DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

MISCELLANEOUS INVESTIGATIONS SERIES
MAP I–1947–B

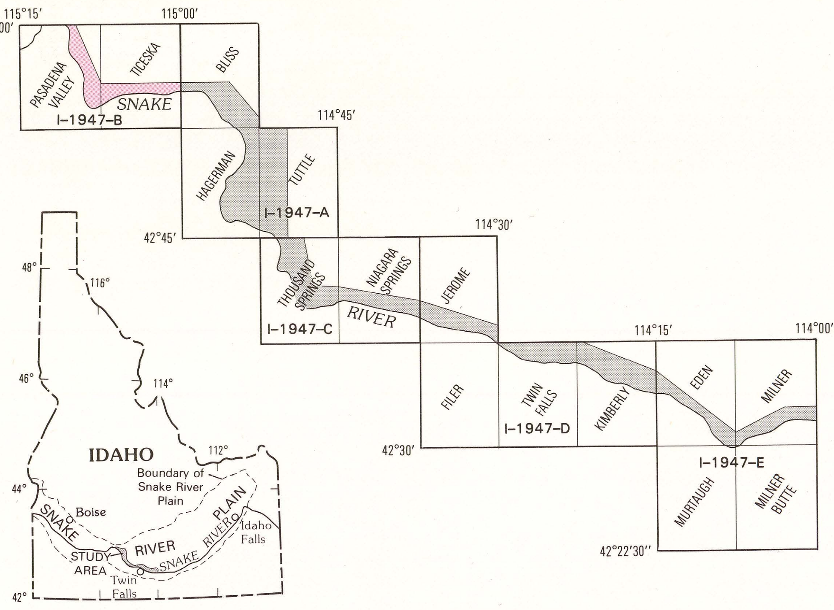


Figure 1.—Index map showing study area (shaded), location of this report (colored), and names of U.S. Geological Survey 7.5-minute quadrangle maps.

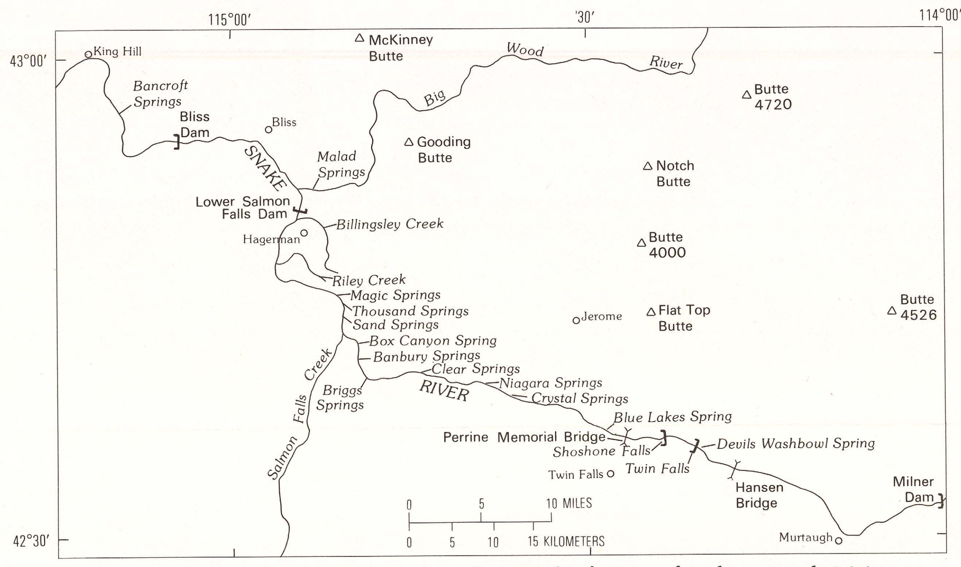


Figure 2.—Map showing major springs and geographic features of study area and vicinity.

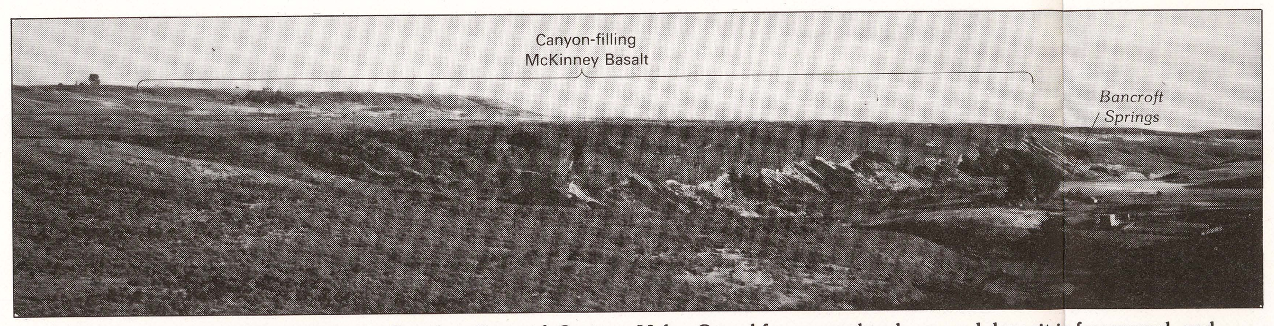


Figure 3.—Canyon-filling McKinney Basalt at Bancroft Springs. Melon Gravel forms sagebrush-covered deposit in foreground, and occurs as boulders on surface of McKinney Basalt at center. Sugar Bowl Gravel forms distant terrace at left. (Photograph by H. E. Malde, 1971, fig. 9).

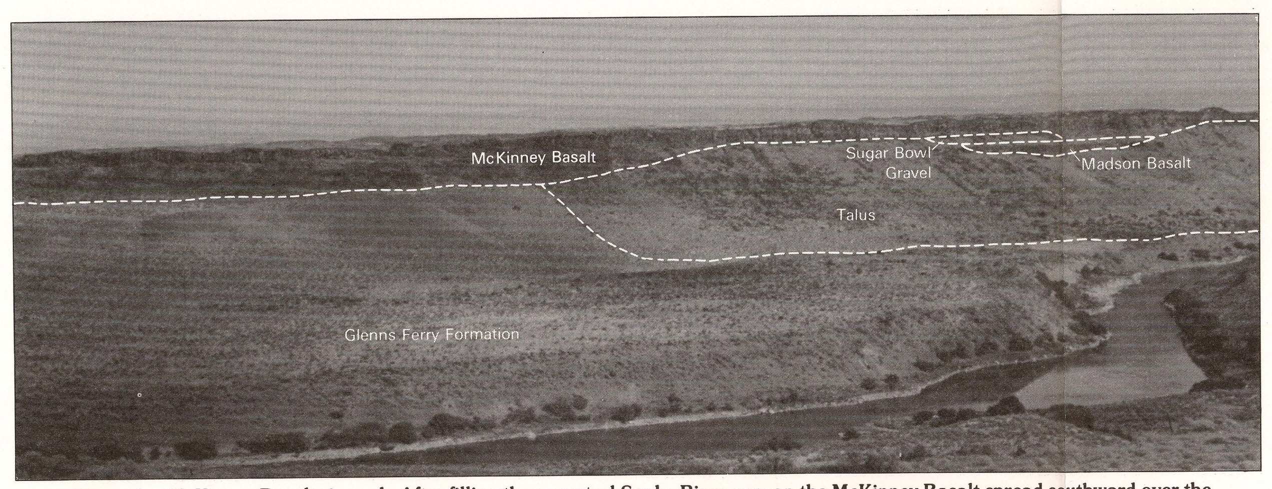


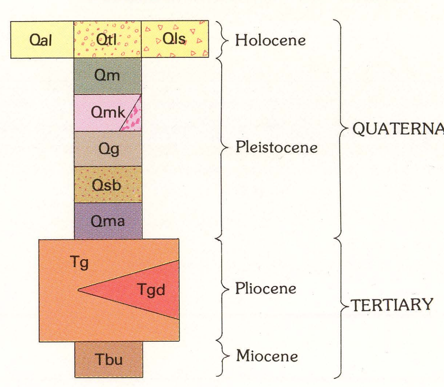
Figure 4.—McKinney Basalt rimrock. After filling the ancestral Snake River canyon the McKinney Basalt spread southward over the Madson Basalt, which can be seen as discontinuous outcrops beneath the McKinney Basalt, diverting the Snake River to its present position. The smooth bench just above river level is Glenns Ferry Formation covered with a veneer of Melon Gravel. The higher bench at left-center, upon which the Madson and McKinney basalts rest is also Glenns Ferry Formation. No springs occur along this part of the canyon.

Table 1.—*Data chart for springs in map area*
[Altitude estimated from topographic map]

Spring location no.	Spring name	Map unit from which spring emerges	Aquifer	Altitude in feet	Estimated discharge in ft³/s	Measured discharge in ft³/s	Remarks
1	Bancroft Springs	Talus deposit	McKinney Basalt	2,530	>10.0	[1]17.0	Several springs emerge from base of talus, 15–30 ft above river level

[1]Thomas (1968)

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

- **Qal** — **Stream alluvium (Holocene)**—Unconsolidated clay, silt, and sand along Snake River
- **Qtl** — **Talus (Holocene)**—Unconsolidated deposits of unsorted, generally angular material of various sizes along canyon walls
- **Qls** — **Landslide deposit (Holocene)**—Hummocky, unconsolidated deposits of blocky material in a matrix of silt or sand that occur locally along canyon walls
- **Qm** — **Melon Gravel (Pleistocene)**—Unconsolidated pebbles, cobbles, and boulders of locally derived basalt in a matrix of basaltic sand deposited along Snake River in sites and bars by catastrophic overflow of Lake Bonneville
- **Qmk** — **McKinney Basalt (Pleistocene)**—Flows of gray, olivine-rich, pahoehoe basalt from vent at McKinney Butte, located 9 mi north of Bliss. Canyon-filling flows exposed at profile-control locations 203 and 215. Pillow lava facies shown by pattern
- **Qg** — **Gravel (Pleistocene)**—Unconsolidated terrace deposits composed of quartzite and porphyry cobbles, locally includes as much as 75 ft of colluvial silt and clay at top. Previously miscorrelated with Crowsnest Gravel that occurs upstream from Hagerman (Malde, 1982)
- **Qsb** — **Sugar Bowl Gravel (Pleistocene)**—Unconsolidated terrace deposits composed mostly of quartzite and porphyry pebbles
- **Qma** — **Madson Basalt (Pleistocene)**—Flows of gray olivine basalt from an unidentified vent east of Bliss

Glenns Ferry Formation (Pliocene)

- **Tg** — **Lake and stream deposits**—Massive siltstone, flaggy sandstone, carbonaceous shale, and fine-pebble gravel characterized by abrupt lateral facies changes (Malde and Powers, 1962)
- **Tgd** — **Deer Gulch lava flow**—Flows of dark-gray, fine-grained olivine basalt from vent 9 mi southwest of Bliss (Malde and Powers, 1972)

Banbury Basalt (Miocene)

- **Tbu** — **Basalt of upper part**—Flows of dark-gray and dark-brown olivine basalt and porphyritic plagioclase-olivine basalt. Thin beds of sand and silt locally separate flows

Contact

Spring location—Number corresponds to spring location number in table 1

Profile-control location—Corresponds to numbers across top of profile
- 203 **Indicates location at which geologic section was measured using an alidade**
- TP–1 **Indicates location at which geologic section was constructed from geologic map**

3 **Photograph location**—Approximate camera location and orientation, dashed lines indicate approximate edges of photograph

INTRODUCTION

The Snake River Plain is a broad, arcuate region of low relief that extends more than 300 mi across southern Idaho. The Snake River enters the plain near Idaho Falls and flows westward along the southern margin of the eastern Snake River Plain (fig. 1), a position mainly determined by the basaltic lava flows that erupted near the axis of the plain. The highly productive Snake River Plain aquifer north of the Snake River underlies most of the eastern plain. The aquifer is composed of basaltic rocks that are interbedded with fluvial and lacustrine sedimentary rocks. The top of the aquifer (water table) is typically less than 500 ft below the land suface, but is deeper than 1,000 ft in a few areas. The Snake River has excavated a canyon into the nearly flat-lying basaltic and sedimentary rocks of the eastern Snake River Plain between Milner Dam and King Hill (fig. 2), a distance of almost 90 mi. For much of its length the canyon intersects the Snake River Plain aquifer, which discharges from the north canyon wall as springs of variable size, spacing, and altitude. Geologic controls on springs are of importance because nearly 60 percent of the aquifer's discharge occurs as spring flow along this reach of the canyon. This report is one of several that describes the geologic occurrence of springs along the northern wall of the Snake River canyon from Milner Dam to King Hill.

To understand the local geologic controls on springs, the Water Resources Division of the U.S. Geological Survey initiated a geologic mapping project as part of their Snake River Plain Regional Aquifer System-Analysis Program. Objectives of the project were (1) to prepare a geologic map of a strip of land immediately north of the Snake River canyon, (2) to map the geology of the north canyon wall in profile, (3) to locate spring occurrences along the north side of the Snake River between Milner Dam and King Hill, and (4) to estimate spring discharge from the north wall of the canyon.

PREVIOUS INVESTIGATIONS

Since the early 1900's several investigations have been conducted in order to evaluate the geologic and hydrologic conditions of the eastern Snake River Plain (Russell, 1902; Stearns and others, 1938; Mundorff and others, 1964; and Whitehead, 1986), and to assess the impact of springs on the flow of the Snake River (Ross, 1903; Crandall, 1919; Nace and others, 1958; and Thomas, 1969). The geologic and hydrologic investigations were primarily concerned with determining how the regional geology and structure of the Snake River Plain limit the extent of the regional aquifer, the direction of ground-water flow, and the quantity of water within the aquifer. Investigations by Malde and Powers (1962, 1972), Malde (1971, 1982), and Covington (1976; unpub. data, 1979) provide the geologic framework used in the present study.

Prior to 1950 the flow of only a few of the larger springs along this reach of the Snake River had been measured annually. In April 1950, the U.S. Geological Survey began annual measurements of major springs along the Snake River from Milner to King Hill in order to determine variations in total spring discharge for that reach of the Snake River. Permanent gaging stations were established on the outlet channels at Devils Washbowl Spring, Blue Lakes Spring, Box Canyon Spring, and Riley Creek (fig. 2).

MAPPING METHODS OF PRESENT STUDY

Mapping was conducted by standard planetable and alidade methods with the exception of determination of horizontal distance. The near-vertical nature and relative inaccessibility of the north canyon wall made stadia determination of horizontal distance impractical, thus horizontal distances were measured directly from topographic maps. The horizontal mapping scale was 1:12,000; profiles were constructed with 5× vertical exaggeration. Stratigraphic sections were measured at selected sites (profile-control locations) along the north canyon wall using the alidade, and geologic contacts were drawn between the measured sections to produce a geologic map. The location and spacing of the measured sections were determined by geological complexity, visibility and access, and irregularities of the canyon wall. Geologic information between the center line of the river and a vertical plane drawn between measured sections was then projected onto that vertical plane to produce the geologic profile. Because the canyon wall, river, and plane of profile are seldom parallel, lines of projection are typically oblique to the plane of the profile. Profile-control location points are locations where the plane of the profile changes direction as well as locations where stratigraphic sections have been measured. Spring locations and altitudes were also determined by alidade methods, plotted on the geologic maps and projected onto the profiles. In a few places where the use of a planetable and alidade was not practical, geologic information was projected onto the profile from existing geologic maps. Springs that could not be seen with the alidade were plotted by inspection on the geologic map and then projected onto the profile. No field measurements of spring discharges were made during this study. Discharges of springs were visually estimated in the field during mapping by comparing the appearance of a spring with one of known discharge. No estimates were made for spring discharges in excess of 10 ft^3/s (cubic feet per second). All measured spring discharges reported are from previous investigations.

GEOLOGIC FRAMEWORK

East of King Hill the Snake River Plain is an area of low topographic relief marked by scattered volcanic vents that rise a few hundred feet above the surrounding plain. The surface of the plain is dominated by late Cenozoic basaltic lava flows and interbedded fluvial and lacustrine sedimentary rocks of the Snake River Group. These late Cenozoic rocks were deposited unconformably on middle Cenozoic basalt flows and fluvial and lacustrine sedimentary rocks of the Idaho Group and on tuffs of the Idavada Volcanics. Several basalts of the Snake River Group are known to have filled ancestral canyons of the Snake River in the region west of Milner Dam, diverting the river progressively farther south along the margins of successive canyon-filling lava flows (Malde, 1971).

Basalt flowing into a canyon first dams the river and forms a temporary lake. As lava continues to flow into the canyon, dense subaerial lavas are deposited downstream from the dam, whereas subaqueous basalt is deposited upstream as pillow lavas and basaltic sands to the highest level of the temporary lake. As subsequent basalt flows spread across the area, the pillow lavas would be capped by dense lava, and the river would be diverted. Pillow lavas and basaltic sands resulting from subaqueous deposition of basaltic lava are generally unsorted, coarse grained, poorly indurated, and have extremely high porosity and hydraulic conductivity. Interconnection of numerous canyons resulting from this cut-and-fill process creates the framework for an aquifer with extremely high transmissivity and storage capacity.

Geologic mapping and examination of the exposures on the northern wall of the Snake River canyon have established the proximity of most springs with an ancestral canyon-filling unit. Inspection of the spring locations indicate that most of the springs discharge from pillow lavas and (or) basaltic sands associated with a former canyon-filling episode.

Although ancestral canyon-filling deposits play the most significant role in the location of springs along the present canyon, several other factors related to the late Cenozoic history of the Snake River are also important. These factors include the distribution of the Banbury Basalt, the Glenns Ferry Formation, flood debris, and talus deposits. The top of the Banbury Basalt relative to other more permeable rock units, defines the lower limit of spring emergence along the present canyon. Sedimentary rocks of the Glenns Ferry Formation create irregular zones of low hydraulic conductivity within the aquifer and where present along the Snake River have a local influence on spring locations. Flood debris (Melon Gravel) deposited by the Bonneville Flood (Malde, 1968) covers much of the canyon floor throughout the study area and its open-work texture allows easy movement of spring water across the canyon floor to emerge just above river level. Talus deposits along the canyon wall conceal the altitude of the water table by allowing water to move downward to a position near the base of the talus before emerging as a spring. No evidence for fault control of spring locations was found along the present canyon within the study area.

ANCESTRAL CANYON-FILLING DEPOSITS

McKinney Basalt

The McKinney Basalt, erupted from McKinney Butte (fig. 2), flowed south into the ancestral canyon of the Big Wood River at a location just north of Bliss. The basalt began to fill the canyon and flow downstream to the confluence with the Snake River a few miles west of Bliss (Malde, 1971). A dam was formed across the Snake River, and the Snake River canyon began to fill with basalt downstream to a location near King Hill. After filling the ancestral Snake River canyon (fig. 3) the McKinney Basalt spread southward over the older Madson Basalt (fig. 4) to the edge of an upland formed by older sedimentary basin deposits. This southward spread of subaerial McKinney Basalt eventually diverted the course of the Snake River to its present position across the Ticeska and Pasadena Valley quadrangles. At the east edge of the Ticeska quadrangle (profile-control location 203) subaerial McKinney Basalt can be seen overlying a pillow lava facies of McKinney Basalt (fig. 5) that was deposited in the temporary lake formed behind the lava dam.

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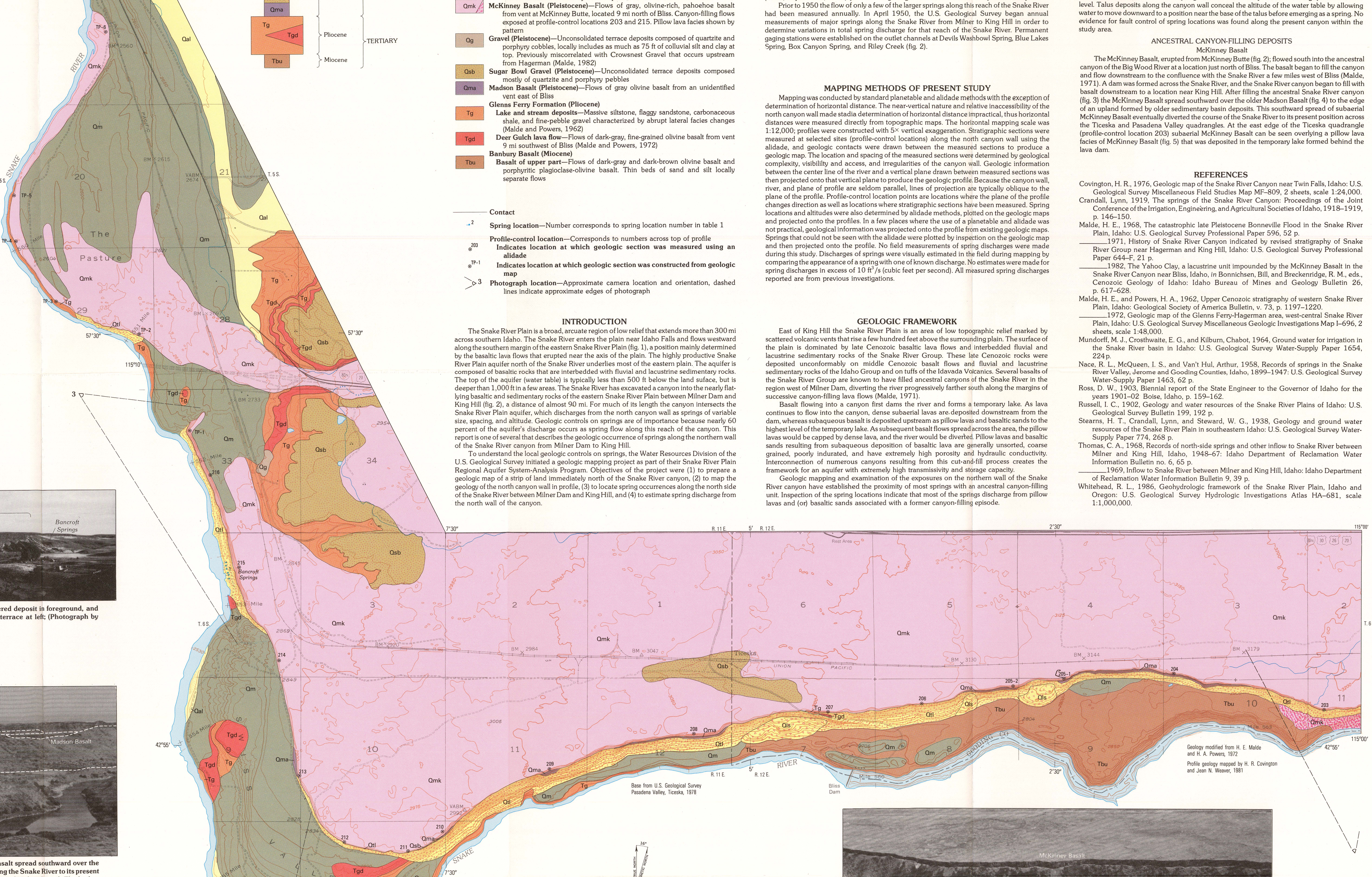


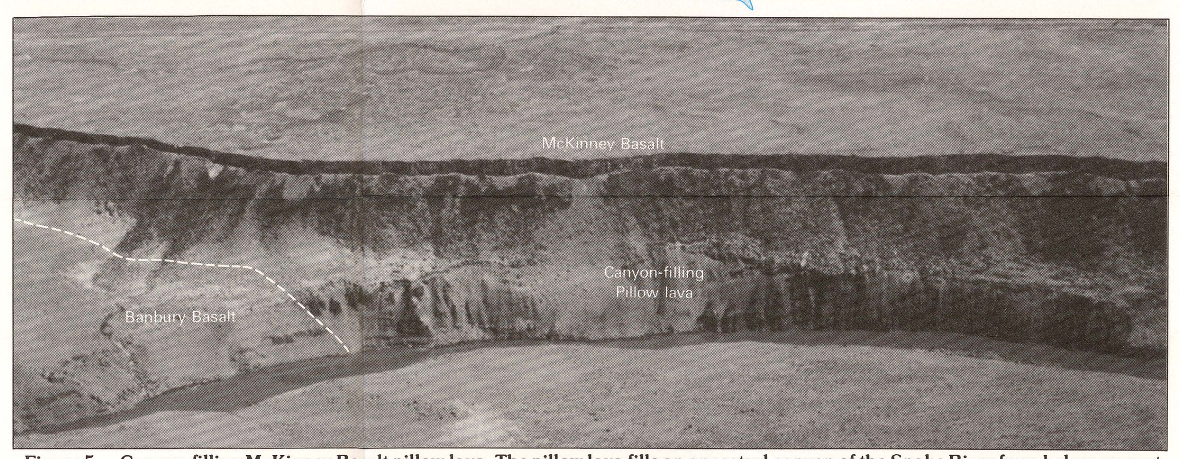
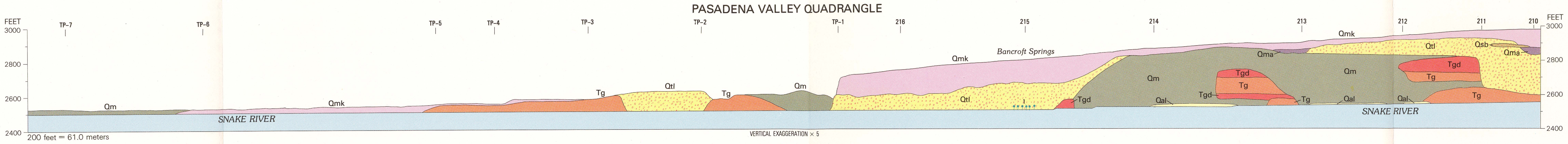
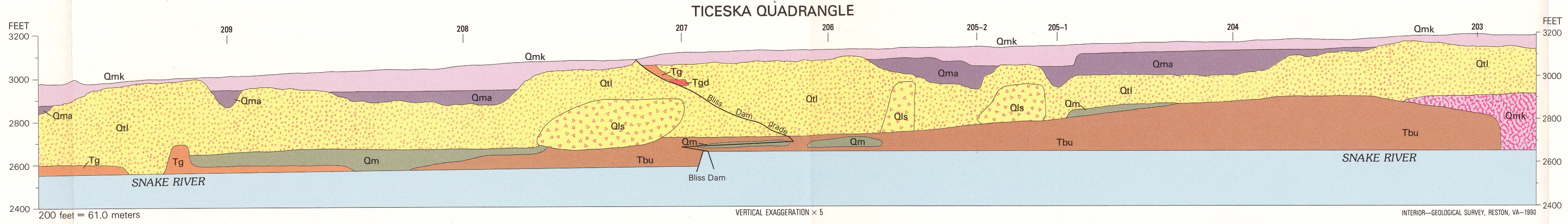


Figure 5.—Canyon-filling McKinney Basalt pillow lava. The pillow lava fills an ancestral canyon of the Snake River from below present river level to an altitude of 3,130 ft. The pillow lava is capped by a subaerial flow of McKinney Basalt. The bench, just above river level at left, is Banbury Basalt that formed part of the ancestral south canyon wall.

PASADENA VALLEY QUADRANGLE



TICESKA QUADRANGLE



INTERIOR—GEOLOGICAL SURVEY, RESTON, VA—1990

GEOLOGIC MAP AND PROFILES OF THE NORTH WALL OF THE SNAKE RIVER CANYON, PASADENA VALLEY AND TICESKA QUADRANGLES, IDAHO

By
H. R. Covington and Jean N. Weaver

1990

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