Phocene(7)

Miocene(?)

Foces(?)

TERTIARY

CRETACEOUS AND

S AND MISSISSIPPIAN

CAMBRIAN

PRECAMBRAN

PERMIAN PENNSYLVANIAN

JURASSIC

AULT-Dashed where approximately located or inferred; dotted where concealed. Ball on downthrown side

ANTICLINE-Showing trace of axial plane and direction of plunge of axis

SYNCLINE-Showing trace of axial plane and direction of plunge

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Introduction

The eleven maps in the set (7-437 through 79-447) are part of a cross prepared as a result of cooperative venture between his outland nowell Counties, Montana and the U.S. Geological Survey. When, the senior author, at one time served as ecologic consultant to the counties, and he is primarily reponsible for the ecologic mapping of the southern half of the Bis Fork-Avon area. It kind mapped the northern half of the area and his maps are available as Open-File legorts (listed below). Weber is now a realogist with the U.S. Forest Service in Creat Falls, Montana; Witkind is a cologist with the U.S. Geological Survey in Denver, Colorido.

The area studied extends from the Big Fork Quadrangle on the north to the von quadrangle on the south (see index map). All the maps are products of that study and are intended for use by environmental and land-use planners.

Copies of the available maps can be purchased from:

Open File Services Section, Branch of Distribution, Box 25425, Federal Center, Denver, Colorado 30225

The maps can also be examined at the following offices:

Denver Public Inquiries Office, U.S. Geological Survey, 1012, Federal Building, 1961 Stout Street, Denver, Colorado 80202

Sair Lake City Public Inquiries Office, U.S. Geological Survey, 8015, Federal Office Building, 125 South State Street Sait Lake City, Urah Balli

Spokane Public Inquiries Office, U.S. Coological Survey, 578, U.S. Courthouse Building, West 920 Riverside Avenue, Spokane, Washington 96201

1.	Avon (N. 2/3)	79-437
2.	Gata Mountain (W. 1/3)	79-438
3.	Big Fork	78-174
4.	Browns Lake	79-439
3.	Chamberlain Mountain	79-440
5.	Chimney Lakes (NE 1/4)	79-441
7.	Gilly Creek	77-860
8.	Condon (W. half)	77-540
9.	Coopers Lake (S. half)	77-460
10.	Grater lake (W. half)	78-173
11.	Cygnet Lake	77-198
12.	Finn (SW 1/4)	79-442
13.	Greenough	79-443
14.	Helmville (N. half)	79-444

15. Holland Lake (W. half) 77-199

In addition to these maps, another map, by Witkind which discusses the seismicity of the six Fork-Avon area, has been published as U.S. Geological Survey Miscellaneous Field Studies Map (F-92) and is titled Unjor active faults and seismicity in and near the Big Fork-Avon area, northwestern Montana.

Surficial deposits

Most of the surficial deposits in the southern part of the Six Fork-Avon area were formed primarily during several advances and subsequent malts of large laciers. The ir t dvance recognised locally probably occurred about 150,000 years ago, during the Bull Lake Glaciation of the Pleistocene, when ice from the mountains to the north spread southward across the Blacktoot River. Deposits of this placier are shown on the maps by the letters "bl" added to the symbol, thus "Otbl--Till deposited by Bull Lake(?) ice." Subsequently, some 20,000 to 30,000 years are during the Pinedale Glaciation of the Pleistocene, another glacier again moved southward into the area. It apparently reached almost as far south as Helmville, before it withdrew and then readvanced again. This readvance, however, did not extend as far to the south, probably reaching only to Kleinschmidt Lake. Deposits of these two advances have also been differentiated on the map. The deposits of the first, or older, advance are shown on the map by the letter "o" added to the symbol, thus "Oto--Till deposited by older ice." The deposits of the second, or younger advance, are shown on the map by the letter "y" added to the symbol, thus, "Ity--Till deposited by younger

In addition to the debris, mainly till, deposited by the ice, other material, chiefly and and gravel, was carried for to the south by the maltwaters of the wasting placers. These deposits, termed potward, are similarly identified on the map by the letters "bl" or "o" or "o" depending upon which glacer furnished them.

In some localities deposits of more than one ice advance may have been inadvertently grouped and thus mapped as the deposits of a single advance.

lh. Lake Ine 77-200 17. Marcum Mountain (W. half) 79-445 18. Wada Lake (S. half) 79-446 19. Wando 77-196 20. Ovanda (8. 1/3) 79-447 21. Ovando Mountain (S. half) 77-465 22. Feck take (E. half) 77-539 23. Salmon Lake 77-197 24. Salmon Prairie 25. Neeley Lake East 26. Seeley Lake West 77-201 7. Swan Lake (SW 1/4) 78-135 28. Woodworth 29. Yew Creek (NE 1/4)

[This is a combined map description for quadrangles in the southern part of the Big Pork-Avon environmental study area (Open-File Reports 79-437 to 79-447). Not all units will appear on all maps.

- Oal

  ALLOVIUM (NOLOCENE) -- Light to lark gray and provinsh gray;
  strain-deposited, unconsolidated, moderately to wellbedded, interstratified amenblage of silt, sand, and
  gravel. Typically clay-rich and cohesive where inclued
  into claystones, siltstones, and shales of older basinfill deposits. Cold-bearing sand and gravel occur locally
  in the northward-draining valleys of the Garnet Pange, and
  in the westward-draining valleys of the mountains east of
  Helmville and Avon. Characterized by shallow depths to
  ground water. Soil draining is poor and shrin-swell
  potentials are inferred to be relatively low
  - ALLUVIAL FAN DEPOSITS (HOLGERNE) -- Small, moderately sloping poorly sorted, crudely stratified silt, sand, gravel, cobbies, and boulders at the mouths of small culties and high-gradient streams. Ground-aster conditions are quite variable, and flash-flood hazard potential is high, especially near the upper apex of the fan. Shrink-swell potential is inferred to be generally low
  - COLLUVIUM (HOLOGENE) -- Unsorted debris that has slid or been washed downslope to form small, thin, and hummocky deposits. Best developed in terrine underlain by Tertiary volcanic rocks. Shrink-swell potentials are variable, and are inferred to range from moderate to high
  - LANDSLIDE DEPOSITS (CLATERIARY) Small, fan- and lobate-shaped humanicky masses of emiconsolidated soil, till, Tertiary basin fill, and volcanic debris. Clay and soil-moisture content are generally high. Small springs or seeps are common. Many of these landslides are active and all should be considered unstable. Shrink-swell potential are variable, and are inferred to range from moderate to high
    - SEDIMENTS DEPOSITED BY MELTWATERS OF PINEDALE GLACIATION (QUATERNARY) -- YOUNGER ICE
    - I custrine Deposits—Pink; rhythmically be ded silt, sandy silt, and clay with included lenses of and and gravel. Forms gently slopin, smooth surfaces at altitudes generally below 1,158 m (3,800 ft). Soil drain we range from fair to poor, but lateral perme bility may be high within the interbodded sindy beds and lenses. High frost-heave susceptibility. Clay-rich beds have a moderate anrink—swell potential
    - Ice-Contact Pepper It--Dark brown and brown; composed of moderately all sorted silt, and, and gravel. Forms an elonate, ently sloping bench. Clasts range in shape from an ular to rounded; most are rounded. Size range from 3 mm to 20 cm (1/8-8 in.); dominant sizes range from 13 mm to 5 cm (1/2-2 in.). Cobble and sull an all r to rounded boulders 0.6-1 m (2-3 ft) are attered across the surface. Formed in contact with was time ice
    - Kame Deposits—Tark brown and brown; consist of moderately to poorly sorted silt, sand, and revel. Forms mall, conical to ellipsoidal, steep-sided hillock. Few well-rounded cobbles cattered irregularly through the unit. Formed by a glicial stress that flowed down into standard ice miss
    - Outwash—Light brown, and gravish brown moder tely well sorted; composed of silt, and, and subrounded to round d pebbly and cobbly ravel. commonly the upper 1 m (3 ft) is composed of light-brown, fine— to mediam—grained sand. The composed of light-brown is sufficiently sand to the mediam—grained sand. The composed of light-brown is sufficiently sand to the mediam—grained sand. The composed of light-brown is sufficiently sand to the mediam—grained sand. The composed of light-brown is sufficiently sand to the mediam—grained sand to

Terrice Deposits—Cray, tan, brown, and pink; unconsolidated, moderately well sorted, well-bedied silt, sand, gravel, and cobbles in smooth-surfaced, dissected deposits flanking modern stream channels, and in abandoned channels 5-6 m (15-20 ft) above modern stream channels. These deposits are typically moderately to well-drained, and are interred to have relatively low arrink-swell potential

SEDIMENTS DEPOSITED BY MELTWATERS OF PINEDALE CLACIATION (UPPER PLEISTRACESE) -- OLDER ICE

- Outwash-Dark brown, raddish brown, and brown; consists of moderately well sorted silt, sand, and subangular to rounded gravel and cobbly gravel. Forms smooth, locally dissected plains and terraces which lie 6-30 m (20-100 ft) above the younger outwash deposits. Ground water occurs at moderate depths
- Outwash can be posit -- wen-surfaced, gently slowing, coneshaped deposit of inconsolidated, moderately sorted silt, sand, gravel, and combles. Probably formed at some time after the Blackfoot giver was diverted by lobes of ice which lay in the Monture, North Fork of the Blackfoot, and Nevada Creek valleys
- Deltaic crivels— Tin to brown locally crasheded, unconsolidated, well—sorted, medium— to coarse—crained and, and gravel. That game in shape from in ular to round. Deposited in a small placial lake formed where southward dvancing the impinged upon the northern flank of the farnet Range blocking the northward lowing ancestral Pearson resk (see Thomberlain Jountain quadrangle)

## TILL OF PINEDALE GLACIATION (UPPER PLEISTOCENE)

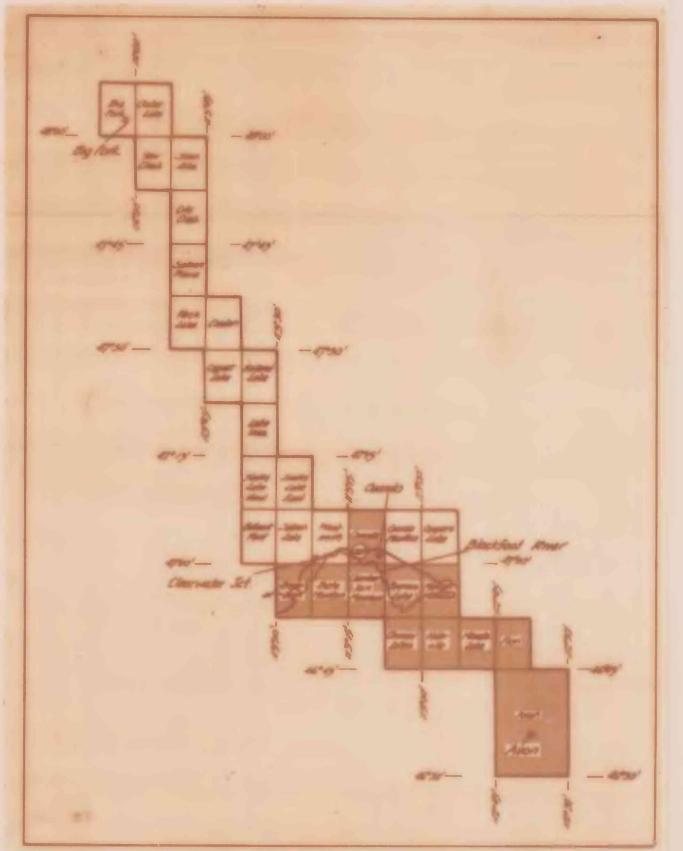
- Till Deposited by Younger Ice-Characterized by a striking knob-and-kettle topogrammy with many lakes and swamps.

  Consists of a betargeneous a semblage of unsorted gravel, cobbles, and boulders in a light reddish-brown to tan silty to clave matrix. Any large boulders are cattered across both the lateral and ground morning, and the terminal moraine near Kleinschmidt Lake; locally parts of the moraine surface slope as such as 65 percent. Clasts range in shape from angular to well rounded, and are predominantly quartities, arguillites, and lime tones of the belt Supergroup. Soil drainage and permeability is variable, but generally is poor
- Till Deposited by Older lee heracterized by somewhat subdued knob-and-kettle topography. Consists of a heteroleneous assemblage of ravel, cobbles, and boulders in a red ish-brown, dense, ranular, calcareous, clayey to silty, locally and matrix. Generally less than 15 percent of the till is ravel size or larger. Sparse boulders are cattered cross both the lateral and ground moraines; surface slopes are commonly less than 25 percent. Clast range in hape from angular to well rounded, and are predominantly quartities, raillities, and limestons of the Belt Subergroup. Soil drainage and perme bility lenerally is poor
- obl

  Outwash OF BULL LAKE(?) ICE (PLEISTOCENE)--Brown and reddish
  brown; unconsolidated, mildly calcareous, well-bedded and
  moder tely well sorted silt, and, gr vel, and cobbles.

  Forms even-sericed, ently sloping, highly dissected
  remants which are about 12 m (40 ft) above the outwash of
  the older ice. Soil drainage is moderate to good
  - formless, sently undulating deposit of low relief characterized by parse kettle depressions, and a few boulder scattered cross the surface. Consists of an unconsolidated, uncorted as emplage of sand, gravel, cobbles, and boulders in a brown to reddish-brown, cobbles, and boulders, 3-4 m (10-13 ft) cross, are scattered through the till; they are specially common near Nin mile Prairie (see free nough quadrangle). Clay contint is higher and this till consequently is more susceptible to mass movement than the younger tills. Where de-ply dissected yields a continuous ruble venerally.

- PIECONT ALLUVILI (OUATERNARY AND TERTIARY) -- Reddin brown and tan: unconsolidated, moderately well surted, stratified silty and and silt, and, and gravel which mantle broad, mo the surficed benches that flink the mountains in the Helmville-Avon area. Deposits thin basin and, and typically are courser-grained nor the mountains. Overlies truncated pre-Tertiary and ertiary edimentary and volcanic rocks, and is expented by modern stream valleys and allies. Locally the upper part of the deposit is a kly cemented by calcium arbanate. Soundness and durability of the gravel is quite variable but typically is poor if the ravels contain high percentages of volcanic rock types. To see deposits rich in volcanic rock types are sost common in his as which are adjacent to extensive outcrops of volcanic rocks.
- ASIN DEPOSITS, UNUIVIDED (TENTIARY)—Brown arayish brown, and vellowish brown; secionsolidated to consolidated clays, shales, siltstone, and sandstones with attor amounts of conslowerate. Also included are white, ray, brown, vellowish brown, and red beds of altered columns at, and ash—rich shale and siltstone. Competence is fir to cond in the brown siltstone and analyticals but poor in the light—column shale, clays, and ash beds. "Popular" surface on the shales, clays, and ash beds "Popular" surface on the shales, clays, and ash beds indicate high—swell potential. Soil drainage is fir to correct any localities this unit underlies till, outwest, or alluvium and restricts and controls the lownward and lateral migration of the local ground ward.
  - VOLCANIC ROCKS, UNDIVIDED (TEXTIANT) -- Small outcrops of trachyte, and site, lamprophyre, and extrusive volcanic breccia are in the estern part of the grant or Cronnuch (see Cronnuch quadrantle). The sive healt and amounts of travelite, darite, volcanic breccia, and minor amounts of travelite, darite, diorite, abbro, lat te, and welded the grant the eastern part of the area near Helmville and Avon (see Helmville and Avon quadrantles). The volcanic breccia are clay rich and very susceptible to many movement
- Consists of the intrusive (arnet stock and other smaller igneous hodies. Cenerally shows well-developed blocky jointing; we there to sheroidal boulders. Cold minerals are in quartz veins that fill fracture in the quartz monzonite in zone within about half mile of the surrounding marble and limestone country rock
- TKi ACIDIC AND INTERMEDIATE INTRUSIVE ROCKS (TERTIARY AND CRETACEOUS) -- Includes small intrusive inner bodies ranging in composition from quartz monomite to dacite
- KJu CRETACEOUS AND JURASSIC BERROCK, UNDIVIDED-Folded and faulted outcrops of (in descending order) the Cretaceous Blackleaf and Kootenai Formations and the Jurassic Swift, Rierdon, and Sawtooth Formations
- PMM PERMIAN TO NISSISSIPPIAN BEDROCK, UNDIVIDED--Folded and faulted outcrops of the Phosphoria and Quadrant Formation, and the Madison Group. Locally some limestons and dolomite beds of the Jefferson Formation (Devonian) may be included with the Madison Group
- Gu CAMBRIAN STRATA, UNDIVIDED-Folded, faulted and locally intruded and metamorphosed outrops of the (in descending order) Ha mark and Silver Hill Formations and Flathe douartzite. Near the Carnet stock the limestones of the Hamark(?) and Silver Hills Formations have been metamorphosed to marble
- PSD BELT SUPERCROUP ROCKS, UNDIVIDED (PRECAMBRIAN -- consists of various units of the Belt Super roup, chiefly the Hount Shields (ar illite and sandstone), Shepard (ar illite and dolomite), and Snowslip (ar illite and sandstone) Formations in the northern part of the are and the quartzite and claystone of Black Mountain, Bonner Quartzite and the Mount Shields, Shepard, and Snowslip (calcareous midstone and quartzite) Formations in the southern part of the area



Index map showing quadrangles in the Big Fork-Avon area. Those quadrangles in Open-File Reports 79-437 to 79-447 are shaded.