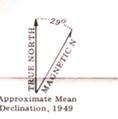


Base from U.S. Geological Survey, Healy A-1, 1949;
B-1, 1950, Quadrangles, Alaska.



Bedrock geology by T.E. Smith, 1968-71, assisted
by S.R. Bruff, 1968; S.W. Iovese, 1969; and G.L.
Kline, 1971. Surficial geology generalized from un-
pub. maps by D.M. Hopkins, R. Kachadoorian, and
D.R. Nichols. USGS. Isotope geochronology by M.A.
Lanphere and D.L. Turner. Cartography by L.C. Schell



CORRELATION OF MAP UNITS

SURFICIAL DEPOSITS

- Qaf, Qas, Qm, Qr, Qs, Qv, Qw, Qx, Qy, Qz
- Quaternary: Holocene and Pleistocene

METAMORPHIC ROCKS

- Kgn, Ks, Kp
- Cretaceous: Late Cretaceous Age or Metamorphism

SEDIMENTARY AND VOLCANIC ROCKS

- TRab, TRas, TRas, TRab
- Jurassic to Paleozoic(?)
- Triassic: Middle and Late Triassic

CALC-ALKALINE AND OTHER GRANITOIDAL ROCKS

- TKgd, TKad, Ks
- Tertiary(?) Cretaceous: Late Cretaceous

ALKALI GABBRO

- TRab
- Jurassic: Late Jurassic

DESCRIPTION OF MAP UNITS

ALLUVIAL AND PALUDAL DEPOSITS

- Qaf: ALLUVIAL FANS—Poorly consolidated gravels and sands ranging from coarse bouldery gravel at apex of fans to sand and silt at toes of larger fans. Some have varying amounts of intermixed wood and peaty material.
- Qas: ALLUVIAL PLAINS—Bedded and sorted stream deposits varying from clean medium gravel near glaciers or in high valleys to silt in large river drainages.
- Qs: SWAMP DEPOSITS—Accumulations of silt and sand in areas of poor drainage with large amounts of intermixed vegetative matter. Periodically covered by standing water. Away from rivers, swamps are probably drained lake basins.

GLACIAL DEPOSITS AND ROCK GLACIERS

- Qr: ROCK GLACIERS—Lobe, tongue-shaped, and spatulate accumulations of shattered bedrock rubble with varying amounts of interstitial silt and ice. Restricted to cirques and protected mountain valleys. A few are presently active.
- Qm: MORAINAL DEPOSITS—Lateral, medial, and end moraines with generally sharp topographic forms along valley sides or bottoms. Mostly composed of coarse rubble till except in larger valleys, where till is sandy or silty matrix.
- Qs: GROUND MORAINAL COMPLEX—Till and subordinate water-laid material. Irregular to subdued topography. Locally channelled or pitted. Includes some kames and sharply crested eskers.
- Qv: OUTWASH DEPOSITS—Sorted and bedded sands and gravels lying generally in front of corral moraines. Some were deposited on ice (since melted), destroying or deforming bedding or forming pitted deposits.
- Qw: ICE-CONTACT DEPOSITS—Coarse alluvium deposited in channels inset into moraine material, formed against receding ice sheet in lowlands south of Clearwater Mountains.

METAMORPHIC ROCKS

- Kgn: GNEISS AND HIGH-GRADE SCHIST—Layered pelitic gneiss and schist with abundant kyanite, staurolite, and sillimanite. Subordinate migmatitic and augen gneiss near larger intrusions. Includes local mafic and calc-magnesian horizons. K-Ar age of amphibolite at locality 2 is 66.2 m.y. (hornblende). Unit is generally less gneissic in northernmost exposures. Retrograde micro-textures widely developed.
- Ks: SCHIST—Pelitic semischist and schist of brownish hue forming gradational unit in biotite and almandine zones of regional metamorphic succession. Local calc-magnesian interlaminae. Helictic and spiral microtextures present in amphiboles and garnets. K-Ar age of schist at locality 3 is 57.2 m.y. (biotite).
- Kp: SPOTTED PHYLLITE—Medium- to dark-gray foliated rocks with planar compositional laminations. Spotting due to porphyroblastic biotite in random orientations, or less commonly to knots of amphibole or garnet. Numerous rotational microtextures. K-Ar age of actinolitic hornblende from amphibolite horizon at locality 1 is 64.1 m.y.

SEDIMENTARY AND VOLCANIC ROCKS

- TRab: ARGILLITE—Black to olive-gray argillite, siltstone, and graywacke constituting parent sediments from which pelitic metamorphite was developed. Mainly massive though commonly laminated, showing cyclic grading, festooned cross bedding, and load casts. Minor strata of intraformational conglomerate and dark carbonaceous limestone or calcareous siltstone. Northern part of unit grades into slate and phyllite. Heavily stippled zones are marker beds of massive graywacke. Unit may include minor Late Jurassic and Early Cretaceous strata of equivalent composition.
- TRas: Predominantly metabasalt with associated volcanoclastic sedimentary rocks and argillite.
- TRab: Grayish-green volcanoclastic sedimentary rocks and metamorphosed equivalents; locally contains intraclasts of black carbonaceous argillite. Includes subordinate flow rocks.
- TRab: CONGLOMERATE—Wedgelike unit of cobble and boulder conglomerate with polymictic matrix. Well-rounded hematite-coated clasts include basalt, diorite, and graywacke. Matrix now largely recrystallized to chlorite, epidote, and prehnite-bearing aggregate.

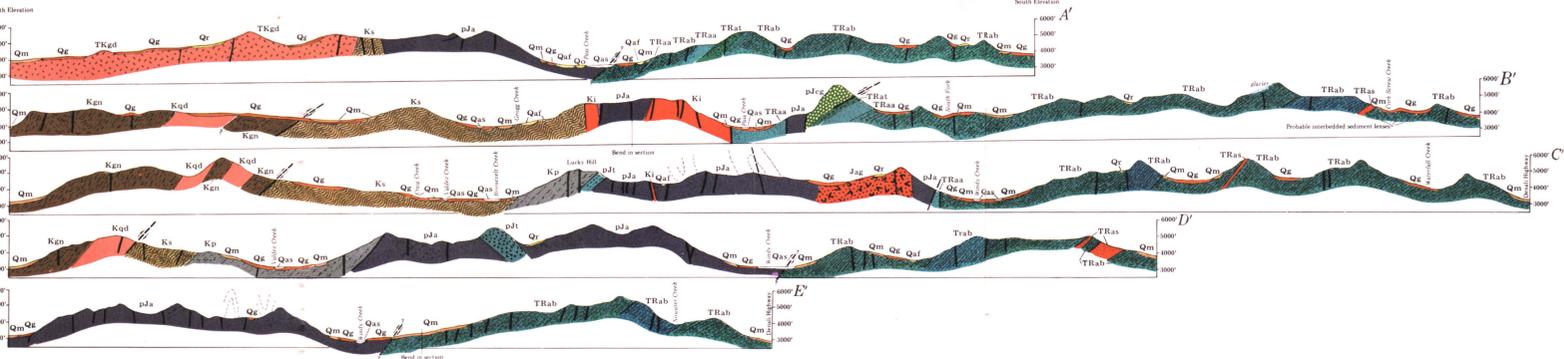
AMPHITHEATRE GROUP

- TRab: Grayish-green and grayish-red basalt and basaltic andesite. Weakly metamorphosed. Flow thickness varies from inches to about 100 feet. Chemically similar to island-arc tholeiites. Mainly subaerial and submarine. Numerous pillowed horizons. Northern part of unit abundantly amygdaloidal. Amygdaloid minerals are quartz, chlorite, calcite, epidote, prehnite, and pumpellyite. Unit locally includes dikes and sills of similar composition, e.g., in Raft Creek drainage.
- TRab: Area of bold overprint underlain by thickly bedded greenish flows with numerous exposures of columnar jointing and pillows. Dotted lines within unit indicate traces of bedded flows. This unit and underlying rocks may be as old as upper Paleozoic.
- TRab: Clayey and silty lenses and interbeds of microsparite that are locally carbonaceous, laminated, or fossiliferous. In areas of greater deformation they have been transformed to calc-phyllite or calc-schist. Locality A contains the marine fossils *Halobia cf. H. Superba* and *Tropites sp.* Marbles from locality B contain structures suggestive of scleractinian colonial corals such as *Thamasteria(?)*.

GEOLOGIC MAP SYMBOLS

- Contact—Dashed where approximate or gradational, dotted where concealed, queried where probable or inferred.
- Thrust fault—Dashed where approximately located. Sawtooth on upper plate.
- High-angle fault—Dashed where approximately located or inferred; dotted where concealed. U, upthrown side; D, downthrown side. Arrows indicate relative lateral movement. Bar and ball indicate dip.
- Fold—Showing crestline or troughline and direction of plunge. Dotted where concealed.
- Anticline
- Syncline
- Overturned
- Strike and dip of beds: Inclined, Vertical, Overturned, Crenulated
- Horizontal foliation and bedding
- Strike and dip of foliation—Dip symbol in unconsolidated deposit indicates isolated bedrock outcrop too small to illustrate.
- Vertical
- Crenulated
- Strike and dip of joints
- Inclined arrow indicates lineation
- Mineral prospects and mines showing principal commodity sought. Where numbered, described in text.
- Landing area; unmaintained
- Fossil locality
- Locality A: *Halobia cf. H. Superba* and *Tropites sp.*
- Locality B: Poorly preserved scleractinian corals, i.e., *Thamasteria(?)* and spongiomorphid coelenterates.
- Site of K-Ar age date. Relevant data reported in table below.
- Glacier

| Locality | Sample | Mineral | Unit | K ₂ O (weight percent) | 40Ar/40Arad (moles/g) | 40Ar/40Ar total | Age ± 1σ (m.y.) |
|----------|-----------|------------|------|-----------------------------------|---------------------------|-----------------|-----------------|
| 1 | 68 ASB638 | Hornblende | Kp | 0.310 0.304 x = 0.307 | 2.958 x 10 ⁻¹¹ | 0.85 | 64.1 ± 1.9 |
| 2 | 69AS199 | Hornblende | Kgn | 0.182 0.194 x = 0.188 | 1.872 x 10 ⁻¹¹ | 0.43 | 66.2 ± 2.4 |
| 3 | 69AS1556 | Biotite | Ks | 8.93 | 7.659 x 10 ⁻¹⁰ | 0.73 | 57.2 ± 2 |
| 4 | 69AS137 | Biotite | TKgd | 9.20 | 8.453 x 10 ⁻¹⁰ | 0.86 | 61.2 ± 2 |
| | Do --- | Hornblende | TKgd | 0.835 | 8.332 x 10 ⁻¹⁰ | 0.54 | 66.3 ± 2 |
| 5 | 69AS1252A | Biotite | Jag | 8.62 | 1.707 x 10 ⁻⁹ | 0.93 | 130 ± 4 |
| | 69AS1252 | Hornblende | Jag | 1.055 | 2.313 x 10 ⁻¹⁰ | 0.88 | 143 ± 4 |



GEOLOGIC MAP OF THE WESTERN CLEARWATER MOUNTAINS, CENTRAL ALASKA

by
T. E. Smith
1981