WATER LEVELS IN CONTINUOUSLY MONITORED WELLS IN THE YUCCA MOUNTAIN AREA, NEVADA, 1989

U.S. GEOLOGICAL SURVEY

Open-File Report 93-098

Prepared in cooperation with the
U.S. DEPARTMENT OF ENERGY under
Interagency Agreement DE-AI08-92NV10874

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Denver, Colorado
1995

U.S. DEPARTMENT OF THE INTERIOR

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U.S. GEOLOGICAL SURVEY

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CONVERSION FACTORS AND VERTICAL DATUM

Multiply	By	To obtain
kilometer (km)	0.6214	mile
meter (m)	3.2808	foot
millimeter (mm)	0.03937	inch
pounds per square inch (psi)	703.1	kilograms per square meter
square kilometer (km^2)	0.3861	square mile

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

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ABSTRACT

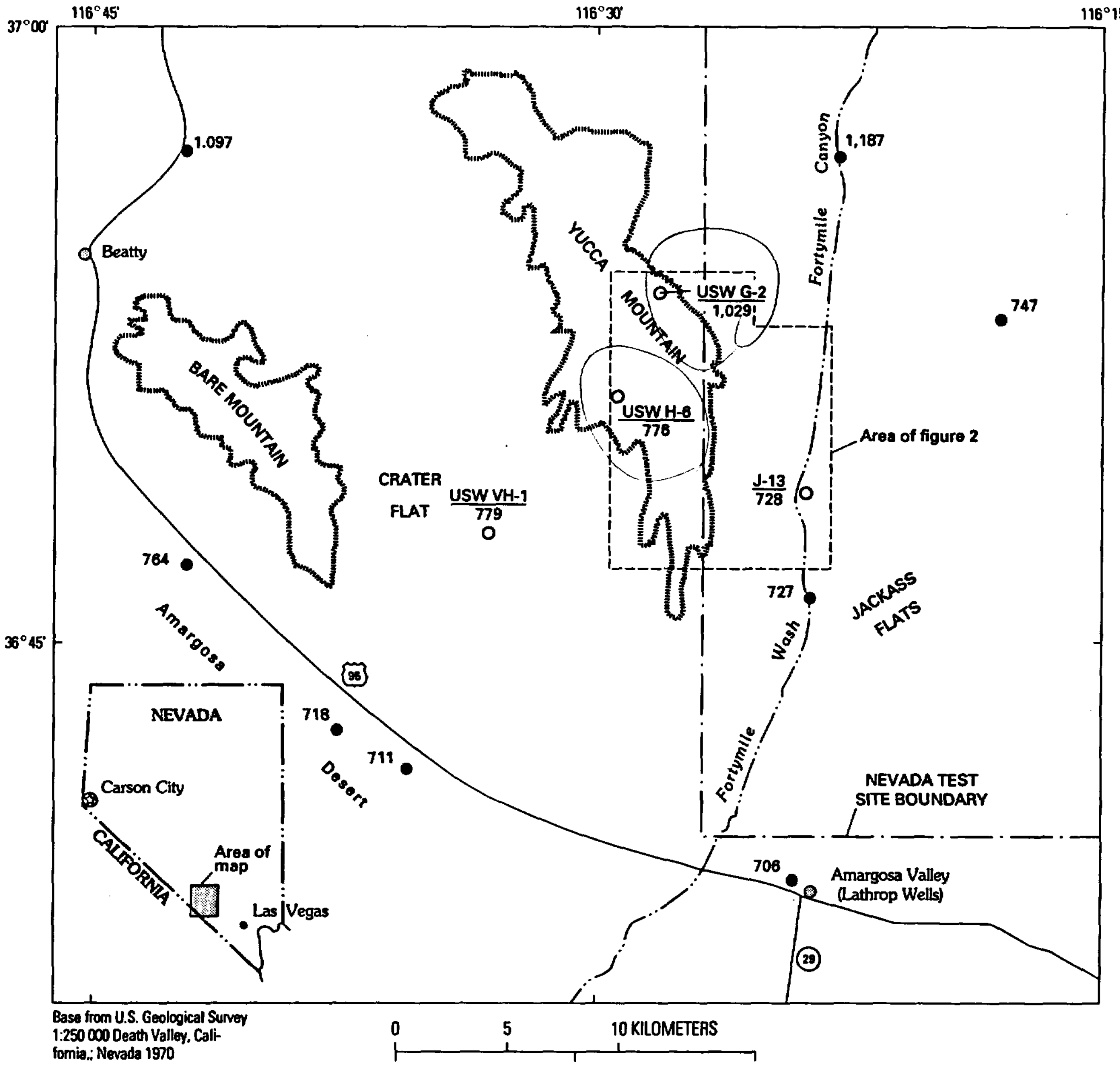
Water levels have been monitored hourly in 16 wells representing 24 intervals in the Yucca Mountain area, Nevada. Water levels were monitored using pressure transducers and were recorded by data loggers. The pressure transducers were periodically calibrated by raising and lowering them in the wells. The water levels were normally measured at approximately the same time that the transducers were calibrated. Where the transducer output appeared reasonable, it was converted to water levels using the calibrations and manual water-level measurements. The amount of transducer output that was converted to water levels ranged from zero for one interval to 100 percent for one interval.

Fifteen of the wells were completed in Tertiary volcanic rocks and one well was completed in Paleozoic carbonate rocks. Each well monitored from one to four depth intervals. Water-level fluctuation caused by barometric pressure changes and earth tides were observed. Transducer output is presented in graphic form and, where appropriate, water-level altitude is presented in graphical and tabular form.

INTRODUCTION

The Yucca Mountain area is being evaluated by the U.S. Department of Energy for suitability to store high-level nuclear waste in a mined, underground repository. A 150 km^2 area located about 150 km^2 northwest of Las Vegas in southern Nevada is being studied extensively (fig. 1). Water levels in selected wells have been periodically measured beginning in 1981 and have been continuously (actually hourly or more frequently) measured beginning in 1983 in a few wells (although no usable data were obtained until 1985) to gain a better understanding of the ground-water flow system in the area. Water levels will be used to determine the direction and rate of ground-water flow. They also will be used to estimate hydraulic parameters of the flow system. In the Yucca Mountain area, the water table is in ash-flow and air-fall tuffs of Tertiary age. Saturated carbonate rocks of Paleozoic age underlie the Tertiary volcanic rocks. The terminology for stratigraphic units in this report follow Carr (1988), Carr and others (1986), Byers and others (1976), and Winograd and Thordarson (1975).

This report describes the equipment and methods used to collect and process continuous water-level data, presents the data collected for 16 wells, and contains hydrographs showing water-level altitudes for 15 of these wells. The data presented in this report are not truly continuous; they are a series of discrete points of sufficient frequency that they appear to be continuous. Water levels were monitored using pressure transducers and electronic data loggers. The transducer/data-logger systems were calibrated by raising and lowering the transducers in the wells, and at approximately the same time, manual water-level measurements were made using steel tapes or multiconductor cables. The manual water-level measurements were adjusted for thermal expansion, mechanical stretch, equipment calibration, and borehole deviation from vertical.



EXPLANATION

USW VH-1 / 779 ○	WELL—Upper number is well number, lower number is approximate altitude of water level, in meters above sea level
711 ●	WELL—Number is altitude of water level reported in Waddell (1982).

Figure 1.–Location of Yucca Mountain area and selected water-level altitudes (from Robison and others, 1988).

Water-level altitudes were computed based on the calibration, the manual water-level measurement and the surveyed altitude of the reference point.

This report is a companion and supplement to reports (Robison and others, 1988; Gemmell, 1990; O'Brien, 1991) on periodically measured water levels in the Yucca Mountain area and Luckey and others (1993) on continuously measured water levels. Robison and others (1988) described the details of how the manual water-level measurements were made and corrected to compute the altitude of water level.

The water-level data were obtained as part of the Yucca Mountain Project of the U.S. Department of Energy. The Yucca Mountain Project is described by a Site Characterization Plan (U.S. Department of Energy, 1988). The data in this study were collected by the U.S. Geological Survey and its contractors in cooperation with the U.S. Department of Energy under Interagency Agreement DE-AI08-92NV10874.

The data contained in this report were collected by Ronald J. Spaulding and Gary L. Otto, hydrologic technicians for Foothill Engineering, Inc. under the direction of Darrell A. Baldwin, U.S. Geological Survey. The data processing techniques were checked and verified by Michelle S. Boucher, Quality Assurance Specialist with Foothill Engineering, Inc. The authors processed the data and are fully responsible for all the data. The authors acknowledge the assistance of James H. Robison, U.S. Geological Survey (retired), who initially conceived of and designed the water-level network, and Leonard E. Wollitz, U.S. Geological Survey (retired), who implemented the water-level network.

WELL DESIGNATIONS

Each well used in the study of the Yucca Mountain area has a unique name or number. Wells on the Nevada Test Site (NTS) use a NTS designation, whereas wells off the NTS use a slightly different designation. Wells on the NTS begin with UE (U for underground and E for exploratory), followed by the NTS area number (always 25 in this report). This designation --UE-25-- commonly is followed by one or more letters signifying the purpose of the well or simply by a sequential letter, followed by a sequence number. Wells off the NTS begin with the letters USW (U for underground, S for southern Nevada, and W for waste). The designation--USW--is followed by one or more letters signifying the purpose of the well followed by a sequence number. The letters signifying purpose that are used in this report are G (drilled primarily to collect geologic data), H (drilled primarily to collect hydrologic data), VH (drilled to collect volcanic and hydrologic data); p (drilled to collect data on rocks of Paleozoic age), and WT (drilled primarily to determine the altitude of the water table). The only well not using this designation system and referred to in this report is well J-13 (fig. 1).

Nevada State Coordinates are used to identify location of wells cited in this report. These coordinates are for the central zone of Nevada and are based on a Transverse Mercator projection. The origin of this projection for the central zone of Nevada is latitude 34° 45' N., and the central meridian is at longitude 116° 40' W. The Nevada State Coordinates listed in the "Well Data, Transducer Output, and Water Levels" section are in meters north of the baseline and in meters plus 152,400 east of the central meridian. The Nevada State Coordinates for the wells were determined by Holmes & Narver, Inc., contractor to the U.S. Department of Energy for surveying at the NTS and Yucca Mountain area. Latitude and longitude values of the wells were calculated from the Nevada State Coordinates.

The Site ID number is used for unique identification of the well in the U.S. Geological Survey's computer files. The Site ID is generated by combining the original designations of the latitude and longitude with a two-digit sequence number. The Site ID is for convenience of identification only and should not be used as an actual location number because the original designations of latitude and longitude may be inaccurate. Even if original values of the latitude and longitude are revised later, the Site ID for the well is not changed. If more than one well exists within the 1-second rectangle of latitude and longitude, the two-digit sequence number is used to ensure uniqueness of the Site ID.

Some wells within the water-level network have had packers or piezometers installed so that the water level of discrete intervals could be measured. In these instances, before the packers or piezometers were installed, the well was assigned one Site ID (generally with a sequence number of 01), and each depth interval was assigned its own unique Site ID by incrementing the sequence number. Hence, some wells within the network have several Site ID's. When this occurs, all Site ID's are listed by location in the "Well Data, Transducer Output, and Water Levels" section, and the interval of the well that is represented by each Site ID is identified. Water levels from different intervals in the well may represent different hydrologic conditions and should not be compared directly.

WATER-LEVEL NETWORK

Well drilling for preliminary evaluation of the suitability of the Yucca Mountain site began in 1980; the first wells were completed in 1981. Water levels were measured as each well was completed and tested. After these initial water-level measurements, the U.S. Geological Survey began to measure the water levels periodically to determine stability of the original measurements and to determine if any cycles or trends occur in the water levels that might provide insight about the hydrologic system. The almost horizontal potentiometric surface beneath part of the area (Robison, 1984) indicated that long-term mean water levels might be needed at a number of wells to determine the hydraulic gradients with adequate precision. In addition, periodic measurements were not adequate to determine short-term water-level changes that could be used to evaluate conceptual models and mechanisms of ground-water flow beneath Yucca Mountain. In late 1983, testing of methods for continuous water-level monitoring was begun at well UE-25b #1. Continuous water-level records were obtained intermittently in well USW H-1 in 1983, and in well USW H-4 in 1984, while procedures and equipment were tested to overcome operational difficulties. In early 1985, procedures were sufficiently developed that formal data collection began. By 1986, the present water-level network for continuous monitoring had essentially evolved.

Short-term water-level changes, induced by barometric-pressure changes and earth tides, can be used to estimate hydraulic properties of the flow system. Hourly water levels are sufficient to make these estimates; hence that is the normal frequency of measurement in the continuous water-level network. Very short-term water-level changes, such as those induced by earthquakes and underground nuclear explosions, would normally not be detected by hourly measurements. To detect water-level changes with a duration of a few seconds would be very difficult with the equipment used in the continuous water-level network.

At the beginning of 1989, the network included 26 wells, 14 of which were being monitored continuously and 12 of which were being monitored periodically. By the end of 1989, 15 wells were monitored continuously and 11 were monitored periodically, one of continuously monitored wells having been changed to the periodically monitored group and two of the previously periodically monitored wells being monitored continuously. A summary of these wells is given in table 1; the location of the wells are shown in figures 1 or 2.

Table 1. *Summary of wells monitored for water levels*
[p, periodic measurements; h, hourly monitoring; d, discontinued]

Well number	Drilled depth (meters)	Date completed	Water level[1] Approximate depth (meters)	Water level[1] Approximate altitude (meters)	Frequency monitored at end of 1989
USW WT-1	515	5-83	471	730	p
USW WT-2	628	7-83	571	731	h
UE-25 WT #3	348	5-83	300	730	p
UE-25 WT #4	482	6-83	438	731	p
UE-25 WT #6	383	6-83	280	1,035	h
USW WT-7	491	7-83	421	776	p
USW WT-10	431	8-83	347	776	p
USW WT-11	441	8-83	363	731	h
UE-25 WT #12	399	8-83	345	730	p
UE-25 WT #13	354	7-83	304	729	h
UE-25 WT #14	399	9-83	346	730	p
UE-25 WT #15	415	11-83	354	729	p
UE-25 WT #16	521	11-83	473	738	h
UE-25 WT #17	443	10-83	394	730	p
UE-25b #1	1,220	9-81	470	731	h
UE-25c #1	914	10-83	400	731	d
UE-25c #2	914	3-84	402	730	h
UE-25c #3	914	6-84	402	730	h
UE-25p #1	1,805	5-83	362	752	h
USW G-3	1,533	3-82	750	730	h
USW H-1	1,829	1-81	572	731	h
USW H-3	1,219	3-82	752	732	h
USW H-4	1,219	6-82	518	730	h
USW H-5	1,219	8-82	703	775	h
USW H-6	1,220	10-82	526	776	h
USW VH-1	762	2-81	184	779	p
J-13	1,063	1-63	283	728	p

[1]Composite water level of saturated interval, or level of shallowest interval monitored.

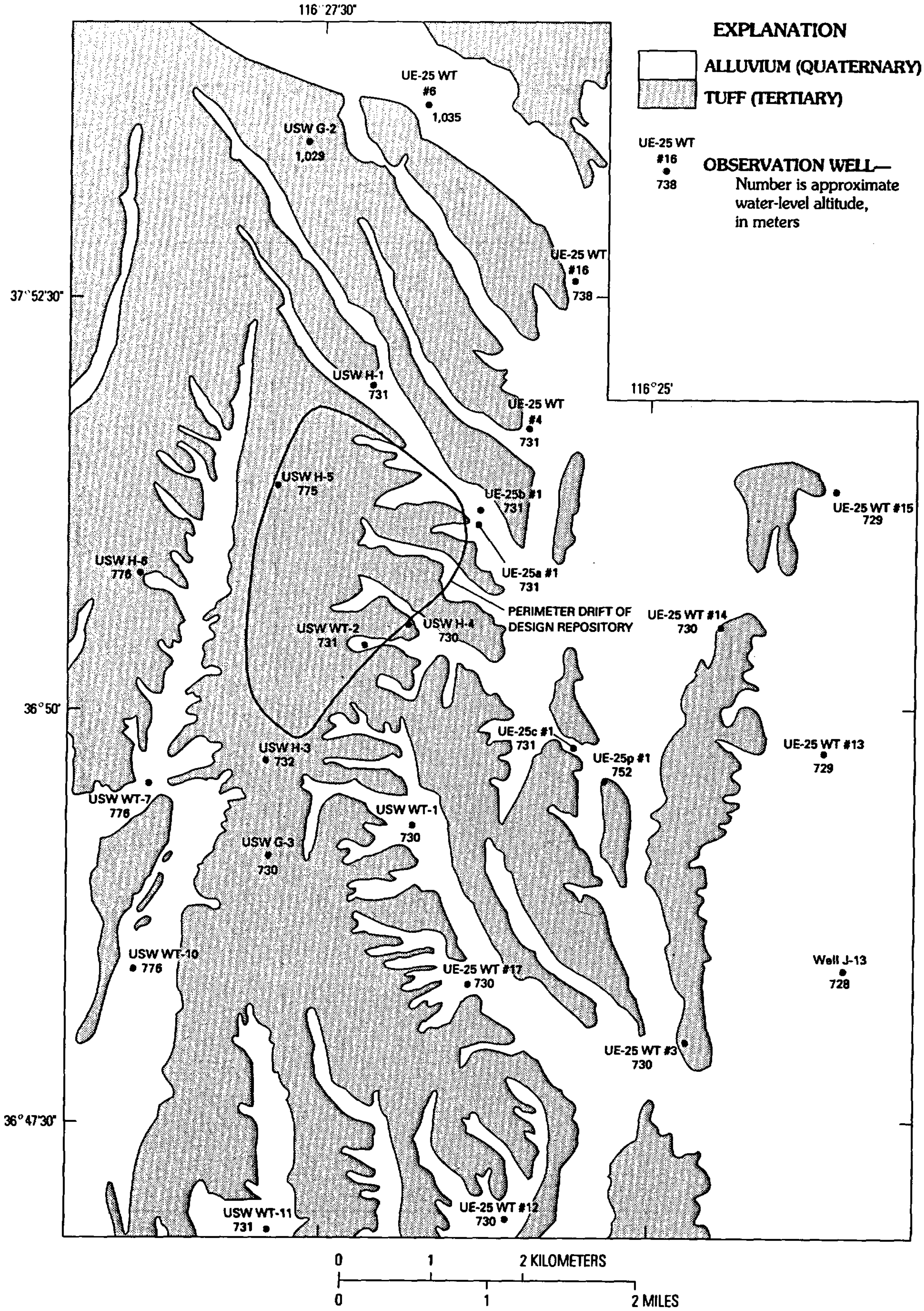


Figure 2.--Location of wells and 1989 water-level altitudes in the vicinity of Yucca Mountain.

GENERAL DESCRIPTION OF WATER-LEVEL ALTITUDE

The water-level altitudes in the Yucca Mountain area range from 706 m above sea level at well 230 S15 E50 18CC 2 near Amargosa Valley to the south to 1,187 m at well UE-29a #2 along Fortymile Canyon to the north (fig. 1). Only water-level altitudes of selected wells are shown in figure 1. Water-level altitudes beneath Yucca Mountain are shown in greater detail in figure 2. Some of the points in figure 2 are from the periodic water-level network described by Robison and others (1988) and O'Brien (1991) and are not discussed in this report. Water-level altitudes shown in figure 2 are highest to the north at well UE-25 WT #6, at about 1,035 m above sea level.

In wells USW H-6, USW WT-7, and USW WT-10, west of Yucca Mountain, and in well USW H-5 on Yucca Mountain, the water levels all are about 776 m above sea level. The water-level altitude is approximately 44 m lower at well USW H-3, approximately 1.4 kilometers east of well USW WT-7. From the eastern edge and southern end of Yucca Mountain to western Jackass Flats, the water level decreases from about 730 to about 728 m in altitude (fig. 2) and decreases further to 706 m at Amargosa Valley (fig. 1).

Well UE-25p #1 has a water-level altitude of approximately 752 m above sea level while nearby wells have a water-level altitude of approximately 730 m. However, well UE-25p #1 monitors water levels in Paleozoic carbonate rocks while all other wells monitor water levels in overlying Tertiary volcanic rocks.

GENERAL DESCRIPTION OF WATER-LEVEL FLUCTUATIONS

The first wells in the Yucca Mountain area west of Fortymile Wash were completed in 1981 and some water-level measurements were made. By 1983, the water-level-measuring techniques were sufficiently developed to obtain high-precision water-level measurements. Between 1983 and 1989, water levels in the Yucca Mountain area have remained relatively stable. The water-level altitude for 1983-89 in well UE-25 WT #17, which is located several kilometers south-southeast of the potential repository, is shown in figure 3. For more than 6 years, the water-level measurements have been within a 0.5-m range with no apparent trend. The apparent water-level rise of about 0.2 m between April and June 1985 (fig. 3) corresponded to a change in measuring equipment and probably is not real (Robison and others, 1988, p. 67). This apparent change of 0.2 m is small compared to the depth-to-water of 394 m.

Water levels in other wells in the area, for example UE-25 WT #6 (Robison and others, 1988, p. 37) and the lower intervals of USW H-1 (Robison and others, 1988, p. 101-102), had some significant changes following completion of the well, but the rate of change decreased over time and the water levels may be approaching equilibrium. For example, well UE-25 WT#6, completed June 29, 1983, had a water-level altitude of 1,030.5 m on September 7, 1983 (Robison and others, 1988, p. 36). One year later, the water level had risen about 2.7 m, two years later, it had risen an additional 0.8 m and three years later, it had risen an additional 0.1 m (Robison and others, 1988, p. 36). Data in this report in the section "Well data, transducer output, and water levels" indicates that by 1989, the water level which is at about 1,035 m, may still be rising slowly. The lower two intervals of well USW H-1 appeared to be rising slowly after about two years (Robison and others, 1988, p. 101-102) and may still be rising very slowly. The early changes probably represent the length of time that these wells needed to return to equilibrium following drilling and testing. The long recovery period probably indicates very low permeability of the rocks penetrated by these wells.

Short-term changes in barometric pressure cause corresponding short-term changes in water levels (Ferris and others, 1962, p. 83-85). In an open well which is cased below the water table and which taps partially confined or deep unconfined aquifers (typical of the wells in the continuous water-level monitoring network), water levels may decline in response to increases in barometric pressure. Similarly, decreases in barometric pressure may induce a rise in water levels. These barometrically induced water-level changes are less than 0.2 m at Yucca Mountain. Barometrically induced water-level changes occur periodically at semi-diurnal and diurnal periods due to heating and cooling of the atmosphere. Other changes occur periodically over days to weeks and are associated with weather systems. The water-level altitude for December 1989 for well USW WT-11 is shown in figure 4. The barometric pressure (inverted) at land surface at well USW H-4 for the same period is shown in figure 5. There is a very close correspondence between trends in figures 4 and 5. Barometric pressure changes at Yucca Mountain tend to be largest during the early spring and smallest during mid-summer.

Aquifers also respond to earth tides (Ferris and others, 1962, p. 86-87); water levels in some wells near Yucca Mountain exhibit responses to earth tides. Earth tides, similar to ocean tides, are caused by the gravitational attraction of the Earth, the moon, and the sun. There are five principal earth tides (Melchior, 1966), with periods of approximately 12 and 24 hours. Near Yucca Mountain, the combined effect of the earth tides can cause water levels to fluctuate up to 0.15 m over several hours to about 1 day. The water level for December 1989 for well UE-25p #1 is shown in figure 6. The calculated earth tide (Harrison, 1971) for the same period is shown in figure 7. Although there is a general correspondence between the water level in the well and the barometric pressure at USW H-4 (fig. 5), there also is a very noticeable tidal component in the water-level fluctuations. On December 2-4 and December 17-19, when the earth tide fluctuations were at a minimum, the daily water-level fluctuations were small. During the second and fourth weeks in December, when the earth-tide fluctuations were large, the daily water-level fluctuations were large.

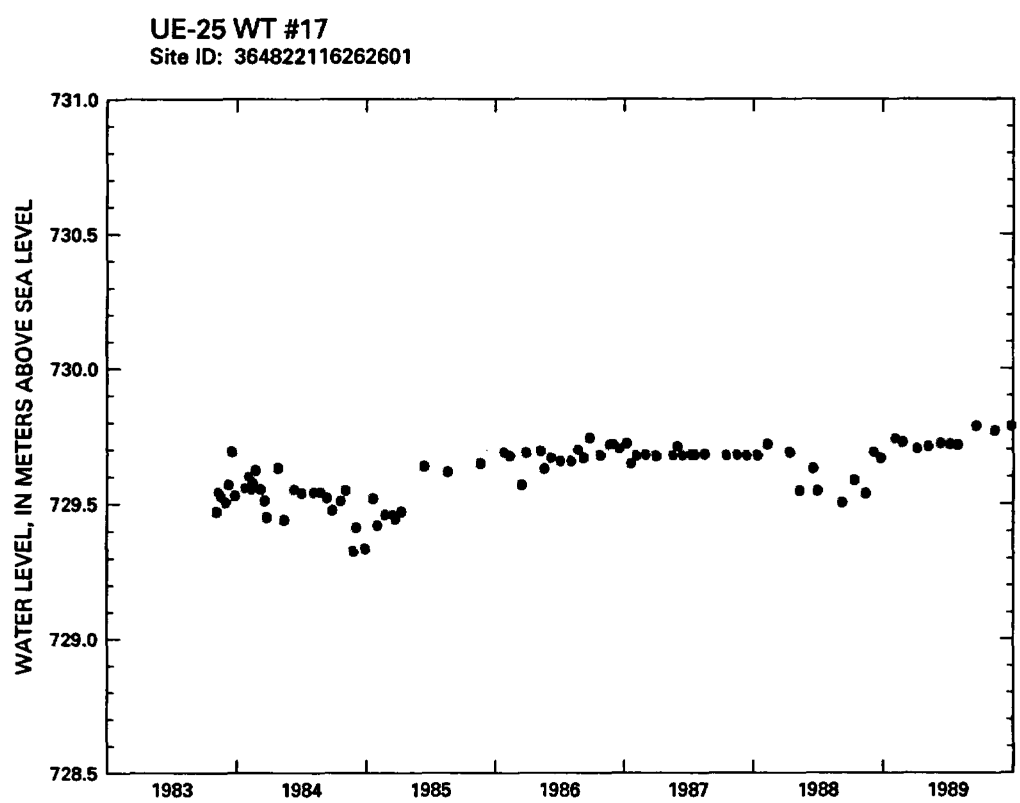


Figure 3.--Water-level altitude for well UE-25 WT #17 from 1983 through 1989.

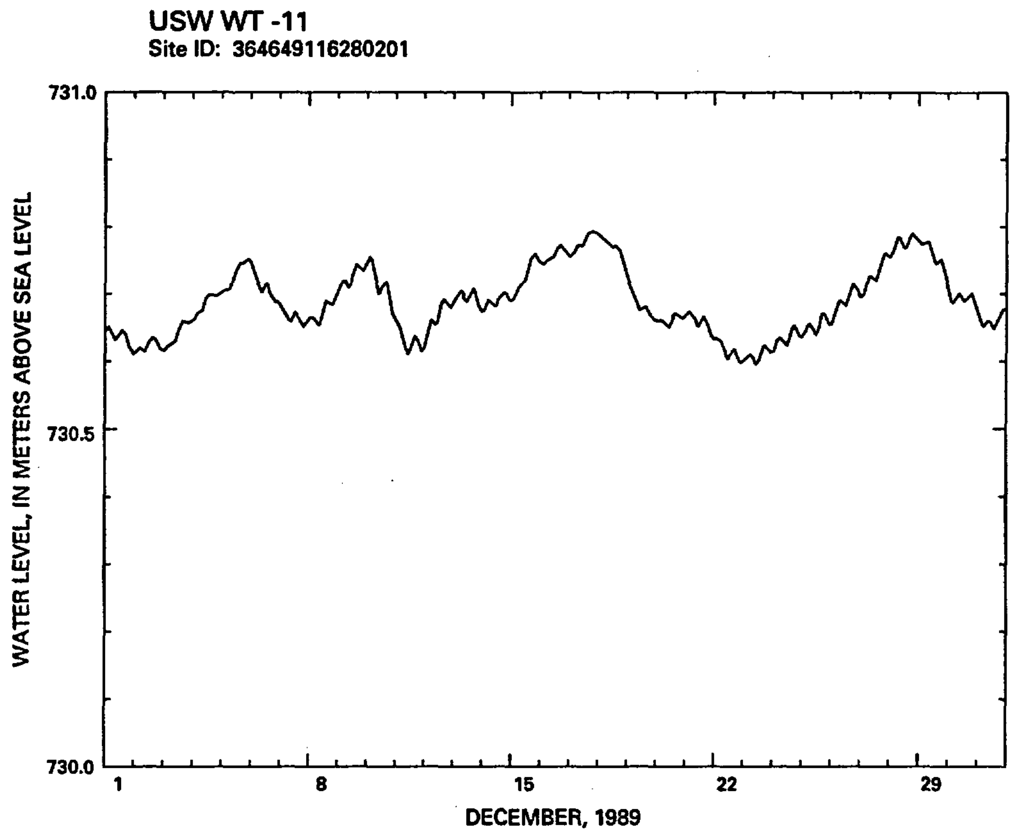


Figure 4.--Water-level altitude for well USW WT-11 for December 1989.

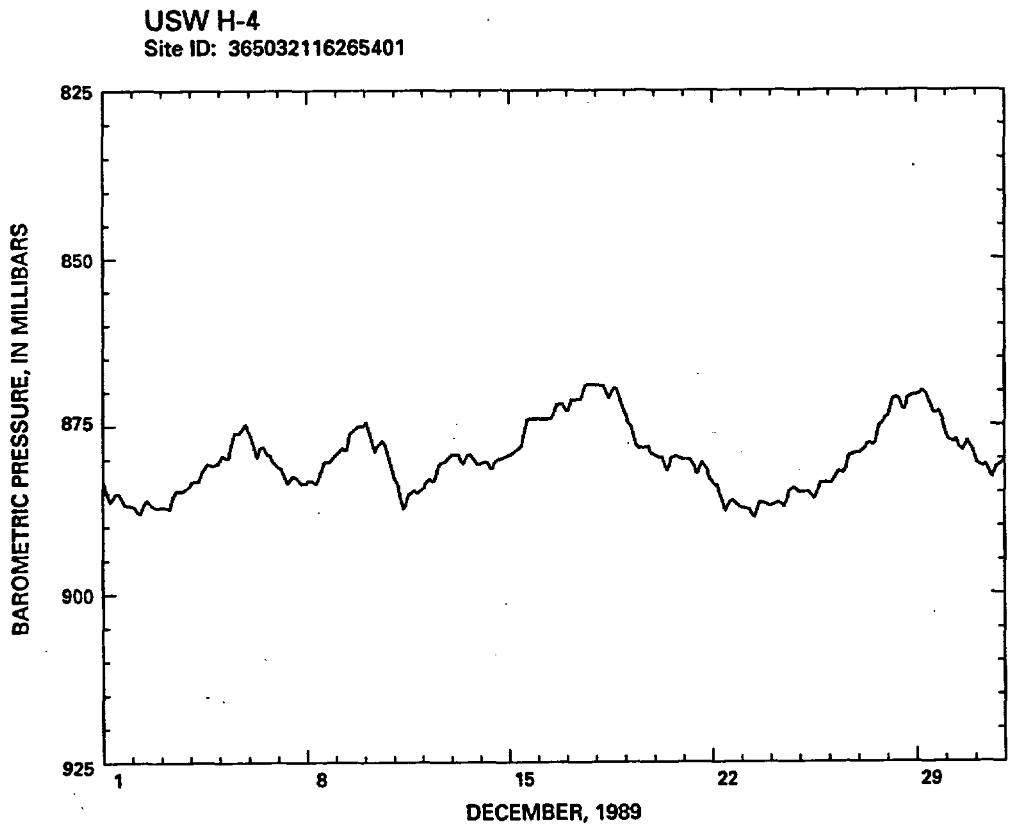


Figure 5.--Barometric pressure (inverted) at well USW H-4 for December 1989.

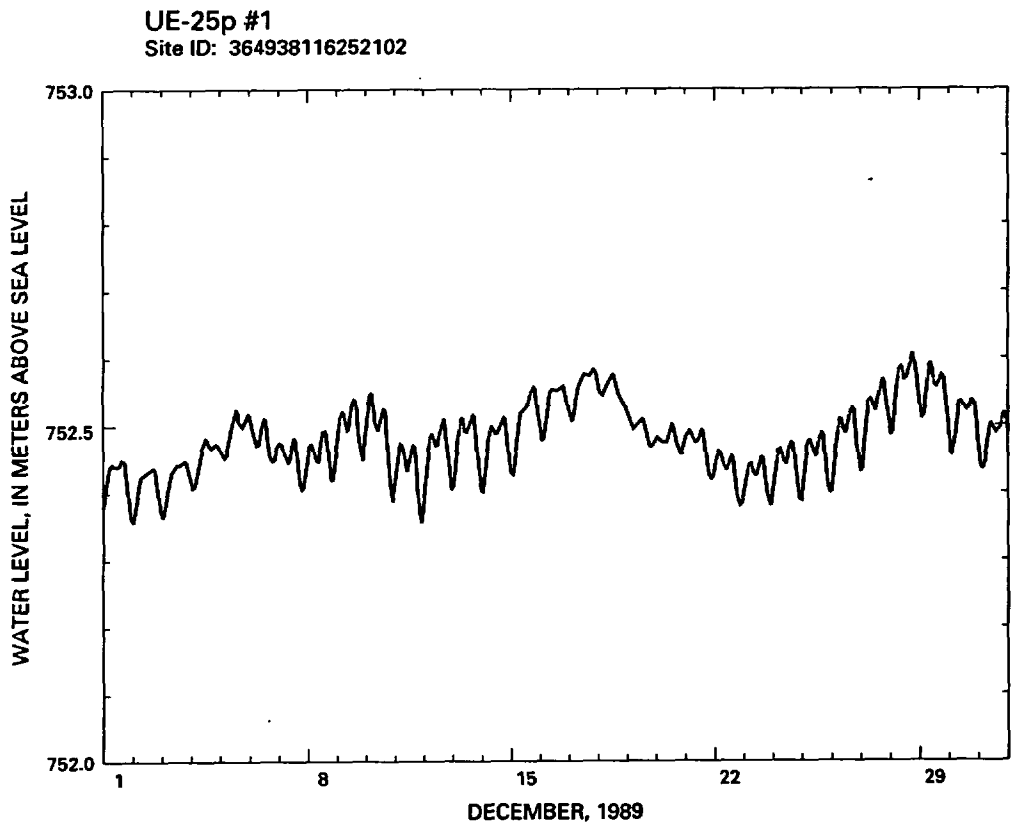


Figure 6.--Water-level altitude for well UE-25p #1 for December 1989.

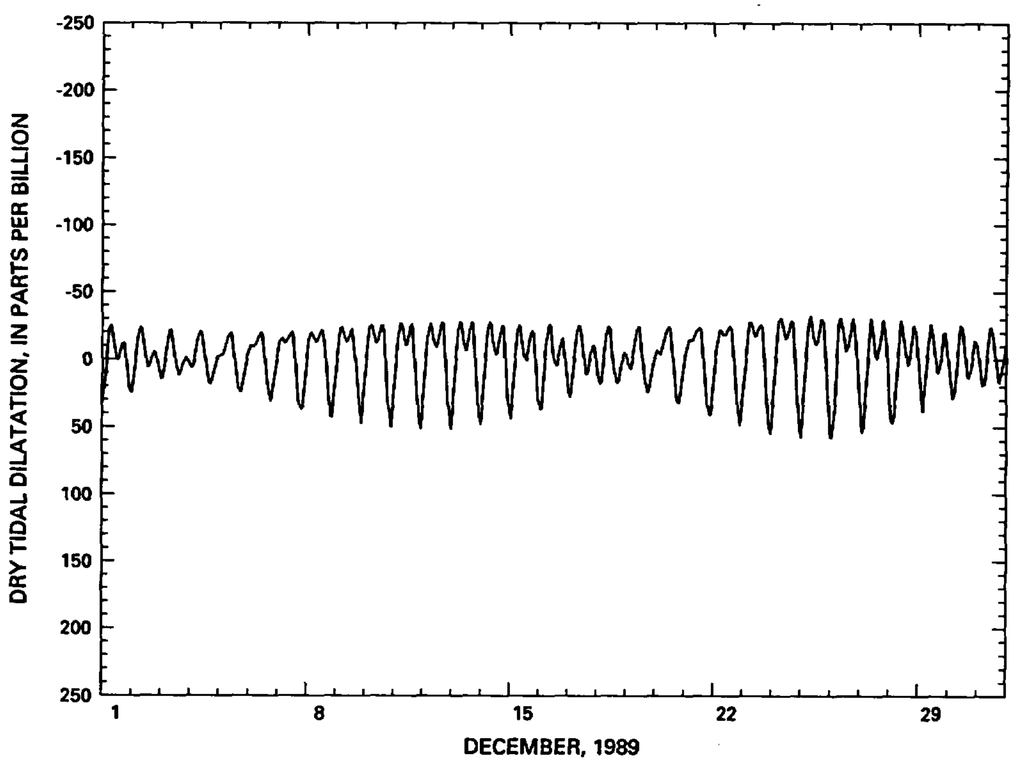


Figure 7.--Calculated earth tides for December 1989.

DATA-COLLECTION SYSTEM

Periodic Measurements

Periodic water-level measurements at wells require on-site visits by trained personnel who make the measurements and record the results. Frequency of periodic measurements have varied over time. Some newly drilled wells were measured more frequently immediately after completion; at times, some wells have been measured less frequently because of temporary shortage of personnel, breakdown of equipment, or inaccessibility due to road washouts. Frequency of periodic measurements generally has been once to twice per month with monthly being the norm during 1989 (O'Brien, 1991).

Periodic water-level measurements have been made using single and multiconductor cables and steel tapes. The equipment and measuring techniques vary and depend on a number of factors, such as development and availability of equipment, well construction that limits some equipment or techniques, or length of time and number of personnel needed for a technique. Robison and others (1988) described the equipment and techniques used to make periodic measurements. The precision of the measurements has improved over time as the calibration techniques and use of the equipment have been refined and as personnel have gained experience.

Periodic water-level measurements have been made near Yucca Mountain since 1981. Most water-level measurements made in 1981 and in the first part of 1982 were made using a single-conductor cable. Most measurements from September 1982 through April 1985 were made with a four-conductor cable. Most measurements after May 1985 were made using steel tapes. A four-conductor cable was used after May 1985, only if the steel tape could not be lowered into the well.

Hourly Measurements

Continuous water-level measurements require that equipment be left in the well to record water levels. Trained personnel install the equipment in the well, occasionally calibrate or replace equipment, and periodically retrieve the data from the site.

The data presented in this report are not actually continuous data; they are a series of discrete points of sufficient frequency that they appear to be continuous when viewed over a period of weeks to months. At the end of 1989, standard operation in the continuous water-level network was to collect one reading every hour, although before 1988 at some wells, standard operation was to collect one reading every 10 minutes and to average the six readings to obtain an hourly mean. The hourly readings or the 1-hour averages were stored and later retrieved from the site. In some instances, more frequent data were collected.

Pressure transducers were used to measure water-level fluctuations. Because of the great depths to water, up to 752 m, traditional water-level sensing methods; float-cable-pulley system, water-seeking device, and bubble tube; were not feasible. However, electronic signals from a submerged pressure transducer were relatively easy to transmit through a multiconductor suspension cable to a recording device accessible to personnel on the surface. Electronic data loggers at the surface were used to control and record data from the pressure transducers.

Equipment

The continuous water-level network used a transducer to sense its submergence depth, a wireline cable to transmit the information between the transducer and the surface, and a data logger to control the system and record the data. An external 12-volt battery provided power to the system and a solar panel kept the battery charged.

A wireline cable, consisting of four conductors, appropriate insulation, and two external wire wraps (for strength and stability), was used to transmit signals between the surface and the downhole pressure transducer. The required length of wireline cable to monitor a typical well at Yucca Mountain weighed several tens of kilograms, so power equipment was used to install it and calibrate the system.

The water-level monitoring systems were periodically calibrated; the calibration usually included a manual water-level measurement. These manual water-level measurements were made using either a multiconductor cable or a steel tape. Equipment for these manual measurements, its use, and necessary corrections and adjustments, are described in detail by Robison and others (1988). The manual measurements, after adjustments, result in altitudes of water surface at the time of calibration.

Transducers

A transducer is a device to convert a change in a mechanical quantity (such as pressure) into a change in an electrical quantity (such as resistance). Pressure transducers are a type of transducer used to measure pressure, and a depth-measurement transducer is a specific type of pressure transducer that can be immersed in water to measure the depth of submersion. In this report, the term "transducer" refers to a depth-measurement pressure transducer.

The transducer consists of a strain gage to convert pressure into electrical resistance and a Wheatstone bridge to allow measurement of the change in resistance. A constant voltage is applied across the bridge, and the voltage difference between the fixed-resistance part of the bridge and the variable-resistance part (because of the strain gage) is measured. As depth of submergence increases, transducer output voltage increases. The applied voltage is in the 5- to 10-volt range, whereas the output voltage (with 10 volts applied and the transducer submerged to its pressure limit) is typically in the 30- to 100-millivolt range. Output voltage is directly proportional to input voltage, assuming constant submergence, so if the input voltage is decreased by one-half, the output voltage is decreased by one-half.

Transducers are made for a range of pressures. Pressure ranges in the continuous water-level network have varied from 0-5 psi (submergence to 3.5 meters) to 0-100 psi (submergence to 70 m). Most of the transducers used in 1989 were for the pressure range 0-10 psi (submergence to 7 m). An absolute transducer measures absolute pressure, whereas a gage transducer measures pressure relative to atmospheric pressure. A gage transducer has a vent tube from one side of the strain gage to above the water surface. A gage transducer is preferable in the water-level network because then only water-level fluctuations affect the transducer output, and air-pressure changes do not. Both gage and absolute transducers have been used in the water-level network. The only absolute transducer in the network in 1989 (used in well USW H-6 in January, February, and early March) produced no usable data.

The transducers were calibrated when installed in the well, when removed from the well (if they were still functional), and at times while in service in the well. The transducers were calibrated every 4 months while in service in 1989.

The calibration consisted, in most instances, of manually raising or, in some instances, lowering the transducer in increments and noting the change in transducer output. The data logger (described in the next section) was used in the calibration to provide the applied voltage and to measure the output voltage, so the calibration was for the transducer-data-logger system and not just for the transducer.

On June 6, 1989, the transducer-data logger at well USW WT-2 was calibrated. The calibration started with the transducer submerged about 1.52 m below the water surface; this starting point is referred to as the set point. The following values were obtained:

Displacement from set point (meters)	Transducer output (millivolts)
0.00	9.7458
0.15	8.7184
0.30	7.7124
0.61	5.7047
0.91	3.7311
1.23	1.7173
1.52	−0.34605
1.68	−0.34820

The transducer output is the average of three readings taken after the transducer output had stabilized. The last point is off the trend of the rest of the points (fig 8), indicating that the transducer was no longer submerged. A regression analysis was performed on the data, excluding the last point. The slope of the regression line was −6.596 millivolts per meter, the intercept of the regression line was 9.735 millivolts, and the coefficient of determination was 100.0 percent. The slope of the regression line, the transducer output, and the manual water-level measurement were used to convert transducer output to water-level altitude. The negative slope of the regression line indicates that the calibration was performed while raising the transducer; lowering it would have produced a positive slope.

Data Loggers

The Campbell Scientific 21X Micrologger (data logger) used in the continuous water-level network is a microprocessor-based data-acquisition system. The data logger is a combination microprocessor, clock, voltage regulator, controller, data processor, and data-storage device. It must be continuously powered to maintain its electronic memory. The power requirements are so small that a battery can easily provide the needed power. The data logger is a programmable unit and most aspects of its operation can be altered. The variables described in this section were defined while programming the data logger.

The data logger provided 5,000-millivolt excitation to the transducer for 10 seconds and then read the transducer output for 250 microseconds. The data logger could read transducer output in a range of ±50 millivolts. If multiple transducers were installed in a single well, one data logger controlled all the transducers.

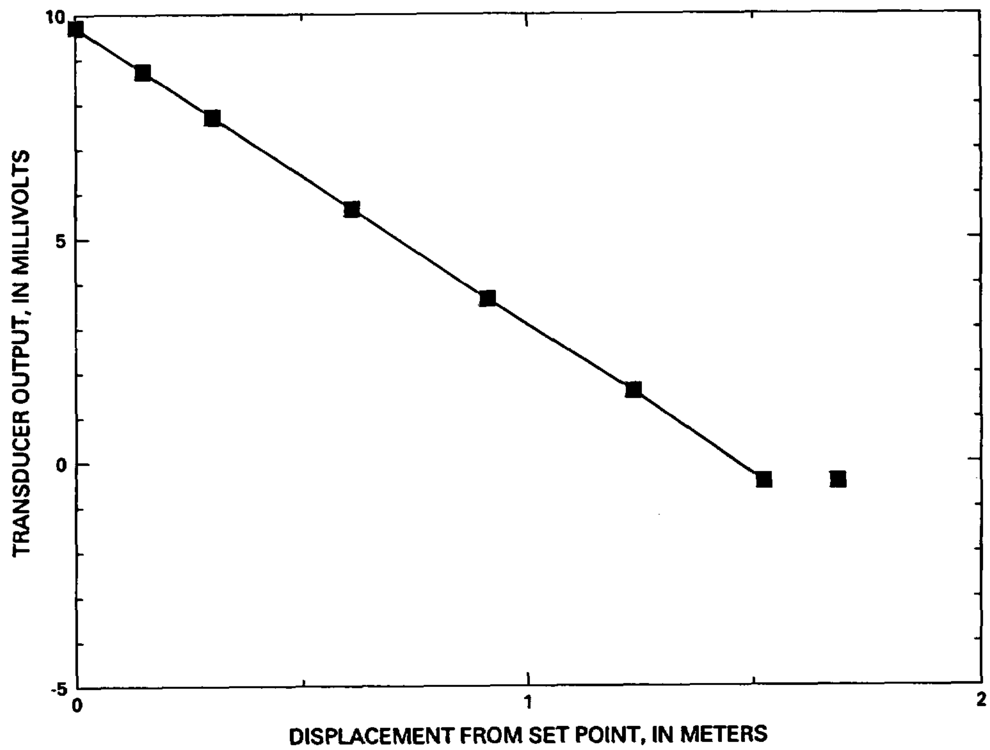


Figure 8.--Transducer calibration for well USW WT-2 on June 6, 1989.

The data loggers were programmed to make and store one reading per hour. In special cases, readings were made more frequently. In addition to transducer output, the data logger also read the battery voltage, the excitation voltage, and the internal temperature of the data logger. These variables were important to evaluate the reliability of the recorder. The data logger stored all of the preceding data in its memory plus the Julian day and time of the reading. Using output from one transducer plus the indicator data, the data logger had sufficient memory for 4 months of data. Using four transducers, the data logger could store 3 months of data. The data logger used a "write-over ring memory," in which, when the memory is full, new data were written over the oldest data.

Data from the data logger were transferred to cassette tapes through a serial port on the data logger approximately every 15 days. Two separate cassette tapes in two separate tape recorders were made in case one system malfunctioned. A voice recording on the tape identified the well from which the data were recorded. The data on the cassette tape were then transferred to a computer for subsequent processing.

Processing and Adjustments

The data stored in the data loggers and transferred to a computer were not water-level data but rather transducer output. Several steps were taken to convert the transducer output to water-level data. First-level filtering removed extraneous values and converted the data to a convenient format. The data then were evaluated to determine reliable periods of record. Data for these periods were converted to water-level altitude.

First-Level Filtering

First-level filtering edited the transducer output for non-data points and calibration data. Non-data points were recorded when the data logger could not obtain a voltage from the transducer. Instrument malfunction, instrument failure, and other undetermined effects caused non-data points to be recorded. The non-data points were recorded as ±6,999 or ±99,999, depending on how the data logger was programmed. These values were deleted from the data file and the deletion resulted in gaps in the record. Transducer output recorded during calibration also were deleted from the data file during first-level filtering.

First-level filtering also adjusted the transducer output to a standard voltage. The excitation voltage to the transducer was normally 5,000 millivolts. This voltage, while not exact, generally was maintained within very close tolerances by the data logger. All transducer output was adjusted to 5,000 millivolts excitation using the equation:

$$T_C = T_R \cdot 5000 / V_X \qquad (1)$$

where T_C is the adjusted transducer output, in millivolts;
T_R is the unadjusted transducer output, in millivolts;
V_X is the excitation voltage, in millivolts; and
5,000 is the standard excitation voltage, in millivolts.

The first-level filtering was done using a computer program. The program also reformatted the data into a more usable format. The format of the data, as transferred from the data logger, depended on how the data logger was programmed. If the program in the data logger was changed, the format of the data would change. To eliminate problems due to format changes, all transducer output was converted to a standard format for further processing.

The first-level filtered output is graphically displayed in the sections of this report pertaining to individual wells. These graphs show that each transducer had its own characteristic output. Some transducers tended to have output that drifted more than others. Some transducers were more sensitive than others. Some transducers seemed to be sensitive to large pressure changes but insensitive to small pressure changes. These transducer-output graphs should not be interpreted as water-level changes; they are only graphs of first-level filtered transducer output.

Conversion to Water-Level Altitude

If a transducer were to function for a long time so that it was calibrated several times during its life, if its output was free of drift, and if its characteristics did not change with time, the transducer output could have been converted relatively easily to water-level altitude. However, this ideal situation never occurred in the continuous water-level network and, in most cases, the transducer output was far from ideal. As a result, a significant amount of transducer output in this report could not be converted to water-level altitude.

First-level-filtered transducer output was evaluated by two hydrologists who looked for periods during which transducer output could be converted to water-level altitude. The hydrologists examined the data from short time intervals, during which hourly and daily variation could be clearly seen to determine the validity of the data. The data were compared to barometric-pressure record, earth-tide potential, and other periods of record for the same site and depth interval. The examination was done by the hydrologists independently of one another; where both agreed the data were valid, the data were selected for conversion to water-level altitudes. Only full days of data were selected for conversion. If one or both hydrologists were not convinced the data were valid, the status of the data was left as indeterminate and the conversion from transducer output to water-level altitude was not done. The indeterminate status did not necessarily mean the data were invalid; it simply meant that one or both hydrologists were not convinced the data were valid. Conversely, conversion to water-level altitude simply meant that both hydrologists agreed the data were valid.

For those data that were selected for conversion, the regression-line slope and the manual water-level measurement determined during calibration were used to convert the selected transducer output to water-level altitude. The manual measurement indicated the altitude of the water level at the time of the calibration, whereas the slope of the regression line related the change in depth of submergence to change in transducer output.

The equation for converting transducer output to water-level altitude under ideal conditions is:

$$W = W_c + (T_c - T)/S_c \qquad (2)$$

where W is the water-level altitude, in meters;

W_c is the water-level altitude at calibration, in meters;

T_c is the transducer output at set point following calibration, in millivolts;

T is the transducer output, in millivolts; and

S_c is the slope of the regression line, in millivolts per meter.

In those instances where the slope of the regression was positive because of the direction of movement during calibration, the slope was converted to a negative number for use in the formula. The calibration factor is therefore such that a decrease in the transducer output always indicates a decline in water level.

For example, for well USW WT-2 on June 6, 1989, the water-level altitude at calibration was 730.73 m (based on a manual measurement). The calibration indicated that a 1 m decline in water level would cause the transducer output to decline by approximately 6.6 millivolts. After calibration, the transducer output increased 0.26 millivolts in the next 5 hours, remained constant for 1 hour, and then decreased 0.08 millivolts in the next 4 hours. This change in transducer output would indicate a water-level altitude of 730.77 m 5 hours after calibration and a water-level altitude of 730.76 m 5 hours later.

Although the slope of regression line generally did not change dramatically between calibrations, it usually changed some. The change in slope was assumed to occur linearly between calibrations. The water-level altitude was assumed to have remained constant from the last transducer output prior to calibration through the first transducer output after calibration. This assumption probably introduced, at most, a few hundreths of a meter error in the water-level altitude as calculated. If more than one calibration was done on a transducer on the same day, the last calibration was used to calculate the water-level altitude unless the coefficient of determination of the regression lines indicated that another calibration was superior. Some specific assumptions were made for processing certain periods of record for some wells; specific assumptions are discussed in the "Well Data, Transducer Output and Water Levels" section.

Some transducers tended to drift more than others. Drift is defined as a change in transducer output without a corresponding change in water level. Linear drift was easily removed by assuming a linear change in the transducer output at the set point between calibrations. Some transducers exhibited what appeared to be non-linear drift. This drift was removed by estimating a water-level altitude at various times between calibrations. These estimated water levels are listed in the individual sections of "Well Data, Transducer Output, and Water Levels." If the estimated water levels are not correct, they may introduce some error into the water-level record. However, these errors probably are smaller than would have occurred without the non-linear drift correction.

Quality Assurance

Data in this report will be used to evaluate the suitability of the Yucca Mountain site for a potential high-level nuclear-waste repository. Confidence in the reliability of collection, processing, and reporting of the water-level data is necessary so the data may be used with confidence to assess the expected performance of the potential repository. A quality assurance program has been implemented to support the reliability of the data.

Onsite Checks and Processing

Water-level measurements were obtained by methods described by formal technical procedures as required by the quality assurance program. The technical procedures included tests and adjustments done during the measuring operation to ensure that the equipment was operating properly and that expected precision and accuracy was attained. For example, the procedure for measuring water-level changes with a pressure transducer specified how to install the transducer, how to calibrate it in place, and how to maintain the records of the calibrations.

Data were recorded in logbooks at the well site. Data recorded were: time and date of the visit or calibration; names of operators making the visit; technical procedure used (for calibration); identification of specific equipment used for calibration; and correction factors, if any, applied to the data at the well site. In addition, the entry in the logbooks may include comments about anything that may have been relevant to the data, such as discussion of problems with equipment or weather conditions during the calibration.

Office Processing and Review

After completion of the calibration, the data were reviewed for completeness and accuracy by the supervisor responsible for onsite operations. The original logbooks and records were maintained at the onsite operations headquarters on the Nevada Test Site. Photocopies were periodically transmitted to the office of the project chief for water-level measurements, which is located in Denver, Colo. The records were reviewed, and any needed adjustments not done during onsite operations were made.

The transducer output was entered into a temporary data base and was plotted to facilitate general review for reasonableness and to discover any instrumentation problems. After this review, the transducer output was converted to water levels (if appropriate). Both the first-level filtered transducer output and the water-level altitude were placed in permanent computer data bases, such as the Unit Values file of the National Water Information System used by the U.S. Geological Survey.

WELL DATA, TRANSDUCER OUTPUT, AND WATER LEVELS

Information and data for individual wells are included in the following sections. Each well is presented in a separate section; each section is further subdivided. Each section begins with sources of information about the well. Much of this is published information; complete bibliographic citations are in the "References" section. Important information about the well, including location, drilling specifications, and intervals monitored are summarized in the "Well Specifications" section. Equipment used to monitor water levels, including a list of transducers used and their calibrations and comments, are provided in the "History of Instrumentation and Calibrations" section. The character of the transducer output is discussed in "Transducer Output", and the periods of record that were converted are given in the "Water-Level Altitude" section. First-level filtered transducer output is presented in graphical form in a figure consisting of one or more plots each covering one quarter of the year, distinguished by an upper case letter in the upper-left corner of the plot if the figure contains more than one plot. The scales used in the figure were selected to present the data in as much detail as possible while still presenting all of the data. Full scale in these plots is always at least 10 millivolts. The major divisions are always 10 millivolts apart and the minor divisions are always 1 millivolt apart.

A figure consisting of a series of quarterly plots, each plot distinguished by a letter in the upper-left corner, presents water-level altitude where transducer output was converted. Although the altitude of the water level varies from well-to-well and from interval-to-interval, full scale for these figures is always 2.5 m. The daily mean water-level altitudes where transducer output was converted to water-level altitude are presented in a table. A daily mean water-level altitude was not calculated if a 5-hour or larger gap occurred during the day. Monthly mean, monthly minimum, and monthly maximum water-level altitudes were calculated from the daily mean values if a complete month of daily mean water-level altitude existed.

Water-Table Wells

A series of water-table wells, designated by WT in the well name, were drilled from April 1983 to May 1985. The purpose of these holes was to determine the location of the water table. Six water-table wells are represented in this section and fourteen are listed in table 1. In addition to these wells, well UE-25 WT #5 was drilled but was abandoned because of adverse hole conditions and well UE-25 WT #18 was drilled but the access tubing in it did not reach the water table. Two wells, USW WT-8 and USW WT-9, were planned but were not yet started when drilling was suspended in 1986.

The water-table wells were all drilled in a similar manner. The wells were started with a 375-mm bit and surface casing was set. The wells were continued with a 222-mm bit to below the water table. Depth of penetration below the water table ranged from 44 m to 103 m. The wells were not cased below the water table. A 62-mm inside-diameter tubing with a well screen on the bottom provided an access for measuring water levels.

Well USW WT-2

Information about the history of well USW WT-2 and about previous data from the well was obtained from various sources. These sources are: Robison (1984, 1986); Robison and others (1988); Fenix & Scisson, Inc. (1986a, 1987c).

Well specifications

The following are specifications for well USW WT-2:

1. Location and identification:

   Latitude and longitude: 36°50'23" N.; 116°27'18" W.
   Nevada State Central Zone Coordinates (m): N 231,849; E 171,274.
   U.S. Geological Survey Site ID: 365023116271801.

2. Drilling and casing information:

   Well started: July 8, 1983.
   Well completed: July 16, 1983.
   Drilling method: Rotary, using rock bits and air-foam circulating medium; bottom-hole core obtained.
   Bit diameter below water level: 222 mm.
   Casing extending below water level: None [surface casing only, to a depth of 18 m].
   Total drilled depth: 628 m.

3. Access to and description of interval for measuring water levels:

   62-mm inside-diameter access tubing that has a 3.6-m long well screen on bottom, extending from land surface to a depth of 622 m; saturated interval of borehole within Prow Pass Member of Crater Flat Tuff.

4. Information for calculating water-level altitude:

   Reference point: Top of metal tag on well casing; altitude 1,301.13 m (surveyed by U.S. Geological Survey, 1984).
   Depth correction for borehole deviation from vertical: 0.53 m, based on approximate depth to water of 571 m.

History of instrumentation, calibrations, and comments

Manual water-level measurements were made from July 20, 1983 through March 20, 1985. Beginning in March 1985, the water level has been monitored continuously using a downhole pressure transducer with a data logger at land surface.

The following transducers were used in well USW WT-2 in 1989:

[Range is pressure limit for transducer, in pounds per square inch]

Date of use		Transducer			
Beginning	Ending	Type	Model	Range	Serial number
10-01-87	02-07-89	Gage	Druck 10/D	10	153536
02-07-89	06-06-89	Gage	Druck 930	10	245438
06-06-89	12-31-90[1]	Gage	Druck 930	10	228778

[1]Still in use as of December 31, 1990.

The following calibrations of the water-level monitoring system were used to process the 1989 data from well USW WT-2:

Transducer				Water level	
		Regression line			
Serial number	Calibration date	Slope (millivolts per meter)	Coefficient of determination	Date	Altitude (meters)
153536	10-25-88	–6.350	0.999	10-25-88	730.72
153536	02-07-89	–13.420	0.984	02-07-89	730.69
245438	02-07-89	–6.727	1.000	02-07-89	730.69
245438	06-06-89	–6.660	0.999	06-06-89	730.73
228778	06-06-89	–6.596	1.000	06-06-89	730.73
228778	09-15-89	–6.517	1.000	09-15-89	730.71
228778	12-14-89	–6.576	1.000	12-14-89	730.77
228778	03-26-90	–6.543	1.000	03-26-90	730.80

Transducer output from January through December 1989 is shown in figure 9A through 9D. These data are the transducer output after first-level filtering (described in the "First-Level Filtering" section) has been applied. The first transducer (serial number 153536), in use in January and early February 1989, generally produced erratic output (fig. 9A). Its calibration changed dramatically between October 1988 and February 1989; this is unusual. The second transducer (serial number 245438) produced erratic output and the output drifted downward excessively until late February 1989 (fig. 9A). A battery failure caused a gap in the output of several days at that time. The second transducer produced reasonable output from late February until early June except for March 25 and 26 (fig. 9A) when it produced spurious-looking output similar to that which has been associated in some other wells with the passage of an atmospheric low. A third transducer (serial number 228778), which was installed early in June, produced reasonable output through December 31, 1989, and was still in use December 31, 1990.

USW WT-2
Site ID: 365023116271801
INTERVAL: 571 - 628

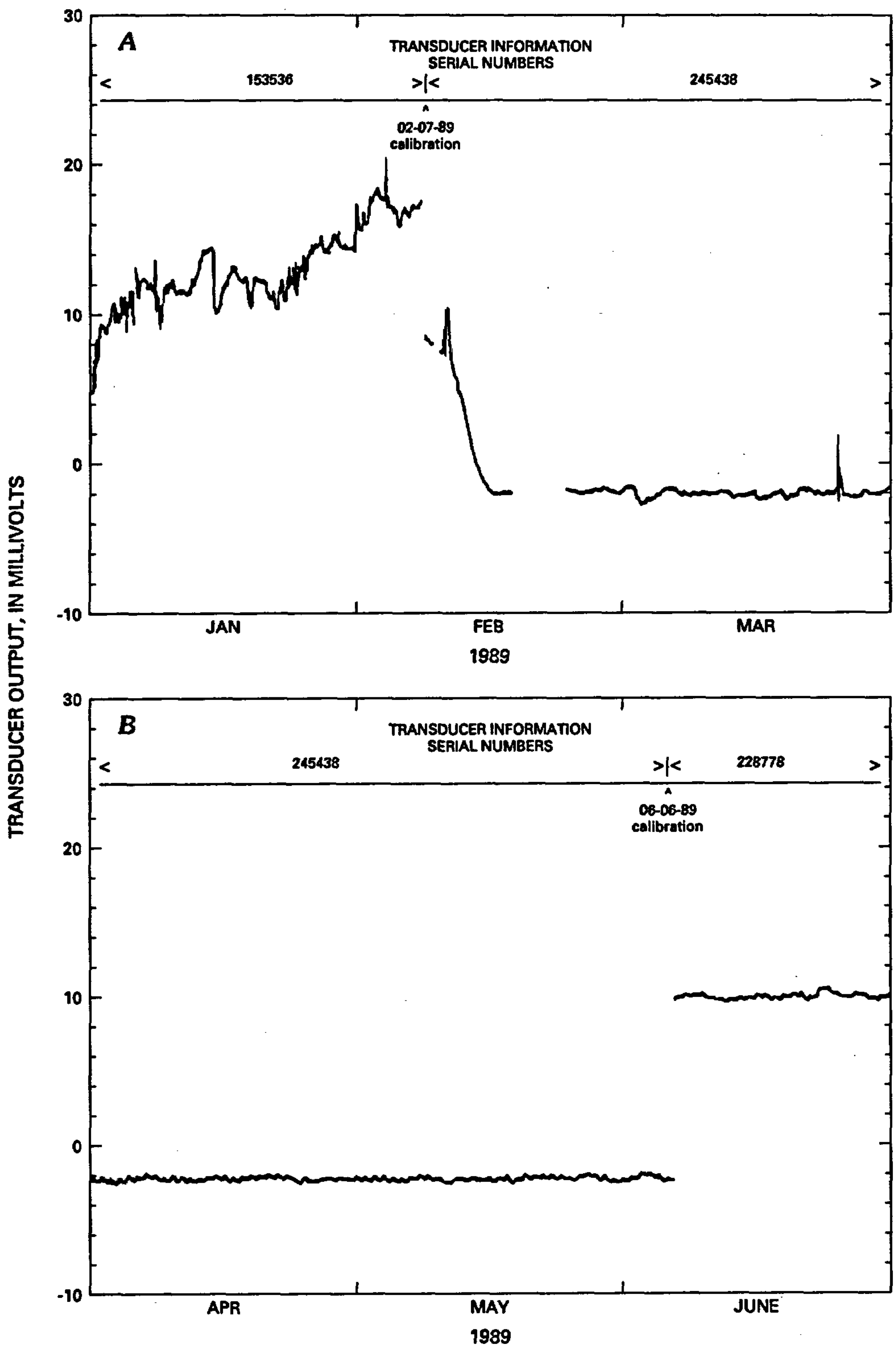


Figure 9.–Transducer output for well USW WT-2.

USW WT-2
Site ID: 365023116271801
INTERVAL: 571 - 628

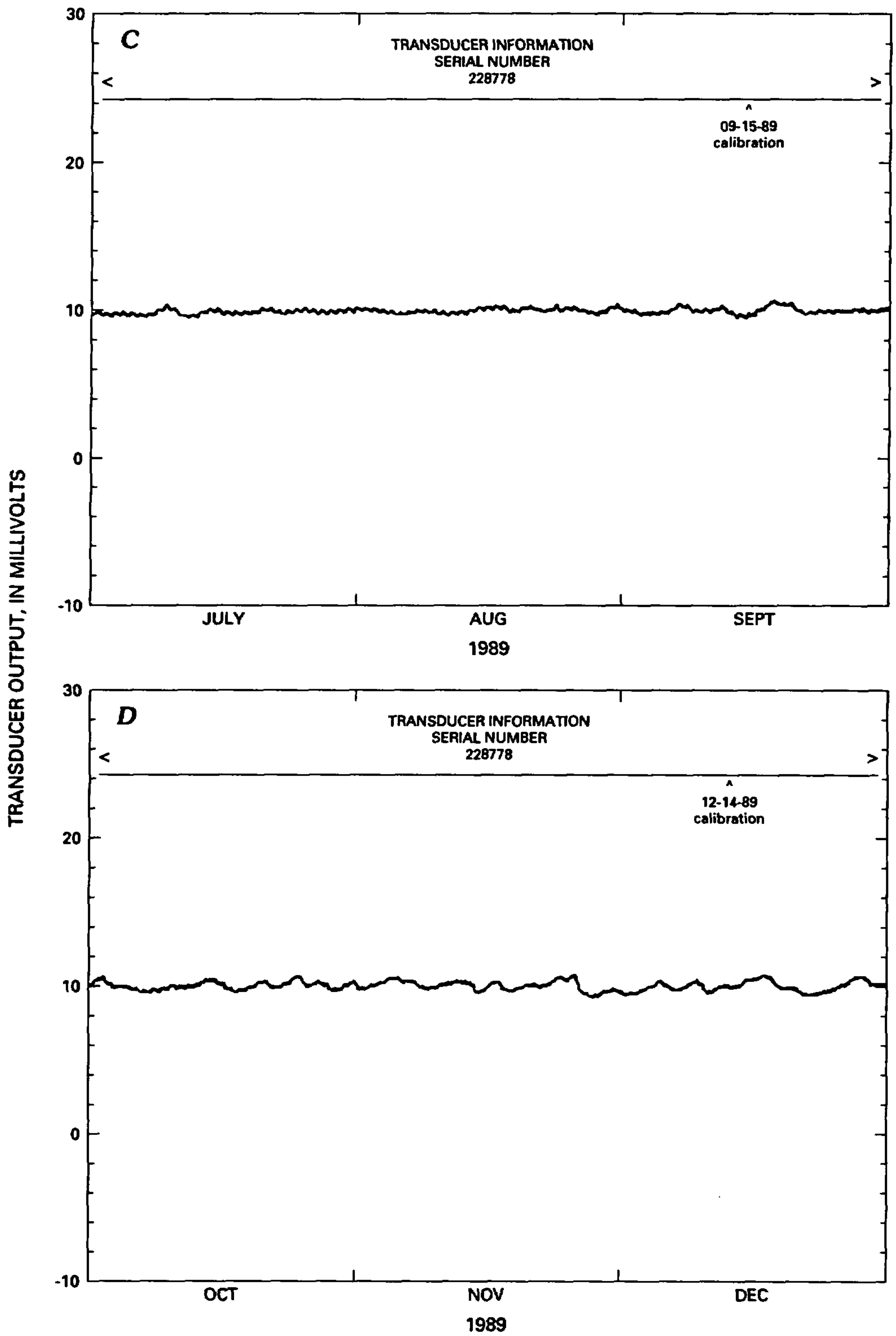


Figure 9.--Transducer output for well USW WT-2.--Continued

In addition to water-level altitudes calculated from measurements at the time of calibrations, water level altitude was estimated for the following day:

Date	Estimated water-level altitude (meters)
02-23-89	730.69

The altitude estimate was based on the assumption that the water level did not change between February 7 and 23, and was used to remove what was judged to be transducer drift.

Transducer output was converted to water-level altitude for the following periods:

Beginning date	Ending date
02-23-89	03-24-89
03-27-89	12-31-89

The water-level altitudes are shown in figure 10A through 10D, and the daily mean water-level altitudes are given in table 2. Approximately 85 percent of the transducer output was converted to water-level altitude. The longest period was 280 days, March 27 through December 31, 1989.

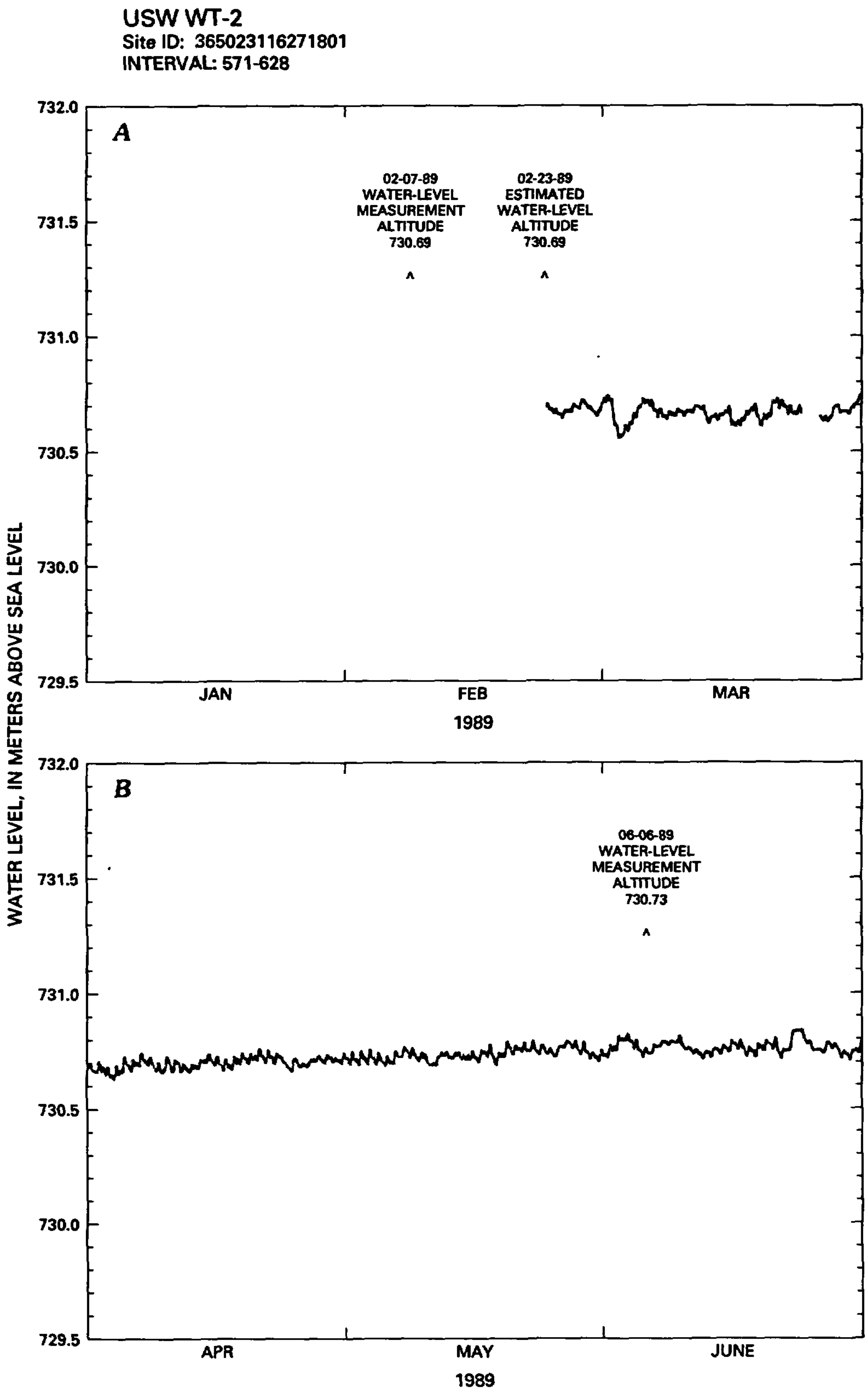


Figure 10.--Water-level altitude for well USW WT-2.

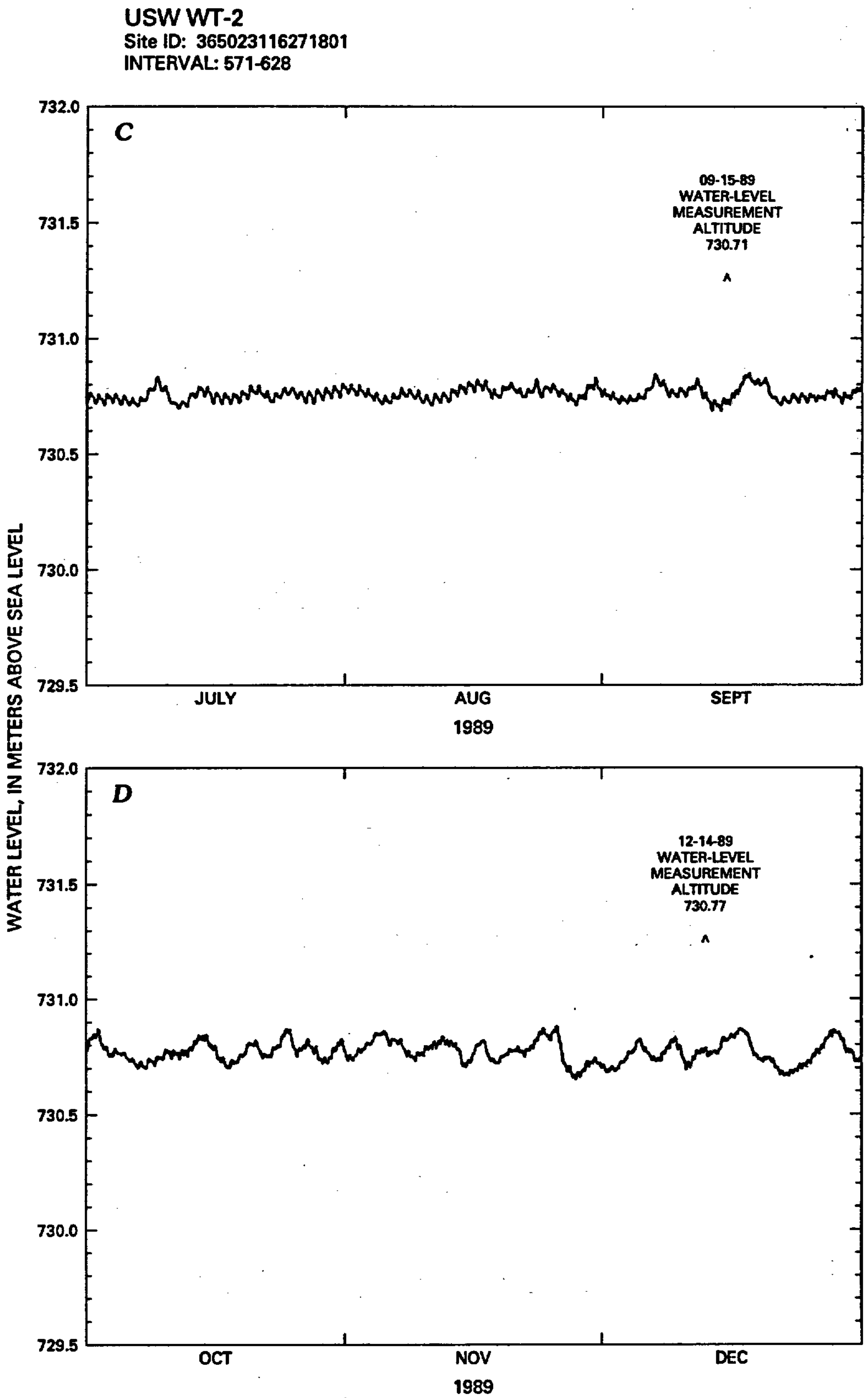


Figure 10.--Water-level altitude for well USW WT-2.--Continued

Table 2. *Daily mean water-level altitude for 1989, in meters above sea level, for well USW WT-2*
[Monthly mean, maximum (max), and minimum (min) computed from the daily mean values, indicated only for months that have complete data sets. Dashes indicate insufficient data to calculate daily mean water-level altitude]

Interval: 571-628 m **Site ID: 365023116271801**

DAY	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
						1989						
1	—	—	730.68	730.70	730.72	730.74	730.75	730.78	730.75	730.80	730.75	730.71
2	—	—	730.73	730.68	730.72	730.78	730.74	730.77	730.74	730.84	730.76	730.69
3	—	—	730.63	730.67	730.72	730.80	730.74	730.76	730.74	730.78	730.79	730.71
4	—	—	730.59	730.66	730.73	730.77	730.74	730.75	730.74	730.76	730.83	730.75
5	—	—	730.64	730.69	730.72	730.74	730.73	730.73	730.76	730.76	730.85	730.80
6	—	—	730.70	730.70	730.71	730.75	730.73	730.74	730.81	730.73	730.82	730.78
7	—	—	730.71	730.72	730.72	730.78	730.72	730.76	730.80	730.71	730.81	730.74
8	—	—	730.67	730.71	730.74	730.78	730.75	730.76	730.76	730.72	730.76	730.75
9	—	—	730.66	730.69	730.74	730.79	730.80	730.75	730.76	730.73	730.75	730.80
10	—	—	730.67	730.69	730.73	730.76	730.78	730.74	730.77	730.75	730.77	730.79
11	—	—	730.67	730.70	730.71	730.74	730.73	730.73	730.80	730.76	730.79	730.72
12	—	—	730.68	730.69	730.71	730.73	730.71	730.74	730.75	730.76	730.81	730.75
13	—	—	730.68	730.68	730.74	730.74	730.73	730.75	730.71	730.77	730.81	730.77
14	—	—	730.64	730.70	730.73	730.75	730.76	730.77	730.71	730.81	730.77	730.76
15	—	—	730.65	730.72	730.73	730.76	730.77	730.79	730.74	730.82	730.72	730.80
16	—	—	730.66	730.71	730.73	730.77	730.74	730.79	730.78	730.78	730.77	730.83
17	—	—	730.62	730.70	730.73	730.74	730.74	730.80	730.83	730.73	730.80	730.85
18	—	—	730.65	730.70	730.75	730.75	730.74	730.76	730.81	730.71	730.74	730.84
19	—	—	730.68	730.72	730.72	730.77	730.75	730.76	730.81	730.73	730.74	730.76
20	—	—	730.63	730.73	730.75	730.77	730.76	730.79	730.75	730.78	730.77	730.74
21	—	—	730.68	730.74	730.76	730.74	730.77	730.77	730.73	730.80	730.78	730.73
22	—	—	730.71	730.73	730.76	730.78	730.75	730.76	730.74	730.75	730.77	730.68
23	—	—	730.68	730.73	730.76	730.83	730.74	730.79	730.74	730.76	730.81	730.68
24	—	730.68	—	730.71	730.76	730.78	730.76	730.77	730.74	730.81	730.85	730.70
25	—	730.67	—	730.70	730.75	730.75	730.77	730.78	730.74	730.84	730.84	730.72
26	—	730.69	—	730.70	730.75	730.76	730.76	730.77	730.75	730.77	730.81	730.76
27	—	730.70	730.64	730.70	730.78	730.76	730.75	730.75	730.76	730.80	730.70	730.80
28	—	730.69	730.67	730.72	730.77	730.73	730.75	730.73	730.74	730.77	730.67	730.85
29	—		730.68	730.72	730.75	730.73	730.76	730.77	730.76	730.73	730.70	730.82
30	—		730.68	730.72	730.73	730.75	730.77	730.80	730.78	730.76	730.73	730.76
31	—		730.72		730.73		730.77	730.77		730.80		730.74
MONTHLY												
MEAN	—	—	—	730.70	730.74	730.76	730.75	730.76	730.76	730.77	730.78	730.76
MAX	—	—	—	730.74	730.78	730.83	730.80	730.80	730.83	730.84	730.85	730.86
MIN	—	—	—	730.66	730.71	730.73	730.71	730.73	730.71	730.71	730.67	730.68

Well UE-25 WT #3

Information about the history of well UE-25 WT #3 and about previous data from the well was obtained from various sources. These sources are: Robison (1984, 1986); Robison and others (1988); Fenix & Scisson, Inc. (1986a, 1987c).

Well specifications

The following are specifications for well UE-25 WT #3:

1. Location and identification:

   Latitude and longitude: 36°47'57" N.; 116°24'58" W.
   Nevada State Central Zone Coordinates (m): N 227,379; E 174,768.
   U.S. Geological Survey Site ID: 364757116245801.

2. Drilling and casing information:

   Well started: April 29, 1983.
   Well completed: May 25, 1983.
   Drilling method: Rotary, using rock bits and air-foam circulating medium; bottom-hole core obtained.
   Bit diameter below water level: 222 mm.
   Casing extending below water level: None [surface casing only, to a depth of 12 m].
   Total drilled depth: 348 m.

3. Access to and description of interval for measuring water levels:

   62-mm inside-diameter tubing that has a 3.6-m long well screen on bottom, extending from land surface to a depth of 343 m; saturated interval of borehole within Bullfrog Member of Crater Flat Tuff.

4. Information for calculating water-level altitude:

   Reference point: Top of metal tag on well casing; altitude 1,030.11 m (surveyed by U.S. Geological Survey, 1984).
   Depth correction for borehole deviation from vertical: 0.27 m, based on approximate depth to water of 300 m.

History of instrumentation, calibrations, and comments

Manual water-level measurements were made from June 7, 1983 through March 22, 1985. Beginning in March 1985, the water level was monitored continuously using a downhole pressure transducer with a data logger at land surface. The transducer used in this well failed shortly after the beginning of 1989 and was not replaced. UE-25 WT #3 was then transferred to the periodic network.

The following transducer was used in well UE-25 WT #3 in 1989:

[Range is pressure limit for transducer, in pounds per square inch]

Date of use		Transducer			
Beginning	Ending	Type	Model	Range	Serial number
12-13-88	1-28-89	Gage	Druck PTX	5	3018

No calibrations were performed on transducers in this well and no transducer output was converted to water-level altitude for this well in 1989.

Transducer output in January 1989 is shown in figure 11. These data are the transducer output after first-level filtering (described in the "First-Level Filtering" section) has been applied. The transducer (serial number 3018) failed shortly after the beginning of 1989 and was not replaced. The longest period of continuous record for well UE-25 WT #3 was 769 days, November 24, 1986 through December 31, 1988.

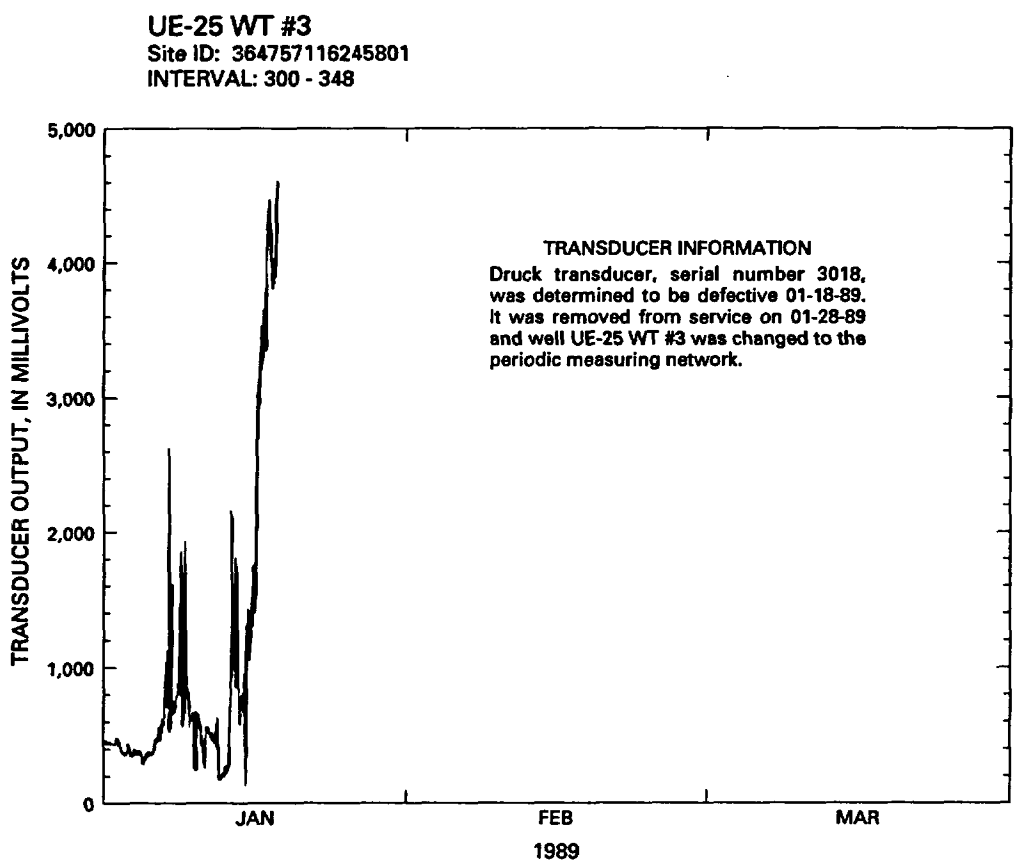


Figure 11.--Transducer output for well UE-25 WT #3.

Well UE-25 WT #6

Information about the history of well UE-25 WT #6 and about previous data from the well was obtained from various sources. These sources are: Robison (1984, 1986); Robison and others (1988); Fenix & Scisson, Inc. (1986a, 1987c).

Well specifications

The following are specifications for well UE-25 WT #6:

1. Location and identification:

   Latitude and longitude: 36°53'40" N.; 116°26'46" W.
   Nevada State Central Zone Coordinates (m): N 237,920; E 172,067.
   U.S. Geological Survey Site ID: 365340116264601.

2. Drilling and casing information:

   Well started: June 20, 1983.
   Well completed: June 29, 1983.
   Drilling method: Rotary, using rock bits and air-foam circulating medium; bottom-hole core obtained.
   Bit diameter below water level: 171 mm.
   Casing extending below water level: None [surface casing only, to a depth of 76.5 m].
   Total drilled depth: 383 m.

3. Access to and description of interval for measuring water levels:

   62-mm inside-diameter tubing that has a 3.6-m long well screen on bottom, extending from land surface to a depth of 372 m; saturated interval of borehole within tuffaceous beds of Calico Hills.

4. Information for calculating water-level altitude:

   Reference point: Top of metal tag on well casing; altitude 1,314.78 m (surveyed by U.S. Geological Survey, 1984).
   Depth correction for borehole deviation from vertical: 0.24 m, based on approximate depth to water of 280 m.

History of instrumentation, calibrations, and comments

Manual water-level measurements were made from July 6, 1983 through July 21, 1986. Beginning in July 1986, the water level has been monitored continuously using a downhole pressure transducer with a data logger at land surface. The water level rose more than 8 m in the first 2 months after drilling and continued to rise at a slower rate through December 1989. This rise was likely the result of water levels equilibrating after drilling. The period required to equilibrate could have been unusually long because of the low hydraulic conductivity of the rocks (tuffaceous beds of Calico Hills) which were penetrated below the water table.

The following transducers were used in well UE-25 WT #6 in 1989:

[Range is pressure limit for transducer, in pounds per square inch]

Date of use		Transducer			
Beginning	Ending	Type	Model	Range	Serial number
09-28-88	02-13-89	Gage	Druck 930	10	239128
02-14-89	07-31-89	Gage	Druck 930	10	240067
07-31-89	05-07-90	Gage	Druck 930	10	273129

The following calibrations of the water-level monitoring system were used to process the 1989 data from well UE-25 WT #6:

Transducer				Water level	
		Regression line			
Serial number	Calibration date	Slope (millivolts per meter)	Coefficient of determination	Date	Altitude (meters)
239128	09-28-88	-6.854	1.000	09-28-88	1,035.02
240067	02-14-89	-6.864	1.000	02-14-89	1,035.06
273129	07-31-89	-6.734	1.000	07-31-89	1,035.21
273129	10-12-89	-6.779	1.000	10-12-89	1,035.24
273129	01-31-90	-6.813	1.000	01-31-90	1,035.51

Transducer output from January through December 1989 is shown in figure 12A through 12D. These data are the transducer output after first-level filtering (described in the "First-Level Filtering" section) has been applied. The first transducer (serial number 239128) produced erratic output through mid- February 1989. The second transducer (serial number 240067) in use February through July 1989, produced reasonable output through the first part of June except for several days near the middle of May when it produced erratic output. The third transducer (serial number 273129) in use July through the end of 1989 produced reasonable output throughout that period.

UE-25 WT #6
Site ID: 365340116264601
INTERVAL: 280 - 383

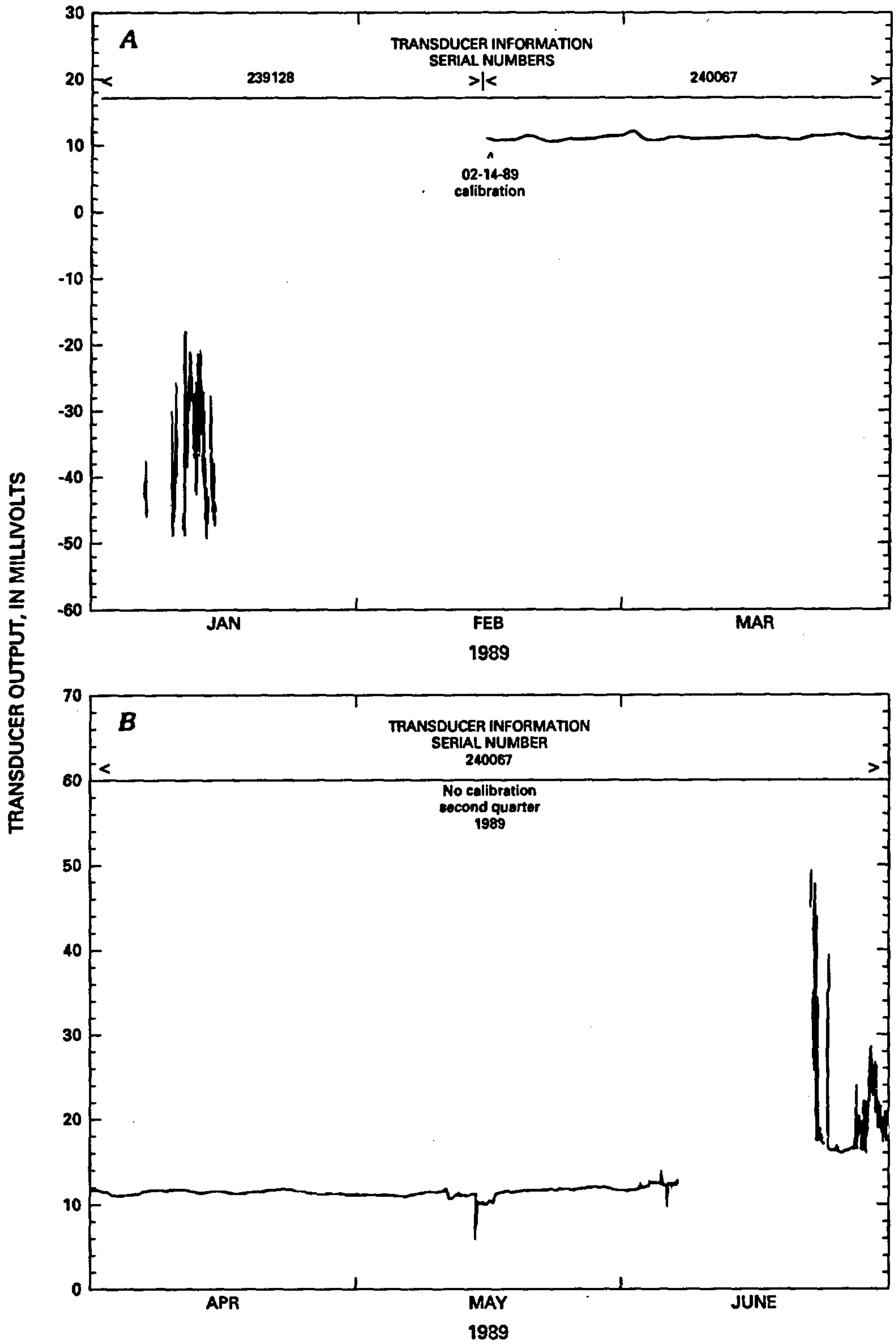


Figure 12.--Transducer output for well UE-25 WT #6.

UE-25 WT #6
Site ID: 365340116264601
INTERVAL: 280 - 383

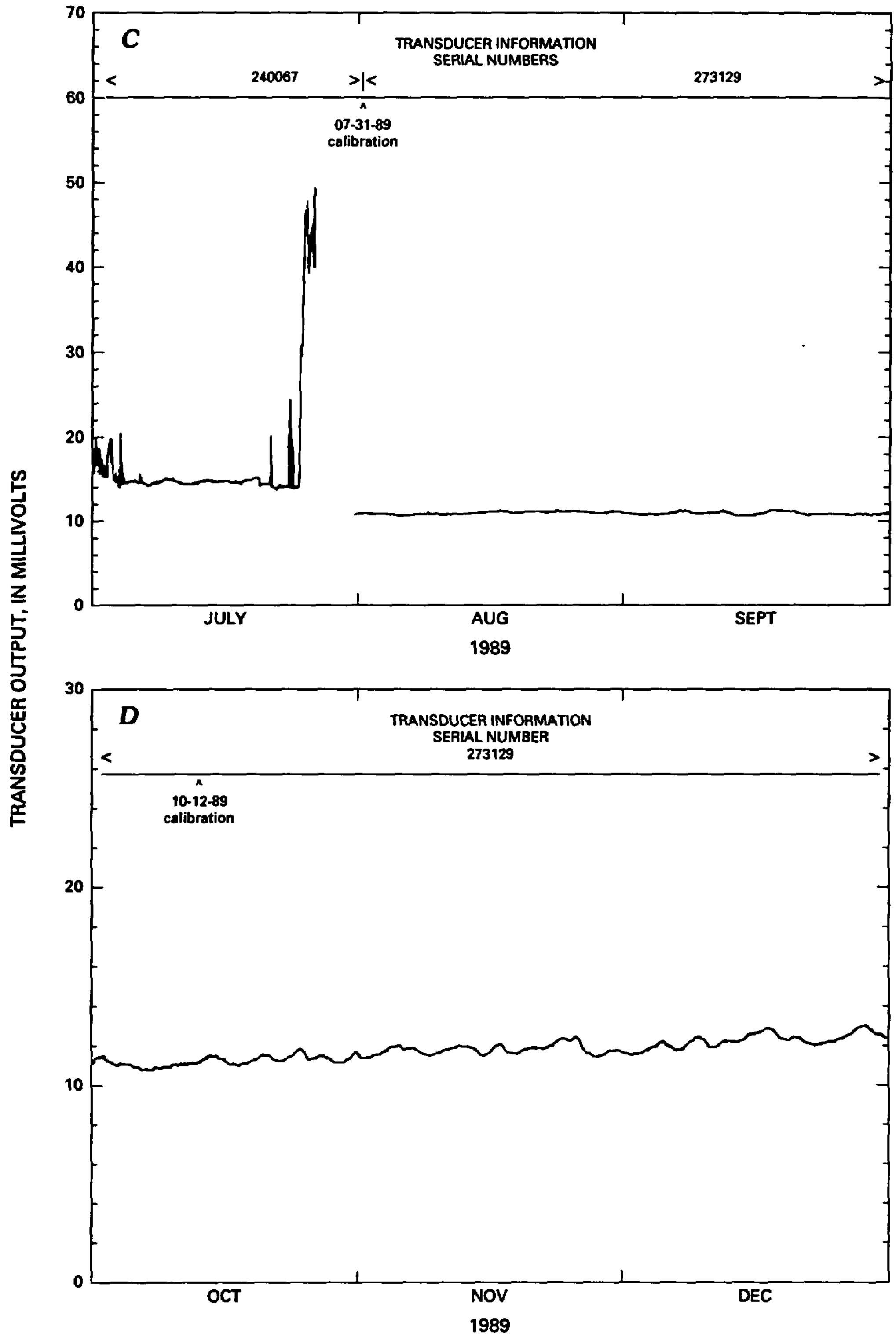


Figure 12.--Transducer output for well UE-25 WT #6.--Continued

The second transducer (serial number 240067) failed about 2 months before a measured water-level altitude and an attempted calibration. The calibration of 02-14-89 was used through 06-01-89 without any correction for drift that may have occurred during that 3 1/2 month period.

Transducer output was converted to water-level altitude for the following periods:

Beginning date	Ending date
02-15-89	05-10-89
05-18-89	06-01-89
08-01-89	12-31-89

The water-level altitudes are shown in figure 13A through 13D and the daily mean water-level altitudes are given in table 3. Approximately 70 percent of the transducer output was converted to water-level altitude. The longest period of continuous record in 1989 was 153 days, August 1 through December 31, 1989. The longest period of continuous record to date was 250 days, July 22, 1986 through March 28, 1987.

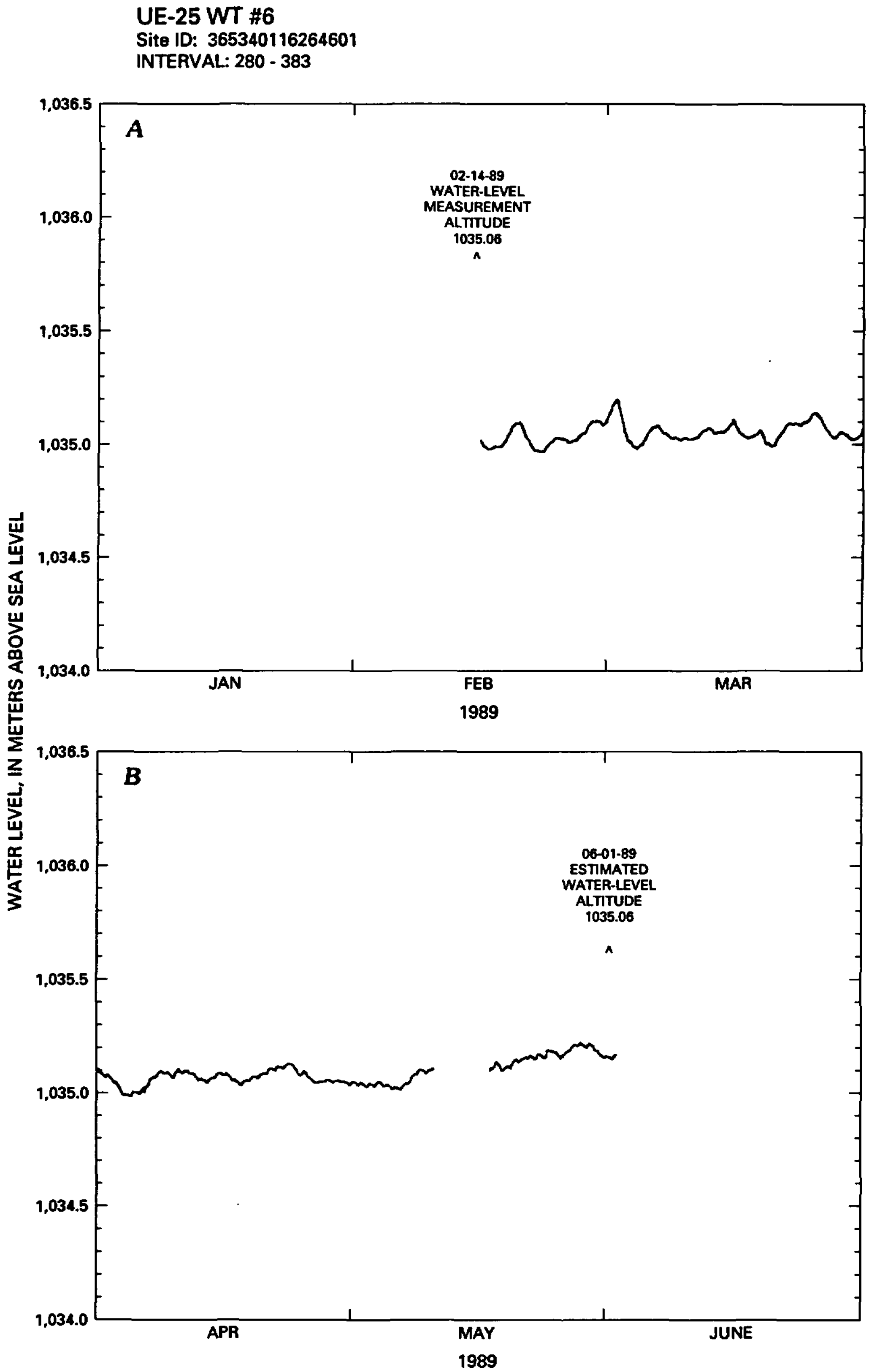


Figure 13.--Water-level altitude for well UE-25 WT #6.

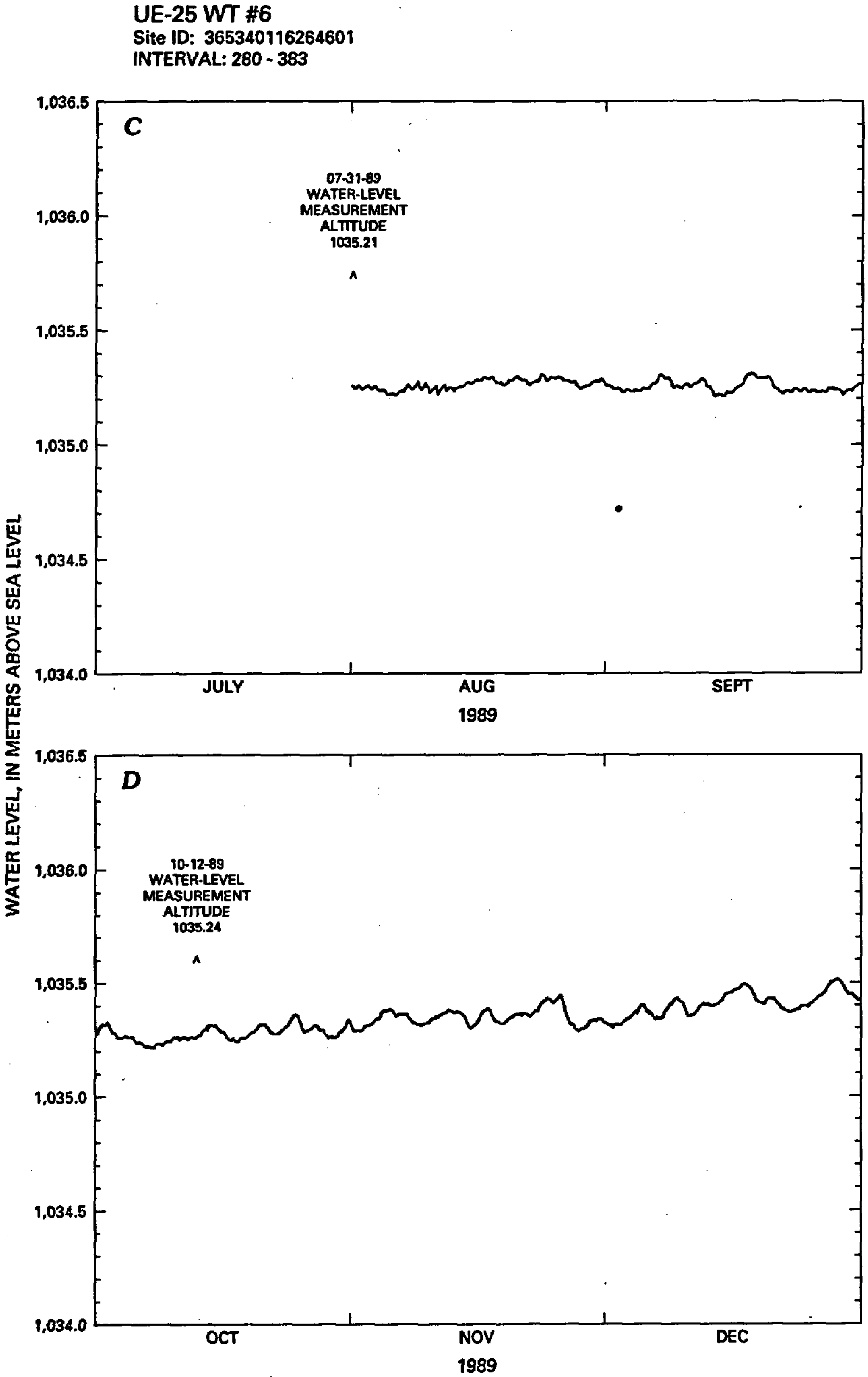


Figure 13.–Water-level altitude for well UE-25 WT #6.–Continued

Table 3. *Daily mean water-level altitude for 1989, in meters above sea level, for well UE-25 WT #6*
[Monthly mean, maximum (max), and minimum (min) computed from the daily mean values, indicated only for months that have complete data sets. Dashes indicate insufficient data to calculate daily mean water-level altitude]

Interval: 280-383 m — Site ID: 365340116264601

DAY	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
						1989						
1	—	—	1,035.09	1,035.09	1,035.04	—	—	1,035.25	1,035.24	1,035.27	1,035.29	1,035.33
2	—	—	1,035.16	1,035.07	1,035.04	—	—	1,035.25	1,035.23	1,035.31	1,035.29	1,035.31
3	—	—	1,035.14	1,035.05	1,035.03	—	—	1,035.24	1,035.23	1,035.27	1,035.31	1,035.32
4	—	—	1,035.02	1,035.00	1,035.04	—	—	1,035.23	1,035.23	1,035.25	1,035.35	1,035.35
5	—	—	1,034.99	1,034.99	1,035.04	—	—	1,035.22	1,035.24	1,035.25	1,035.38	1,035.38
6	—	—	1,035.03	1,035.00	1,035.02	—	—	1,035.22	1,035.28	1,035.23	1,035.36	1,035.38
7	—	—	1,035.08	1,035.03	1,035.02	—	—	1,035.24	1,035.29	1,035.21	1,035.36	1,035.35
8	—	—	1,035.05	1,035.07	1,035.05	—	—	1,035.25	1,035.25	1,035.21	1,035.32	1,035.36
9	—	—	1,035.03	1,035.09	1,035.09	—	—	1,035.25	1,035.25	1,035.22	1,035.31	1,035.41
10	—	—	1,035.02	1,035.08	—	—	—	1,035.24	1,035.25	1,035.24	1,035.33	1,035.42
11	—	—	1,035.02	1,035.09	—	—	—	1,035.24	1,035.27	1,035.25	1,035.35	1,035.37
12	—	—	1,035.04	1,035.08	—	—	—	1,035.24	1,035.25	1,035.25	1,035.37	1,035.38
13	—	—	1,035.07	1,035.06	—	—	—	1,035.24	1,035.22	1,035.25	1,035.37	1,035.41
14	—	—	1,035.06	1,035.05	—	—	—	1,035.26	1,035.21	1,035.29	1,035.35	1,035.41
15	—	1,034.99	1,035.06	1,035.07	—	—	—	1,035.27	1,035.23	1,035.30	1,035.31	1,035.44
16	—	1,034.99	1,035.09	1,035.08	—	—	—	1,035.28	1,035.26	1,035.28	1,035.34	1,035.47
17	—	1,035.00	1,035.05	1,035.06	—	—	—	1,035.29	1,035.30	1,035.25	1,035.38	1,035.49
18	—	1,035.05	1,035.03	1,035.04	1,035.12	—	—	1,035.27	1,035.29	1,035.24	1,035.33	1,035.49
19	—	1,035.09	1,035.05	1,035.06	1,035.11	—	—	1,035.26	1,035.29	1,035.26	1,035.32	1,035.43
20	—	1,035.03	1,035.01	1,035.07	1,035.12	—	—	1,035.28	1,035.25	1,035.28	1,035.35	1,035.42
21	—	1,034.98	1,035.01	1,035.09	1,035.14	—	—	1,035.28	1,035.22	1,035.31	1,035.36	1,035.43
22	—	1,034.98	1,035.06	1,035.10	1,035.15	—	—	1,035.26	1,035.23	1,035.28	1,035.36	1,035.39
23	—	1,035.02	1,035.09	1,035.11	1,035.16	—	—	1,035.28	1,035.23	1,035.27	1,035.38	1,035.38
24	—	1,035.03	1,035.09	1,035.12	1,035.17	—	—	1,035.28	1,035.23	1,035.31	1,035.42	1,035.40
25	—	1,035.01	1,035.11	1,035.08	1,035.18	—	—	1,035.29	1,035.23	1,035.34	1,035.42	1,035.41
26	—	1,035.03	1,035.12	1,035.07	1,035.16	—	—	1,035.28	1,035.23	1,035.29	1,035.41	1,035.43
27	—	1,035.06	1,035.07	1,035.04	1,035.19	—	—	1,035.26	1,035.24	1,035.30	1,035.32	1,035.47
28	—	1,035.10	1,035.04	1,035.05	1,035.21	—	—	1,035.24	1,035.22	1,035.29	1,035.29	1,035.52
29	—		1,035.05	1,035.05	1,035.21	—	—	1,035.26	1,035.24	1,035.26	1,035.32	1,035.50
30	—		1,035.03	1,035.05	1,035.19	—	—	1,035.27	1,035.26	1,035.26	1,035.34	1,035.46
31	—		1,035.06		1,035.16		—	1,035.26		1,035.31		1,035.44
MONTHLY												
MEAN	—	—	1,035.06	1,035.06	—	—	—	1,035.26	1,035.25	1,035.27	1,035.35	1,035.41
MAX	—	—	1,035.16	1,035.12	—	—	—	1,035.29	1,035.30	1,035.34	1,035.42	1,035.52
MIN	—	—	1,034.99	1,034.99	—	—	—	1,035.22	1,035.21	1,035.21	1,035.29	1,035.31

Well USW WT-11

Information about the history of well USW WT-11 and about previous data from the well was obtained from various sources. These sources are: Robison (1984, 1986); Robison and others (1988); Fenix & Scisson, Inc. (1986a, 1987c).

Well specifications

The following are specifications for well USW WT-11:

1. Location and identification:

   Latitude and longitude: 36°46'49" N.; 116°28'02" W.

   Nevada State Central Zone Coordinates (m): N 225,269; E 170,193.

   U.S. Geological Survey Site ID: 364649116280201.

2. Drilling and casing information:

   Well started: August 3, 1983.

   Well completed: August 9, 1983.

   Drilling method: Rotary, using rock bits and air-foam circulating medium; bottom-hole core obtained.

   Bit diameter below water level: 222 mm.

   Casing extending below water level: None [surface casing only, to a depth of 14 m].

   Total drilled depth: 441 m.

3. Access to and description of interval for measuring water levels:

   62-mm inside-diameter tubing that has a 3.6-m long well screen on bottom, extending from land surface to a depth of 416 m; saturated interval of borehole within Topopah Spring Member of Paintbrush Tuff to tuffaceous beds of Calico Hills.

4. Information for calculating water-level altitude:

   Reference point: Top of metal tag on well casing; altitude 1,094.11 m (surveyed by U.S. Geological Survey, 1984).

   Depth correction for borehole deviation from vertical: 0.12 m, based on approximate depth to water of 363 m.

History of instrumentation, calibrations, and comments

Manual water-level measurements were made from September 1, 1983, through December 13, 1985. Beginning in December 1985, the water level has been monitored continuously using a downhole pressure transducer with a data logger at land surface.

The following transducers were used in well USW WT-11 in 1989:

[Range is pressure limit for transducer, in pounds per square inch]

Date of use		Transducer			
Beginning	Ending	Type	Model	Range	Serial number
12-29-87	03-29-89	Gage	Druck PDCR 10/D	10	79567
03-29-89	11-01-90	Gage	Druck 930	10	235181

The following calibrations of the water-level monitoring system were used to process the 1989 data from well USW WT-11:

Transducer				Water level	
		Regression line			
Serial number	Calibration date	Slope (millivolts per meter)	Coefficient of determination	Date	Altitude (meters)
79567	03-29-89	-4.799	0.999	03-29-89	730.68
235181	03-29-89	-6.823	1.000	03-29-89	730.68
235181	07-26-89	-6.810	1.000	07-26-89	730.70
235181	10-18-89	-6.848	1.000	10-18-89	730.65
235181	02-02-90	-6.739	1.000	02-02-90	730.62

Transducer output from January through December 1989 is shown in figure 14A through 14D. These data are the transducer output after first-level filtering (described in the "First-Level Filtering" section) has been applied. The first transducer (serial number 79567), in use between January and March 1989, generally produced erratic output. The second transducer (serial number 235181), in use between March 1989 and November 1990, produced reasonable output in 1989 except for 2 days in May (fig. 14B), 2 days in August and 2 days in September (fig. 14C), 1 day in October (fig. 14D), and several spikes of less than 3 hours duration at other times.

Transducer output was converted to water-level altitude for the following periods:

Beginning date	Ending date
03-30-89	05-10-89
05-16-89	08-06-89
08-12-89	09-15-89
09-17-89	09-18-89
09-20-89	10-24-89
10-26-89	12-31-89

USW WT-11
Site ID: 364649116280201
INTERVAL: 363 - 441

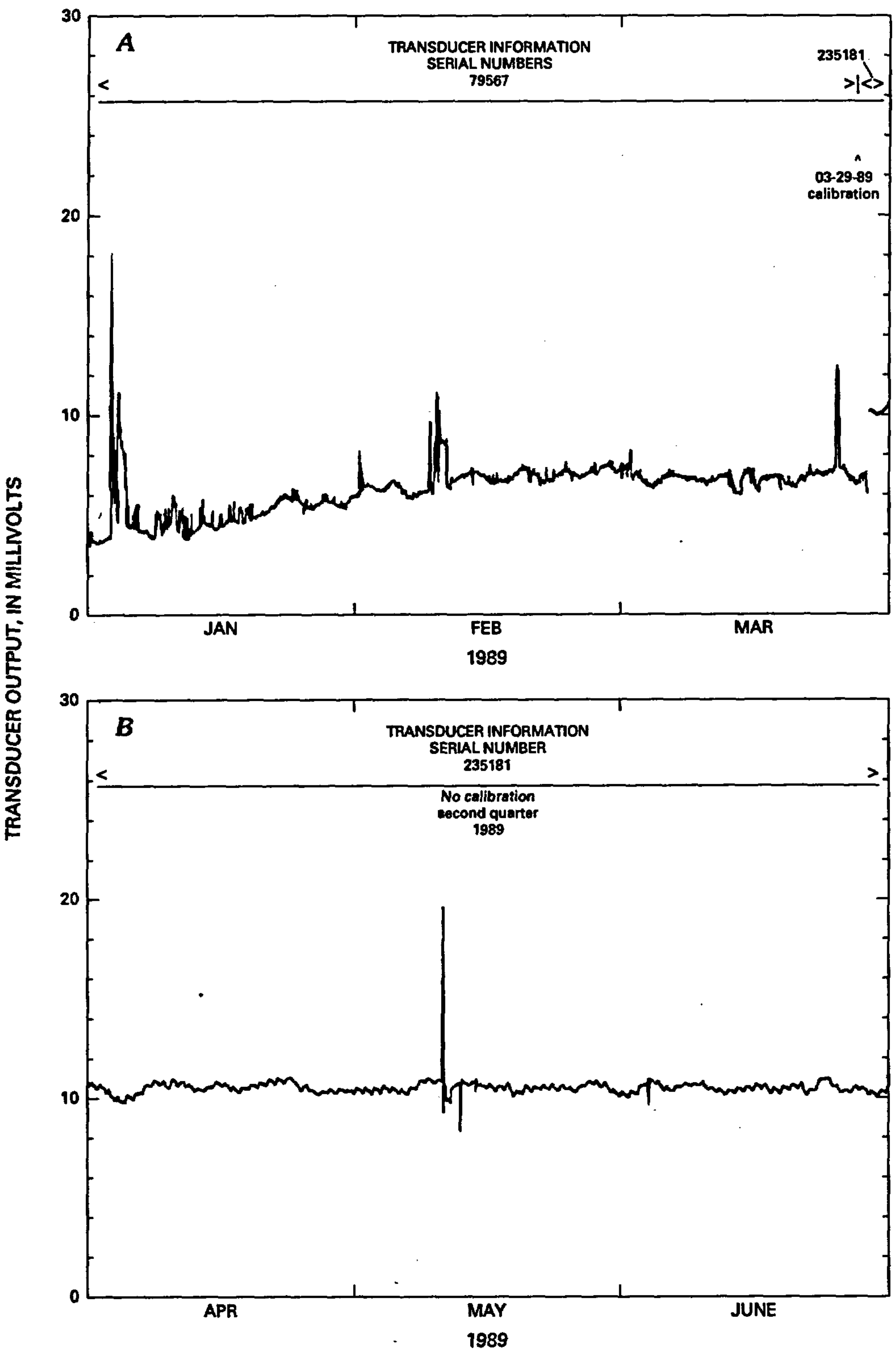


Figure 14.--Transducer output for well USW WT-11.

USW WT-11
Site ID: 364649116280201
INTERVAL: 363 - 441

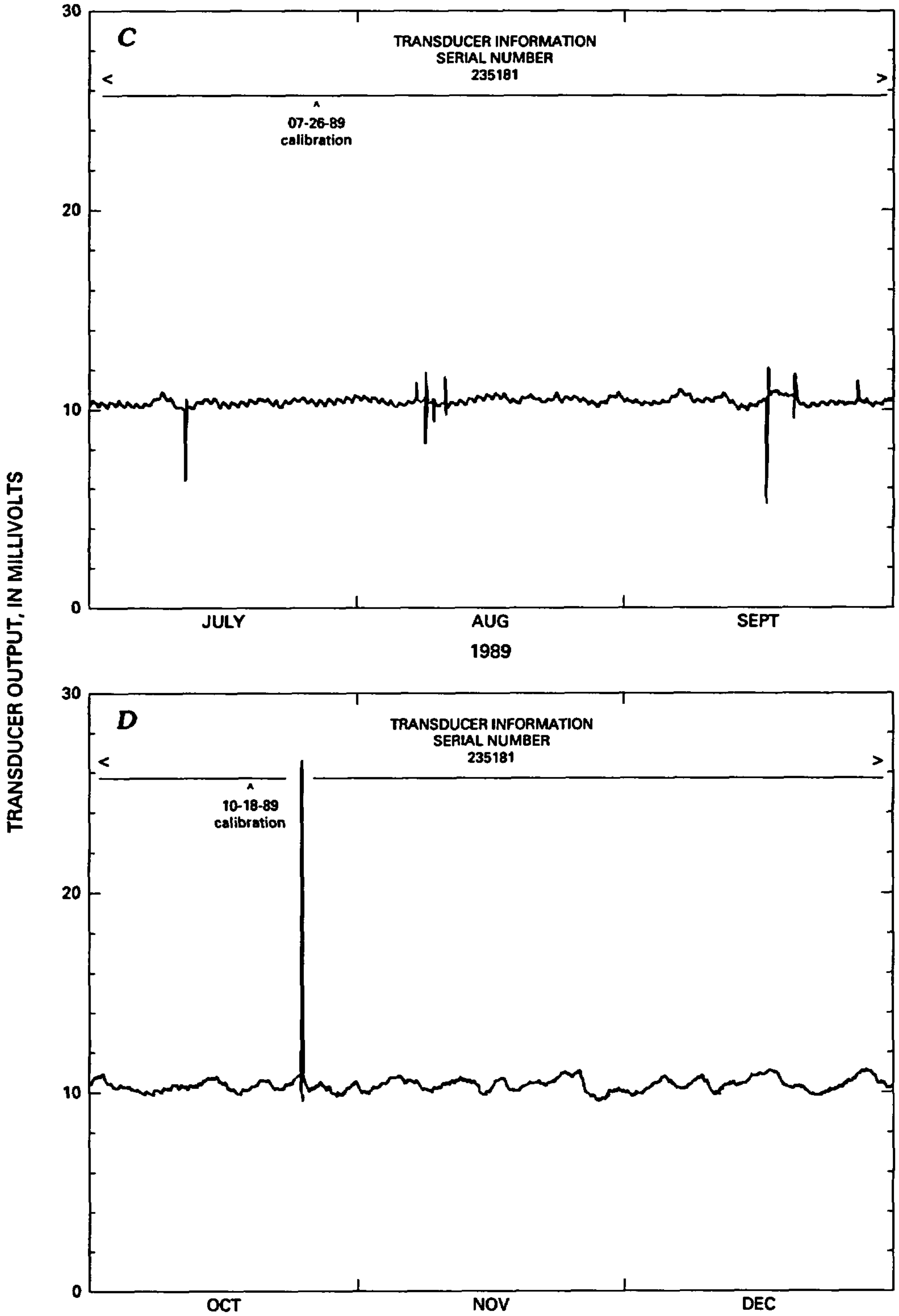


Figure 14.--Transducer output for well USW WT-11.--Continued

There were a number of spikes between June and September 1989. These spikes represent one or a few readings that deviate from the expected values. These spikes were not coincident with a site visit or any other identifiable event. These spikes probably represent a system malfunction of some type. The details of these spikes are as follows:

Date	Time	Value (millivolts)	
		Recorded	Expected
06-03-89	18:00	9.61	10.90
07-12-89	13:00	6.42	10.07
07-12-89	14:00	10.56	10.11
09-26-89	19:00	11.47	10.49

In this list, the expected value is the time weighted average of the previous and subsequent reasonable values. The spikes, if converted to water levels, would represent water-level changes in a 1-hour period of 0.06 to 0.54 m. Because of the possibility of some sort of system malfunction exists, these points were not converted to water levels.

The water-level altitudes are shown in figure 15A through 15D, and the daily mean water-level altitudes are given in table 4. Approximately 72 percent of the transducer output was converted to water-level altitude. The longest continuous record period in 1989 was 83 days, May 16, 1989 through August 6, 1989. The longest period to date was 283 days, December 30, 1987 through October 7, 1988.

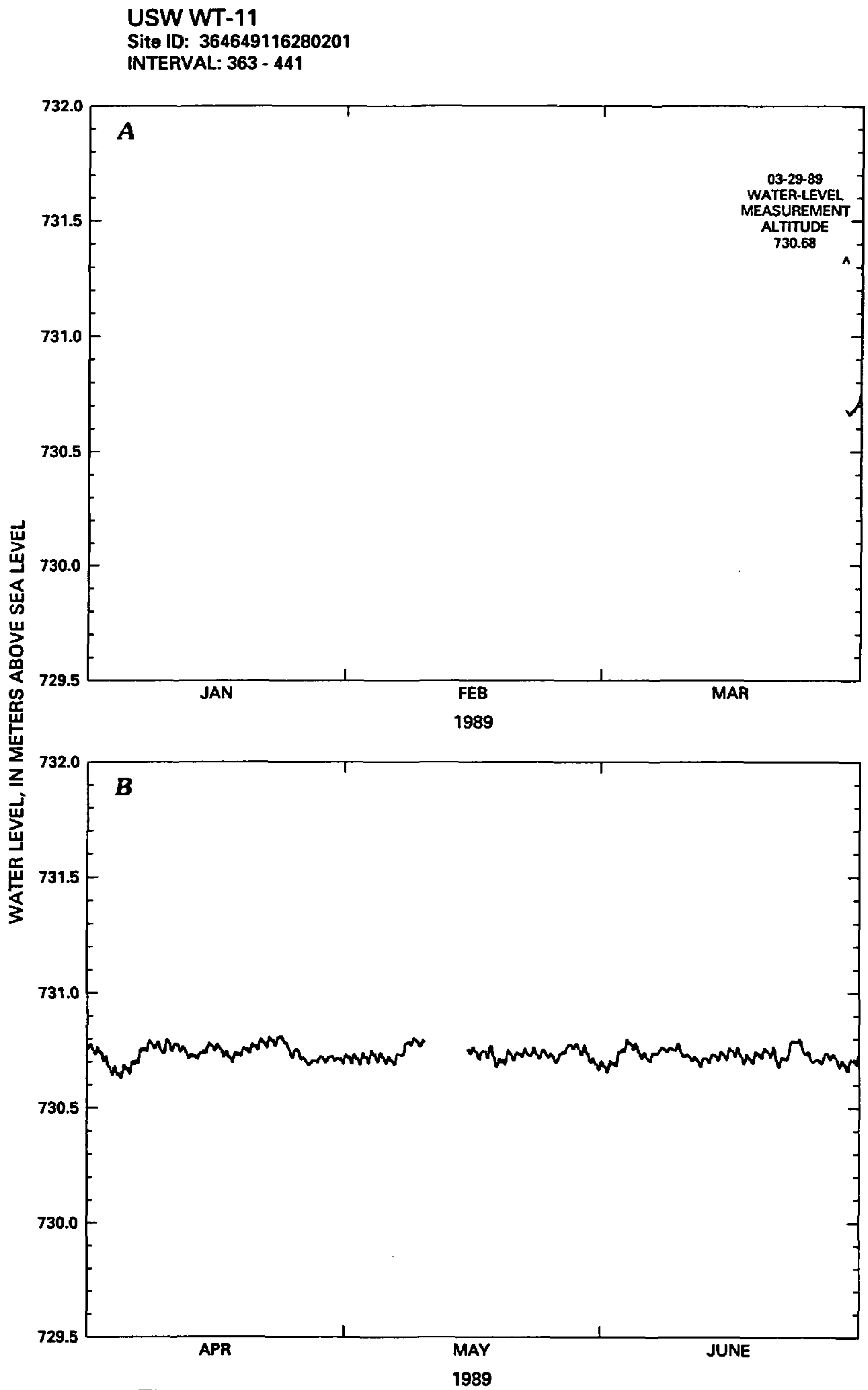


Figure 15.--Water level altitude for well USW WT-11.

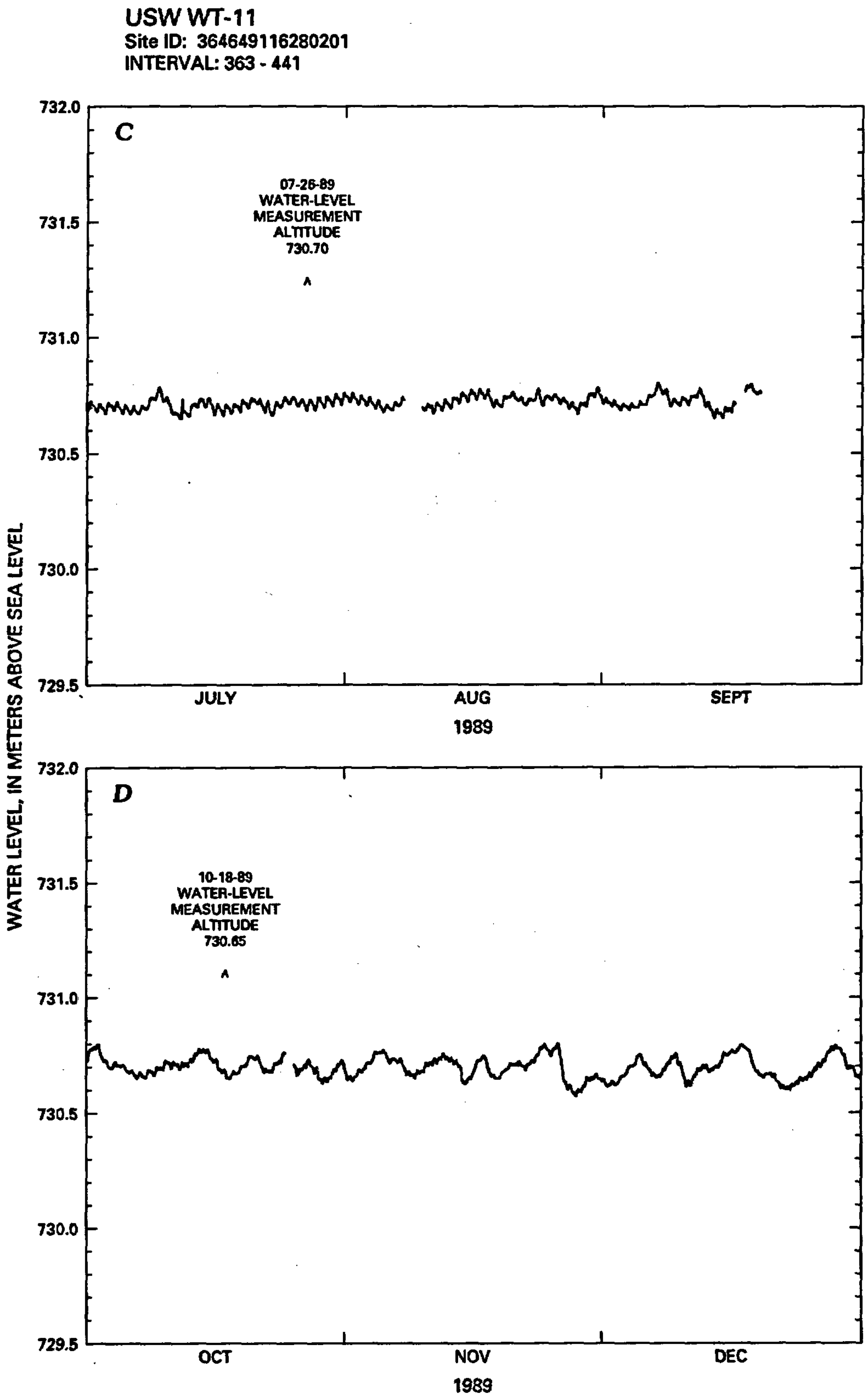


Figure 15.--Water-level altitude for well USW WT-11.--Continued

Table 4. *Daily mean water-level altitude for 1989, in meters above sea level, for well USW WT-11*
[Monthly mean, maximum (max), and minimum (min) computed from the daily mean values, indicated only for months that have complete data sets. Dashes indicate insufficient data to calculate daily mean water-level altitude]

Interval: 363-441 m — Site ID: 364649116280201

DAY	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
						1989						
1	—	—	—	730.76	730.70	730.68	730.71	730.74	730.71	730.74	730.66	730.64
2	—	—	—	730.74	730.71	730.70	730.70	730.73	730.70	730.78	730.66	730.62
3	—	—	—	730.70	730.70	730.76	730.69	730.72	730.70	730.73	730.70	730.64
4	—	—	—	730.65	730.71	730.76	730.70	730.71	730.70	730.70	730.74	730.68
5	—	—	—	730.64	730.71	730.72	730.69	730.69	730.72	730.70	730.76	730.72
6	—	—	—	730.66	730.70	730.71	730.69	730.70	730.77	730.68	730.73	730.71
7	—	—	—	730.71	730.70	730.74	730.69	—	730.77	730.66	730.72	730.67
8	—	—	—	730.75	730.74	730.75	730.71	—	730.72	730.67	730.67	730.67
9	—	—	—	730.76	730.78	730.75	730.75	—	730.72	730.68	730.66	730.72
10	—	—	—	730.75	—	730.72	730.74	730.70	730.73	730.70	730.69	730.71
11	—	—	—	730.76	—	730.71	730.68	730.70	730.75	730.71	730.72	730.63
12	—	—	—	730.75	—	730.69	730.67	730.71	730.72	730.70	730.73	730.66
13	—	—	—	730.72	—	730.71	730.68	730.71	730.67	730.72	730.73	730.69
14	—	—	—	730.72	—	730.72	730.72	730.74	730.67	730.76	730.70	730.69
15	—	—	—	730.75	—	730.73	730.72	730.75	—	730.76	730.64	730.73
16	—	—	—	730.75	730.74	730.74	730.69	730.75	—	730.72	730.69	730.76
17	—	—	—	730.73	730.72	730.71	730.69	730.75	730.78	730.68	730.73	730.78
18	—	—	—	730.71	730.73	730.71	730.69	730.72	—	730.66	730.66	730.76
19	—	—	—	730.73	730.69	730.73	730.70	730.72	—	730.68	730.66	730.68
20	—	—	—	730.75	730.71	730.74	730.71	730.75	730.70	730.72	730.70	730.66
21	—	—	—	730.76	730.72	730.70	730.72	730.73	730.68	730.73	730.71	730.66
22	—	—	—	730.77	730.73	730.73	730.70	730.72	730.69	730.69	730.70	730.61
23	—	—	—	730.78	730.73	730.79	730.69	730.75	730.70	730.69	730.73	730.61
24	—	—	—	730.78	730.72	730.74	730.72	730.73	730.70	—	730.78	730.63
25	—	—	—	730.73	730.72	730.70	730.73	730.74	730.70	—	730.76	730.65
26	—	—	—	730.71	730.71	730.71	730.72	730.73	730.71	730.68	730.73	730.69
27	—	—	—	730.69	730.75	730.72	730.71	730.71	730.71	730.70	730.61	730.73
28	—	—	—	730.70	730.76	730.69	730.71	730.70	730.70	730.68	730.58	730.78
29	—		—	730.70	730.74	730.68	730.72	730.73	730.71	730.64	730.62	730.75
30	—		730.67	730.71	730.70	730.71	730.73	730.76	730.73	730.66	730.65	730.69
31	—		730.72		730.68		730.73	730.73		730.71		730.66
MONTHLY												
MEAN	—	—	—	730.73	—	730.72	730.71	—	—	—	730.69	730.69
MAX	—	—	—	730.78	—	730.79	730.75	—	—	—	730.78	730.78
MIN	—	—	—	730.64	—	730.68	730.67	—	—	—	730.58	730.61

Well UE-25 WT #13

Information about the history of well UE-25 WT #13 and about previous data from the well was obtained from various sources. These sources are: Robison (1984, 1986); Robison and others (1988); Fenix & Scisson, Inc. (1986a, 1987c).

Well specifications

The following are specifications for well UE-25 WT #13:

1. Location and identification:

   Latitude and longitude: 36°49'43" N.; 116°23'51" W.

   Nevada State Central Zone Coordinates (m): N 230,647; E 176,405.

   U.S. Geological Survey Site ID: 364945116235001.

2. Drilling and casing information:

   Well started: June 29, 1983.

   Well completed: July 7, 1983.

   Drilling method: Rotary, using rock bits and air-foam circulating medium; bottom-hole core obtained.

   Bit diameter below water level: 222 mm.

   Casing extending below water level: None [surface casing only, to a depth of 68 m].

   Total drilled depth: 354 m.

3. Access to and description of interval for measuring water levels:

   62-mm inside-diameter tubing that has a 3.6-m long well screen on bottom, extending from land surface to a depth of 346 m; saturated interval of borehole within Topopah Spring Member of Paintbrush Tuff.

4. Information for calculating water-level altitude:

   Reference point: Top of metal tag on well casing; altitude 1,032.51 m (surveyed by U.S. Geological Survey, 1984).

   Depth correction for borehole deviation from vertical: 0.01 m, based on approximate depth to water of 304 m.

History of instrumentation, calibrations, and comments

Manual water-level measurements were made from July 8, 1983 through February 12, 1985. Beginning in February 1985, the water level has been monitored continuously using a downhole pressure transducer with a data logger at land surface.

The following transducers were used in well UE-25 WT #13 in 1989:

[Range is pressure limit for transducer, in pounds per square inch]

Date of use		Transducer			
Beginning	Ending	Type	Model	Range	Serial number
08-05-88	06-07-89	Gage	Druck 930	10	237110
06-07-89	11-02-89	Gage	Druck 930	10	270335
11-02-89	12-31-90[1]	Gage	Druck 930	10	273130

[1]Still in use as of December 31, 1990.

The following calibrations of the water-level monitoring system were used to process the 1989 data from well UE-25 WT #13:

Transducer				Water level	
		Regression line			
Serial number	Calibration date	Slope (millivolts per meter)	Coefficient of determination	Date	Altitude (meters)
237110	08-05-88	–6.972	1.000	08-05-88	728.98
237110	01-31-89	–6.989	1.000	01-31-89	729.04
270335	06-07-89	–6.817	0.999	06-07-89	729.21
270335	10-03-89	–6.761	0.999	10-03-89	729.18
270335	11-02-89	–7.809	0.995	11-02-89	729.14
273130	11-02-89	6.872[1]	1.000	11-02-89	729.14
273130	02-12-90	–6.688	1.000	02-12-90	729.28

[1]Calibration while running transducer into well; this accounts for the number being positive.

Transducer output from January through December 1989 is shown in figure 16A through 16D. These data are the transducer output after first-level filtering (described in the "First-Level Filtering" section) has been applied. The first transducer (serial number 237110) in use from January to June 1989 produced reasonable output until late April when the output began to drift upward and became erratic (fig. 16B). The second transducer (serial number 270335) in use from June through November 1989 produced reasonable output for about a month but produced anomalous output from July (fig. 16C) until it was replaced in November 1989. The third transducer (serial number 273130) produced reasonable output from November through December 1989 (fig. 16D) and was still in use December 31, 1990.

The first transducer (serial number 237110) failed after 04-17-89 so there was no ending measurement or calibration. The calibration of 01-31-89 was used through 04-17-89 without correcting for drift in the transducer output.

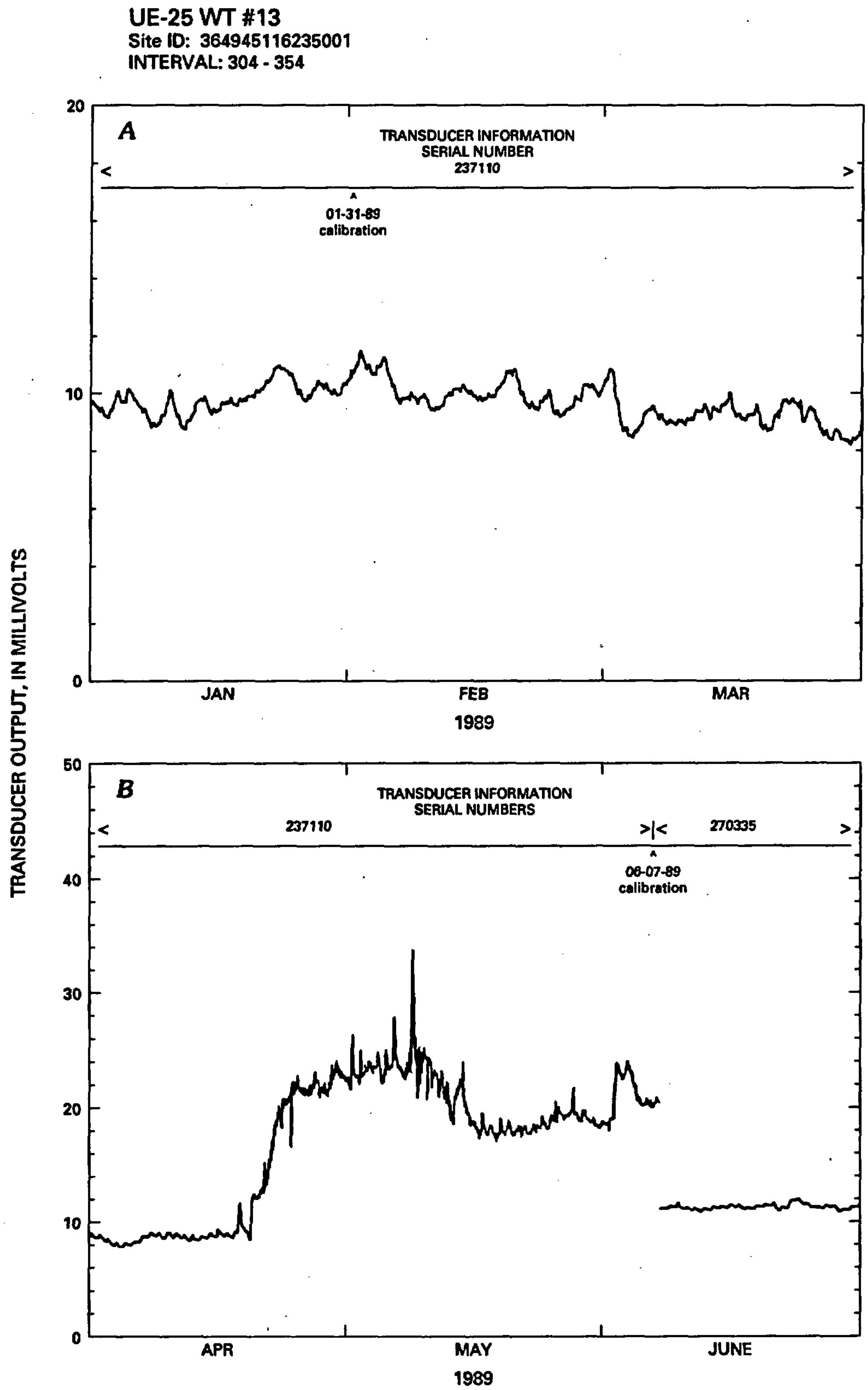


Figure 16.--Transducer output for well UE-25 WT #13.

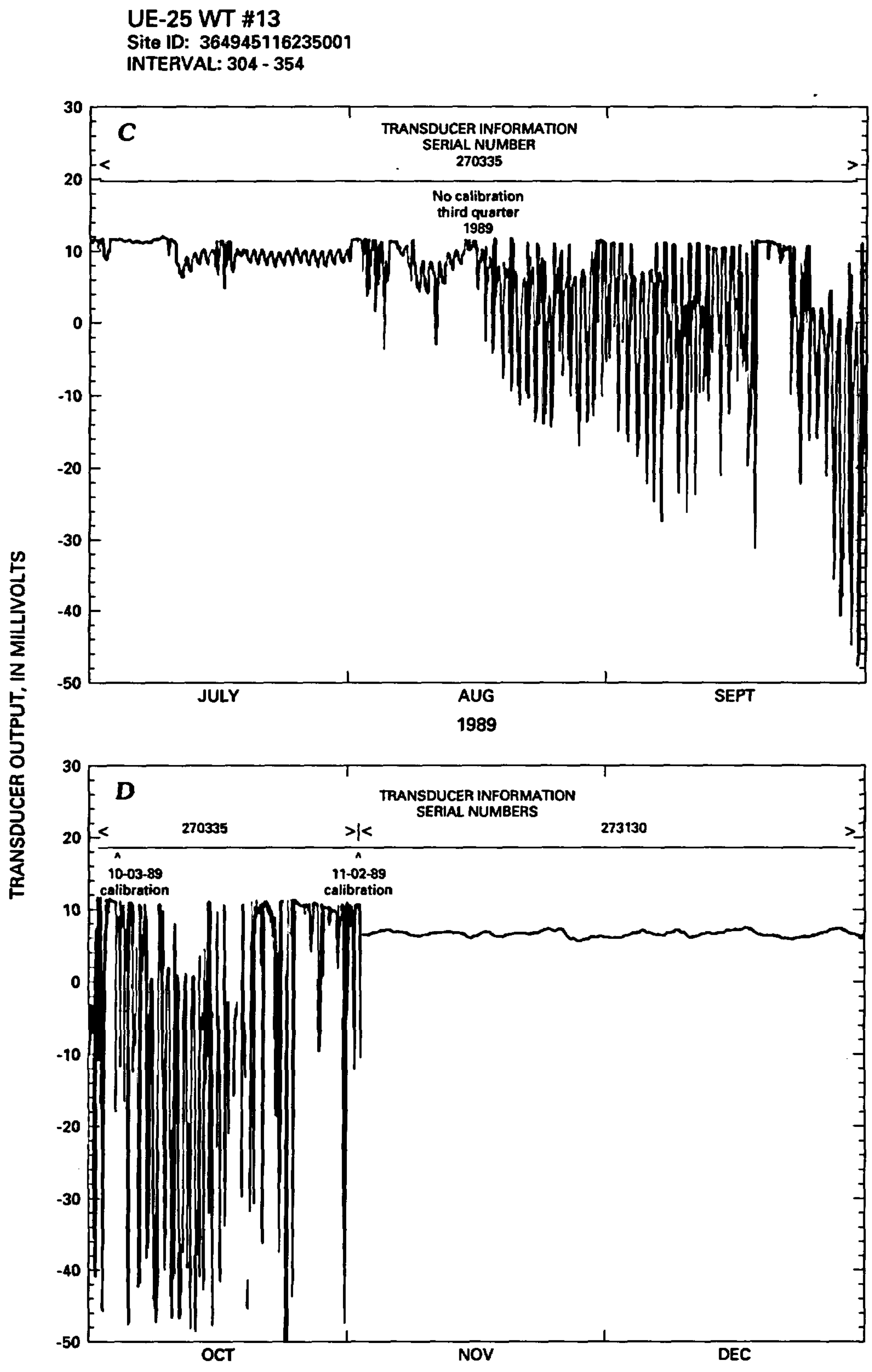


Figure 16.--Transducer output for well UE-25 WT #13.--Continued

Transducer output was converted to water-level altitude for the following periods:

Beginning date	Ending date
01-01-89	04-17-89
06-08-89	06-30-89
11-03-89	12-31-89

The water-level altitudes are shown in figure 17A through 17C, and the daily mean water-level altitudes are given in table 5. Approximately 52 percent of the transducer output was converted to water-level altitude. The longest period of continuous record was 427 days, February 12, 1985 through April 14, 1986. The longest period in 1989 was 107 days, January 1, 1989 through April 17, 1989.

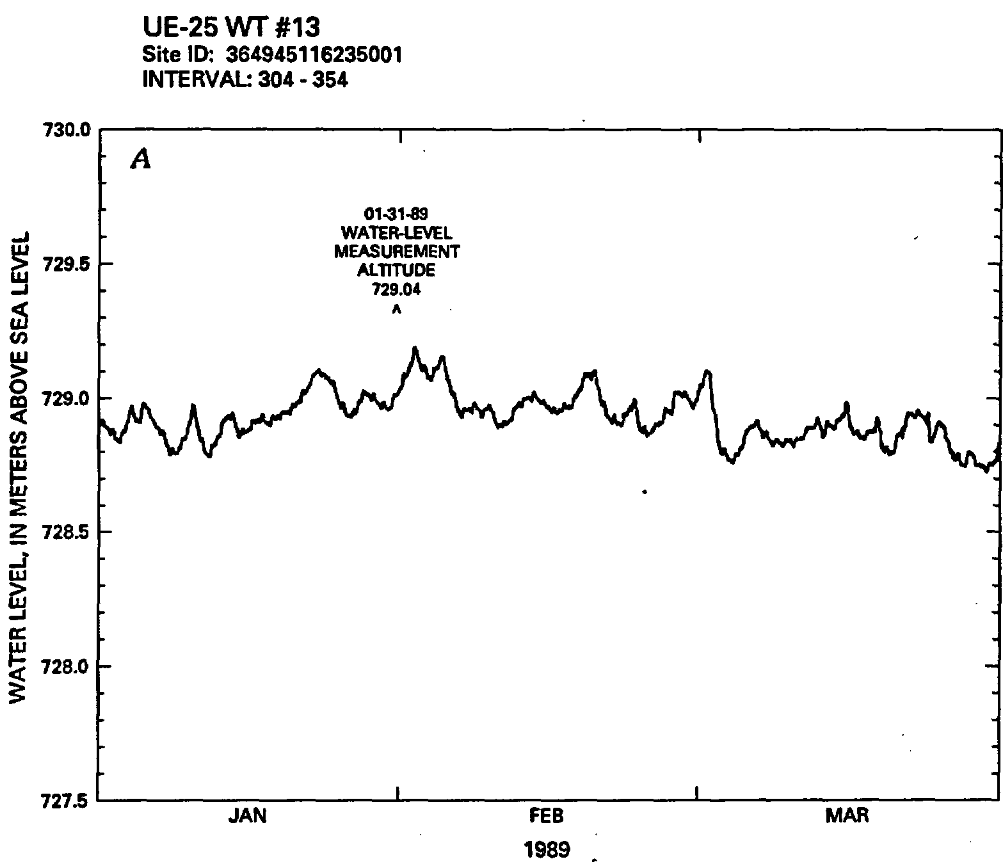


Figure 17.--Water-level altitude for well UE-25 WT #13.

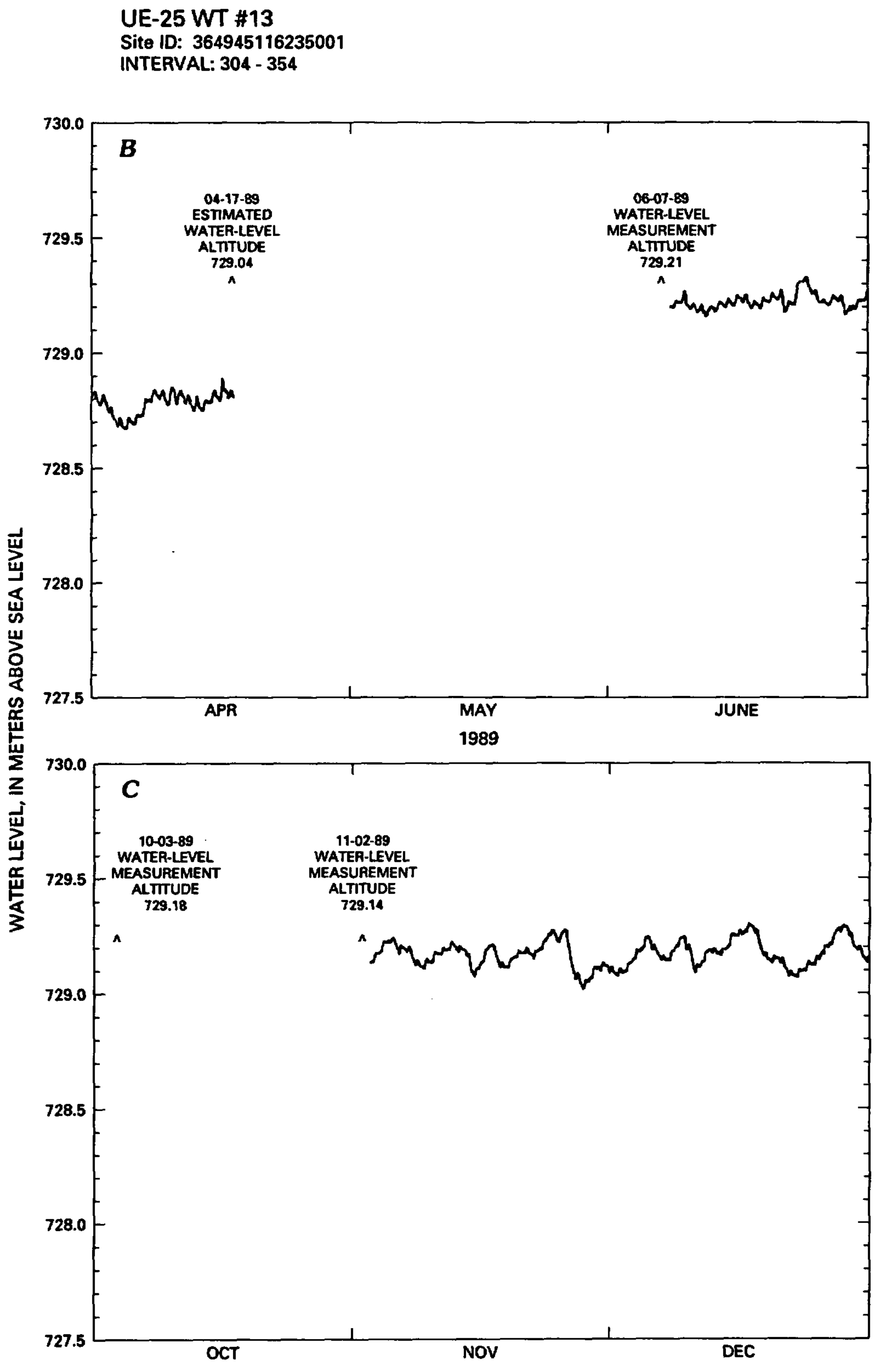


Figure 17.--Water-level altitude for well UE-25 WT #13.--Continued

Table 5. *Daily mean water-level altitude for 1989, in meters above sea level, for well UE-25 WT #13*
[Monthly mean, maximum (max), and minimum (min) computed from the daily mean values, indicated only for months that have complete data sets. Dashes indicate insufficient data to calculate daily mean water-level altitude]

Interval: 304-354 m Site ID: 364945116235001

DAY	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
						1989						
1	728.90	729.14	728.98	728.82	—	—	—	—	—	—	—	729.10
2	728.87	729.11	729.06	728.79	—	—	—	—	—	—	—	729.09
3	728.85	729.09	728.96	728.75	—	—	—	—	—	—	729.15	729.11
4	728.93	729.12	728.80	728.69	—	—	—	—	—	—	729.20	729.16
5	728.94	729.01	728.77	728.69	—	—	—	—	—	—	729.22	729.21
6	728.92	728.94	728.84	728.71	—	—	—	—	—	—	729.19	729.20
7	728.87	728.96	728.89	728.76	—	—	—	—	—	—	729.18	729.15
8	728.80	728.95	728.86	728.81	—	729.20	—	—	—	—	729.13	729.16
9	728.82	728.93	728.83	728.81	—	729.22	—	—	—	—	729.12	729.21
10	728.92	728.90	728.83	728.81	—	729.19	—	—	—	—	729.15	729.20
11	728.84	728.93	728.83	728.81	—	729.18	—	—	—	—	729.18	729.11
12	728.80	728.98	728.86	728.79	—	729.18	—	—	—	—	729.20	729.15
13	728.88	729.00	728.90	728.77	—	729.19	—	—	—	—	729.19	729.18
14	728.92	728.98	728.88	728.77	—	729.21	—	—	—	—	729.15	729.17
15	728.87	728.95	728.90	728.80	—	729.22	—	—	—	—	729.09	729.22
16	728.89	728.96	728.94	728.82	—	729.23	—	—	—	—	729.16	729.25
17	728.92	728.98	728.87	—	—	729.20	—	—	—	—	729.19	729.27
18	728.91	729.05	728.86	—	—	729.21	—	—	—	—	729.12	729.25
19	728.93	729.07	728.88	—	—	729.23	—	—	—	—	729.12	729.16
20	728.95	728.98	728.81	—	—	729.24	—	—	—	—	729.16	729.14
21	729.00	728.91	728.82	—	—	729.20	—	—	—	—	729.17	729.13
22	729.06	728.92	728.90	—	—	729.25	—	—	—	—	729.16	729.08
23	729.08	728.96	728.94	—	—	729.31	—	—	—	—	729.20	729.08
24	729.05	728.88	728.91	—	—	729.26	—	—	—	—	729.25	729.11
25	728.97	728.88	728.88	—	—	729.22	—	—	—	—	729.24	729.13
26	728.94	728.93	728.85	—	—	729.22	—	—	—	—	729.20	729.18
27	728.99	728.98	728.78	—	—	729.23	—	—	—	—	729.07	729.23
28	729.00	729.01	728.77	—	—	729.18	—	—	—	—	729.04	729.28
29	728.97		728.76	—	—	729.20	—	—	—	—	729.08	729.25
30	728.98		728.74	—	—	—	—	—	—	—	729.11	729.18
31	729.05		728.79		—		—	—		—		729.15
MONTHLY												
MEAN	728.93	728.98	728.86	—	—	—	—	—	—	—	—	729.17
MAX	729.08	729.14	729.06	—	—	—	—	—	—	—	—	729.28
MIN	728.80	728.88	728.74	—	—	—	—	—	—	—	—	729.08

Well UE-25 WT #16

Information about the history of well UE-25 WT #16 and about previous data from the well was obtained from various sources. These sources are: Robison (1984, 1986); Robison and others (1988); Fenix & Scisson, Inc. (1986a, 1987c).

Well specifications

The following are specifications for well UE-25 WT #16:

1. Location and identification:

   Latitude and longitude: 36°52'39" N.; 116°25'34" W.

   Nevada State Central Zone Coordinates (m): N 236,043; E 173,856.

   U.S. Geological Survey Site ID: 365239116253401.

2. Drilling and casing information:

   Well started: November 2, 1983.

   Well completed: November 10, 1983.

   Drilling method: Rotary, using rock bits and air-foam circulating medium; bottom-hole core obtained.

   Bit diameter below water level: 222 mm.

   Casing extending below water level: None [surface casing only, to a depth of 31 m].

   Total drilled depth: 521 m.

3. Access to and description of interval for measuring water levels:

   62-mm inside-diameter tubing that has a 3.6-m long well screen on bottom, extending from land surface to a depth of 514 m; saturated interval of borehole within tuffaceous beds of Calico Hills.

4. Information for calculating water-level altitude:

   Reference point: Top of metal tag on well casing; altitude 1,210.63 m (surveyed by U.S. Geological Survey, 1984).

   Depth correction for borehole deviation from vertical: 0.06 m, based on approximate depth to water of 473 m.

History of instrumentation, calibrations, and comments

Manual water-level measurements were made from November 22, 1983 through August 6, 1986. Beginning in August 1986, the water level has been monitored continuously using a down-hole pressure transducer with a data logger at land surface.

The following transducers were used in well UE-25 WT #16 in 1989:

[Range is pressure limit for transducer, in pounds per square inch]

Date of use		Transducer			
Beginning	Ending	Type	Model	Range	Serial number
06-20-88	02-14-89	Gage	Druck 930	10	237105
02-15-89	12-31-90[1]	Gage	Druck 930	10	238458

[1]Still in use as of December 31, 1990.

The following calibrations of the water-level monitoring system were used to process the 1989 data from well UE-25 WT #16:

Transducer				Water level	
Serial number	Calibration date	Regression line: Slope (millivolts per meter)	Regression line: Coefficient of determination	Date	Altitude (meters)
238458	02-15-89	-6.715	1.000	02-15-89	738.33
238458	06-13-89	-6.792	1.000	06-13-89	738.36
238458	09-13-89	-6.770	1.000	09-13-89	738.37
238458	12-28-89	-6.795	1.000	12-28-89	738.35
238458	02-21-90	-6.645	0.999	02-21-90	738.27

Transducer output from January through December 1989 is shown in figure 18A through 18D. These data are the transducer output after first-level filtering (described in the "First-Level Filtering" section) has been applied. The first transducer (serial number 237105) in use in January and February 1989, produced only erratic output (fig. 18A). The second transducer (serial number 238458) in use after February 1989 produced reasonable output, except for a short period of erratic output at the end of March and the beginning of April (fig. 18A and 18B). This transducer was still in use at the end of December 1990.

Transducer output was converted to water-level altitude for the following periods:

Beginning date	Ending date
02-16-89	03-25-89
04-07-89	12-31-89

The water-level altitudes are shown in figure 19A through 19D, and the daily mean water-level altitudes are given in table 6. Approximately 84 percent of the transducer output was converted to water-level altitude. The longest period of continuous record for well UE-25 WT #16 was 269 days, April 7 through December 31, 1989.

UE-25 WT #16
Site ID: 365239116253401
INTERVAL: 473 - 521

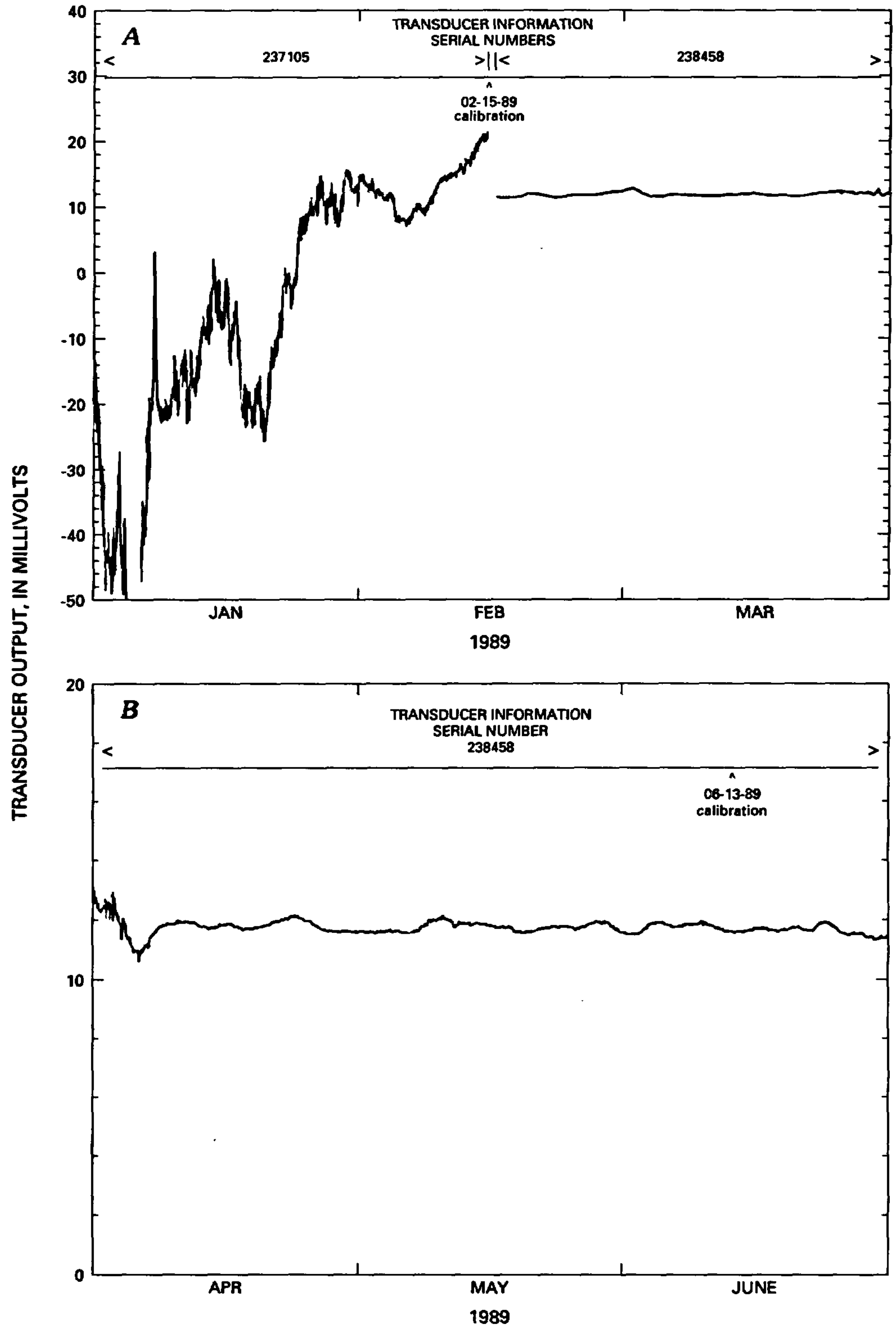


Figure 18.—Transducer output for well UE-25 WT #16.

UE-25 WT #16
Site ID: 365239116253401
INTERVAL: 473 - 521

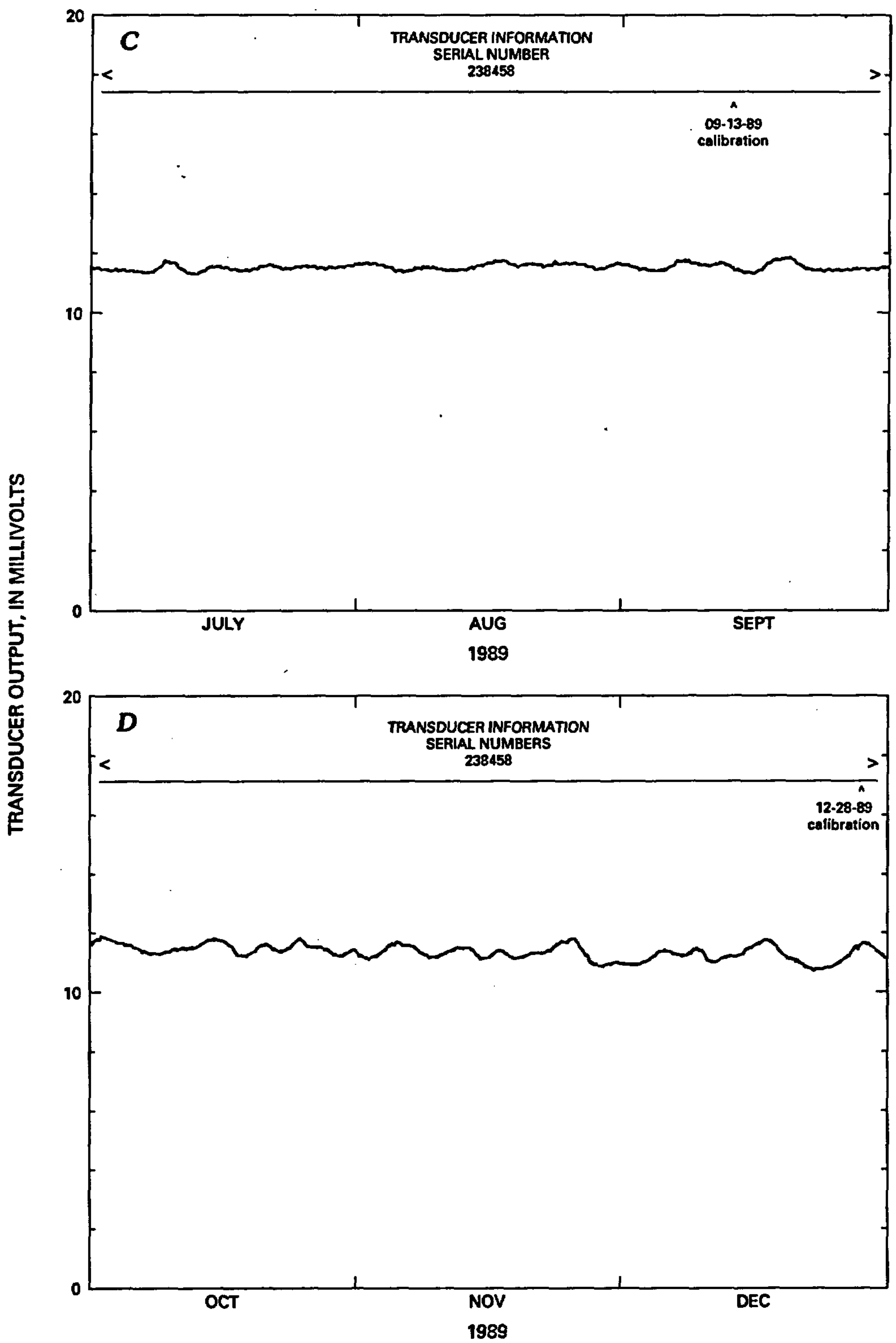


Figure 18.--Transducer output for well UE-25 WT #16.--Continued

UE-25 WT #16
Site ID: 365239116253401
INTERVAL: 473 - 521

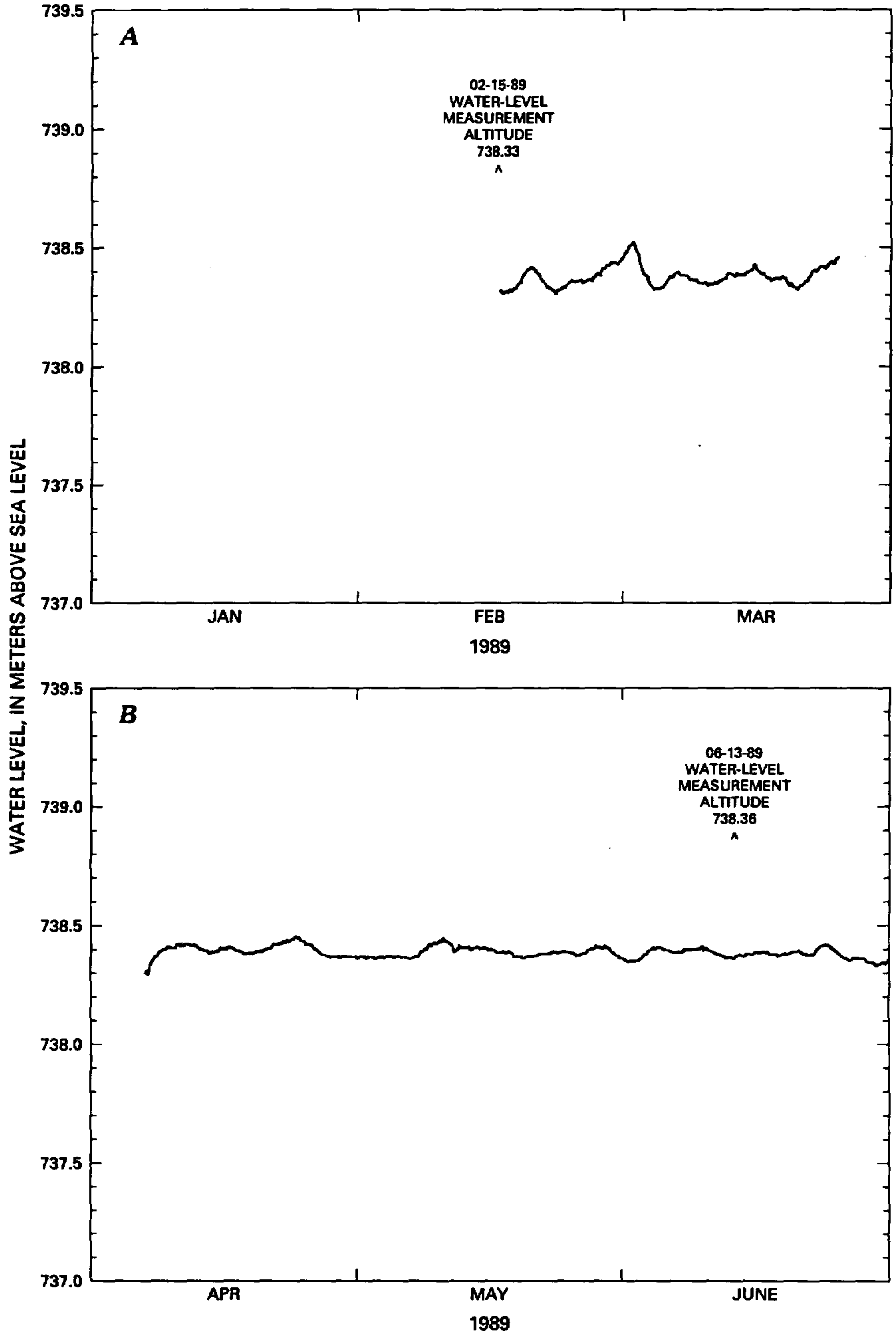


Figure 19.--Water-level altitude for well UE-25 WT #16.

UE-25 WT #16
Site ID: 365239116253401
INTERVAL: 473 - 521

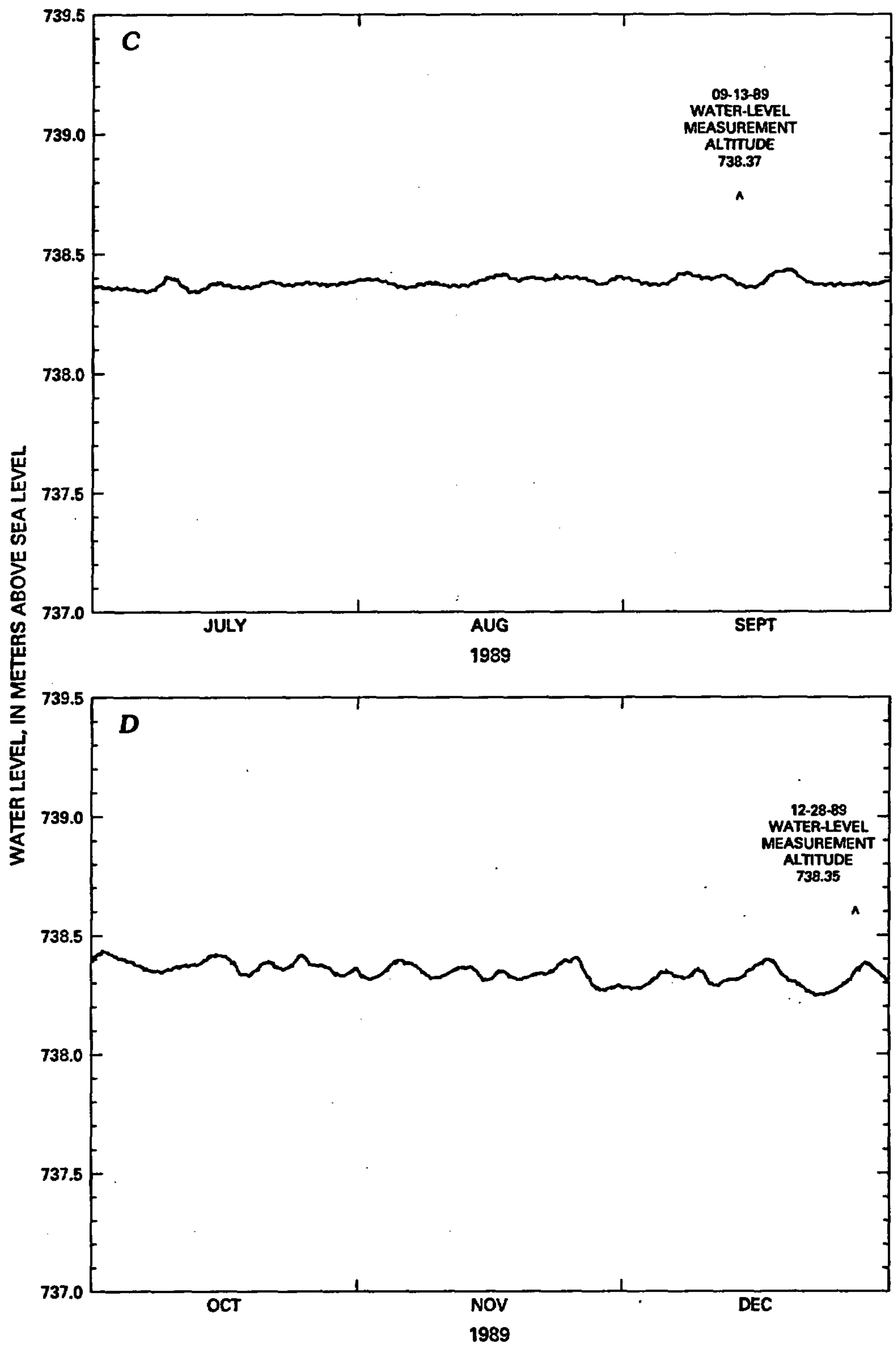


Figure 19.--Water-level altitude for well UE-25 WT #16.--Continued

Table 6. *Daily mean water-level altitude for 1989, in meters above sea level, for well UE-25 WT #16*
[Monthly mean, maximum (max), and minimum (min) computed from the daily mean values, indicated only for months that have complete data sets. Dashes indicate insufficient data to calculate daily mean water-level altitude]

Interval: 473-521 m **Site ID: 365239116253401**

DAY	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
						1989						
1	—	—	738.44	—	738.36	738.35	738.36	738.39	738.39	738.40	738.33	738.28
2	—	—	738.49	—	738.36	738.35	738.36	738.39	738.37	738.42	738.32	738.28
3	—	—	738.48	—	738.36	738.39	738.35	738.38	738.37	738.42	738.33	738.28
4	—	—	738.38	—	738.36	738.41	738.35	738.37	738.37	738.40	738.36	738.30
5	—	—	738.33	—	738.36	738.40	738.35	738.36	738.37	738.39	738.39	738.33
6	—	—	738.34	—	738.36	738.39	738.34	738.35	738.40	738.37	738.38	738.34
7	—	—	738.38	738.31	738.36	738.39	738.34	738.36	738.41	738.35	738.37	738.33
8	—	—	738.38	738.37	738.37	738.40	738.35	738.37	738.40	738.35	738.34	738.32
9	—	—	738.37	738.39	738.40	738.40	738.38	738.37	738.39	738.35	738.32	738.34
10	—	—	738.35	738.40	738.42	738.40	738.39	738.37	738.39	738.36	738.32	738.35
11	—	—	738.34	738.40	738.42	738.38	738.37	738.36	738.40	738.36	738.34	738.30
12	—	—	738.35	738.40	738.39	738.37	738.34	738.36	738.39	738.37	738.36	738.29
13	—	—	738.38	738.39	738.40	738.37	738.34	738.36	738.37	738.37	738.36	738.31
14	—	—	738.38	738.38	738.40	738.38	738.36	738.38	738.36	738.40	738.35	738.31
15	—	—	738.39	738.39	738.40	738.38	738.37	738.39	738.36	738.41	738.31	738.34
16	—	738.31	738.41	738.39	738.39	738.39	738.37	738.40	738.38	738.41	738.32	738.36
17	—	738.32	738.39	738.38	738.38	738.38	738.36	738.41	738.41	738.38	738.35	738.39
18	—	738.36	738.37	738.37	738.38	738.38	738.35	738.39	738.42	738.34	738.33	738.39
19	—	738.41	738.37	738.37	738.37	738.38	738.36	738.39	738.42	738.33	738.31	738.34
20	—	738.38	738.34	738.38	738.36	738.39	738.36	738.39	738.40	738.36	738.32	738.31
21	—	738.33	738.33	738.40	738.37	738.38	738.38	738.39	738.38	738.38	738.33	738.29
22	—	738.31	738.37	738.41	738.37	738.39	738.37	738.39	738.37	738.36	738.34	738.26
23	—	738.34	738.40	738.43	738.38	738.42	738.36	738.39	738.37	738.36	738.35	738.25
24	—	738.36	738.42	738.43	738.38	738.40	738.37	738.39	738.37	738.38	738.38	738.25
25	—	738.36	—	738.41	738.38	738.37	738.37	738.40	738.37	738.41	738.39	738.26
26	—	738.37	—	738.39	738.37	738.36	738.37	738.39	738.37	738.38	738.38	738.29
27	—	738.40	—	738.37	738.39	738.37	738.37	738.38	738.37	738.37	738.32	738.33
28	—	738.43	—	738.36	738.40	738.35	738.37	738.37	738.37	738.36	738.28	738.37
29	—		—	738.36	738.41	738.34	738.37	738.38	738.37	738.34	738.27	738.38
30	—		—	738.36	738.39	738.35	738.37	738.39	738.38	738.33	738.28	738.35
31	—		—		738.36		738.38	738.39		738.35		738.32
MONTHLY												
MEAN	—	—	—	—	738.38	738.38	738.36	738.38	738.38	738.37	738.34	738.32
MAX	—	—	—	—	738.42	738.42	738.39	738.41	738.42	738.42	738.39	738.39
MIN	—	—	—	—	738.36	738.34	738.34	738.35	738.36	738.33	738.27	738.25

Geologic, Hydrologic, and Supply Wells

A series of four geologic wells, designated with the letter G, were drilled from March 1980 to January 1983 to obtain core to define the geologic framework at Yucca Mountain. When the study of the Yucca Mountain area was initially planned, the intent was to pair a hydrologic well, designated with the letter H, with each geologic well. This was done for numbers 1, 3, and 4; however, because of drilling problems at well USW G-2, hydrologic well number 2 was never drilled. Two additional hydrologic wells (USW H-5 and USW H-6) also were drilled without a paired geologic well.

The hydrologic wells were drilled in a similar manner. All are about 1,220 m deep (except USW H-1) and were cased to below the water table. Bit diameter below the water table was generally 222 mm. The first three geologic wells were deeper than the hydrologic wells and were drilled with a smaller bit. The fourth geologic hole was shallower than the hydrologic holes; it was drilled with a 222 mm bit.

Wells UE-25b #1 and UE-25p #1 were dual-purpose wells designed to collect both geologic and hydrologic information. In configuration, UE-25b #1 is similar to the hydrologic wells and UE-25p #1 is similar to the geologic wells. The UE-25c complex consists of three wells drilled in a small cluster to develop techniques to measure hydraulic and transport characteristics of fractured rocks. They were drilled much like the hydrologic wells but were only 914 m deep. The wells are designated UE-25c #1, UE-25c #2, and UE-25c #3.

Well UE-25b #1

Information about the history of well UE-25b #1 and about previous data from the well was obtained from various sources. These sources are: Lobmeyer and others (1983); Lahoud and others (1984); Robison (1984, 1986); Robison and others (1988); Fenix & Scisson, Inc. (1986b, 1987c).

Well specifications

The following are specifications for well UE-25b #1:

1. Location and identification:

   Latitude and longitude: 36°51'08" N.; 116°26'23" W.
   Nevada State Central Zone Coordinates (m): N 233,246; E 172,644.
   U.S. Geological Survey Site ID's:
   365108116262301 (entire well)
   365108116262302 (lower interval)
   365108116262303 (upper interval)

2. Drilling and casing information:

   Well started: April 3, 1981.
   Well completed: September 22, 1981.
   Drilling method: Rotary, using rock bits and air-foam circulating medium; cores obtained in selected intervals.
   Bit diameter below water level: 311 mm to 520 m; 222 mm to 650 m; 216 mm from 650 to 1,220 m.
   Casing extending below water level: 226-mm inside diameter to 518 m; casing string is tack cemented in and perforated below the water level.
   Total drilled depth: 1,220 m.

3. Access to and description of interval for measuring water levels:

   48-mm inside diameter tubing, open ended, to depth of about 488 m; upper interval of borehole, from near water table to top of inflatable packer, within tuffaceous beds of Calico Hills, and Prow Pass, Bullfrog, and upper Tram Members of Crater Flat Tuff; Site ID: 365108116262303.
   62-mm inside diameter tubing that has an inflatable packer on bottom end, to depth of 1,199 m; lower interval of borehole from below packer to bottom of well, within lower Tram Member of Crater Flat Tuff and Lithic Ridge Tuff; Site ID: 365108116262302.

4. Information for calculating water-level altitude:

   Reference point: Top of metal tag on well casing; altitude 1,200.73 m (surveyed by U.S. Geological Survey, 1984).
   Depth correction for borehole deviation from vertical: 0.27 m, based on approximate depth to water of 470 m.

History of instrumentation, calibrations, and comments

Manual water-level measurements were made from November 10, 1981 through October 1983. Measurements made through January 21, 1983, were composite water levels of the entire saturated portion of the well. Early in 1983, an inflatable packer was installed at a depth of 1,199 m, and water levels of the intervals above and below the packer were measured separately. Beginning in October 1983, the water levels have been monitored continuously using downhole pressure transducers with a data logger at land surface. There were numerous equipment and operational difficulties, and no usable record was produced until equipment and procedures were changed in March 1985.

The following transducers were used in well UE-25b #1 in 1989:

[Range is pressure limit for transducer, in pounds per square inch]

Date of use		Transducer			
Beginning	Ending	Type	Model	Range	Serial number
		Site ID: 365108116262303			
		Interval: 470-1,199 meters			
12-02-88	02-08-89	Gage	Druck 930	10	237109
02-08-89	08-29-89	Gage	Druck 930	10	235182
08-30-89	04-06-90	Gage	Druck 930	10	270334
		Site ID: 365108116262302			
		Interval: 1,199-1,220 meters			
12-12-88	11-07-89	Gage	Druck 930	10	235180
11-07-89	06-12-90	Gage	Druck 930	5	260788

The following calibrations of the water-level monitoring system were used to process the 1989 data from well UE-25b #1:

Transducer				Water level	
		Regression line			
Serial number	Calibration date	Slope (millivolts per meter)	Coefficient of determination	Date	Altitude (meters)
		Site ID: 365108116262303			
		Interval: 470-1,199 meters			
235182	02-08-89	–6.732	1.000	02-08-89	730.63
235182	05-10-89	–6.685	0.999	05-10-89	730.74
270334	08-30-89	–6.592	1.000	08-30-89	730.73
270334	11-07-89	–6.540	1.000	11-07-89	730.73
270334	02-27-90	–6.386	1.000	02-27-90	730.71
		Site ID: 365108116262302			
		Interval: 1,199-1,220 meters			
235180	12-12-88	–6.897	1.000	12-12-88	729.71
235180	04-05-89	–6.749	1.000	04-05-89	729.66
235180	08-03-89	–6.824	1.000	08-03-89	729.69
260788	11-07-89	–17.472	1.000	11-07-89	729.82
260788	02-27-90	–17.631	1.000	02-27-90	729.82

Transducer output from January through December 1989 is shown in figure 20A through 20H. These data are the transducer output after first-level filtering (described in the "First-Level Filtering" section) has been applied. In the upper interval, the first transducer (serial number 237109), in use in January and February, produced erratic output (fig. 20A). The second transducer (serial number 235182), in use from February through August, produced reasonable output except for a short period in May (fig. 20B) and when it failed in August 1989 (fig 20C). The third transducer (serial number 270334), in use from August through December 1989, produced only anomalous output. In the lower interval, the first transducer (serial number 235180), in use from January through November 1989, produced reasonable output except for short periods in January and February (fig. 20E) until the transducer failed in September (fig. 20G). The second transducer (serial number 260788), in use November through December 1989, produced reasonable output during that time (fig. 20H).

Transducer output was converted to water-level altitude for the following periods:

Beginning date	Ending date
Site ID: 365108116262303	
Interval: 470-1,199 meters	
02-09-89	05-09-89
05-13-89	08-06-89
Site ID: 365108116262302	
Interval: 1,199-1,220 meters	
01-01-89	01-03-89
01-06-89	02-07-89
02-13-89	09-11-89
11-08-89	12-31-89

The water-level altitudes are shown in figure 21A through 21G, and the daily mean water-level altitudes are given in table 7. Approximately 48 percent of the transducer output for the upper interval was converted to water-level altitude. The longest period of continuous record for the upper interval was 158 days, June 8 through November 12, 1988. The longest period for the upper interval in 1989 was 90 days, February 9 through May 9, 1989. Approximately 82 percent of the transducer output for the lower interval was converted to water-level altitude. The longest period for the lower interval was 211 days, February 13 through September 11, 1989, longer than any previous period of continuous record.

UE-25b #1
Site ID: 365108116262303
INTERVAL: 470 - 1,199

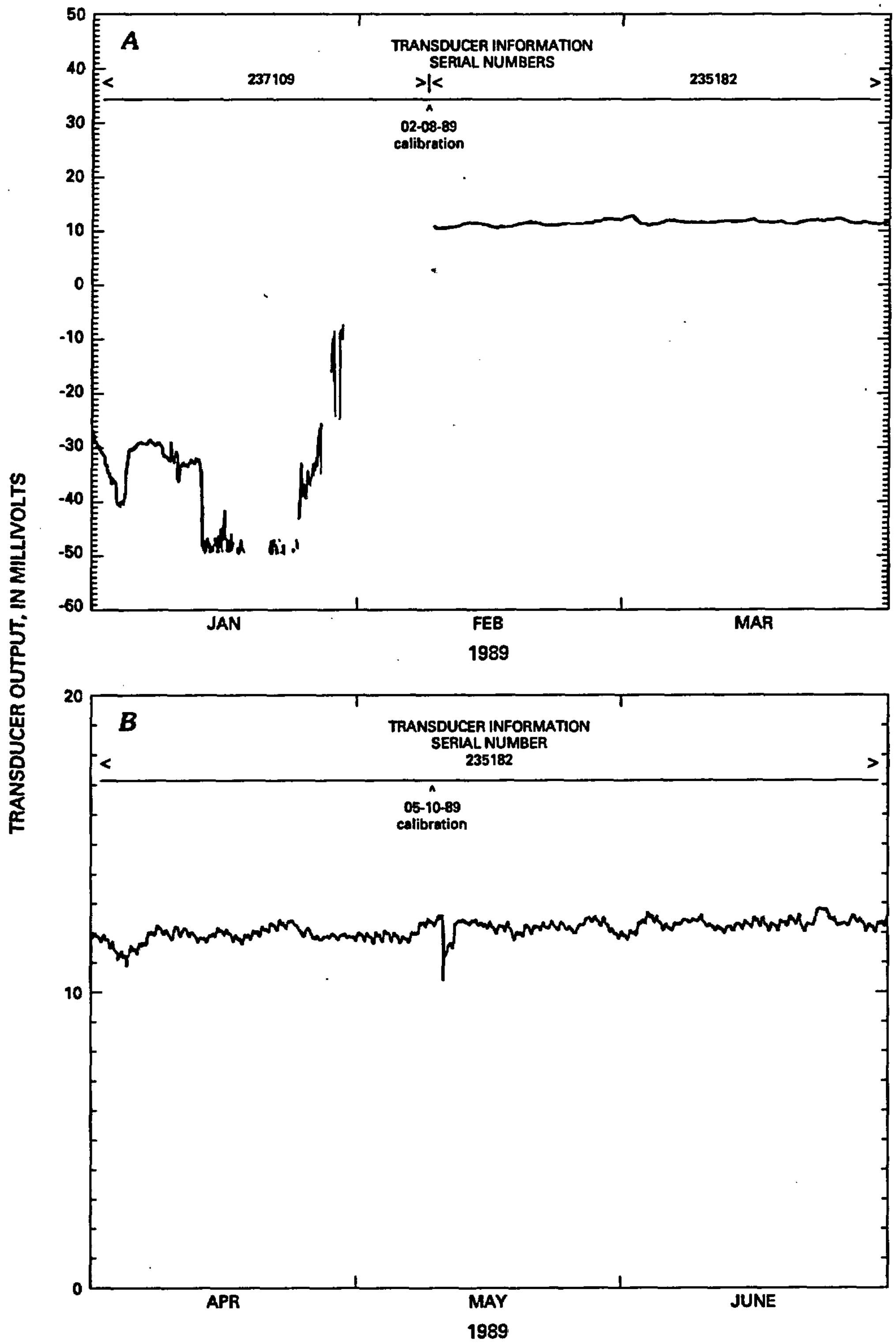


Figure 20.–Transducer output for well UE-25b #1.

UE-25b #1
Site ID: 365108116262303
INTERVAL: 470 - 1,199

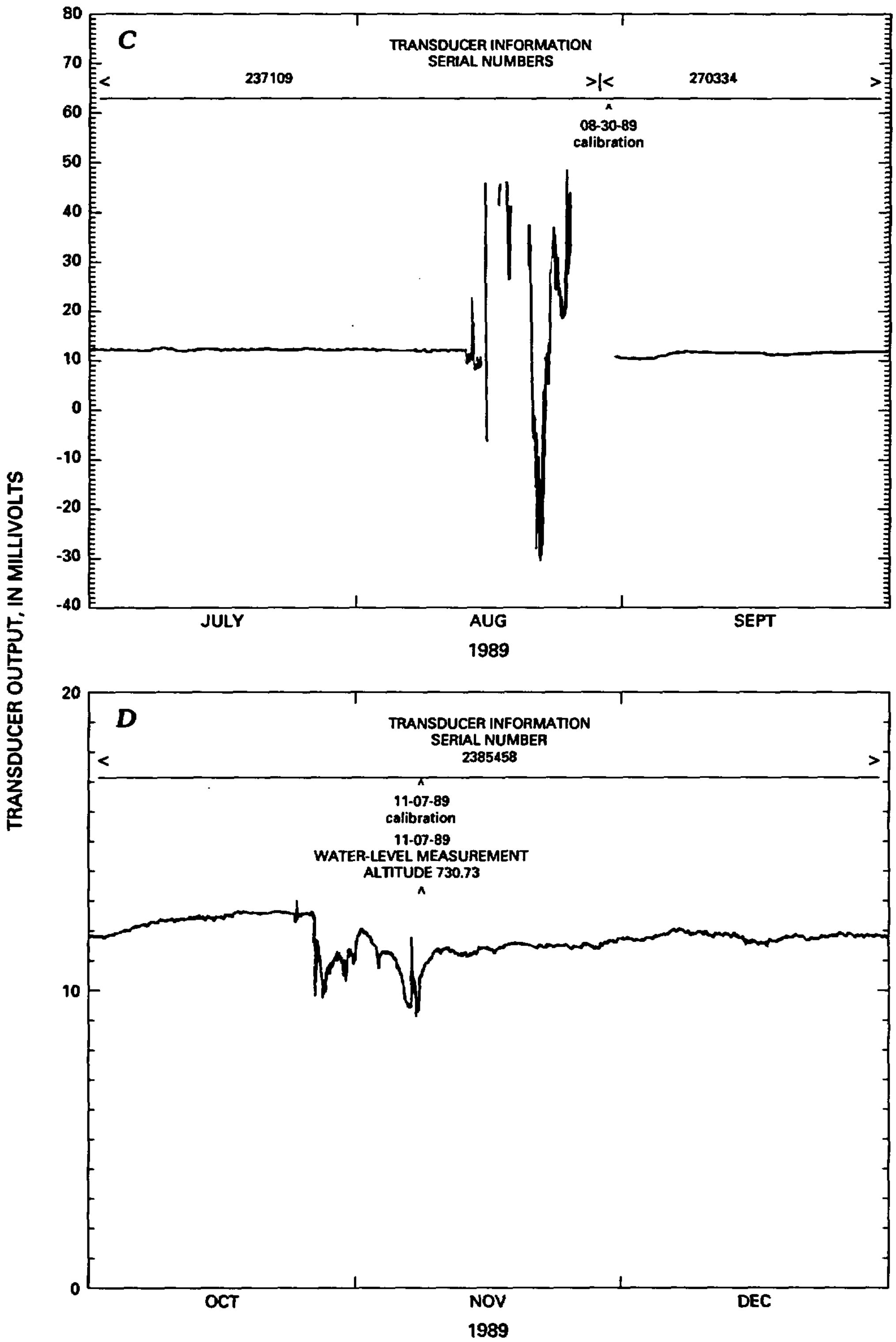


Figure 20.--Transducer output for well UE-25b #1.--Continued

UE-25b #1
Site ID: 365108116262302
INTERVAL: 1,199 - 1,220

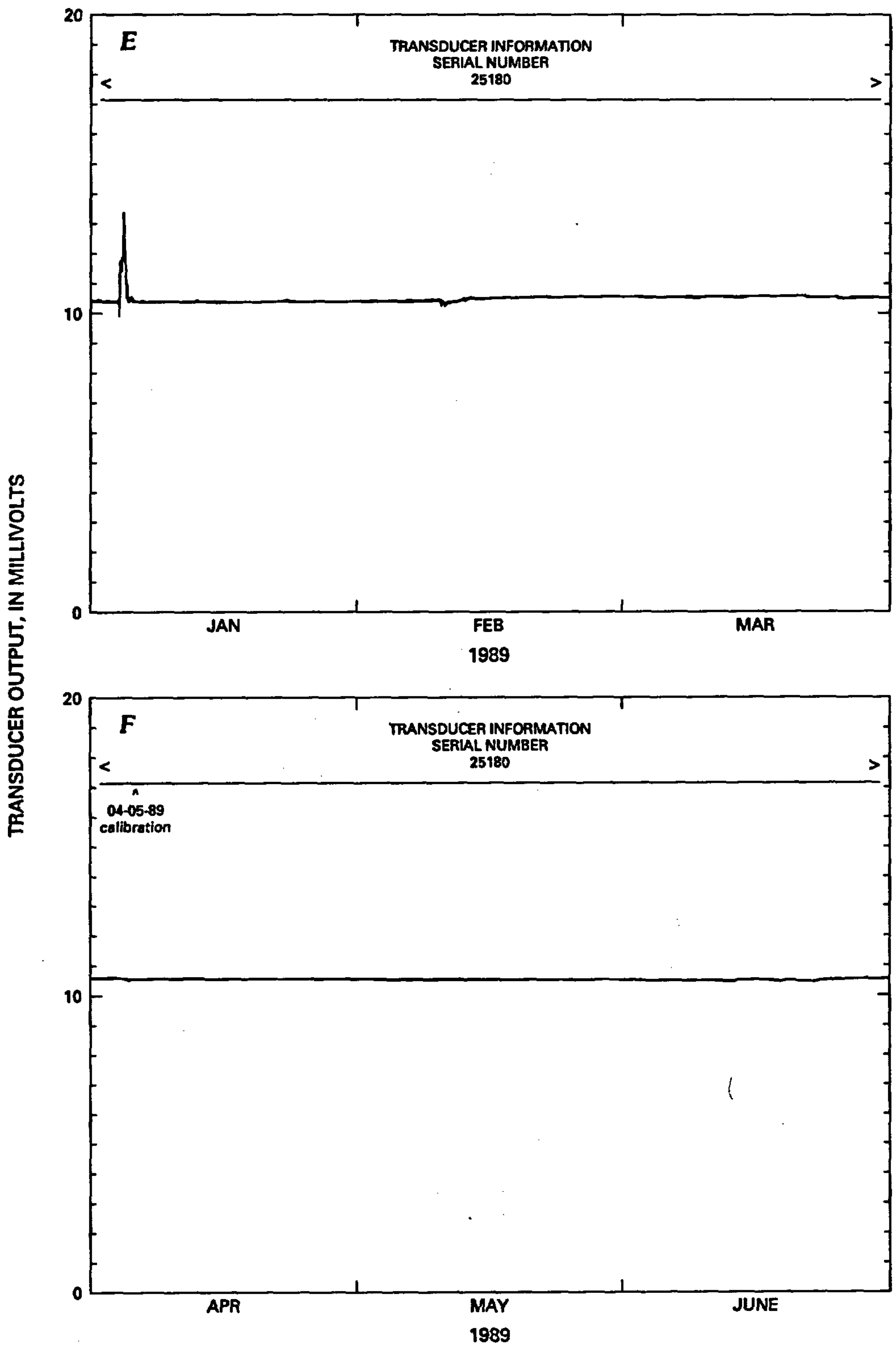


Figure 20.--Transducer output for well UE-25b #1.--Continued

UE-25b #1
Site ID: 365108116262302
INTERVAL: 1,199 - 1,220

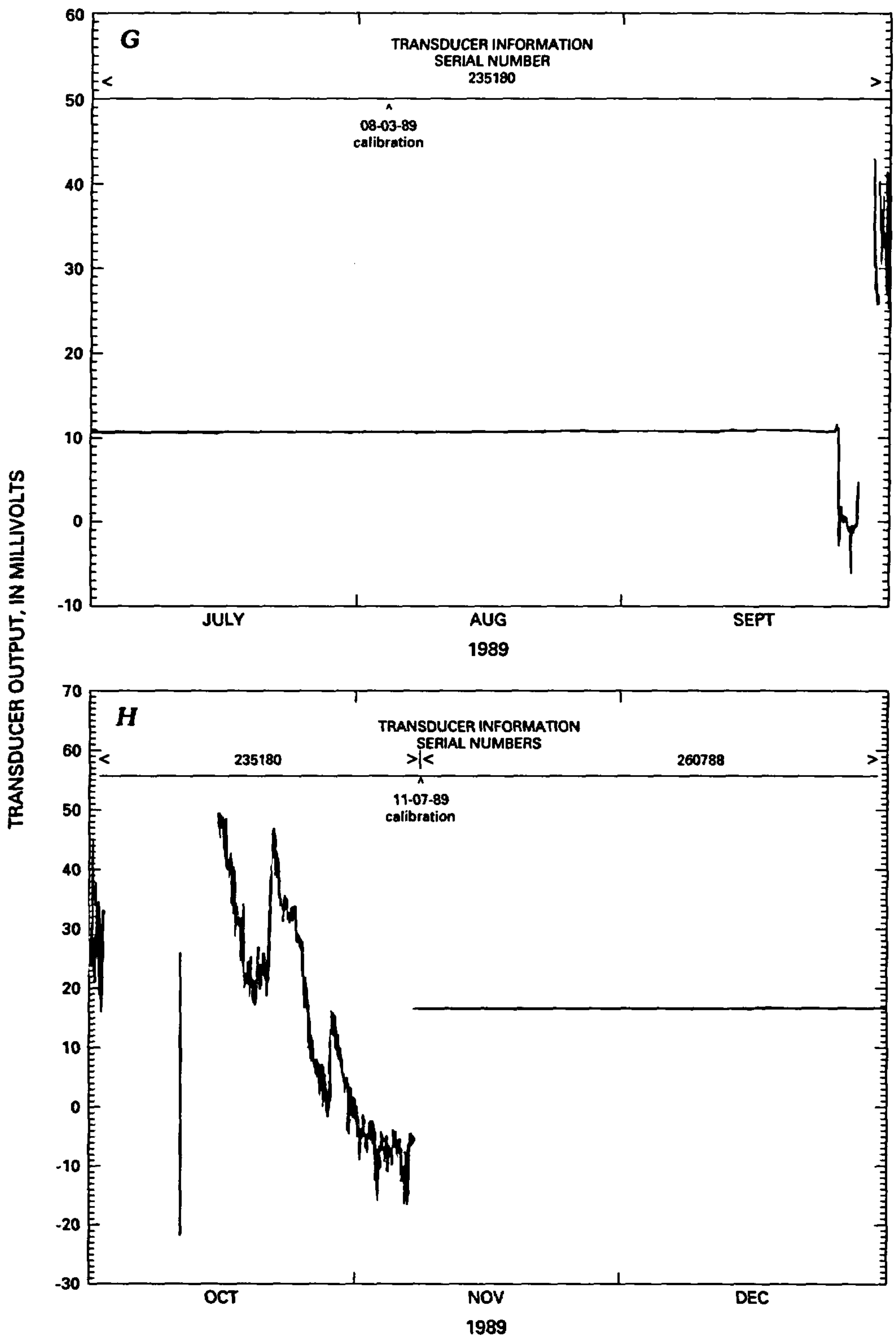


Figure 20.--Transducer output for well UE-25b #1.--Continued

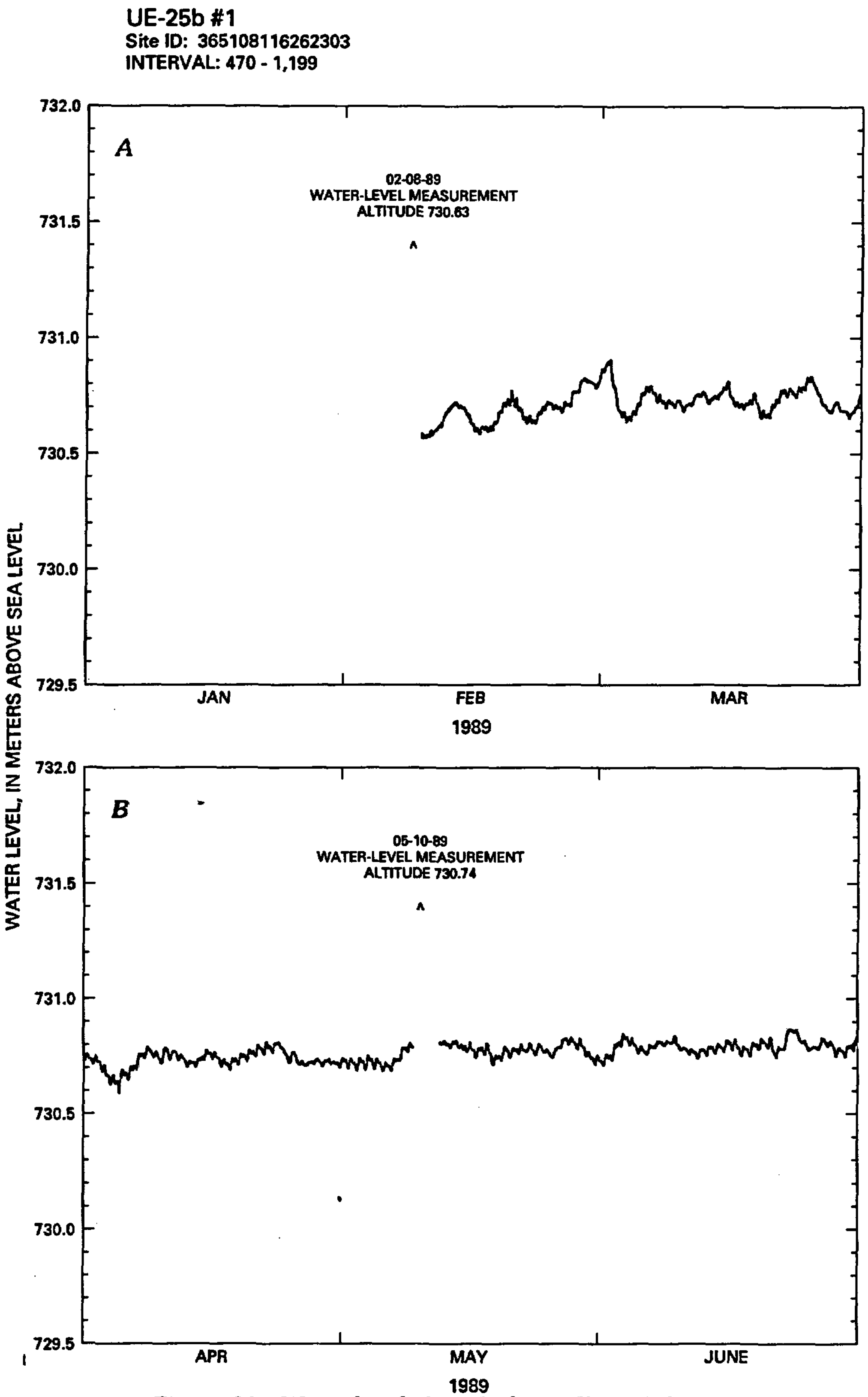


Figure 21.--Water-level altitude for well UE-25b #1.

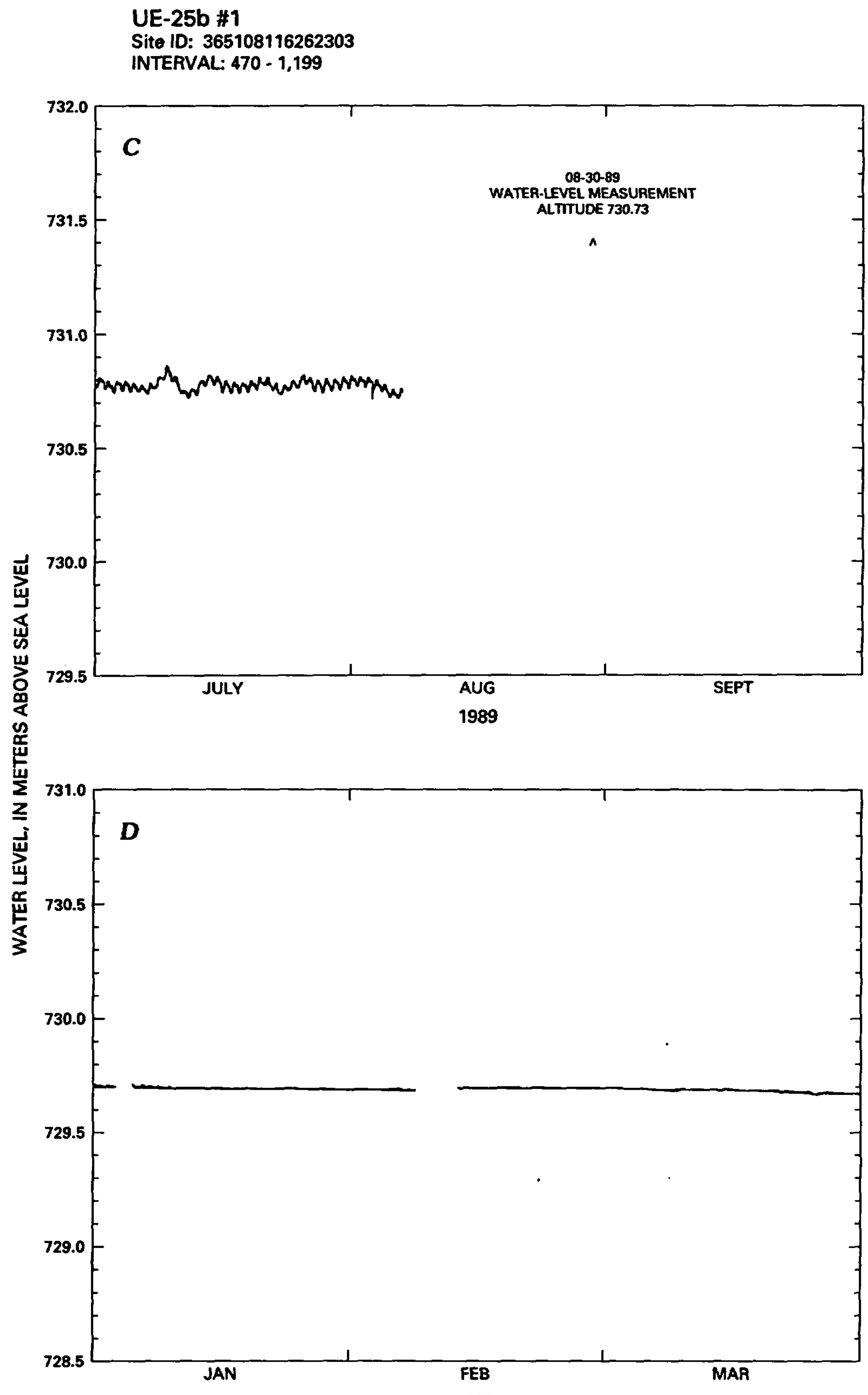


Figure 21.--Water-level altitude for well UE-25b #1.--Continued

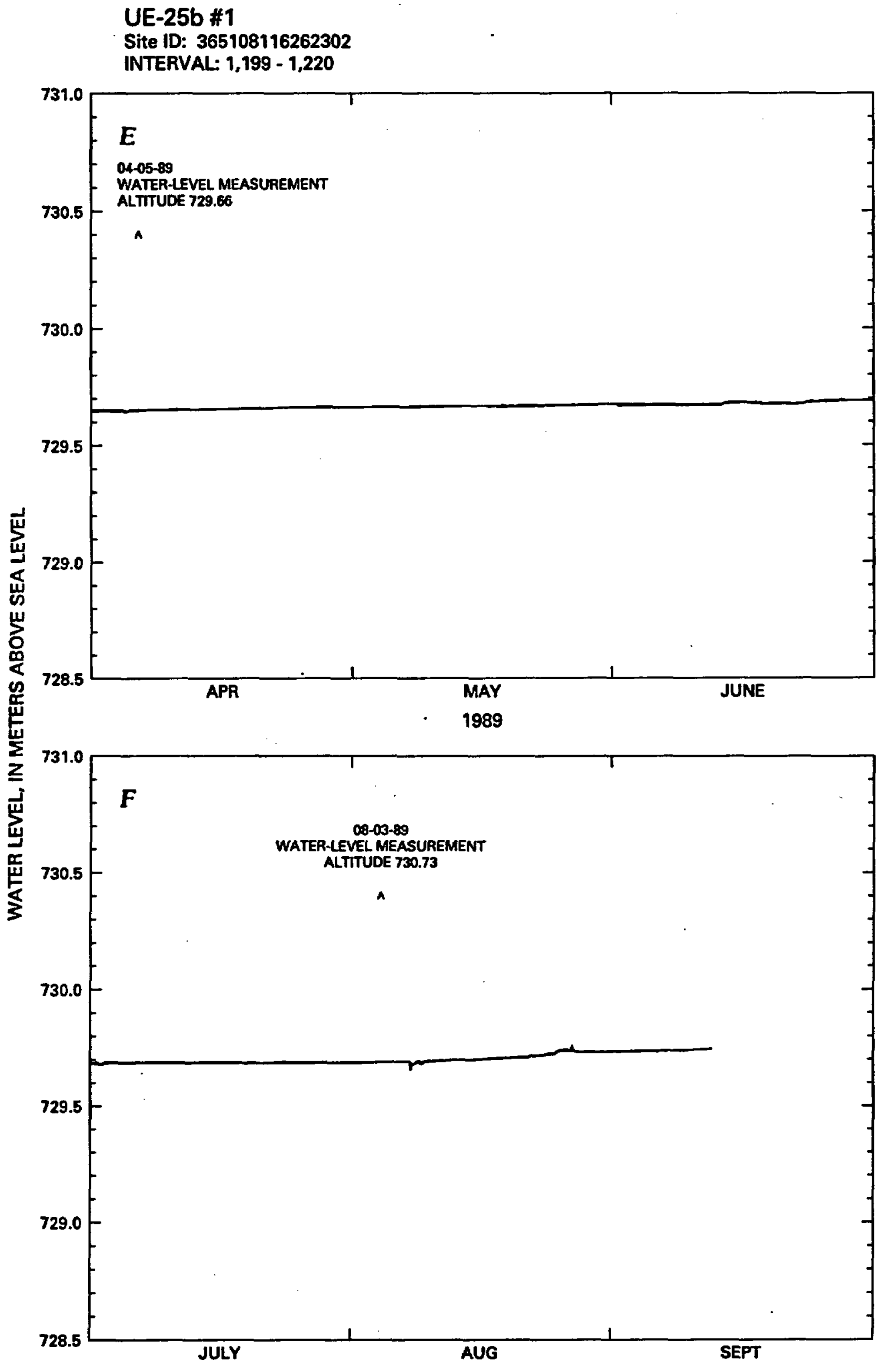


Figure 21.--Water-level altitude for well UE-25b #1.--Continued

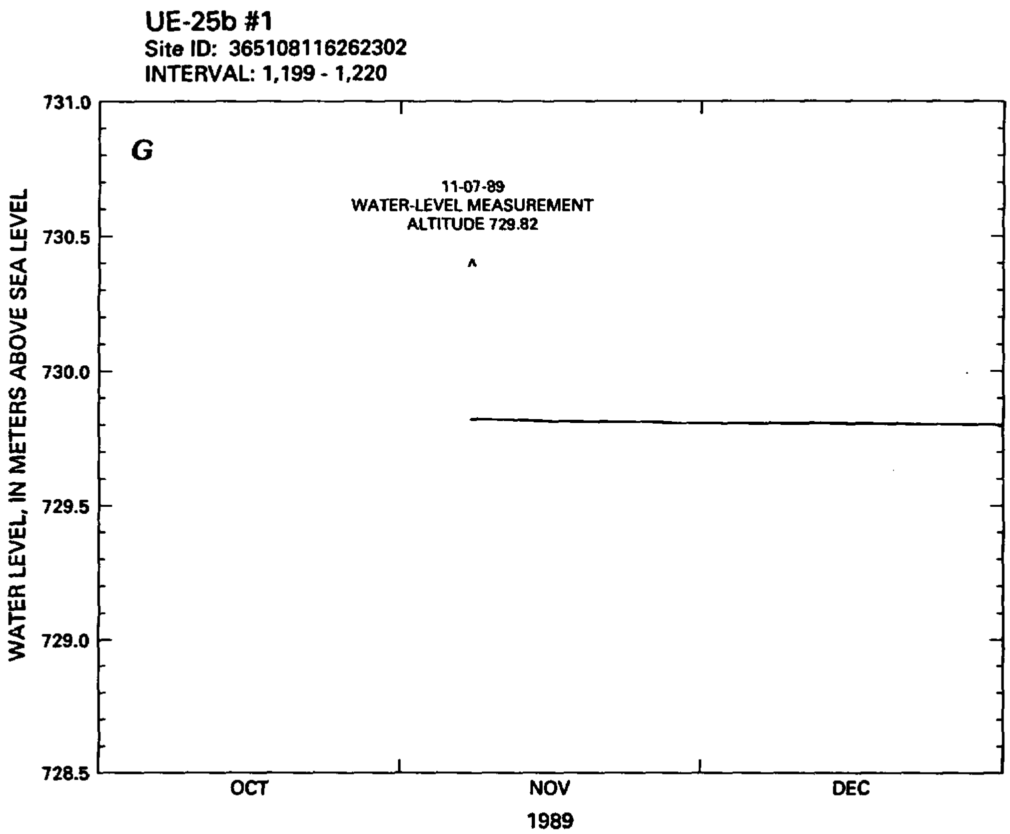


Figure 21.--Water-level altitude for well UE-25b #1.--Continued

Table 7. *Daily mean water-level altitude for 1989, in meters above sea level, for well UE-25b #1*
[Monthly mean, maximum (max), and minimum (min) computed from the daily mean values, indicated only for months that have complete data sets. Dashes indicate insufficient data to calculate daily mean water-level altitude]

Interval: 470-1,199 m   Site ID: 365108116262303

DAY	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
						1989						
1	—	—	730.80	730.75	730.72	730.73	730.79	730.79	—	—	—	—
2	—	—	730.87	730.73	730.72	730.76	730.78	730.79	—	—	—	—
3	—	—	730.80	730.70	730.72	730.81	730.77	730.78	—	—	—	—
4	—	—	730.67	730.65	730.72	730.81	730.78	730.76	—	—	—	—
5	—	—	730.66	730.65	730.72	730.78	730.77	730.74	—	—	—	—
6	—	—	730.73	730.68	730.71	730.77	730.76	—	—	—	—	—
7	—	—	730.77	730.72	730.71	730.80	730.76	—	—	—	—	—
8	—	—	730.74	730.77	730.75	730.80	730.78	—	—	—	—	—
9	—	730.57	730.72	730.76	—	730.81	730.82	—	—	—	—	—
10	—	730.59	730.71	730.75	—	730.78	730.81	—	—	—	—	—
11	—	730.63	730.70	730.76	—	730.76	730.75	—	—	—	—	—
12	—	730.69	730.72	730.75	—	730.76	730.74	—	—	—	—	—
13	—	730.70	730.75	730.72	730.81	730.77	730.76	—	—	—	—	—
14	—	730.66	730.73	730.72	730.80	730.78	730.80	—	—	—	—	—
15	—	730.60	730.75	730.75	730.79	730.79	730.80	—	—	—	—	—
16	—	730.60	730.78	730.75	730.78	730.79	730.77	—	—	—	—	—
17	—	730.61	730.71	730.73	730.77	730.77	730.77	—	—	—	—	—
18	—	730.69	730.71	730.72	730.78	730.77	730.77	—	—	—	—	—
19	—	730.72	730.73	730.74	730.74	730.79	730.77	—	—	—	—	—
20	—	730.69	730.67	730.75	730.76	730.80	730.78	—	—	—	—	—
21	—	730.64	730.68	730.77	730.76	730.77	730.79	—	—	—	—	—
22	—	730.65	730.74	730.78	730.77	730.81	730.77	—	—	—	—	—
23	—	730.70	730.77	730.79	730.78	730.85	730.75	—	—	—	—	—
24	—	730.70	730.76	730.79	730.77	730.81	730.77	—	—	—	—	—
25	—	730.70	730.79	730.75	730.77	730.78	730.79	—	—	—	—	—
26	—	730.73	730.80	730.73	730.76	730.80	730.80	—	—	—	—	—
27	—	730.78	730.71	730.72	730.80	730.80	730.77	—	—	—	—	—
28	—	730.81	730.69	730.73	730.81	730.77	730.77	—	—	—	—	—
29	—		730.69	730.72	730.80	730.77	730.78	—	—	—	—	—
30	—		730.67	730.72	730.76	730.80	730.78	—	—	—	—	—
31	—		730.72		730.73		730.79	—		—		—
MONTHLY												
MEAN	—	—	730.73	730.73	—	730.79	730.78	—	—	—	—	—
MAX	—	—	730.87	730.79	—	730.85	730.82	—	—	—	—	—
MIN	—	—	730.66	730.65	—	730.73	730.74	—	—	—	—	—

Table 7. *Daily mean water-level altitude for 1989, in meters above sea level, for well UE-25b #1 (Continued)*

Interval: 1,199-1,220 m **Site ID: 365108116262302**

DAY	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
						1989 (Continued)						
1	729.69	729.68	729.68	729.66	729.67	729.67	729.68	729.69	729.73	—	—	729.81
2	729.69	729.68	729.68	729.66	729.67	729.67	729.68	729.69	729.73	—	—	729.81
3	—	729.68	729.68	729.66	729.67	729.67	729.68	729.69	729.73	—	—	729.81
4	—	729.68	729.68	729.66	729.67	729.67	729.68	729.69	729.74	—	—	729.81
5	—	729.68	729.68	729.66	729.67	729.67	729.68	729.69	729.74	—	—	729.81
6	729.69	729.67	729.68	729.66	729.67	729.67	729.68	729.69	729.74	—	—	729.81
7	729.69	—	729.68	729.66	729.67	729.67	729.68	729.69	729.74	—	—	729.81
8	729.69	—	729.67	729.66	729.67	729.67	729.68	729.69	729.74	—	729.82	729.81
9	729.69	—	729.67	729.66	729.67	729.67	729.68	729.69	729.74	—	729.82	729.81
10	729.69	—	729.67	729.66	729.67	729.67	729.69	729.69	729.74	—	729.82	729.81
11	729.69	—	729.68	729.66	729.67	729.67	729.69	729.69	—	—	729.82	729.81
12	729.68	—	729.68	729.66	729.67	729.67	729.69	729.70	—	—	729.82	729.81
13	729.69	729.68	729.68	729.66	729.67	729.67	729.69	729.70	—	—	729.82	729.81
14	729.68	729.68	729.68	729.66	729.67	729.67	729.68	729.70	—	—	729.82	729.81
15	729.68	729.68	729.67	729.66	729.67	729.67	729.68	729.70	—	—	729.82	729.81
16	729.68	729.68	729.68	729.66	729.67	729.68	729.68	729.70	—	—	729.82	729.81
17	729.68	729.68	729.68	729.66	729.67	729.67	729.68	729.70	—	—	729.82	729.81
18	729.68	729.68	729.67	729.66	729.67	729.67	729.69	729.70	—	—	729.81	729.81
19	729.68	729.68	729.67	729.67	729.67	729.67	729.68	729.71	—	—	729.81	729.81
20	729.68	729.68	729.67	729.67	729.67	729.67	729.68	729.71	—	—	729.81	729.81
21	729.68	729.69	729.67	729.67	729.67	729.67	729.68	729.71	—	—	729.81	729.81
22	729.68	729.69	729.67	729.67	729.67	729.67	729.68	729.72	—	—	729.81	729.81
23	729.68	729.68	729.67	729.67	729.67	729.68	729.69	729.72	—	—	729.81	729.81
24	729.68	729.69	729.67	729.67	729.67	729.68	729.69	729.73	—	—	729.81	729.81
25	729.68	729.68	729.67	729.67	729.67	729.68	729.69	729.74	—	—	729.81	729.81
26	729.68	729.68	729.66	729.67	729.67	729.68	729.69	729.74	—	—	729.81	729.81
27	729.68	729.68	729.66	729.67	729.67	729.68	729.69	729.73	—	—	729.81	729.81
28	729.68	729.68	729.66	729.67	729.67	729.68	729.69	729.73	—	—	729.81	729.81
29	729.68		729.66	729.67	729.67	729.68	729.69	729.73	—	—	729.81	729.81
30	729.68		729.66	729.67	729.67	729.68	729.69	729.73	—	—	729.81	729.81
31	729.68		729.66		729.67		729.69	729.73		—		729.81
MONTHLY												
MEAN	—	—	729.67	729.66	729.67	729.67	729.68	729.71	—	—	—	729.81
MAX	—	—	729.68	729.67	729.67	729.68	729.69	729.74	—	—	—	729.81
MIN	—	—	729.66	729.66	729.67	729.67	729.68	729.69	—	—	—	729.81

Well UE-25c #2

Information about the history of well UE-25c #2 and about previous data from the well was obtained from various sources. These sources are: Fenix & Scisson, Inc. (1986c, 1987c); R.W. Spengler, U.S. Geological Survey (written commun., 1985).

Well specifications

The following are specifications for well UE-25c #2:

1. Location and identification:

   Latitude and longitude: 36°49'45" N.; 116°25'43" W.
   Nevada State Central Zone Coordinates (m): N 230,688; E 173,624.
   U.S. Geological Survey Site ID: 364947116254401

2. Drilling and casing information:

   Well started: January 9, 1984.
   Well completed: March 21, 1984.
   Drilling method: Rotary, using rock bits and air-foam circulating medium; selected cores obtained.
   Bit diameter below water level: 375 mm to 463 m; 251 mm from 463 to 914 m.
   Casing extending below water level: 273-mm inside diameter to 416 m.
   Total drilled depth: 914 m.

3. Access to and description of interval for measuring water levels:

   44-mm inside-diameter open-ended tubing extending from land surface to a depth of 720.9 m; saturated interval of borehole within rhyolite lavas and tuffs of Calico Hills and Prow Pass, Bullfrog, and Tram Members of Crater Flat Tuff.

4. Information for calculating water-level altitude:

   Reference point: Top of well casing, northwest side; altitude 1,132.2 m (surveyed by U.S. Geological Survey, 1984).
   Depth correction for borehole deviation from vertical: 0.06 m, based on approximate depth to water of 402 m.

History of instrumentation, calibrations, and comments

Manual water-level measurements were made from March 21, 1984 through September 13, 1989, except for some periods of testing when the well was instrumented. Beginning in September 1989, the water level has been monitored continuously using a downhole pressure transducer with a data logger at land surface.

The following transducers were used in well UE-25c #2 in 1989:

[Range is pressure limit for transducer, in pounds per square inch]

Date of use		Transducer			
Beginning	Ending	Type	Model	Range	Serial number
09-13-89	05-02-90	Gage	Druck 930	10	273128

The following calibrations of the water-level monitoring system were used to process the 1989 data from well UE-25c #2:

Transducer				Water level	
		Regression line			
Serial number	Calibration date	Slope (millivolts per meter)	Coefficient of determination	Date	Altitude (meters)
273128	09-13-89	-6.793	1.000	09-13-89	730.00
273128	01-03-90	-6.851	0.999	01-03-90	729.75

Transducer output from September through December 1989 is shown in figure 22A and 22B. These data are the transducer output after first-level filtering (described in the "First-Level Filtering" section) has been applied. The transducer (serial number 273128) in use in September through December produced reasonable output during that entire period.

Transducer output was converted to water-level altitude for the following period:

Beginning date	Ending date
09-14-89	12-31-89

There was one spike in the transducer output in 1989 (fig. 22 B). This spike consists of three transducer output readings that deviate from the trend of the record. This spike was not coincident with a site visit or any other identifiable event and probably represents a system malfunction of some type. The details of the spike are as follows:

Date	Time	Value (millivolts)	
		Recorded	Expected
10-25-89	12:00	8.35	8.95
10-25-89	13:00	8.71	8.95
10-25-89	14:00	8.84	8.95

Expected values are obtained by averaging the reading before and the reading following the spike. The difference of 0.6 millivolts represents a difference of about 0.09 m in 1 hour. Because of the possibility of some sort of system malfunction, these transducer outputs were not converted to water levels.

The water-level altitudes are shown in figure 23A and 23B, and the daily mean water-level altitudes are given in table 8. Transducer output was converted to water-level altitude for virtually 100 percent of the period of record. This was for a period of 109 days, September 14 through December 31, 1989.

UE-25c #2
Site ID: 364947116254401
INTERVAL: 402 - 914

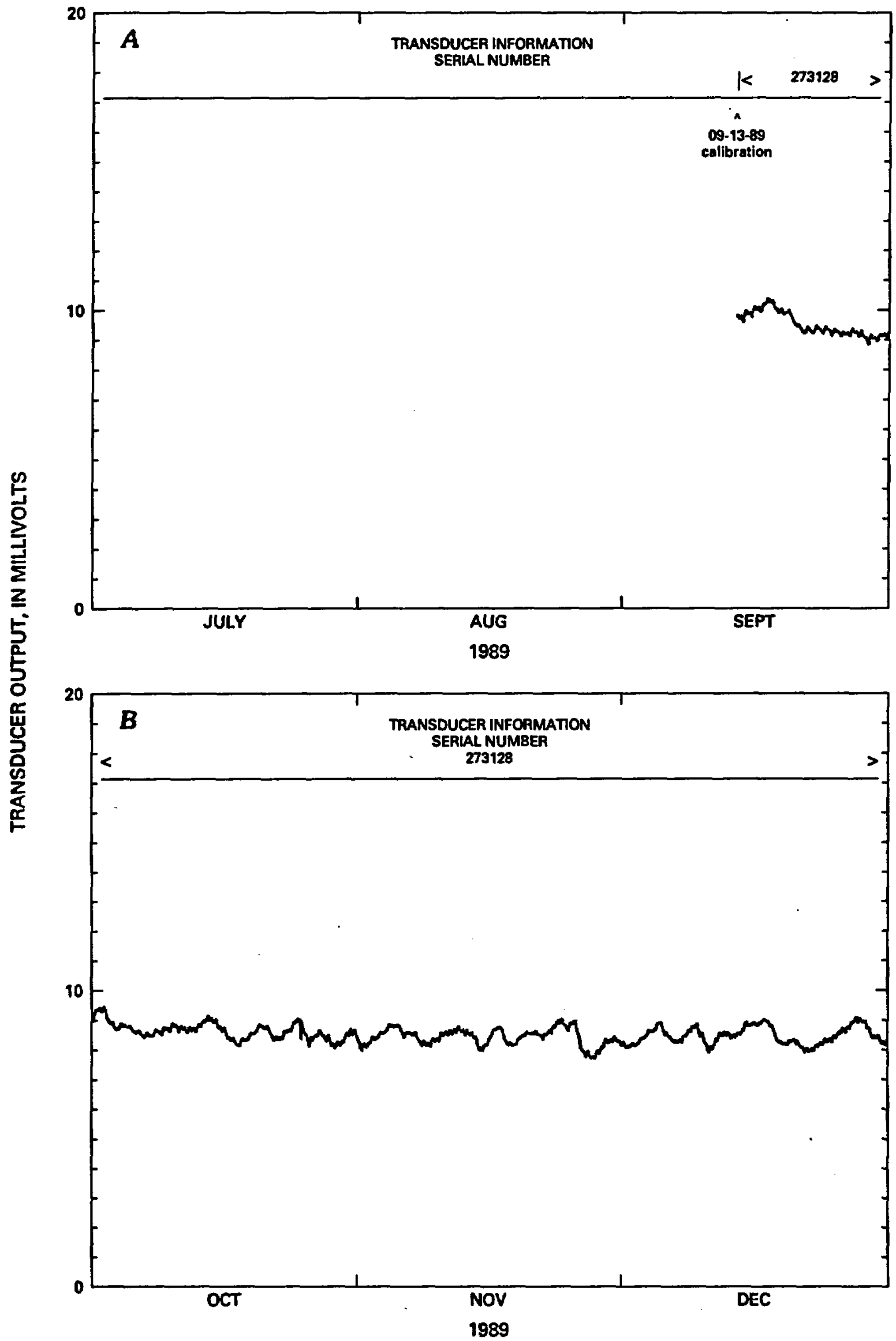


Figure 22.--Transducer output for well UE-25c #2.

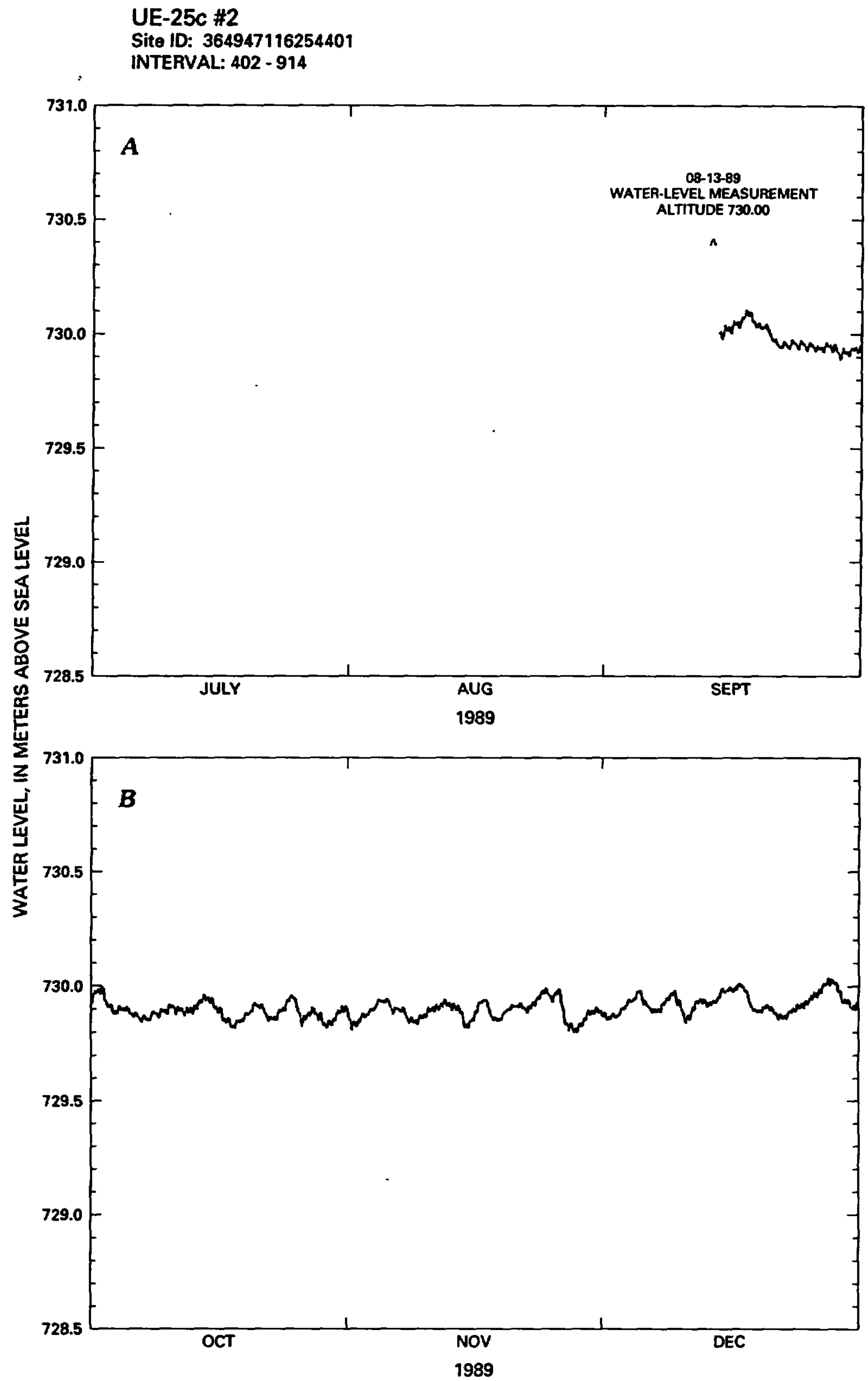


Figure 23.–Water-level altitude for well UE-25c #2.

Table 8. *Daily mean water-level altitude for 1989, in meters above sea level, for well UE-25c #2*
[Monthly mean, maximum (max), and minimum (min) computed from the daily mean values, indicated only for months that have complete data sets. Dashes indicate insufficient data to calculate daily mean water-level altitude]

Interval: 402-914 m   Site ID: 364947116254401

DAY	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
						1989						
1	—	—	—	—	—	—	—	—	—	729.95	729.83	729.87
2	—	—	—	—	—	—	—	—	—	729.98	729.86	729.86
3	—	—	—	—	—	—	—	—	—	729.91	729.89	729.88
4	—	—	—	—	—	—	—	—	—	729.89	729.92	729.92
5	—	—	—	—	—	—	—	—	—	729.89	729.93	729.96
6	—	—	—	—	—	—	—	—	—	729.87	729.90	729.93
7	—	—	—	—	—	—	—	—	—	729.86	729.89	729.89
8	—	—	—	—	—	—	—	—	—	729.86	729.85	729.91
9	—	—	—	—	—	—	—	—	—	729.88	729.85	729.95
10	—	—	—	—	—	—	—	—	—	729.90	729.88	729.93
11	—	—	—	—	—	—	—	—	—	729.90	729.90	729.86
12	—	—	—	—	—	—	—	—	—	729.89	729.92	729.91
13	—	—	—	—	—	—	—	—	—	729.90	729.91	729.93
14	—	—	—	—	—	—	—	—	730.01	729.94	729.88	729.93
15	—	—	—	—	—	—	—	—	730.03	729.93	729.84	729.96
16	—	—	—	—	—	—	—	—	730.06	729.89	729.90	729.98
17	—	—	—	—	—	—	—	—	730.09	729.84	729.92	730.00
18	—	—	—	—	—	—	—	—	730.04	729.83	729.86	729.97
19	—	—	—	—	—	—	—	—	730.03	729.86	729.87	729.90
20	—	—	—	—	—	—	—	—	729.98	729.90	729.90	729.90
21	—	—	—	—	—	—	—	—	729.95	729.90	729.91	729.90
22	—	—	—	—	—	—	—	—	729.96	729.86	729.90	729.87
23	—	—	—	—	—	—	—	—	729.96	729.87	729.93	729.88
24	—	—	—	—	—	—	—	—	729.95	729.92	729.97	729.90
25	—	—	—	—	—	—	—	—	729.94	—	729.95	729.92
26	—	—	—	—	—	—	—	—	729.94	729.86	729.92	729.96
27	—	—	—	—	—	—	—	—	729.94	729.89	729.82	729.99
28	—	—	—	—	—	—	—	—	729.92	729.86	729.81	730.02
29	—		—	—	—	—	—	—	729.93	729.83	729.87	729.98
30	—		—	—	—	—	—	—	729.94	729.87	729.89	729.93
31	—		—		—		—	—		729.90		729.92
MONTHLY												
MEAN	—	—	—	—	—	—	—	—	—	—	729.89	729.93
MAX	—	—	—	—	—	—	—	—	—	—	729.97	730.02
MIN	—	—	—	—	—	—	—	—	—	—	729.81	729.86

Well UE-25c #3

Information about the history of well UE-25c #3 and about previous data from the well was obtained from various sources. These sources are: Fenix & Scisson, Inc. (1986c, 1987c); R.W. Spengler, U.S. Geological Survey (written commun., 1985).

Well specifications

The following are specifications for well UE-25c #3:

1. Location and identification:

   Latitude and longitude: 36°49'46" N.; 116°25'44" W.
   Nevada State Central Zone Coordinates (m): N 230,706; E 173,600.
   U.S. Geological Survey Site ID:
   364947116254501 (entire well)
   364947116254502 (upper interval)
   364947116254503 (lower interval)

2. Drilling and casing information:

   Well started: March 20, 1984.
   Well completed: June 11,1984.
   Drilling method: Rotary, using rock bits and air-foam circulating medium; selected core obtained.
   Bit diameter below water level: 375 mm to 463 m; 251 mm from 463 to 914 m.
   Casing extending below water level: 273-mm inside diameter to 403 m; casing string is tack cemented in and perforated below the water level.
   Total drilled depth: 914 m.

3. Access to and description of interval for measuring water levels:

   48-mm inside-diameter open-ended tubing extending from land surface to a depth of 692 m; upper saturated interval of borehole within rhyolite lavas and tuffs of Calico Hills, and Prow Pass and Bullfrog Members of Crater Flat Tuff; Site ID: 364947116254502.
   62-mm inside-diameter tubing with packer on bottom, extending from land surface to a depth of 753 m; lower interval of borehole within Bullfrog and Tram Members of Crater Flat Tuff; Site ID: 364947116254503.

4. Information for calculating water-level altitude:

   Reference point: Top of well casing, south-east side; altitude 1132.3 m (surveyed by U.S. Geological Survey, 1984).
   Depth correction for borehole deviation from vertical: 0.10 m, based on approximate depth to water of 402 m.

History of instrumentation, calibrations, and comments

Manual water-level measurements were made from June 1984 through September 1989, except for several periods of testing when the well was temporarily instrumented. Beginning in September 1989, the water level has been monitored continuously using a downhole pressure transducer with a data logger at land surface.

The following transducers were used in well UE-25c #3 in 1989:

[Range is pressure limit for transducer, in pounds per square inch]

Date of use		Transducer			
Beginning	Ending	Type	Model	Range	Serial number
		Site ID: 364947116254502			
		Interval: 402-753 meters			
09-14-89	01-11-90	Gage	Druck 930	10	273361
		Site ID: 364947116254503			
		Interval: 753-914 meters			
09-12-89	08-28-90	Gage	Druck 930	10	270337

The following calibrations of the water-level monitoring system were used to process the 1989 data from well UE-25c #3:

Transducer				Water level	
		Regression line			
Serial number	Calibration date	Slope (millivolts per meter)	Coefficient of determination	Date	Altitude (meters)
		Site ID: 364947116254502			
		Interval: 402-753 meters			
273361	09-14-89	–6.623	1.000	09-14-89	730.15
		Site ID: 364947116254503			
		Interval: 753-914 meters			
270337	09-12-89	–10.585	1.000	09-12-89	730.52
270337	01-03-90	–11.086	0.994	01-03-90	730.48

Transducer output from September through December 1989 is shown in figure 24A through 24D. These data are the transducer output after first-lèvel filtering (described in the "First-Level Filtering" section) has been applied.

UE-25c #3
Site ID: 364947116254502
INTERVAL: 402 - 753

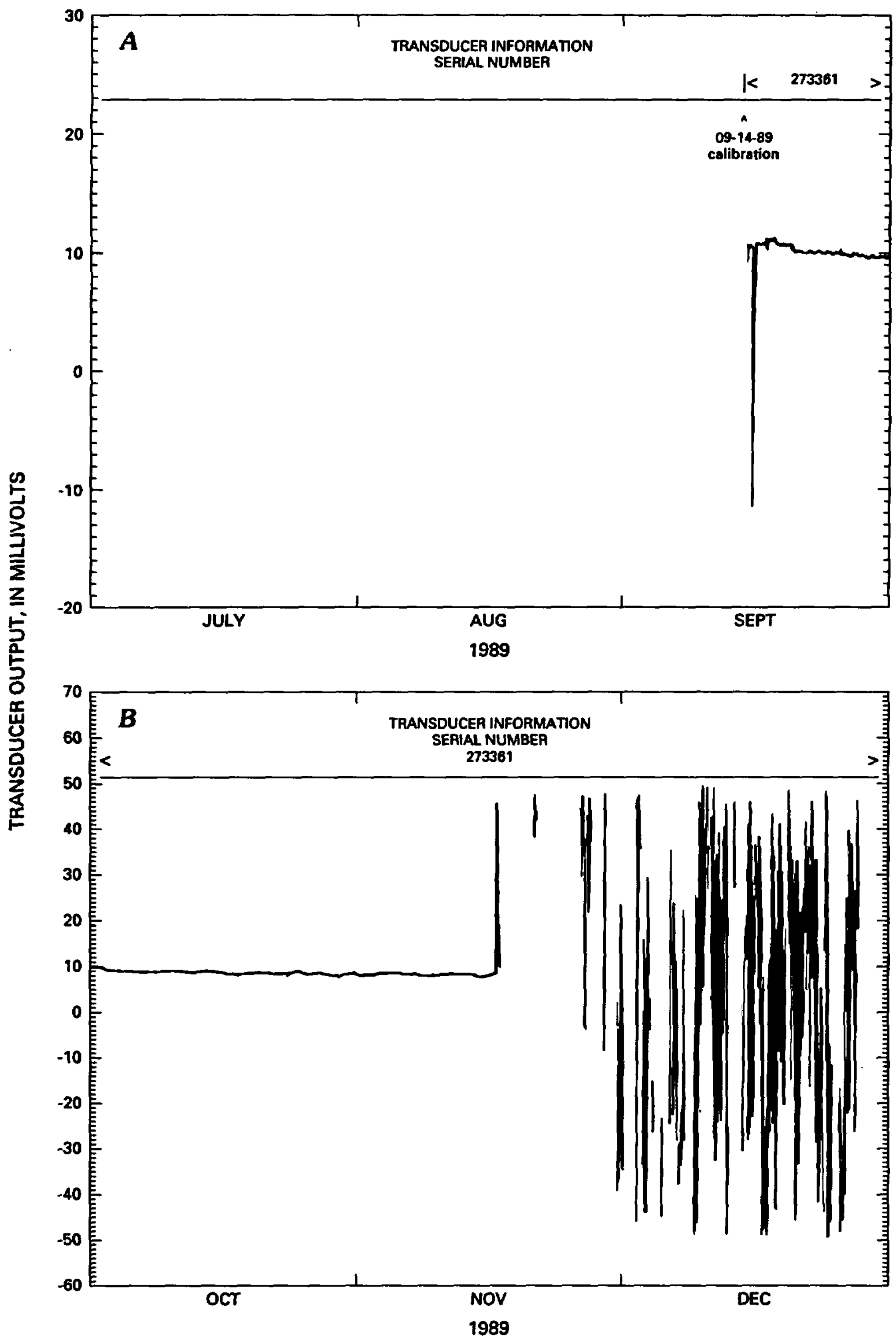


Figure 24.--Transducer output for well UE-25c #3.

UE-25c #3
Site ID: 364947116254503
INTERVAL: 753 - 914

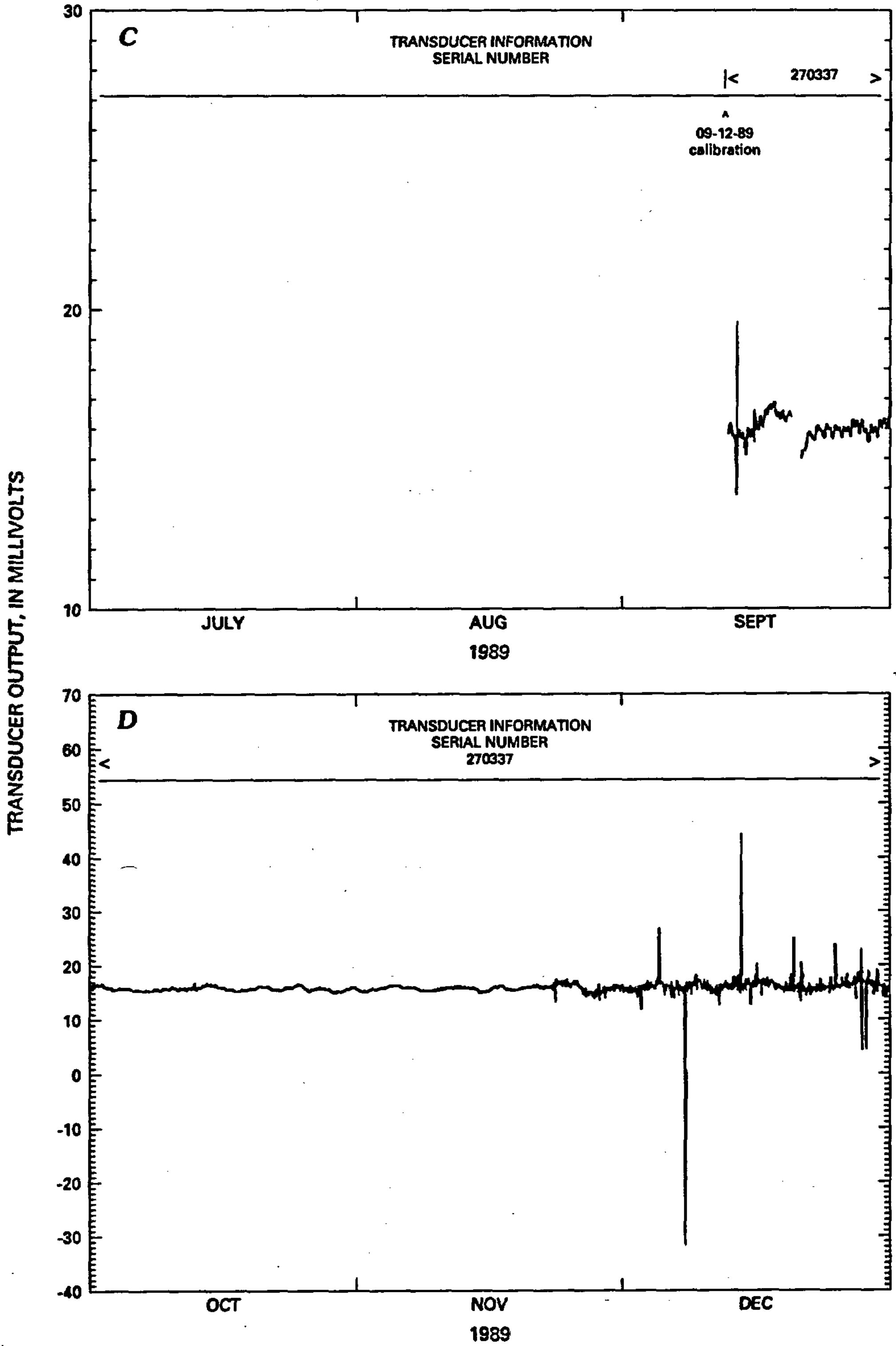


Figure 24.--Transducer output for well UE-25c #3.--Continued

In addition to water-level altitudes calculated from measurements at the time of calibrations, water-level altitude was estimated for the following day to end a period of apparently valid transducer output which had no ending calibration or water-level measurement:

Site ID: 364947116254502
Interval: 402-753 meters

Date	Estimated water-level altitude (meters)
11-16-89	730.15

The estimated water-level altitudes may introduce some error into the record, but the error probably is small compared to transducer drift. The water-level altitude calculated without correction for drift would have been 729.86 m.

Transducer output was converted to water-level altitude for the following periods:

Beginning date		Ending date
	Site ID: 364947116254502	
	Interval: 402-753 meters	
09-16-89		11-16-89
	Site ID: 364947116254503	
	Interval: 753-914 meters	
09-22-89		11-16-89

There were three spikes in the transducer output from the upper interval of well UE25c #3 in 1989 (fig. 24C and 24D), and one spike from the lower interval (fig. 24B). Each of these spikes represents a single transducer output that deviates from the trend of the record. These spikes were not coincident with a site visit or any other identifiable event and probably represent a system malfunction of some type. The details of the spikes are as follows:

Date	Time	Value (millivolts)	
		Recorded	Expected
	Site ID: 364947116254502		
	Interval: 402-753 meters		
09-16-89	21:00	10.15	10.76
09-25-89	06:00	10.28	9.88
10-24-89	00:00	7.89	8.53
	Site ID: 364947116254503		
	Interval: 753-914 meters		
10-13-89	06:00	17.03	15.79

These spikes, if converted to water levels, would indicate a change in water level ranging from over 0.1 m to about 0.05 m in within 1 or 2 hours. Because of the possibility of some sort of system malfunction, this transducer output was not converted to a water level.

The water-level altitudes are shown in figure 25A through 25D, and the daily mean water-level altitudes are given in table 9. For the upper interval, out of 109 days of record, approximately 56 percent of the transducer output was converted to water-level altitude. This was a 62-day period from September 16 to November 16, 1989. For the lower interval, out of 111 days of record, approximately 51 percent of the transducer output was converted to water-level altitude. This was a 56-day period from September 22 to November 16, 1989.

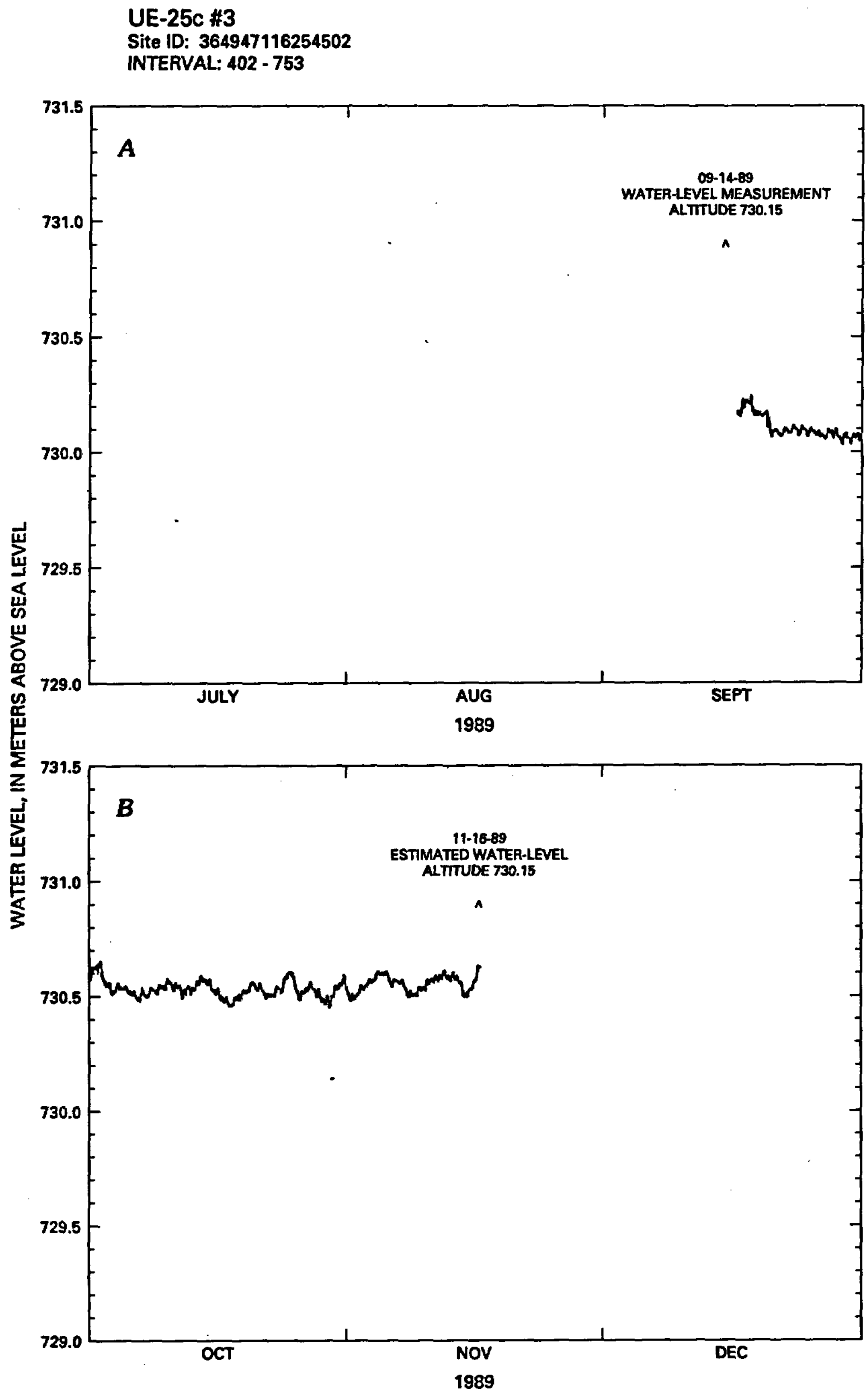


Figure 25.--Water-level altitude for well UE-25c #3.

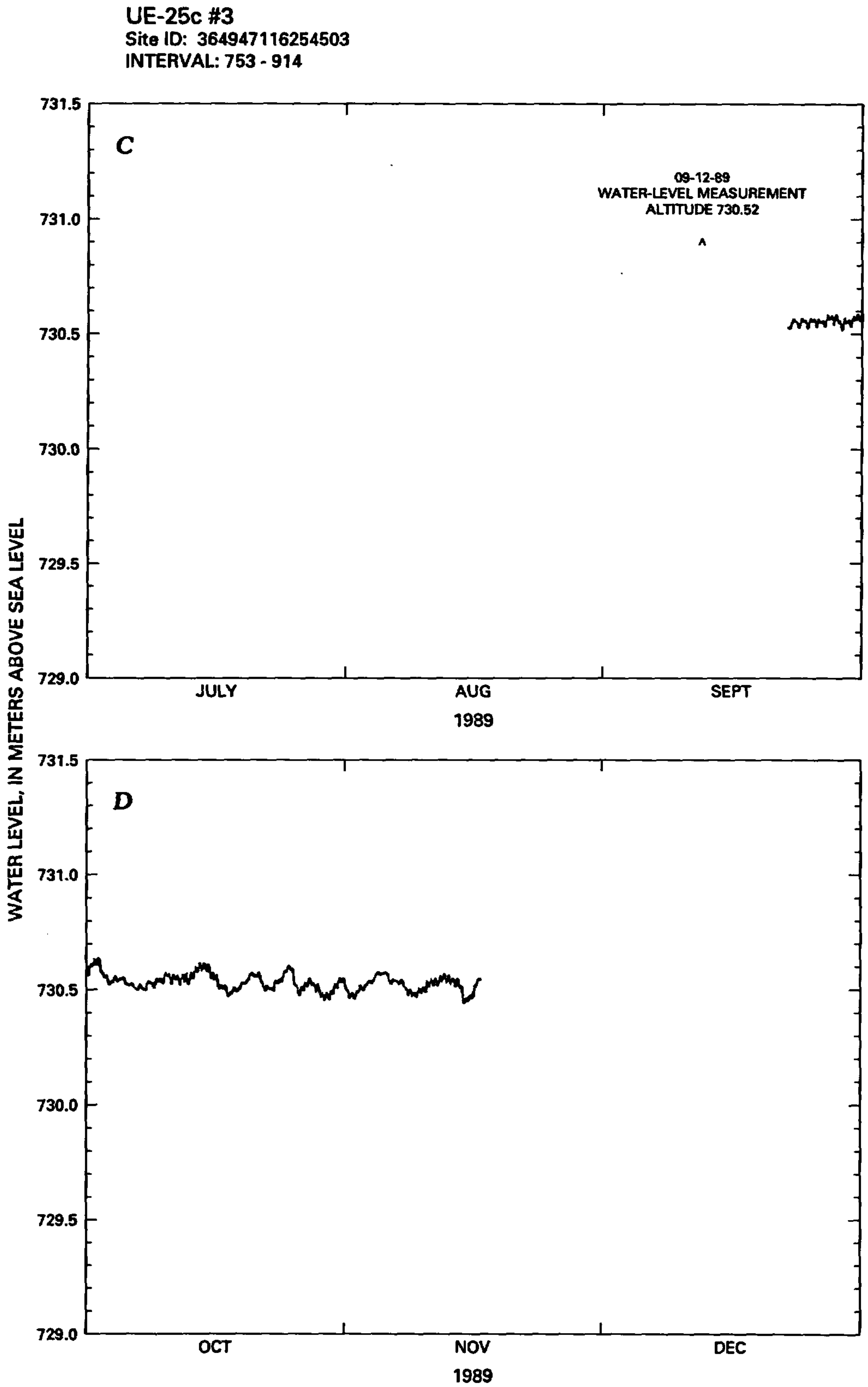


Figure 25.--Water-level altitude for well UE-25c #3.--Continued

[Monthly mean, maximum (max), and minimum (min) computed from the daily mean values, indicated only for months that have complete data sets. Dashes indicate insufficient data to calculate daily mean water-level altitude]

Interval: 402-753 m   Site ID: 364947116254502

DAY	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
						1989						
1	—	—	—	—	—	—	—	—	—	730.09	729.99	—
2	—	—	—	—	—	—	—	—	—	730.11	730.01	—
3	—	—	—	—	—	—	—	—	—	730.04	730.05	—
4	—	—	—	—	—	—	—	—	—	730.02	730.08	—
5	—	—	—	—	—	—	—	—	—	730.02	730.09	—
6	—	—	—	—	—	—	—	—	—	730.00	730.06	—
7	—	—	—	—	—	—	—	—	—	730.00	730.05	—
8	—	—	—	—	—	—	—	—	—	730.01	730.00	—
9	—	—	—	—	—	—	—	—	—	730.02	730.01	—
10	—	—	—	—	—	—	—	—	—	730.04	730.04	—
11	—	—	—	—	—	—	—	—	—	730.04	730.07	—
12	—	—	—	—	—	—	—	—	—	730.02	730.08	—
13	—	—	—	—	—	—	—	—	—	730.02	730.08	—
14	—	—	—	—	—	—	—	—	—	730.06	730.05	—
15	—	—	—	—	—	—	—	—	—	730.05	730.01	—
16	—	—	—	—	—	—	—	—	—	730.01	—	—
17	—	—	—	—	—	—	—	—	730.22	729.98	—	—
18	—	—	—	—	—	—	—	—	730.17	729.97	—	—
19	—	—	—	—	—	—	—	—	730.15	730.00	—	—
20	—	—	—	—	—	—	—	—	730.09	730.03	—	—
21	—	—	—	—	—	—	—	—	730.09	730.03	—	—
22	—	—	—	—	—	—	—	—	730.10	730.00	—	—
23	—	—	—	—	—	—	—	—	730.10	—	—	—
24	—	—	—	—	—	—	—	—	730.09	—	—	—
25	—	—	—	—	—	—	—	—	—	730.08	—	—
26	—	—	—	—	—	—	—	—	730.08	730.00	—	—
27	—	—	—	—	—	—	—	—	730.08	730.03	—	—
28	—	—	—	—	—	—	—	—	730.06	730.01	—	—
29	—		—	—	—	—	—	—	730.06	729.97	—	—
30	—		—	—	—	—	—	—	730.07	730.01	—	—
31	—		—		—		—	—		730.05		—
MONTHLY												
MEAN	—	—	—	—	—	—	—	—	—	—	—	—
MAX	—	—	—	—	—	—	—	—	—	—	—	—
MIN	—	—	—	—	—	—	—	—	—	—	—	—

Table 9. *Daily mean water-level altitude for 1989, in meters above sea level, for well UE-25c #3 (Continued)*

Interval: 753-914 m   Site ID: 364947116254503

DAY	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
						1989 (Continued)						
1	—	—	—	—	—	—	—	—	—	730.58	730.47	—
2	—	—	—	—	—	—	—	—	—	730.61	730.49	—
3	—	—	—	—	—	—	—	—	—	730.55	730.52	—
4	—	—	—	—	—	—	—	—	—	730.53	730.55	—
5	—	—	—	—	—	—	—	—	—	730.54	730.57	—
6	—	—	—	—	—	—	—	—	—	730.51	730.53	—
7	—	—	—	—	—	—	—	—	—	730.50	730.53	—
8	—	—	—	—	—	—	—	—	—	730.51	730.48	—
9	—	—	—	—	—	—	—	—	—	730.52	730.48	—
10	—	—	—	—	—	—	—	—	—	730.54	730.51	—
11	—	—	—	—	—	—	—	—	—	730.54	730.53	—
12	—	—	—	—	—	—	—	—	—	730.54	730.54	—
13	—	—	—	—	—	—	—	—	—	—	730.53	—
14	—	—	—	—	—	—	—	—	—	730.58	730.50	—
15	—	—	—	—	—	—	—	—	—	730.58	730.46	—
16	—	—	—	—	—	—	—	—	—	730.54	—	—
17	—	—	—	—	—	—	—	—	—	730.50	—	—
18	—	—	—	—	—	—	—	—	—	730.48	—	—
19	—	—	—	—	—	—	—	—	—	730.51	—	—
20	—	—	—	—	—	—	—	—	—	730.55	—	—
21	—	—	—	—	—	—	—	—	—	730.55	—	—
22	—	—	—	—	—	—	—	—	730.53	730.50	—	—
23	—	—	—	—	—	—	—	—	730.54	730.51	—	—
24	—	—	—	—	—	—	—	—	730.54	730.55	—	—
25	—	—	—	—	—	—	—	—	730.54	730.57	—	—
26	—	—	—	—	—	—	—	—	730.55	730.49	—	—
27	—	—	—	—	—	—	—	—	730.55	730.52	—	—
28	—	—	—	—	—	—	—	—	730.53	730.50	—	—
29	—		—	—	—	—	—	—	730.54	730.47	—	—
30	—		—	—	—	—	—	—	730.56	730.50	—	—
31	—		—		—		—	—		730.53		—
MONTHLY												
MEAN	—	—	—	—	—	—	—	—	—	—	—	—
MAX	—	—	—	—	—	—	—	—	—	—	—	—
MIN	—	—	—	—	—	—	—	—	—	—	—	—

Well UE-25p #1

Information about the history of well UE-25p #1 and about previous data from the well was obtained from various sources. These sources are: Craig and Johnson (1984); Craig and Robison (1984); Robison (1984, 1986); Robison and others (1988); Fenix & Scisson, Inc. (1986d, 1987c).

Well specifications

The following are specifications for well UE-25p #1:

1. Location and identification:

   Latitude and longitude: 36°49'38" N.; 116°25'21" W.
   Nevada State Central Zone Coordinates (m): N 230,481; E 174,188.
   U.S. Geological Survey Site ID:
   364938116252101 (entire well)
   364938116252102 (lower interval).

2. Drilling and casing information:

   Well started: November 13, 1982.
   Well completed: May 24, 1983.
   Drilling method: Rotary, using rock bits and air-foam circulating medium; cores obtained in selected intervals.
   Bit diameter below water level: 375 mm to 487 m; 251 mm from 487 to 1,304 m; 175 mm from 1,304 to 1,317 m; 171 mm from 1,317 to 1,798 m; 156 mm from 1,798 to 1,805 m.
   Casing extending below water level: 255-mm inside diameter from land surface to 477 m; 177-mm inside diameter from 453 to 1,297m; casing string is cemented in, has no perforations.
   Total drilled depth: 1,805 m.

3. Access to and description of interval for measuring water levels:

   38-mm inside-diameter tubing, open end, to depth of 418 m; well construction is such that hydraulic head of the tuffs of Tertiary age is not monitored. Only the hydraulic head in the underlying carbonate rocks of Paleozoic age is measured (Tertiary-Paleozoic contact is at 1,244 m);
   Site ID: 364938116252102.
   Note: Also installed, to enable temperature measurements, is 38-mm inside-diameter tubing, closed end, and filled with water, to depth of 413 m.

4. Information for calculating water-level altitude:

   Reference point: Top of metal tag on well casing; altitude 1,114.21 m (surveyed by U.S. Geological Survey, 1984).
   Depth correction for borehole deviation from vertical: 0.06 m, based on approximate depth to water of 362 m.

History of instrumentation, calibrations, and comments

Manual water-level measurements were made as the well was being drilled in February and May 1983. Manual measurements were also made from October 21, 1983 through October 12, 1984. Beginning in March 1985, the water level has been monitored continuously using a down-hole pressure transducer with a data logger at land surface.

The following transducers were used in well UE-25p #1 in 1989:

[Range is pressure limit for transducer, in pounds per square inch]

Date of use		Transducer			
Beginning	Ending	Type	Model	Range	Serial number
06-14-88	02-15-89	Gage	Druck 930	10	237107
02-15-89	01-24-90	Gage	Druck 930	10	244285

The following calibrations of the water-level monitoring system were used to process the 1989 data from well UE-25p #1:

Transducer				Water level	
		Regression line			
Serial number	Calibration date	Slope (millivolts per meter)	Coefficient of determination	Date	Altitude (meters)
237107	02-15-89	–9.689	0.999	02-15-89	752.52
244285	02-15-89	–6.964	1.000	02-15-89	752.52
244285	06-14-89	–6.972	1.000	06-14-89	752.52
244285	09-13-89	–7.043	1.000	09-13-89	752.46
244285	12-28-89	–7.009	1.000	12-28-89	752.57

Transducer output from January through December 1989 is shown in figure 26A through 26D. These data are the transducer output after first-level filtering (described in the "First-Level Filtering" section) has been applied. The first transducer (serial number 237107) in use in January and February generally produced erratic output (fig. 26A). The second transducer (serial number 244285) in use from February through December 1989, generally produced reasonable output except for short periods of erratic output in March (fig. 26A), May (fig. 26B), August and September (fig. 26C).

The transducer failed shortly after 12-31-89 and the calibration of 12-28-89 was used to the end of a convertible period for transducer 244285. There were two spikes in the transducer output late August 1989 (fig. 26C). Each of these spikes represents a single transducer output that deviates from the trend of the record. These spikes were not coincident with a site visit or any other iden-

UE-25p #1
Site ID: 364938116252102
INTERVAL: 1,297-1,805

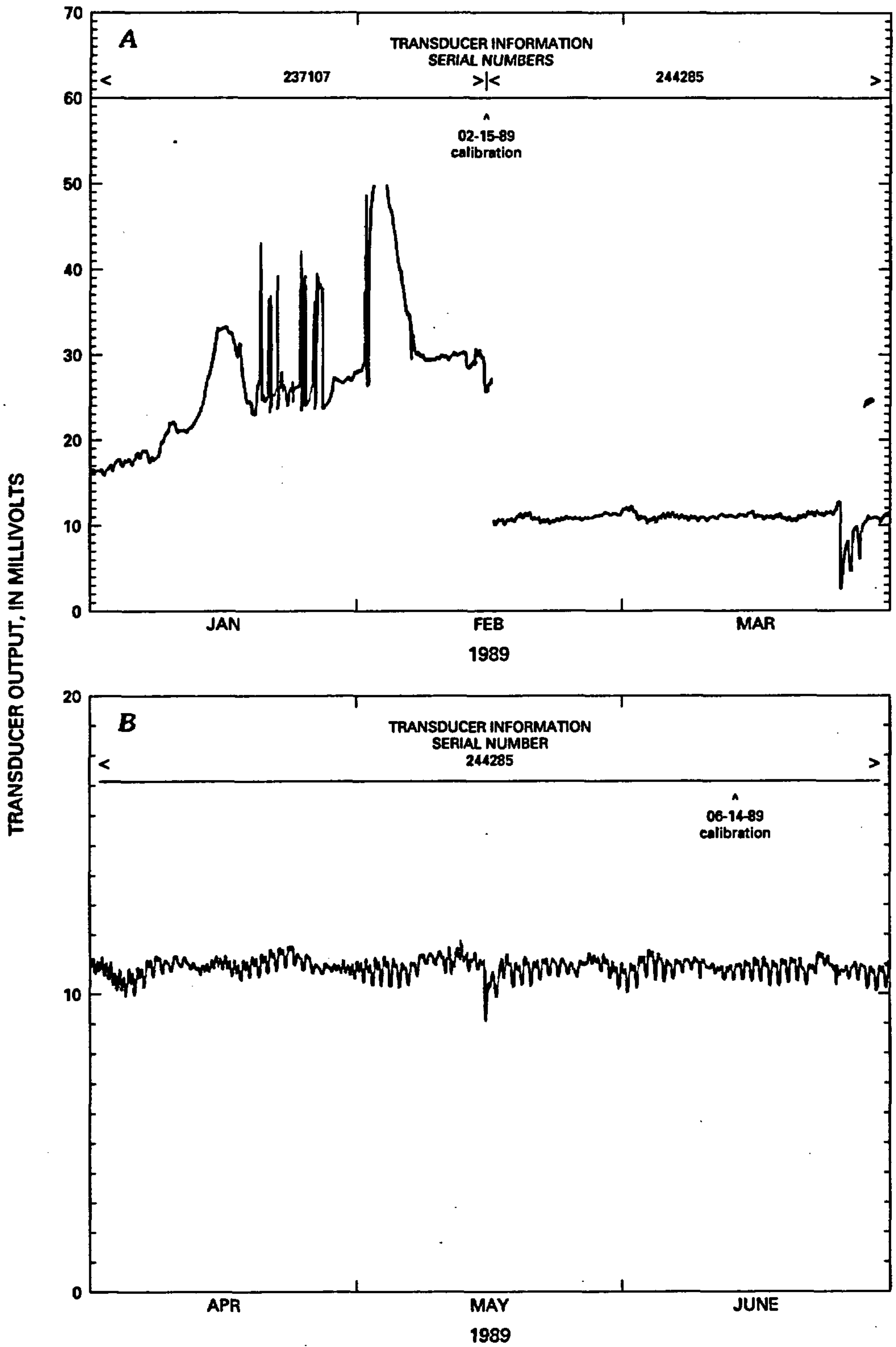


Figure 26.--Transducer output for well UE-25p #1.

UE-25p #1
Site ID: 364938116252102
INTERVAL: 1,297-1,805

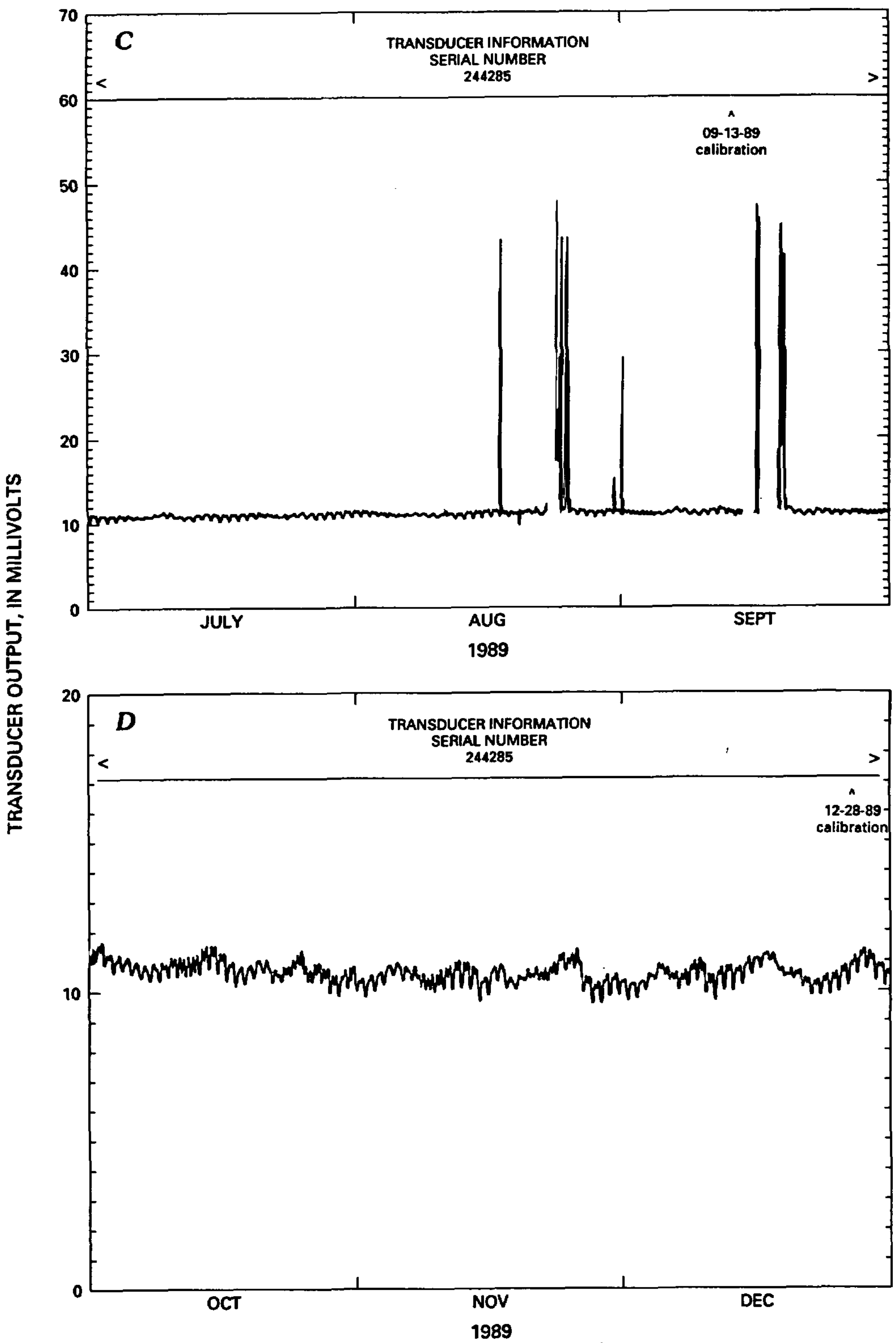


Figure 26.--Transducer output for well UE-25p #1.--Continued

tifiable event and probably represent a system malfunction of some type. The details of the spikes are as follows:

Date	Time	Value (millivolts)	
		Recorded	Expected
08-30-89	17:00	15.18	11.39
08-31-89	14:00	29.47	10.90

In this table, the expected value is the mean of the previous and subsequent values. The spikes, if converted to water levels, would represent water-level changes in a 1-hour period of 0.54 m and 2.65 m. Because the possibility that some sort of system malfunction exists, these points were not converted to water levels.

Transducer output was converted to water-level altitude for the following periods:

Beginning date	Ending date
02-16-89	03-25-89
03-29-89	05-10-89
05-18-89	08-16-89
08-26-89	09-09-89
09-20-89	12-31-89

The water-level altitudes are shown in figure 27A through 27D, and the daily mean water-level altitudes are given in table 10. Approximately 79 percent of the transducer output was converted to water-level altitude. The longest period in 1989 was 103 days, September 20 through December 31, 1989. The longest period to date was 470 days, March 7, 1985 through June 19, 1986.

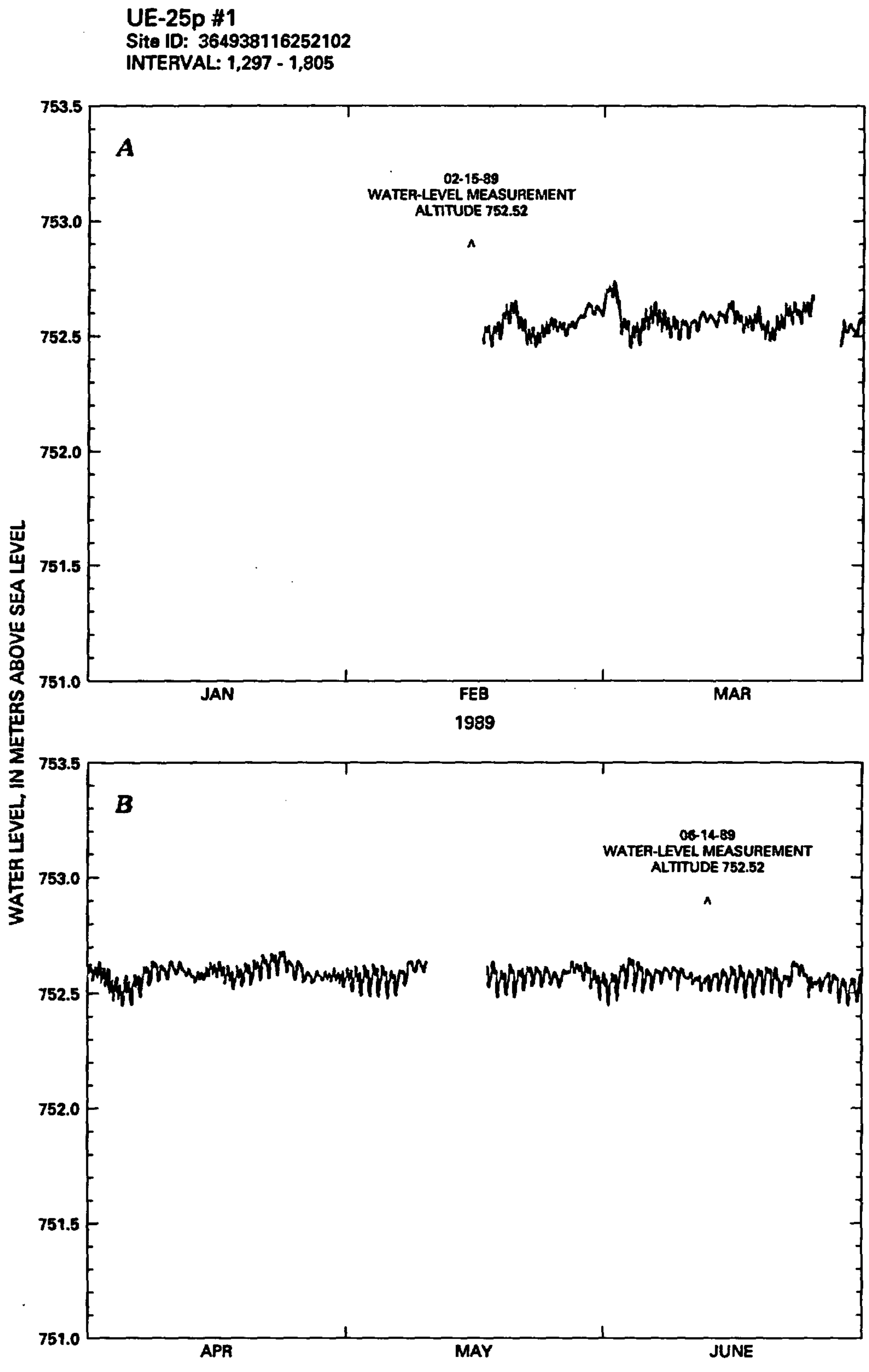


Figure 27.--Water-level altitude for well UE-25p #1.

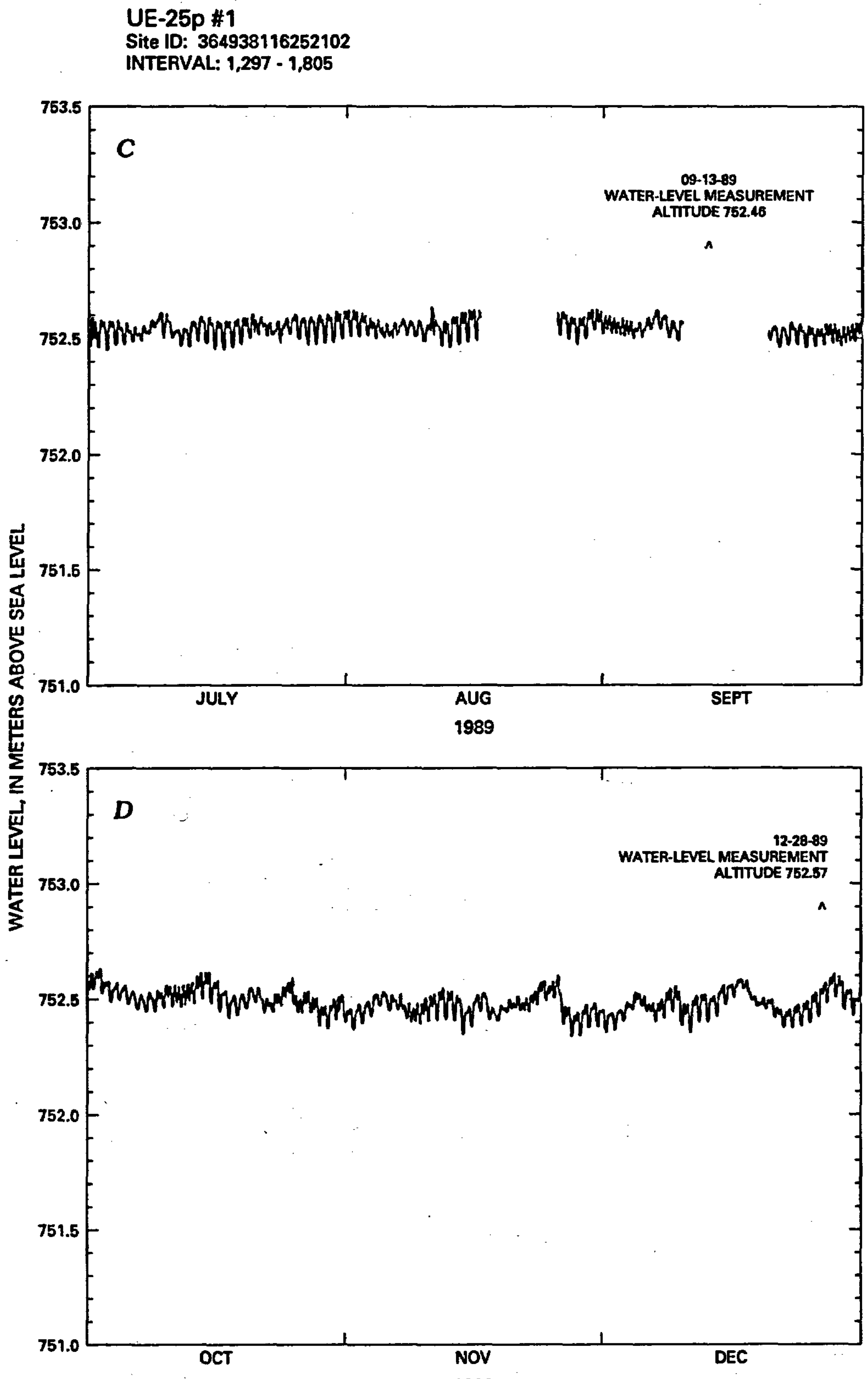


Figure 27.--Water-level altitude for well UE-25p #1.--Continued

Table 10. *Daily mean water-level altitude for 1989, in meters above sea level, for well UE-25p #1*
[Monthly mean, maximum (max), and minimum (min) computed from the daily mean values, indicated only for months that have complete data sets. Dashes indicate insufficient data to calculate daily mean water-level altitude]

Interval: 1,297-1,805 m — Site ID: 364938116252102

DAY	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
						1989						
1	—	—	752.61	752.59	752.57	752.54	752.54	752.57	752.55	752.55	752.42	752.42
2	—	—	752.69	752.58	752.57	752.56	752.53	752.57	752.54	752.58	752.43	752.41
3	—	—	752.64	752.56	752.56	752.60	752.52	752.56	752.54	752.54	752.45	752.42
4	—	—	752.53	752.51	752.57	752.60	752.53	752.54	752.53	752.52	752.48	752.45
5	—	—	752.51	752.51	752.57	752.58	752.52	752.53	752.54	752.52	752.50	752.49
6	—	—	752.56	752.52	752.55	752.57	752.52	752.53	752.58	752.50	752.48	752.48
7	—	—	752.59	752.55	752.55	752.59	752.52	752.55	752.57	752.48	752.47	752.45
8	—	—	752.57	752.59	752.59	752.60	752.54	752.54	752.54	752.48	752.44	752.46
9	—	—	752.54	752.59	752.62	752.60	752.57	752.54	—	752.49	752.43	752.50
10	—	—	752.54	752.59	—	752.58	752.56	752.52	—	752.50	752.45	752.49
11	—	—	752.54	752.60	—	752.57	752.52	752.56	—	752.50	752.47	752.43
12	—	—	752.56	752.59	—	752.55	752.51	752.52	—	752.50	752.49	752.46
13	—	—	752.58	752.57	—	752.56	752.52	752.54	—	752.51	752.49	752.48
14	—	—	752.57	752.57	—	752.57	752.54	752.55	—	752.55	752.46	752.47
15	—	—	752.59	752.60	—	752.57	752.54	752.56	—	752.56	752.42	752.51
16	—	752.51	752.62	752.60	—	752.58	752.53	—	—	752.53	752.46	752.53
17	—	752.52	752.57	752.58	—	752.56	752.52	—	—	752.49	752.48	752.56
18	—	752.58	752.56	752.57	752.59	752.56	752.53	—	—	752.47	752.43	752.55
19	—	752.61	752.58	752.58	752.56	752.58	752.54	—	—	752.47	752.44	752.49
20	—	752.54	752.53	752.59	752.57	752.58	752.55	—	752.52	752.50	752.46	752.48
21	—	752.50	752.53	752.61	752.56	752.55	752.55	—	752.51	752.50	752.47	752.47
22	—	752.50	752.58	752.62	752.57	752.58	752.54	—	752.52	752.47	752.47	752.43
23	—	752.54	752.60	752.64	752.58	752.62	752.53	—	752.52	752.47	752.50	752.42
24	—	752.54	752.60	752.64	752.58	752.57	752.54	—	752.51	752.50	752.54	752.44
25	—	752.53	—	752.60	752.58	752.55	752.56	—	752.51	752.53	752.53	752.45
26	—	752.55	—	752.59	752.56	752.56	752.55	752.57	752.52	752.47	752.51	752.48
27	—	752.59	—	752.57	752.60	752.56	752.54	752.55	752.52	752.49	752.42	752.52
28	—	752.62	—	752.57	752.61	752.54	752.54	752.54	752.51	752.46	752.40	752.56
29	—		752.52	752.57	752.60	752.53	752.55	752.56	752.52	752.43	752.42	752.55
30	—		752.53	752.57	752.57	752.54	752.55	752.58	752.53	752.44	752.44	752.51
31	—		752.57		752.55		752.57	752.56		752.46		752.49
MONTHLY												
MEAN	—	—	—	752.58	—	752.57	752.54	—	—	752.50	752.46	752.48
MAX	—	—	—	752.64	—	752.62	752.57	—	—	752.58	752.54	752.56
MIN	—	—	—	752.51	—	752.53	752.51	—	—	752.43	752.40	752.41

Well USW G-3

Information about the history of well USW G-3 and about previous data from the well was obtained from various sources. These sources are: Robison (1984, 1986); Robison and others (1988); Fenix & Scisson, Inc. (1987b, c).

Well specifications

The following are specifications for well USW G-3:

1. Location and identification:

   Latitude and longitude: 36°49'05" N.; 116°28'01" W.
   Nevada State Central Zone Coordinates (m): N 229,447; E 170,226.
   U.S. Geological Survey Site ID: 364905116280101.

2. Drilling and casing information:

   Well started: January 8, 1982.
   Well completed: March 21, 1982.
   Drilling method: Rotary, using mostly air-foam, and occasional polymer added for circulating medium; many drilling problems encountered in upper part of hole, including lost circulation and lost or stuck tools; hole cored from 795 m to total depth.
   Bit diameter below water level: 222 mm to 792 m; 121 mm from 792 to 795 m; 100 mm from 795 m to total depth.
   Casing extending below water level: 126-mm inside diameter to 792 m; bottom casing tack cemented; no perforations.
   Total drilled depth: 1,533 m.

3. Access to and description of interval for measuring water levels:

   Casing, 126-mm inside diameter, extending from land surface to a depth of 792 m; saturated interval of borehole within Tram member of the Crater Flat Tuff and the Lithic Ridge Tuff.

4. Information for calculating water-level altitude:

   Reference point: Top of metal tag on well casing; altitude 1,480.47 m (surveyed by U.S. Geological Survey, 1984).
   Depth correction for borehole deviation from vertical: 0.57 m, based on approximate depth to water of 750 m.

History of instrumentation, calibrations, and comments

Manual water-level measurements were made from December 22, 1982 through March 12, 1986. Beginning in March 1986, the water level has been monitored continuously using a down-hole pressure transducer with a data logger at land surface.

The following transducer was used in well USW G-3 in 1989:

[Range is pressure limit for transducer, in pounds per square inch]

Date of use		Transducer			
Beginning	Ending	Type	Model	Range	Serial number
10-14-88	12-31-90[1]	Gage	I.M.O.	15	305061

[1]Still in use as of December 31, 1990.

The following calibrations of the water-level monitoring system were used to process the 1989 data from well USW G-3:

Transducer				Water level	
		Regression line			
Serial number	Calibration date	Slope (millivolts per meter)	Coefficient of determination	Date	Altitude (meters)
305061	10-14-88	-1.314	1.000	10-14-88	730.36
305061	02-02-89	-1.349	1.000	02-02-89	730.47
305061	05-10-89	-1.306	0.999	05-10-89	730.40
305061	08-22-89	-1.316	1.000	08-22-89	730.36
305061	11-13-89	-1.080	1.000	11-13-89	730.34
305061	12-19-89	-1.300	0.999	12-19-89	730.35

The calibration of November 13, 1989 appears to have been during a period of anomalous output of the transducer (fig. 28D) and was not used to convert millivolt readings to water levels.

Transducer output from January through December 1989 is shown in figure 28a through 28D. These data are the transducer output after first-level filtering (described in the "First-Level Filtering" section) has been applied. The transducer (serial number 305061) produced reasonable output except for several days in January and February (fig. 28A), most of May, several days in June (fig. 28B), most of August, several days in September (fig. 28C), several days at the end of October, and all of November and December, 1989 (fig. 28D). The daily variation in output of transducer used in this well was very small (less than 0.1 mv in most cases). Much of the short term variation is probably noise in the recording system which was greater than the actual variation in transducer output. The transducer was still in use December 31, 1990.

USW G-3
Site ID: 364905116280101
INTERVAL: 750-1,533

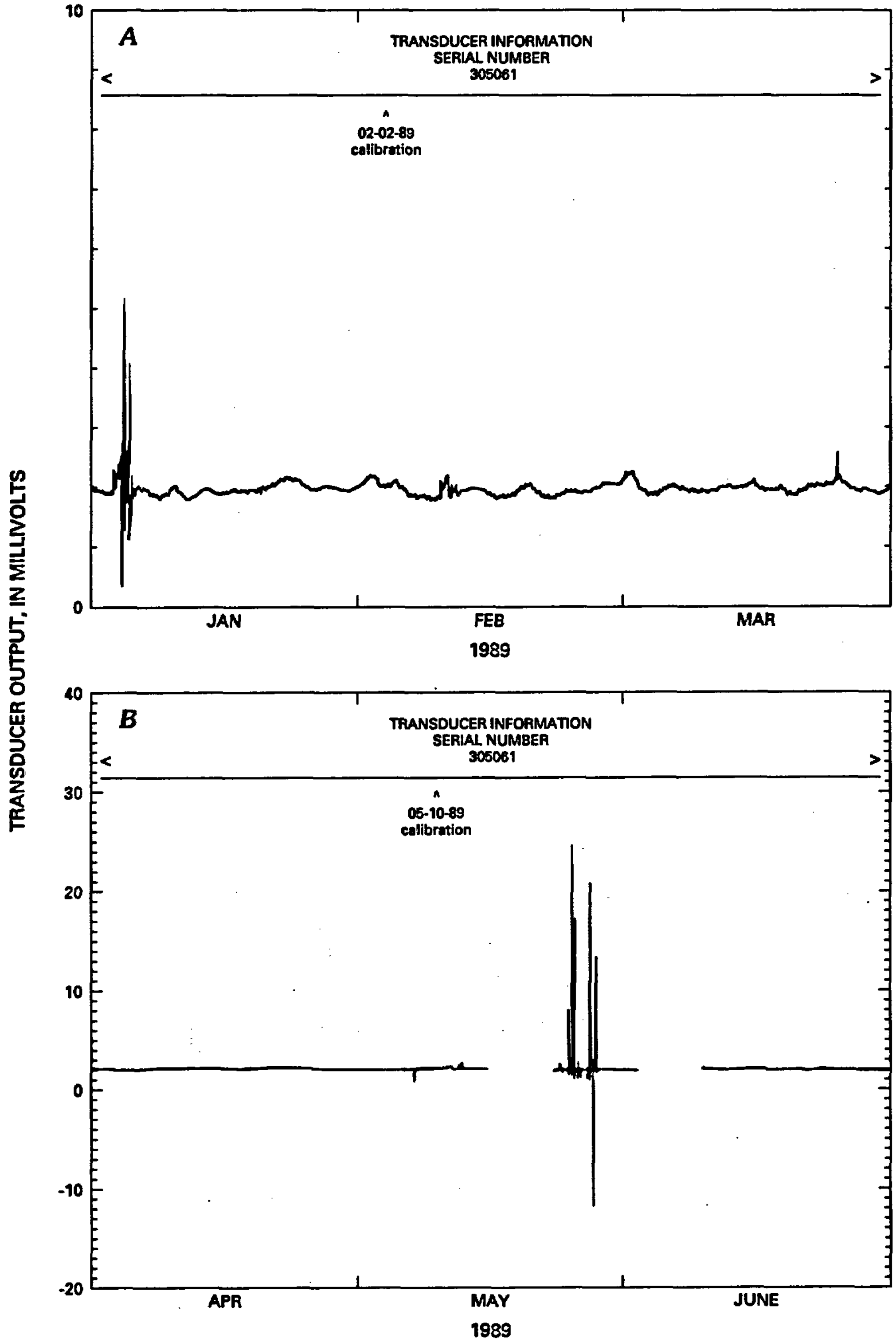


Figure 28.--Transducer output for well USW G-3.

USW G-3
Site ID: 364905116280101
INTERVAL: 750-1,533

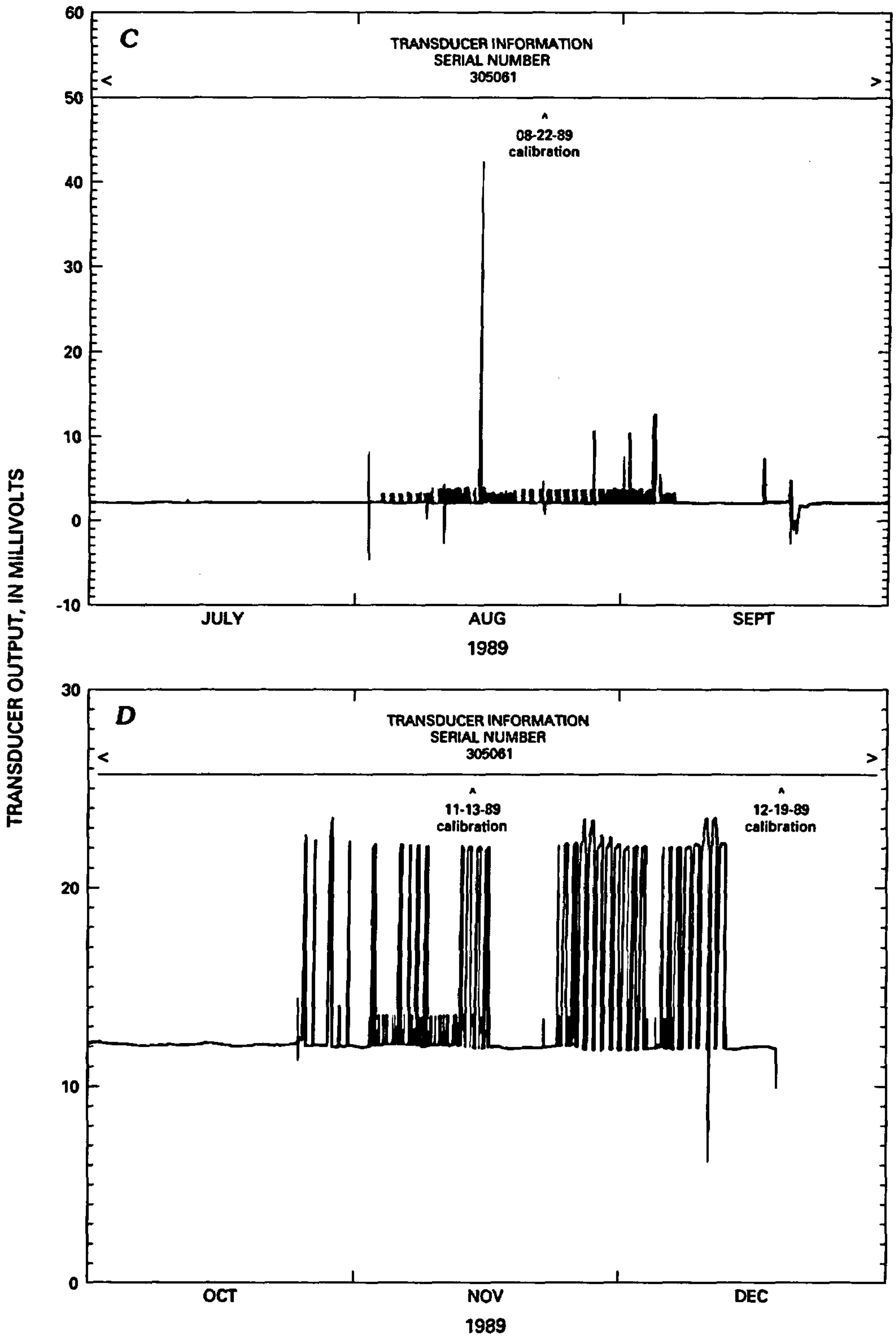


Figure 28.--Transducer output for well USW G-3.--Continued

There were two spikes in the transducer output in 1989 (fig. 28). Each of these spikes represents a single transducer output that deviates from the trend of the record. These spikes were not coincident with a site visit or any other identifiable event and probably represent a system malfunction of some type. The details of the spikes are as follows:

Date	Time	Value (millivolts)	
		Recorded	Expected
03-25-89	22:54	2.58	2.15
07-12-89	13:00	2.32	1.89

These rapid changes of 0.43 millivolts would represent changes in water level of 0.33 meters. These values were not converted to water levels.

From February 9 through 11, the instrumentation seemed to be malfunctioning. Although the water level that could be calculated from transducer output during that period would be within a reasonable range, the rapid variation indicated is unlikely (fig. 28A), therefore, the data from that period was excluded from the data converted to water-level altitude.

Transducer output was converted to water-level altitude for the following periods:

Beginning date	Ending date
01-01-89	01-02-89
01-06-89	02-08-89
02-12-89	05-04-89
06-10-89	08-01-89
09-07-89	09-15-89
09-22-89	10-22-89

The water-level altitudes are shown in figure 29A through 29D, and the daily mean water-level altitudes are given in table 11. Approximately 58 percent of the transducer output was converted to water-level altitude. The longest period in 1989 was 82 days, February 12 through May 4, 1989. The longest period of continuous record for USW G-3 was 163 days, January 23 through July 4, 1987.

USW G-3
Site ID: 364905116280101
INTERVAL: 750 - 1,533

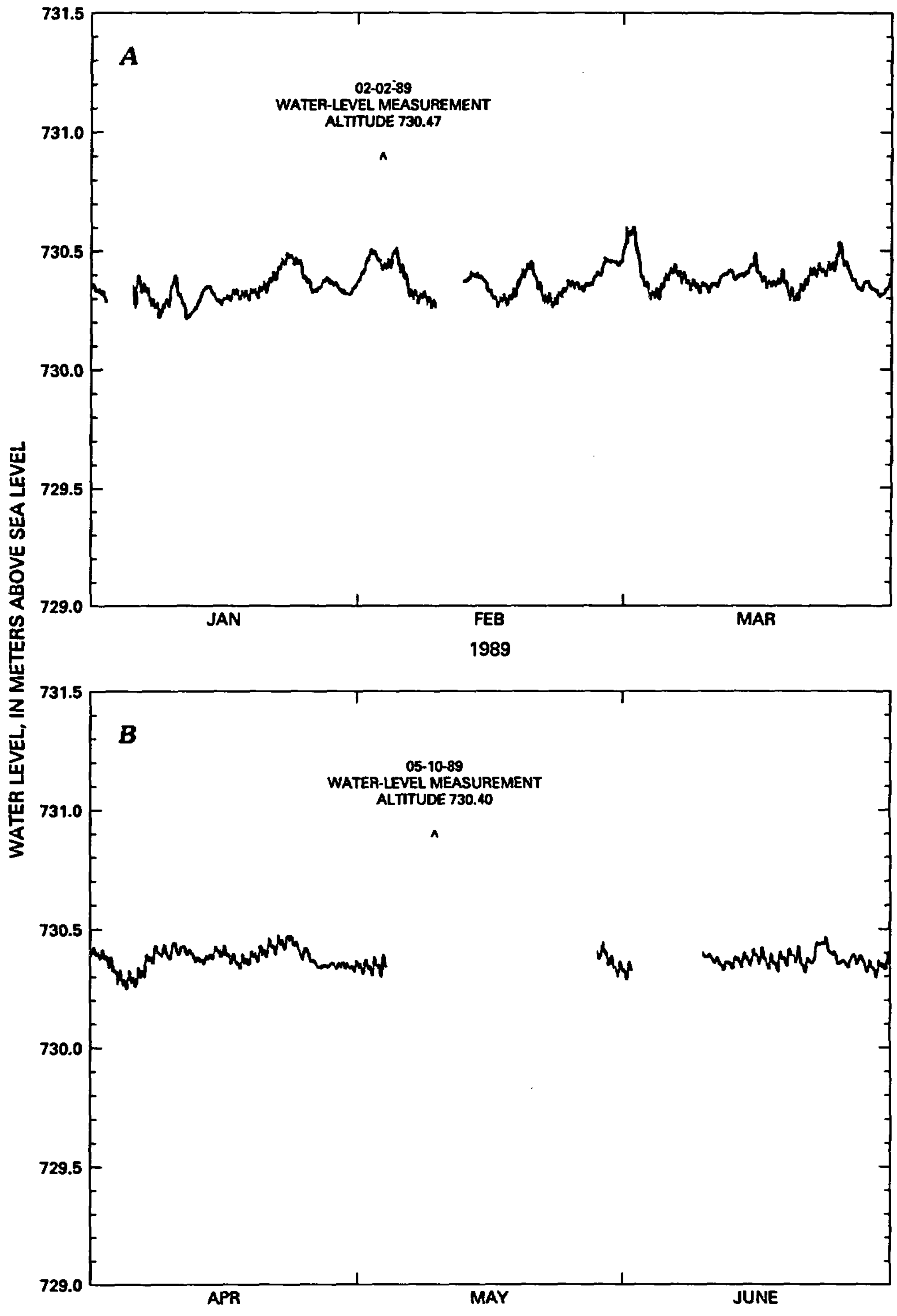


Figure 29.--Water-level altitude for well USW G-3.

USW G-3
Site ID: 364905116280101
INTERVAL: 750 - 1,533

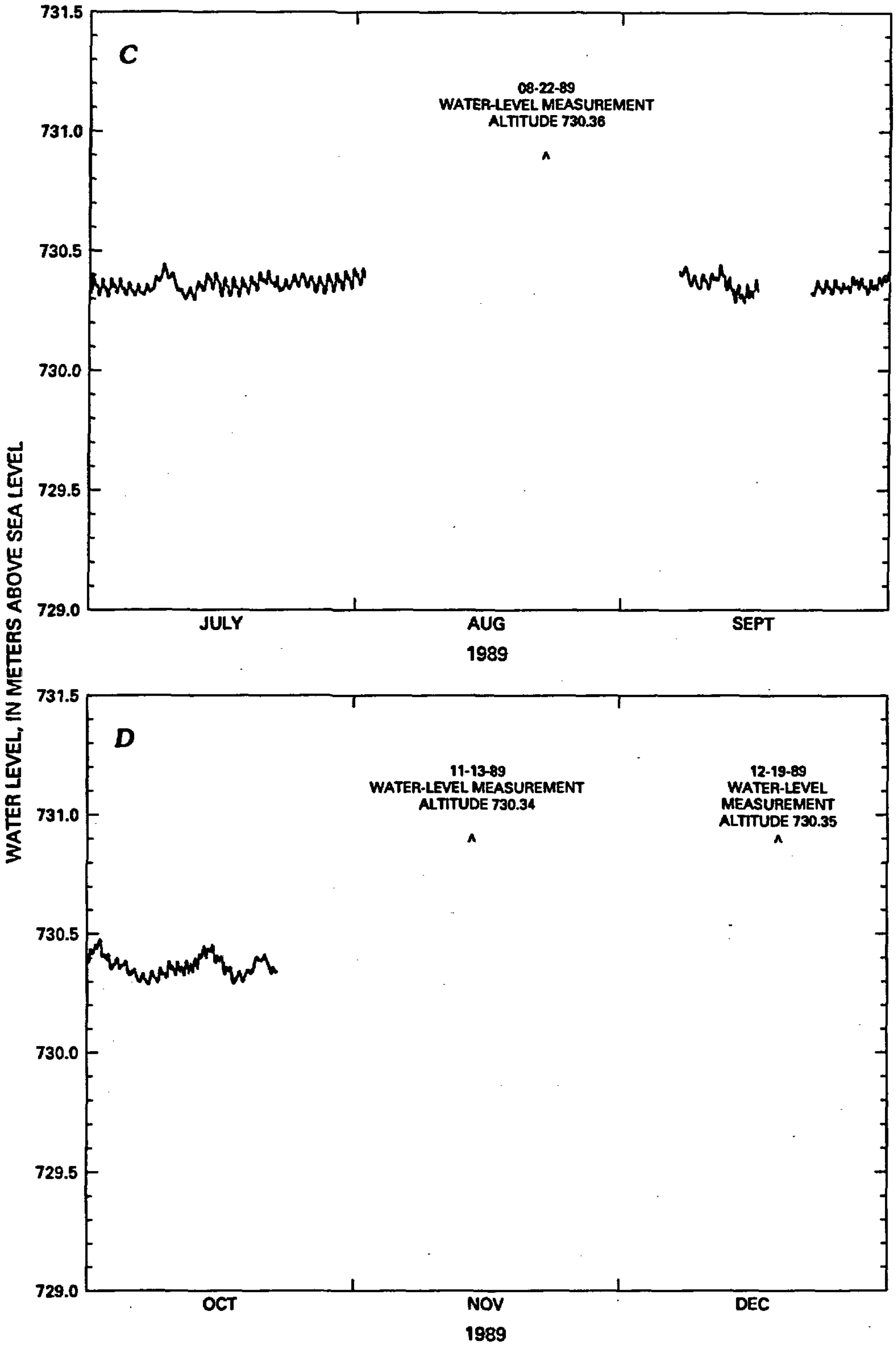


Figure 29.--Water-level altitude for well USW G-3.--Continued

Table 11. *Daily mean water-level altitude for 1989, in meters above sea level, for well USW G-3*
[Monthly mean, maximum (max), and minimum (min) computed from the daily mean values, indicated only for months that have complete data sets. Dashes indicate insufficient data to calculate daily mean water-level altitude]

Interval: 750-1,533 m — Site ID: 364905116280101

DAY	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
						1989						
1	730.35	730.48	730.45	730.40	730.34	—	730.36	—	—	730.40	—	—
2	—	730.46	730.55	730.39	730.34	—	730.35	—	—	730.45	—	—
3	—	730.44	730.51	730.35	730.34	—	730.34	—	—	730.40	—	—
4	—	730.47	730.35	730.29	—	—	730.35	—	—	730.37	—	—
5	—	730.39	730.32	730.28	—	—	730.34	—	—	730.37	—	—
6	730.33	730.31	730.36	730.29	—	—	730.33	—	—	730.33	—	—
7	730.33	730.31	730.41	730.33	—	—	730.33	—	730.41	730.31	—	—
8	730.26	730.28	730.39	730.39	—	—	730.35	—	730.37	730.31	—	—
9	730.27	730.35	730.36	730.40	—	—	730.40	—	730.37	730.32	—	—
10	730.35	730.42	730.35	730.40	—	730.38	730.39	—	730.37	730.34	—	—
11	730.28	730.36	730.35	730.41	—	730.36	730.34	—	730.40	730.35	—	—
12	730.23	730.38	730.37	730.40	—	730.35	730.32	—	730.36	730.35	—	—
13	730.30	730.39	730.40	730.37	—	730.36	730.33	—	730.32	730.36	—	—
14	730.34	730.36	730.39	730.37	—	730.37	730.37	—	730.32	730.41	—	—
15	730.29	730.30	730.40	730.39	—	730.38	730.37	—	—	730.42	—	—
16	730.30	730.29	730.44	730.40	—	730.39	730.35	—	—	730.39	—	—
17	730.32	730.31	730.38	730.37	—	730.36	730.34	—	—	730.34	—	—
18	730.31	730.38	730.36	730.36	—	730.36	730.34	—	—	730.31	—	—
19	730.32	730.43	730.38	730.37	—	730.38	730.35	—	—	730.33	—	—
20	730.34	730.35	730.32	730.39	—	730.39	730.37	—	—	730.37	—	—
21	730.38	730.29	730.32	730.41	—	730.35	730.38	—	—	730.39	—	—
22	730.43	730.30	730.38	730.43	—	730.39	730.37	—	730.34	—	—	—
23	730.47	730.34	730.42	730.44	—	730.44	730.35	—	730.35	—	—	—
24	730.45	730.36	730.42	730.44	—	730.40	730.37	—	730.35	—	—	—
25	730.37	730.35	730.45	730.40	—	730.36	730.38	—	730.35	—	—	—
26	730.34	730.37	730.47	730.37	—	730.37	730.37	—	730.36	—	—	—
27	730.37	730.42	730.38	730.34	—	730.37	730.36	—	730.36	—	—	—
28	730.36	730.46	730.35	730.35	—	730.34	730.36	—	730.35	—	—	—
29	730.33		730.35	730.34	—	730.33	730.37	—	730.36	—	—	—
30	730.33		730.32	730.34	730.36	730.36	730.38	—	730.38	—	—	—
31	730.39		730.36		730.33		730.39	—		—		—
MONTHLY												
MEAN	—	730.37	730.39	730.37	—	—	730.36	—	—	—	—	—
MAX	—	730.48	730.55	730.44	—	—	730.40	—	—	—	—	—
MIN	—	730.28	730.32	730.28	—	—	730.32	—	—	—	—	—

Well USW H-1

Information about the history of well USW H-1 and about previous data from the well was obtained from various sources. These sources are: Rush and others (1983); Rush and others (1984); Robison (1984, 1986); Robison and others (1988); Fenix & Scisson, Inc. (1987a, c).

Well specifications

The following are specifications for well USW H-1:

1. Location and identification:

   Latitude and longitude: 36°51'57" N.; 116°27'12" W.
   Nevada State Central Zone Coordinates (m): N 234,774; E 171,416.
   U.S. Geological Survey Site ID's:
   365157116271201 (entire well)
   365157116271202 (lowermost interval)
   365157116271203 (second interval from bottom)
   365157116271204 (third interval from bottom)
   365157116271205 (uppermost interval)

2. Drilling and casing information:

   Well started: September 3, 1980.
   Well completed: January 25, 1981 (initial completion, including geophysical logging and hydraulic testing); July 6, 1982 (re-completion; four piezometers installed).
   Drilling method: Rotary, using rock bits and air-foam circulating medium; cores obtained in selected intervals.
   Bit diameter below water level: 311 mm to 688 m; 222 mm from 688 m to 1,829 m.
   Casing extending below water level: 226-mm inside diameter to 687 m. Casing string is tack cemented and perforated below the water table. See section 3 for description of intervals open to water.
   Total drilled depth: 1,829 m.

3. Access to and description of interval for measuring water levels:

   Tube 1—44-mm inside diameter, that has a 3.6-m long well screen on bottom, extending from land surface to depth of 1,806 m; responds to depth interval from 1,783 to 1,814 m within older flows and tuffs beneath the Lithic Ridge Tuff (Carr, 1988, p.37); Site ID: 365157116271202.
   Tube 2—44-mm inside diameter, that has a 3.6-m long well screen on bottom, extending from land surface to depth of 1,115 m; responds to depth interval from 1,097 to 1,123 m within Tram Member of Crater Flat Tuff, and lava flow and flow breccia beneath the Tram Member; Site ID: 365157116271203.
   Tube 3—44-mm inside diameter, that has a 3.6-m long well screen on bottom, extending from land surface to depth of 741 m;

responds to depth interval from 716 to 765 m within Bullfrog Member of Crater Flat Tuff; Site ID: 365157116271204.

Tube 4–62-mm inside diameter, open ended, extending from land surface to depth of 640 m; responds to depth interval from 572 to 673 m within Prow Pass Member of Crater Flat Tuff; Site ID: 365157116271205.

Note: During re-completion, a gravel pack was placed in the vicinity of the well screens for tubes 1, 2, and 3; and other intervals were grouted with cement to ensure that the piezometers are isolated hydraulically from each other.

4. Information for calculating water-level altitude:

Reference point: Top of metal tag on well casing; altitude 1,303.10 m (surveyed by U.S. Geological Survey, 1984).

Depth correction for borehole deviation from vertical:
0.14 m in tube 1, based on approximate depth to water of 518 m;
0.17 m in tubes 2, 3, and 4; based on approximate depths to water of 572 m.

History of instrumentation, calibrations, and comments

Manual water-level measurements on the open hole were made from 1981 through early 1982. An unsuccessful attempt was made at continuous monitoring of water levels July 1982 through June 1983 using downhole pressure transducers and a datalogger recording data on paper tape. Manual measurements of water levels in the four peizometer tubes were made from June 1983 through February 1985. Beginning in February 1985, the water level has been monitored continuously using downhole pressure transducers with a data logger at land surface.

The following transducers were used in well USW H-1 in 1989:

[Range is pressure limit for transducer, in pounds per square inch]

Date of use		Transducer			
Beginning	Ending	Type	Model	Range	Serial number
		Site ID: 365157116271202			
		Interval: 1,783-1,814 meters (Tube 1)			
11-22-88	10-05-89	Gage	Druck 930	10	240065
10-06-89	11-07-90	Gage	Druck 930	5	260791
		Site ID: 365157116271203			
		Interval: 1,097-1,123 meters (Tube 2)			
11-25-88	10-05-89	Gage	Druck 930	10	232661
10-06-89	02-06-90	Gage	Druck 930	5	260793
		Site ID: 365157116271204			
		Interval: 716-765 meters (Tube 3)			
08-24-88	12-31-90[1]	Gage	Druck 930	101	239125
		Site ID: 365157116271205			
		Interval: 572-673 meters (Tube 4)			
02-13-85	02-28-89	Gage	Psi-Tronix	15	1856
02-28-89	11-08-90	Gage	Druck 930	10	235187

[1]Still in use as of December 31, 1990.

The following calibrations of the water-level monitoring system were performed in well USW H-1:

Transducer				Water level	
		Regression line			
Serial number	Calibration date	Slope (millivolts per meter)	Coefficient of determination	Date	Altitude (meters)
		Site ID: 365157116271202			
		Interval: 1,783-1,814 meters (Tube 1)			
240065	11-22-88	–7.075	1.000	11-22-88	785.00
240065	03-21-89	–7.139	1.000	03-21-89	785.02
240065	03-21-89	–7.051	1.000	03-21-89	785.02
240065	07-11-89	–7.143	1.000	07-11-89	785.16
260791	10-06-89	–17.796	1.000	10-06-89	785.37
260791	01-29-90	–17.468	1.000	01-29-90	785.22
		Site ID: 365157116271203			
		Interval: 1,097-1,123 meters (Tube 2)			
232661	11-25-88	–7.008	0.999	11-25-88	735.92
232661	03-21-89	–7.019	.999	03-21-89	735.89
232661	07-11-89	–6.988	.999	07-11-89	735.88
232661	10-05-89	–6.788	1.000	10-06-89	736.24
260793	10-06-89	–17.708	1.000	10-06-89	736.24
317093	02-06-90	–7.063	1.000	02-06-90	736.14
		Site ID: 365157116271204			
		Interval: 716-765 meters (Tube 3)			
239125	08-25-88	–7.025	1.000	08-24-88	730.48
239125	03-21-89	–6.964	1.000	03-21-89	730.50
239125	07-11-89	–7.020	1.000	07-11-89	730.52
239125	10-10-89	–6.945	1.000	10-10-89	730.50
239125	01-29-90	–6.826	1.000	01-29-90	730.55
		Site ID: 365157116271205			
		Interval: 572-673 meters (Tube 4)			
1856	08-23-88	–3.901	1.000	08-23-88	730.99
1856	02-28-89	–3.719	1.000	02-28-89	730.96
235187	02-28-89	–6.698	1.000	02-28-89	730.96
235187	06-15-89	–6.447	0.997	06-15-89	730.88
235187	09-14-89	–6.682	1.000	09-14-89	730.84
235187	12-14-89	–6.712	1.000	12-14-89	730.89
235187	03-26-90	–6.550	0.999	03-26-90	730.92

Transducer output from January through December 1989 is shown in figure 30A through 30P. These data are the transducer output after first-level filtering (described in the "First-Level Filtering" section) has been applied. In tube 1, the first transducer (serial number 240065) used from January 1989 through October 1989 generally produced erratic output from January through mid-March (fig. 30A). It produced reasonable output through mid-July (fig. 30B), then erratic output through early October 1989 (fig. 30C and 30D). The second transducer (serial number 260791) in use from October through December 1989, generally produced reasonable output (fig. 30D).

In tube 2, the first transducer (serial number 232661) used from January through early October generally produced reasonable output through early July (fig. 30E, 30F, and 30G). It produced erratic output through early October (fig. 30H). The second transducer (serial number 260793) in use from October through December produced reasonable output until late October, then produced erratic output until late November and again produced reasonable output through December (fig. 30H).

In tube 3, the transducer (serial number 239125) used from January through December 1989 generally produced reasonable output except for a short period in mid-March when the data logger was shorted out and the data were lost (fig. 30I through 30L). This transducer was still in use at the end of December 1990.

In tube 4, the first transducer (serial number 1856) used from January through February 1989, generally produced reasonable output (fig. 30M through 30P). The second transducer (serial number 235187) in use from February through December 1989, generally produced reasonable output except for a short period in March when the data were accidently lost (fig. 30M) and a short period of erratic output in May (fig. 30N) and October 1989 (fig. 30P).

The transducer (serial number 260793) in use at the end of 1989 in tube 2 failed before it could be recalibrated. The calibration of 10-06-89 was used to convert transducer output to water-level altitude without accounting for any drift in the transducer output.

USW H-1
Site ID: 365157116271202
INTERVAL: 1,783-1,1,814

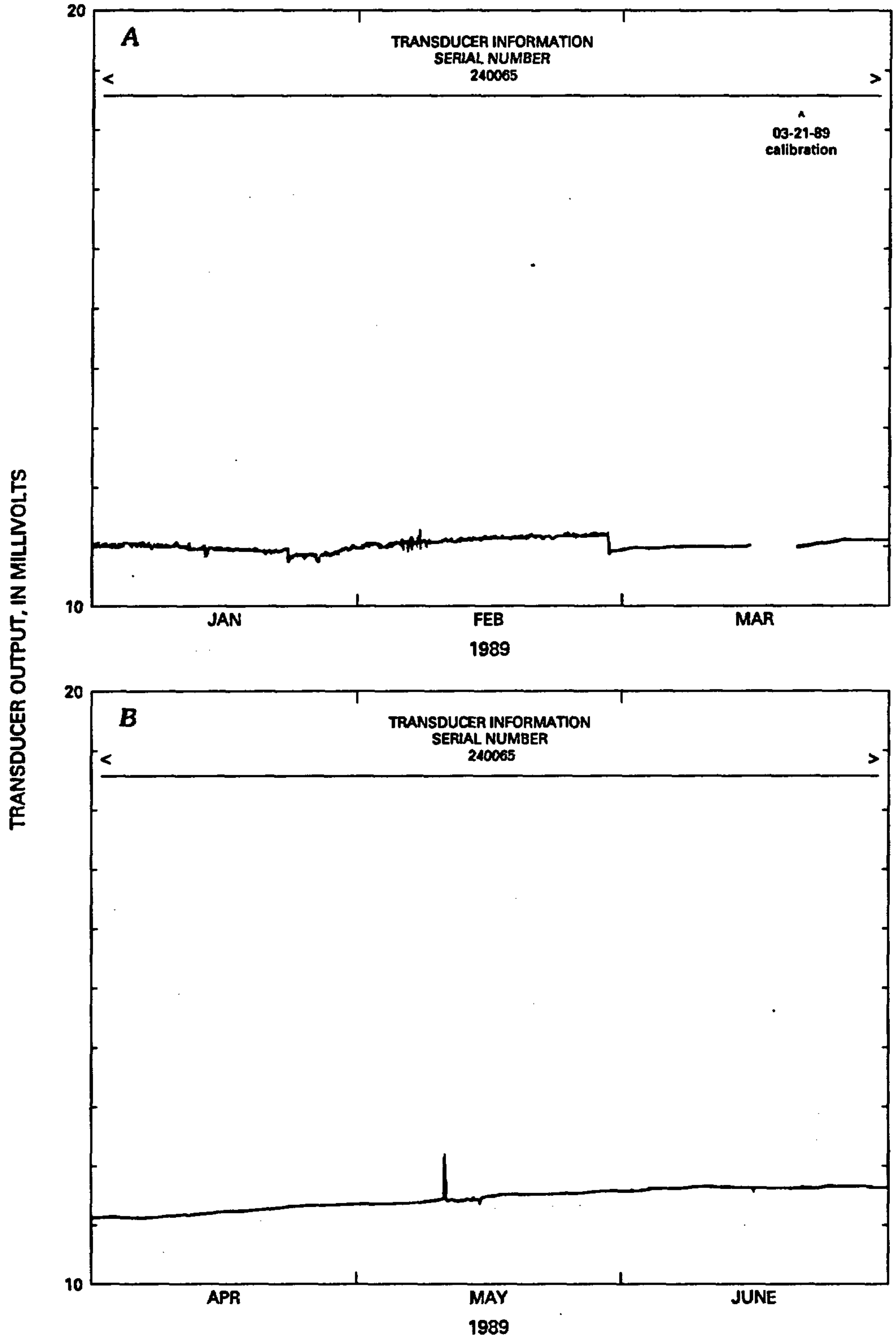


Figure 30.–Transducer output for well USW H-1.

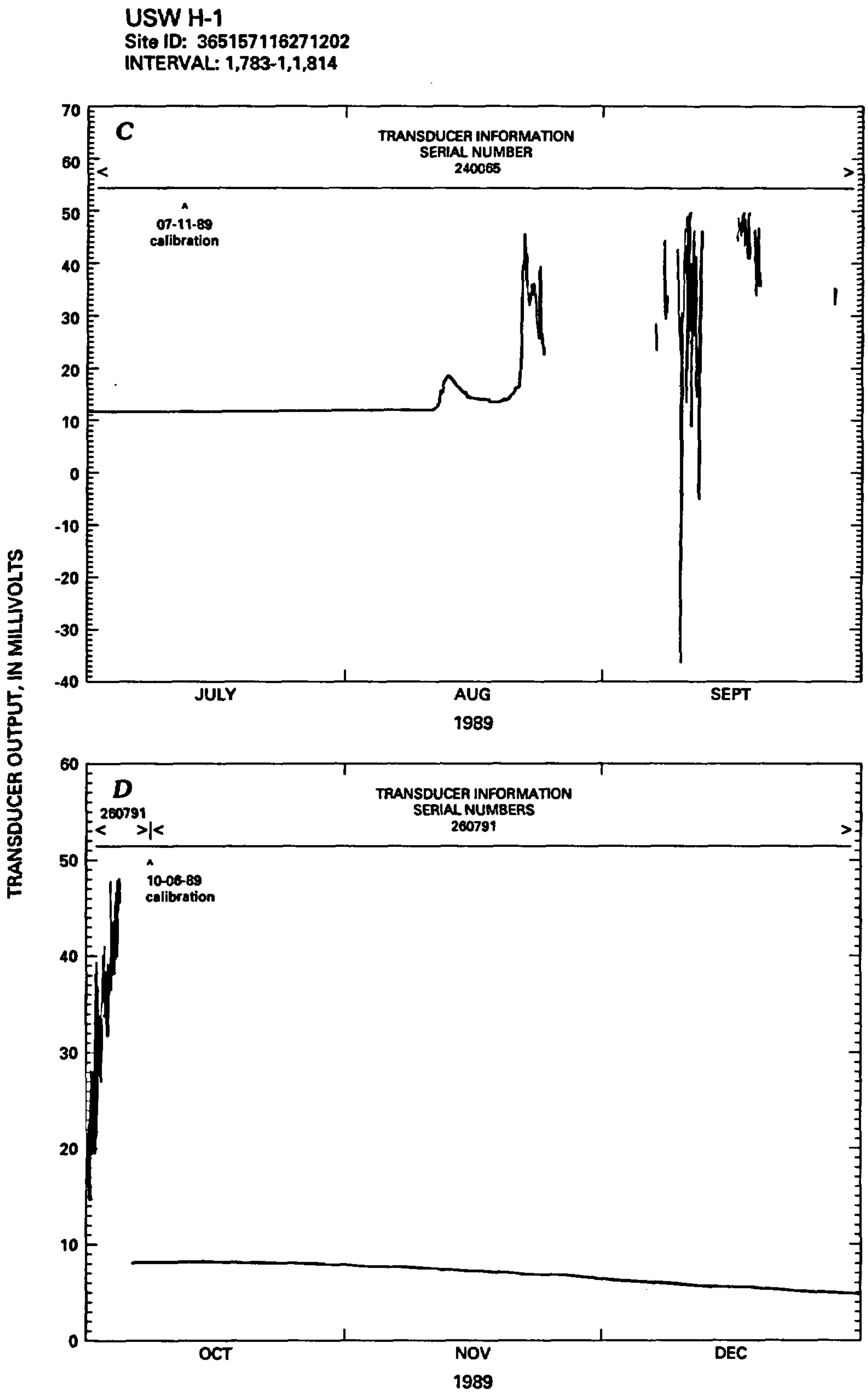


Figure 30.--Transducer output for well USW H-1.--Continued

USW H-1
Site ID: 365157116271203
INTERVAL: 1,097-1,123

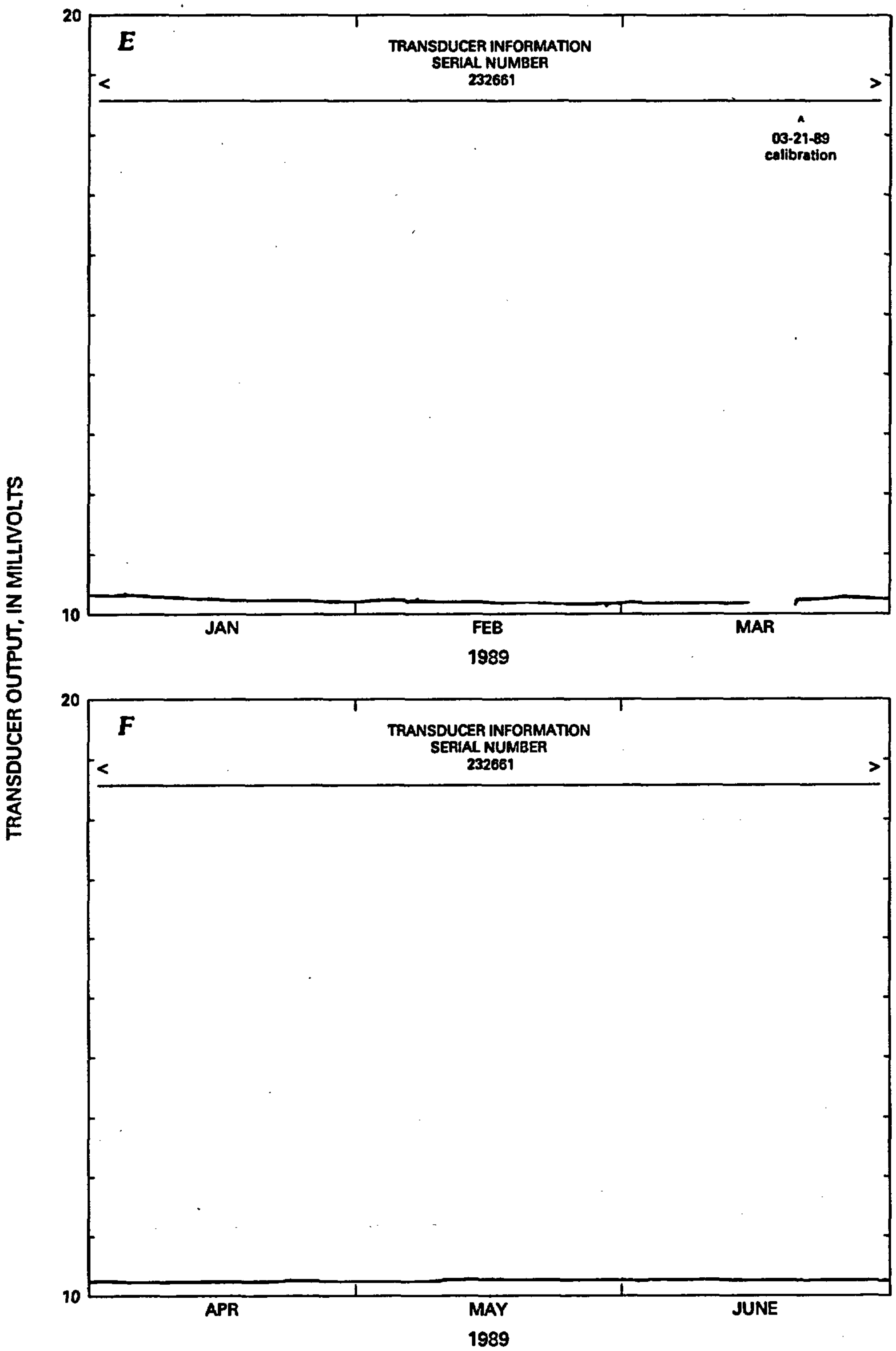


Figure 30.--Transducer output for well USW H-1.--Continued

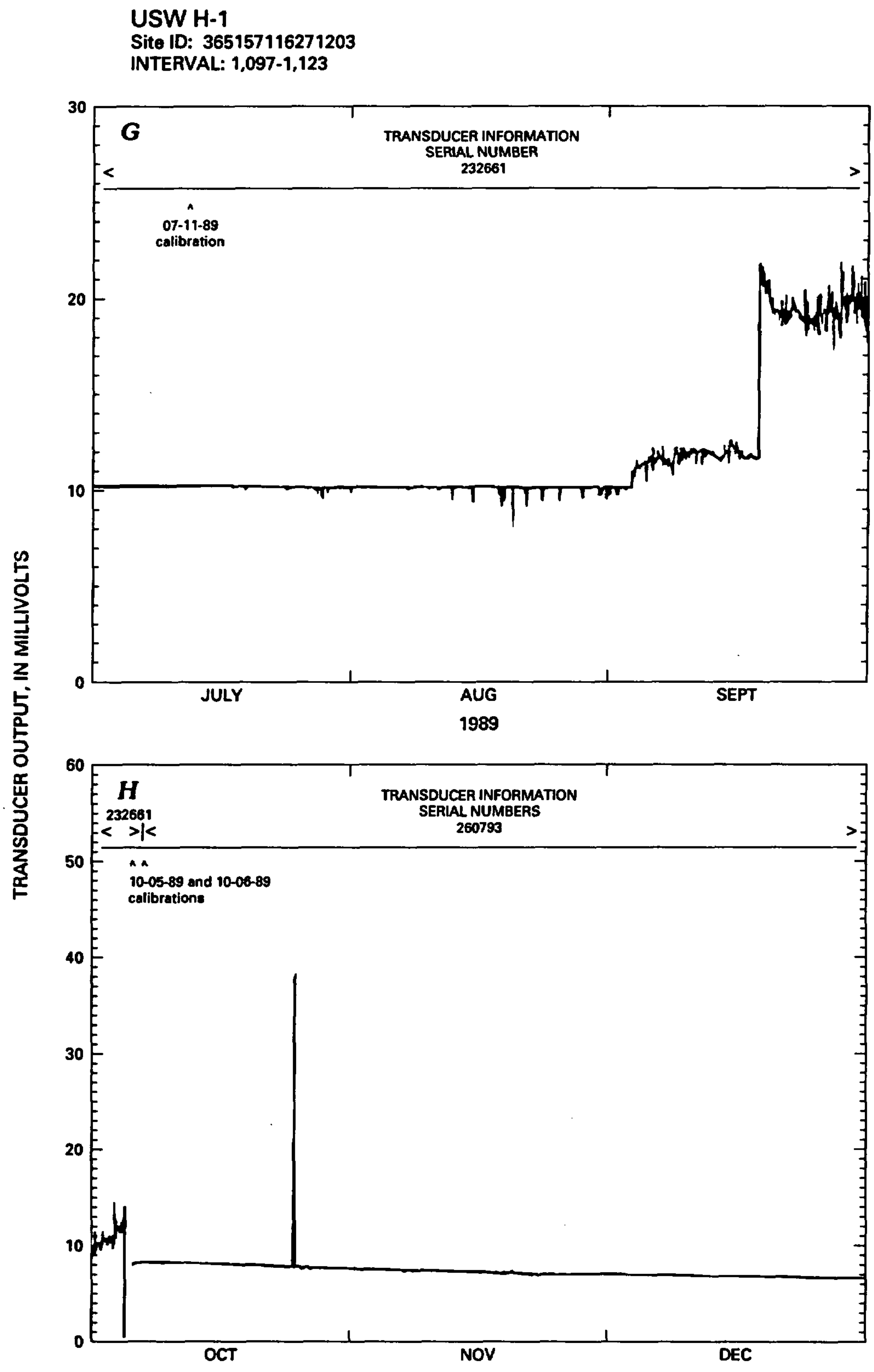


Figure 30.--Transducer output for well USW H-1.--Continued

USW H-1
Site ID: 365157116271204
INTERVAL: 716-765

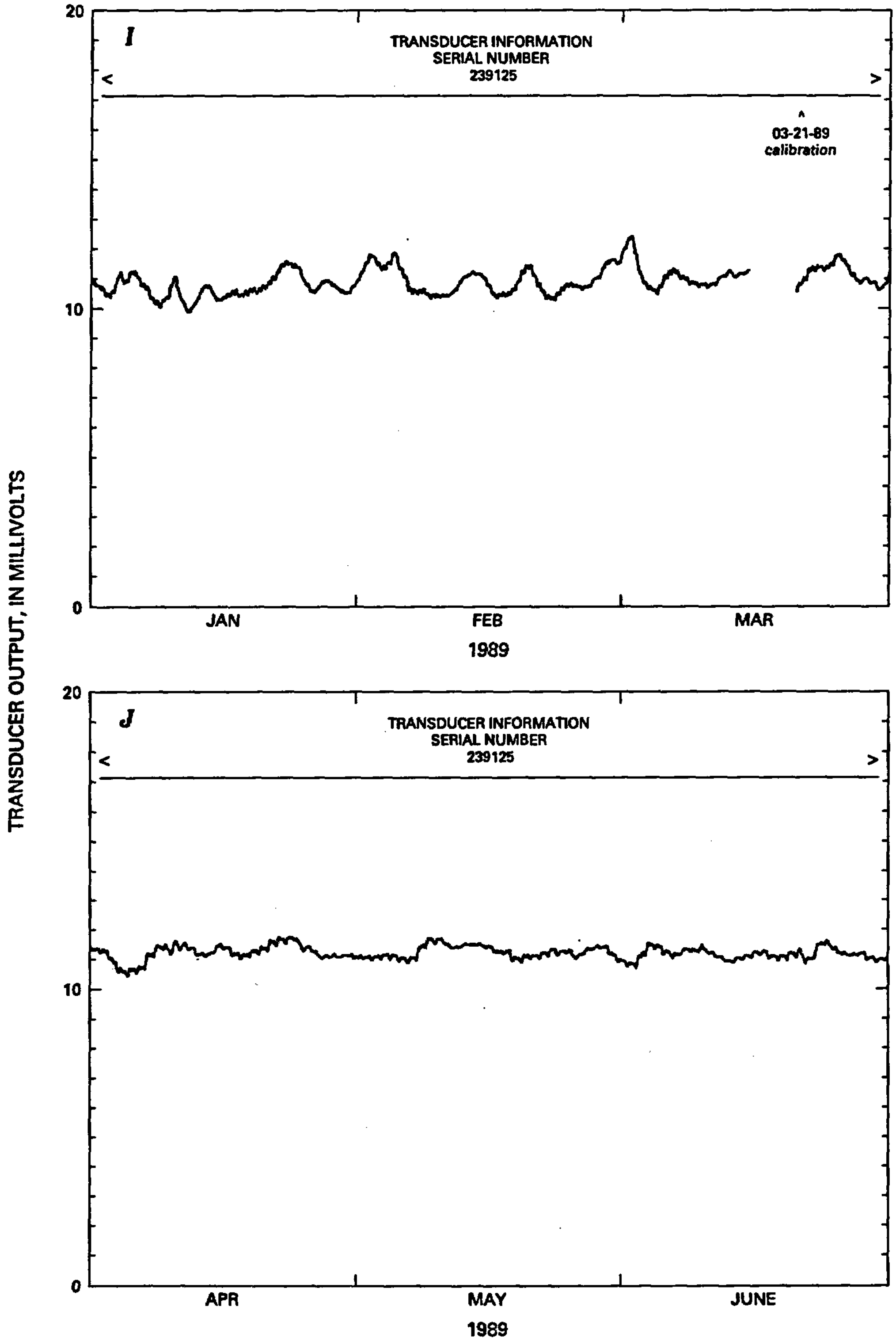


Figure 30.--Transducer output for well USW H-1.--Continued

USW H-1
Site ID: 365157116271204
INTERVAL: 716-765

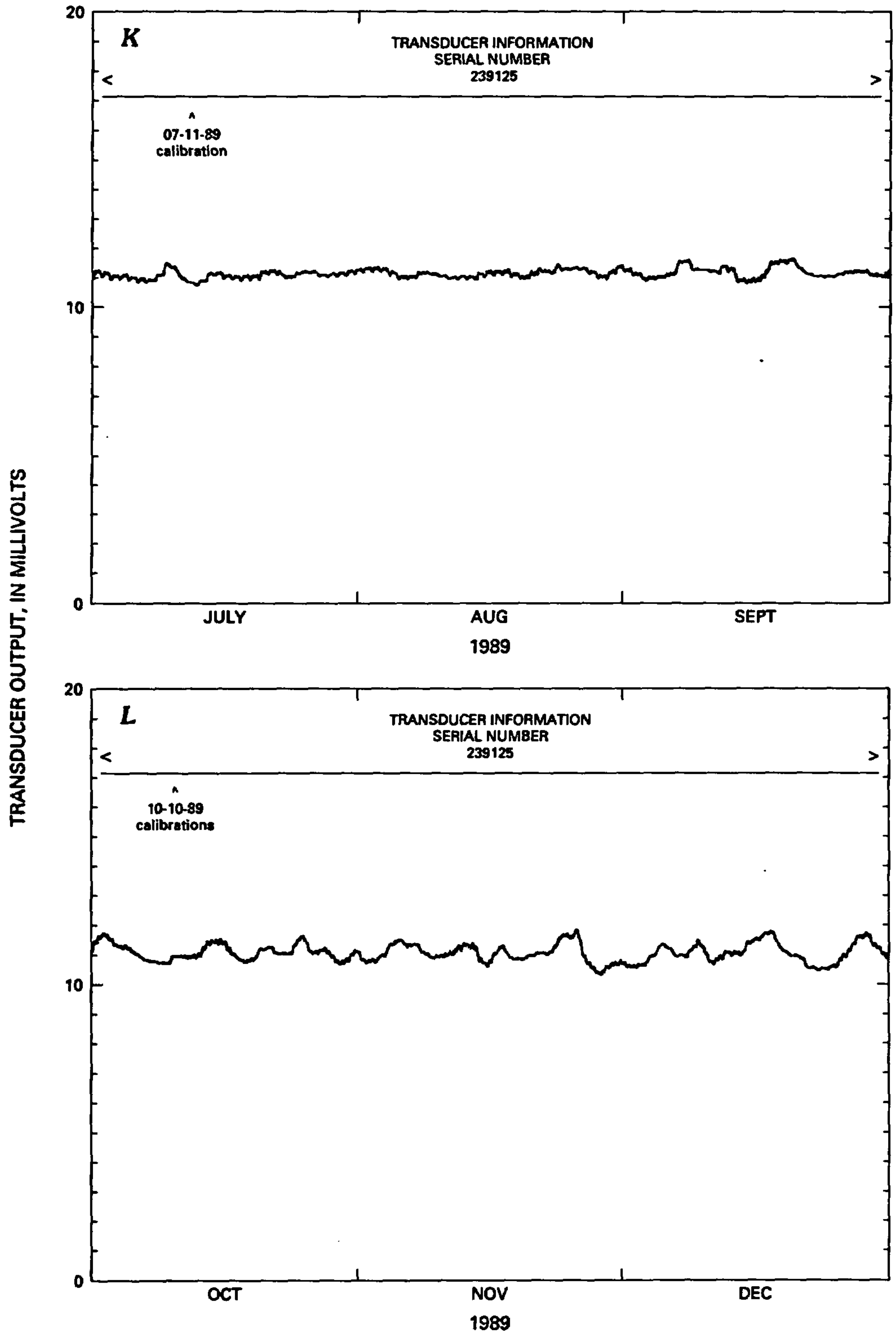


Figure 30.--Transducer output for well USW H-1.--Continued

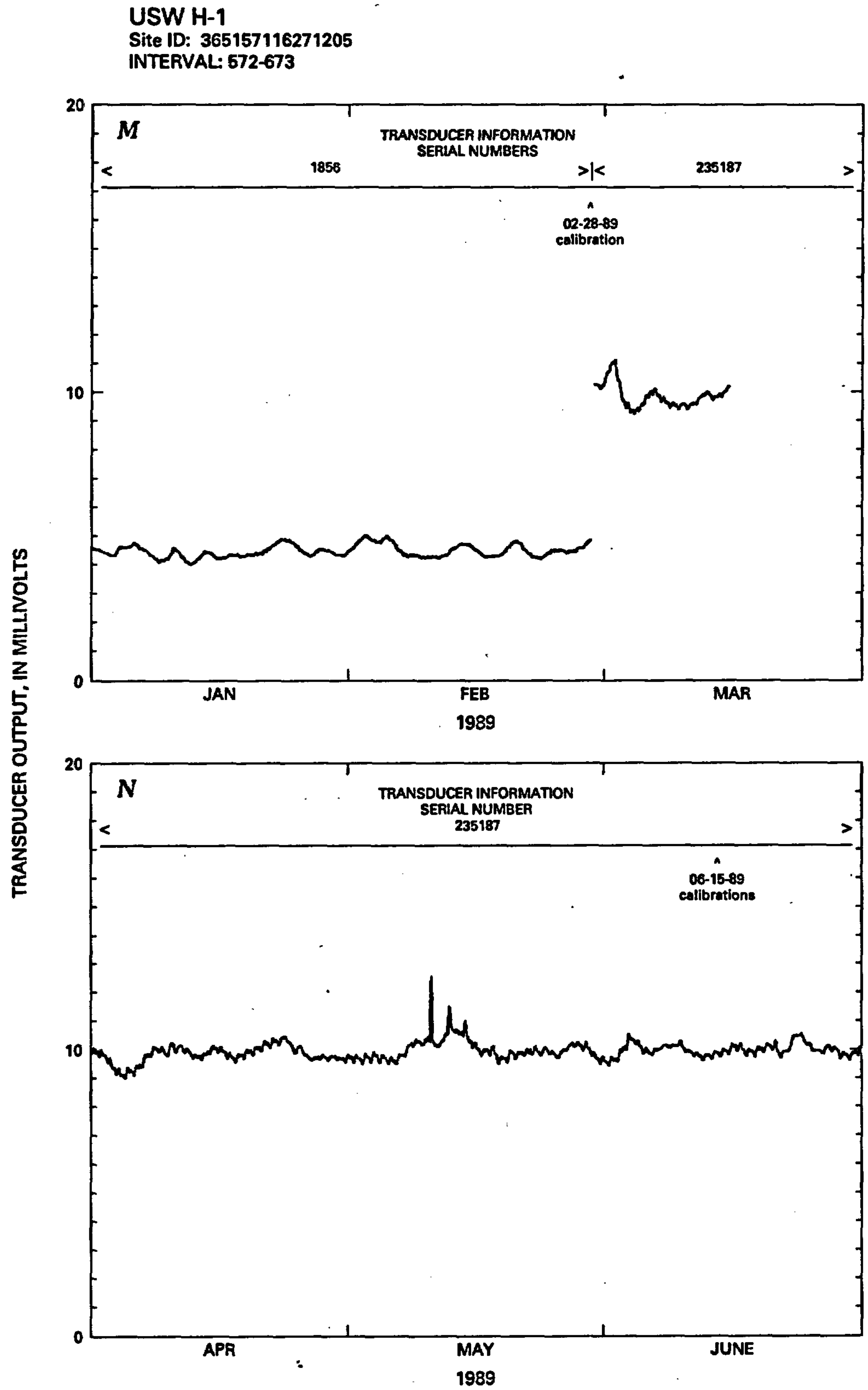


Figure 30.—Transducer output for well USW H-1.—Continued

USW H-1
Site ID: 365157116271205
INTERVAL: 572-673

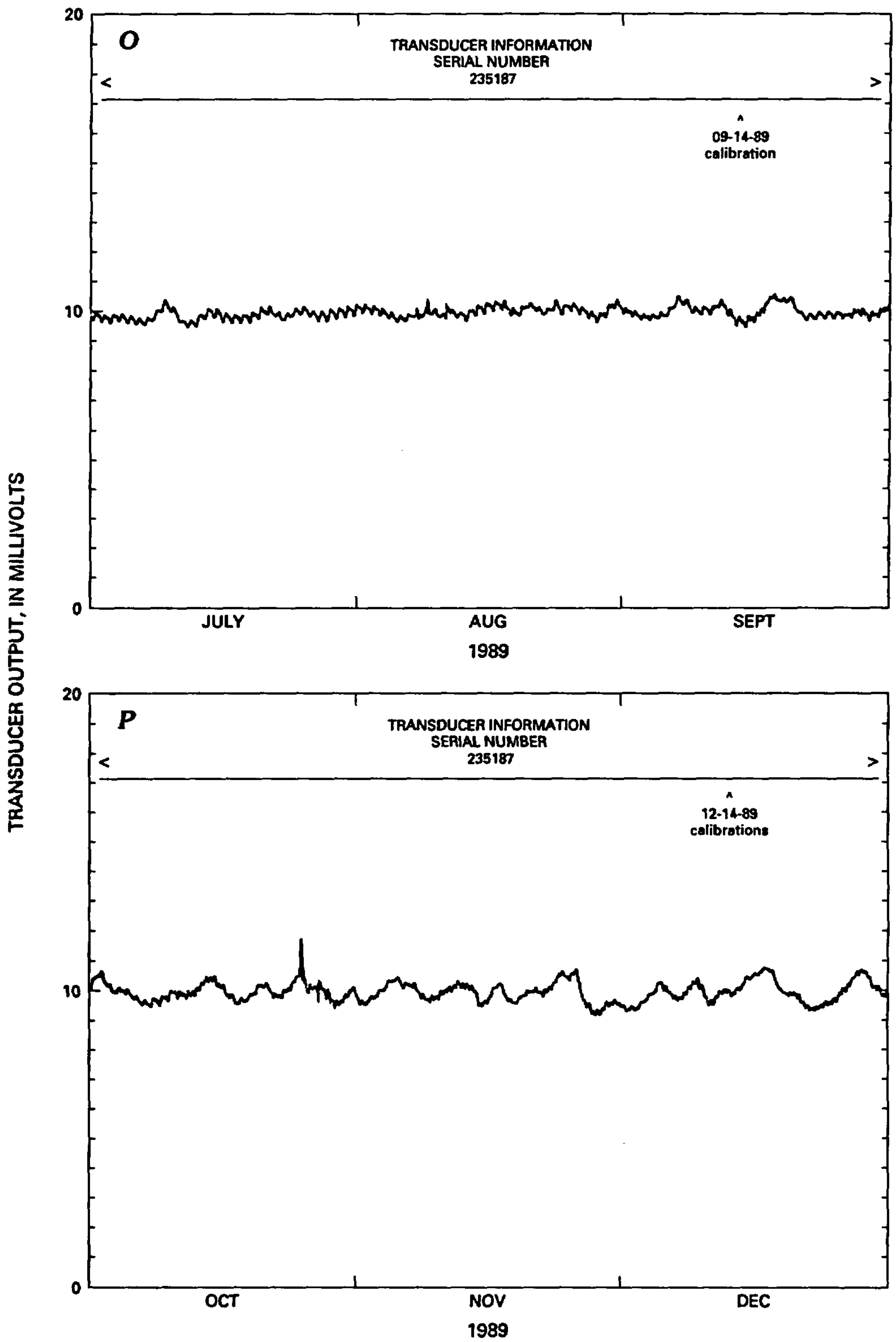


Figure 30.--Transducer output for well USW H-1.--Continued

Transducer output was converted to water-level altitude for the following periods:

Beginning date	Ending date
Site ID: 365157116271202	
Interval: 1,783-1,814 meters (Tube 1)	
03-22-89	05-10-89
05-12-89	07-10-89
10-07-89	12-31-89
Site ID: 365157116271203	
Interval: 1,097-1,123 meters (Tube 2)	
01-01-89	03-15-89
03-22-89	07-10-89
10-10-89	10-24-89
12-01-89	12-31-89
Site ID: 365157116271204	
Interval: 716-765 meters (Tube 3)	
01-01-89	03-15-89
03-22-89	12-31-89
Site ID: 365157116271205	
Interval: 572-673 meters (Tube 4)	
01-01-89	03-15-89
03-22-89	05-10-89
05-16-89	10-24-89
10-26-89	12-31-89

The water-level altitudes are shown in figure 31A through 31P, and the daily mean water-level altitudes are given in table 12. Approximately 54 percent of the transducer output from tube 1 was converted to water-level altitude. The longest continuous period in 1989 was 86 days, from October 7, 1989 through December 31, 1989. The longest period from previous years' records was 208 days, March 24 through November 17, 1986. Approximately 63 percent of the transducer output from tube 2 was converted to water-level altitude. The longest period of continuous record to date was 111 days from March 22 through July 10, 1989. Approximately 98 percent of the transducer output from tube 3 was converted to water-level altitude. The longest period of continuous record to date was 285 days from March 22 through December 31, 1989. Approximately 97 percent of the transducer output from tube 4 was converted to water-level altitude. The longest period of continuous record in 1989 was 162 days from May 16 through October 24, 1989. The longest continuous period of convertible data from previous years was 238 days, October 21, 1986 through June 15, 1987.

USW H-1
Site ID: 365157116271202
INTERVAL: 1,783-1,814

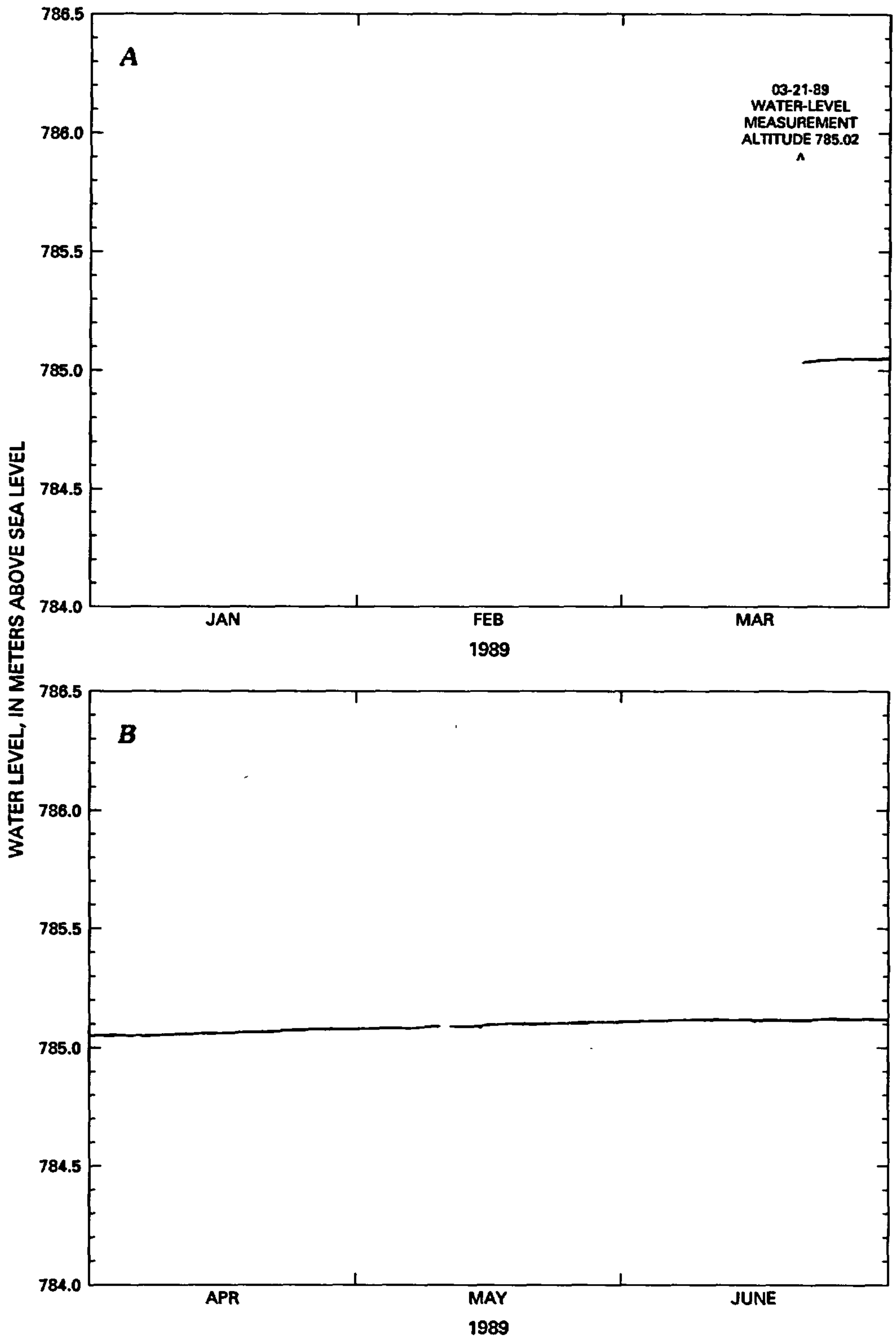


Figure 31.–Water-level altitude for well USW H-1.

USW H-1
Site ID: 365157116271202
INTERVAL: 1,783-1,814

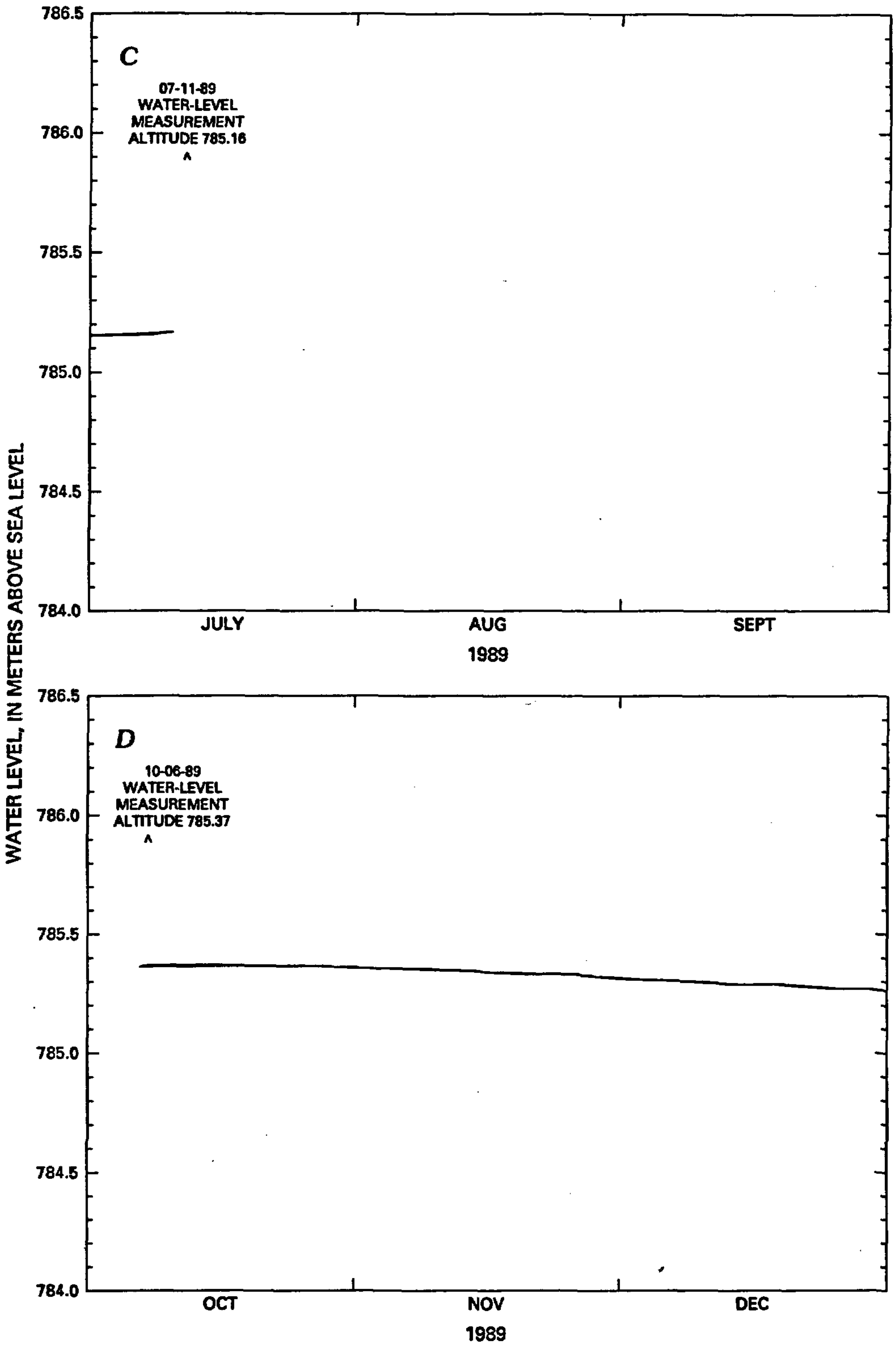


Figure 31.--Water-level altitude for well USW H-1.--Continued

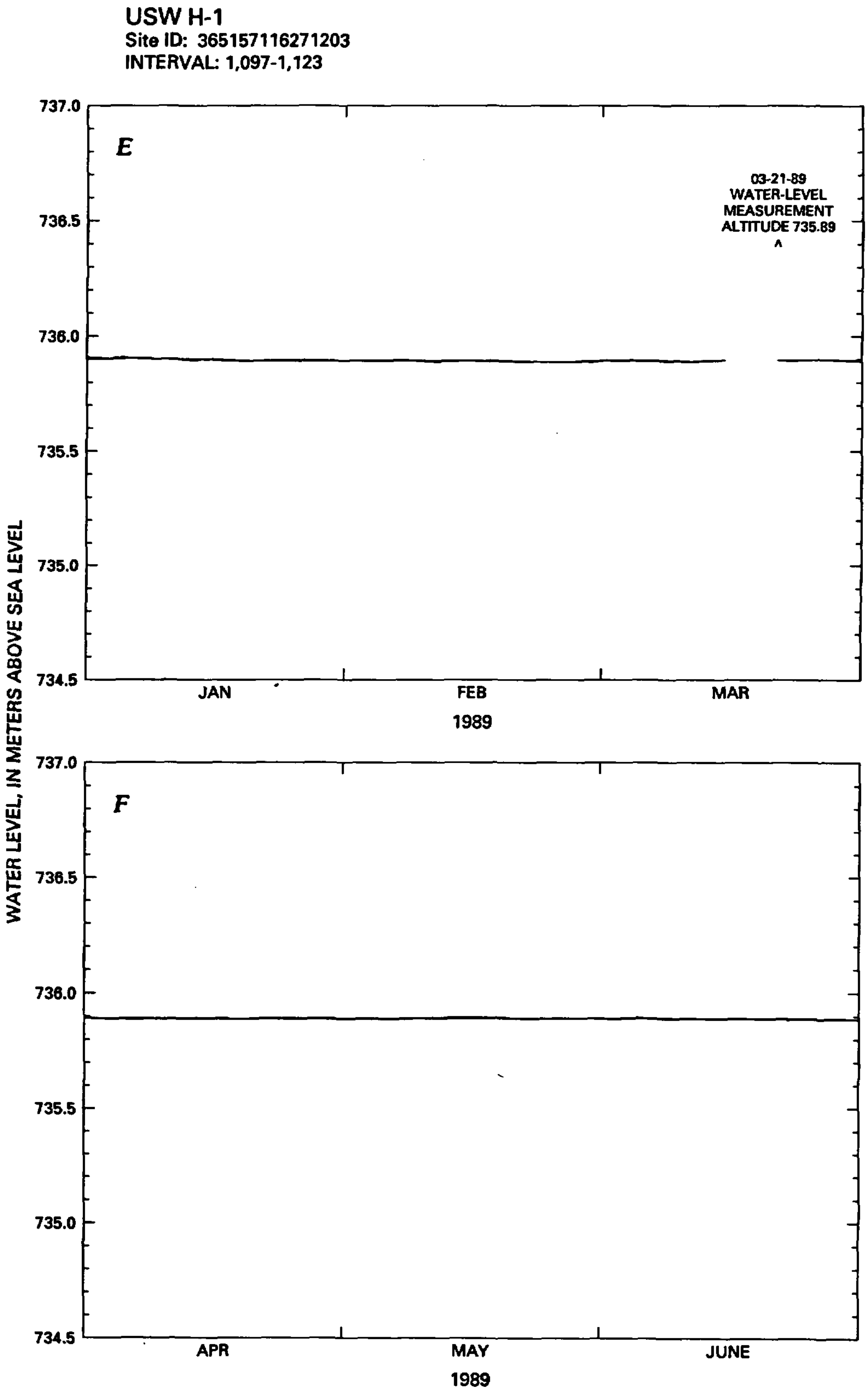


Figure 31.--Water-level altitude for well USW H-1.--Continued

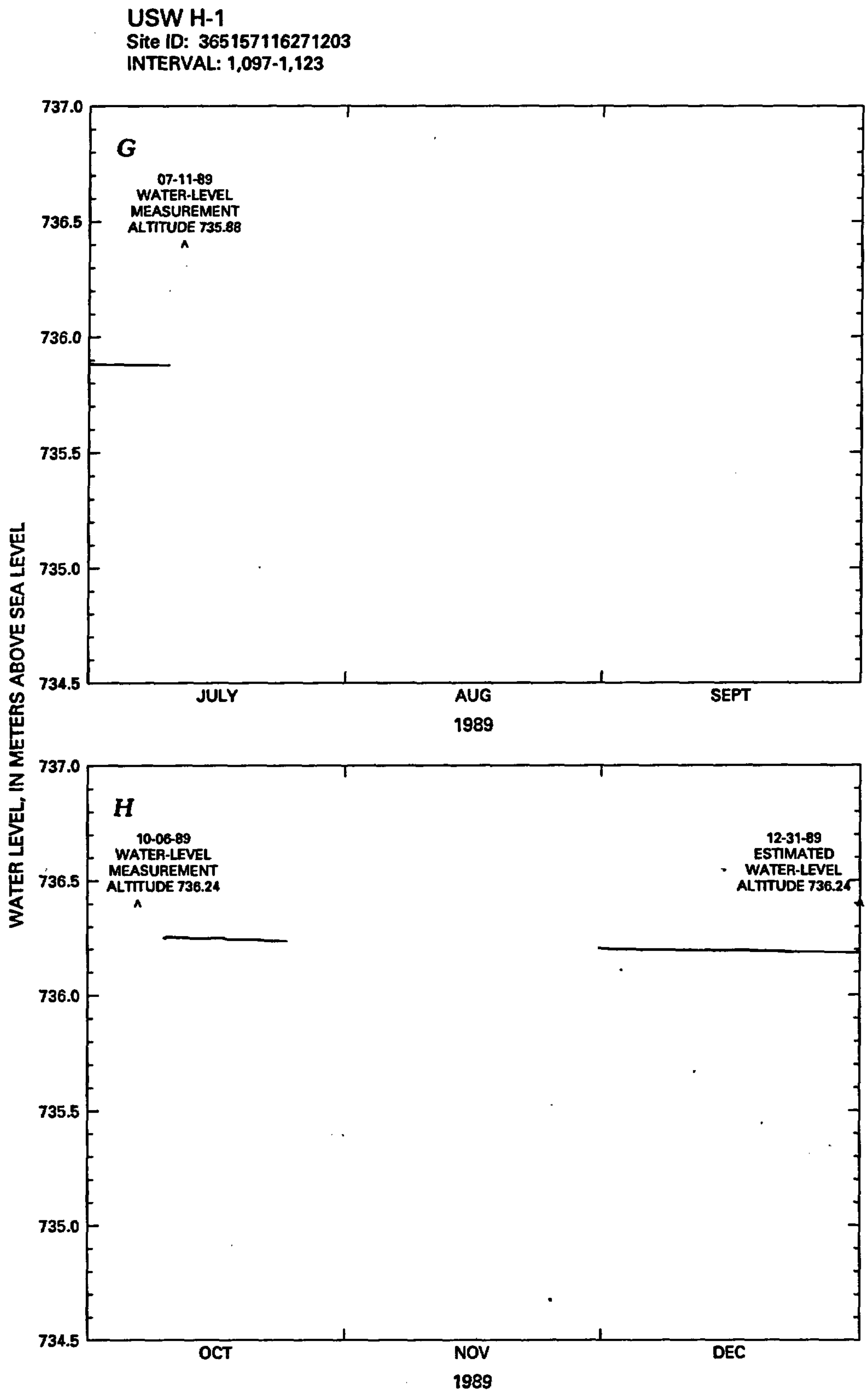


Figure 31.--Water-level altitude for well USW H-1.--Continued

USW H-1
Site ID: 365157116271204
INTERVAL: 716-765

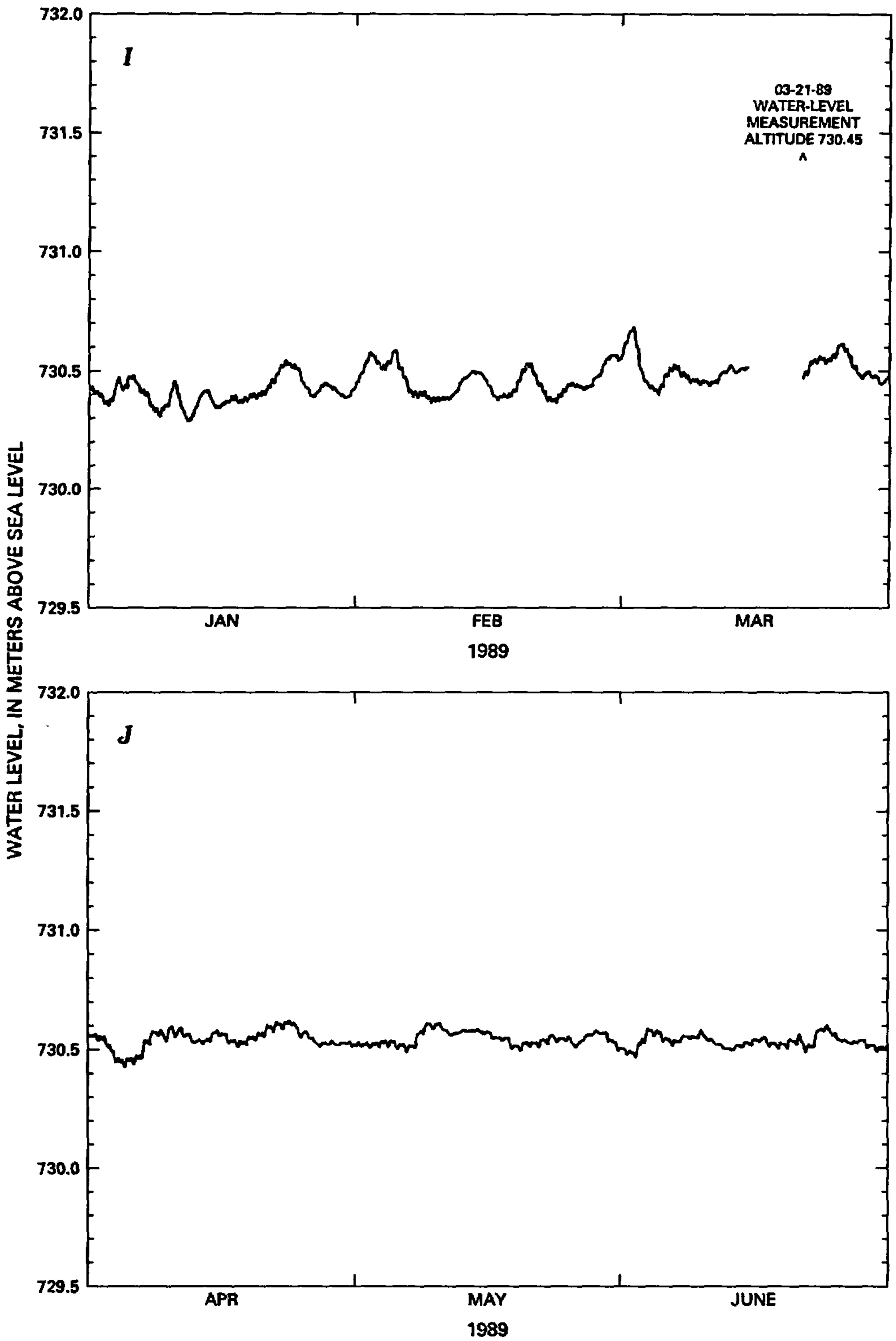


Figure 31.--Water-level altitude for well USW H-1.--Continued

USW H-1
Site ID: 365157116271204
INTERVAL: 716-765

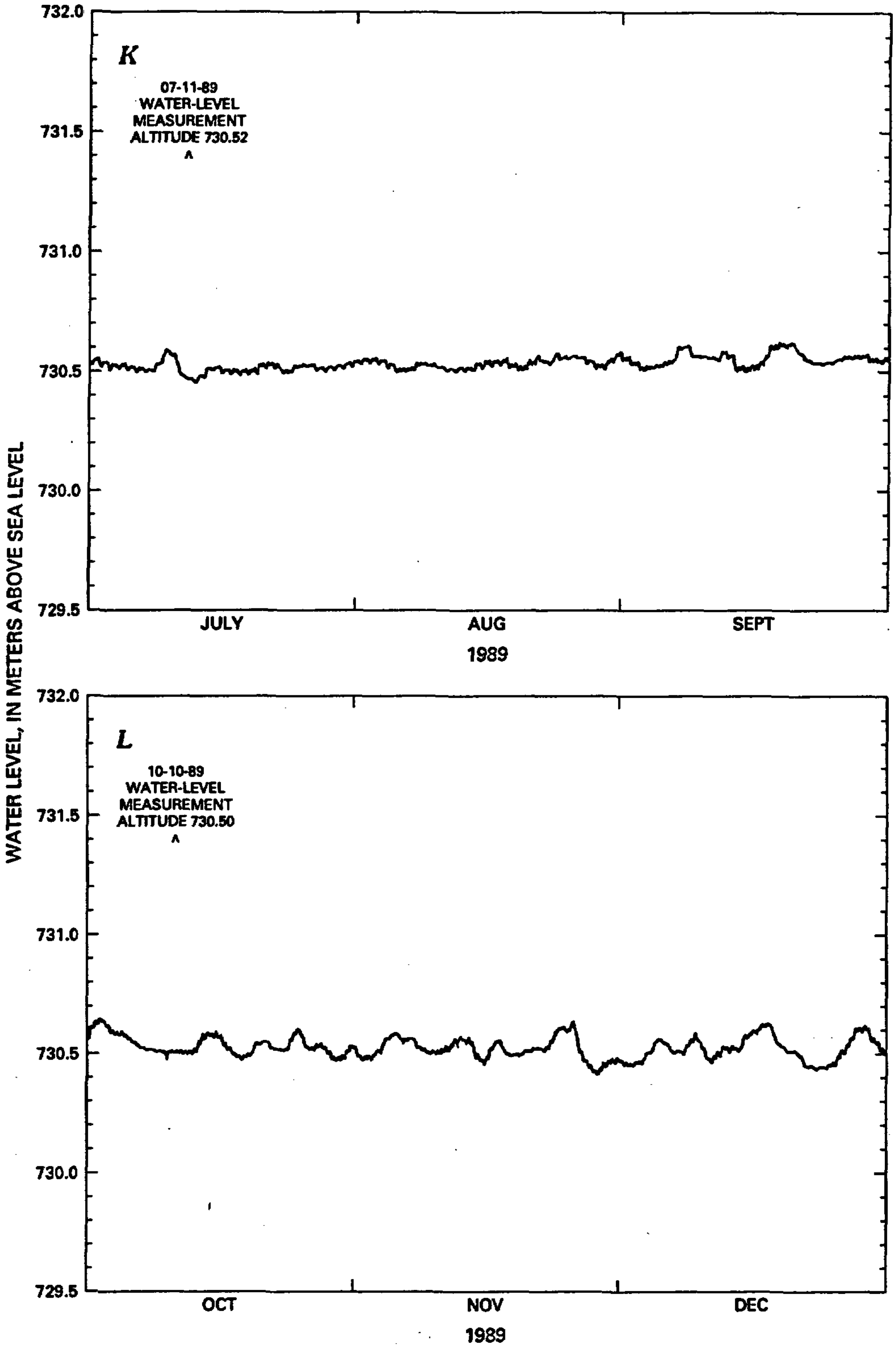


Figure 31.–Water-level altitude for well USW H-1.–Continued

USW H-1
Site ID: 365157116271205
INTERVAL: 572-673

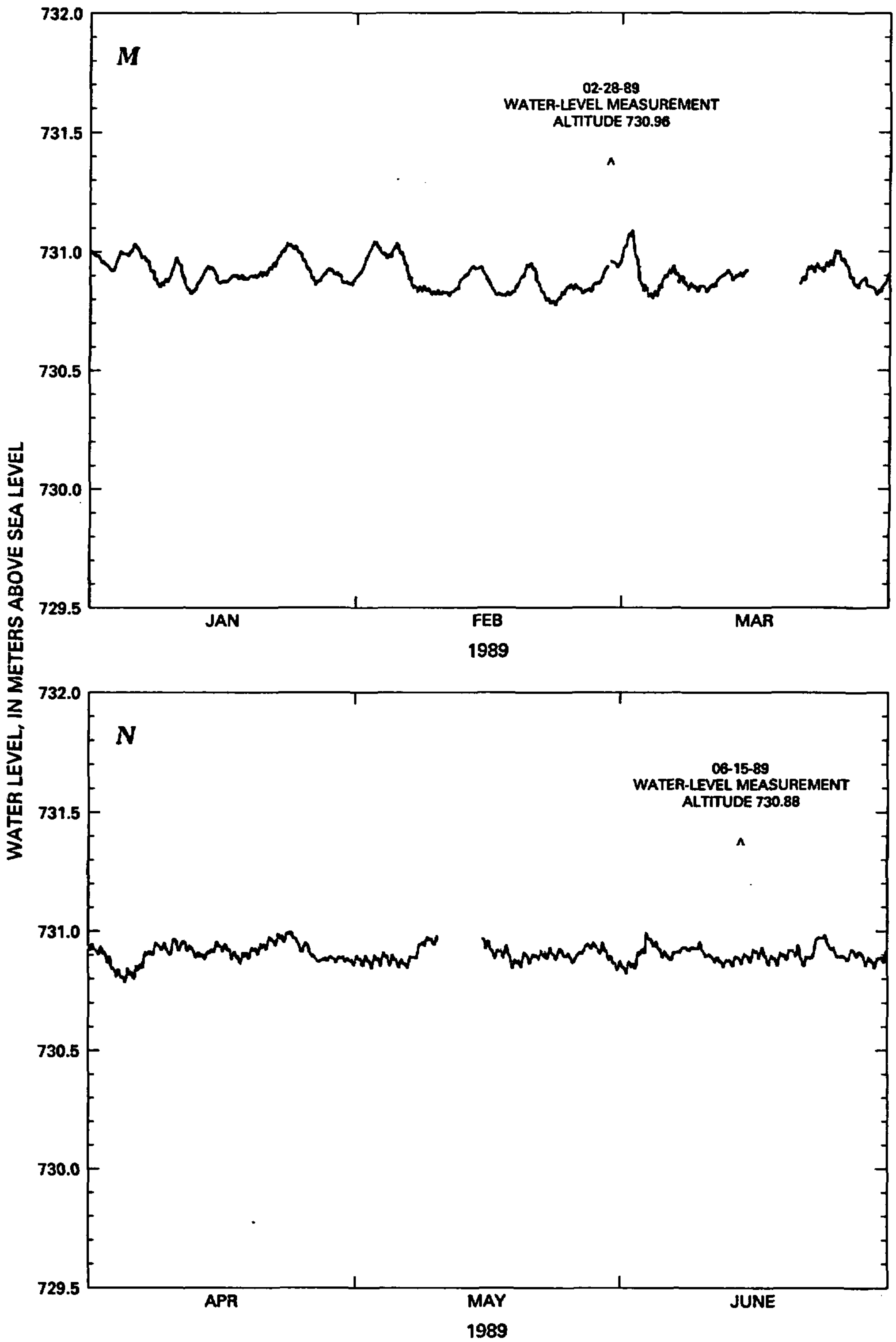


Figure 31.--Water-level altitude for well USW H-1.--Continued

USW H-1
Site ID: 365157116271205
INTERVAL: 572-673

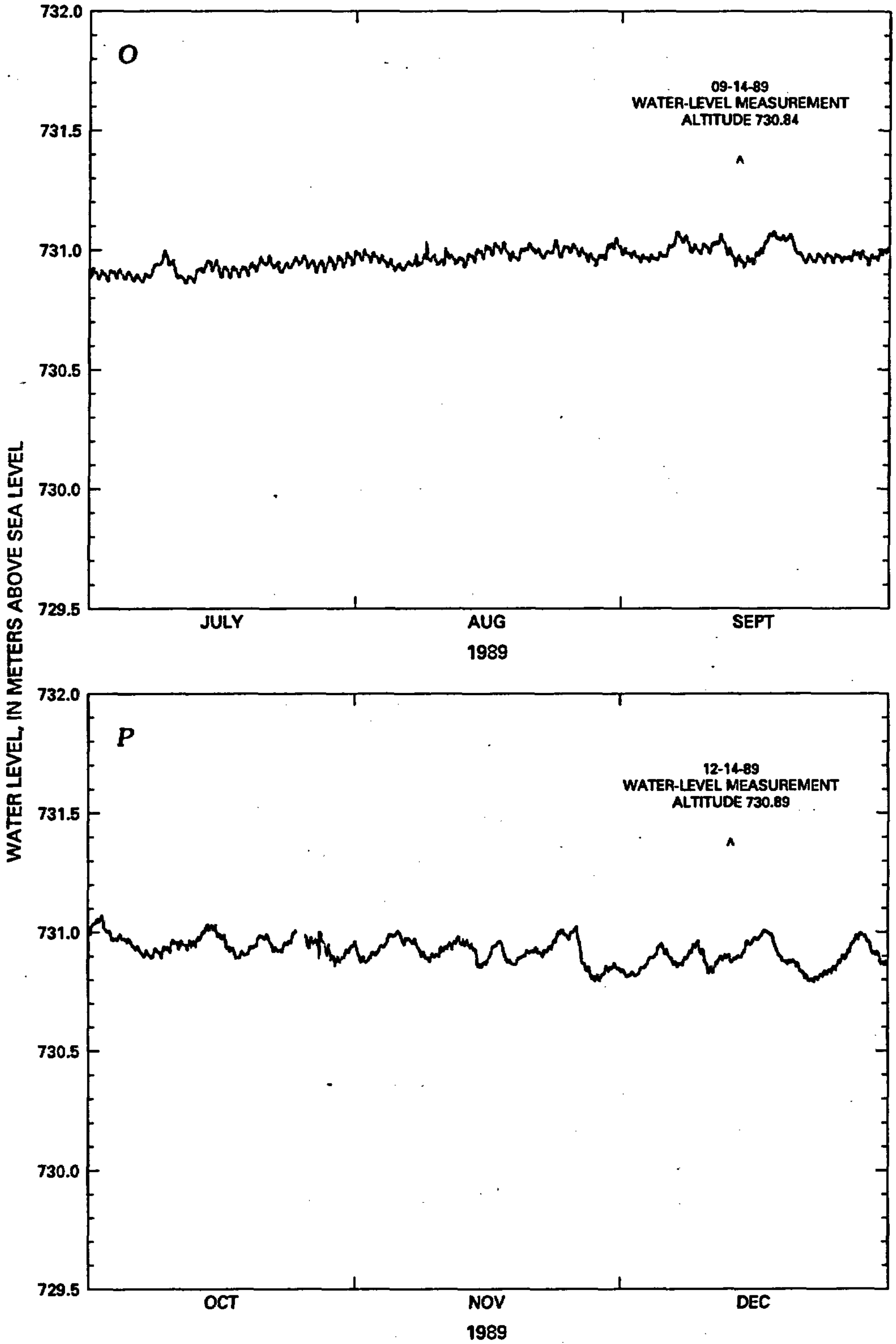


Figure 31.–Water-level altitude for well USW H-1.–Continued

Table 12. *Daily mean water-level altitude for 1989, in meters above sea level, for well USW H-1*
[Monthly mean, maximum (max), and minimum (min) computed from the daily mean values, indicated only for months that have complete data sets. Dashes indicate insufficient data to calculate daily mean water-level altitude]

Interval: 1,783-1,814 m   Site ID: 365157116271202

DAY	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
						1989						
1	—	—	—	785.04	785.09	785.13	785.15	—	—	—	785.37	785.32
2	—	—	—	785.05	785.09	785.13	785.15	—	—	—	785.37	785.32
3	—	—	—	785.05	785.09	785.14	785.15	—	—	—	785.37	785.32
4	—	—	—	785.05	785.09	785.14	785.15	—	—	—	785.37	785.31
5	—	—	—	785.05	785.09	785.14	785.15	—	—	—	785.37	785.31
6	—	—	—	785.05	785.09	785.14	785.15	—	—	—	785.37	785.31
7	—	—	—	785.05	785.09	785.14	785.15	—	—	785.37	785.37	785.31
8	—	—	—	785.05	785.10	785.14	785.16	—	—	785.37	785.36	785.31
9	—	—	—	785.05	785.10	785.15	785.16	—	—	785.37	785.36	785.30
10	—	—	—	785.05	—	785.15	—	—	—	785.37	785.36	785.30
11	—	—	—	785.06	—	785.15	—	—	—	785.38	785.36	785.30
12	—	—	—	785.05	785.10	785.15	—	—	—	785.38	785.36	785.30
13	—	—	—	785.06	785.10	785.15	—	—	—	785.38	785.36	785.29
14	—	—	—	785.06	785.10	785.14	—	—	—	785.38	785.35	785.29
15	—	—	—	785.06	785.11	785.14	—	—	—	785.38	785.35	785.29
16	—	—	—	785.06	785.11	785.15	—	—	—	785.38	785.35	785.29
17	—	—	—	785.07	785.12	785.15	—	—	—	785.38	785.35	785.29
18	—	—	—	785.07	785.12	785.15	—	—	—	785.38	785.35	785.29
19	—	—	—	785.07	785.12	785.15	—	—	—	785.38	785.34	785.29
20	—	—	—	785.07	785.12	785.15	—	—	—	785.38	785.34	785.29
21	—	—	—	785.07	785.12	785.15	—	—	—	785.38	785.34	785.29
22	—	—	785.02	785.07	785.12	785.15	—	—	—	785.38	785.34	785.28
23	—	—	785.03	785.08	785.12	785.15	—	—	—	785.38	785.34	785.28
24	—	—	785.03	785.08	785.12	785.15	—	—	—	785.38	785.34	785.28
25	—	—	785.04	785.08	785.12	785.15	—	—	—	785.38	785.34	785.27
26	—	—	785.04	785.08	785.12	785.15	—	—	—	785.38	785.34	785.27
27	—	—	785.04	785.08	785.13	785.15	—	—	—	785.38	785.34	785.27
28	—	—	785.04	785.09	785.13	785.15	—	—	—	785.38	785.33	785.27
29	—		785.04	785.09	785.13	785.15	—	—	—	785.37	785.33	785.27
30	—		785.04	785.09	785.13	785.15	—	—	—	785.37	785.33	785.27
31	—		785.04		785.13		—	—		785.37		785.27
MONTHLY												
MEAN	—	—	—	785.06	—	785.15	—	—	—	—	785.35	785.29
MAX	—	—	—	785.09	—	785.15	—	—	—	—	785.37	785.32
MIN	—	—	—	785.04	—	785.13	—	—	—	—	785.33	785.27

Table 12. *Daily mean water-level altitude for 1989, in meters above sea level, for well USW H-1 (Continued)*

Interval: 1,097-1,123

Site ID: 365157116271203

DAY	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
					1989 (Continued)							
1	735.91	735.89	735.89	735.89	735.89	735.89	735.88	—	—	—	—	736.21
2	735.91	735.89	735.89	735.89	735.89	735.89	735.88	—	—	—	—	736.21
3	735.90	735.89	735.89	735.89	735.89	735.89	735.88	—	—	—	—	736.21
4	735.90	735.90	735.89	735.89	735.89	735.89	735.88	—	—	—	—	736.20
5	735.91	735.90	735.89	735.89	735.89	735.89	735.88	—	—	—	—	736.20
6	735.90	735.89	735.89	735.89	735.89	735.89	735.88	—	—	—	—	736.20
7	735.90	735.89	735.89	735.89	735.89	735.89	735.88	—	—	—	—	736.20
8	735.90	735.89	735.89	735.89	735.89	735.89	735.88	—	—	—	—	736.20
9	735.90	735.89	735.89	735.89	735.89	735.89	735.88	—	—	—	—	736.20
10	735.90	735.89	735.89	735.89	735.89	735.89	—	—	—	736.25	—	736.20
11	735.90	735.89	735.89	735.89	735.89	735.89	—	—	—	736.25	—	736.20
12	735.90	735.89	735.89	735.89	735.89	735.89	—	—	—	736.25	—	736.20
13	735.90	735.89	735.89	735.89	735.89	735.89	—	—	—	736.25	—	736.20
14	735.90	735.89	735.89	735.89	735.89	735.89	—	—	—	736.25	—	736.20
15	735.90	735.89	—	735.89	735.89	735.89	—	—	—	736.25	—	736.20
16	735.89	735.89	—	735.89	735.89	735.89	—	—	—	736.25	—	736.20
17	735.89	735.89	—	735.89	735.89	735.89	—	—	—	736.25	—	736.20
18	735.89	735.89	—	735.89	735.89	735.89	—	—	—	736.24	—	736.20
19	735.89	735.89	—	735.89	735.89	735.89	—	—	—	736.24	—	736.20
20	735.89	735.89	—	735.89	735.89	735.89	—	—	—	736.24	—	736.20
21	735.89	735.89	—	735.89	735.89	735.88	—	—	—	736.24	—	736.20
22	735.89	735.89	735.89	735.89	735.89	735.89	—	—	—	736.24	—	736.20
23	735.89	735.89	735.89	735.89	735.89	735.89	—	—	—	736.24	—	736.20
24	735.89	735.89	735.89	735.89	735.89	735.89	—	—	—	—	—	736.19
25	735.89	735.89	735.90	735.89	735.89	735.89	—	—	—	—	—	736.19
26	735.89	735.89	735.90	735.89	735.89	735.89	—	—	—	—	—	736.19
27	735.89	735.89	735.90	735.89	735.89	735.89	—	—	—	—	—	736.19
28	735.89	735.88	735.90	735.89	735.89	735.88	—	—	—	—	—	736.19
29	735.89		735.90	735.89	735.89	735.88	—	—	—	—	—	736.19
30	735.89		735.89	735.89	735.89	735.88	—	—	—	—	—	736.19
31	735.89		735.89		735.89		—	—		—		736.19
MONTHLY												
MEAN	735.90	735.89	—	735.89	735.89	735.89	—	—	—	—	—	736.20
MAX	735.91	735.90	—	735.89	735.89	735.89	—	—	—	—	—	736.21
MIN	735.89	735.88	—	735.89	735.89	735.88	—	—	—	—	—	736.19

Table 12. *Daily mean water-level altitude for 1989, in meters above sea level, for well USW H-1 (Continued)*

Interval: 716-765 m **Site ID: 365157116271204**

DAY	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
					1989 (Continued)							
1	730.42	730.55	730.56	730.54	730.51	730.49	730.54	730.54	730.54	730.58	730.50	730.47
2	730.39	730.54	730.63	730.53	730.51	730.49	730.54	730.54	730.52	730.63	730.48	730.45
3	730.37	730.52	730.61	730.50	730.51	730.55	730.53	730.54	730.52	730.62	730.49	730.46
4	730.44	730.56	730.46	730.44	730.51	730.57	730.52	730.53	730.53	730.58	730.54	730.48
5	730.45	730.48	730.42	730.43	730.51	730.55	730.52	730.51	730.54	730.57	730.57	730.53
6	730.45	730.40	730.45	730.43	730.51	730.53	730.51	730.51	730.57	730.55	730.56	730.55
7	730.40	730.40	730.51	730.47	730.50	730.54	730.50	730.52	730.60	730.52	730.56	730.52
8	730.33	730.38	730.49	730.52	730.52	730.55	730.51	730.53	730.57	730.51	730.53	730.51
9	730.34	730.38	730.46	730.55	730.57	730.56	730.55	730.52	730.56	730.50	730.50	730.54
10	730.42	730.38	730.45	730.54	730.59	730.55	730.57	730.52	730.56	730.50	730.50	730.56
11	730.35	730.42	730.45	730.55	730.59	730.53	730.51	730.51	730.56	730.50	730.51	730.49
12	730.30	730.48	730.46	730.55	730.56	730.51	730.47	730.51	730.57	730.50	730.54	730.49
13	730.37	730.49	730.50	730.52	730.56	730.51	730.47	730.51	730.52	730.50	730.55	730.52
14	730.41	730.47	730.50	730.51	730.57	730.52	730.49	730.52	730.51	730.55	730.54	730.52
15	730.35	730.40	—	730.53	730.57	730.53	730.51	730.53	730.52	730.57	730.47	730.54
16	730.36	730.39	—	730.55	730.56	730.55	730.50	730.54	730.54	730.56	730.49	730.58
17	730.38	730.40	—	730.52	730.55	730.53	730.50	730.54	730.60	730.52	730.54	730.61
18	730.38	730.47	—	730.51	730.54	730.52	730.50	730.53	730.61	730.49	730.51	730.62
19	730.39	730.52	—	730.52	730.52	730.53	730.50	730.52	730.62	730.48	730.49	730.55
20	730.40	730.45	—	730.54	730.50	730.54	730.51	730.52	730.58	730.51	730.50	730.52
21	730.44	730.39	—	730.56	730.52	730.52	730.52	730.54	730.55	730.54	730.51	730.51
22	730.50	730.38	730.50	730.58	730.52	730.54	730.52	730.54	730.54	730.53	730.52	730.46
23	730.53	730.42	730.54	730.59	730.53	730.59	730.51	730.55	730.54	730.51	730.53	730.44
24	730.51	730.44	730.55	730.59	730.54	730.58	730.51	730.56	730.54	730.53	730.59	730.44
25	730.43	730.43	730.57	730.55	730.54	730.55	730.52	730.56	730.56	730.58	730.60	730.45
26	730.40	730.45	730.59	730.54	730.52	730.54	730.52	730.56	730.56	730.53	730.59	730.49
27	730.44	730.49	730.53	730.51	730.54	730.54	730.52	730.55	730.57	730.52	730.48	730.54
28	730.43	730.55	730.48	730.51	730.56	730.53	730.51	730.53	730.56	730.52	730.43	730.60
29	730.40		730.48	730.51	730.57	730.52	730.52	730.53	730.55	730.48	730.44	730.60
30	730.40		730.46	730.51	730.54	730.52	730.52	730.56	730.56	730.48	730.46	730.55
31	730.47		730.49		730.51		730.53	730.56		730.51		730.51
MONTHLY												
MEAN	730.41	730.45	—	730.52	730.54	730.54	730.51	730.53	730.56	730.53	730.52	730.52
MAX	730.53	730.56	—	730.59	730.59	730.59	730.57	730.56	730.62	730.63	730.60	730.62
MIN	730.30	730.38	—	730.43	730.50	730.49	730.47	730.51	730.51	730.48	730.43	730.44

Table 12. *Daily mean water-level altitude for 1989, in meters above sea level, for well USW H-1 (Continued)*

Interval: 572-673 m

Site ID: 365157116271205

DAY	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
					1989 (Continued)							
1	730.99	731.00	730.95	730.92	730.87	730.85	730.91	730.98	730.98	731.02	730.90	
2	730.96	731.02	731.04	730.90	730.87	730.88	730.90	730.97	730.97	731.06	730.91	730.83
3	730.93	730.98	730.99	730.87	730.87	730.95	730.89	730.96	730.97	731.01	730.93	730.84
4	730.98	731.01	730.85	730.81	730.88	730.96	730.90	730.95	730.97	730.98	730.98	730.88
5	730.99	730.96	730.82	730.80	730.88	730.92	730.89	730.93	730.99	730.97	731.00	730.93
6	731.01	730.87	730.87	730.81	730.86	730.90	730.89	730.93	731.04	730.94	730.98	730.92
7	730.96	730.84	730.92	730.86	730.87	730.93	730.88	730.95	731.05	730.92	730.97	730.88
8	730.89	730.83	730.89	730.91	730.91	730.93	730.91	730.96	731.01	730.92	730.92	730.89
9	730.87	730.83	730.86	730.92	730.96	730.94	730.96	730.97	731.00	730.93	730.90	730.94
10	730.93	730.82	730.85	730.92	—	730.91	730.95	730.95	731.01	730.95	730.92	730.93
11	730.92	730.85	730.85	730.93	—	730.89	730.89	730.97	731.04	730.96	730.94	730.85
12	730.84	730.90	730.87	730.92	—	730.88	730.88	730.96	731.00	730.95	730.97	730.88
13	730.87	730.93	730.91	730.89	—	730.89	730.89	730.96	730.96	730.97	730.96	730.90
14	730.93	730.91	730.89	730.89	—	730.89	730.93	730.98	730.95	731.01	730.93	730.90
15	730.89	730.85	—	730.92	—	730.91	730.94	730.99	730.97	731.02	730.87	730.94
16	730.88	730.82	—	730.92	730.95	730.92	730.92	731.01	731.01	730.98	730.92	730.97
17	730.90	730.82	—	730.89	730.91	730.89	730.91	731.01	731.06	730.93	730.95	731.00
18	730.89	730.87	—	730.88	730.91	730.89	730.91	730.98	731.05	730.91	730.89	730.99
19	730.90	730.94	—	730.90	730.87	730.91	730.92	730.98	731.05	730.93	730.89	730.91
20	730.90	730.89	—	730.92	730.88	730.93	730.94	731.01	730.99	730.97	730.92	730.88
21	730.93	730.81	—	730.94	730.89	730.89	730.95	730.99	730.96	730.98	730.93	730.87
22	730.98	730.79	730.90	730.96	730.90	730.93	730.94	730.98	730.97	730.94	730.92	730.82
23	731.02	730.83	730.93	730.97	730.91	730.99	730.92	731.01	730.97	730.94	730.96	730.81
24	731.00	730.85	730.93	730.97	730.91	730.95	730.94	731.00	730.97	—	731.01	730.83
25	730.94	730.84	730.97	730.93	730.90	730.91	730.96	731.01	730.96	—	731.00	730.85
26	730.88	730.84	730.97	730.90	730.89	730.91	730.94	730.99	730.97	730.97	730.97	730.89
27	730.90	730.88	730.90	730.87	730.93	730.92	730.93	730.97	730.98	730.98	730.85	730.94
28	730.91	—	730.86	730.88	730.94	730.89	730.94	730.96	730.96	730.94	730.81	730.99
29	730.88		730.86	730.88	730.93	730.88	730.95	730.99	730.97	730.89	730.84	730.97
30	730.87		730.83	730.88	730.89	730.91	730.96	731.03	730.99	730.91	730.86	730.91
31	730.92		730.88		730.86		730.97	731.00		730.95		730.88
MONTHLY												
MEAN	730.92	—	—	730.90	—	730.91	730.92	730.98	730.99	—	730.93	730.90
MAX	731.02	—	—	730.97	—	730.99	730.97	731.03	731.06	—	731.01	731.00
MIN	730.84	—	—	730.80	—	730.85	730.88	730.93	730.95	—	730.81	730.81

Well USW H-3

Information about the history of well USW H-3 and about previous data from the well was obtained from various sources. These sources are: Thordarson, Rush, Spengler, and Waddell (1984); Thordarson, Rush, and Waddell (1984); Robison (1984, 1986); Robison and others (1988); Fenix & Scisson, Inc. (1987a, c).

Well specifications

The following are specifications for well USW H-3:

1. Location and identification:

   Latitude and longitude: 36°49'42" N.; 116°28'00" W.

   Nevada State Central Zone Coordinates (m): N 230,594; E 170,216.

   U.S. Geological Survey Site ID's:
   364942116280001 (entire well)
   364942116280004 (upper interval)
   364942116280005 (lower interval)

2. Drilling and casing information:

   Well started: January 27, 1982.

   Well completed: March 19, 1982.

   Drilling method: Rotary, using rock bits and air-foam circulating medium.

   Bit diameter below water level: 375 mm to 808 m; 222 m from 808 m to 1219 m.

   Casing extending below water level: 253 mm diameter to 792 m, not perforated below the water level.

   Total drilled depth: 1,219 m.

3. Access to and description of intervals for measuring water levels:

   41-mm inside diameter open ended tubing, extending from land surface to depth of about 762 m; upper interval of well, from near water table to top of inflatable packer, within bedded tuff and Tram Member of Crater Flat Tuff; Site ID: 364942116280004.

   62-mm inside diameter tubing that has an inflatable packer on bottom end extending from land surface to 1,114 m; lower interval from below packer to bottom of well, within Lithic Ridge Tuff; Site ID: 364942116280005.

   Note: Inflatable packer installed January 1983 at a depth of 1,190 m; removed late November 1983 during period of additional hydraulic testing; re-installed in May 1984 at depth of 1,114 m.

4. Information for calculating water-level altitude:

Reference point: Top of metal tag on well casing; altitude 1483.47 m (surveyed by U.S. Geological Survey, 1984).

Depth correction for borehole deviation from vertical: 0.08 m, based on approximate depth to water of 752 m.

History of instrumentation, calibrations, and comments

Manual water-level measurements were made from March 19, 1982, through October 15, 1985. Beginning in October 1985, the water level has been monitored continuously using a downhole pressure transducer with a data logger at land surface.

In December 1990, the inflatable packer was removed for maintenance. Inspection of the packer revealed that the 62-mm access tube to the lower interval was completely plugged and had been plugged since the packer was installed in May 1984. Water levels previously reported by Robison and others (1988) in this well for Site ID: 364942116280005 are, therefore, invalid and should not be used. These water levels only represent water levels in a closed tube. Water levels for this well reported under other Site ID's are not suspect.

The following transducers were used in well USW H-3 in 1989:

[Range is pressure limit for transducer, in pounds per square inch]

Date of use		Transducer			
Beginning	Ending	Type	Model	Range	Serial number
		Site ID: 364942116280004			
		Interval: 752-1,114 meters			
05-12-88	01-11-89	Gage	Druck 930	15	203409
01-20-89	12-04-90	Gage	I.M.O.	15	335621

The following calibrations of the water-level monitoring system were used to process the 1989 data from well USW H-3:

Transducer				Water level	
		Regression line			
Serial number	Calibration date	Slope (millivolts per meter)	Coefficient of determination	Date	Altitude (meters)
		Site ID: 364942116280004			
		Interval: 752-1,114 meters			
335621	01-20-89	−1.355	0.994	01-20-89	731.86
335621	05-08-89	−1.346	1.000	05-08-89	731.87
335621	06-05-89	−1.339	1.000	06-05-89	731.90
335621	10-03-89	−1.327	1.000	10-03-89	731.94
335621	01-26-90	−1.332	1.000	01-26-90	731.90

Transducer output for the upper interval from January through December 1989 is shown in figure 32A through 32D. These data are the transducer output after first-level filtering (described in the "First-Level Filtering" section) has been applied. The first transducer (serial number 203409) in use in January 1989 generally produced erratic output (fig. 32A). The second transducer (serial number 335621) in use from January through December 1989, generally produced reasonable output except for short periods of erratic output in February, March (fig. 32A), May (fig. 32B), November and December (fig. 32D).

There were four spikes in the transducer output in 1989 (fig. 32D). Each of these spikes represents a single transducer output that deviates from the trend of the record. These spikes were not coincident with a site visit or any other identifiable event and probably represent a system malfunction of some type. The details of the spikes are as follows:

Date	Time	Value (millivolts)	
		Recorded	Expected
Site ID: 364942116280004			
Interval: 752-1,114 meters			
11-09-89	09:00	2.07	2.18
12-18-89	23:00	2.00	2.20
12-24-89	05:00	2.21	1.98
12-25-89	04:00	1.88	1.99

In this table, the expected value is the mean of the previous and subsequent values. The spikes, if converted to water levels, would represent water level changes in a 1-hour period from 0.08 to 0.21 m. Because the possibility exists for some sort of system malfunction, these four points were not converted to water-level altitude.

Transducer output was converted to water-level altitude for the following periods:

Beginning date	Ending date
Site ID: 364942116280004	
Interval: 752-1,114 meters	
02-01-89	02-07-89
02-13-89	03-01-89
03-04-89	03-24-89
03-27-89	05-10-89
05-21-89	12-31-89

The water-level altitudes are shown in figure 33A through 33D and the daily mean water-level altitudes are given in table 13. Approximately 88 percent of the transducer output from the transducer in the upper interval was converted to water-level altitude. The longest period in 1989 was 225 days, May 21 through December 31, 1989. There is a longer period continuous record, 291 days, from May 19, 1986 to March 5, 1987. No transducer output was collected or converted from the lower interval in 1989.

USW H-3
Site ID: 364942116280004
INTERVAL: 752-1,114

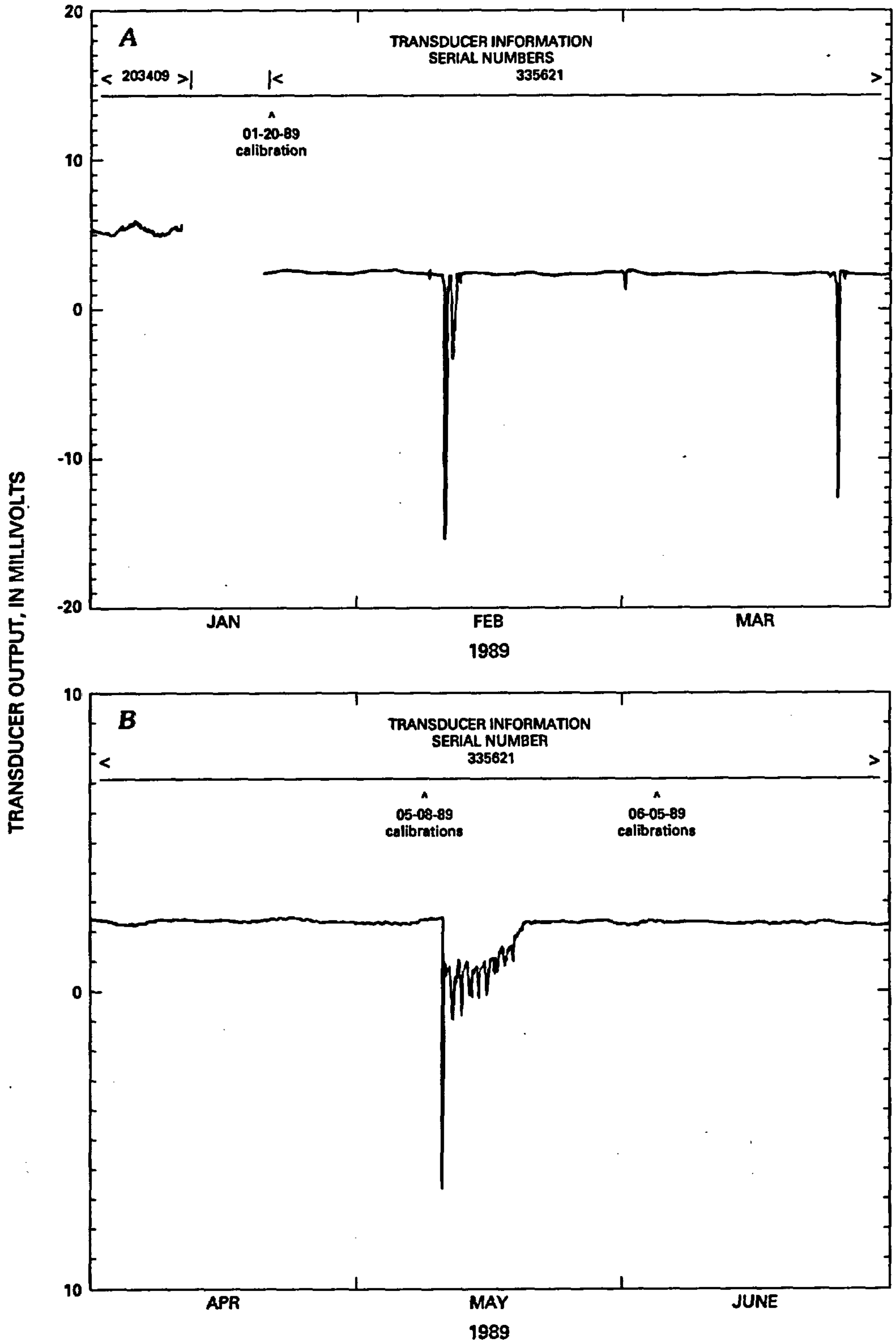


Figure 32.--Transducer output for well USW H-3.

USW H-3
Site ID: 364942116280004
INTERVAL: 752-1,114

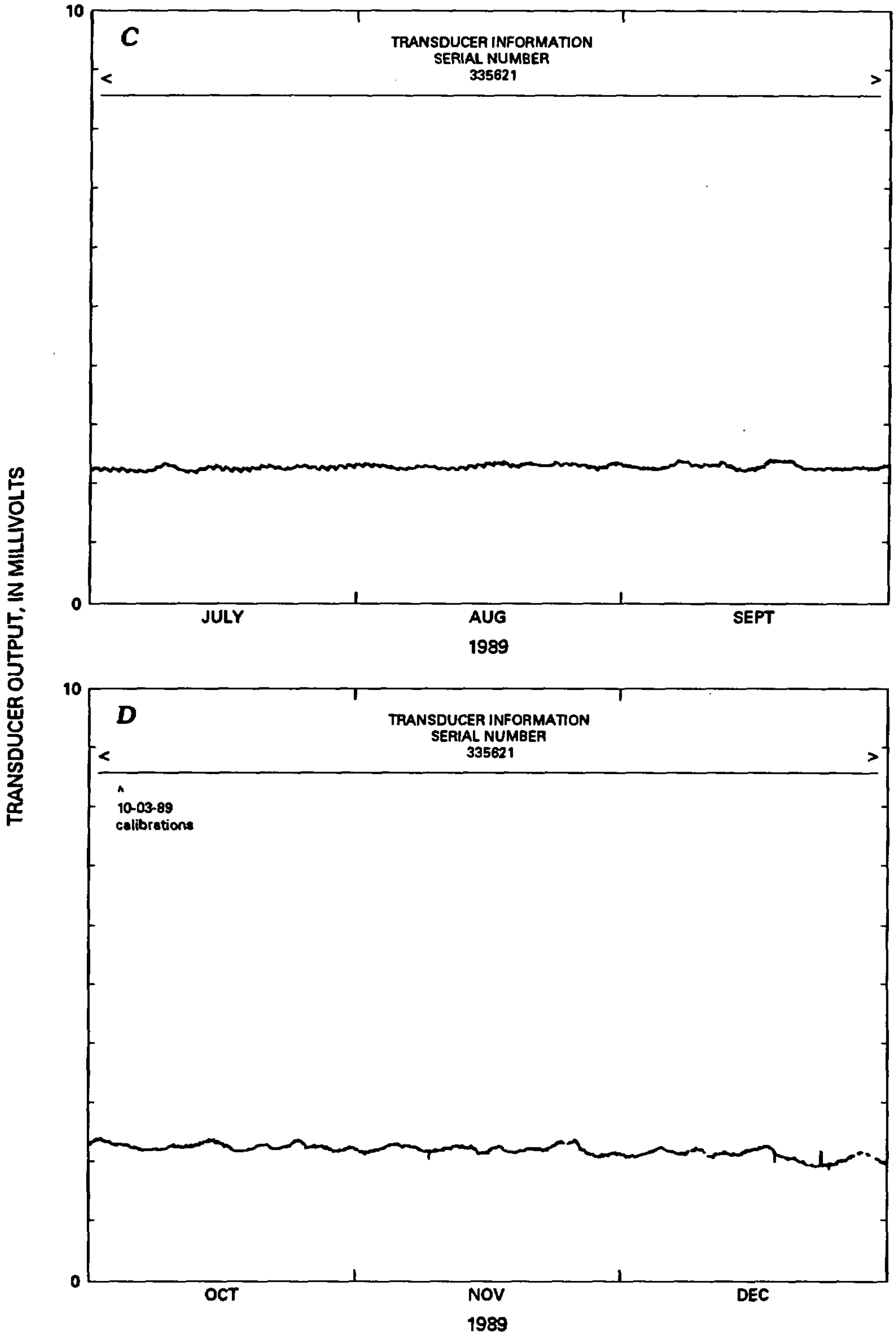


Figure 32.--Transducer output for well USW H-3.--Continued

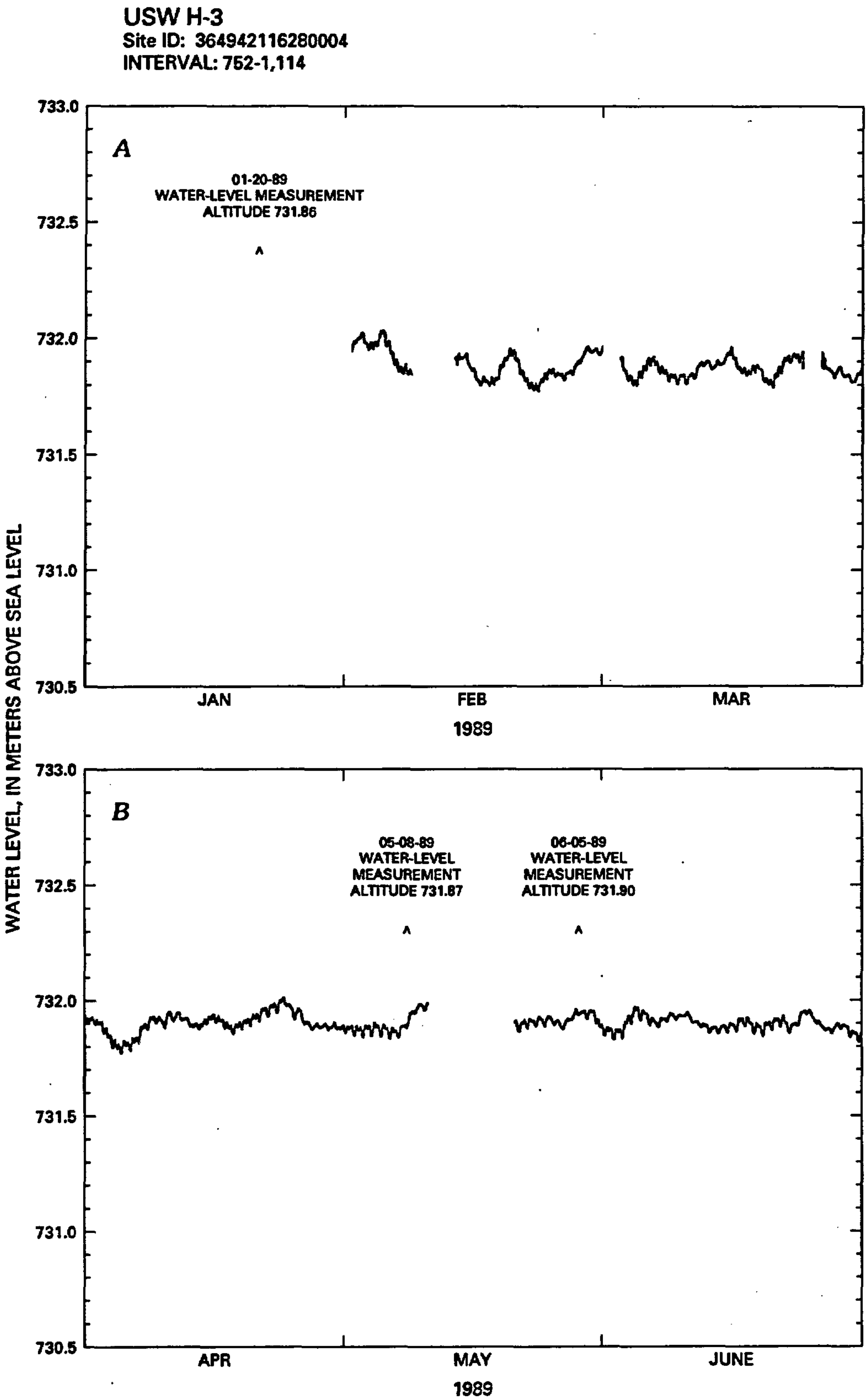


Figure 33.–Water-level altitude for well USW H-3.

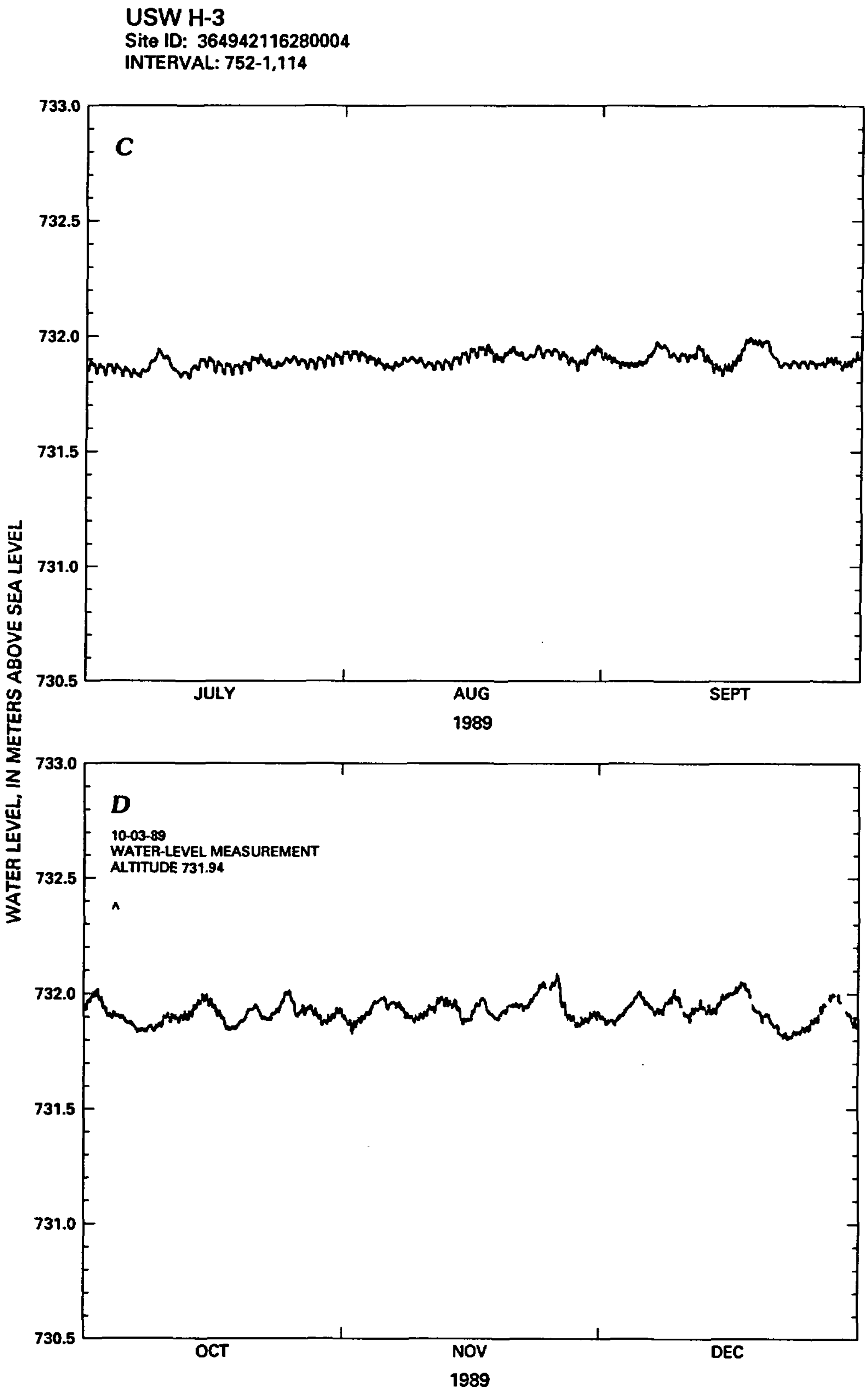


Figure 33.--Water-level altitude for well USW H-3.--Continued

Table 13. *Daily mean water-level altitude for 1989, in meters above sea level, for well USW H-3*
[Monthly mean, maximum (max), and minimum (min) computed from the daily mean values, indicated only for months that have complete data sets. Dashes indicate insufficient data to calculate daily mean water-level altitude]

Interval: 752-1,114 m **Site ID: 364942116280004**

DAY	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
						1989						
1	—	731.99	—	731.91	731.87	731.86	731.88	731.92	731.90	731.94	731.87	731.90
2	—	731.99	—	731.89	731.87	731.88	731.86	731.92	731.88	731.99	731.87	731.88
3	—	731.97	732.01	731.86	731.87	731.94	731.86	731.91	731.88	731.94	731.90	731.89
4	—	732.01	731.87	731.81	731.87	731.95	731.86	731.89	731.88	731.89	731.94	731.93
5	—	731.95	731.82	731.79	731.87	731.92	731.85	731.87	731.89	731.89	731.97	731.98
6	—	731.88	731.85	731.80	731.86	731.91	731.84	731.87	731.94	731.86	731.95	731.98
7	—	—	731.90	731.83	731.86	731.92	731.84	731.89	731.96	731.84	731.95	731.94
8	—	—	731.87	731.89	731.90	731.93	731.86	731.90	731.92	731.84	731.91	731.93
9	—	—	731.84	731.90	731.95	731.94	731.91	731.89	731.91	731.84	731.89	731.97
10	—	—	731.83	731.90	—	731.92	731.91	731.88	731.91	731.87	731.91	731.99
11	—	—	731.83	731.92	—	731.89	731.86	731.88	731.93	731.89	731.93	—
12	—	731.89	731.85	731.92	—	731.88	731.84	731.88	731.91	731.89	731.97	731.93
13	—	731.92	731.89	731.89	—	731.88	731.84	731.88	731.87	731.90	731.95	731.94
14	—	731.90	731.88	731.88	—	731.89	731.88	731.91	731.86	731.94	731.94	731.93
15	—	731.83	731.89	731.91	—	731.90	731.89	731.92	731.87	731.97	731.88	731.96
16	—	731.82	731.93	731.91	—	731.91	731.87	731.93	731.92	731.94	731.93	732.00
17	—	731.82	731.88	731.89	—	731.89	731.86	731.94	731.98	731.89	731.96	732.03
18	—	731.89	731.86	731.87	—	731.88	731.86	731.92	731.97	731.84	731.91	732.03
19	—	731.93	731.87	731.89	—	731.90	731.87	731.91	731.97	731.86	731.90	—
20	—	731.87	731.83	731.90	—	731.92	731.88	731.94	731.91	731.90	731.94	731.91
21	—	731.80	731.82	731.93	731.89	731.89	731.90	731.92	731.88	731.93	731.95	731.89
22	—	731.80	731.88	731.95	731.90	731.91	731.89	731.91	731.88	731.89	731.94	731.84
23	—	731.84	731.91	731.97	731.91	731.96	731.87	731.93	731.88	731.89	731.98	731.82
24	—	731.85	—	731.98	731.91	731.92	731.89	731.93	731.88	731.94	—	731.84
25	—	731.84	—	731.94	731.91	731.89	731.90	731.93	731.88	731.99	—	731.85
26	—	731.86	—	731.92	731.89	731.88	731.89	731.92	731.89	731.92	732.03	731.89
27	—	731.91	731.89	731.88	731.92	731.90	731.88	731.90	731.89	731.92	731.92	—
28	—	731.95	731.85	731.88	731.95	731.87	731.88	731.88	731.88	731.91	731.88	—
29	—		731.85	731.88	731.95	731.86	731.89	731.90	731.89	731.88	731.88	—
30	—		731.82	731.88	731.92	731.88	731.90	731.94	731.92	731.89	731.91	—
31	—		731.86		731.87		731.91	731.92		731.92		731.88
MONTHLY												
MEAN	—	—	—	731.89	—	731.90	731.87	731.91	731.90	731.90	—	—
MAX	—	—	—	731.98	—	731.96	731.91	731.94	731.98	731.99	—	—
MIN	—	—	—	731.79	—	731.86	731.84	731.87	731.86	731.84	—	—

Well USW H-4

Information about the history of well USW H-4 and about previous data from the well was obtained from various sources. These sources are: Whitfield and others (1984); Whitfield and others (1985); Robison (1984, 1986); Robison and others (1988); Erickson and Waddell (1985); Fenix & Scisson, Inc. (1987a, c).

Well specifications

The following are specifications for well USW H-4:

1. Location and identification:

   Latitude and longitude: 36°50'32" N.; 116°26'54" W.
   Nevada State Central Zone Coordinates (m): N 232,149; E 171,880.
   U.S. Geological Survey Site ID's:
   365032116265401 (entire well)
   365032116265402 (upper interval)
   365032116265403 (lower interval)

2. Drilling and casing information:

   Well started: March 22, 1982.
   Well completed: June 7, 1982.
   Drilling method: Rotary, using rock bits and air-foam circulating medium; selected core obtained.
   Bit diameter below water level: 375 mm to 564 m; 222 mm from 564 m to 1219 m.
   Casing extending below water level: 253 mm diameter to 561 m, perforated below the water level.
   Total drilled depth: 1,219 m.

3. Access to and description of interval for measuring water levels:

   48-mm inside diameter open ended tubing, extending from land surface to depth of 525 m; upper interval of well near water table to top of inflatable packer within Prow Pass, Bullfrog, and Tram Members of Crater Flat Tuff, bedded tuff, and upper Lithic Ridge Tuff; Site ID: 365032116265402.
   62-mm inside diameter tubing with inflatable packer on bottom end, extending from surface to 1,188 m; lower interval of well, within Lithic Ridge Tuff; Site ID: 365032116265403.

4. Information for calculating water-level altitude:

   Reference point: Top of metal tag on well casing; altitude 1,248.74 m (surveyed by U.S. Geological Survey, 1984).
   Depth correction for borehole deviation from vertical: 0.06 m, based on approximate depth to water of 518 m.

History of instrumentation, calibrations, and comments

Manual water-level measurements were made from June 7, 1982 through 1984. Beginning in 1984, barometric pressure and water level have been monitored continuously using a recording barometer and downhole pressure transducers with a data logger at land surface. Data were recorded on a paper tape from 1984 through February 1985. Data have been recorded electronically since February 1985.

The following transducers were used in well USW H-4 in 1989:

[Range is pressure limit for transducer, in pounds per square inch]

Date of use		Transducer			
Beginning	Ending	Type	Model	Range	Serial number
		Site ID: 365032116265402			
		Interval: 518-1,181 meters			
05-02-88	10-23-90	Gage	Druck 930	10	226106
		Site ID: 365032116265403			
		Interval: 1,181-1,219 meters			
06-01-88	04-11-89	Gage	Druck 930	10	226105
04-11-89	10-23-90	Gage	Druck 930	10	235178

The following calibrations of the water-level monitoring system were used to process the 1989 data from well USW H-4:

Transducer				Water level	
		Regression line			
Serial number	Calibration date	Slope (millivolts per meter)	Coefficient of determination	Date	Altitude (meters)
		Site ID: 365032116265402			
		Interval: 518-1,181 meters			
226106	10-12-88	-6.695	1.000	10-12-88	730.33
226106	01-31-89	-6.546	1.000	01-31-89	730.40
226106	05-08-89	-6.632	1.000	05-08-89	730.38
226106	08-29-89	-6.602	1.000	08-29-89	730.38
226106	11-09-89	-6.612	1.000	11-09-89	730.30
226106	02-13-90	-6.681	1.000	02-13-90	730.52
		Site ID: 365032116265403			
		Interval: 1,181-1,219 meters			
226105	10-12-88	-6.670	1.000	10-12-88	730.27
235178	04-11-89	-6.739	1.000	04-11-89	730.58
235178	08-03-89	-6.797	1.000	08-03-89	730.63
235178	11-09-89	-6.687	1.000	11-09-89	730.56
235178	02-13-90	-6.639	1.000	02-13-90	730.71

Transducer output from January through December 1989 is shown in figure 34A through 34H. These data are the transducer output after first-level filtering (described in the "First-Level Filtering" section) has been applied. In the upper interval, the transducer (serial number 226106) used from June 1988 through October 1990 produced reasonable output except for periods of erratic output in January, February, March (fig. 34A), and April, May (fig. 34B), August (fig. 34C), and October (fig. 34D). In the lower interval, the first transducer (serial number 226105) used from June 1988 through April 1989 generally produced erratic output or no data (fig. 34E and 34F). The second transducer (serial number 235178) in use from April 1989 through October 1990, generally produced reasonable output except for short periods of erratic output in May (fig. 34F) and August 1989 (fig. 34G).

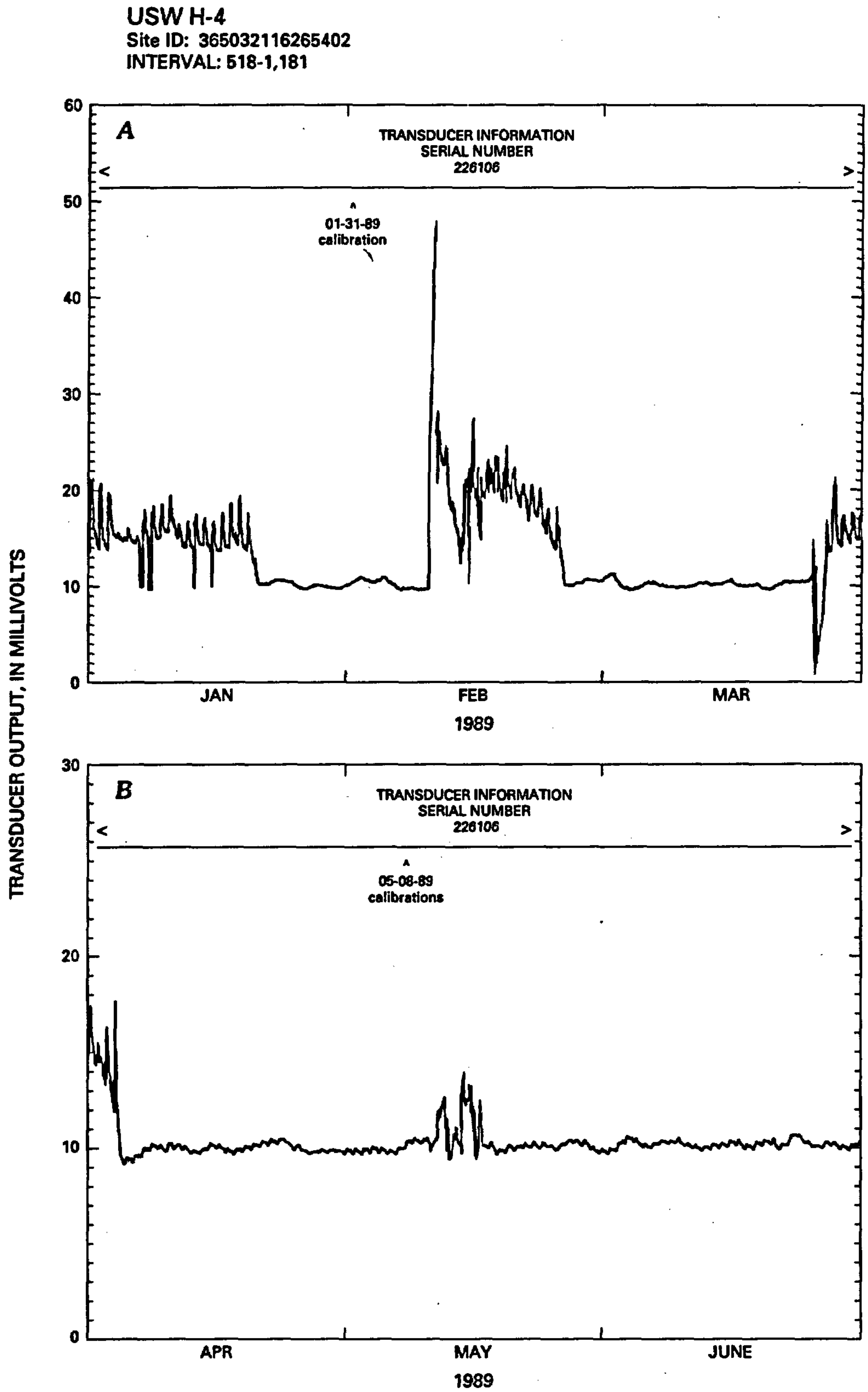


Figure 34.--Transducer output for well USW H-4.

USW H-4
Site ID: 365032116265402
INTERVAL: 518-1,181

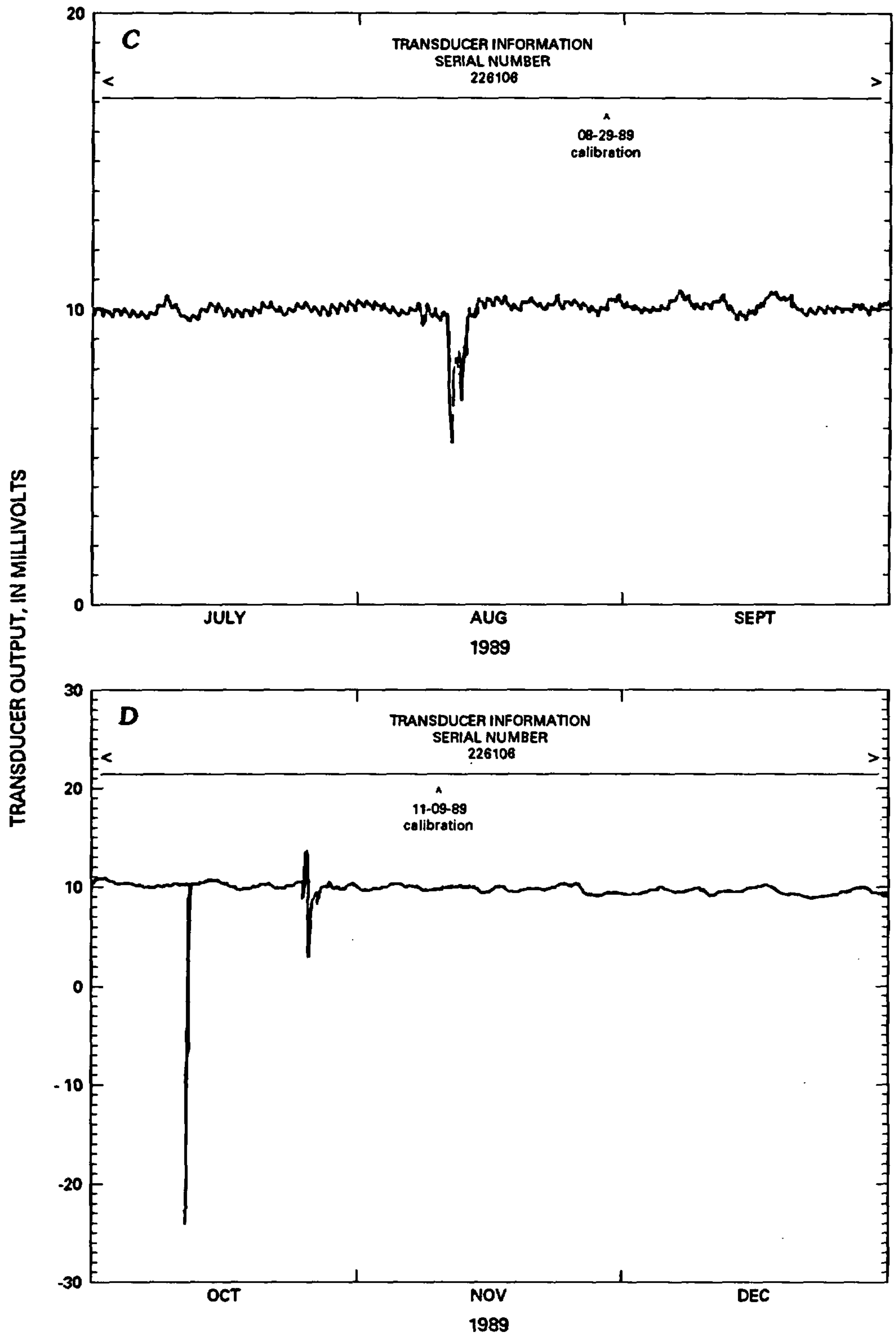


Figure 34.--Transducer output for well USW H-4.--Continued

USW H-4
Site ID: 365032116265403
INTERVAL: 1,181-1,219

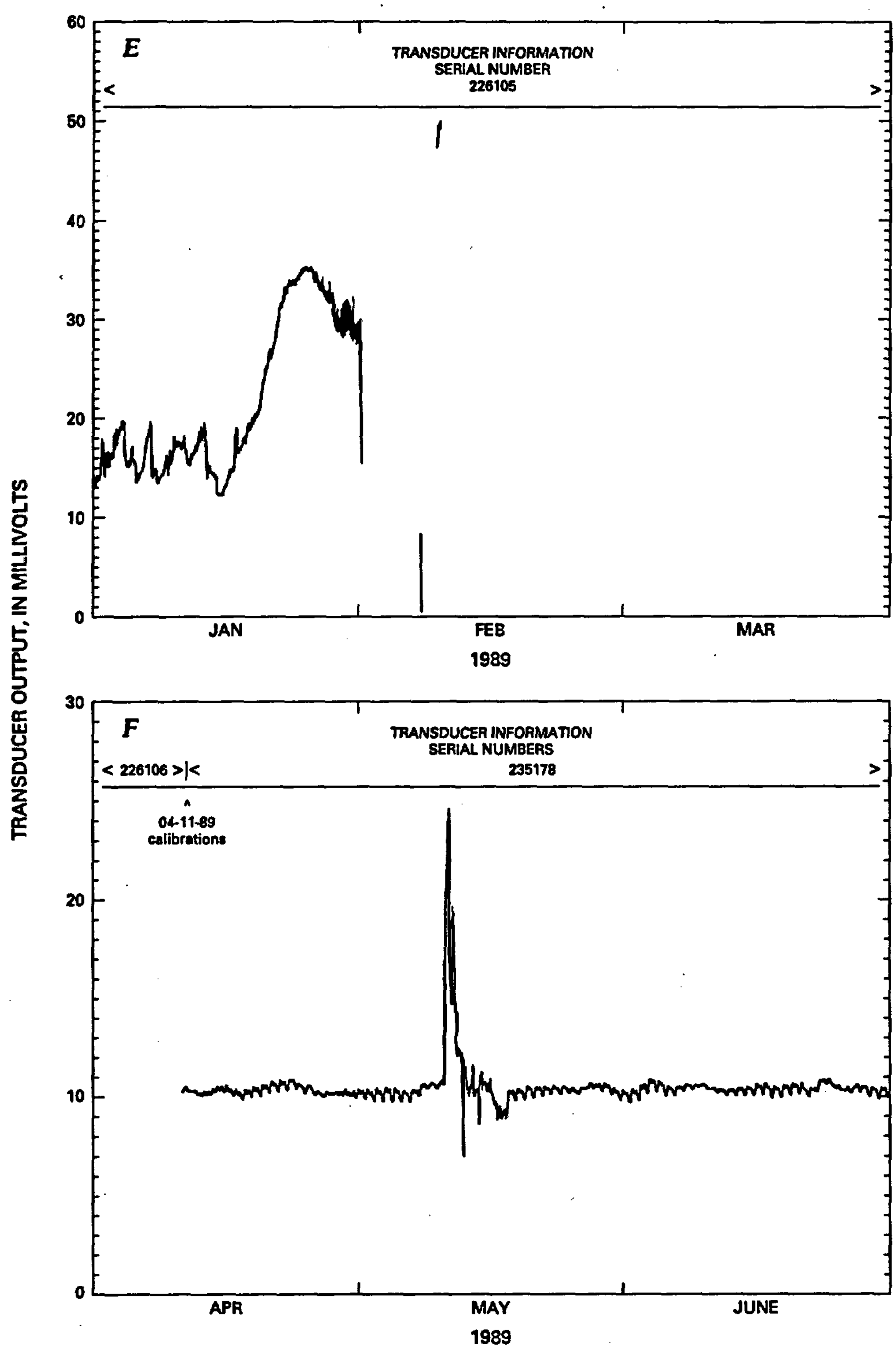


Figure 34.--Transducer output for well USW H-4.--Continued

USW H-4
Site ID: 365032116265403
INTERVAL: 1,181-1,219

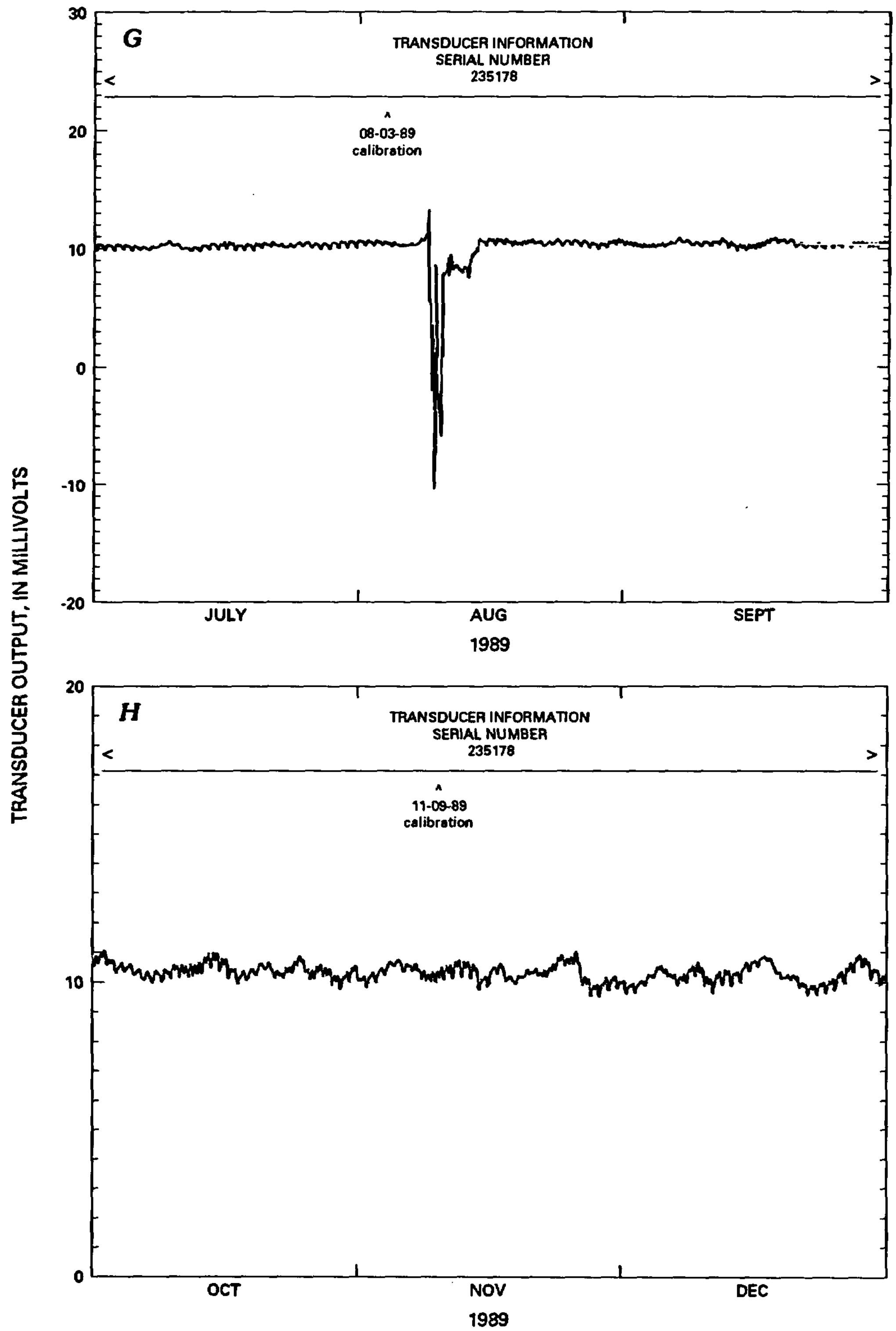


Figure 34.--Transducer output for well USW H-4.--Continued

There was one spike in the transducer output from the upper interval in 1989 (fig. 34D). This spike represents a single transducer output that deviates from the trend of the record. This spike was not coincident with a site visit or any other identifiable event and probably represents a system malfunction of some type. The details of the spike are as follows:

Date	Time	Value (millivolts)	
		Recorded	Expected
Site ID: 365032116265402			
Interval: 518-1,181 meters			
10-12-89	13:00	–24.98	10.06

In this table, the expected value is the average of the transducer output 1 hour before and 1 hour after the spike. The spike, if converted to a water level, would represent a level far below the bottom of the transducer. Because the value represents some sort of system malfunction, it was not converted to a water level.

Transducer output was converted to water-level altitude for the following periods:

Beginning date	Ending date
Site ID: 365032116265402	
Interval: 518-1,181 meters	
01-21-89	02-08-89
02-26-89	03-25-89
04-05-89	05-10-89
05-18-89	08-06-89
08-15-89	10-24-89
11-01-89	12-31-89
Site ID: 365032116265403	
Interval: 1,181-1,219 meters	
04-12-89	05-10-89
05-19-89	08-06-89
08-15-89	12-31-89

The water-level altitudes are shown in figure 35A through 35G, and the daily mean water-level altitudes are given in table 14. Approximately 81 percent of the transducer output from the upper interval was converted to water-level altitude. The longest period of continuous record in 1989 was 81 days, May 18 through August 6, 1989. There was a period of continuous record of 195 days, May 6 through November 16, 1986. Approximately 68 percent of the transducer output from the lower interval was converted to water-level altitude. The longest period of continuous record in 1989 was 139 days, August 15 through December 31, 1989. There was a period of continuous record of 155 days, June 27 through November 28, 1986.

USW H-4
Site ID: 365032116265402
INTERVAL: 518-1,181

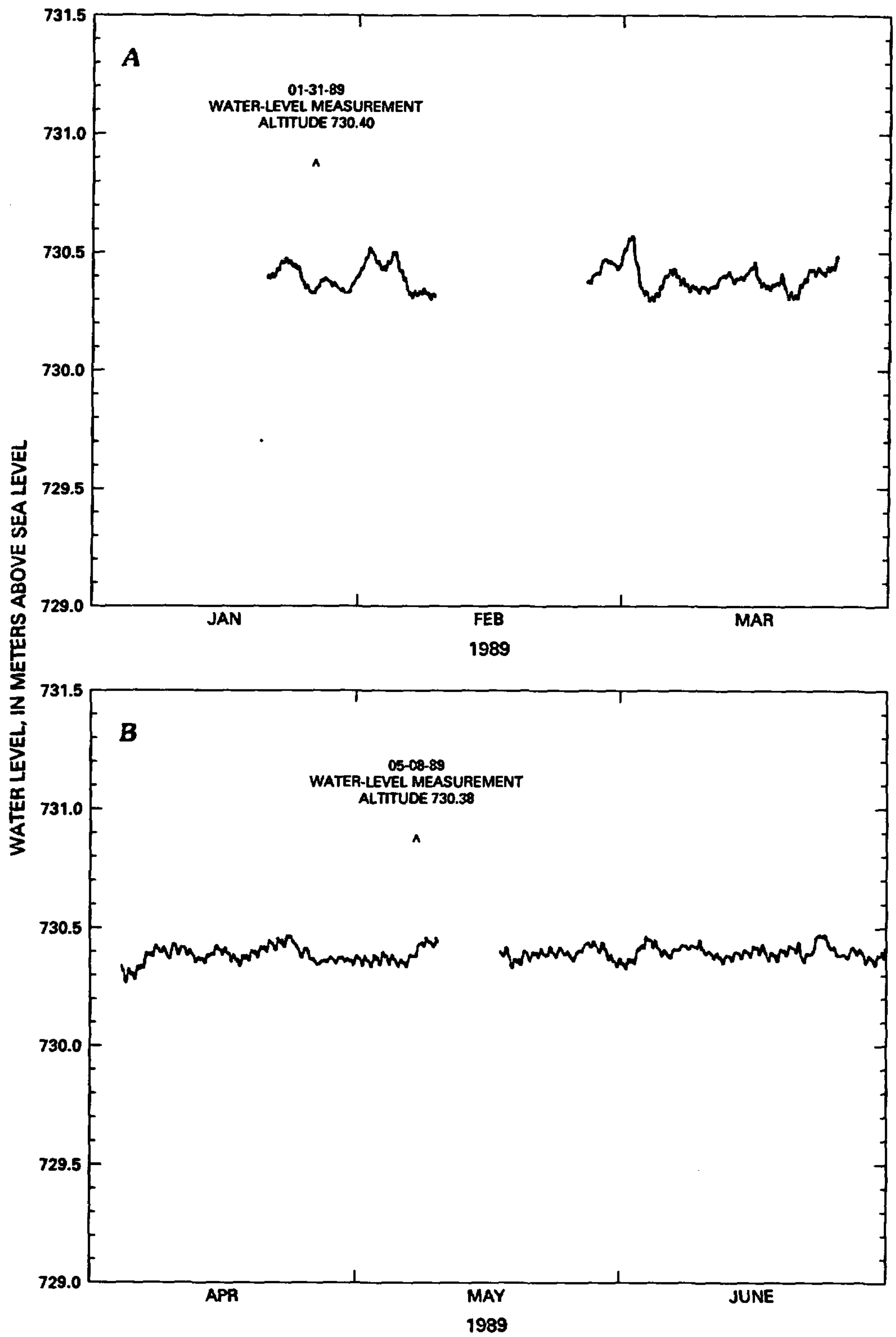


Figure 35.–Water-level altitude for well USW H-4.

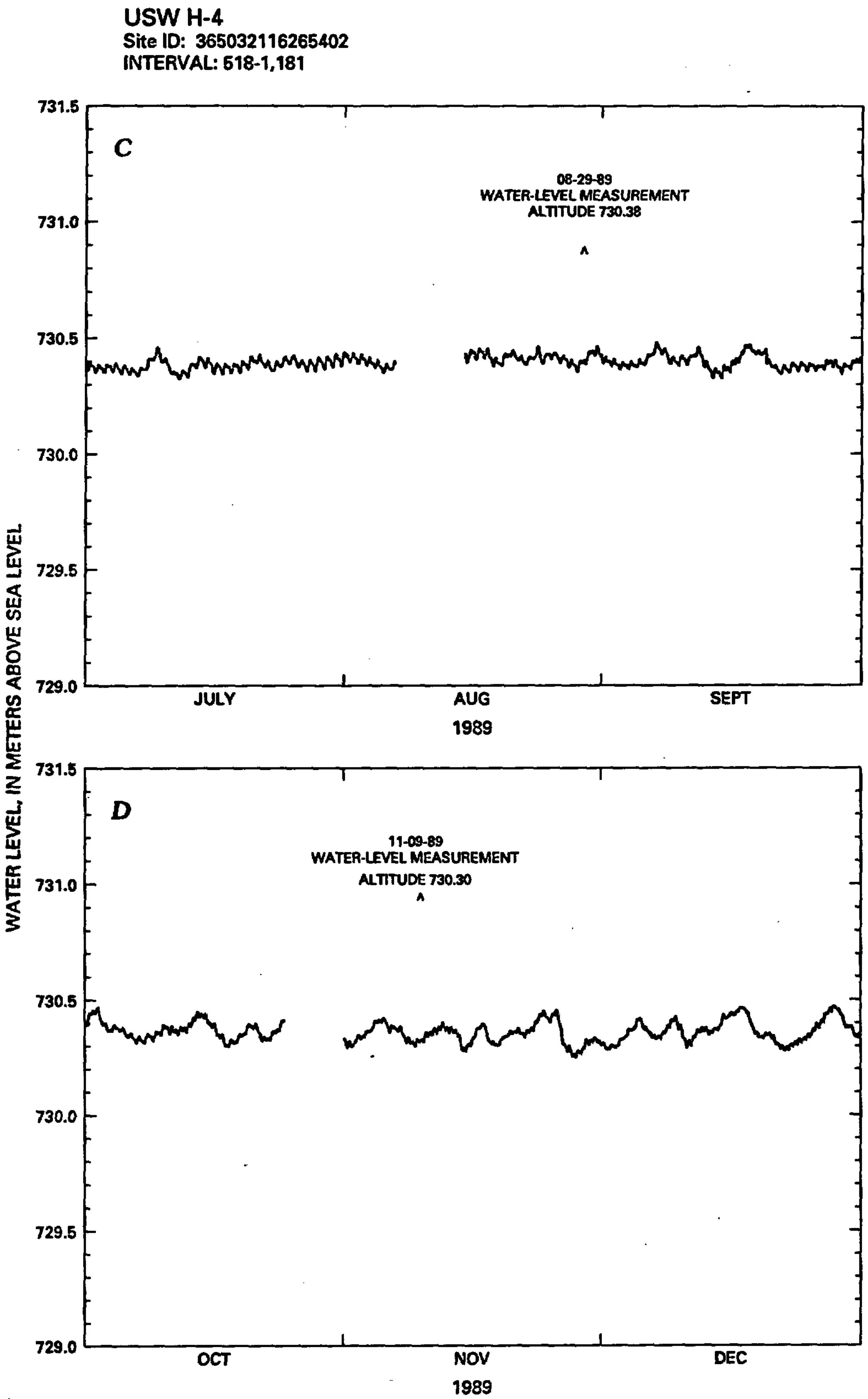


Figure 35.–Water-level altitude for well USW H-4.–Continued

USW H-4
Site ID: 365032116265403
INTERVAL: 1,181-1,219

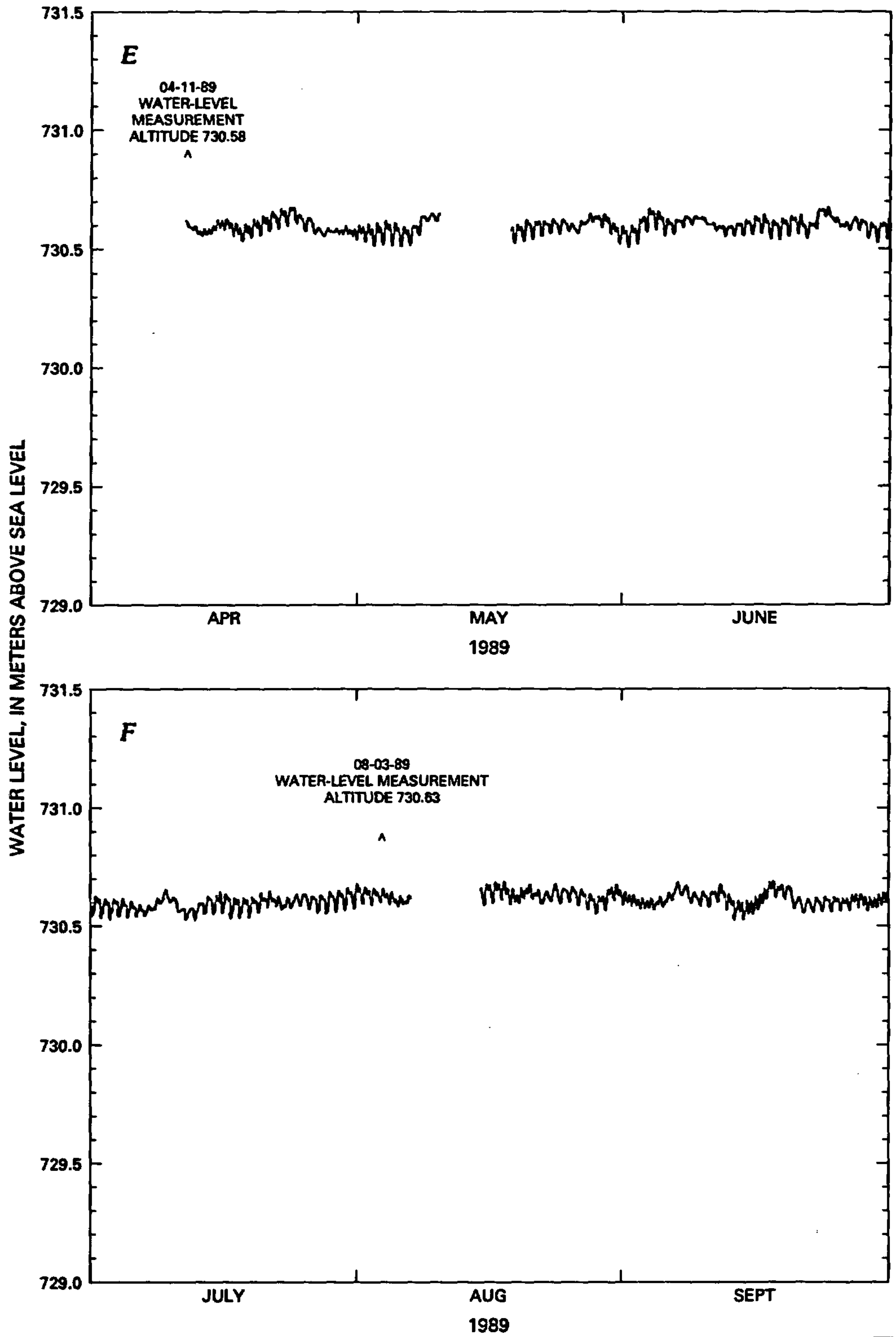


Figure 35.--Water-level altitude for well USW H-4.--Continued

USW H-4
Site ID: 365032116265403
INTERVAL: 1,181-1,219

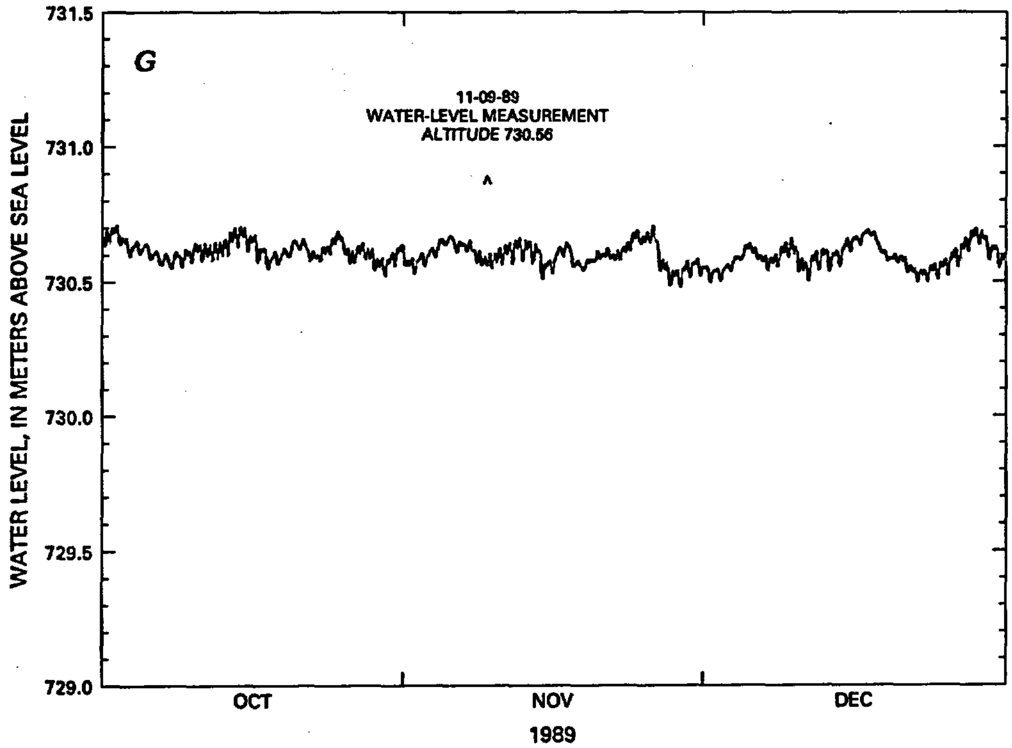


Figure 35.--Water-level altitude for well USW H-4.--Continued

Table 14. *Daily mean water-level altitude for 1989, in meters above sea level, for well USW H-4*
[Monthly mean, maximum (max), and minimum (min) computed from the daily mean values, indicated only for months that have complete data sets. Dashes indicate insufficient data to calculate daily mean water-level altitude]

Interval: 518-1,181 m **Site ID: 365032116265402**

DAY	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
						1989						
1	—	730.49	730.45	—	730.37	730.35	730.38	730.41	730.39	730.42	730.31	730.30
2	—	730.46	730.53	—	730.37	730.38	730.37	730.40	730.38	730.46	730.33	730.29
3	—	730.44	730.46	—	730.37	730.43	730.36	730.40	730.38	730.40	730.35	730.31
4	—	730.48	730.33	—	730.37	730.43	730.37	730.38	730.38	730.38	730.39	730.35
5	—	730.39	730.31	730.31	730.37	730.39	730.36	730.37	730.40	730.38	730.41	730.39
6	—	730.32	730.37	730.32	730.36	730.38	730.35	—	730.44	730.35	730.38	730.38
7	—	730.33	730.42	730.37	730.36	730.41	730.35	—	730.44	730.33	730.37	730.34
8	—	—	730.38	730.41	730.40	730.41	730.38	—	730.40	730.34	730.33	730.34
9	—	—	730.35	730.42	730.44	730.42	730.42	—	730.40	730.35	730.31	730.39
10	—	—	730.34	730.41	—	730.39	730.40	—	730.40	730.37	730.34	730.38
11	—	—	730.35	730.42	—	730.37	730.35	—	730.43	730.38	730.36	730.31
12	—	—	730.37	730.41	—	730.37	730.34	—	730.39	730.37	730.38	730.34
13	—	—	730.41	730.38	—	730.38	730.36	—	730.35	730.38	730.37	730.36
14	—	—	730.39	730.38	—	730.39	730.39	—	730.35	730.43	730.34	730.36
15	—	—	730.40	730.41	—	730.40	730.39	730.42	730.37	730.43	730.29	730.40
16	—	—	730.43	730.41	—	730.40	730.37	730.43	730.41	730.39	730.35	730.42
17	—	—	730.37	730.38	—	730.38	730.37	730.43	730.46	730.34	730.38	730.45
18	—	—	730.36	730.37	730.40	730.38	730.37	730.40	730.43	730.31	730.31	730.43
19	—	—	730.38	730.39	730.36	730.40	730.38	730.40	730.42	730.34	730.32	730.35
20	—	—	730.32	730.41	730.37	730.41	730.39	730.43	730.37	730.37	730.35	730.34
21	730.40	—	730.33	730.43	730.38	730.37	730.40	730.41	730.36	730.38	730.36	730.33
22	730.44	—	730.40	730.44	730.39	730.41	730.38	730.40	730.37	730.34	730.35	730.29
23	730.46	—	730.42	730.45	730.39	730.45	730.37	730.43	730.37	730.35	730.39	730.29
24	730.43	—	730.42	730.45	730.39	730.41	730.39	730.41	730.37	—	730.43	730.31
25	730.36	—	—	730.40	730.39	730.37	730.40	730.42	730.37	—	730.42	730.33
26	730.33	730.39	—	730.38	730.38	730.38	730.39	730.40	730.38	—	730.39	730.37
27	730.38	730.43	—	730.36	730.41	730.39	730.38	730.39	730.38	—	730.28	730.41
28	730.36	730.46	—	730.37	730.43	730.36	730.38	730.38	730.37	—	730.26	730.45
29	730.34		—	730.37	730.41	730.36	730.39	730.41	730.38	—	730.30	730.43
30	730.35		—	730.37	730.37	730.38	730.40	730.44	730.40	—	730.32	730.37
31	730.41		—		730.35		730.41	730.41		—		730.35
MONTHLY												
MEAN	—	—	—	—	—	730.39	730.38	—	730.39	—	730.35	730.36
MAX	—	—	—	—	—	730.45	730.42	—	730.46	—	730.43	730.45
MIN	—	—	—	—	—	730.35	730.34	—	730.35	—	730.26	730.29

Table 14. *Daily mean water-level altitude for 1989, in meters above sea level, for well USW H-4 (Continued)*

Interval: 1,181-1,219 m **Site ID: 365032116265403**

DAY	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
					1989 (Continued)							
1	—	—	—	—	730.57	730.56	730.59	730.64	730.62	730.65	730.57	730.55
2	—	—	—	—	730.57	730.58	730.58	730.64	730.61	730.69	730.58	730.53
3	—	—	—	—	730.57	730.62	730.58	730.64	730.60	730.65	730.60	730.54
4	—	—	—	—	730.57	730.63	730.59	730.63	730.61	730.63	730.63	730.58
5	—	—	—	—	730.57	730.60	730.58	730.61	730.62	730.63	730.66	730.61
6	—	—	—	—	730.56	730.60	730.57	—	730.66	730.60	730.63	730.61
7	—	—	—	—	730.56	730.62	730.57	—	730.66	730.59	730.63	730.57
8	—	—	—	—	730.59	730.62	730.58	—	730.63	730.58	730.59	730.58
9	—	—	—	—	730.63	730.63	730.62	—	730.63	730.59	730.58	730.62
10	—	—	—	—	—	730.61	730.61	—	730.63	730.61	730.59	730.61
11	—	—	—	—	—	730.59	730.57	—	730.65	730.62	730.61	730.55
12	—	—	—	730.60	—	730.58	730.56	—	730.62	730.62	730.63	730.58
13	—	—	—	730.58	—	730.59	730.57	—	730.59	730.63	730.63	730.59
14	—	—	—	730.58	—	730.59	730.60	—	730.58	730.66	730.60	730.59
15	—	—	—	730.60	—	730.60	730.60	730.65	730.60	730.67	730.56	730.62
16	—	—	—	730.60	—	730.61	730.61	730.66	730.63	730.65	730.60	730.65
17	—	—	—	730.58	—	730.59	730.59	730.66	730.67	730.61	730.62	730.67
18	—	—	—	730.57	—	730.59	730.59	730.64	730.66	730.58	730.57	730.67
19	—	—	—	730.59	730.57	730.60	730.59	730.63	730.66	730.60	730.57	730.60
20	—	—	—	730.60	730.58	730.61	730.60	730.65	730.61	730.63	730.59	730.59
21	—	—	—	730.62	730.59	730.58	730.62	730.64	730.60	730.64	730.60	730.57
22	—	—	—	730.63	730.60	730.62	730.61	730.63	730.60	730.60	730.60	730.54
23	—	—	—	730.64	730.60	730.66	730.60	730.65	730.61	730.60	730.63	730.53
24	—	—	—	730.65	730.60	730.63	730.61	730.64	730.61	730.64	730.67	730.54
25	—	—	—	730.61	730.60	730.60	730.62	730.65	730.61	730.66	730.66	730.56
26	—	—	—	730.59	730.59	730.60	730.61	730.63	730.62	730.60	730.64	730.59
27	—	—	—	730.57	730.62	730.61	730.60	730.62	730.62	730.62	730.55	730.63
28	—	—	—	730.58	730.63	730.59	730.61	730.60	730.61	730.60	730.52	730.67
29	—		—	730.57	730.62	730.58	730.62	730.62	730.62	730.57	730.54	730.66
30	—		—	730.57	730.59	730.60	730.62	730.65	730.64	730.58	730.56	730.61
31	—		—		730.57		730.63	730.63		730.61		730.58
MONTHLY												
MEAN	—	—	—	—	—	730.60	730.60	—	730.62	730.62	730.60	730.59
MAX	—	—	—	—	—	730.66	730.63	—	730.67	730.69	730.67	730.67
MIN	—	—	—	—	—	730.56	730.56	—	730.58	730.57	730.52	730.53

Well USW H-5

Information about the history of well USW H-5 and about previous data from the well was obtained from various sources. These sources are: Bentley and others (1983); Robison (1984, 1986); Robison and others (1988); Fenix & Scisson, Inc. (1987a, c).

Well specifications

The following are specifications for well USW H-5:

1. Location and identification:

   Latitude and longitude: 36°51'22" N.; 116°27'55" W.
   Nevada State Central Zone Coordinates (m): N 233,670; E 170,355.
   U.S. Geological Survey Site ID's:
   365122116275501 (entire well)
   365122116275502 (upper interval)
   365122116275503 (lower interval)

2. Drilling and casing information:

   Well started: May 19, 1982.
   Well completed: August 1, 1982.
   Drilling method: Rotary, using rock bits and air-foam circulating medium; selected core obtained.
   Bit diameter below water level: 375 mm to 792 m; 222 mm from 792 m to 1,219 m.
   Casing extending below water level: 255 mm diameter to 788 m, perforated below the water level.
   Total drilled depth: 1,219 m.

3. Access to and description of interval for measuring water levels:

   48-mm inside-diameter open-ended tubing, extending from land surface to a depth of 708 m; upper saturated interval of borehole within Bullfrog and Tram Members of Crater Flat Tuff, bedded tuff, and unnamed lava beneath the Tram Member (Carr, 1988, p.37); Site ID: 365122116275502.
   62-mm inside-diameter tubing that has an inflatable packer on bottom end, extending from land surface to 1,091 m; lower interval within unnamed lava beneath the Tram Member of Crater Flat Tuff (Carr, 1988, p.37); Site ID: 365122116275503.

4. Information for calculating water-level altitude:

   Reference point: Top of metal tag on well casing; altitude 1,478.94 m (surveyed by U.S. Geological Survey, 1984). Depth correction for borehole deviation from vertical: 0.08 m, based on approximate depth to water of 703 m.

History of instrumentation, calibrations, and comments

Manual water-level measurements were made from November 19, 1982 through February 2, 1985. Beginning in February 1985, the well has been monitored continuously using downhole pressure transducers with a data logger at land surface.

The following transducer was used in well USW H-5 in 1989:

[Range is pressure limit for transducer, in pounds per square inch]

Date of use		Transducer			
Beginning	Ending	Type	Model	Range	Serial number
		Site ID: 365122116275502			
		Interval: 703-1,091 meters			
02-18-88	03-15-90	Gage	Druck 930	10	219283

Due to equipment stuck in the access tubing, no transducer was installed in the lower interval during the period covered by this report.

The following calibrations of the water-level monitoring system were used to process the 1989 data from well USW H-5:

Transducer				Water level	
		Regression line			
Serial number	Calibration date	Slope (millivolts per meter)	Coefficient of determination	Date	Altitude (meters)
		Site ID: 365122116275502			
		Interval: 703-1,091 meters			
219283	10-11-88	-6.445	1.000	10-11-88	775.45
219283	02-02-89	-6.484	0.999	02-02-89	775.57
219283	05-16-89	-6.603	1.000	05-16-89	775.51
219283	08-22-89	-6.465	1.000	08-22-89	775.47
219283	11-14-89	-6.608	1.000	11-14-89	775.49
219283	12-11-89	-6.345	0.999	12-13-89	775.52
219283	12-13-89	-6.600	1.000	12-13-89	775.52
219283	03-15-90	-6.397	0.999	03-15-90	775.53

Transducer output from January through December 1989 is shown in figure 36A through 36D. These data are the transducer output after first-level filtering (described in the "First-Level Filtering" section) has been applied. The only transducer (serial number 219283) in use from January through December 1989, generally produced reasonable output until late July except for a short period of erratic output in January (fig. 36A). In late July, it began producing erratic output (fig. 36C) and continued to do so through October (fig. 36D). It produced reasonable output from the first of November until the transducer was raised to slightly less than 1 m below the water level on December 13. It produced erratic output through the end of December 1989.

USW H-5
Site ID: 365122116275502
INTERVAL: 703-1,091

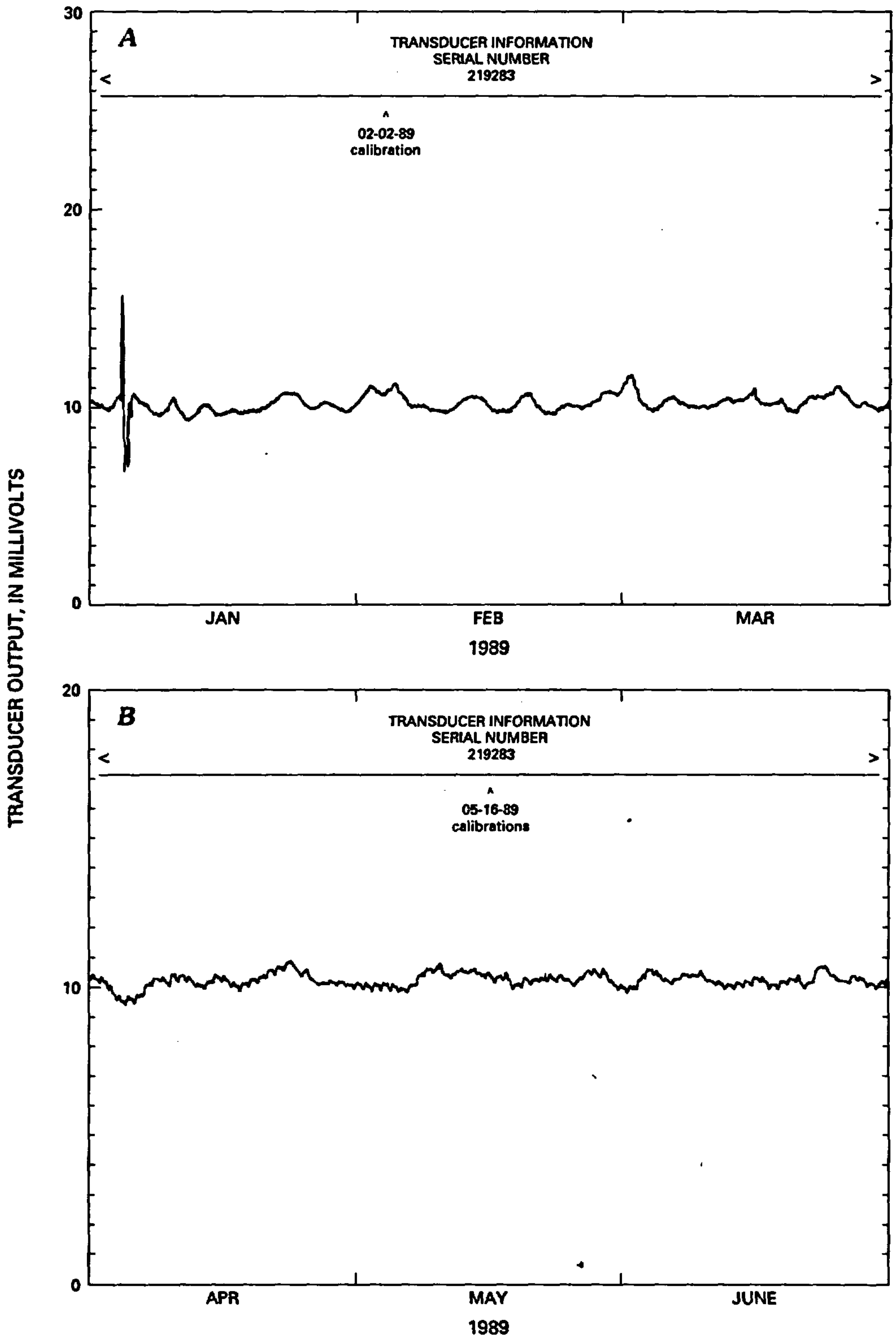


Figure 36.--Transducer output for well USW H-5.

USW H-5
Site ID: 365122116275502
INTERVAL: 703-1,091

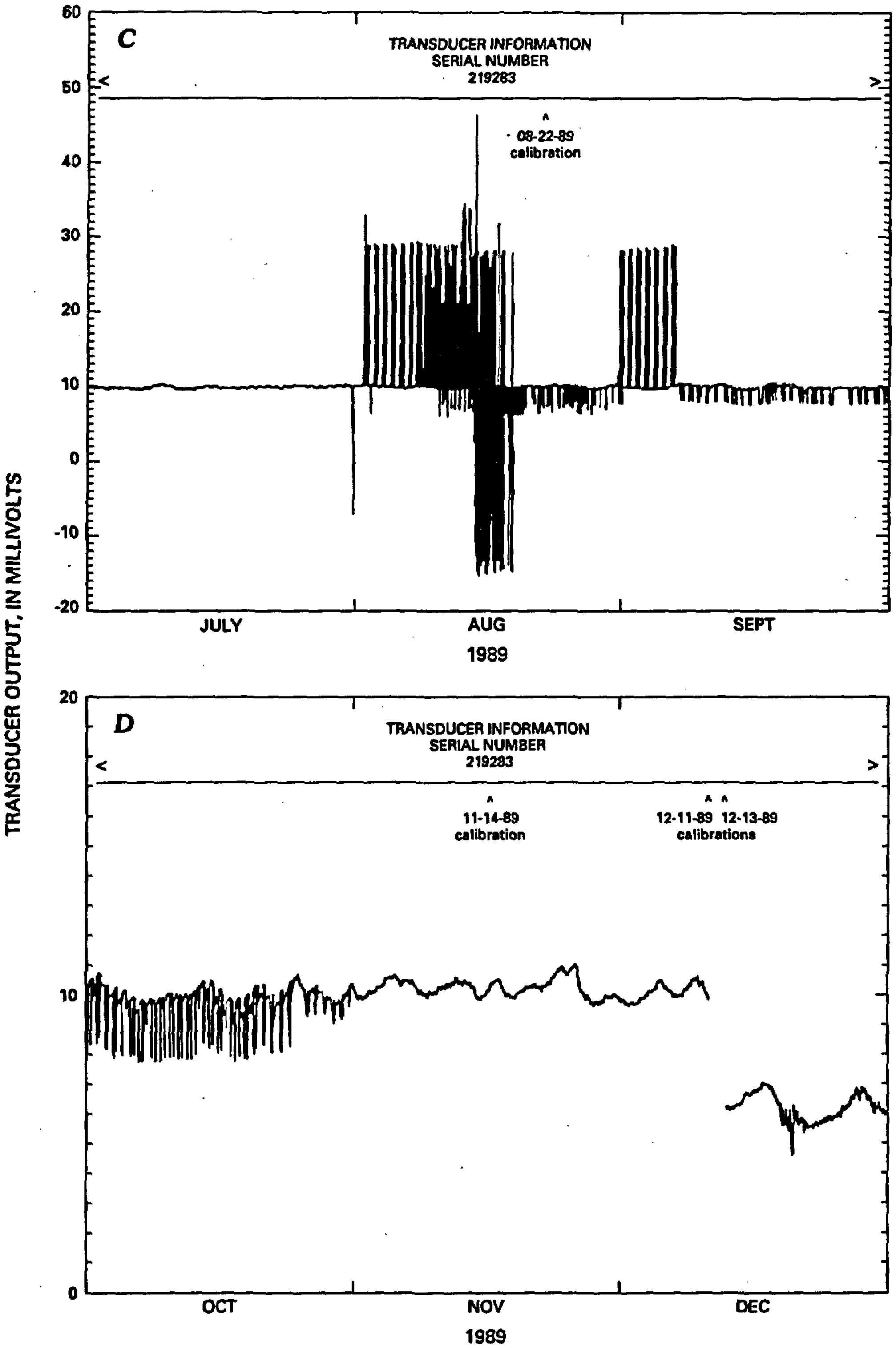


Figure 36.--Transducer output for well USW H-5.--Continued

Transducer output for the upper interval was converted to water-level altitude for the following periods:

Beginning date	Ending date
Site ID: 365122116275502	
Interval: 703-1,091 meters	
01-01-89	01-03-89
01-06-89	07-30-89
11-01-89	12-10-89

The water-level altitudes are shown in figure 37A through 37D, and the daily mean water-level altitudes are given in table 15. Approximately 68 percent of the transducer output from the upper interval was converted to water-level altitude. The longest period of continuous record in 1989 was 206 days, January 6 through July 30, 1989. The longest period of continuous record to date was 210 days, April 21 through November 16, 1986. No usable data were generated from the lower interval in 1989.

USW H-5
Site ID: 365122116275502
INTERVAL: 703-1,091

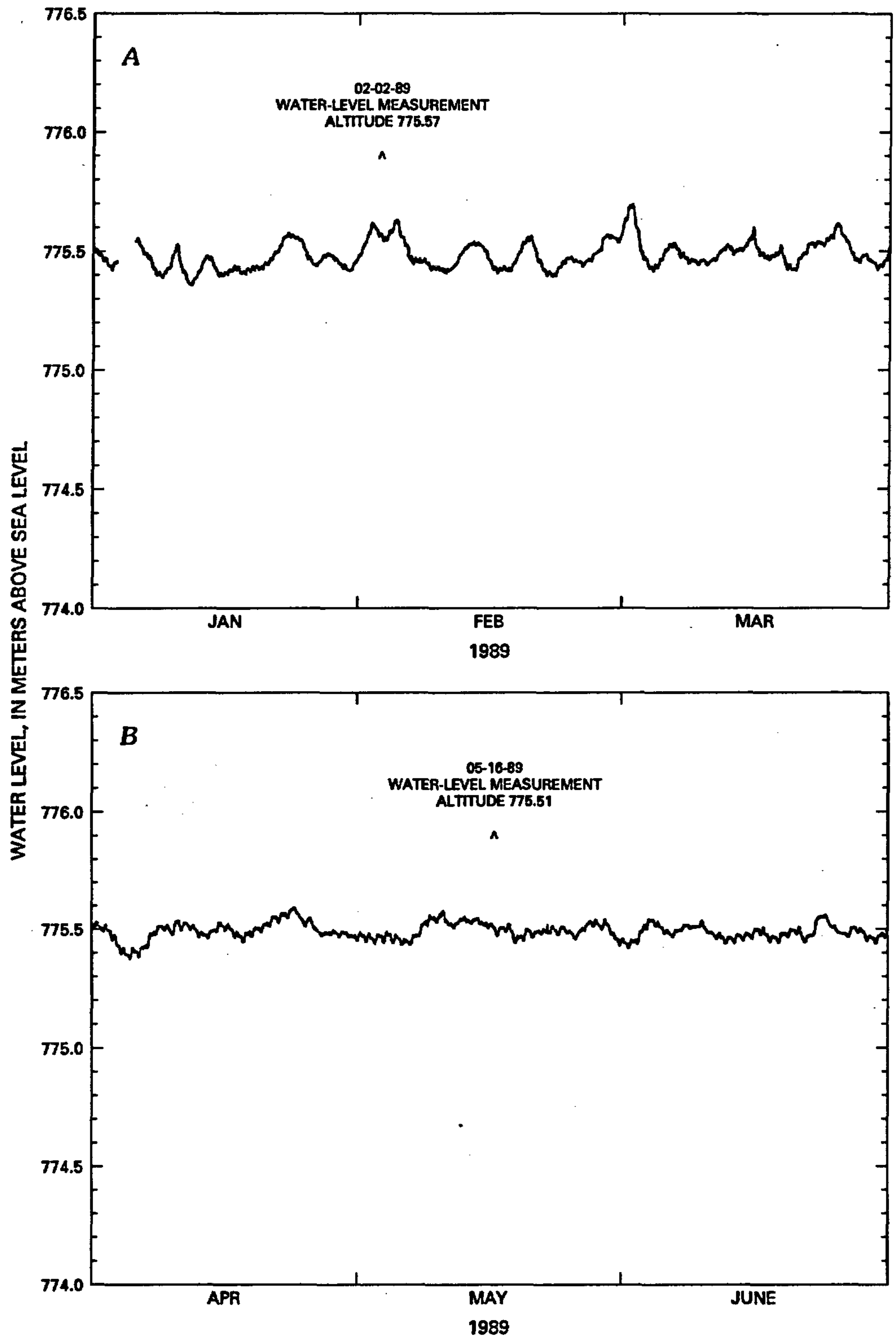


Figure 37.--Water-level altitude for well USW H-5.

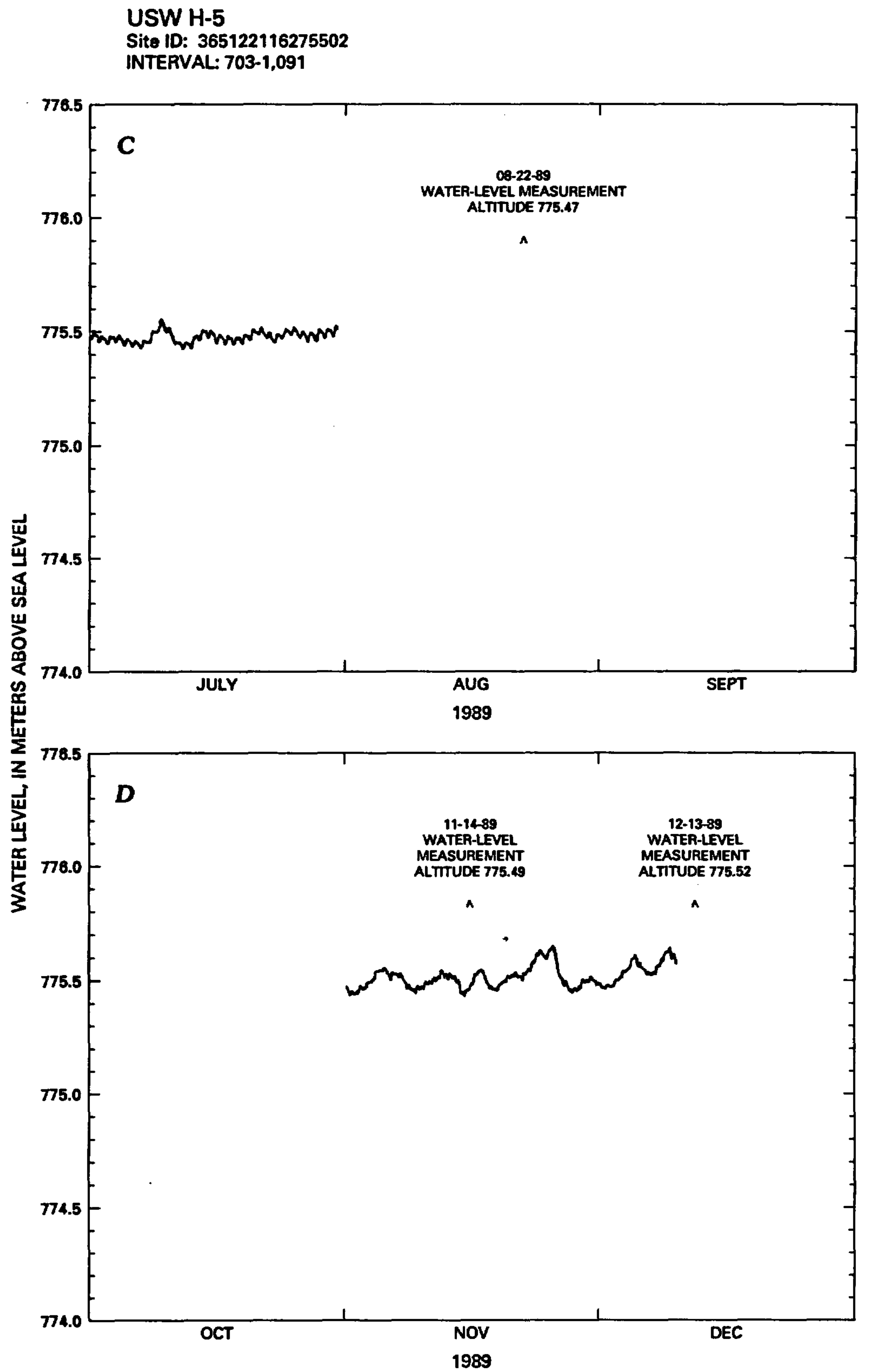


Figure 37.--Water-level altitude for well USW H-5.--Continued

Table 15. *Daily mean water-level altitude for 1989, in meters above sea level, for well USW H-5*
[Monthly mean, maximum (max), and minimum (min) computed from the daily mean values, indicated only for months that have complete data sets. Dashes indicate insufficient data to calculate daily mean water-level altitude]

Interval: 703-1,091 m   Site ID: 365122116275502

DAY	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
						1989						
1	775.50	775.59	775.55	775.52	775.47	775.44	775.48	—	—	—	775.44	775.48
2	775.46	775.57	775.65	775.50	775.46	775.46	775.47	—	—	—	775.45	775.47
3	—	775.56	775.60	775.46	775.46	775.52	775.46	—	—	—	775.48	775.49
4	—	775.60	775.46	775.41	775.47	775.53	775.47	—	—	—	775.52	775.53
5	—	775.52	775.43	775.39	775.46	775.49	775.45	—	—	—	775.54	775.58
6	—	775.46	775.48	775.40	775.45	775.48	775.45	—	—	—	775.52	775.57
7	775.47	775.45	775.52	775.44	775.45	775.51	775.44	—	—	—	775.51	775.54
8	775.41	775.43	775.49	775.49	775.49	775.51	775.47	—	—	—	775.47	775.55
9	775.41	775.42	775.46	775.50	775.54	775.52	775.52	—	—	—	775.45	775.61
10	775.49	775.42	775.45	775.50	775.55	775.49	775.51	—	—	—	775.47	—
11	775.41	775.46	775.45	775.51	775.54	775.47	775.46	—	—	—	775.50	—
12	775.37	775.52	775.47	775.51	775.52	775.46	775.44	—	—	—	775.52	—
13	775.43	775.53	775.51	775.48	775.54	775.46	775.45	—	—	—	775.52	—
14	775.46	775.50	775.50	775.47	775.54	775.47	775.48	—	—	—	775.49	—
15	775.40	775.43	775.51	775.50	775.53	775.48	775.49	—	—	—	775.44	—
16	775.41	775.42	775.55	775.51	775.52	775.49	775.47	—	—	—	775.50	—
17	775.42	775.43	775.49	775.48	775.49	775.47	775.46	—	—	—	775.53	—
18	775.41	775.51	775.47	775.47	775.50	775.47	775.46	—	—	—	775.47	—
19	775.43	775.54	775.49	775.49	775.46	775.49	775.47	—	—	—	775.47	—
20	775.44	775.46	775.44	775.50	775.47	775.49	775.48	—	—	—	775.50	—
21	775.47	775.41	775.44	775.53	775.48	775.46	775.50	—	—	—	775.52	—
22	775.53	775.41	775.50	775.55	775.49	775.50	775.48	—	—	—	775.52	—
23	775.56	775.46	775.53	775.56	775.49	775.55	775.47	—	—	—	775.56	—
24	775.54	775.46	775.53	775.57	775.49	775.52	775.49	—	—	—	775.62	—
25	775.47	775.45	775.57	775.53	775.49	775.49	775.50	—	—	—	775.61	—
26	775.44	775.47	775.57	775.51	775.47	775.49	775.49	—	—	—	775.59	—
27	775.48	775.52	775.50	775.48	775.51	775.50	775.48	—	—	—	775.49	—
28	775.47	775.56	775.47	775.48	775.53	775.47	775.48	—	—	—	775.45	—
29	775.43		775.46	775.48	775.52	775.46	775.49	—	—	—	775.48	—
30	775.43		775.44	775.47	775.49	775.49	—	—	—	—	775.50	—
31	775.50		775.48		775.45		—	—		—		—
MONTHLY												
MEAN	—	775.48	775.50	775.49	775.49	775.49	—	—	—	—	775.50	—
MAX	—	775.60	775.65	775.57	775.55	775.55	—	—	—	—	775.62	—
MIN	—	775.41	775.43	775.39	775.45	775.44	—	—	—	—	775.44	—

Well USW H-6

Information about the history of well USW H-6 and about previous data from the well was obtained from various sources. These sources are: Craig and others (1983); Robison (1984, 1986); Robison and others (1988); Fenix & Scisson, Inc. (1987a, c).

Well specifications

The following are specifications for well USW H-6:

1. Location and identification:

   Latitude and longitude: 36° 50'49" N.; 116° 28'55" W.
   Nevada State Central Zone Coordinates (m): N 232,654; E 168,882.
   U.S. Geological Survey Site ID's:
   365049116285501 (entire well)
   365049116285504 (upper interval)
   365049116285505 (lower interval)

2. Drilling and casing information:

   Well started: August 7, 1982.
   Well completed: October 28, 1982.
   Drilling method: Rotary, using rock bits and air-foam circulating medium; selected core obtained.
   Bit diameter below water level: 375 mm to 583 m; 222 mm from 583 to 1,216 m; 156 mm from 1,216 m to 1,220 m.
   Casing extending below water level: 250-mm diameter to 581 m, perforated below the water level.
   Total drilled depth: 1,220 m.

3. Access to and description of interval for measuring water levels:

   48-mm inside diameter open-ended tubing, extending from land surface to 533 m; saturated upper interval within Prow Pass, Bullfrog, and Tram members of Crater Flat Tuff, and bedded tuff; Site ID: 365049116285504.
   62-mm inside diameter tubing with inflatable packer on bottom end, extending from land surface to 752 m; lower interval within Tram Member of Crater Flat Tuff, bedded tuff, unnamed lava between Tram Member and Lithic Ridge Tuff (Carr, 1988 p.37) and Lithic Ridge Tuff; Site ID: 365049116285505.

4. Information for calculating water-level altitude:

   Reference point: Top of metal tag on well casing; altitude 1,302.06 m (surveyed by U.S. Geological Survey, 1984).
   Depth correction for borehole deviation from vertical: 0.05 m, based on approximate depth to water of 526 m.

History of instrumentation, calibrations, and comments

Manual water-level measurements were made from December 15, 1982 through July 19, 1984. Beginning in August 1985, the water level has been monitored continuously using downhole pressure transducers with a data logger at land surface.

The following transducers were used in well USW H-6:

[Range is pressure limit for transducer, in pounds per square inch]

Date of use		Transducer			
Beginning	Ending	Type	Model	Pressure	Serial number
		Site ID: 365049116285504			
		Interval: 526-752 meters			
04-13-88	05-10-90		Druck PDCR 10/D	10	226102
		Site ID: 365049116285505			
		Interval: 752-1220 meters			
08-13-85	03-29-89	Absolute	Bell & Howell	25	6054
03-30-89	05-10-90	Gage	Druck 930	10	235186

The following calibrations of the water-level monitoring system were performed in well USW H-6:

Transducer				Water level	
		Regression line			
Serial number	Calibration date	Slope (millivolts per meter)	Coefficient of determination	Date	Altitude (meters)
		Site ID: 365049116285504			
		Interval: 526-752 meters			
226102	10-21-88	−6.576	0.999	10-21-88	775.91
226102	02-03-89	−6.702	1.000	02-03-89	776.00
226102	05-12-89	−6.640	1.000	05-12-89	775.84
226102	08-15-89	−6.626	1.000	08-18-89	775.95
226102	08-18-89	−6.575	1.000	08-18-89	775.95
226102	10-18-89	−6.571	0.999	10-18-89	775.90
226102	02-02-90	−6.455	0.999	02-02-90	775.90
		Site ID: 365049116285505			
		Interval: 752-1,220 meters			
6054	10-21-88	−0.852	1.000	10-21-88	775.90
6054	02-03-89	−0.866	1.000	02-03-89	775.92
235186	03-30-89	−6.674	1.000	03-29-89	775.85
235186	07-26-89	−6.742	1.000	07-26-89	775.90
235186	10-18-89	−6.714	1.000	10-18-89	775.85
235186	02-02-90	−6.709	1.000	02-02-90	775.90

Transducer output from January through December 1989 is shown in figures 38A through 38H. These data are the transducer output after first-level filtering (described in the "First-Level Filtering" section) has been applied. In the upper interval, the transducer (serial number 226102) used from January through December 1989, generally produced reasonable output except for short periods of erratic output in January, March (fig. 38A), and October (fig. 38D).

In the lower interval, the first transducer (serial number 6054) used from January through March 1989, produced no reasonable output (fig. 38E). The second transducer (serial number 235186), in use from March through December 1989, generally produced reasonable output.

Transducer output was converted to water-level altitude for the following periods:

Beginning date	Ending date
Site ID: 365049116285504	
Interval: 526-752 meters	
01-01-89	01-03-89
01-06-89	03-25-89
03-31-89	07-06-89
07-10-89	10-24-89
11-01-89	12-31-89
Site ID: 365049116285505	
Interval: 752-1,220 meters	
03-31-89	07-07-89
07-09-89	12-31-89

The water-level altitudes are shown in figure 39A through 39H, and the daily mean water-level altitudes are given in table 16. Approximately 95 percent of the transducer output from the upper interval was converted to water-level altitude. The longest period was 107 days, July 10, 1989 through October 24, 1989. Approximately 75 percent of the transducer output from the lower interval was converted to water-level altitude. The longest period was 176 days, July 9 through December 31, 1989.

USW H-6
Site ID: 365049116285504
INTERVAL: 526-752

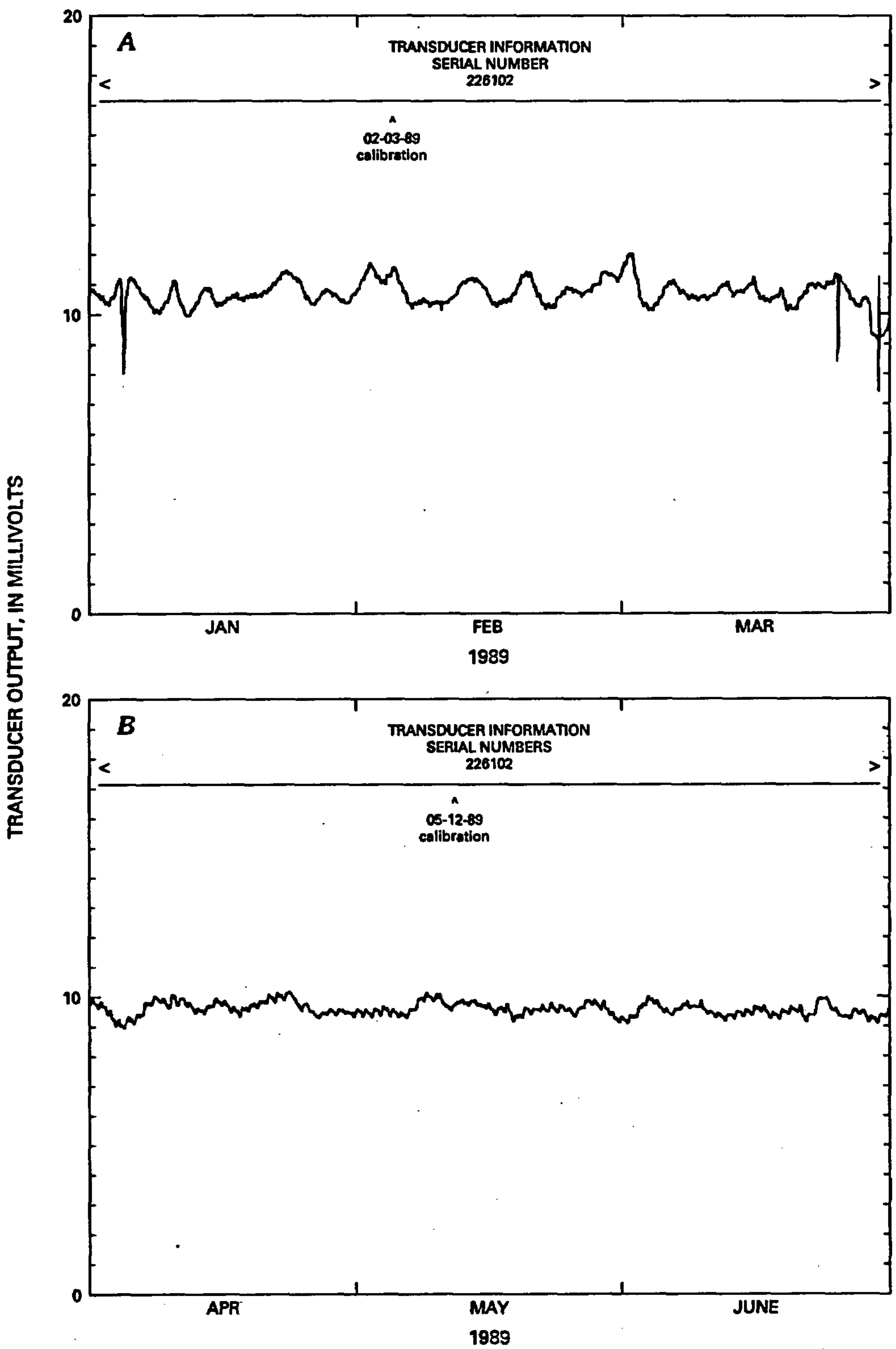


Figure 38.—Transducer output for well USW H-6.

USW H-6
Site ID: 365049116285504
INTERVAL: 526-752

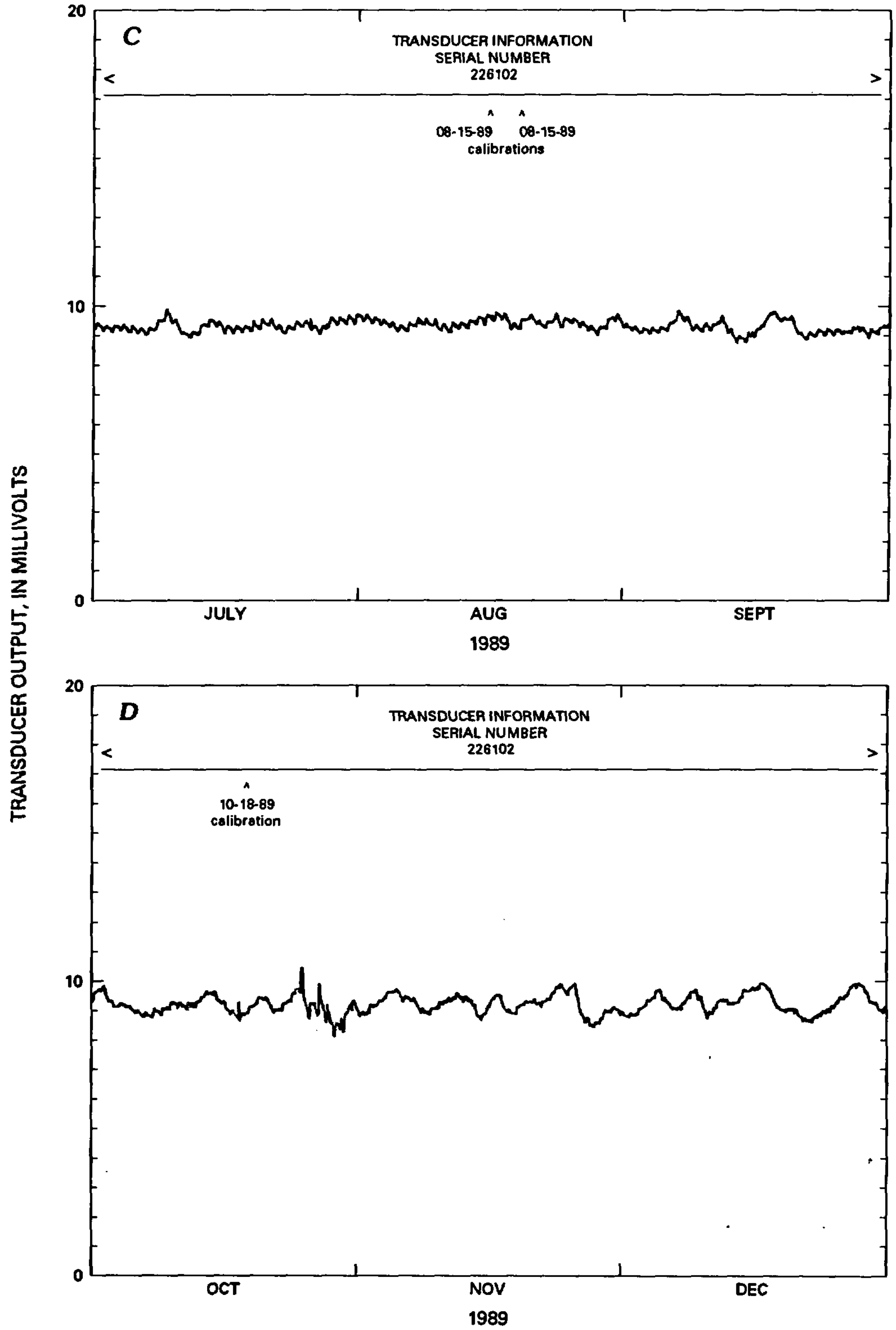


Figure 38.--Transducer output for well USW H-6.--Continued

USW H-6
Site ID: 365049116285505
INTERVAL: 752-1,220

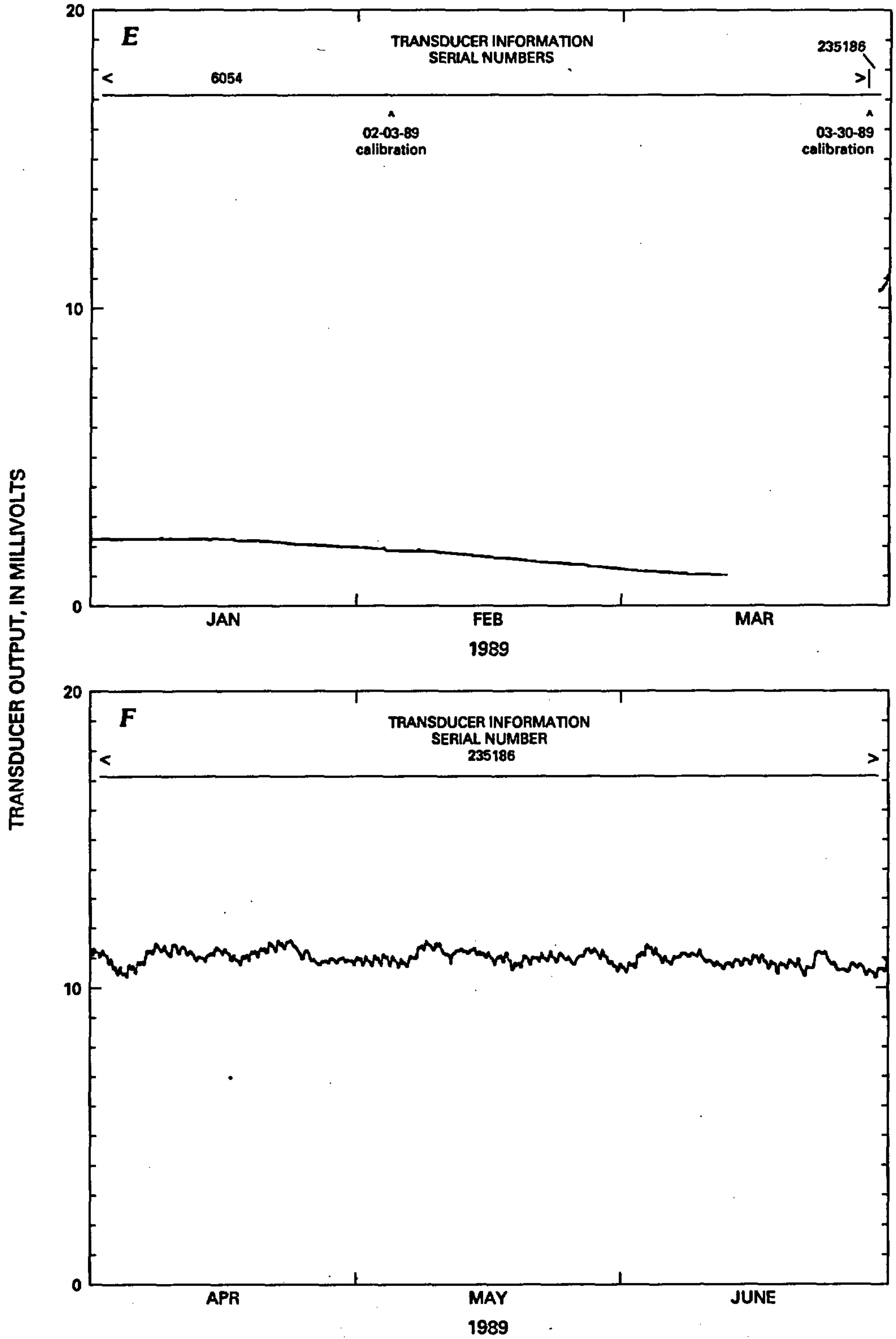


Figure 38.--Transducer output for well USW H-6.--Continued

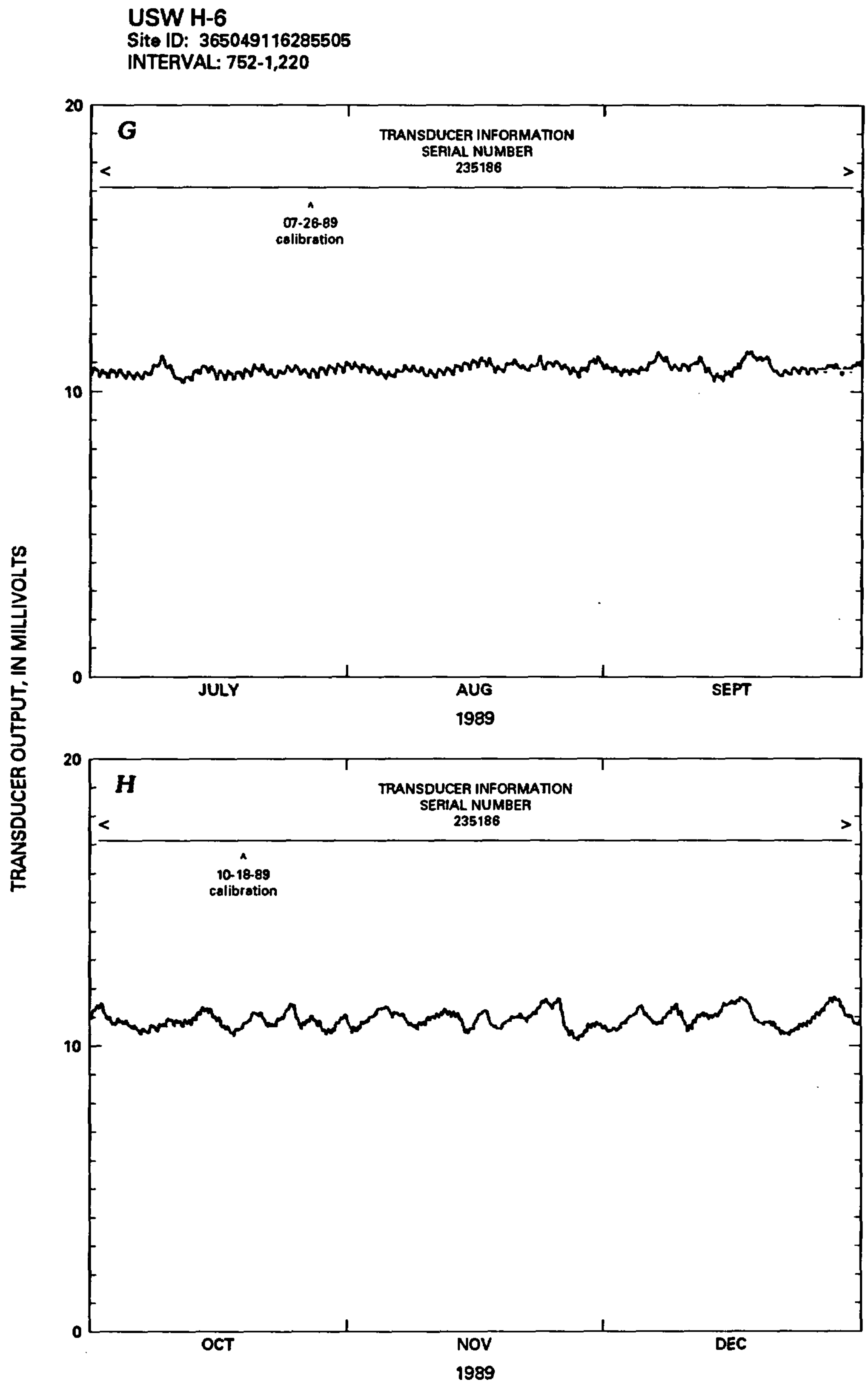


Figure 38.--Transducer output for well USW H-6.--Continued

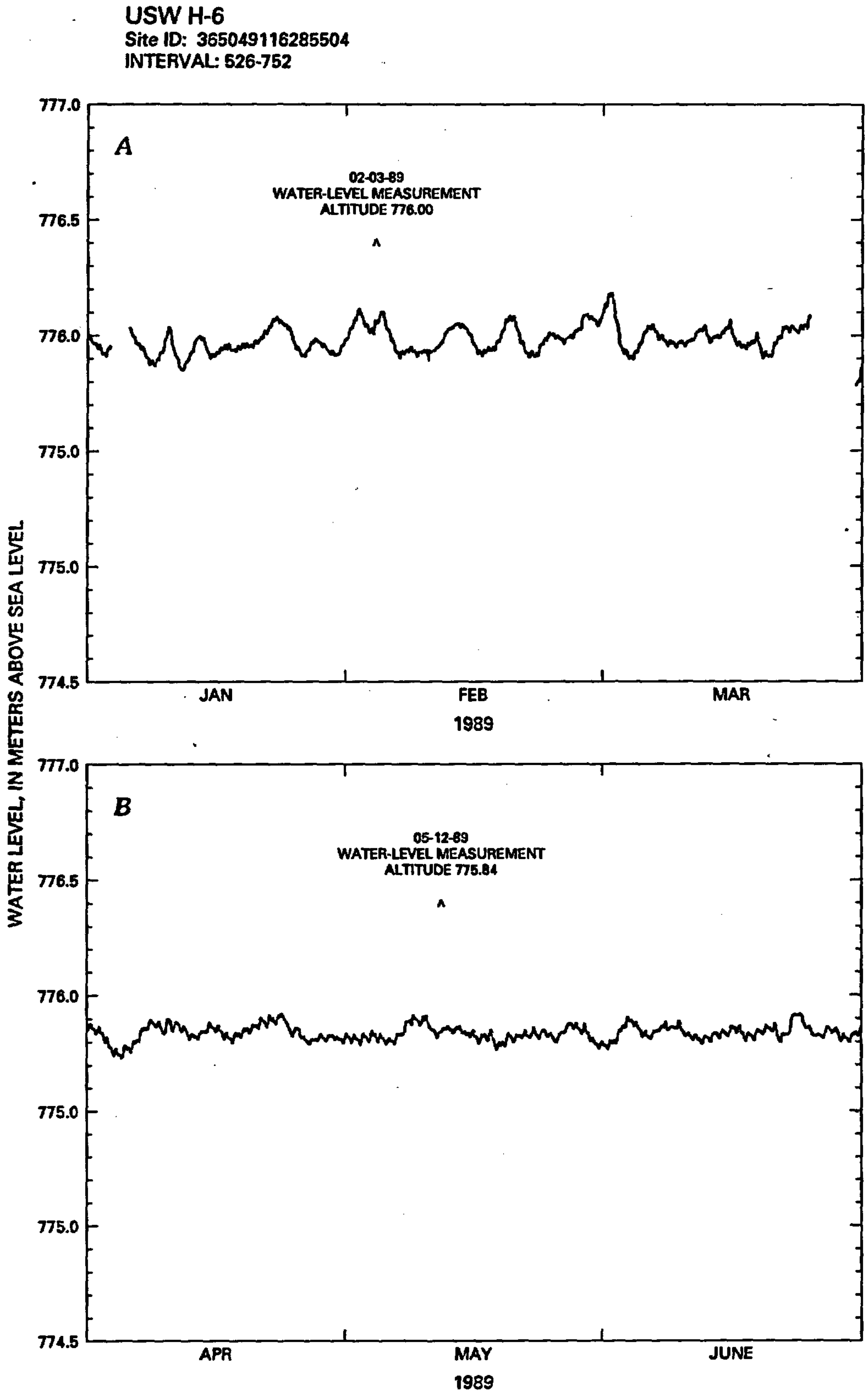


Figure 39.–Water-level altitude for well USW H-6.

USW H-6
Site ID: 365049116285504
INTERVAL: 526-752

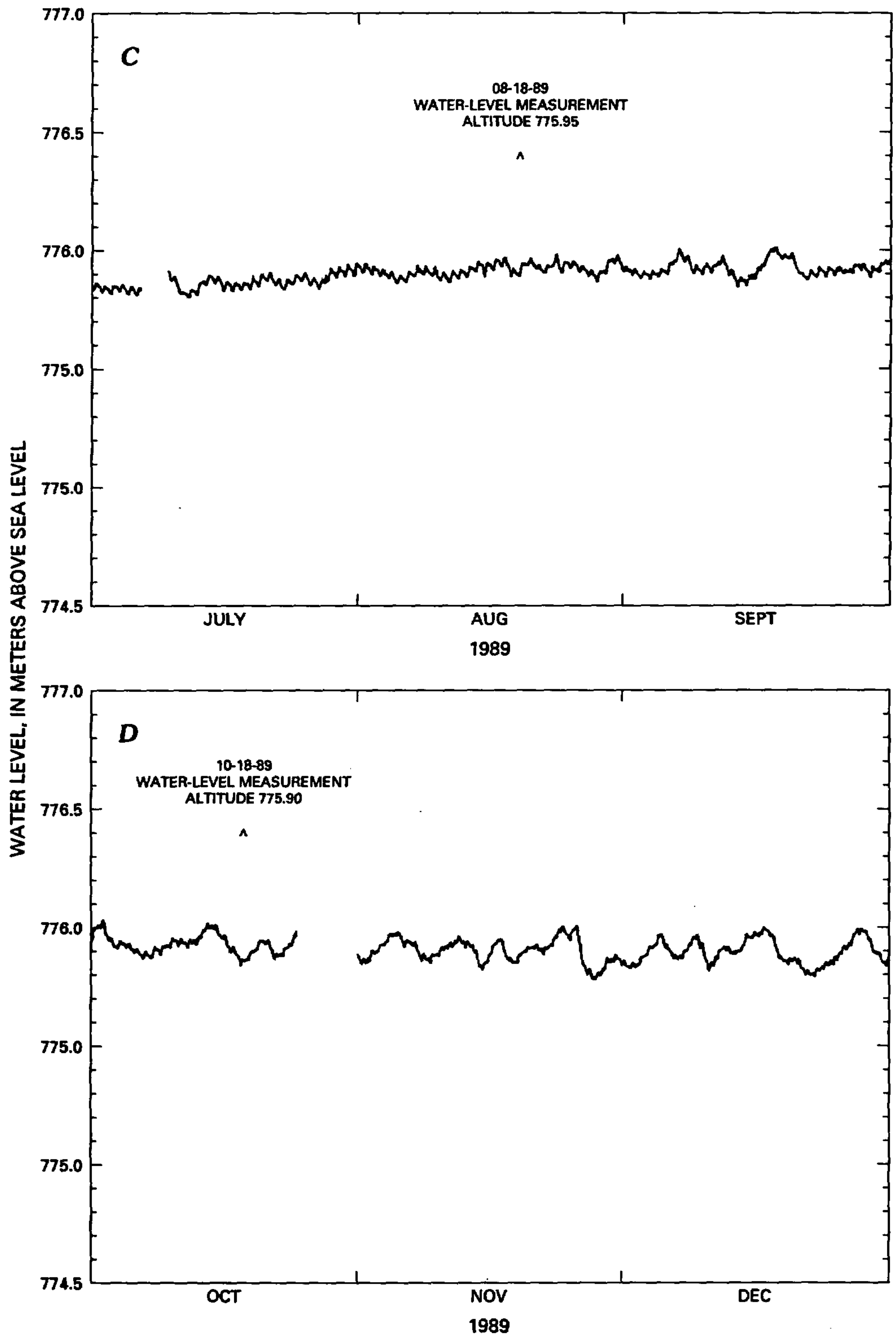


Figure 39.--Water-level altitude for well USW H-6.--Continued

USW H-6
Site ID: 365049116285505
INTERVAL: 752-1,220

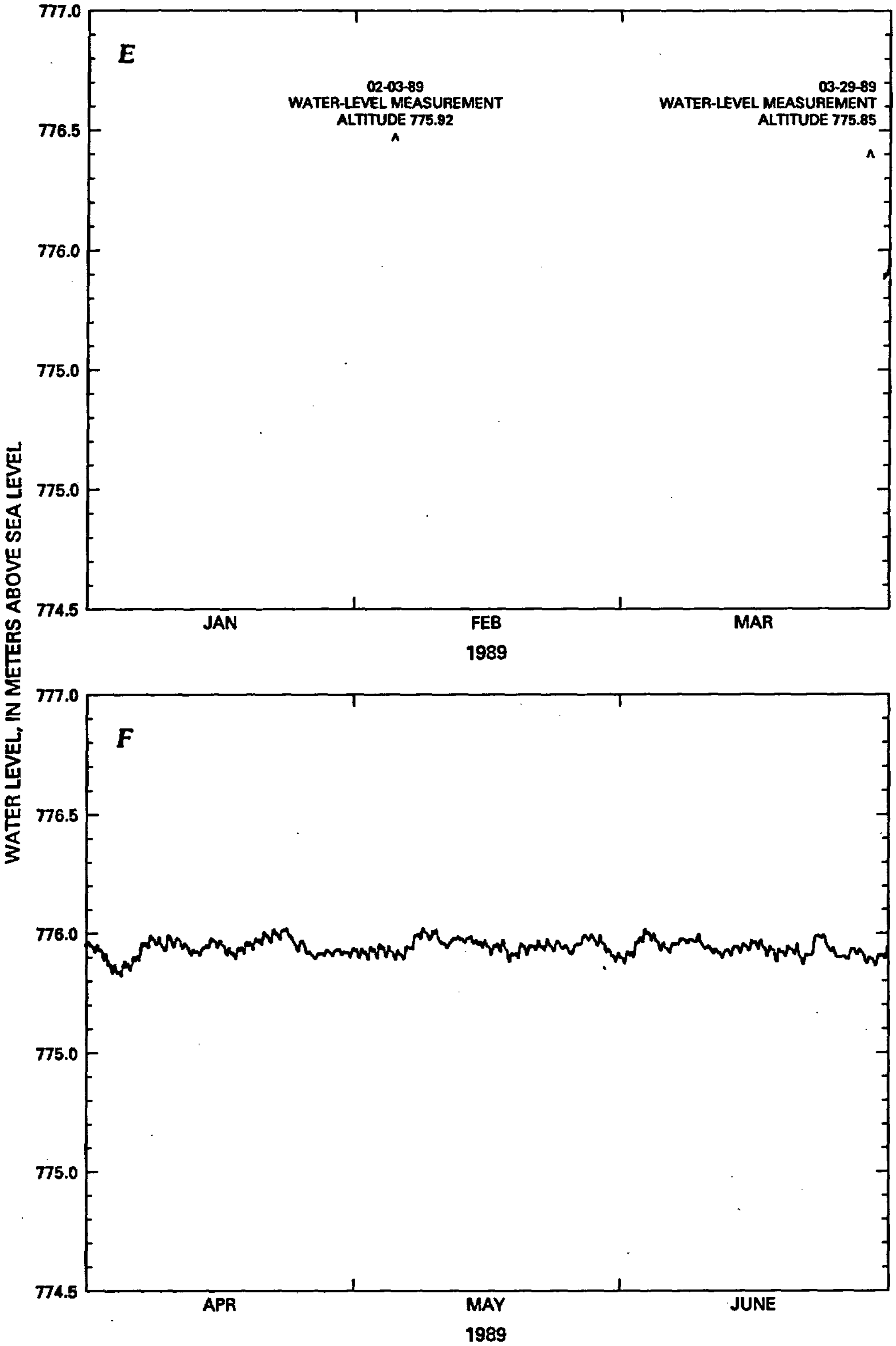


Figure 39.--Water-level altitude for well USW H-6.--Continued

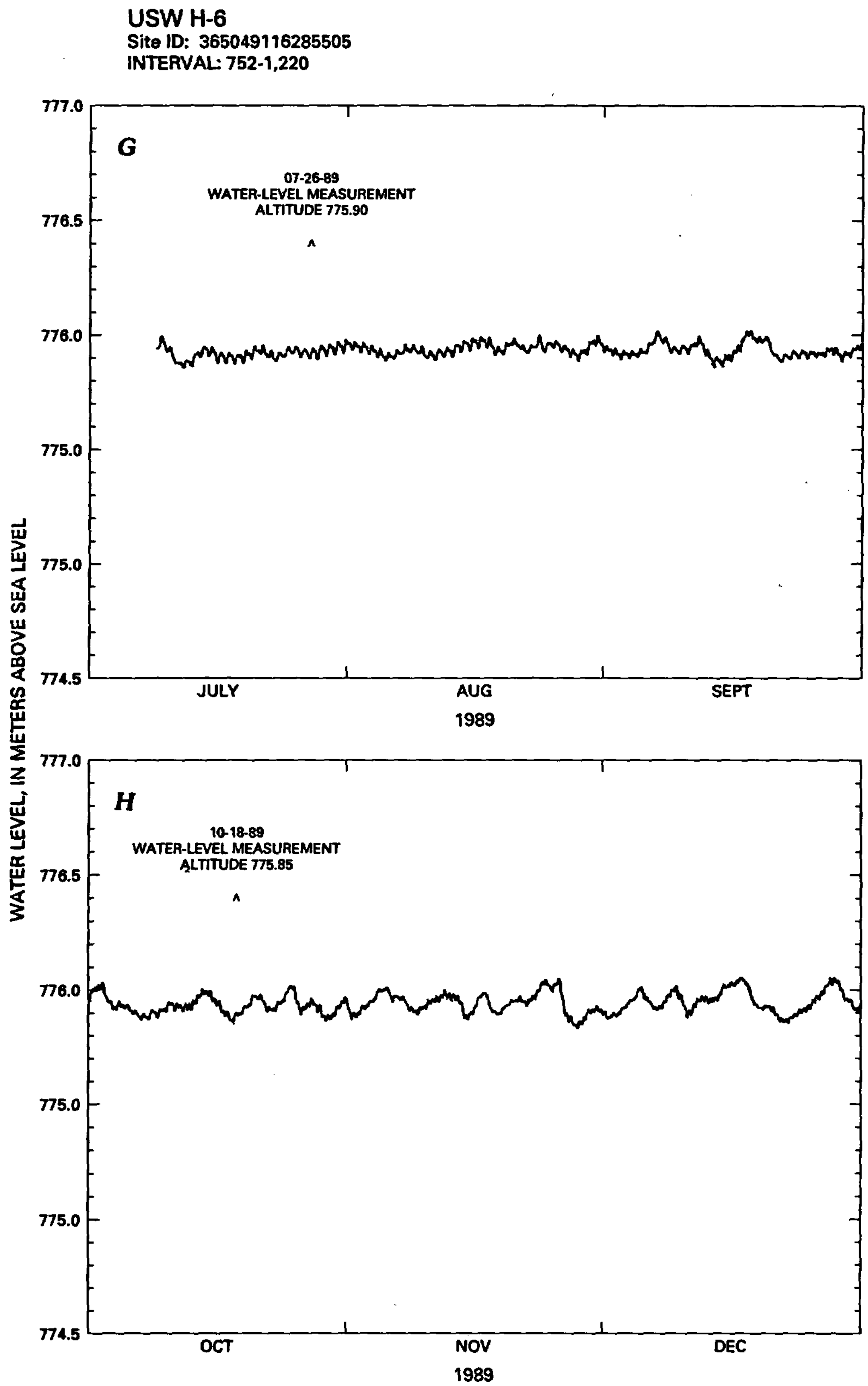


Figure 39.--Water-level altitude for well USW H-6.--Continued

Table 16. *Daily mean water-level altitude for 1989, in meters above sea level, for well USW H-6*
[Monthly mean, maximum (max), and minimum (min) computed from the daily mean values, indicated only for months that have complete data sets. Dashes indicate insufficient data to calculate daily mean water-level altitude]

Interval: 526-752 m — Site ID: 365049116285504

DAY	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
						1989						
1	775.98	776.08	776.06	775.86	775.81	775.78	775.85	775.92	775.91	775.97	775.86	775.85
2	775.95	776.05	776.15	775.84	775.81	775.82	775.84	775.91	775.89	776.01	775.88	775.84
3	—	776.04	776.07	775.80	775.80	775.88	775.83	775.91	775.89	775.95	775.91	775.86
4	—	776.07	775.92	775.74	775.81	775.87	775.84	775.89	775.90	775.92	775.95	775.90
5	—	775.98	775.91	775.74	775.81	775.84	775.83	775.87	775.92	775.92	775.97	775.94
6	776.00	775.92	775.98	775.76	775.80	775.83	—	775.88	775.97	775.90	775.94	775.92
7	775.94	775.93	776.03	775.81	775.80	775.85	—	775.90	775.96	775.88	775.92	775.88
8	775.88	775.92	775.99	775.86	775.85	775.86	—	775.91	775.92	775.89	775.87	775.89
9	775.90	775.92	775.97	775.86	775.89	775.86	—	775.90	775.92	775.90	775.87	775.94
10	775.99	775.94	775.96	775.85	775.88	775.83	775.88	775.88	775.92	775.93	775.89	775.93
11	775.91	775.99	775.96	775.86	775.87	775.82	775.83	775.88	775.95	775.93	775.92	775.84
12	775.87	776.04	775.99	775.84	775.83	775.81	775.81	775.89	775.91	775.93	775.94	775.89
13	775.95	776.04	776.02	775.81	775.85	775.82	775.84	775.90	775.87	775.94	775.93	775.91
14	775.98	776.00	775.98	775.82	775.85	775.83	775.87	775.93	775.87	775.99	775.89	775.90
15	775.91	775.93	776.00	775.85	775.84	775.84	775.87	775.93	775.90	775.99	775.84	775.94
16	775.93	775.93	776.03	775.85	775.83	775.85	775.85	775.94	775.95	775.95	775.90	775.97
17	775.95	775.95	775.96	775.82	775.81	775.82	775.85	775.95	776.00	775.90	775.93	775.99
18	775.94	776.04	775.95	775.81	775.82	775.83	775.85	775.91	775.97	775.86	775.86	775.96
19	775.95	776.07	775.98	775.83	775.78	775.85	775.86	775.91	775.96	775.88	775.87	775.88
20	775.96	775.97	775.92	775.85	775.80	775.86	775.87	775.94	775.90	775.92	775.90	775.86
21	776.00	775.92	775.93	775.87	775.81	775.82	775.88	775.93	775.89	775.93	775.91	775.85
22	776.05	775.93	776.00	775.88	775.82	775.87	775.86	775.92	775.90	775.88	775.90	775.81
23	776.06	775.99	776.03	775.89	775.83	775.92	775.85	775.95	775.91	775.90	775.94	775.81
24	776.03	775.99	776.02	775.88	775.83	775.86	775.87	775.93	775.91	—	775.99	775.84
25	775.94	775.98	—	775.84	775.83	775.83	775.88	775.94	775.91	—	775.97	775.86
26	775.92	776.00	—	775.82	775.81	775.84	775.87	775.92	775.92	—	775.93	775.90
27	775.97	776.05	—	775.79	775.85	775.85	775.86	775.90	775.93	—	775.81	775.95
28	775.95	776.08	—	775.81	775.87	775.82	775.89	775.89	775.91	—	775.79	775.99
29	775.92		—	775.81	775.85	775.82	775.90	775.92	775.92	—	775.92	775.95
30	775.93		—	775.81	775.81	775.85	775.91	775.96	775.95		775.87	775.89
31	776.00		775.83		775.78		775.92	775.92				775.86
MONTHLY												
MEAN	—	775.99	—	775.83	775.83	775.84	—	775.91	775.92	—	775.90	775.90
MAX	—	776.08	—	775.89	775.89	775.92	—	775.96	776.00	—	775.99	775.99
MIN	—	775.92	—	775.74	775.78	775.78	—	775.87	775.87	—	775.79	775.81

Table 16. *Daily mean water-level altitude for 1989, in meters above sea level, for well USW H-6 (Continued)*

Interval: 752-1,220 m **Site ID: 365049116285505**

DAY	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
						1989 (Continued)						
1	—	—	—	775.96	775.92	775.90	775.91	775.95	775.92	775.96	775.89	775.90
2	—	—	—	775.94	775.92	775.93	775.90	775.94	775.91	776.00	775.91	775.89
3	—	—	—	775.90	775.92	775.98	775.90	775.93	775.91	775.94	775.94	775.91
4	—	—	—	775.85	775.93	775.98	775.90	775.92	775.92	775.92	775.98	775.95
5	—	—	—	775.85	775.92	775.95	775.89	775.90	775.93	775.92	776.00	775.99
6	—	—	—	775.87	775.91	775.94	775.89	775.91	775.98	775.89	775.97	775.97
7	—	—	—	775.92	775.92	775.96	—	775.93	775.97	775.87	775.96	775.93
8	—	—	—	775.96	775.96	775.97	—	775.93	775.93	775.88	775.91	775.94
9	—	—	—	775.97	776.00	775.97	775.96	775.92	775.93	775.89	775.91	775.99
10	—	—	—	775.96	775.99	775.94	775.94	775.91	775.94	775.92	775.93	775.98
11	—	—	—	775.96	775.98	775.92	775.88	775.91	775.96	775.92	775.96	775.91
12	—	—	—	775.95	775.95	775.92	775.87	775.92	775.92	775.92	775.98	775.94
13	—	—	—	775.92	775.98	775.93	775.89	775.93	775.88	775.93	775.97	775.97
14	—	—	—	775.92	775.97	775.94	775.92	775.95	775.89	775.97	775.94	775.96
15	—	—	—	775.96	775.96	775.94	775.92	775.96	775.91	775.97	775.89	776.00
16	—	—	—	775.96	775.95	775.95	775.90	775.97	775.95	775.93	775.94	776.03
17	—	—	—	775.93	775.93	775.92	775.90	775.96	776.00	775.89	775.97	776.05
18	—	—	—	775.92	775.94	775.91	775.89	775.93	775.98	775.87	775.91	776.03
19	—	—	—	775.94	775.90	775.92	775.90	775.93	775.97	775.90	775.91	775.95
20	—	—	—	775.95	775.92	775.93	775.92	775.96	775.91	775.95	775.95	775.93
21	—	—	—	775.98	775.93	775.89	775.93	775.94	775.89	775.96	775.96	775.92
22	—	—	—	775.99	775.94	775.94	775.91	775.93	775.91	775.91	775.95	775.88
23	—	—	—	775.99	775.95	775.98	775.90	775.96	775.91	775.92	775.98	775.88
24	—	—	—	775.99	775.94	775.93	775.92	775.94	775.91	775.97	776.03	775.90
25	—	—	—	775.95	775.94	775.90	775.93	775.95	775.91	775.99	776.02	775.93
26	—	—	—	775.93	775.93	775.91	775.92	775.94	775.92	775.91	775.98	775.97
27	—	—	—	775.90	775.97	775.92	775.91	775.92	775.93	775.94	775.87	776.01
28	—	—	—	775.92	775.98	775.89	775.92	775.91	775.91	775.91	775.85	776.05
29	—		—	775.92	775.96	775.89	775.93	775.94	775.92	775.87	775.89	776.02
30	—		—	775.92	775.93	775.92	775.94	775.97	775.95	775.90	775.92	775.96
31	—		775.92		775.90		775.95	775.94		775.94		775.93
MONTHLY												
MEAN	—	—	—	775.94	775.94	775.93	—	775.94	775.93	775.92	775.94	775.96
MAX	—	—	—	775.99	776.00	775.98	—	775.97	776.00	776.00	776.03	776.05
MIN	—	—	—	775.85	775.90	775.89	—	775.90	775.88	775.87	775.85	775.88

REFERENCES CITED

Bentley, C.B., Robison, J.H., and Spengler, R.W., 1983, Geohydrologic data for test well USW H-5, Yucca Mountain area, Nye County, Nevada: U.S. Geological Survey Open-File Report 83–853, 34 p., (NNA. 870519.0098)

Byers, F.M. Jr., Carr, W.J, Orkild, P.P., Quinlivan, W.D., and Sargent, K.A., 1976, Volcanic suites and related cauldrons of Timber Mountain-Oasis Valley caldera complex, southern Nevada: U.S. Geological Survey Professional Paper 919, 70 p., (NNA.870406.0239)

Carr, W.J., Byers, F.M. Jr., and Orkild, P.P., 1986, Stratigraphic and volcano-tectonic relations of Crater Flat Tuff and some older volcanic units, Nye County, Nevada: U.S. Geological Survey Professional Paper 1323, 28 p., (HQS.880517.1115)

Carr, W.J., 1988, Volcano-tectonic setting of Yucca Mountain and Crater Flat, southwestern Nevada, *in* Carr, M.D. and Yount, J.C. (eds.), Geologic and hydrologic investigations of a potential nuclear waste disposal site at Yucca Mountain, southern Nevada: U.S. Geological Survey Bulletin 1790, p. 35–49 (NN1.881128.0011)

Craig, R.W., and Johnson, K.A., 1984, Geohydrologic data for test well UE-25p #1, Yucca Mountain area, Nye County, Nevada: U.S. Geological Survey Open-File Report 84–450, 63 p., (NNA.870406.0256)

Craig, R.W., Reed, R.L., and Spengler, R.W., 1983, Geohydrologic data for test well USW H-6, Yucca Mountain area, Nye County, Nevada: U.S. Geological Survey Open-File Report 83–856, 35 p., (NNA.870406.0058)

Craig, R.W., and Robison, J.H., 1984, Geohydrology of test well UE-25p #1, Yucca Mountain area, Nye County, Nevada: U.S. Geological Survey Water-Resources Investigations Report 84–4248, 57 p., (HQS.880517.1133)

Erickson, J.R., and Waddell, R.K., 1985, Identification and characterization of hydrologic properties of fractured tuff using hydraulic and tracer tests—test well USW H-4, Yucca Mountain, Nye County, Nevada: U.S. Geological Survey Water-Resources Investigations Report 85–4066, 30 p., (NNA.870407.0184)

Fenix & Scisson, Inc., 1986a, NNWSI hole histories—UE-25 WT #3, UE-25 WT #4, UE-25 WT #5, UE-25 WT #6, UE-25 WT #12, UE-25 WT #13, UE-25 WT #14, UE-25 WT #15, UE-25 WT #16, UE-25 WT #17, UE-25 WT #18, USW WT-1, USW WT-2, USW WT-7, USW WT-10, USW WT-11: U.S. Department of Energy DOE/NV/10322–10, 111 p., (NNA.870317.0155)

____1986b, NNWSI hole history—UE-25b #1: U.S. Department of Energy DOE/NV/10322–13, 37 p., (HQS.880517.1200)

____1986c, NNWSI hole history—UE-25c #1, UE-25c #2, UE-25c #3: U.S. Department of Energy DOE/NV/10322–14, 61 p., (NNA.900326.0029)

____1986d, NNWSI hole history—UE-25p #1: U.S. Department of Energy DOE/NV/10322–16, 39 p., (NNA.900326.0029)

____1987a, NNWSI hole histories—USW H-1, USW H-3, USW H-4, USW H-5, USW H-6: U.S. Department of Energy DOE/NV/10322-18, 99 p., (NNA.900330.0184)

____1987b, NNWSI hole histories—USW G-1, USW G-2, USW G-3, USW G-4, USW GA-1, USW GU-3: U.S. Department of Energy DOE/NV/10322-19, 187 p., (HQS.880517.1194)

____1987c, NNWSI drilling and mining summary: U.S. Department of Energy DOE/NV/10322-24, 45 p., (NNA.890922.0283)

Ferris, J.G., Knowles, D.B., Brown, R.H., and Stallman, R.W., 1962, Theory of aquifer tests: U.S. Geological Survey Water Supply Paper 1536-E, 174 p., (NNA.901106.0145)

Gemmell, J.M., 1990, Water levels in periodically measured wells in the Yucca Mountain area, Nevada, 1988: U.S. Geological Survey Open-File Report 90-113, 47 p., (NNA.900221.0001)

Harrison, D.H., 1971, New computer programs for the calculation of earth tides: Cooperative Institute for Research in Environmental Sciences, NOAA/Univ. of Colorado, 29 p., (NNA.901211.0227)

Lahoud, R.G., Lobmeyer, D.H., and Whitfield, M.S., Jr., 1984, Geohydrology of volcanic tuff penetrated by test well UE-25b #1, Yucca Mountain, Nye County, Nevada: U.S. Geological Survey Water-Resources Investigations Report 84-4253, 44 p., (NNA.870519.0107)

Lobmeyer, D.H., Whitfield, M.S., Jr., Lahoud, R.G., and Bruckheimer, Laura, 1983, Geohydrologic data for test well UE-25b #1, Nevada Test Site, Nye County, Nevada: U.S. Geological Survey Open-File Report 83-855, 48 p., (NNA.870406.0060)

Luckey, R.R., Lobmeyer, D.H., and Burkhardt, D.J., 1993, Water levels in continuously monitored wells in the Yucca Mountain area, Nevada, 1985-88: U.S. Geological Survey Open-File Report 91-493, 252 p., (NNA.930112.0131)

Melchior, P., 1966, The Earth Tides: Pergamon Press Ltd., Oxford, 458 p., (NNA.901211.0228)

O'Brien, G.M., 1991, Water levels in periodically measured wells in the Yucca Mountain area, Nevada, 1989: U.S. Geological Survey Open-File Report 91-178, 51 p., (NNA.910708.0041)

Robison, J.H., 1984, Ground-water level data and preliminary potentiometric surface maps, Yucca Mountain and vicinity, Nye County, Nevada: U.S. Geological Survey Water-Resources Investigations Report 84-4197, 8 p., (NNA.870519.0096)

____1986, Letter from J.H. Robison (U.S. Geological Survey, Lakewood, Colorado) to D.L. Vieth (U.S. Department of Energy/Nevada Operations Office, Las Vegas, Nevada), September 17, 1986; regarding revisions of Yucca Mountain water levels reported in Robison, 1984., (HQS.880517.1935)

Robison, J.H., Stephens, D.M., Luckey, R.R., and Baldwin, D.A., 1988, Water levels in periodically measured wells in the Yucca Mountain area, Nevada, 1981-87: U.S. Geological Survey Open-File Report 88-468, 132 p., (NNA.890306.0113)

Rush, F.E., Thordarson, William, and Bruckheimer, Laura, 1983, Geohydrologic and drill-hole data for test well USW H-1, adjacent to Nevada Test Site, Nye County, Nevada: U.S. Geological Survey Open-File Report 83–141, 38 p., (NNA.870519.0103)

Rush, F.E., Thordarson, William, and Pyles, D.G., 1984, Geohydrology of test well USW H-1, Yucca Mountain, Nye County, Nevada: U.S. Geological Survey Water-Resources Investigations Report 84–4032, 56 p., (NNA.870518.0067)

Thordarson, William, Rush, F.E., Spengler, R.W., and Waddell, S.J., 1984, Geohydrologic and drill-hole data for test well USW H-3, Yucca Mountain, Nye County, Nevada: U.S. Geological Survey Open-File Report 84–149, 54 p., (NNA.870406.0056)

Thordarson, William, Rush, F.E., and Waddell, S.J., 1984, Geohydrology of test well USW H-3, Yucca Mountain, Nye County, Nevada: U.S. Geological Survey Water-Resources Investigations Report 84–4272, 38 p., (HQS.880517.1852)

U.S. Department of Energy, 1988, Site characterization plan, Yucca Mountain site, Nevada research and development area, Nevada: U.S. Department of Energy Report DOE RW/0199, 8v., various pagination. (HQS.881201)

Whitfield, M.S., Jr., Eshom, E.P., Thordarson, William, and Schaefer, D.H., 1985, Geohydrology of rocks penetrated by test well USW H-4, Yucca Mountain, Nye County, Nevada: U.S. Geological Survey Water-Resources Investigations Report 85–4030, 33 p., (HQS.880517.1870)

Whitfield, M.S., Jr., Thordarson, William, and Eshom, E.P., 1984, Geohydrologic and drill-hole data for test well USW H-4, Yucca Mountain, Nye County, Nevada: U.S. Geological Survey Open-File Report 84–449, 39 p., (NNA.870407.0317)

Winograd, I.J, and Thordarson, William, 1975, Hydrogeologic and hydrochemical framework, south-central Great Basin, Nevada-California, with special reference to the Nevada Test Site: U.S. Geological Survey Professional Paper 712-C, 126 p., (HQS.880517.2908)

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