



- ABBREVIATED DESCRIPTIONS OF METAMORPHIC MAP UNITS**  
(See text for more detailed information)
- SOUTHERN PRINCE OF WALES ISLAND AND ADJACENT ISLANDS**
- GNS (CQ) + LPP (DS) **Greenschist-facies greenschist, greenschist, schist, phyllite, marble, and minor metapelitic rocks**—Protoliths are Late Proterozoic and (or) Cambrian in age. The older greenschist-facies metamorphism is Late Cambrian and Early Ordovician in age. A younger (prehnite-pumpellyite facies) metamorphism during Silurian and earliest Devonian time is inferred to have affected this unit.
  - AMP (CQ) **Amphibolite-facies schist and gneiss**—Protoliths are Late Proterozoic and (or) Cambrian in age. Metamorphism was Late Cambrian and Early Ordovician in age. A younger (prehnite-pumpellyite facies) metamorphism during Silurian and earliest Devonian time is inferred to have also affected this unit.
  - LPP (DS) **Weakly metamorphosed metasedimentary rocks, metavolcanic rocks, metapelitic rocks, metachert, and metalmstone**—Protoliths are Ordovician and Silurian in age. Metamorphism occurred during Silurian and earliest Devonian time.
  - GNS (DS) **Greenschist-facies greenschist, semischist, phyllite, slate, and metalmstone**—Protoliths are Ordovician and Silurian in age. Metamorphism occurred during Silurian and earliest Devonian time.
  - GNS (DS) + GNS (K) **Polymetamorphosed greenschist- and locally epidote-amphibolite-facies greenschist, greenschist, impure quartzite, phyllite, marble, metadiorite, and metatrendolite**—Protoliths are Ordovician and Silurian in age. The earlier metamorphism occurred during Silurian and earliest Devonian time, and the later metamorphism sometime during mid- or early Late Cretaceous time.
- GLACIER BAY AND CHICHAGOF AND BARANOF ISLANDS AREA**
- AMP (QK) **Amphibolite- or hornblende-hornfels-facies amphibolite, gneiss, schist, marble, and granulite**—Protoliths are pre-Jurassic in age. Metamorphism occurred sometime during Paleozoic to Early Cretaceous time.
  - GNS (QK) **Greenschist-facies schist, phyllite, slate, metalmstone, and minor quartzite**—Protoliths are pre-Jurassic to Silurian in age. Metamorphism occurred sometime during latest Triassic to Early Cretaceous time.
  - AMP (QK) **Amphibolite-facies gneiss, amphibolite, schist, and minor phyllite and marble**—Protoliths are presumed to be Silurian to Permian in age. Metamorphism occurred sometime during latest Triassic to Early Cretaceous time.
  - GNS (QK) **Greenschist-facies metabasalt and minor argillite, metalmstone, metadiorite, and metalmstone**—Protoliths are Late Triassic in age. Metamorphism occurred sometime during latest Triassic to Early Cretaceous time.
  - LPP (QK) **Weakly metamorphosed metasedimentary and metavolcanic rocks, metalmstone, and metachert**—Protoliths consist of Silurian and (or) Devonian, Mississippian, Permian, and Early Jurassic(?) age. Metamorphism occurred sometime during Early Jurassic(?) to Early Cretaceous time.
  - AMP (QK) **Amphibolite-facies and hornblende-hornfels-facies schist, gneiss, and marble**—Unit also includes minor amount of granitoid and greenschist. Protoliths are Silurian and Devonian in age. Metamorphism is interpreted to have taken place during late Early Cretaceous plutonism.
  - LPP (QK) **Transitional prehnite-pumpellyite- to greenschist-facies greenschist, greenschist, marble, and underlying metasedimentary and metavolcanic rocks**—Protoliths include Paleozoic and (or) Mesozoic rocks and underlying rocks of presumed Late Triassic age. Metamorphism occurred sometime during Late Triassic to early Tertiary time.
  - LPP (QK) **Undifferentiated prehnite-pumpellyite- and lower greenschist-facies metasedimentary and metavolcanic rocks**—Unit comprises metamorphosed flysch and mélange consisting of phyllite, metagraywacke, argillite, metachert, metadiorite, metalmstone, greenschist, and gneiss. Flyschal protoliths are probably Cretaceous in age, but blocks within an area considered to be reworked are Triassic(?), Late Jurassic, and Early Cretaceous in age, and the mélange matrix is interpreted to be, in part, Late Jurassic in age. Regional low-grade metamorphism occurred sometime during Late Jurassic to early Tertiary time; subsequent low-pressure thermal metamorphism accompanied early Tertiary (Eocene) plutonism.
  - LPP (QK) + GNS (QK) **Polymetamorphosed rocks containing albite-epidote hornfels-facies assemblages superimposed over prehnite-pumpellyite- to greenschist-facies assemblages**—Unit consists of metasedimentary rocks, amphibolite, greenschist, and schist. Protoliths are probably Cretaceous in age, but blocks within an area considered to be reworked are Triassic(?), Late Jurassic, and Early Cretaceous in age, and the mélange matrix is interpreted to be, in part, Late Jurassic in age. Regional low-grade metamorphism occurred sometime during Late Jurassic to early Tertiary time; subsequent low-pressure thermal metamorphism accompanied early Tertiary (Eocene) plutonism.
  - LPP (QK) + AMP (QK) **Polymetamorphosed rocks containing hornblende-hornfels-facies assemblages superimposed over prehnite-pumpellyite- to greenschist-facies assemblages**—Unit includes metagraywacke and slate hornfels, schist, and gneiss. Protolith and metamorphic history are the same as described immediately above.
  - GNS (QK) **Transitional greenschist- to amphibolite-facies schist, semischist, and amphibolite**—Protoliths are probably Cretaceous in age. Metamorphism occurred sometime during Cretaceous and (or) early Tertiary time.
  - AMP (QK) **Amphibolite-facies gneiss, schist, and amphibolite**—Protoliths are probably Cretaceous in age. Metamorphism occurred sometime during Cretaceous and (or) early Tertiary time.
  - LPP (QK) **Laumontite-quartz- and (or) prehnite-pumpellyite-facies upper Mesozoic metasedimentary and mafic meta-igneous rocks**—Unit consists of mélange containing large blocks of gneiss, phyllite, metagraywacke, argillite, and metachert; bedded sequences of slate, metalmstone, and gneiss; and altered diorite. Metamorphism occurred during latest Cretaceous and (or) early Tertiary time.
- WESTERN METAMORPHIC BELT**
- Admiralty Island and adjacent mainland area
- LPP (QK) **Prehnite-pumpellyite facies metasedimentary and metavolcanic rocks, metachert, and minor metalmstone**—Protoliths are Ordovician and Permian through Early Cretaceous in age. Metamorphism is considered to be late Early Cretaceous in age.
  - GNS (QK) **Greenschist-facies phyllite, greenschist, gneiss, slate, marble, metagraywacke, argillite, and minor migmatite and schist**—Protoliths are Ordovician to Early Cretaceous in age. Metamorphism is considered to be late Early Cretaceous in age.
  - GNS (QK) **Undifferentiated greenschist- and amphibolite-facies schist, hornfels, metachert, marble, slate, phyllite, amphibolite, gneiss, and migmatite**—Protoliths are Ordovician to Early Cretaceous in age. Metamorphism is considered to be late Early Cretaceous in age.
- Kuparuk, Eklon, and Revellagido islands and Cleveland Peninsula area
- LPP (QK) **Prehnite-pumpellyite to lower greenschist-facies greenschist, greenschist, metasedimentary rocks, metalmstone, and metachert**—Protoliths are Late Jurassic to mid-Cretaceous in age. Metamorphism is mid-Cretaceous in age.
  - LPP (QK) + GNS (QK) **Polymetamorphosed greenschist, metasedimentary rocks, and gneiss**—Protoliths are presumed to be Late Jurassic to mid-Cretaceous in age. Blocks were regionally metamorphosed under prehnite-pumpellyite- to greenschist-facies conditions during mid-Cretaceous time, then subsequently metamorphosed under low-pressure cooling to intermediate-pressure greenschist-facies conditions during early Late Cretaceous time.
  - GNS (QK) **Greenschist-facies metasedimentary, metavolcanic, and sparse metapelitic rocks**—Protoliths range in age from Late Silurian to Cretaceous. Metamorphism occurred sometime during mid- or early Late Cretaceous time.
  - AMP (QK) **Intermediate-pressure amphibolite-facies schist, gneiss, and minor marble and migmatite**—Protoliths range in age from Permian(?) to Cretaceous(?). Metamorphism is interpreted to have been associated with the intrusion of early Late Cretaceous plutons.
- Mainland Belt
- GNS (QK) **Greenschist-facies metachert, semischist, phyllite, marble, and metapelitic rocks**—Protoliths are late Paleozoic to Late Jurassic in age. Metamorphism occurred sometime during Late Jurassic to early Tertiary time.
  - GNS (QK) + GNS (QK) **Polymetamorphosed greenschist-facies schist, semischist, phyllite, slate, metalmstone, and granulite**—Protoliths are Permian(?), Triassic, Jurassic(?), and Cretaceous(?) in age. Earlier metamorphism occurred during early Late Cretaceous time, and later metamorphism occurred during latest Cretaceous and (or) early Tertiary time.
  - LPP (QK) **Prehnite-pumpellyite-facies metachert, metagraywacke, metapelite, and metapelitic rocks**—Protoliths include Lower(?) Cretaceous fossiliferous rocks and mid-Cretaceous plutonic rocks. Metamorphism occurred during latest Cretaceous and (or) early Tertiary time.
  - GNS (QK) **Intermediate-pressure greenschist-facies phyllite, slate, schist, and gneiss**—Protoliths are Permian(?), Triassic, Jurassic(?), and Cretaceous(?) in age. Metamorphism occurred during latest Cretaceous and (or) early Tertiary time.
  - GNS (QK) **Undifferentiated greenschist- and amphibolite-facies phyllite, slate, gneiss, schist, gneiss, and migmatite**—Protoliths are Permian(?), Triassic(?), Jurassic(?), and Cretaceous(?) in age. Metamorphism occurred during latest Cretaceous and (or) early Tertiary time.
  - AMP (QK) **Amphibolite-facies schist, gneiss, and migmatite**—Protoliths are Permian(?), Triassic(?), Jurassic(?), and Cretaceous(?) in age. Metamorphism occurred during latest Cretaceous and (or) early Tertiary time.
  - AMP (QK) **Intermediate- to low-pressure amphibolite-facies migmatite, paragneiss, schist, orthogneiss, and minor marble, quartzite, and amphibolite**—Protoliths are Paleozoic and (or) Mesozoic in age, at least one plutonic protolith is Early Cretaceous in age. Metamorphism occurred during latest Cretaceous and (or) early Tertiary time.

The metamorphic scheme used to compile this map (Zwart and others, 1967, fig. 3, table 1) is based on pressure- and temperature-sensitive metamorphic minerals. Metamorphosed rocks are divided into three facies groups based on increasing temperature: (1) hornblende and prehnite-pumpellyite facies (LPP), (2) greenschist facies (GNS), and (3) epidote-amphibolite and amphibolite facies (AMP). Where possible, the greenschist facies and the epidote-amphibolite and amphibolite facies groups are divided into three facies series on the basis of pressure. H, I, or L in place of the final letter in the symbol used for a facies group indicates a high, intermediate-, or low-pressure facies series, respectively. Numerical subscripts are used to differentiate between units that have the same metamorphic grade and age but that are thought to have different metamorphic histories.

**USE OF METAMORPHIC PATTERNS AND SYMBOLS**

AMP (QK) **Metamorphic facies designation**—Age or localities (ages) of metamorphism given in parentheses. Letters preceding age: l, late; m, middle; e, early. For example, AMP (QK) indicates amphibolite-facies metamorphism occurred sometime during Paleozoic to Early Cretaceous time.

**Undifferentiated facies groups or series**—Dominant facies given first.

GNS, AMP **Undifferentiated greenschist and amphibolite facies**

AML **Undifferentiated intermediate- and low-pressure amphibolite facies**

ONSAMP **Transitional between two facies groups—Lower grade facies given first**

ONSAMP **Transitional between greenschist and amphibolite facies**

**Evolving from one facies series to another during a single continuing episode**

QNL-II **Low-pressure greenschist facies evolving to intermediate-pressure greenschist facies**

**Polymetamorphism**

Two phases—Older given first.

Vertical stripes—Older phase (LPP, GNS (QK))

Horizontal stripes—Younger phase (AMP, (QK))

**Area of migmatite**

Strongly metamorphosed pluton—Metamorphic facies designation of pluton considered to be that of surrounding metamorphic unit; protolith age of metapelitic rocks given in detailed description of metamorphic unit.

Weakly metamorphosed pluton—Known or inferred to have been metamorphosed under low-grade metamorphic conditions (laumontite- or prehnite-pumpellyite- or lowest greenschist facies grade) along with its wallrocks. Protolith age of metapelitic rocks given in detailed description of metamorphic unit.

**Location of metamorphic-mineral occurrence**—a, andalusite; b, kyanite; c, cordierite; e, corundum; g, grossular; gl, glaucophane; k, kyanite; s, sillimanite.

**Metamorphic-mineral locality and number**—Shown on sheet 2 and referred to in table 2.

**GRANITIC AND OTHER ROCK SYMBOLS**

(Areas shown as granitic rocks may include some intrusive rocks of intermediate or mafic composition and some related volcanic and hypabyssal rocks.)

**Quaternary surficial deposits**

Qa **Postmetamorphic intrusive rocks**

Late Tertiary (Miocene), early Tertiary (Oligocene and Eocene)

Tk, K, Kq **Tertiary or Cretaceous, Cretaceous, Late Cretaceous**

QK, Kq, Qj **Early Cretaceous, Cretaceous or Jurassic, Jurassic**

**Intrusive rocks associated with metamorphism**

Early Tertiary (Eocene)—Associated with low-pressure regional thermal metamorphism.

Late Cretaceous—Associated with intermediate-pressure and, in northernmost area of unit, with low-pressure evolving to intermediate-pressure regional metamorphism.

Early Cretaceous—Associated with regional (thermal?) metamorphism of unknown pressure-facies series.

Synkinematic intrusive rocks (early Tertiary (Paleocene) and latest Cretaceous)

Ultramafic rocks (Early Cretaceous)—Unit may also include associated layered gabbroic rocks and minor pillow basalt.

N **Area of unmetamorphosed volcanic and (or) sedimentary rocks**

**LINE SYMBOLS**

Contact or boundary between metamorphic-facies units—Dashed where uncertain, dotted where concealed. Delineation of dotted contacts or boundaries under areas shown as glaciers based on exposure of small outcrops that cannot be delineated at scale of map and (or) on extension of contacts or boundaries along strike between areas in which bedrock is exposed.

High-angle fault—Dashed where uncertain, dotted where concealed. Arrows show relative horizontal movement.

Coast Range megaclement

Thrust fault—Dashed where uncertain, dotted where concealed. Southwest on upper plate.

Contact-metamorphic aureole—Approximately 1 km or more in width.

Sillimanite isograd—Ticks on high-grade side.

Kyanite isograd—Ticks on high-grade side.

1:250,000-scale quadrangle—Boundary, name, and map reference number.

Glacier—May be partly or completely shown with color of unit inferred to underlie glacier.

Standard abbreviations for metamorphic ages are: T, Tertiary; K, Cretaceous; J, Jurassic; Triassic; P, Paleocene; P, Permian; D, Devonian; S, Silurian; O, Ordovician; C, Cambrian.

Base from U.S. Geological Survey, National Atlas Sheet 27, 1970. Albers Equal-Area Conic projection.

SCALE 1:1 000 000

0 25 50 75 100 MILES

0 25 50 75 100 KILOMETERS

# METAMORPHIC FACIES MAP OF SOUTHEASTERN ALASKA

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1990

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