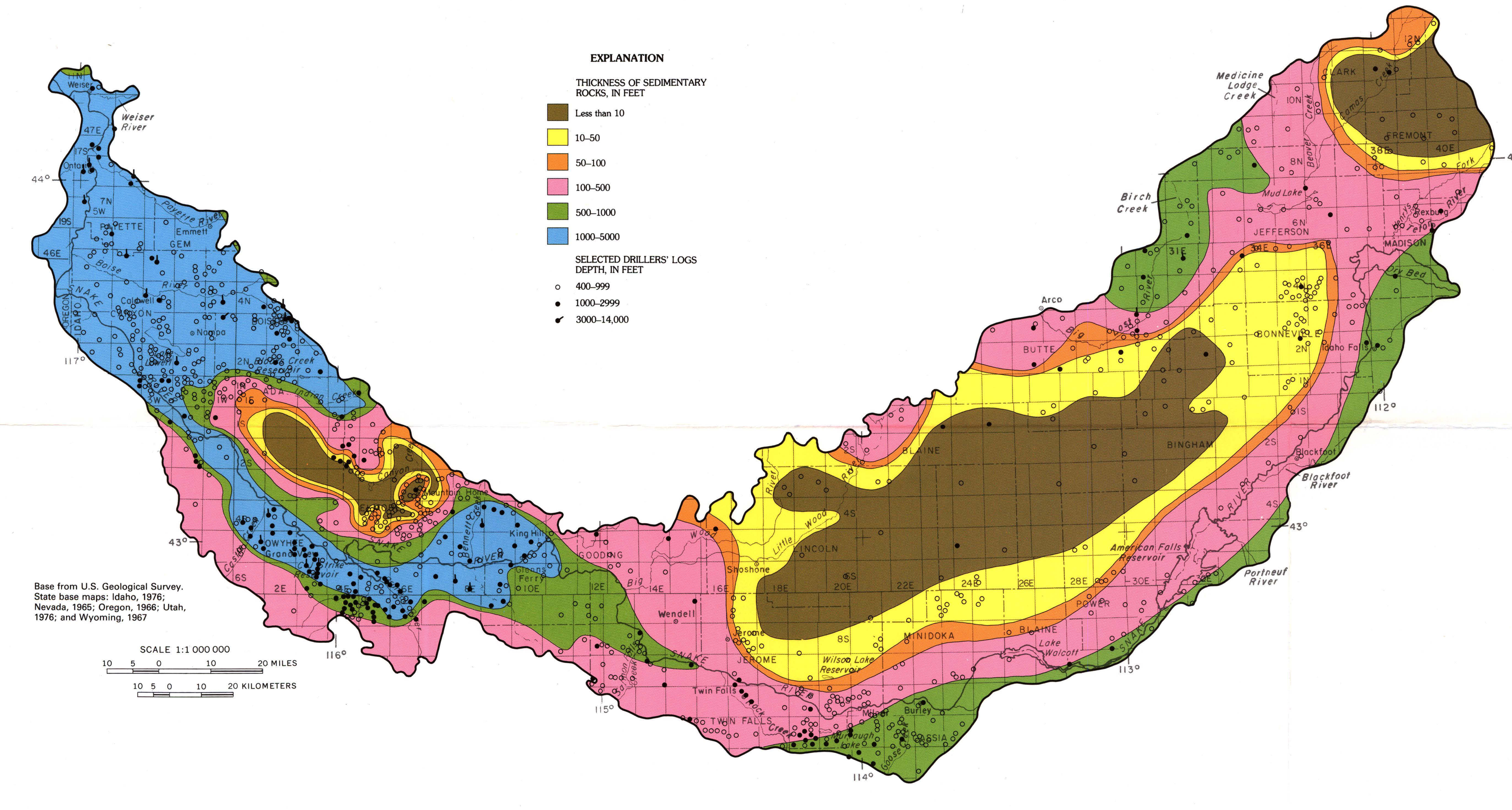
SUBSURFACE GEOLOGY

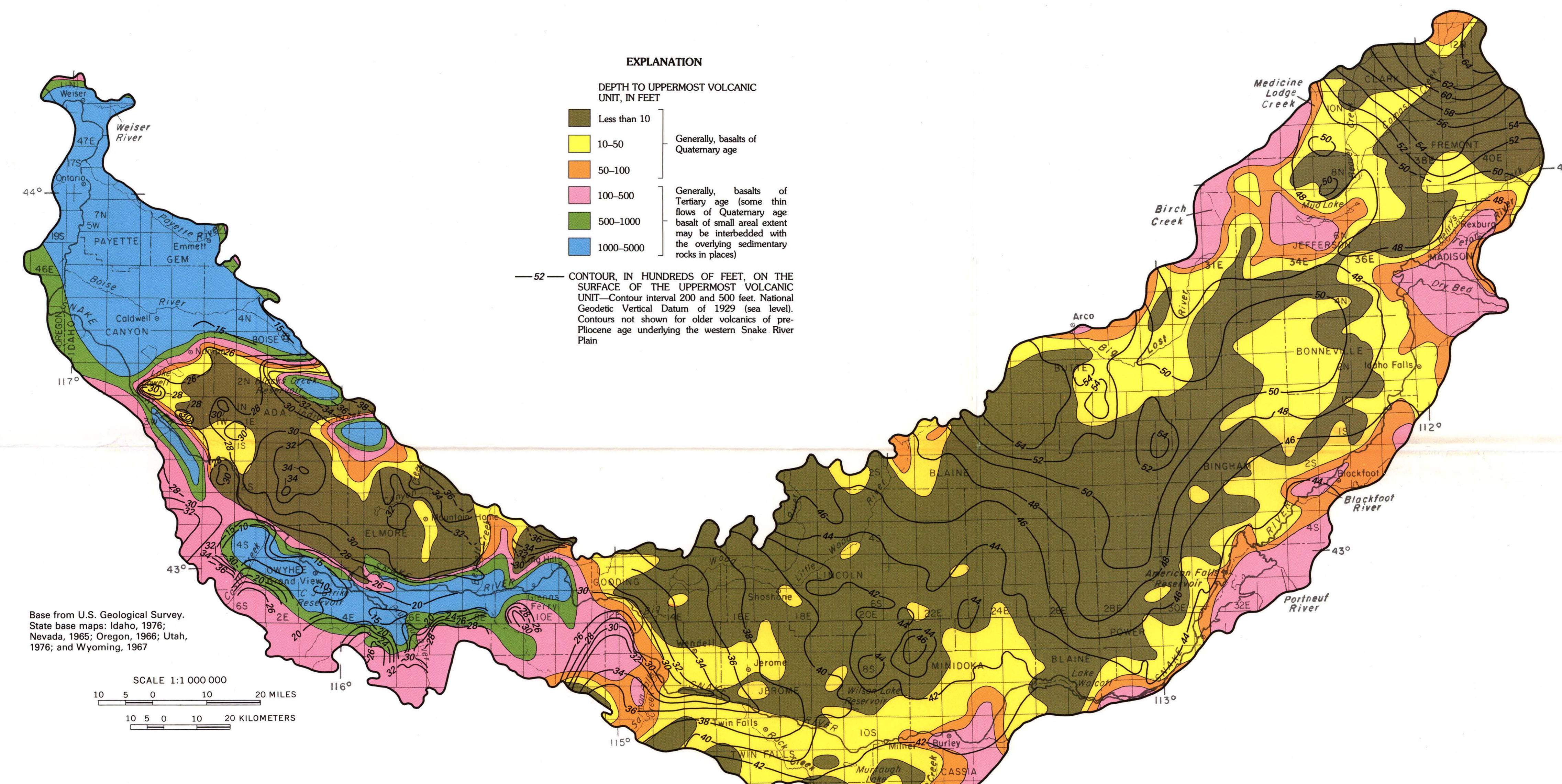


SEDIMENTARY ROCKS OCCUR ALONG THE MARGINS OF THE EASTERN PLAIN AND PREDOMINATE IN MUCH OF THE WESTERN PLAIN. Sedimentary rocks may occur as a single unit or as several units intercalated with volcanic rocks, chiefly basalt, or may occur above and below the volcanic rocks. Their thickness varies from a featheredge to about 5,000 ft near the western boundary of the western plain. Sediment thicknesses were estimated from drillers' logs and are minimum values. Total thicknesses are known in only a few drill holes and are estimated from geophysical data in other areas (see sections below at right).

Sedimentary rocks in the eastern plain generally are unconsolidated and predominate at the mouths of tributary valleys. Grain size ranges from coarse gravel to clay, and degree of sorting is variable. Coarse alluvium occurs near bordering mountains, particularly along the northern boundary. Fine-grained lacustrine deposits predominate near the southern and western boundaries of the plain.

Drillers' logs, geophysical logs, and lithologic information from a project test hole near Wendell suggest widespread occurrence of an unconsolidated sedimentary rock unit underlying the Quaternary basalts in the western part of the eastern plain. The unit has not been mapped extensively in the Snake River canyon between Twin Falls and King Hill but probably is present beneath basaltic talus slopes along the north canyon wall. Road cuts through the talus generally expose sedimentary rocks. The gravel, sand, silt, and clay penetrated in the test hole near Wendell are similar to those in the Glenns Ferry Formation exposed near the boundary between the eastern and the western parts of the plain. Locally throughout the plain, a similar sequence of basalt and sedimentary rocks occurs; the sediments separate the Quaternary and Tertiary basalts (see geologic sections *E–E'* through *I–I'* at right).

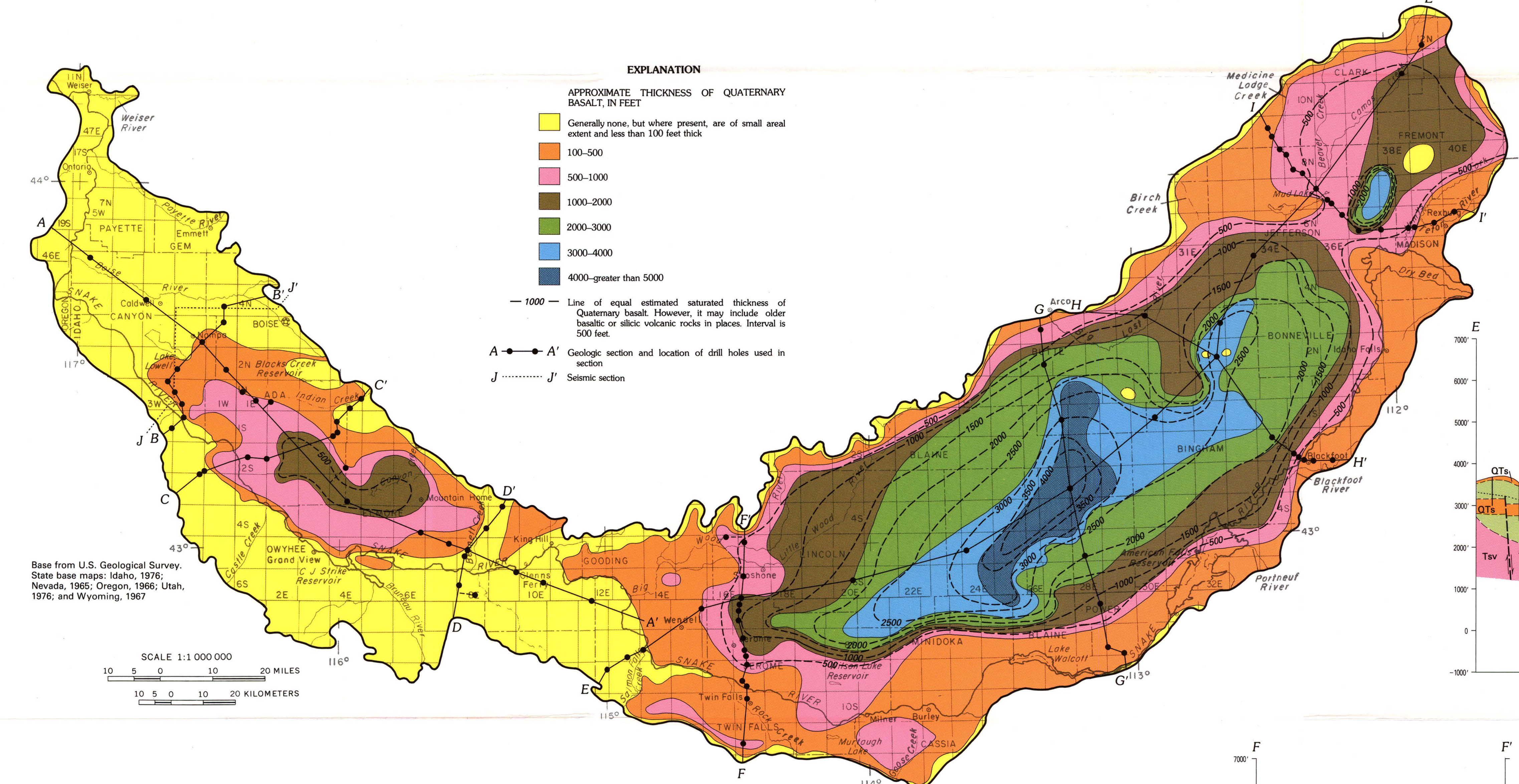
Thicker and more areally extensive sedimentary rocks occur in the western plain (see geologic sections *A–A'* through *D–D'* at right). The upper few tens to several hundred feet are composed of predominantly unconsolidated sand and gravel with some clay. Clay and shale predominate in the lower part of the stratigraphic sections. A blue clay ranging from 10 to more than 400 ft thick underlies much of the western plain at varying depths; it usually occurs between 300 and 700 ft (Wood and Anderson, 1981, p. 36). Locally, the clay separates the deeper water-bearing units, some of which contain thermal water, from the shallower cold water-bearing units (Wood and Anderson, 1981, p. 37). At least five permeable sand zones, each ranging from nearly 100 to more than 200 ft thick, underlie the blue clay in the western plain. In places, permeable freshwater zones may exist as much as 5,000 ft below land surface (Wood and Anderson, 1981, p. 38).



BASALTIC ROCKS OF QUATERNARY TO LATE TERTIARY AGE LIE WITHIN 10 FEET OF LAND SURFACE UNDER MUCH OF THE EASTERN PLAIN AND PART OF THE WESTERN PLAIN. Exceptions occur near the plain's boundaries where sedimentary rocks overlie and are interstratified with the basalt. In the western plain, as much as 5,000 ft of sedimentary rock overlie Miocene basalts. However, thin (less than 100 ft) flows of younger basalt of small areal extent may be interbedded in several places with the sedimentary rocks. Miocene basalts also are present below younger basalts in the eastern part of the eastern plain. Interpretation of gravity data (Hill, 1963, p. 5814) suggests that the Miocene basalts also may extend into the western part of the eastern plain.

Comparison of the map above with the sedimentary-rock distribution map at left indicates the absence of volcanic rocks in the upper 1,000–5,000 ft of the sedimentary sequence in much of the western plain.

Contours on the top of the uppermost volcanic rocks (generally basalt) show, in a general way, source areas of most recent flows. Local source areas are not indicated at the scale shown; however, many are shown on the Idaho State geologic map (Bond and others, 1978). In a few of these places, particularly near the boundaries of the plain, the uppermost volcanic unit is composed of silicic rocks, chiefly rhyolite.



SEVERAL HUNDRED TO SEVERAL THOUSAND FEET OF QUATERNARY BASALTS OF THE SNAKE RIVER GROUP UNDERLIE MUCH OF THE SNAKE RIVER PLAIN. They are thickest along the axis of the eastern plain near its central part, thin toward the boundaries, and generally absent in large parts of the western plain where sedimentary rocks are their stratigraphic equivalent. Malde (1965, p. 261) indicated that the basalt may be greater than 4,200 ft thick in troughs between the Craters of the Moon National Monument (southwest of Arco) and Idaho Falls. LaFehr and Pakiser (1962, p. D77) suggest that the basalts may extend to depths as great as 5,000 ft. Basalt thickness is known from only a few drill holes and is estimated elsewhere by geophysical methods. As a result, variations in thickness shown on the map above and on sections at right are approximate and speculative in some areas. These younger basalts are the most permeable units of the Snake River Group and, where saturated (dashed contours above), comprise the most productive part of the Snake Plain aquifer.

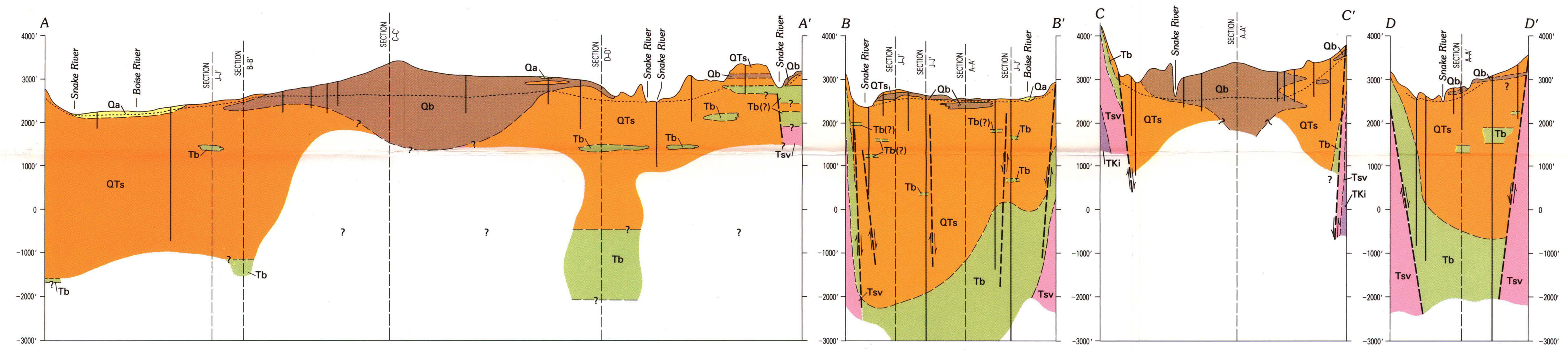
Miocene Banbury Basalt of the Idaho Group and the Miocene Columbia River Basalt Group or equivalent Miocene basalt underlie or flank much of the western plain and part of the eastern plain. In several areas, Banbury Basalt or basalt of equivalent age is separated from the basalts of the Snake River Group by sedimentary rocks several tens to several hundreds of feet thick. These older basalts are, in general, much less permeable than the younger basalts. Reduced hydraulic conductivity with depth has been observed in several deep drill holes and is, in part, due to secondary mineralization. Elsewhere in the eastern plain, silicic volcanic rocks (chiefly Quaternary and Tertiary rhyolite) underlie the younger basalts.

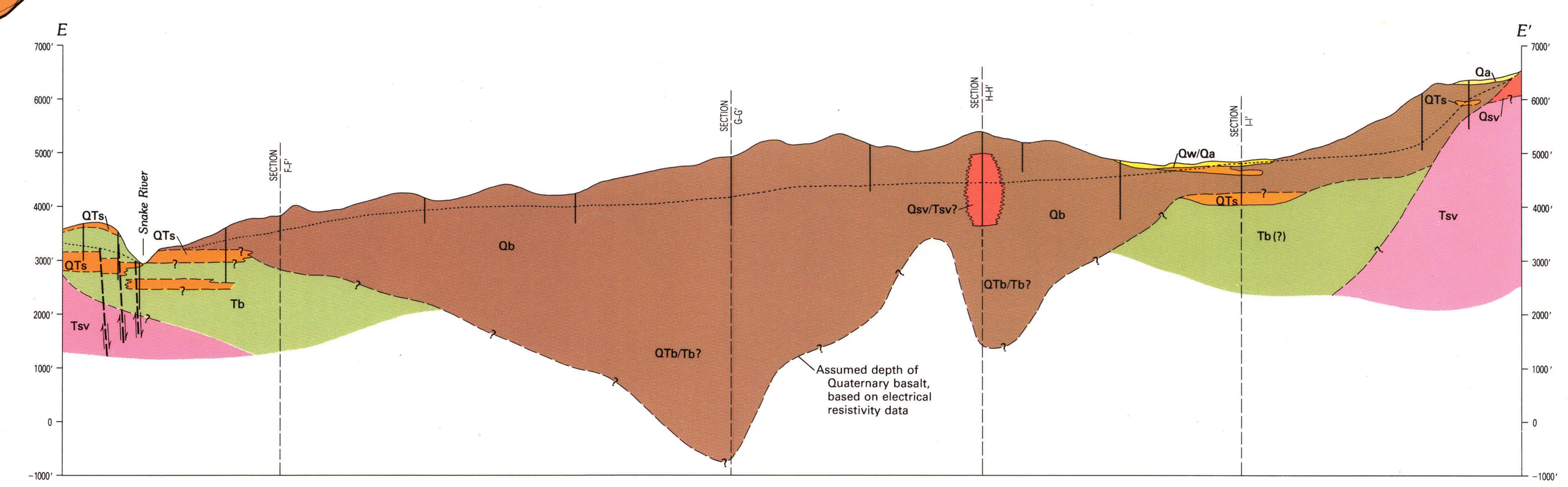
Vertical electrical soundings were used extensively to define the distribution of younger basalts. Interpretation methods and results of the soundings, shown as simplified resistivity profiles, are given on sheet 3. Where no other data were available, gravity models based on regional gravity data (Mabey and others, 1974) were used to obtain an approximation of the younger basalt thickness. Gravity modeling methods are discussed and an example of results is shown on sheet 3.

Kuntz and Dalrymple (1979, p. 5) suggested that much of the Quaternary basalt was extruded along fractures normal to the plain's axis. In the eastern plain, these zones of weakness may be extensions of Basin and Range structural features that are adjacent and normal to the plain's axis (geologic map, sheet 1). Profiles based on vertical electrical soundings tend to support this theory. Basalt vents may be indicated where high resistivity zones extend downward several thousand feet below the apparent average basalt thickness in the area. However, it is recognized that these zones may be the result of instrument limitations rather than rock type.

A map of the estimated saturated thickness of Quaternary basalt (dashed contours above) was made using the above basalt thickness map, topographic maps, drillers' logs, and a water-table contour map drawn by Lindholm, Garabedian, Newton, and Whitehead (1983). The above map does not indicate the total aquifer thickness. The map excludes stratigraphically equivalent sedimentary and volcanic rocks of Holocene to late Tertiary age. Thus, the regional aquifer, particularly along the margins of the plain, is considerably thicker than the saturated basalt shown above. Interbedded sedimentary and other volcanic rocks occurring in thin zones of small areal extent may be included with the Quaternary basalt in places.

For example, northeast and southeast of Arco, small areas of Tertiary silicic volcanics are shown completely surrounded by younger Quaternary basalts. Very little is known about subsurface conditions in these areas. Vertical electrical sounding data indicate high-resistivity materials at depth. The silicic volcanics may extend to considerable depths, and if in the form of volcanic flow rock, its electrical resistivity would be similar to that of Quaternary basalt. If so, in areas of isolated silicic volcanics, no distinction is possible between younger basalt and older volcanic rocks.





EXPLANATION

Note: Explanation of rock units shown on geologic map, sheet 1

- Geologic contact, dashed where uncertain
- Fault; arrow shows direction of movement
- Drill hole
- Water table; approximately located

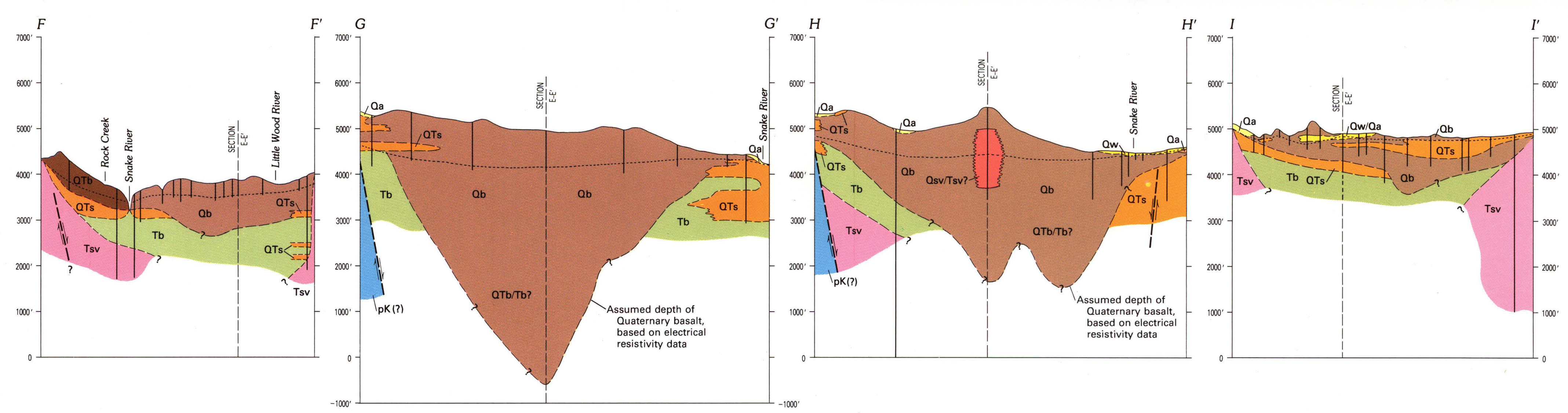
Lines of section shown on map at left
VERTICAL EXAGGERATION X 42, EXCEPT FOR *J–J'* WHICH IS X 21

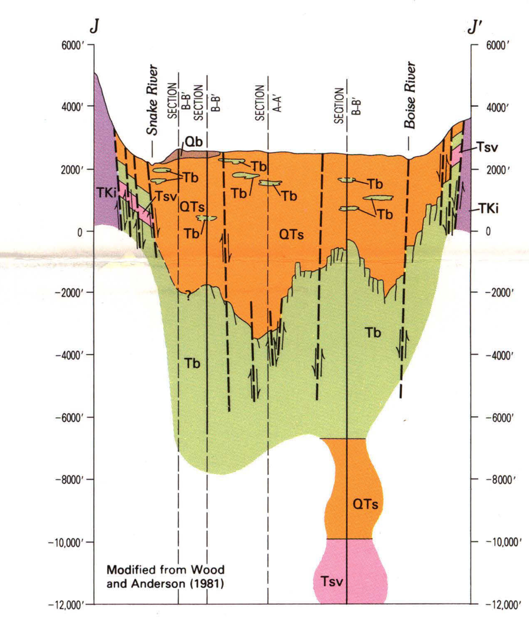
NATIONAL GEODETIC VERTICAL DATUM OF 1929 (SEA LEVEL)

SCALE 1:1 000 000
10 5 0 10 20 MILES
10 5 0 10 20 KILOMETERS

GEOLOGIC SECTIONS SHOW THE PREDOMINANCE OF QUATERNARY AND TERTIARY VOLCANIC ROCKS IN THE UPPER SEVERAL THOUSAND FEET OF THE EASTERN PLAIN. Sedimentary rocks of equivalent age predominate in the western plain. Structurally, the western plain is a graben; bounding faults shown on the sections as single lines represent fault zones. In much of the plain, most wells are completed in the upper several hundred feet of the aquifer; thus, little is known about deeper parts of the aquifer. Where deep drill holes were lacking, rock distribution was estimated using geophysical methods described on sheet 3.

The north wall of the Snake River canyon from Milner to King Hill was mapped by H. R. Covington (U.S. Geological Survey, written commun., 1983) as part of the present study to determine geologic controls with respect to spring locations and amounts of discharge. Many of the springs issue from old river channels filled with pillow lavas. As lava flows dammed and subsequently flowed into water-filled channels of the ancestral river, they cooled rapidly and formed pillow lava. Pillow lavas range texturally from sands to boulders, are extremely permeable, and readily transmit large quantities of water. Springs issue from the present Snake River canyon wall at the contact between pillow lava and underlying less permeable rocks. The sedimentary rocks immediately underlying Quaternary basalt in section *E–E'* are assumed to extend to the north canyon wall where they are obscured by basaltic talus slopes. Contacts between these sedimentary rocks and overlying and underlying basalts are most likely irregular rather than horizontal as shown.





SEISMIC DATA SUGGEST CONSIDERABLE RELIEF ON THE SURFACE OF THE MIOCENE BASALT UNDERLYING THE WESTERN PLAIN. The section above is a modification of sections prepared by Wood and Anderson (1981, p. 14-15) showing interpretation of seismic reflection data, wherein dense Miocene basaltic rocks form the seismic "basement." This basalt is considered to be highly faulted. Data from gravity surveys (Hill, 1963, p. 5813) and a few deep drill holes suggest that Miocene basalt underlies the entire western plain and extends into the eastern plain. A 14,000-ft drill hole (NE¼SE¼SE¼ sec. 27, T. 4 N., R. 1 W., shown on the section above) penetrates the entire basalt unit, which at that location, is about 7,000 ft thick. Malde (1959, p. 272) suggested that the thickness of the dense basalt unit may exceed 30,000 ft in places. Interbedded with the basalt but diminishing with depth are small amounts of sedimentary and tuffaceous rocks.

INTERIOR–GEOLOGICAL SURVEY, RESTON, VA–1986–W84176

GEOHYDROLOGIC FRAMEWORK OF THE SNAKE RIVER PLAIN, IDAHO AND EASTERN OREGON

By
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1986