MAPS OF HELENA AND EAST HELENA QUADRANGLES, MONTANA, SHOWING AREAL DISTRIBUTION OF SURFICIAL DEPOSITS AND BEDROCK AND LOCATION OF GEOLOGICAL FAULTS

EXPLANATION

SURFICIAL DEPOSITS

AF ARTIFICIAL FILL – Earth and refuse fill; unsorted and unstratified; loosely compacted and noncohesive; maximum thickness about 12 feet (4 m); shown only along Last Chance Gulch in city of Helena in Helena quadrangle and northwest of Helena Airport in East Helena quadrangle.

PT PLACER TAILINGS – Piles of coarse, washed, rounded to subrounded gravel, commonly arranged in rows, constituting waste rock dumped during placer-mining operations; unsorted and unstratified; loosely compacted and noncohesive; maximum thickness about 20 feet (6 m).

LD LANDSLIDE DEPOSITS – Coarse, jumbled, dislocated mixture of angular rock debris and soil; unsorted and unstratified; loosely compacted and noncohesive; maximum thickness about 50 feet (15 m).

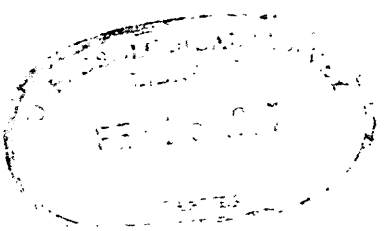
SD STREAM DEPOSITS – Chiefly rounded to subrounded pebble, cobble, and boulder gravel in stream beds, on floodplains, and in alluvial fans; matrix mainly coarse sand; moderately well sorted and interlayered with thin beds and lenses of sand, silt, and clay; loosely to firmly compacted; noncohesive to cohesive; maximum thickness unknown but probably as much as 100 feet (30 m) in western part of Helena Valley.

SW SLOPE WASH – Chiefly angular to subrounded pebble, cobble, and boulder gravel on steep to gentle slopes; matrix mainly silt and clay; poorly sorted and interlayered with thin irregular beds and lenses of sand, silt, and clay; loosely to firmly compacted; noncohesive to cohesive; maximum thickness unknown but probably as much as 20 feet (6 m).

SS STREAM DEPOSITS AND SLOPE WASH, UNDIVIDED – Mixed stream deposits and slope wash not separately mapped.

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 in East Helena quadrangle; well sorted and unstratified; loosely to firmly compacted; noncohesive to cohesive; maximum thickness about 30 feet (9 m); silt constitutes loess and locally stands in vertical walls as much as 15 feet (4.5 m) high.

GD GLACIAL-LAKE DEPOSITS – Sand, silt, and clay along Missouri River and lower course of Prickly Pear and Spokane Creek in East Helena quadrangle; well sorted, thinly and evenly stratified, firmly compacted, and cohesive; maximum thickness about 40 feet (12 m).



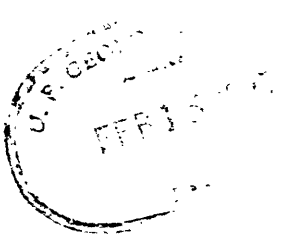
CG OLDER GRAVEL – Chiefly rounded to subrounded pebble, cobble, and boulder gravel on terrace surfaces above major streams, in ancient alluvial fans, and on remnants of old erosion surfaces; poorly to moderately well sorted and interlayered with thin beds and lenses of sand, silt, and clay; loosely to firmly compacted, noncohesive to cohesive, and locally weakly cemented with calcium carbonate, iron oxide, or clay; maximum thickness about 100 feet (30 m).

TD TERTIARY DEPOSITS – Chiefly gravel, sand, silt, clay, bentonite, lignite, and volcanic tuff; mostly well sorted and evenly stratified; firmly compacted, noncohesive to cohesive, and locally strongly cemented; bentonite swells and becomes plastic when wetted; maximum thickness unknown but probably more than 1,200 feet (366 m) in central and eastern parts of Helena Valley.

BEDROCK

SB SEDIMENTARY BEDROCK – Chiefly limestone, dolomite, shale, and sandstone; hard, firm, and dense; permanently and strongly cohesive.

IB IGNEOUS BEDROCK – Chiefly coarse-grained granitic rock and fine-grained volcanic rock; hard, firm, and dense; permanently and strongly cohesive; granitic rocks locally weather to loose granular soil.



CONTACTS

Inferred contact between rock units

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Inferred contact between Tertiary deposits (TD) and bedrock (SB, IB) beneath cover of younger surficial deposits

GEOLOGICAL FAULTS

U
D

Trace of normal fault

U, upthrown side; D, downthrown side

Dashed where inferred; dotted where concealed beneath surficial deposits; queried where interpretive and location uncertain

Trace of thrust fault

Sawteeth on upthrown side

Dashed where inferred; dotted where concealed beneath surficial deposits and Missouri River

HYDROLOGIC BOUNDARY

Approximate boundary of waterlogged areas in Helena Valley

REFERENCES

Knopf, Adolf, 1963, Geology of the northern part of the Boulder bathylith and adjacent area, Montana: U. S. Geol. Survey Misc. Geol. Inv. Map I-381.

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