



- EXPLANATION**
- SURFICIAL DEPOSITS**
- AF** ARTIFICIAL FILL—Refuse fill in old city trash dump northwest of Helena Airport and piles of smelter slag at East Helena. Refuse fill unsorted and unstratified, loosely compacted, uncemented, and as much as 3 m thick; smelter slag unsorted and unstratified, moderately well compacted, uncemented, and as much as 15 m thick
  - 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 volcanic-rock debris and soil; 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
  - WD** WIND-LAID DEPOSITS—Dune-like accumulations of fine sand, and blanketing deposits of silt, on lowlands along Missouri River and on uplands east of Spokane Creek; well sorted and unstratified; loosely to firmly compacted; uncemented to weakly cemented; maximum thickness about 6 m; silt constitutes less and locally stands in vertical walls as much as 4½ m high
  - OG** GLACIAL LAKE DEPOSITS—Sand, silt, and clay along Missouri River and lower reaches of Prickly Pear Creek and Spokane Creek; well sorted, thinly and evenly stratified; firmly compacted; uncemented to weakly cemented; maximum thickness about 12 m
  - OSL** 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 poorly to moderately well sorted gravel; loosely to firmly compacted and weakly cemented; maximum thickness about 20 m
  - OSL** OLDER STREAM AND LAKE DEPOSITS—Gravel, sand, silt, clay, bentonite, lignite, and volcanic ash, 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 thick 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  
 - - - CONCEALED ZONE OF NORMAL FAULTING POSTULATED BY DAVIS AND OTHERS (1963) FROM GRAVIMETRIC DATA—U, upthrown side; D, downthrown side  
 - - - THRUST FAULT—Dashed where inferred; dotted where concealed; sawteeth on upthrown side  
 X 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)  
 ○340 WATER WELL—Number indicates depth in feet

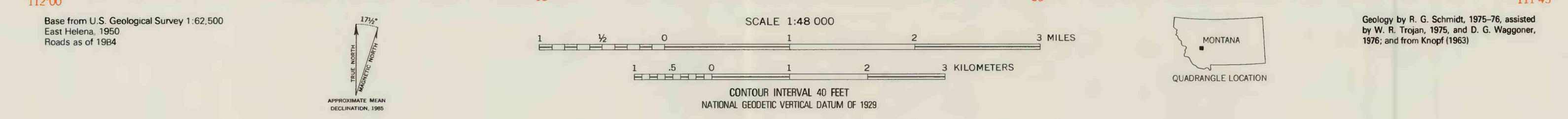
**REFERENCES CITED**

Davis, W. E., Kinoshita, W. T., and Smedes, H. W., 1963. Bouguer gravity, aeromagnetic, and generalized geologic map of East Helena and Canyon Ferry quadrangles and part of the Diamond City quadrangle, Lewis and Clark, Broadwater, and Jefferson Counties, Montana: U.S. Geological Survey Geophysical Investigations Map GP-444.

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.

Smedes, H. W., 1966. Geology and igneous petrology of the northern Elkhorn Mountains, Jefferson and Broadwater Counties, Montana: U.S. Geological Survey Professional Paper 510, 116 p.

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 Counties, Montana: U.S. Geological Survey Open-File Report 78-110, 2 sheets, scale 1:48,000.



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