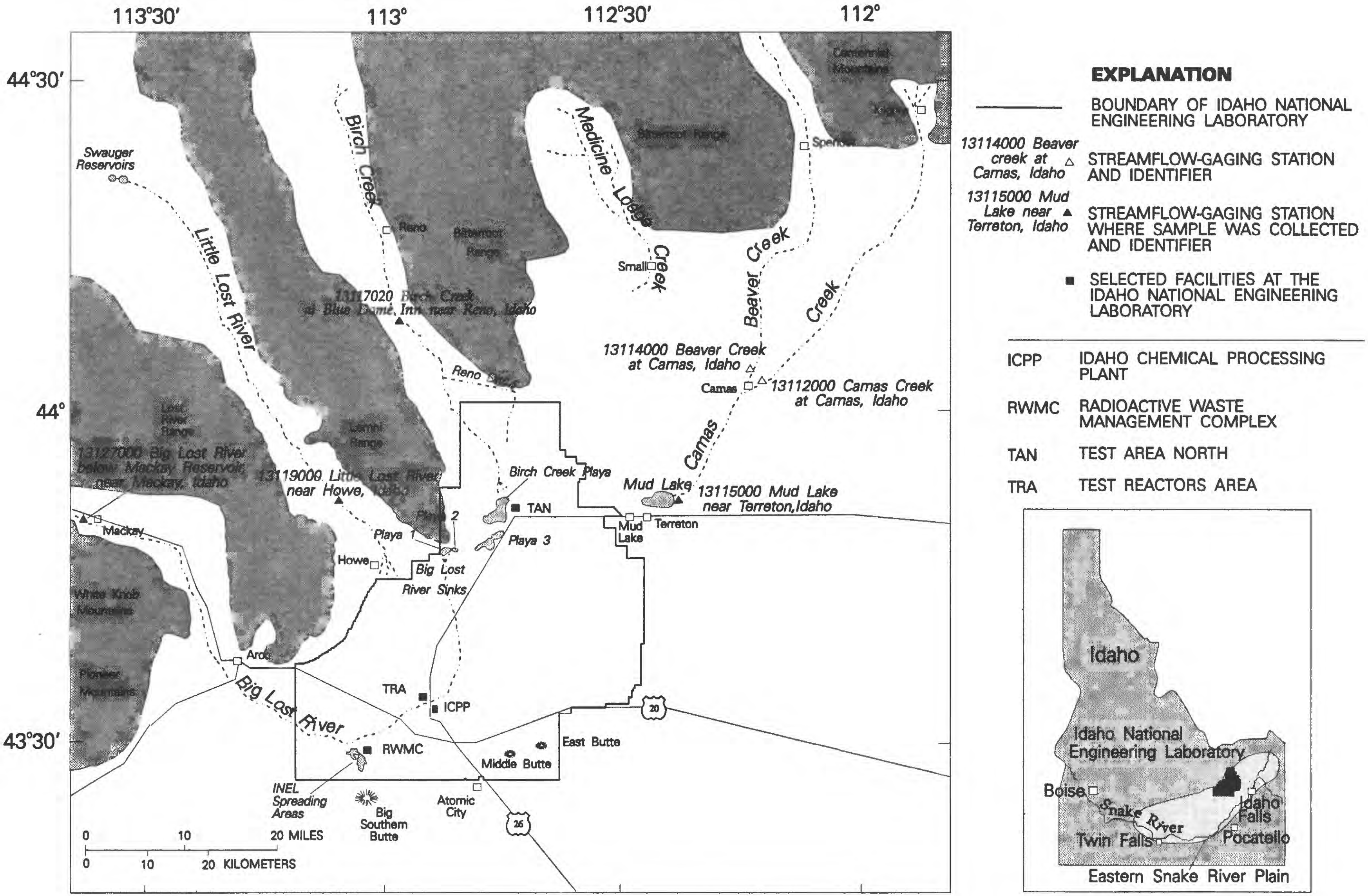

Figure 1.–Locations of the Idaho National Engineering Laboratory, surface-water sampling sites, and selected facilities.

resources of the area now known as the INEL. The purpose of that study was to characterize these resources prior to the development of nuclear reactor testing facilities. Since 1949, the USGS has maintained a monitoring network at the INEL to determine hydrologic trends and to delineate the movement of facility-related radionuclide and chemical wastes in the Snake River Plain aquifer.

This report presents a compilation of hydrogen (H) and oxygen (O) isotope data collected during 1991-92 from the Snake River Plain aquifer and selected surface sites on tributary drainages to the Snake River Basin. The data were collected as part of the continuing hydrogeologic investigations at the INEL.

Hydrologic Conditions

The Snake River Plain aquifer is one of the most productive aquifers in the United States (U.S. Geological Survey, 1985, p. 193). The aquifer underlies the eastern Snake River Plain and consists of a thick sequence of basalts and sedimentary interbeds filling a large, arcuate, structural basin in southeastern Idaho (fig. 1).

Surface Water

Stable isotope samples for H and O were collected at several streamflow-gaging stations to characterize the isotopic composition of surface water in the upper reaches of the Big Lost and Little Lost Rivers, Birch Creek, and Camas Creek—a tributary basin to Mud Lake.

The Big Lost River drains more than 1,400 mi^2 of mountainous area that includes parts of the Lost River Range and Pioneer Mountains west of the INEL (fig. 1). Flow in the Big Lost River infiltrates to the Snake River Plain aquifer along its channel and at sinks and playas at the river's terminus. Since 1958, excess runoff has been diverted to spreading areas in the southwestern part of the INEL (fig. 1) where much of the water rapidly infiltrates to the aquifer (Orr and Cecil, 1991, p. 23). Water samples were collected at the USGS gaging station on the Big Lost River below Mackay Reservoir. The drainage area for this station is 813 mi^2 and the average discharge for 75 years of record is 309 ft^3/s (Harenberg and others, 1992, p. 179).

The Little Lost River drains more than 700 mi^2 of mountainous area that includes parts of the Lost River Range and Lemhi Range northwest of the INEL (fig. 1). Flow in the Little Lost River infiltrates to the Snake River Plain aquifer along the lower reach of its channel and at sinks and playas at the river's terminus. Since 1984, water has been diverted for flood control 1 mi upstream from the gaging station near Howe. The average discharge for 44 years of record is 77.1 ft^3/s (Harenberg and others, 1989, p. 229).

Birch Creek drains the mountainous area north of the INEL that includes parts of the Lemhi Range and Bitterroot Range. Natural flow in Birch Creek infiltrates to the Snake River Plain aquifer along its channel and at sinks and playas at the creek's terminus (Stearns and Bryan, 1925, p. 106). From about 1900 to April 1987, flow from Birch Creek was diverted through Reno Ditch for irrigation during the growing season. Since April 1987, flow has been diverted for power generation and returned either to Reno Ditch for irrigation or to a canal that routes it to the northern part of the INEL (Ted Sorenson, Sorenson & Associates Consulting Engineers, oral commun., 1992). Isotope samples were collected from Birch Creek about 5 mi upstream from the diversion at the USGS's gaging station at Blue Dome Inn near Reno, Idaho. The drainage area for the station is 380 mi^2 and the average discharge for 6 years of record is 77.5 ft^3/s (Harenberg and others, 1992, p. 174).

Camas Creek and Beaver Creek drain the mountainous area northeast of the INEL that includes parts of the Bitterroot Range and the Centennial Mountains. The two creeks join near Camas and flow into Mud Lake. Isotope samples were collected from flowing water in Camas Creek at the USGS gaging station, Mud Lake near Terreton, Idaho. The streamflow gage—Beaver

Creek at Camas, Idaho—measures discharge from an area of 510 mi^2 and is located 1.4 mi upstream from the mouth. The average discharge for 52 years of record is 5.8 ft^3/s. The streamflow gage—Camas Creek at Camas, Idaho—measures discharge from an area of 400 mi^2 and is located 1.1 mi upstream from the confluence with Beaver Creek. The average discharge for 59 years of record is 35 ft^3/s. The combined drainage area for these two streams makes up the bulk of the 1,130 mi^2 drainage area for the gage where the samples were collected (Harenberg and others, 1992, p. 169, 171-172).

Ground Water

Stable isotope samples for H and O were collected from selected wells and a spring on or near the INEL to characterize the isotopic composition of water from the Snake River Plain aquifer.

Recharge to the Snake River Plain aquifer is principally from infiltration of applied irrigation water, infiltration of streamflow, and alluvial ground-water inflow from adjoining mountain drainage basins. Some recharge may be from direct infiltration of precipitation, although the small amount of annual precipitation on the plain (8 in. at the INEL), evapotranspiration, and the great depth to water (in places exceeding 900 ft) probably minimize this source of recharge (Orr and Cecil, 1991, p. 22-23).

Water in the Snake River Plain aquifer moves principally through fractures and interflow zones in the basalt. A significant proportion of ground water moves through the upper 800 ft of saturated rocks (Mann, 1986, p. 21). Hydraulic conductivity of basalt in the upper 800 ft of the aquifer generally is 1 to 100 ft/day. Hydraulic conductivity of underlying rocks is several orders of magnitude smaller. The effective base of the Snake River Plain aquifer at the INEL probably ranges from about 850 to 1,220 ft below land surface (Orr and Cecil, 1991, p. 25).

Depth to water in wells completed in the Snake River Plain aquifer ranges from about 200 ft in the northern part of the INEL to more than 900 ft in the southeastern part. In July 1988, the altitude of the water table was about 4,590 ft above sea level near Test Area North (TAN) and about 4,420 ft near the Radioactive Waste Management Complex (RWMC). Water flowed southward and southwestward beneath the INEL at an average hydraulic gradient of about 4 ft/mi. Locally, however, the hydraulic gradient ranged from about 1 to 15 ft/mi. From July 1985 to July 1988, water-level changes in INEL wells ranged from a 26.8-ft decline near the RWMC to a 4.3-ft rise north of TAN. Water levels generally declined in the southern two-thirds of the INEL during that time and rose in the northern one-third (Orr and Cecil, 1991, p. 25-27).

Ground water moves southwestward from the INEL and eventually is discharged to springs along the Snake River downstream from Twin Falls, about 100 mi southwest of the INEL. About 4.3 million acre-ft of ground water were discharged to these springs in 1988 (Mann, 1989, p. 2).

Previous Investigations

The USGS has conducted geologic, hydrologic, and water-quality investigations at the INEL since it was selected as a reactor testing area in 1949. An investigation of the hydrogeology and geochemistry of the unsaturated zone at the RWMC was conducted by Rightmire and Lewis (1987). They used stable isotopes of H and/or O to differentiate sources of recharge to the Snake River Plain aquifer and perched-water bodies, to tentatively identify historical changes in climatic conditions, and to determine whether clay minerals were detrital or authigenic in origin.

In study of the solute geochemistry of the Snake River Plain regional aquifer system, Wood and Low (1988) used stable isotopes of H and O to determine the origin of recharge water to the Snake

River Plain aquifer and the origin of water in the geothermal system in the Snake River Basin. In addition, stable isotope data of H and O were reported by Spinazola and others (1992) for water samples from five wells near Mud Lake.

Acknowledgments

The authors gratefully acknowledge the well owners for granting permission to collect water samples. Thanks are extended to Roy C. Bartholomay and Beverly Stephens of the USGS for technically reviewing the manuscript.

METHODS AND QUALITY ASSURANCE

The methodology used in sampling for hydrogen and oxygen isotopes generally followed the guidelines established by the USGS (Claassen, 1982; Pritt and Jones, 1989; R.J. Pickering, USGS, written commun., 1981). Field methods, quality assurance practices, and delta notation are outlined in the following sections.

Sample Containers

Sample containers were either 125-mL amber glass or 125-mL polyethylene bottles with polyseal caps. Samples analyzed by the USGS's National Water Quality Laboratory (NWQL) were placed in containers and processed in accordance with laboratory requirements specified by Pritt and Jones (1989). Containers were supplied by the NWQL and had undergone a rigorous quality control procedure (Pritt, 1989, p. 75) to eliminate sample contamination.

Sample Locations and Sample Collection

Samples were collected from 4 surface-water sites (tables 1-4), 1 irrigation well (table 5), 3 domestic wells (table 5), 4 production wells (table 5), 29 water-quality monitoring wells (table 5), and 1 commercial spring (table 5). Sample site locations are shown in figures 1 and 2. Surface-water sites were sampled by collecting a grab sample from an area of moving water at a specified point. The irrigation well was equipped with a line-shaft turbine pump and was sampled from the center of the discharge line at the wellhead. Domestic wells were equipped with submersible pumps and were sampled from the spigot nearest the wellhead. Production wells were equipped with line-shaft turbine pumps and were sampled at the spigot in their discharge lines. The water-quality monitoring wells were equipped with dedicated submersible pumps and were sampled from a portable sampling apparatus that was attached at the wellhead. The spring sample was taken from a spigot in the discharge line that collects water from the spring. All portable equipment was decontaminated before and after sample collection.

Prior to sampling, all wells were pumped a minimum of three well-bore volumes until water chemistry stabilized as evidenced by constant temperature, pH, and specific conductance measurements. After collection, sample containers were sealed with black tape and laboratory film, labeled, and stored under secured conditions. The containers then were packed in ice chests, sealed, and shipped to the NWQL.

Conditions at the sampling site during sample collection were recorded in a field logbook and a chain-of-custody record was used to track samples from time of collection until delivery to the NWQL. These records are available for inspection at the USGS Project Office at the INEL.

Quality Assurance

A detailed description of internal quality control and of overall quality assurance practices used by the USGS's NWQL were provided in reports by Friedman and Erdman (1982) and Jones (1987). The water samples were collected in accordance with the USGS, INEL Project Office, Quality Assurance Plan and Field Methods for

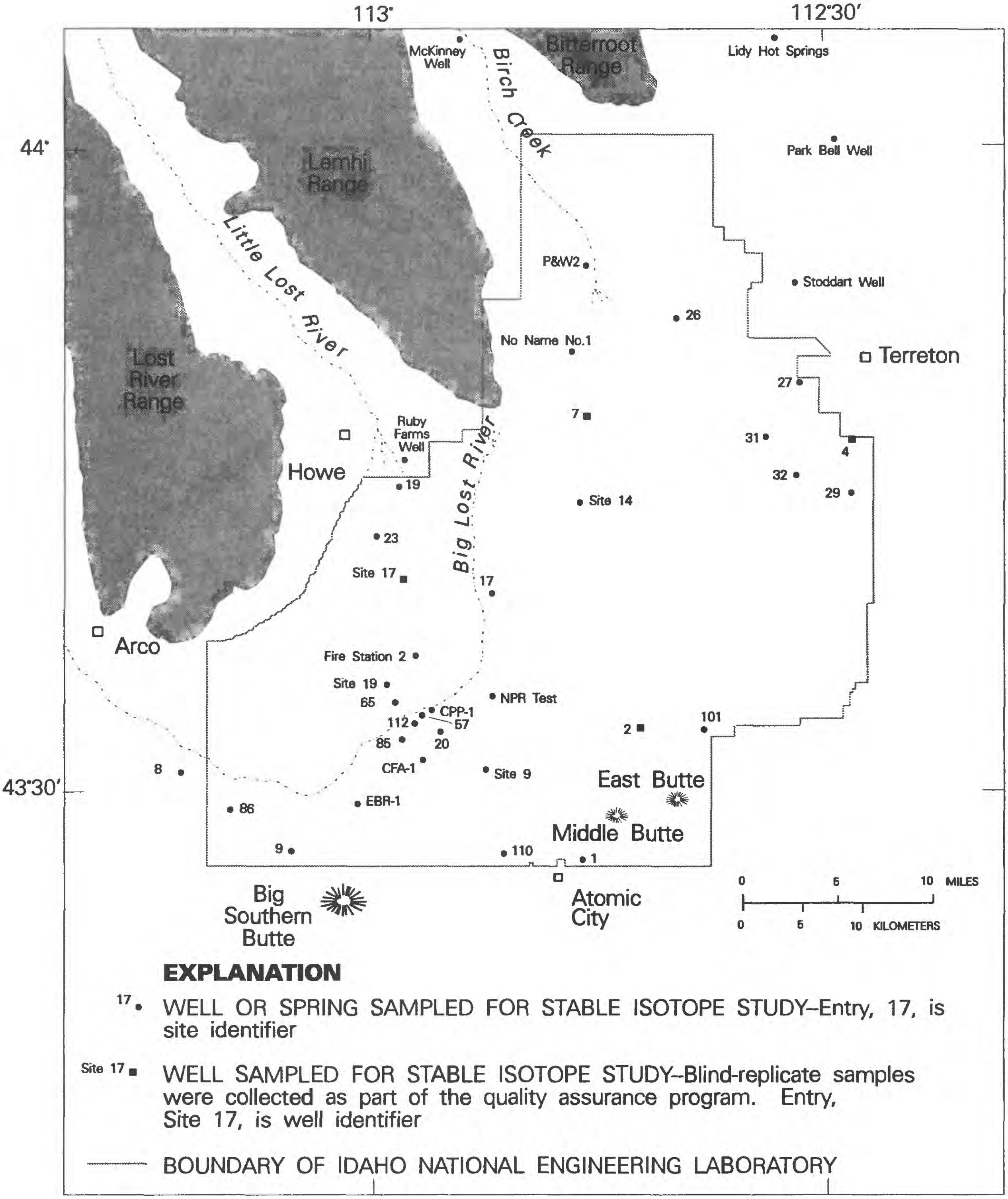

Figure 2.–Locations of ground-water sampling sites.

Quality of Water Activities. This plan is available for inspection at the INEL Project Office. Additional quality assurance instituted for this study included four blind-replicate ground-water samples. Stable H and O measurements in the blind-replicate samples (QAC-1, QAC-2, QAC-3, and QAC-4) were the same as in the primary samples (USGS 7, USGS 2, USGS 4, and Site 17), given the analytical uncertainties.

Delta Notation

The absolute measurement of isotopic ratios is a difficult analytical task and, as a result, relative isotopic ratios are measured as a matter of convention (Toran, 1982). For example,

$^{18}O/^{16}O$ of a sample is compared to $^{18}O/^{16}O$ of a standard:

$\delta^{18}O = (R_{sample}/R_{standard} - 1) \times 1{,}000$,
where
$R_{sample} = {}^{18}O/^{16}O$ in the sample,
$R_{standard} = {}^{18}O/^{16}O$ in the standard, and
$\delta^{18}O$ = relative difference in concentration, in units of parts per thousand (permil).

Delta ^{18}O ($\delta^{18}O$) is referred to as delta notation and is the value reported by isotopic laboratories for stable isotope analysis. δ^2H can be derived by analogy to $\delta^{18}O$ where the ratio $^2H/H$ replaces $^{18}O/^{16}O$ in R_{sample} and $R_{standard}$. The standard used for determining $\delta^{18}O$ and δ^2H in water is standard mean ocean water (SMOW) as defined by Craig (1961). The respective precisions of measurement for $\delta^{18}O$ and δ^2H at the NWQL are 0.15 permil and 1.5 permil at the 95-percent confidence level(Ann Mullin, USGS, oral commun., 1991; Carol Kendall, USGS, oral commun., 1994).

STABLE ISOTOPES OF HYDROGEN AND OXYGEN

Water samples were collected and analyzed for concentrations of stable isotopes of H and O at 4 surface-water sites (fig. 1) and 38 ground-water sites (fig. 2). The surface-water sites were sampled monthly from March 1991 through April 1992 and after a storm event on June 18, 1992 (tables 1-4). The ground-water sites were sampled one time each during 1991 or 1992.

Surface Water

Relative isotopic ratios reported as δ^2H and $\delta^{18}O$ for water from the Big Lost River below Mackay Reservoir near Mackay, Idaho ranged from -138.0 to -129.0 permil and from -18.00 to -17.05 permil, respectively (table 1). The values of δ^2H and $\delta^{18}O$ for water from the Little Lost River near Howe, Idaho ranged from -139.0 to -136.0 permil and from -18.25 to -17.80 permil, respectively (table 2). The values of δ^2H and $\delta^{18}O$ for water from Birch Creek at Blue Dome Inn near Reno, Idaho ranged from -143.0 to -140.0 permil and from -18.75 to -18.55 permil, respectively (table 3). The values of δ^2H and $\delta^{18}O$ for water from Mud Lake near Terreton, Idaho ranged from -135.0 to -122 permil and from -17.85 to -15.55 permil, respectively (table 4).

Ground Water

Relative isotopic ratios reported as δ^2H and $\delta^{18}O$ for water from the 38 ground-water sites ranged from -141.0 to -120.0 permil and from -18.55 to -14.95 permil, respectively (table 5).

SUMMARY

This report presents relative stable isotopic ratios of hydrogen and oxygen (reported as δ^2H and $\delta^{18}O$, respectively) in water from 4 surface-water and 38 ground-water sites on or near the INEL. The four surface-water sites were sampled monthly from March 1991 through April 1992 and once after a storm event on June 18, 1992. The 38 ground-water sites were sampled one time each in 1991 or 1992. These data were collected as part of

the USGS's continuing hydrogeologic investigations at the INEL.

The relative ratios reported as δ^2H and $\delta^{18}O$ in water from the four surface-water sites ranged from -143.0 to -122 permil and from -18.75 to -15.55 permil, respectively. The values of δ^2H and $\delta^{18}O$ for water from the 38 ground-water sites ranged from -141.0 to -120.0 permil and from -18.55 to -14.95 permil, respectively.

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Table 1.—Stable isotopes of hydrogen and oxygen for Big Lost River below Mackay Reservoir near Mackay, Idaho (13127000)

[Location shown in figure 1. Symbols: δ^2H indicates delta notation for stable hydrogen isotope ratios; $\delta^{18}O$ indicates delta notation for stable oxygen isotope ratios; permil indicates parts per thousand relative to standard mean ocean water (Craig, 1961); ± indicates plus or minus; * indicates sample bottle broken enroute to laboratory]

Date sampled	δ^2H (±1.5 permil)	$\delta^{18}O$ (±0.15 permil)
03/28/91	-138.0	-18.00
05/02/91	-135.0	-17.85
05/31/91	-135.0	-17.75
07/02/91	-129.0	-17.20
07/30/91	-129.0	-17.05
08/29/91	-133.0	-17.30
10/02/91	-135.0	-17.80
11/04/91	-136.0	-18.00
12/06/91	*	*
01/03/92	-136.0	-17.85
02/07/92	-136.0	-17.95
03/06/92	-136	-18
04/06/92	-136	-17.8
04/30/92	-137	-17.75
06/18/92	-134	-17.45

Table 2.—Stable isotopes of hydrogen and oxygen for Little Lost River near Howe, Idaho (13119000)

[Location shown in figure 1. Symbols: δ^2H indicates delta notation for stable hydrogen isotope ratios; $\delta^{18}O$ indicates delta notation for stable oxygen isotope ratios; permil indicates parts per thousand relative to standard mean ocean water (Craig, 1961); ± indicates plus or minus]

Date sampled	δ^2H (±1.5 permil)	$\delta^{18}O$ (±0.15 permil)
03/28/91	-137.0	-18.10
05/02/91	-136.0	-18.10
05/31/91	-137.0	-18.05
07/02/91	-137.0	-18.00
07/30/91	-138.0	-18.00
08/29/91	-137.0	-17.80
10/02/91	-139.0	-18.15
11/04/91	-139.0	-18.25
12/16/91	-139.0	-18.10
01/03/92	-139.0	-18.20
02/07/92	-139.0	-18.20
03/06/92	-139	-18.25
04/06/92	-138	-18
04/30/92	-137	-17.85
06/18/92	-137	-18.1

Table 3.—Stable isotopes of hydrogen and oxygen for Birch Creek at Blue Dome Inn near Reno, Idaho (13117020)

[Location shown in figure 1. Symbols: δ^2H indicates delta notation for stable hydrogen isotope ratios; $\delta^{18}O$ indicates delta notation for stable oxygen isotope ratios; permil indicates parts per thousand relative to standard mean ocean water (Craig, 1961); ± indicates plus or minus]

Date sampled	δ^2H (±1.5 permil)	$\delta^{18}O$ (±0.15 permil)
03/28/91	-143.0	-18.70
05/02/91	-140.0	-18.55
05/31/91	-141.0	-18.60
07/02/91	-140.0	-18.75
07/30/91	-142.0	-18.65
08/29/91	-141.0	-18.70
10/02/91	-142.0	-18.70
11/04/91	-142.0	-18.55
12/06/91	-142.0	-18.55
01/03/92	-142.0	-18.75
02/07/92	-142.0	-18.70
03/06/92	-142	-18.75
04/06/92	-142	-18.6
04/30/92	-142	-18.7
06/18/92	-142	-18.65

Table 4.—Stable isotopes of hydrogen and oxygen for Mud Lake near Terreton, Idaho (13115000)

[Location shown in figure 1. Symbols: δ^2H indicates delta notation for stable hydrogen isotope ratios; $\delta^{18}O$ indicates delta notation for stable oxygen isotope ratios; permil indicates parts per thousand relative to standard mean ocean water (Craig, 1961); ± indicates plus or minus]

Date sampled	δ^2H (±1.5 permil)	$\delta^{18}O$ (±0.15 permil)
03/28/91	-132.0	-17.75
05/02/91	-133.0	-17.60
05/31/91	-134.0	-17.85
07/02/91	-131.0	-17.75
07/30/91	-133.0	-17.70
08/29/91	-134.0	-17.85
10/02/91	-135.0	-17.75
11/04/91	-133.0	-17.30
12/06/91	-129.0	-16.70
01/03/92	-130.0	-16.90
02/07/92	-135.0	-17.50
03/06/92	-122	-15.55
04/06/92	-133	-17.6
04/30/92	-135	-17.7
06/18/92	-134	-17.8

Table 5.—Stable isotopes of hydrogen and oxygen for selected wells and a spring on or near the Idaho National Engineering Laboratory, Idaho

[Locations shown in figure 2. Use category: C indicates commercial operation; D indicates domestic well; I indicates irrigation well; M indicates water-quality monitoring well; P indicates production well; and QA indicates quality assurance for preceding sample. Symbols: δ^2H indicates delta notation for stable hydrogen isotope ratios; $\delta^{18}O$ indicates delta notation for stable oxygen isotope ratios; permil indicates parts per thousand relative to standard mean ocean water (Craig, 1961); ± indicates plus or minus]

Sample identifier	Use category	Date sampled	δ^2H (±1.5 permil)	$\delta^{18}O$ (±0.15 permil)
USGS 1	M	05/30/91	-135.0	-18.00
USGS 2	M	05/28/91	-135.0	-17.95
QAC-2	QA	05/28/91	-134.0	-17.95
USGS 4	M	06/04/91	-120.0	-14.95
QAC-3	QA	06/04/91	-120.0	-14.95
USGS 7	M	05/20/91	-136.0	-18.10
QAC-1	QA	05/20/91	-137.0	-18.00
USGS 8	M	05/31/91	-137.0	-18.00
USGS 9	M	05/31/91	-136.0	-18.00
USGS 17	M	06/06/91	-137.0	-17.65
USGS 19	M	05/21/91	-136.0	-18.10
USGS 20	M	05/30/91	-139.0	-18.10
USGS 23	M	05/21/91	-137.0	-18.25
USGS 26	M	05/23/91	-136.0	-18.00
USGS 27	M	05/23/91	-135.0	-17.85
USGS 29	M	06/12/91	-134.0	-17.65
USGS 31	M	06/12/91	-136.0	-17.90
USGS 32	M	06/12/91	-135.0	-17.75
USGS 57	M	05/13/91	-136.0	-17.70
USGS 65	M	05/16/91	-133.0	-16.90
USGS 85	M	06/04/91	-136.0	-17.90
USGS 86	M	05/31/91	-139.0	-18.30

Table 5.—Stable isotopes of hydrogen and oxygen for selected wells and a spring on or near the Idaho National Engineering Laboratory, Idaho-Continued

Sample identifier	Use category	Date sampled	δ^2H (±1.5 permil)	$\delta^{18}O$ (±0.15 permil)
USGS 101	M	05/15/91	-135.5	-18.00
USGS 110	M	05/08/91	-133.0	-17.80
USGS 112	M	05/13/91	-136.5	-17.65
CFA-1	P	06/19/91	-137.0	-17.55
CPP-1	P	06/06/91	-137.0	-17.85
EBR-1	P	06/19/91	-139.0	-18.35
Fire Station 2	P	06/19/91	-139.0	-18.15
Lidy Hot Springs	C	08/20/92	-135.	-18.1
McKinney Well	D	06/13/91	-141.0	-18.55
No Name No. 1	M	05/22/91	-128.0	-16.10
NPR Test	M	06/20/91	-137.0	-17.75
P&W 2	M	05/22/91	-140.0	-18.55
Park Bell Well	I	06/11/91	-135.0	-17.90
Ruby Farms Well	D	05/10/91	-138.0	-18.15
Site 9	M	06/25/91	-137.0	-17.95
Site 14	M	06/13/91	-136.0	-18.00
Site 17	M	06/18/91	-140.0	-18.15
QAC-4	QA	06/18/91	-139.0	-18.15
Site 19	M	05/09/91	-138.0	-18.10
Stoddart Well	D	06/12/91	-135.0	-17.85