DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

PROFESSIONAL PAPER 1316
PLATE 1

EXPLANATION

SURFICIAL DEPOSITS

- AF — ARTIFICIAL FILL—Earth fill along Last Chance Gulch in city of Helena and refuse fill in old trash dump northeast of Helena; unsorted and unstratified; loosely compacted and uncemented; maximum thickness about 4 m
- PT — PLACER TAILINGS—Piles of coarse, washed gravel, commonly arranged in rows, constituting waste rock from placer-mining operations; unsorted and unstratified; loosely compacted and uncemented; maximum thickness about 6 m
- LD — LANDSLIDE DEPOSIT—Coarse, jumbled mass of angular blocks of quartzite; unsorted and unstratified; loosely compacted and uncemented; maximum thickness about 15 m
- SD — STREAM DEPOSITS—Gravel, sand, silt, and clay in stream beds, on flood plains, and in alluvial fans; mostly well sorted sandy gravel; loosely to firmly compacted; uncemented to weakly cemented; maximum thickness unknown but probably as much as 30 m
- SW — SLOPE WASH—Gravel, sand, silt, and clay on steep to gentle slopes; mostly poorly sorted clayey gravel; loosely to firmly compacted; uncemented to weakly cemented; maximum thickness unknown but probably as much as 6 m
- SS — MIXED STREAM DEPOSITS AND SLOPE WASH, UNDIVIDED
- OG — OLDER GRAVEL—Gravel, sand, silt, and clay on terrace surfaces above major streams, in ancient alluvial fans, and on remnants of old erosion surfaces; mostly moderately well sorted gravel; loosely to firmly compacted and weakly cemented; maximum thickness about 6 m
- OSL — OLDER STREAM AND LAKE DEPOSITS—Gravel, sand, silt, clay, bentonite, lignite, and volcanic tuff, well-sorted and evenly stratified, firmly compacted, weakly to moderately well cemented; bentonite swells and becomes plastic when wetted; maximum thickness unknown but probably more than 500 m in central part of Helena Valley

BEDROCK

- SB — SEDIMENTARY BEDROCK—Limestone, dolomite, shale, and sandstone; hard, firm, and dense; permanently and strongly cohesive
- PB — PLUTONIC BEDROCK—Mostly coarse grained crystalline granitic rock; hard, firm, and dense; permanently and strongly cohesive; locally weathered to loose granular soil
- VB — VOLCANIC BEDROCK—Mostly fine grained crystalline lava and volcanic tuff; hard, firm, and dense; permanently and strongly cohesive

- APPROXIMATE CONTACT BETWEEN UNITS
- INFERRED CONTACT BETWEEN OLDER STREAM AND LAKE DEPOSITS (OSL) AND BEDROCK (SB, PB) BENEATH COVER OF YOUNGER SURFICIAL DEPOSITS
- STRIKE-SLIP FAULT—Arrows show inferred relative direction of horizontal movement. Dashed where inferred; dotted where concealed; queried where location uncertain
- NORMAL FAULT—Dashed where inferred; dotted where concealed; U, upthrown side; D, downthrown side; queried where location uncertain
- GRAVEL PIT
- APPROXIMATE LINE OF EQUAL DEPTH TO WATER TABLE—Datum is land surface; contour interval 6 ft. Measured September 1976; from Wilke and Johnson (1978)
- 510 WATER WELL—Depth, in feet

REFERENCES CITED

Knopf, Adolf, 1963, Geology of the northern part of the Boulder batholith and adjacent area, Montana: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-381.

Wilke, K. R., and Johnson, M. V., 1978, Maps showing depth to water table, September 1976, and area inundated by the June 1975 flood, Helena Valley, Lewis and Clark County, Montana: U.S. Geological Survey Open-File Report 78-110, 2 sheets, scale 1:48,000.

Base from U.S. Geological Survey
1:62,500 Helena, 1950
Roads as of 1984

APPROXIMATE MEAN DECLINATION, 1985

SCALE 1:48 000

CONTOUR INTERVAL 40 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

QUADRANGLE LOCATION

Geology by R. G. Schmidt, 1975–76, assisted by W. R. Trojan, 1975, and D. G. Waggoner, 1976; and from Knopf (1963)

MAP OF HELENA QUADRANGLE, MONTANA, SHOWING DISTRIBUTION OF SURFICIAL DEPOSITS AND BEDROCK AND TRACES OF GEOLOGIC FAULTS