STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

Tony Knowles, *Governor*

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1997

This DGGS Report of Investigations is a final report of scientific research. It has received technical review and may be cited as an agency publication.

Report of Investigations 97-15c
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SURFICIAL GEOLOGIC MAP OF THE TANANA B-1 QUADRANGLE, CENTRAL ALASKA

by
DeAnne S. Pinney[1]

DISCUSSION

Gold was first discovered in the Rampart district by the Schieffelin brothers in the fall of 1882, although it was not until the spring of 1896 that a permanent settlement was established at Rampart and organized placer mining was begun (Mertie, 1934). Placer mining began on Little Minook Creek, and gold was subsequently mined on Hunter, Minook, Little Minook Junior, Hoosier, Slate, and Ruby Creeks. Early studies of the placer geology of the Rampart area by Mertie (1934; 1937) indicated that much of the placer gold from Minook Creek and eastward came from high-level bench gravels of Pliocene (?) age preserved on Idaho, California, and McDonald bars. Mertie (1934) believed that the gold in Ruby and Slate Creeks had a local bedrock source. There is strong evidence that gold in lower Minook Creek and its tributaries is of mixed origin. Fragile, bright gold particles suggestive of a local source are mixed with rounded nuggets that have clearly been transported some distance from their source. Current work utilizing state-of-the-art electron microprobe techniques indicates a complex, multi-source origin for much of the Rampart district placer gold, involving both local and transported components (Clautice, oral commun., 1997).

One of the most striking geomorphic features of the Rampart area is the series of terraces preserved on the northeastern side of lower Minook Creek. Mertie (1934) identified six individual terrace levels, excluding the modern floodplain, of which three are represented on the map. The other three levels appear as poorly developed benches between the two youngest well-developed terraces. The uppermost mapped terrace (QTg), 430 m above Minook Creek, consists of the gold-bearing gravel-capped bedrock benches forming the features known as Idaho, California, and McDonald bars. Although no gravel cap was confirmed on Yukon Bar in the far northeastern part of the map area due to thick cover and poor preservation, this surface probably also correlates with the highest terrace. Early prospect shafts on Idaho Bar showed the gravels to be at least 30 m thick (Mertie, 1934). Mertie (1934; 1937) concluded the deposits are Pliocene(?) in age on the basis of stratigraphic and geomorphic relations with known Tertiary and Pleistocene deposits, and no new evidence has come to light to refine his age designation. The thick, coarse-grained gravels atop these oldest terraces may have been deposited by glacial outwash streams draining the highlands around Elephant Mountain in the southeastern corner of this quadrangle during late Tertiary or early Quaternary time. A younger gravel-capped terrace 150 m above Minook Creek (Qat1) is not known to be auriferous, although geomorphic considerations imply it should be. The third terrace level, approximately 30 m above Minook Creek (Qat2), is thickly mantled by redeposited (and, in some places, primary) eolian silt. This is the principal placer gold-bearing deposit mined in Hunter Creek and has yielded a rich Pleistocene mammalian fauna. Deciduous wood collected from the upper part of the terrace gravel in lower Hunter Creek valley provides a minimum radiocarbon age for the deposits of 10,960±200 yr. B.P. (GX-22411).

I postulate that the terrace sequence of lower Minook Creek may be related to complex movements along Minook Creek and Victoria Creek faults since latest Tertiary time. The southernmost extent of the gravel-capped bars (QTg) is clearly truncated by the trace of the Victoria Creek fault zone, and no gravel has been found atop similar bench-like features west of Minook Creek fault. Reifenstuhl and others (1997) map a series of progressively downthrown blocks between Elephant Mountain and the Yukon River, including a fault-bounded block that contains the terrace deposits. Alluvial deposits are preserved on this relatively downthrown block north of the Victoria Creek fault zone; relatively upthrown surfaces south of the fault are stripped of alluvial cover all the way to the southern drainage divide at Elephant Mountain and probably provided the source for the thick gravel deposits on the terraces. In response to progressively lower base level on the relatively downthrown blocks to the north, downcutting by lower Minook Creek and its northeastern tributaries incised these alluvial deposits and underlying bedrock to form the terraces. Based on the terrace sequence, this fault-bounded block may have undergone at least three, and possibly as many as six, episodes of movement during Pleistocene time. Dating of the individual terrace levels could give a chronology of episodic movement along the faults; unfortunately I found no dateable material except in the youngest terrace (Qat2).

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Traces of multiple and high-level terraces are also present in Garnet Creek valley along the west side of the quadrangle. This valley is strongly asymmetric, with a steep northeast-facing slope and a much more gentle, thickly colluviated southwest-facing slope upon which the terrace remnants are preserved. The distinctive valley morphology is probably the result of colluviation on the southwest-facing slope due to the effects of insolation under periglacial conditions in the past (Washburn, 1973). The terraces may be related to movement (uplift) along the Victoria Creek fault zone and perhaps several other faults mapped in the area by Reifenstuhl and others (1997), the traces of which cut Tertiary and younger deposits. Alternatively, the terraces may simply be the result of progressive incision by Garnet Creek during one or more periods of climatic amelioration.

Cirque-like forms are present on the north side of Baldry Mountain at an elevation of approximately 3,500 ft (1,070 m) and on Elephant Mountain between 2,500 ft (760 m) and 3,700 ft (1,130 m). The lower cirque-like features of Elephant Mountain are only tentatively identified as cirques and may represent an extremely ancient glacial event or may result entirely from nonglacial erosional processes. The Baldry Mountain features are highly modified but are at an elevation more consistent with that of known cirques in the Yukon-Tanana Upland (Péwé and others, 1967; Weber, 1986; Reger and Pinney, 1995). The high-elevation features on the north side of Elephant Mountain are also modified, but retain a more obvious cirque morphology.

Glacial deposits are recognized only in the valleys of the Elephant Mountain cirques that feed into Chapman Creek. The upper reaches of Chapman Creek are outside the map area, but head in highlands to the east that have also clearly been glaciated. On the basis of cirque-floor elevations and the modified and highly vegetated character of the deposits, I suggest that the informally-named Elephant Mountain glaciation correlates with the mid-Pleistocene Mount Harper glacial episode of the Yukon-Tanana Upland described by Weber (1986). Similar deposits have been identified in the Mount Prindle area by Weber and Hamilton (1984) (Little Champion advance) and in the Circle mining district by Reger and Pinney (1995) (Mastodon Dome glaciation). If this correlation is correct, then the older cirques on Baldry and Elephant Mountains likely correlate to the early(?) Pleistocene Charley River glacial episode of Weber (1986).

If Elephant Mountain was high enough to support these later glaciations, it would also have been capable of supporting the possible pre-Pleistocene glaciation that Weber (1986) identified on the Goodpaster River. On the basis of age, lithology, extremely coarse-grained nature, and the likelihood of their gold source to be, at least in part, the plutons of Elephant Mountain mapped by Reifenstuhl and others (1997) (Clautice, oral commun., 1997), I suggest that the gravels of Idaho, California, and McDonald bars (QTg) may have been deposited by ancestral Minook Creek as it drained the glaciated highlands of Elephant Mountain during latest Tertiary time.

DESCRIPTION OF MAP UNITS

ALLUVIAL DEPOSITS

Qaf	Alluvial fan deposits—Fan-shaped, heterogeneous mixtures of gravel with some sand and silt and few to numerous, subangular to rounded boulders, especially in proximal areas; may include debris-flow deposits; thick to thin bedded; surface smooth, except for numerous shallow, interconnected channels
Qal	Alluvium in modern stream channels—Elongate deposits of stratified gravel and sand with few to numerous boulders beneath modern floodplains and associated low terraces; well sorted and medium to thick bedded, locally crossbedded
Qat2	Younger alluvial terrace deposits of lower Hunter, Hoosier, and Minook Creeks—Stratified pebble-cobble gravel and coarse sand forming elevated benches bordering modern floodplains with a maximum tread elevation of approximately 30 m above the modern streams; surface smooth, except for local low scarps; capped by up to 10 m primary and reworked eolian silt containing Pleistocene mammalian remains, including mammoth, sheep, horse and bison in the Hunter Creek area; plant remains and freshwater mollusk shells present in thin peat layers in the silt cap; radiocarbon dating of wood preserved in the gravel and overlying silt indicates the upper alluvial gravels were deposited between 10,960±200 yr. B.P. (GX-22411) and 8,800±160 yr. B.P. (GX-22410); bench gravels are auriferous and are mined in Hunter Creek drainage

Qat1	Older alluvial terrace deposits of lower Minook Creek—Stratified pebble-cobble gravel and medium sand forming elevated benches bordering east side of lower Minook Creek with a maximum tread elevation of approximately 150 m above the present stream; surface smooth; capped by approximately 50 cm primary and reworked eolian silt
Qfo	Old fan deposits of lower Chapman Creek—Fan-shaped, heterogeneous mixture of coarse gravel with some sand and silt and numerous rounded cobbles up to 40 cm in diameter; up to 6 m thick at distal parts and graded to a base level several meters higher than the present stream level; surface thickly vegetated and mostly smooth with some relict stream channels and prominent ridges of cobble-gravel bar deposits aligned parallel to paleochannels
Qfp	Floodplain alluvium bordering modern streams—Elongate deposits of stratified pebble-cobble gravel and medium sand with few to numerous boulders forming modern floodplains and associated low (<3 m) terraces; lower surfaces may be flooded during periods of maximum stream discharge; surface smooth except for local low scarps
Qof	Outwash fan deposits—Fan-shaped, heterogeneous mixtures of washed pebble-cobble gravel with some sand and silt and numerous subangular to rounded boulders deposited by meltwater streams draining the margins of former glaciers; thin to thick bedded, locally crossbedded and contain imbricate clasts; surface generally smooth and gently sloping, except for local low scarps and perched, abandoned paleodrainage channels
QTg	High-level bench gravel—Stratified gravel, sand and silt, possibly of glaciofluvial origin, forming elevated benches in the northeastern part of the map area with a maximum tread elevation of approximately 430 m above the present streams; moderately to well sorted and medium to thick bedded, locally crossbedded; clasts are well rounded and include boulders up to 2 m in diameter; commonly characterized by distinctive bright orange silt and clay filling interstices of tightly packed gravel and granule-pebble matrix; perennially frozen and up to at least 30 m thick (Mertie, 1937); thickly mantled by primary and redeposited eolian silt; surface generally smooth and heavily vegetated; bench gravels are auriferous and extensively prospected, but are not currently being mined

COLLUVIAL DEPOSITS

Qac	Undifferentiated alluvial and colluvial valley-fill deposits—Fan-shaped and elongate heterogeneous mixtures of subangular rock fragments and gravel with some silt and sand deposited in upper stream courses primarily by brief, intense summer stream flow, debris flows, and gelifluction; surface smooth, except for local low scarps and shallow, steep-sided channels. In the lower northwestern part of the map area the unit includes a considerable amount of reworked loess.
Qc	Undifferentiated colluvium—Irregular, heterogeneous blankets, aprons, and fans of angular to subrounded rock fragments, gravel, sand and silt that are left on slopes, slope bases, or high-level surfaces by residual weathering and complex mass-movement processes, including rolling, sliding, flowing, gelifluction, and frost creep; probably perennially frozen; locally washed by meltwater and slope runoff; surface generally reflects configuration of underlying bedrock surface
Qca	Colluvial apron and fan deposits—Apron- and fan-shaped, heterogeneous mixtures of angular rock fragments with trace to some gravel, sand and silt deposited at the bases of steep walls of modern stream valleys; may include or be capped by a considerable amount of redeposited eolian silt; locally washed by meltwater and slope runoff; surface steep to gently sloping
Qcs	Solifluction deposits—Irregular drapes of poorly sorted mixtures of angular rock fragments of local origin, with trace to some sand and silt deposited on the upper slopes of Elephant Mountain primarily by solifluction and gelifluction; probably perennially frozen; surface gently to moderately sloping with prominent scallop-shaped ridges and lobes oriented approximately perpendicular to slope

Qct Talus deposits—Apron- and cone-shaped heterogeneous mixtures of angular rock fragments and trace to some gravel, sand, and silt deposited on steep slopes by snow avalanches, free fall, tumbling, rolling, and sliding; surface steep, slightly irregular, and covered with numerous angular rock fragments

Qls Landslide deposits—Oval to tongue-shaped heterogeneous mixtures of fractured bedrock and pebble-cobble gravel with trace to some sand and silt, deposited by near-surface to deep flowing and sliding due to slope failures in bedrock and unconsolidated surficial deposits; surface slightly irregular

EOLIAN DEPOSITS

Qer Primary and reworked upland silt—Heterogeneous blankets of silt and organic silt originally laid down by eolian processes and subsequently extensively reworked by fluvial and colluvial processes; primary loess deposits occur as blankets of massive silt up to 20 m thick; reworked deposits probably perennially frozen and ice rich; primary deposits dry and generally ice free, but probably perennially frozen; surface smooth to locally gullied

Qes Dune sand deposits—Homogeneous blankets of medium to fine sand in longitudinal dunes deposited by wind along the banks of the Yukon River; surface is partially stabilized by vegetation and forms prominent elongate ridges up to 10 m high parallel to prevailing wind direction

GLACIAL DEPOSITS

Qd Modified drift—Heterogeneous blankets of non-stratified pebble-cobble gravel with some sand and silt and few to numerous subangular to subrounded boulders deposited directly from glacial ice and modified by mass movement; weathering rinds of monzonite clasts up to 3 cm thick; surface smooth and rounded to gently hummocky with scattered rounded monzonite erratics up to 2.5 m in diameter; may be thickly mantled by angular colluvial debris, especially on lower valley walls

LACUSTRINE DEPOSITS

Ql Undifferentiated lacustrine deposits—Arcuate or semicircular deposits of silt, sand and organic silt along margins of local small lakes and filling basins of shallow lakes; generally of thermokarst origin; saturated and locally frozen, locally ice rich; surface horizontal and smooth

MANMADE DEPOSITS

Qh Mine tailings—Water-washed pebble-cobble gravel with trace to some sand reworked by placer mining operations; moderate to well sorted; surface irregular or forming symmetrical ridges and cones

REFERENCES CITED

Mertie, J.B., Jr., 1934, Mineral deposits of the Rampart and Hot Springs districts, Alaska: U.S. Geological Survey Bulletin 844-D, p. 163-226.

Mertie, J.B., Jr., 1937, The Yukon-Tanana region, Alaska: U.S. Geological Survey Bulletin 872, 276 p.

Péwé, T.L., Burbank, L., and Mayo, L.R., 1967, Multiple glaciation of the Yukon-Tanana Upland, Alaska: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-507, 1 sheet, scale 1:500,000.

Reger, R.D., and Pinney, D.S., 1995, Surficial geologic map of the Circle mining district, Alaska; Alaska Division of Geological & Geophysical Surveys Report of Investigations 95-2c, 1 sheet, scale 1:63,360.

Reifenstuhl, R.R., Dover, J.H., Pinney, D.S., Newberry, R.J., Clautice, K.H., Liss, S.A., Blodgett, R.B., Bundtzen, T.K., and Weber, F.R., 1997, Geologic map of the Tanana B-1 Quadrangle, central Alaska: Alaska Division of Geological & Geophysical Surveys Report of Investigations 97-15a, 1 sheet, scale 1:63,360.

Washburn, 1973, Periglacial processes and environments: New York, St. Martin's Press, 320 p.

Weber, F.R., 1986, Glacial geology of the Yukon-Tanana Upland, *in* Hamilton, T.D., Reed, K.M., and Thorson, R.M., eds, Glaciation in Alaska - The geologic record, Anchorage, Alaska Geological Society, p. 79-98.

Weber, F.R., and Hamilton, T.D., 1984, Glacial geology of the Mt. Prindle area, Yukon-Tanana Upland, Alaska: Alaska Division of Geological & Geophysical Surveys Professional Report 86, p. 42-48.