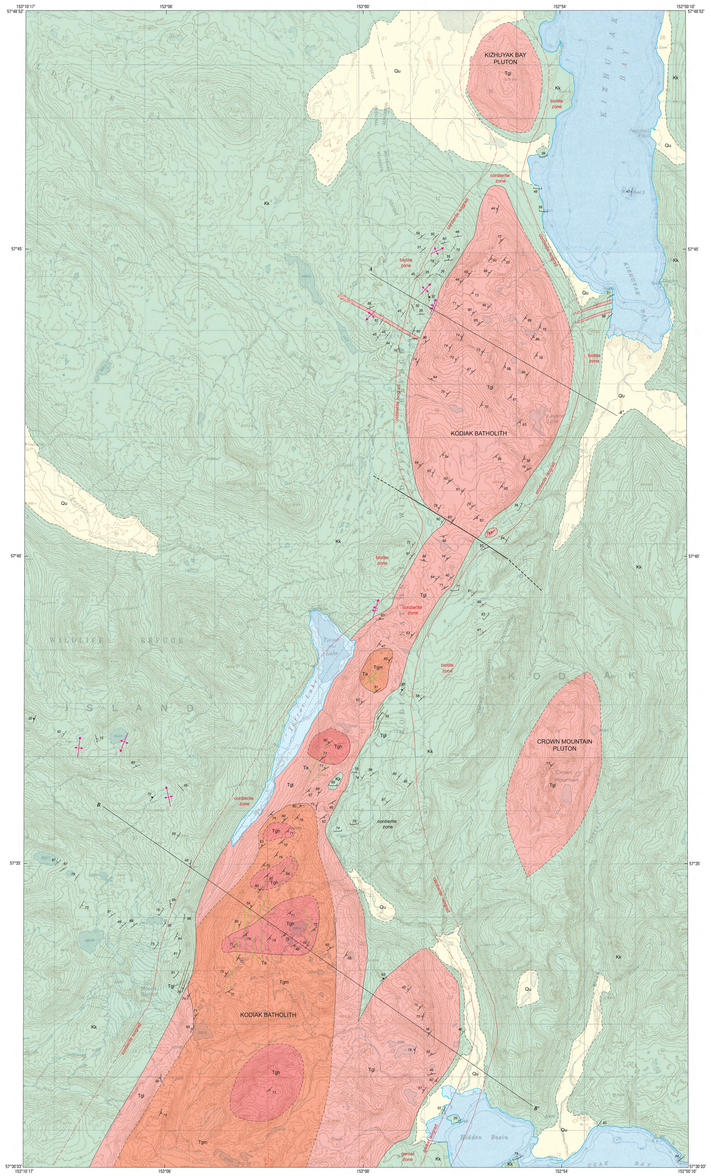
U.S. Department of the Interior
U.S. Geological Survey

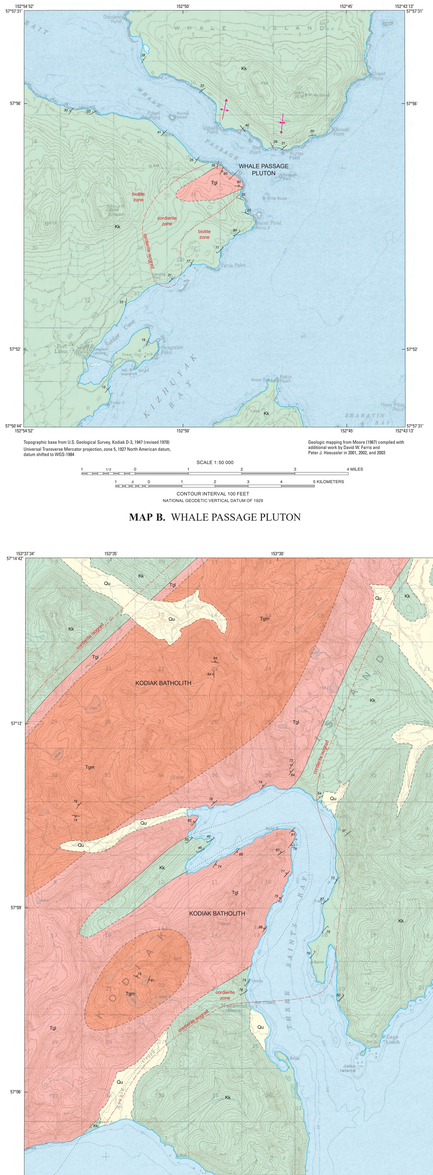
Scientific Investigations Map 3441
Pamphlet accompanies map



Topographic base from U.S. Geological Survey, Kodiak C-3, C-4, D-3, and D-4 1947 (revised 1978)
Universal Transverse Mercator projection, zone 5, 1927 North American datum, datum shifted to WGS-1984

Geologic mapping from Moore (1967) and Moore and others (1983), compiled with additional work by David W. Farris and Peter J. Haeussler in 2001, 2002, and 2003
Manuscript approved for publication September 23, 2019

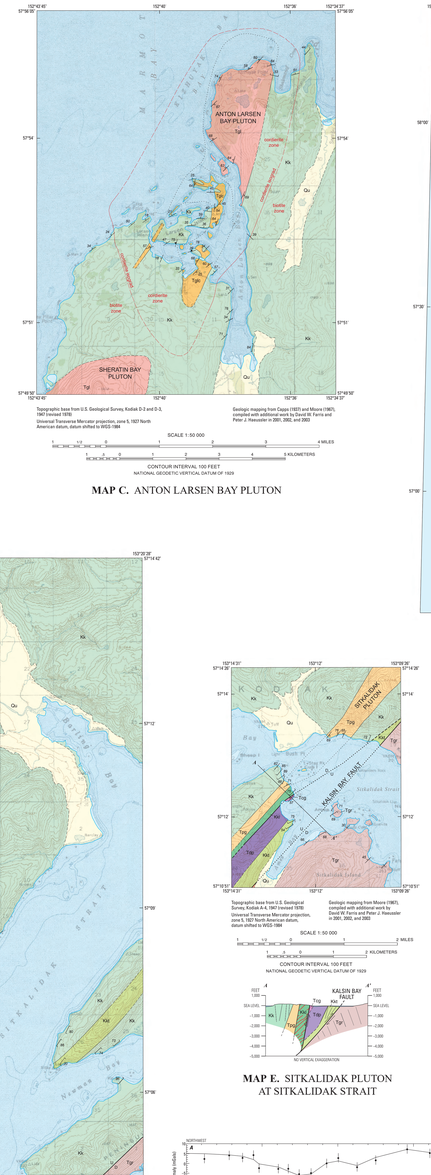
MAP A. KODIAK BATHOLITH NEAR TERROR LAKE



Topographic base from U.S. Geological Survey, Kodiak D-2 and D-3, 1947 (revised 1978)
Universal Transverse Mercator projection, zone 5, 1927 North American datum, datum shifted to WGS-1984

Geologic mapping from Moore (1967) compiled with additional work by David W. Farris and Peter J. Haeussler in 2001, 2002, and 2003

MAP B. WHALE PASSAGE PLUTON



Topographic base from U.S. Geological Survey, Kodiak D-2 and D-3, 1947 (revised 1978)
Universal Transverse Mercator projection, zone 5, 1927 North American datum, datum shifted to WGS-1984

Geologic mapping from Capps (1927) and Moore (1967), compiled with additional work by David W. Farris and Peter J. Haeussler in 2001, 2002, and 2003

MAP C. ANTON LARSEN BAY PLUTON

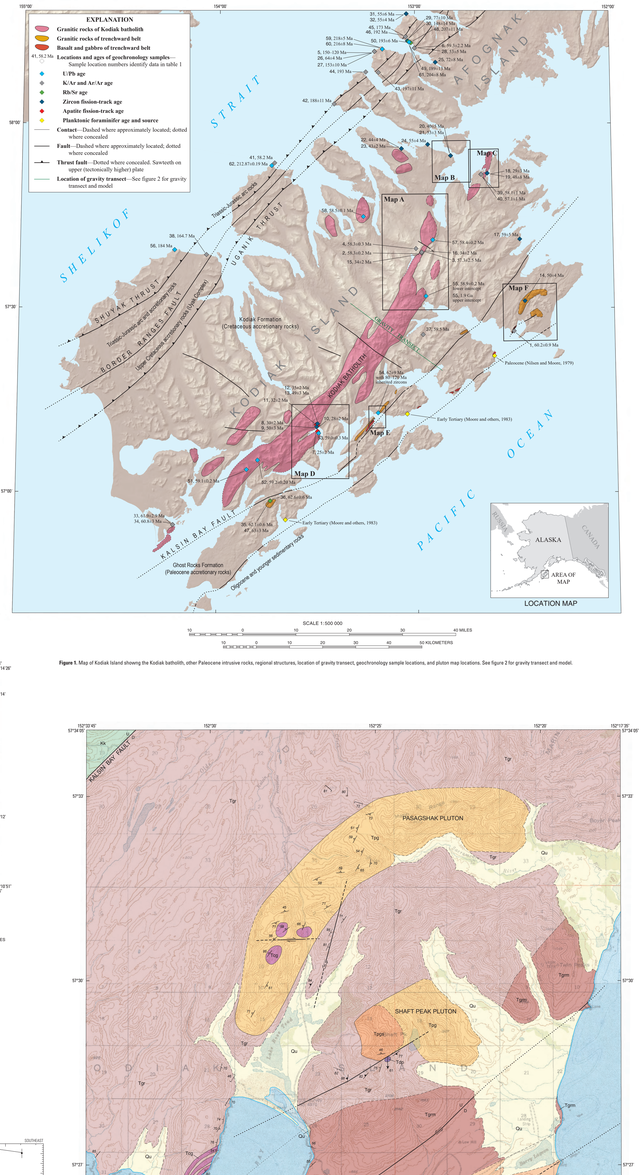
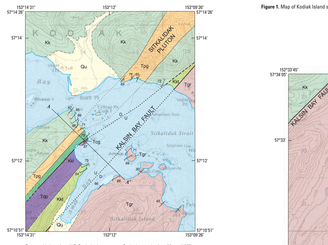
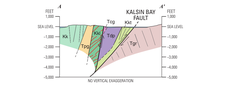


Figure 1. Map of Kodiak Island showing the Kodiak batholith, other Paleocene intrusive rocks, regional structures, location of gravity transect, geochronology sample locations, and pluton map locations. See figure 2 for gravity transect and model.



Topographic base from U.S. Geological Survey, Kodiak A-4, 1947 (revised 1978)
Universal Transverse Mercator projection, zone 5, 1927 North American datum, datum shifted to WGS-1984

Geologic mapping from Moore (1967), compiled with additional work by David W. Farris and Peter J. Haeussler in 2001, 2002, and 2003



MAP E. SITKALIDAK PLUTON AT SITKALIDAK STRAIT

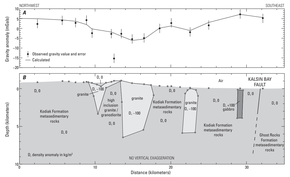


Figure 2. Gravity transect (*A*) and gravity model (*B*) across the Kodiak batholith (see fig. 1 for transect location). This model indicates that the Kodiak batholith is vertically extensive and extends downward for a minimum of 8 km. Densities are constrained by density measurements of the Kodiak batholith and surrounding rocks. Modified from Farris and others (2006).

Topographic base from U.S. Geological Survey, Kodiak A-5, 1947 (revised 1978)
Universal Transverse Mercator projection, zone 5, 1927 North American datum, datum shifted to WGS-1984

Geologic mapping from Moore (1967) and Moore and others (1983), compiled with additional work by David W. Farris and Peter J. Haeussler in 2001, 2002, and 2003

MAP D. KODIAK BATHOLITH AT THREE SAINTS BAY

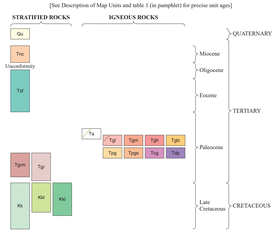
Topographic base from U.S. Geological Survey, Kodiak B-1, C-1, and C-2 1947 (revised 1978)
Universal Transverse Mercator projection, zone 5, 1927 North American datum, datum shifted to WGS-1984

Geologic mapping from Moore (1967) and Fisher and Byrne (1987), compiled with additional work by David W. Farris and Peter J. Haeussler in 2001, 2002, and 2003

MAP F. TRENCHWARD BELT INTRUSIVE ROCKS NEAR PASAGSHAK BAY

CORRELATION OF MAP UNITS

[See Description of Map Units and table 1 (in pamphlet) for precise unit ages]



ABBREVIATED DESCRIPTION OF MAP UNITS

[See Description of Map Units (in pamphlet) for complete unit descriptions]

STRATIFIED ROCKS

Qu **Undivided surficial deposits (Quaternary)**—Unconsolidated sediments dominantly composed of silt, sand, gravel, and glacial till. (Maps A–F)

Tnc **Narrow Cape Formation (Miocene)**—Tan poorly cemented shallow-marine siltstones, sandstones, and conglomerates that contain molluscan fossils and Kodiak batholith granitic cobbles. Bottom of unit contains coarse-grained conglomerate and breccia with clasts as much as 40 cm across derived from the underlying Ghost Rocks Formation. Above basal rocks, finer grained sandstone and siltstone is more common. (Map F)

Tsf **Sitkalidak Formation (Oligocene and Eocene)**—Dark-gray to black argillite and graywacke turbidites. Planar beds typically 10 to 50 cm thick. Thicker graywacke beds often contain argillite rip-up clasts. (Map F)

Ghost Rocks Formation (Paleocene)

Tgm **Mélange**—Mélange zone at south edge of the Ghost Rocks Formation. Rocks range from intensely folded and faulted beds of sandstone and shale to coherent sedimentary beds found only as isolated pinacoidal structures surrounded by shale-dominated mélange. Roofless fold hinges and isoclinal folds common. (Map F)

Tgr **Coherent strata**—Light-gray, highly deformed sandstone and shale. Graywacke beds tend to be coherent with open short-period folds. Soft-sediment deformation prevalent throughout. Shale-rich layers not as common, but typically more deformed and sometimes with mélange texture. Beds are typically 10 to 20 cm thick and as thick as 1 to 2 m. In addition, rocks are intruded by basaltic dikes and small granitic and gabbroic plutons, which range in age from 63 to 60 Ma. (Maps D–F)

Kk **Kodiak Formation (Cretaceous)**—Argillite and graywacke turbidites structurally repeated many times by thrust faults. Beds range from 5- to 10-m-thick massive graywacke to 5- to 10-cm-thick rhythmically bedded argillite. Argillite-rich sections are almost black, whereas the graywacke is dark gray. (Maps A–F)

Kkd **Hostelle**—Sheared homfelsic argillite and graywacke of the Kodiak Formation along the Kalsin Bay Fault. Metamorphic cordierite and biotite present. (Maps D, E)

Kkl **Leucocratic dikes**—Highly disrupted and sheared Kodiak Formation intruded by leucocratic dikes. Unit located between gabbro and granite bodies on Sitkalidak Island. (Maps D, E)

IGNEOUS ROCKS

Kodiak batholith (Paleocene)—Elongate body of biotite granite, granodiorite, and tonalite that extends along the mountainous axis of Kodiak Island. Includes main body and compositionally similar satellite plutons that surround it (map D). This informal unit is further subdivided based on amount of partially assimilated host-rock inclusions. Ranges in age from 59.2±0.2 Ma at the southwest end to 58.4±0.2 Ma at its northeast tip (Farris and others, 2003, 2006)

Ta **Aplite dikes**—White to tan, fine-grained quartz and potassium feldspar aplite dikes, 1 cm to 10 m wide, which intrude high-inclusion unit (Tgb) of Kodiak batholith. (Map A)

Tgl **Low-inclusion unit**—Medium-grained (0.5 to 1 cm) biotite granite and granodiorite containing quartz, potassium feldspar, plagioclase, biotite, and ilmenite. Rocks have low percentage of host-rock inclusions. Sillimanite xenocrysts are rare or absent, unlike medium- and high-inclusion units (Tgn, Tgb). Near pluton margin, muscovite and relatively unaltered host-rock xenoliths are present. (Maps A–D)

Tgn **Medium-inclusion unit**—Biotite-rich granodiorite and tonalite containing as much as 5 to 10 percent partially assimilated host-rock material composed of 1- to 15-cm quartz clots, 1- to 30-cm biotite aggregates, 1- to 10-cm sillimanite xenocrysts, and 5- to 50-cm metamorphosed host-rock xenoliths. Andalusite, kyanite, and garnet xenocrysts also present, but less common than sillimanite. (Maps A, D)

Tgb **High-inclusion unit**—Biotite-rich granodiorite and tonalite containing 10 to 50 percent partially assimilated host-rock material consisting of 1- to 15-cm pure quartz clots, 1- to 30-cm biotite aggregates, 1- to 10-cm sillimanite xenocrysts, and 5- to 50-cm altered host-rock xenoliths. Andalusite, kyanite, and garnet also present. Rocks contain 20 to 40 percent biotite and appear as mixture of highly metamorphosed host-rock fragments and biotite-rich granite. (Map A)

Tgc **Leucocratic muscovite-bearing granite**—Leucocratic muscovite-bearing, biotite-poor granite. Rare garnet. Muscovite concentration increases with proximity to host-rock blocks. Biotite present in schlieren, which generally parallels blocks of host rock. Host-rock blocks are common, in various stages of disaggregation, and typically fragmented along bedding planes. Quartz-filled miarolitic cavities also present. (Map C)

Trenchward belt (Paleocene)—Informal group of units of Paleocene igneous rocks along and south of Kalsin Bay Fault. Composed of small granitic and gabbroic plutons; dikes of porphyritic gabbro, basalt, and andesite; and pillow basalt. Most rocks intrude the Ghost Rocks Formation and range in age from 60 to 63 Ma (Moore and others, 1983); however, some are interbedded with the Ghost Rocks Formation strata (Plumley and others, 1983; Moore and others, 1983)

Tgg **Biotite-rich granodiorite**—Biotite-rich, clinopyroxene-bearing granodiorite and tonalite. Clinopyroxene phenocrysts partially resorbed and altered to biotite. Mafic minerals variably range from 1 to 25 percent. Clinopyroxene increases in abundance with proximity to gabbroic pods, which can be as much as hundreds of meters across. Larger (1–5 mm) plagioclase phenocrysts commonly surrounded by matrix of granular, intergrown quartz and alkali feldspar. (Maps E, F)

Tgp **Granodiorite and granite with voluminous stoped blocks**—Granodiorite and granite that contain greater than 25 percent stoped blocks by volume. Host-rock blocks of the Ghost Rocks Formation range to 5 m across and have dark reaction rims and can be visually reassembled like puzzle pieces. Block margins are sharp to gradational. Where host-rock block concentrations are highest, the granite is most leucocratic and composed almost entirely of quartz, potassium feldspar, and host-rock remnants. (Map F)

Tgt **Porphyritic gabbro**—Porphyritic clinopyroxene-plagioclase gabbro. Plagioclase phenocrysts, 1 to 2 cm in diameter, form a framework filled with smaller, intergrown clinopyroxene and plagioclase grains. Commonly intruded into the Ghost Rocks Formation as thick 10- to 50-m-wide dikes that fine upward. Upper dike sections almost entirely devoid of large plagioclase and may grade into basalt. Equigranular and coarser grained in Pasagshak Pluton and on Sitkalidak Island. (Map F)

Fine-grained basalt—Very fine grained basalt to andesite dikes and pillows typically altered to greenstone with common calcite veins. Rarely visible clinopyroxene phenocrysts. Pillows may show hyaloclastite fragments. Basalt dikes, 20-cm- to 20-m-wide, may show baked margins, grade into pillows, and crosscut mélange features in the Ghost Rocks Formation. In the Pasagshak Bay area, $^{40}Ar/^{39}Ar$ dating on a 3-m-wide dike yielded an age of 60.15±0.86 Ma (Farris, 2010). (Maps E, F)

EXPLANATION OF MAP SYMBOLS

Contact—Solid where location is certain; dashed where inferred (labeled where angular unconformity); dotted where concealed

Faults—Solid where location is certain; dashed where inferred; dotted where concealed

Normal fault—U, upthrown side; D, downthrown side. Arrow pair shows relative motion. Long arrow shows bearing and plunge of lineation

Strike-slip fault—Arrows show relative horizontal movement

Right lateral

Left lateral

Unit Ta dike

Unit Tgl dike

Folds—Solid where location is certain; dashed where approximate. Showing trace of axial surface and direction of plunge where appropriate

Anticline

Syncline

Overturned syncline

Metamorphic isograd—Dashed where inferred

Strike and dip of bedding—In sedimentary and metasedimentary rocks

Inclined

Vertical

Strike and dip of foliation

Magmatic foliation

Foliation in metamorphic and sedimentary rocks

Strike and dip of cleavage

Inclined

INDEX MAP SHOWING SUPPLEMENTAL SOURCES OF GEOLOGIC MAPPING

Selected Geologic Maps of the Kodiak Batholith and other Paleocene Intrusive Rocks, Kodiak Island, Alaska

By
David W. Farris[1] and Peter J. Haeussler[2]
2020

[1]East Carolina University
[2]U.S. Geological Survey

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