



Introduction

Personnel of the U.S. Geological Survey, in conjunction with Mark Weber, Geologic Consultant to Missoula and Powell Counties, are studying the earth and water resources of an area that extends from the Big Fork quadrangle on the north to the Avon quadrangle on the south. This map represents one product of that study, and is for the use of environmental and land-use planners. Additional maps south of Highway 200 have been prepared by Weber.

The areal distribution of all geologic units, except alluvium, was determined in the field. The distribution of the alluvium was plotted in the office from aerial photographs.

Surficial deposits

Most of the surficial deposits in the northern part of the Big Fork-Avon area were formed in the latter stages of the last ice age--the Pinedale glaciation of the Pleistocene--during the advance and waste of several large glaciers. These deposits mantle the lower flanks of the mountains and form the valley floors; they have been dissected and eroded somewhat by modern streams, but most still appear much as when they were formed.

For ease of discussion and to avoid the complexities of glacial nomenclature these deposits have been grouped into two categories, older and younger. The "older" deposits were likely formed either during early or middle Pinedale time, and the "younger" deposits during the late Pinedale. It is possible that in some localities deposits of more than one ice advance have been included in one or the other category.

Deposits of the older ice are identified on the map by the letter "o" added to the symbol, thus "Qo," is, "fill of the older ice."

Deposits of the younger ice are identified on the map by the letter "y" added to the symbol, thus "Qy," is, "outwash of the younger ice."

Locally, along the length of the Swan Valley, deposits of former small tributary glaciers extend into the main valley. These deposits have been mapped separately and are identified by appropriate symbols, thus "Qtb," is, "fill of the Holland Lake ice."

CORRELATION OF MAP UNITS

Qal	Qde	Qe	Qte	Qf	Holocene and Pleistocene	QUATERNARY	
Ql	Qo	Qo	Qo	Qo			
UNCONFORMITY?						Pleistocene	QUATERNARY
Qico	Qeo	Qlo	Qkto	Qoo	Qofo		
UNCONFORMITY						Precambrian	PRECAMBRIAN
pCb							

DESCRIPTION OF MAP UNITS

Qal ALLUVIUM (HOLOCENE)--Screen-deposited, unconsolidated silt, sand, and gravel. Commonly forms the floor of the major stream valleys, as well as of the now-abandoned meltwater channels of former glaciers. Locally includes small deposits of colluvium and other mass-wasting debris. Overlies and normally masks outwash sand and gravel deposited by meltwaters of the wasting glaciers.

Qof ALLUVIAL FAN (HOLOCENE)--Small, moderately sloping, deposit of poorly sorted silt, sand, gravel, cobbles, and boulders at the mouths of small gullies.

Qol COLLUVIUM (HOLOCENE AND PLEISTOCENE)--Small, hummocky deposit of unsorted debris that has slid down valley sides and now partly fills valley bedrock.

Qde DELTA (HOLOCENE AND PLEISTOCENE)--Small, gently sloping, cone-shaped, even-surfaced deposit of semiconsolidated silt, sand, and gravel.

Qe EARTHFLOW (HOLOCENE AND PLEISTOCENE)--Small, fan-shaped mass of semiconsolidated soil and till. Clayey matrix.

Ql LANDSLIDE (HOLOCENE AND PLEISTOCENE)--Lobate, hummocky mass of small slump blocks forming a heterogeneous mixture of soil, till, and bedrock.

Qte TERRACE DEPOSITS (HOLOCENE AND PLEISTOCENE)--Unconsolidated, well sorted silt, sand, gravel, and cobbles in cusp-like embayments along the lower reaches of the Clearwater River. Clasts are well rounded. Tan quartzite and sandstone clasts predominate; other prominent types include green, gray, and purple argillite. These deposits, 3-5 m (10-15 ft) thick, and 5-6 m (15-20 ft) above the valley bottoms, are dissected relicts of a once-continuous stream deposit which partly filled the Clearwater Valley.

PINEDALE GLACIATION (PLEISTOCENE)

Qico Ice-contact deposit of older ice--Small, irregular-shaped deposit of silt, sand, and gravel. Clasts range from subrounded to well rounded; most are well rounded. Tan quartzite and sandstone clasts predominate; other prominent types include green, gray, and purple argillite. Formed in contact with wasting ice.

Qeo Esker deposited by older ice--Sinuous, narrow, steep-sided, hummocky ridge of unconsolidated silt, sand, and gravel. Ridge rises 4-8 m (15-25 ft) above adjacent surface. Crest ranges in width from 2 to 8 m (7-25 ft). Many well rounded cobbles and a few rounded boulders 0.6-1 m (2-3 ft) in diameter. Clasts range in shape from subangular to well rounded; most are well rounded. Tan quartzite and sandstone clasts predominate; other prominent types include green, gray, and purple argillite. Formed by a subglacial stream beneath a stagnant, wasting ice mass.

Qio Lacustrine deposit of older ice--Broad, even-surfaced deposit of light-brown, well bedded, and well sorted lacustrine silt. Formed when eastward-flowing ancestral Blanchard Creek was impounded behind outwash.

Qkto Kame terrace deposited by older ice--Elongate, narrow, irregular- to even-surfaced, terracelike deposit of light-brown to brown unconsolidated silt, sand, and gravel. Clasts range in shape from subrounded to well rounded; most are well rounded. Few rounded boulders scattered through deposit. Tan quartzite and sandstone clasts predominate; other prominent types include green, gray, and purple argillite. Moderately well sorted; in general, about 65 percent of unit is composed of clasts that range in size from about 5 mm to about 76 mm (1/4-3 in.); about 30 percent consists of a fine to coarse sand with included small pebbles as much as 5 mm; and the remaining 5 percent is silt. Many interlayered lenses and pockets of unconsolidated light-brown sand, some as much as 30 m (100 ft) long and 6 m (20 ft) thick. The sand lenses are composed of about 85 percent fine to coarse sand, and about 15 percent silt. Formed by meltwaters between the edge of an ice mass and the adjacent valley wall.

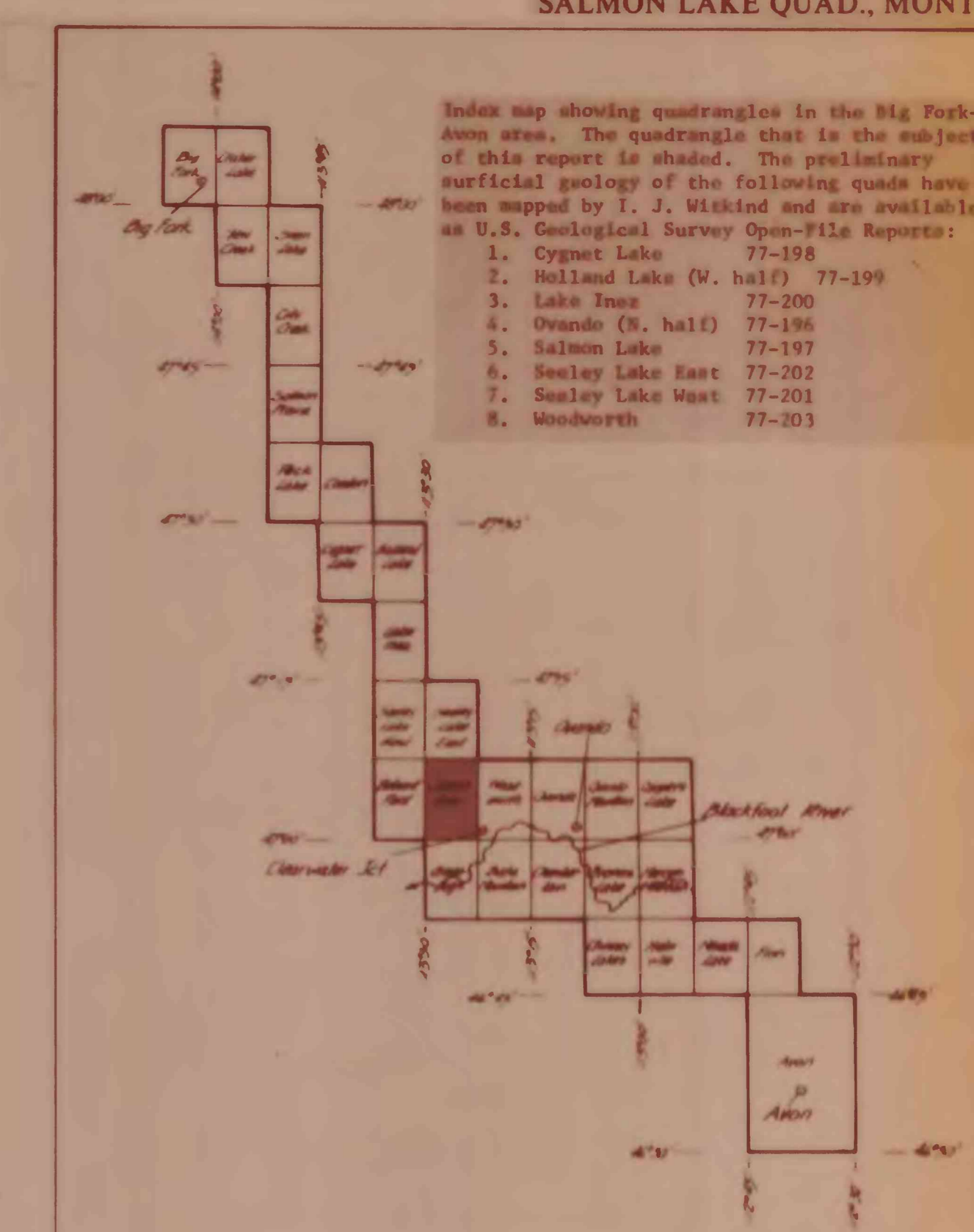
Qoo Outwash deposited by older ice--Even-surfaced, gently sloping, long, narrow deposit of unconsolidated, well bedded and well sorted silt, sand, gravel, and cobbles. Clasts range in shape from subrounded to well rounded with most being well rounded. In general, about 75 percent of unit is composed of clasts that range in size from about 5 mm to about 76 mm (1/4-3 in.); about 15 percent consists of a fine to coarse sand with included small pebbles as much as 5 mm; and the remaining 10 percent is fine silt and clay. Tan quartzite and sandstone predominate; other prominent types include green, gray, and purple argillite. Outwash formed by south-flowing meltwaters derived chiefly from the waste of a trunk glacier which occupied much of Clearwater Valley. Salmon, Elbow, and Harpers Lakes, plus undrained depressions in this outwash plain, were formed when buried ice blocks melted and permitted the overlying sand and gravel to collapse into the resulting voids.

Qofo Outwash fan deposited by older ice--Even-surfaced, gently sloping, cone-shaped deposit of unconsolidated, moderately sorted silt, sand, gravel, cobbles, and boulders. Probably formed when outwash waters flowing southeastward in Blanchard Creek discharged into glacial Blackfoot River.

Qto Till deposited by older ice--Over most of the area forms a hummocky moraine marked by elongate drumlins and narrow linear valleys that trend about S. 60° E. In places forms a thin to thick, smooth and unbroken veneer over bedrock. Consists of an unsorted mixture of gravel, cobbles, and boulders in a light-brown to brown moderately compact clayey and silty matrix. Locally matrix becomes somewhat sandy. Very coarse with many large angular clasts and boulders. Clasts range from angular to rounded with most of the smaller ones being very angular. Sizes range from 0.5 to 35 cm (1/8-14 in.); most are in the range 1-5 cm (1/2-2 in.). Purple clasts predominate; other prominent types include gray and green argillite, and tan quartzite and sandstone. Most boulders are angular to subrounded and range in size from 25 to 30 cm (10-12 in.). Large blacial erratics are common; some are as much as 5 m (15 ft) across. Locally a few small slumps are on steep unstable slopes. General alignment of the drumlins suggests that the ice flowed southeastward across the broad valley now occupied by the Clearwater River. Presumably melt of buried remnants of this ice are responsible for the kettle lakes and other undrained depressions that break the surface of the outwash on both sides of Clearwater River.

Qtor Rubble from till deposited by older ice--Thin, discontinuous veneer and rubble derived from widespread erosion of till of the older ice leaving bedrock widely exposed; few scattered erratics. Elsewhere the till forms small patches of irregular shape and thickness. In general, the upper contact marks the highest limit of the till patches.

pCb OLDER BEDROCK OF BELT SUPERGROUP, UNDIVIDED (PRECAMBRIAN)--Consists of various units of the Belt Supergroup, chiefly the Snowflap (argillite and sandstone), Shepard (argillite and dolomite), and Mount Shields (argillite and sandstone) Formations. These are bright units in varying shades of purple, maroon, green, tan, and gray.



- Index map showing quadrangles in the Big Fork-Avon area. The quadrangle that is the subject of this report is shaded. The preliminary surficial geology of the following quads have been mapped by I. J. Witkind and are available as U.S. Geological Survey Open-File Reports:
1. Cynnet Lake 77-198
 2. Holland Lake (W. half) 77-199
 3. Lake Innes 77-200
 4. Owsada (E. half) 77-196
 5. Salmon Lake 77-197
 6. Seeley Lake East 77-202
 7. Seeley Lake West 77-201
 8. Woodworth 77-203

Base from U.S. Geological Survey, 1965.
U.S. Geological Survey
OPEN FILE REPORT
This map is preliminary and has not been edited or reviewed for conformity with Geological Survey standards or nomenclature.

Geology by Irving J. Witkind, 1975. Traces of faults from unpublished maps by J. E. Harrison (west of the highway 200), and M. R. Mudge, (east of highway), both of the U.S. Geological Survey.

PRELIMINARY MAP SHOWING SURFICIAL DEPOSITS IN THE SALMON LAKE QUADRANGLE, MISSOULA COUNTY, MONTANA
By
Irving J. Witkind
1977

--- CONTACT---Approximately located or inferred. In many places somewhat concealed by debris or dense foliage.
- - - - - FAULT---Dashed where approximately located or inferred, dotted where concealed. U, upthrown side; D, downthrown side.