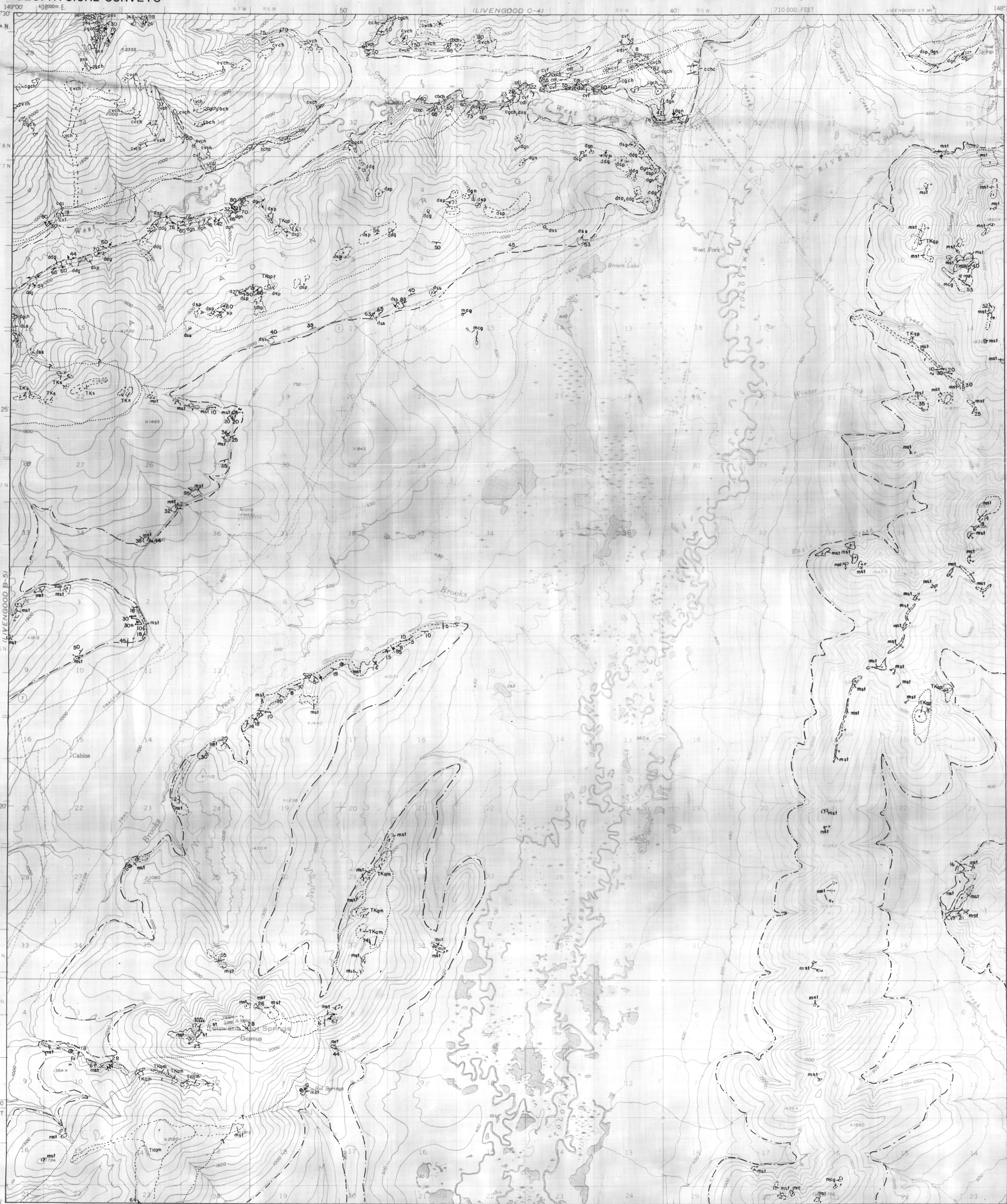
ALASKA DIVISION OF GEOLOGICAL &
GEOPHYSICAL SURVEYS



Base from U.S. Geological Survey Livengood B-4 quadrangle, 1951.

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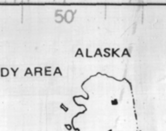


SCALE 1:40,000

CONTOUR INTERVAL 100 FEET

APPROXIMATE MEAN DECLINATION, 1974

Geology by M.D. Albanese, T.E. Smith, M.S. Robinson, T.K. Bundtzen, and G.L. Allegro. With contributions by R.B. Forbes, F.R. Weber, and R.B. Blodgett. Assisted by J. Lindhorst.

Correlation of Rock Units

INTRUSIVES	TKqp, TKs, TKqm	Tertiary or Cretaceous	Mesozoic or Cenozoic
MESOZOIC FLYSCH	mst, mcg	Cretaceous or Jurassic	Mesozoic
DEVONIAN CLASTICS AND MAFIC COMPLEX	dss, dgch; ddg, dgn, dsp	mid-Devonian	Paleozoic
PALEOZOIC CLASTICS AND CHERT TERRANE	pss, pc, pgch	Devonian (?) or Silurian (?)	Paleozoic
CHERT TERRANE	cgch, cbch, cvch; cchc, cvf, cdl	Ordovician to Silurian	Paleozoic

EXPLANATION

INTRUSIVES

TKqp — QUARTZ PORPHYRY---Light-gray, fine- to medium-grained quartz porphyry with relict plagioclase altering to calcite and quartz, anhedral limonitic opaques, and minor muscovite. Groundmass altering to calcite. Weathers to a tannish gray. Generally occurs as small bodies that intrude Mesozoic Flysch sequence along a predominant north-south lineament in the eastern part of the quadrangle.

TKs — QUARTZ SYENITE---Medium-grained, light-gray quartz syenite. Composed mainly of altered potassium feldspar with minor (generally less than 5 percent) plagioclase and quartz, 1 percent pyrite, and abundant limonitic alteration. Intrudes Mesozoic Flysch and Devonian Clastics and Mafic Complex.

TKqm — QUARTZ MONZONITE---Light-gray to pinkish coarse-grained quartz monzonite to monzonite of Tolovana Hot Springs Dome. Contains up to 8 percent biotite, 7 percent blue-green hornblende, and trace tourmaline and pyrite. Potassium feldspar megacrysts up to 5 cm long are present. Intrudes Mesozoic Flysch. Fine-grained latite porphyry border phase occurs in some locations near intrusive contact. Chapman and others (1971) report a biotite K^{40}/Ar^{40} age date of 63.3 ± 2.5 m.y.

MESOZOIC FLYSCH

This unit includes interbedded shale, siltstone, sandstone, and conglomerate. Graded bedding is common. Poorly preserved pelecypods within the conglomerate unit southwest of the study area suggest an Early Cretaceous or possible Jurassic age (Chapman and others, 1971). Poorly preserved plant stems and fragments in the study area have not yielded definitive age dates. Near the Tolovana Dome Hot Springs intrusive contact, the flysch becomes slightly hornfelsed with incipient metamorphic biotite and visible banding up to a few mm thick. The contact of the Mesozoic Flysch with the Devonian Clastics and Mafic Complex is not exposed.

Principal Lithologies

mst — SHALE, SILTSTONE, AND SANDSTONE---Dark- to medium-gray shale and siltstone with predominant cleavage intersecting the bedding at low angles, which suggests possible large-scale isoclinal folding. Sandstone is medium gray to greenish gray, moderately sorted, with subrounded grains of quartz, chert, and minor altered plagioclase, biotite, and chlorite. Shale, siltstone, and sandstone often in repeating graded-bed sequences, with occasional rip-up textures. Flute casts and ripple marks preserved locally.

mcg — CONGLOMERATE---Medium- to dark-gray, poorly sorted conglomerate. Subrounded clasts include dark chert, white quartz, sandstone, siltstone, and hematitic chert. Minor calcite alteration. Pebbles and granules often flattened with local shearing. Fracturing common between clasts. Commonly interbedded with shale, siltstone, and sandstone (mst).

DEVONIAN CLASTICS AND MAFIC COMPLEX

The Devonian Clastics and Mafic Complex includes shales, lithic sandstone, and conglomerates associated with various mafic-igneous rocks. Previously collected megafossils suggested a Middle to Late Devonian age for the clastic sequence (Chapman and others, 1971). Additional mollusk and brachiopod collections suggest a Middle Devonian near-shore subtidal or intertidal(?) depositional environment (R.B. Blodgett, personal commun., 1982).

Clastic rocks are spatially associated with a mafic-ultramafic complex of diorite and gabbro and altered fine-grained basalt (greenstone) containing irregular serpentinite zones. Contacts between the mafic complex and Devonian clastics are poorly exposed and do not reveal definitive relations between the units.

The northern boundary of the Devonian terrane is juxtaposed, possibly by a south-dipping reverse fault, against cherts, basalts, and a thin limestone unit of the pre-Devonian Chert Terrane. Evidence supporting this conclusion includes the abrupt truncation of the Devonian Terrane by the Chert Terrane, the occurrence of extreme shearing, mylonitization, and slickenslide surfaces in two locations along this contact, and the internal structure of the Devonian Terrane, which dips steeply to the south near this contact.

LAYERED ROCKS

Principal Lithologies

dss — SHALE, SILTSTONE, AND SANDSTONE---Shale is medium to dark gray and is commonly interbedded with slightly iron-stained siltstone, which results in an olive-gray coloration. Siltstone and sandstone are well sorted with very fine to coarse-grained, greenish-gray quartz, chert, and plagioclase grains in a cherty matrix. Cyclic graded bedding is common. Contains abundant yellow-brown limonitic alteration. Locally fossiliferous. Gastropods, brachiopods, corals, echinoderms, and plant fragments suggest a late Middle to early Late Devonian age (Chapman and others, 1971).

dgch — GRAY CHERT---Fine-grained, massive to bedded gray chert.

MAFIC COMPLEX

Principal Lithologies

ddg — DIORITE TO GABBRO---Medium-grained, dark-green to dark-gray diorite or gabbro. Mineralogy consists of varying amounts of hornblende, plagioclase, augite, and hypersthene. Locally contains crude layering and possible cumulate textures. Plagioclase grains extensively altered and rocks exhibit slight prehnite-pumpellyite-to greenschist-facies metamorphic overprinting.

dgn — GREENSTONE---Fine-grained, generally more intensely altered variant of diorite-gabbro (ddg) unit.

dsp — SERPENTINITE---Chiefly black to dark-green serpentine-group minerals that occur in random zones or pods in the diorite to gabbro (ddg) and greenstone (dgn) units. Relationships between these rock types uncertain due to their relatively intermixed, random distribution.

PALEOZOIC CLASTICS AND CHERT TERRANE

This terrane consists of shale, calcareous sandstone, conglomerate, and chert that appear to gradationally overlie the Chert Terrane.

Principal Lithologies

pss — SANDSTONE---Medium-dark-gray, fine-grained calcareous sandstone with minor pyrite interbedded with massive, dark-gray argillaceous shale that weathers to red brown. Minor medium-gray recrystallized limestone occurs locally.

pc — CONGLOMERATE---Medium-gray, massive conglomerate. Matrix is a green-gray lithic sandstone that weathers to medium brown. Clasts include angular, deformed shale fragments, chert, quartz, epidote, and felsic rock fragments. Small calcite veinlets and calcareous segregations cut the unit.

pgch — GRAY CHERT---Medium-gray, massive to crudely bedded chert.

CHERT TERRANE

The Chert Terrane is an informal unit that includes the Livengood Dome Chert (Chapman and others, 1979), dolomitic limestone, and a thin layer of amygdaloidal basalt. North of the study area, faunal evidence suggests a Middle Ordovician to Silurian age (Chapman and others, 1979)

cgch — GRAY CHERT---Massive to bedded, medium-gray, highly fractured chert. Beds range from a few cm to 20 cm thick.

cbch — BLACK CHERT---Massive to crudely bedded, highly fractured black chert.

cvch — VARIEGATED CHERT---Mixed tan, gray, white, and black chert with minor red and green varieties. Often crudely bedded.

cchc — CHERT CONGLOMERATE---Limonitic gray chert, shale, and felsite (?) clasts in an iron-stained silica matrix. Secondary carbonate occurs as open-space and fracture fillings.

cvf — AMYGDALOIDAL BASALT---Olive-green, fine- to medium-grained amygdaloidal metabasalt. Local elliptical weathering rinds suggest relict pillows. Relict mafic minerals weather to hematite, resulting in strong red-brown coloration. Secondary calcite and epidote occur as amygdules. Metabasalt appears to be interbedded with dolomite beds (cdl).

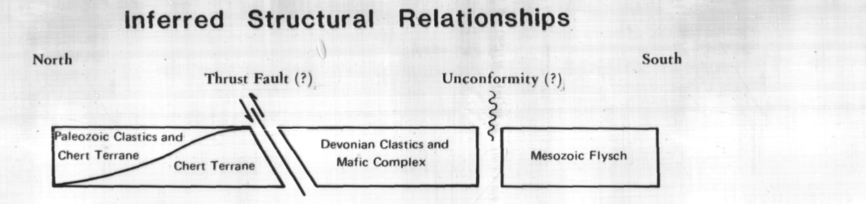
cdl — DOLOMITE---Light-gray, blocky, siliceous dolomite. Locally contains dolomite breccia with dark chert clasts and thin strata-bound layers of chert and chert breccia. Estimated to be 50 ft thick in one location. Poorly preserved invertebrates from a possible extension of this unit (to the north) suggest a Silurian (?) age (Chapman and others, 1971).

REFERENCES CITED

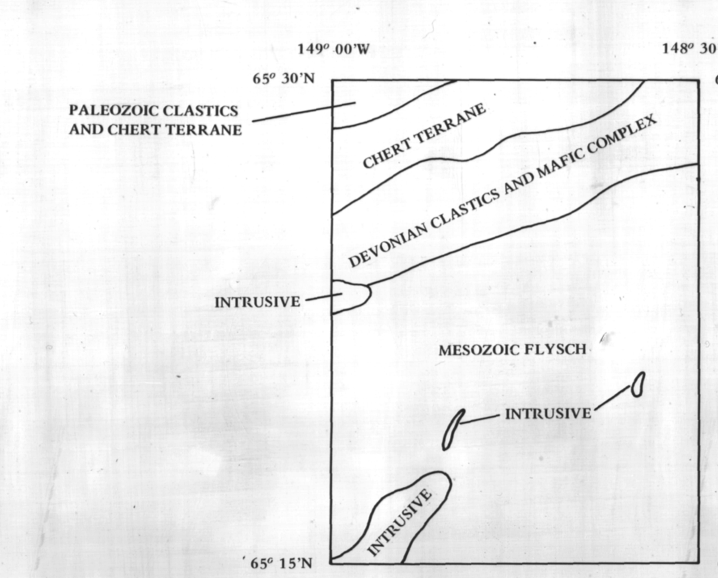
Chapman, R.M., Weber, F.R., and Taber, Bond, 1971, Preliminary geologic map of the Livengood Quadrangle, Alaska: U.S. Geological Survey Open-file Report 71-66 (483), 2 sheets, scale 1:250,000.

Chapman, R.M., Weber, F.R., Churkin, Michael, Jr., and Carter, Claire, 1979, The Livengood Dome Chert, a new Ordivician formation in central Alaska, and its relevance to displacement on the Tintina fault, in Shorter contributions to stratigraphy and structural geology, 1979: U.S. Geological Survey Professional Paper 1126, p. F1-F13.

Inferred Structural Relationships



Distribution of Rock Units



Livengood B-4 Quadrangle

Geologic Map Symbols

- Contact — Solid where known, dashed where approximately located, dotted where concealed or inferred, queried where questionable.
- Fault — Solid where known, dashed where approximately located, dotted where concealed or inferred, queried where questionable.
- Thrust Fault — Solid where known, dashed where approximately located, dotted where concealed or inferred, queried where questionable. Teeth on upper plate.
- 12 — Strike and Dip of Bedding
- 7 — Strike and Dip of Overturned Bedding
- ⊕ — Horizontal Bedding
- 10 — Strike and Dip of Rotated Bedding
- 45 — Strike and Dip of Jointing
- 12 — Strike and Dip of Cleavage
- Anticline
- Trend and plunge of small-scale isoclinal fold axes
- Strike and dip of bedding and the plunge of small-scale fold axes
- Trend and plunge of fold axes
- Approximate limit of outcrop or rubble crop (r)
- Approximate limit of highland area with a thin (?) veneer of surficial cover.
- 2 — Strike and dip of bedding where tops of beds are indicated by primary sedimentary features.

BEDROCK GEOLOGIC MAP OF THE LIVENGOOD B-4 QUADRANGLE, EAST-CENTRAL ALASKA

by
M.D. Albanese

1983