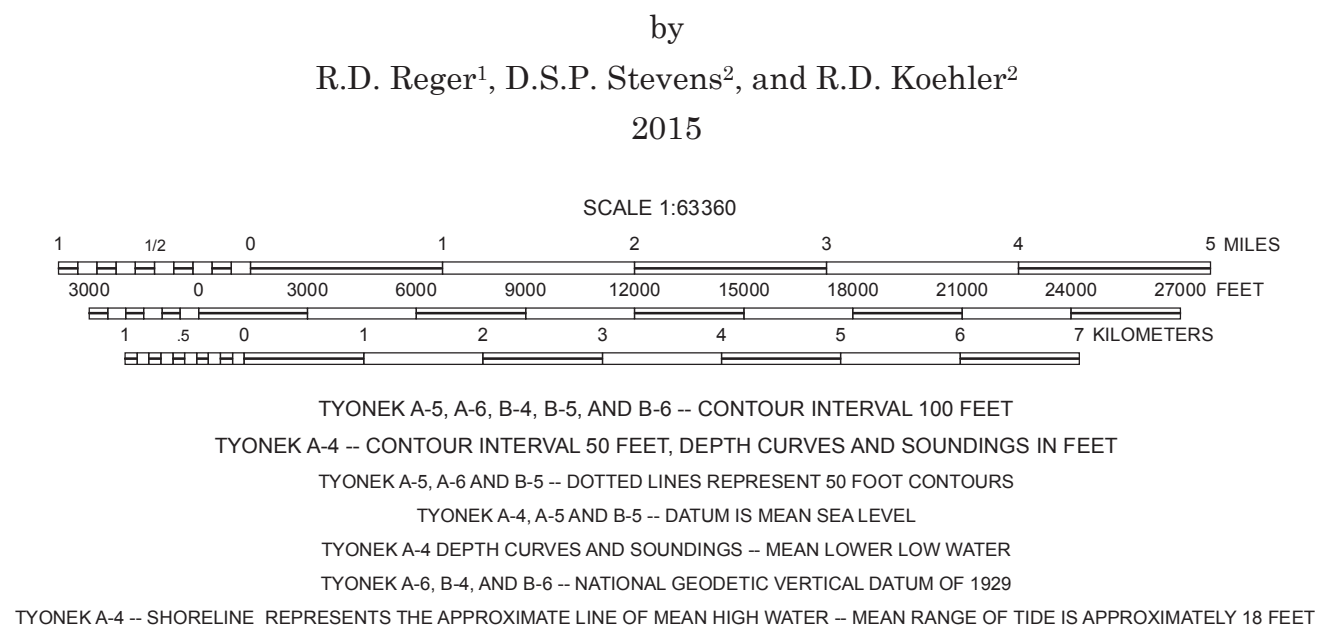


SURFICIAL-GEOLOGIC MAP OF THE TYONEK AREA, COOK INLET, ALASKA



Affiliation:

¹ Reger's Geologic Consulting, P.O. Box 3326, Soldotna, Alaska 99609
² Alaska Division of Geological & Geophysical Surveys, 3354 College Road, Fairbanks, Alaska 99709-2077
³ U.S. Geological Survey, 4210 University Drive, Anchorage, Alaska, 99508

Topographic base map from:
U.S. Geological Survey topographic maps
Tyonek A-4 (1958 - minor revisions 1965)
Tyonek A-5 (1958 - minor revisions 1967)
Tyonek A-6 (1958 - minor revisions 1967)
Tyonek B-4 (1954 - minor revisions 1970)
Tyonek B-5 (1958 - minor revisions 1970)
Tyonek B-6 (1958 - minor revisions 1974)

Projection:
Universal Transverse Mercator Zone 5 North

Datum:
North American Datum of 1927

Geologic field investigations by:
R.D. Reger¹, D.S.P. Stevens², R.D. Koehler³ (2009, 2010)
Geologic interpretation by:
R.D. Reger¹, D.S.P. Stevens², R.D. Koehler³ (2009, 2010)
Airphoto interpretation by:
R.D. Reger¹ (2009, 2010)
Active faults mapped by:
R.D. Koehler³ (2009, 2010)
Geologic GIS data layers created by:
D.S.P. Stevens² (2010, 2011, 2012)

Cartography by:
P.E. Gallagher¹ (2014, 2015)
Cartographic Review by:
M.D. Hendricks¹ (2015)
Editorial review by:
P.K. Davies¹ (2014, 2015)
Peer review by:
T.D. Hubbard¹ (2015)
C.F. Waythomas¹ (2015)

EXPLANATION

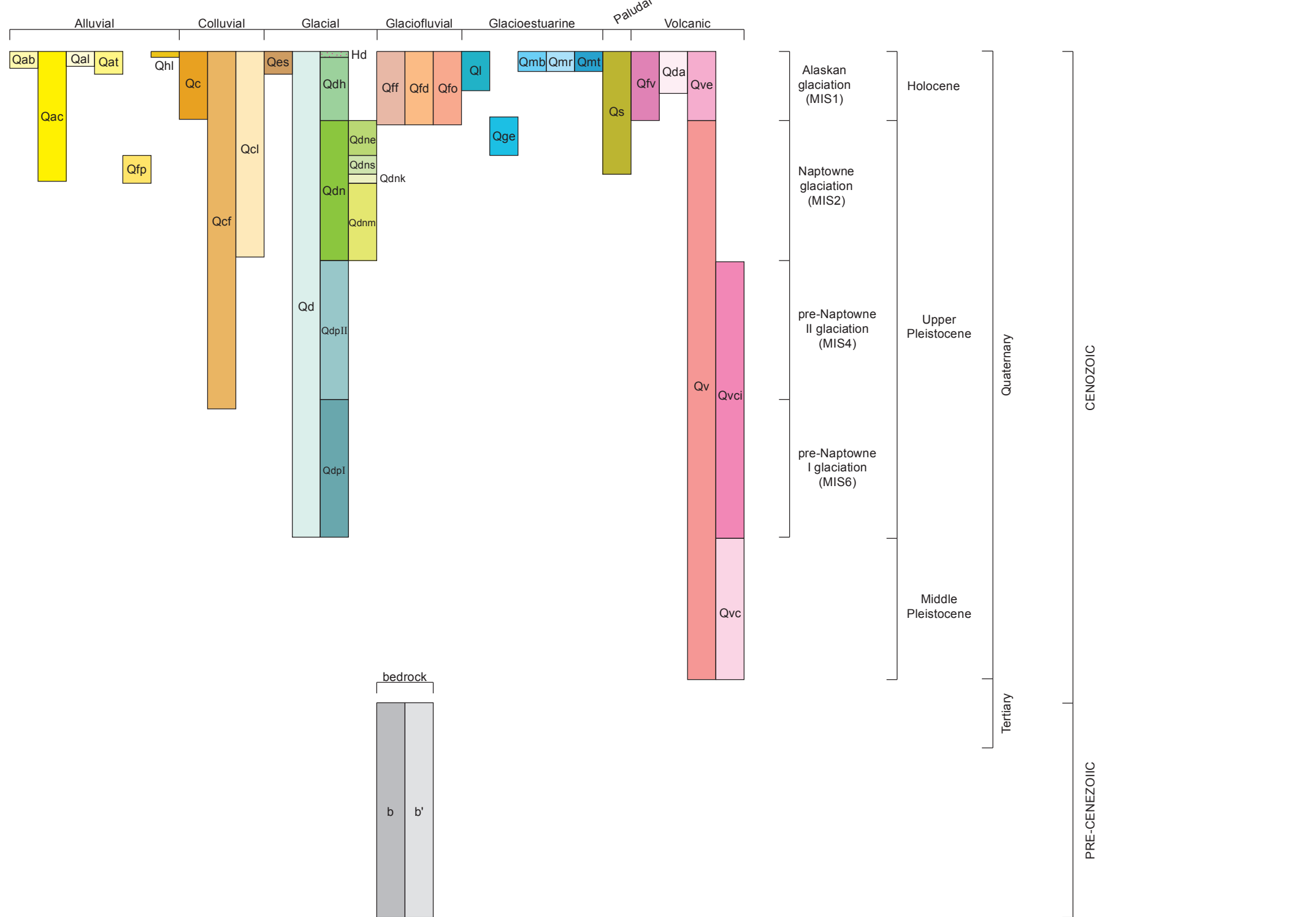
This map shows the distribution of unconsolidated deposits and undifferentiated bedrock exposed at the surface in portions of the Tyonek A-4, A-5, A-6, B-4, B-5, and B-6 quadrangles. Units were mapped by interpretation of ~165,000-scale false-color infrared aerial photographs taken in August 1978. Composite Landsat imagery collected between 1990 and 2003 was used to update glacier extents. Fieldwork was conducted in 2009 and 2010.

Map units shown with a question mark (?), such as "Qcl?", indicate a questionable identification.

DESCRIPTIONS OF MAP UNITS

- Unconsolidated Deposits**
- ALLUVIAL DEPOSITS**
- Qab** ABANDONED-FLOODPLAIN ALLUVIUM—Alluvium of abandoned floodplain of Chakachata River
- Qac** ABANDONED-CHANNEL ALLUVIUM—Undifferentiated late Pleistocene to Holocene abandoned-channel deposits; includes sand and gravel deposited in channels formed by diversion of the Beluga River along margins of Threemile Creek moraine deposited by massive glacier lobe from lower Sestina River valley and ice-marginal and proglacial outwash related to 730 lake and Nikolai lateral and terminal moraines during Killey stage, granular outwash derived from the Denzlow Lake terminal moraine during the Skikak stage, and sand and gravel deltas deposited in slackwaters of Beluga River jokihlups in lower valleys of Scarp and Bishop creeks; overlies varved clays near confluences of Bishop and Scarp creeks with Beluga River
- Qal** UNDIFFERENTIATED ALLUVIUM—Alluvium of active, inactive, and abandoned floodplains; well-sorted and well-stratified polyimetic pebble gravel, sand, and silt comprising channel and overbank deposits of major drainages; includes labar deposits in upper Chakachata River drainage
- Qat** STREAM TERRACE ALLUVIUM—Alluvium of stream terraces; massive to well-sorted, polyimetic pebble gravel with some sand and scattered to numerous subrounded to subangular cobbles and boulders; no longer subject to flooding; includes labar deposits and alluvium of jokihlups in upper Chakachata River drainage and jokihlup deposits in Beluga River drainage
- Qcp** FAN GRAVELS—Granular fans of Killey and Skikak stages near Tyonek and lower Beluga River that are pitted by numerous kettle lakes resulting from fan deposition over stagnant ice related to Threemile Creek moraine; Tyonek outwash fan composed chiefly of sandy pebble thin beds scattered by boulders; no longer subject to flooding; includes labar deposits and alluvium of jokihlups in upper Chakachata River drainage and jokihlup deposits in Beluga River drainage
- Qcl** LAHAR DEPOSITS—Lahar deposits of middle to late Holocene age, including poorly sorted, nonstratified, bouldery gravel with sand and silt matrix and volcanic blocks up to 10 m diameter proximal to Mt. Spurr volcanic complex; transformed into fine-grained labar-rimmed deposits along Chakachata River and Straight Creek (Meyer and Traubert, 1955; Waythomas, 2001, 2007; Waythomas and Nye, 2002)
- Colluvial Deposits**
- Qc** UNDIFFERENTIATED COLLUVIUM—Blankets, aprons, cones, and fans of heterogeneously mixed angular to subangular rock fragments, gravel, sand, and silt deposited by complex, gravity-driven mass movements involving sliding, flowing, and fast creep of weathered bedrock and modified glacial drift; cobbles and boulders are scattered to numerous; on lower benchwalls of cirques and upper walls of glaciated valleys includes talus cones, incipient rock glaciers, and steep fans built by rockfalls and snow avalanches
- Qcd** MIXED COLLUVIUM AND ALLUVIUM—Primarily fan-shaped or elongate, massive to poorly stratified, generally inorganic silt mixed with sandy, angular to subangular pebble gravels derived from weathering of Tertiary bedrock and laid down by debris-flow deposits and torrential water flows during brief, intense storms; colluviation-alluviation
- Qcl** LANDSLIDE DEPOSITS—Massive, extensive slides and flows produced by widespread, retrogressive failures of Tertiary sedimentary bedrock, composed of large blocks of Tyonek Formation mixed with glacial and colluvial diamictites; surface features include sag ponds, prominent marginal scarps, wrinkle ridges, rotated slump blocks and sharp, multilobe toes associated with terminal ridges
- Eolian Deposits**
- Qes** DUNE SAND—Dune sand on low terrace of McArthur River
- Glacial Deposits**
- Undifferentiated**
- Qgl** UNDIFFERENTIATED GLACIAL DRIFT—Heterogeneous, nonstratified, polyimetic pebble-cobble gravel with some sand and silt and few to numerous subangular to subrounded boulders deposited by glacial ice and locally reworked by meltwater washing and associated mass-movement processes; forms thick deposits on lower bedrock walls of glaciated valleys; kettle fillings of interlayered peat, sand, and silt may be several meters thick
- Alaskan Glaciation**
- Qhd** MODERN DRIFT—Drift of very recent age; mapped in areas where satellite imagery shows that glacier ice has retreated since 1978 aerial photography
- Qsh** HOLOCENE DRIFT—Drift of Alaskan glaciation, including 430 lake, Chichaneta River, 353 lake, and Straight Creek moraines; shows evidence of presence or former presence of glacier ice, such as ice-stagnation terrain with kettle lakes and ice-cored moraines; typically buried by or incorporates debris-avalanche deposits and lahars near Mt. Spurr; includes rockfall and snow-avalanche deposits in steep terrain
- Naptoevic Glaciation**
- Qdn** DRIFT OF NAPTOEVIC GLACIATION—Undifferentiated moraine deposits of Naptoevic glaciation of late Wisconsin (MIS 2) age
- Qdm** DRIFT OF ELMENDORF STAGE—Moraine deposits of Elmendorf stage of Naptoevic glaciation, including Carlson Lake moraine (table 1)
- Qdl** DRIFT OF SKIKAK STAGE—Moraine deposits of Skikak stage of Naptoevic glaciation, including Congahubus Lake and Denzlow Lake moraines of Schmol and Yehle (1987) (table 1)
- Qdlr** DRIFT OF KILLEY STAGE—Moraine deposits of Killey stage of Naptoevic glaciation, including Nikolai, 730 lake, and Threemile Creek moraines of Schmol and Yehle (1987) (table 1)
- Qdmr** DRIFT OF MOOSEHORN STAGE—Moraine deposits of Moosehorn stage of Naptoevic glaciation, including 1055 and 810 lakes moraines of Schmol and Yehle (1987) (table 1)
- Pre-Naptoevic Glaciations**
- Qdp** PRE-NAPTOEVIC DRIFT—Deposits of pre-Naptoevic glaciations; moraine remnants and drumlin-like drift ridges modified by slope processes and stream erosion; details of moraine topography obliterated and moraine ridges have round cross profiles; on penultimate Upper Chitina (MIS 4) moraine (Qdp4) deposited by ice from the Cape Glacier corridor, granitic erratics are generally smooth and little weathered; on pre-penultimate moraine deposited by ice from Chakachata-McArthur Embayment, granitic erratics are rough surfaced with feldspar crystals and apatite dikes standing 2–5 mm in relief, have rounded joint junctions, and numerous granitic erratics are broken; no moraine topography remains on pre-penultimate (MIS 6?) Blueberry Hill drift sheet (Qdp6) in Lone Ridge area; on Lone Ridge, Blueberry Hill deposits form very thin and discontinuous cover over bedrock [b(Qdp6)] (table 1)

CORRELATION OF MAP UNITS



GLACIOFLUVIAL DEPOSITS

Qcr EXPANSION-FAN DEPOSITS—Aluvium, debris flows, and lahars of large expansion fan built in the Chakachata-McArthur Embayment by breakout floods caused by breaching of massive debris avalanche that blocked Chakachata River during mid-Holocene (Waythomas, 2001), breaching of smaller late Holocene lahars (Meyer and Traubert, 1955), and episodic outburst of Chakachata Lake, which was dammed by advances of Barrier Glacier; includes the large Beluga expansion fan deposited by Beluga River jokihlups late in the Killey stage.

Qcl DELTA DEPOSITS—Fine-grained prograding delta apron of Chakachata-McArthur River drainage; inorganic silt and clay

Qlo OUTWASH DEPOSITS—Outwash of Alaskan glaciation of Holocene age; massive to well-sorted, polyimetic pebble gravel with some sand; scattered to numerous subrounded to subangular cobble and boulders proximal to former ice limits; in Chakachata River valley includes clay-rich labar deposits related to massive debris avalanche rebounding from mid-Holocene sector collapse of Mt. Spurr (Waythomas, 2007)

LAUSTRINE DEPOSITS

Ql LAKE DEPOSITS—Lake sediments; impounded by massive Chakachata River debris avalanche and Holocene advance of Straight Creek glacier

MARINE DEPOSITS

Qgp GLACIOSTUARINE DEPOSITS—Glaciostuarine sediments in Granite Point area sediments (Kolos sediments of Schmol and others, 1984) correlated with the Bootlegger Cove Formation (Reger, 2009)

Qmb BEACH DEPOSITS—Cobble-pebble gravels and sand

Qmr BEACH-RIDGE DEPOSITS—Complex of gravel ridges separated by fine-grained trough fills

Qmt TIDAL DEPOSITS—Tidal-flat sediments; mostly flocculated clays

PALUDAL DEPOSITS

Qsw SWAMP DEPOSITS—Organic swamp deposits; fibrous and locally woody peat interlayered with thin beds of organic silt, sand, and tephra deposited in lowlands; underlain by Bootlegger Cove Formation beneath coastal plain between Beluga River and Tyonek

VOLCANIC DEPOSITS

Qba VOLCANIC FLOW DRIFT—Fragmental volcanic deposit produced by rock avalanches from Crater Peak (C. Waythomas, 5/22/2015 written comment)

Qda VOLCANIC AVAILANCE DEPOSITS—Debris-avalanche deposit catastrophically emplaced during major mid-Holocene sector collapse on southern flank of Mount Spurr volcanic complex; four recognized facies include (1) blocks, rubble-schlieren, and coarse, angular avalanche debris; (2) altered blocks with little interstitial matrix and outcrop-scale block-against-block texture; (3) a mixed facies of block-cored hummocks surrounded by granular matrix sediments; and (4) poorly sorted, granular, matrix-supported volcanic debris, sand, silt, and clay that grade downvalley into a clay-rich labar deposit (Waythomas, 2001, 2007)

Qv UNDIFFERENTIATED VOLCANIC DEPOSITS—Undifferentiated volcanic deposits and rock of Quaternary age

Qve UNDIFFERENTIATED EOLIAN DEPOSITS—Mixed primary and reworked eolian sand and silt of volcanic composition with thin tephra; surface thought to be channelled by glacial meltwater or snow melt (C. Waythomas, 5/22/2015 written comment)

Qvc VOLCANICASTIC PLATEAU DEPOSITS—Volcaniclastic complex of volcanic plateau consisting of crudely bedded conglomerate to sandy to muddy volcanogenic debris and hyper-concentrated flows (Herritt and others, 2014); upper 1–6 m composed of very coarse sand derived from volcanic cinders reworked by wind, local meltwater, and spring flows and overlain by up to 2 m of loess deposited primarily of Holocene tephra

Qvc VOLCANICASTIC PLATEAU DEPOSITS OVERLIES BY ICE—Volcaniclastic deposits of Quaternary volcanic plateau that has been overridden by glacial ice

Bedrock Deposits

b UNDIFFERENTIATED BEDROCK—Exposed undifferentiated bedrock

b' THINLY COVERED BEDROCK—Undifferentiated bedrock overlain by thin, probably discontinuous cover of colluvium and glacial drift

EXPLANATION OF MAP SYMBOLS

--- CONTACT—Identity and existence certain; location approximate

--- FAULT—Identity and existence certain; location approximate

• RADIOCARBON AGE DATE SAMPLE LOCALITY—Showing sample identification (table 1)

o BOREHOLE LOCALITY—Showing station identification

▲ GLACIAL ERRATIC

REFERENCES CITED

Herritt, T.M., Nye, C.J., Reger, R.D., Wartes, M.A., LePain, D.L., and Gillis, R.J., 2014, Geologic context, age constraints, and sedimentology of a Pleistocene volcanoclastic succession near Mount Spurr volcano, south-central Alaska: Alaska Division of Geological & Geophysical Surveys Report of Investigation 2014-2, 35 p. doi:10.14509/2014.02.01

Meyer, D.E., and Traubert, D.C., 1955, Lahars from the 1952 eruptions of Crater Peak, Mount Spurr Volcano, Alaska, in Keith, T.E.C., ed., The 1952 eruptions of Crater Peak vent, Mount Spurr Volcano, Alaska: U.S. Geological Survey Bulletin 2135 p. 183–198

Reger, R.D., 2009, Reinterpretation of the Kolos deposits near Granite Point, northwestern Cook Inlet, Alaska: Alaska Division of Geological & Geophysical Surveys Preliminary Interpretive Report 2009-2, 8 p. doi:10.14509/182.11

Schmol, H.R., and Yehle, L.A., 1987, Surficial geologic map of the northwestern quarter of the Tyonek A-4 Quadrangle, south-central Alaska: U.S. Geological Survey Miscellaneous Field Studies Map MF-1934, 1 sheet, scale 1:31,680

Waythomas, C.F., 2001, Formation and failure of volcanic debris dams in the Chakachata River valley associated with eruptions of the Spurr volcanic complex, Alaska: Geomorphology, v. 39, p. 111–129

Waythomas, C.F., 2007, Mid-Holocene sector collapse at Mount Spurr volcano, south-central Alaska, in Studies by the U.S. Geological Survey in Alaska, 2006: U.S. Geological Survey Professional Paper 1739-C, v. 1, 13 p.

Waythomas, C.F., and Nye, C.J., 2002, Preliminary volcano-hazard assessment for Mount Spurr volcano, Alaska: U. S. Geological Survey Open-File Report 01-182, 39 p.

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