



Generalized bedrock geologic map compiled by Warren J. Nokleberg from mapping by Warren J. Nokleberg, Ian M. Lange, John N. Aleinikoff, Ronny T. Miyake, and Richard E. Zahner, 1977-85.

PORPHYRY Cu-Mo DEPOSITS, W-Mo AND Cu-Zn-Pb SKARN DEPOSITS,  
AND PORPHYRY Sn DEPOSITS

METALLIFEROUS MINERAL RESOURCE ASSESSMENT MAPS OF THE MOUNT HAYES  
QUADRANGLE, EASTERN ALASKA RANGE, ALASKA

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AND PORPHYRY Sn DEPOSITS

**EXPLANATION**

**Porphyry Cu-Mo deposits**--Area of potential for undiscovered deposits. Letters and numbers refer to table 10

**W-Mo and Cu-Zn-Pb skarn deposits**--Area of potential for undiscovered deposits. Letters and numbers refer to table 11

**Porphyry Sn deposits**--Area of potential for undiscovered deposits. Letters and numbers refer to table 12

NOTE: See sheet 1 for explanation of geologic symbols.

Table 10.--Potential and recognition criteria for porphyry Cu-Mo deposits, Mount Hayes quadrangle, eastern Alaska Range, Alaska  
(\* , letter, element, or mineral indicates criterion present; 0 indicates criterion not observed)

Potential	Recognition criteria present in each area														
	Diagnostic					Secondary									
	Area 1	2	3	4	5	6	7	8	9	10					
Low	A	+	+	+	+	+	+	+	Cu, Mo, Pb, Zn, As, Au	Mo, Pb, Zn, Ag	Sh	cp, sh	0		
Low	B	0	+	+	+	+	+	+	0	0	0	0	0		
Low	C	0	0	+	+	+	+	+	Mo	0	0	cp, sh, mo, py	0		
Low	D	0	0	+	+	+	+	+	0	0	Cu	0	0		
Moderate	E	0	+	+	+	+	+	+	Mo	Mo	0	cp, mo, py, sh	0		
Low	F	0	+	+	+	+	+	+	Mo, Pb, Zn	Pb	Cu, Mo, Pb, Ag	cp, mo, sp, sh	+		
Low	G1	0	+	+	+	+	+	+	0	0	0	sh	+		
Low	G2	0	+	+	+	+	+	+	0	0	0	0	0		
Low	G3	0	+	+	+	+	+	+	0	+	0	sh	0		
Moderate	G4	+	+	+	+	+	+	+	0	0	Pb	0	0		
Low	H1	0	0	+	+	+	+	+	0	0	As	Pb	0		
Moderate	H2	0	0	+	+	+	+	+	0	0	Mo	Pb, Zn, Ag	Cu, Mo, Pb, Zn, Ag, Sb	cp, mo, py, sh, fl	
Low	H3	0	0	+	+	+	+	+	0	0	0	Mo, Pb	Ag, Au, Sb	sp, sh, fl	
Low	H4	0	0	+	+	+	+	+	0	0	0	Pb, As, Au, Pb, Ag	Pb, Sb	sh	
Moderate	I	0	0	+	+	+	+	+	0	0	0	Cu, Mo, Pb, Zn, Ag	Cu, Mo, Pb, Zn, Ag	cp, sh, fl	
Low	J	0	0	+	+	+	+	+	0	0	Mo	Mo, Zn	Cu, Mo, Au, Zn	cp, mo, py, sh	
High	K	+	+	+	+	+	+	+	0	0	0	Cu, Mo, Pb, As, Sb	Cu, Mo	0	
Moderate	L1	0	0	+	+	+	+	+	0	0	+	Mo, Pb, Zn, As, Sb	Cu, Mo, Zn, Ag, Au	cp, py, sh, fl	
Low	L2	0	0	+	+	+	+	+	0	0	0	Cu, Mo, Au	Cu	0	
Low	L3	0	0	+	+	+	+	+	0	0	0	Cu, Mo	Ag	Mo, Pb, Ag	
Moderate	L4	0	0	+	+	+	+	+	0	0	+	Cu, Pb, Zn, As, Sb	Mo, Zn	Pb, Zn	
High	M	+	+	+	+	+	+	+	0	0	0	Cu, Mo, Pb, As, Au	Cu	Cu	
Moderate	N	+	+	+	+	+	+	+	0	0	0	Cu, Pb, Zn, As, Au	Cu	Cu	
Low	O	0	0	+	+	+	+	+	0	0	0	Cu, Pb, Au	0	sh	
Low	P	+	+	+	+	+	+	+	0	0	0	0	Cu, Zn	Cu	cp, sh, sp, sh
Low	Q	0	0	+	+	+	+	+	0	0	0	0	Cu, Mo, Zn	Cu, Zn, Ag	cp, py, sp, sh
Low	R	0	0	+	+	+	+	+	0	0	0	0	Mo, Zn	Pb, Zn	cp, py, sp, sh

**Description of recognition criteria**

**Diagnostic**

- Geologically favorable environment of plutons of generally porphyritic quartz diorite to quartz monzonite, or hypabyssal stocks of andesite to rhyolite.
- Known deposit, prospect, or occurrence.
- Coeval shallow-granitic, hypabyssal, or volcanic rocks.
- Numerous faults and brecciated country rock.
- Intrusion of igneous rocks controlled by regional-scale faulting.
- Hydrothermal alteration.

**Secondary**

- Multiple intrusive phases, some porphyritic.
- Volcanic or intrusive breccias, locally with disseminated or massive sulfides.
- Dikes, quartz veins, or stockwork veinlets with sulfide minerals.
- Replacement massive sulfide minerals or skarns in country rock.
- Breccia pipes locally with sulfides.
- Anomalous values of Cu, Mo, Pb, Zn, As, Au, or Sb in rock samples.
- Anomalous values of Cu, Mo, Pb, Zn, Ag, Au, or Sb in stream-sediment samples.
- Anomalous values of Cu, Mo, Pb, Zn, Ag, Au, or Sb in heavy-mineral-concentrate samples.
- Occurrence of chalcocite, molybdenite, pyrite, sphalerite, galena, scheelite-powellite, or fluorite in heavy-mineral concentrate samples.
- D-shaped aeromagnetic anomaly patterns, for example, strong, local equidimensional aeromagnetic highs with resistant or central low.

Table 11.--Potential and recognition criteria for W-Mo and Cu-Zn-Pb skarn deposits, Mount Hayes quadrangle, eastern Alaska Range, Alaska  
(\* , letter, element, or mineral indicates criterion present; 0 indicates criterion not observed)

Potential	Recognition criteria present in each area							
	Diagnostic				Secondary			
	Area 1	2	3	4	5	6	7	8
Moderate	A	0	+	+	+	+	+	+
Moderate	C	0	0	0	0	+	0	0
Low	H1	0	0	0	0	+	0	0
Moderate	H2	0	0	0	0	+	0	0
Moderate	H3	0	0	0	0	+	0	0
Low	H4	0	0	0	0	+	0	0
Low	J	0	0	0	0	+	0	0
Moderate	L1	0	0	+	+	+	+	+
High	L2	+	+	+	+	+	+	+
Moderate	L3	0	0	0	0	+	0	0
Moderate	L4	0	+	+	+	+	+	+
Moderate	P	0	0	0	0	+	0	0
Moderate	Q	0	0	0	0	+	0	0
Moderate	R	0	0	0	0	+	0	0

**Description of recognition criteria**

**Diagnostic**

- Geologically favorable environment of calc-alkaline plutonic rocks intruding calcareous or lapure calcareous sedimentary rocks.
- Known deposit, prospect, or occurrence.
- Replacement of calcareous wall rocks by irregular masses of contact metamorphic minerals, including andradite-grossularite, diopside-hedenbergite, hornblende, wollastonite, epidote, actinolite, idocrase, and quartz.
- Bleaching of calcareous wall rocks, for example, disappearance of graphite and local silicification.

**Secondary**

- Abundant fractures, folds, or faults in calcareous sedimentary rocks.
- Replacement of granitic rocks adjacent to calcareous sedimentary rocks by andradite-grossularite, diopside-hedenbergite, epidote, hornblende or actinolite, chlorite, calcite, or quartz.
- Hydrothermal alteration of plutonic rocks.
- Anomalous values of W, Mo, Cu, Pb, Zn, Ag, Au, or Sn in rock samples.
- Anomalous values of W, Mo, Cu, Pb, Zn, Ag, Au, or Sn in stream-sediment samples.
- Anomalous values of W, Mo, Cu, Pb, Zn, Ag, or Au in heavy-mineral-concentrate samples.
- Occurrence of scheelite-powellite, molybdenite, chalcocite, bornite, sphalerite, galena, pyrite, arsenopyrite, gold, or fluorite in heavy-mineral-concentrate samples.
- Local aeromagnetic highs, particularly geographically small highs of low to moderate amplitude in regions of otherwise low-magnetic fields.

Table 12.--Potential and recognition criteria for porphyry Sn deposits, Mount Hayes quadrangle, eastern Alaska Range, Alaska  
(\* , letter, element, or mineral indicates criterion present; 0 indicates criterion not observed)

Potential	Recognition criteria present in each area								
	Diagnostic				Secondary				
	Area 1	2	3	4	5	6	7	8	9
Moderate	A	0	+	+	+	+	+	+	+
Moderate	D	0	+	+	+	+	+	+	+
Moderate	F	0	+	+	+	+	+	+	+
Low	G1	0	+	+	+	+	+	+	+
Low	G2	0	+	+	+	+	+	+	+
Low	G3	0	+	+	+	+	+	+	+
Low	G4	0	+	+	+	+	+	+	+
Low	H1	0	+	+	+	+	+	+	+
Moderate	H2	0	+	+	+	+	+	+	+
Moderate	H3	0	+	+	+	+	+	+	+
Moderate	H4	0	+	+	+	+	+	+	+

**Description of recognition criteria**

**Diagnostic**

- Geologically favorable environment of granite intruded into continental platform sedimentary rocks.
- Known deposit, prospect, or occurrence.
- Continental fold belt of thick platform sedimentary rocks and minor volcanic rocks.
- Epizonal multiphase stocks of granitic rocks.

**Secondary**

- Upper level cupolas and roof zones of plutons.
- Locally extensive alteration in granitic rocks consisting of replacement K-feldspar, albite, sericite, chlorite, fluorite, or arsenopyrite.
- Post orogenic intrusion of granitic rocks.
- Associated tin greisens.
- Associated tin placer deposits.
- Anomalous values of Sn, Mo, As, or W in rock samples.
- Anomalous values of Sn, Mo, As, or W in stream-sediment samples.
- Anomalous values of Sn, Mo, As, or W in heavy-mineral-concentrate samples.
- Occurrence of cassiterite, fluorite, molybdenite, or arsenopyrite in heavy-mineral-concentrate samples.