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Introduction to Summary Tables on Significant Metalliferous and Selected Non-Metalliferous Lode Deposits, and Selected Placer Districts for Northeast Asia

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Introduction and Companion Studies

This report describes a summary tabular compilation of the significant metalliferous and selected non-metalliferous lode deposits and placer districts of Northeast Asia. This region includes Eastern Siberia, Russian Southeast, Mongolia, Northeast China, and Japan. The summary tables are for 1,674 significant lode deposits and 92 significant placer districts of the region. The tables are in the files labeled Lode Deposits.doc and Placer Districts.doc in Directory MINDEP on this CD-ROM, and provide the major features of lode deposits and placer districts, respectively. Deposits and districts in the files are listed by map row and map number, as displayed on the map of Northeast Asia Lode Mineral Deposit and Placer District Location (Sheet 1 in Directory METBELTS on this CD-ROM). The complete mineral deposit database is being published separately.

This summary and the complete databases are prepared by a large group of Russian, Chinese, Mongolian, South Korean, Japanese, and USA geologists who are members of the joint international project on *Major Mineral Deposits, Metallogenesis, and Tectonics of Northeast Asia*. This project is being conducted by the Russian Academy of Sciences, the Mongolian Academy of Sciences, Mongolian National University, Ulaanbaatar, Mongolian Technical University, the Mineral Resources Authority of Mongolia, Geological Research Institute, Jilin University, China Geological Survey, Korea Institute of Geoscience and Mineral Resources, the Geological Survey of Japan, and the U.S. Geological Survey. Information about major goals and pubications for this project and for a previous, similar project on the Circum-North Pacific (Russian Far East, Alaska, and Canadian Cordillera) are available in the Directory PROJMAT (Project Materials) on this CD-ROM.

Metallogenic and Tectonic Definitions

The following key definitions are provided for use of the summary tabular compilation.

Deposit. A general term for any lode or placer mineral occurrence, mineral deposit, prospect, and (or) mine.

Metallogenic belt. A geologic unit (area) that either contains or is favorable for a group of coeval and genetically-related, significant lode and placer deposit models.

Mine. A site where valuable minerals have been extracted.

Mineral deposit. A site where concentrations of potentially valuable minerals for which grade and tonnage estimates have been made.

Mineral occurrence. A site of potentially valuable minerals on which no visible exploration has occurred, or for which no grade and tonnage estimates have been made.

Lode and Placer Mineral Deposit Models

For description and classification, lode mineral and placer deposits are classified into various models or types as listed in Table 1. Detailed descriptions of mineral deposit models compiled for Northeast Asia are provided in the companion paper by Obolenskiy and others in Directory MINMOD this CD-ROM.

The deposit models are subdivided into the following four large groups according to major geological rock-forming processes: (1) deposits related to magmatic processes; (2) deposits related to hydrothermal-sedimentary processes; (3) deposits related to metamorphic processes; (4) deposits related to surficial processes and (6) exotic deposits. Each group includes several classes. For example, the group of deposits related to magmatic processes includes two classes: (1) those related to intrusive rocks; and (2) those related to extrusive rocks. Each class includes several clans, and so on. The most detailed subdivisions are for magmatic-related deposits because they are the most abundant in the project area. In the below classification, lode deposit types models that share a similar origin, such as magnesian and (or) calcic skarns, or porphyry deposits, are grouped together under a single genus with several types (or species) within the genus.

Descriptions of Headings for Tabular Descriptions for Significant Lode Deposits and Placer Districts

Map Number, Name, Major Metals, Size

Map number refers to a specific deposit in a given region. Lode deposits and placer districts are numbered separately within individual quadrants bounded by integer values of 4° of latitude and 6° of longitude. The quadrants are numbered from west to east, and are lettered from south to north. A latitude and longitude location is stated for each deposit in degrees and minutes. Names of lode deposits are derived from published sources or common usage. In some cases, two deposits are grouped together and both names are given. In other cases, an alternate name

is given in parentheses. Major metals are the known potentially valuable metals reported for each deposit, and are listed in order of decreasing abundance and(or) value, and are shown by standard chemical symbols. Where known, estimates of tonnage and grade are listed, or else the terms small, medium, or large size (as defined in Table 2), and low-, medium-, or high-grade are used.

Lode Deposit Type

Type of lode deposit, or lode deposit model is an interpretation that was made by examining the summary of the deposit and then classifying the deposit using the deposit models previously described. The type is queried where insufficient description precludes precise determination. For a few deposits, either the closest two deposit models are listed, or else a short description is given in parentheses.

Tabular Descriptions for Significant Placer Districts

Table headings for deposits in placer districts are described only for headings differing from those for lode deposits. District refers to the name of a group of geologically and geographically related placer deposits, as derived from published sources or from general usage. In some cases, two or more districts are grouped together and both names are given. In other cases, an alternate name is given in parentheses. Type refers to the placer deposit type as determined by examining the description of the district and then classifying using one of the deposit models described above.

Table 1. Hierarchial ranking of mineral deposit models.

Deposits related to magmatic processes
- Deposits related to intrusive magmatic rocks
  - I. Deposits related to mafic and ultramafic intrusions
    - A. Deposits associated with differentiated mafic-ultramafic complexes
      - Mafic-ultramafic related Cu-Ni-PGE
      - Mafic-ultramafic related Ti-Fe (±V)
      - Zoned mafic-ultramafic Cr-PGE
    - B. Deposits associated with ophiolitic complexes
      - Podiform chromite
      - Serpentinite-hosted asbestos
    - C. Deposits associated with anorthosite complexes
      - Anorthosite apatite-Ti-Fe-P
    - D. Deposits associated with kimberlite
      - Diamond-bearing kimberlite
  - II. Deposits related to intermediate and felsic intrusions
    - A. Pegmatite
      - Muscovite pegmatite
      - REE-Li pegmatite
    - B. Greisen and quartz vein
      - Fluorite greisen
      - Sn-W greisen, stockwork, and quartz vein
      - W-Mo-Be greisen, stockwork, and quartz vein
    - C. Alkaline metasomatite
      - Ta-Nb-REE alkaline metasomatite
    - D. Skarn (contact metasomatic)
      - Au skarn
      - Boron (datolite) skarn
      - Carbonate-hosted asbestos
      - Co skarn
      - Cu (±Fe, Au, Ag, Mo) skarn
      - Fe skarn
      - Fe-Zn skarn
      - Sn skarn
      - Sn-B (Fe) skarn (ludwigite)
      - W±Mo±Be skarn
      - Zn-Pb (±Ag, Cu) skarn
    - E. Porphyry and granitoid pluton-hosted deposit
      - Cassiterite-sulfide-silicate vein and stockwork
      - Felsic plutonic U-REE
      - Granitoid-related Au vein
      - Polymetallic Pb-Zn ± Cu (±Ag, Au) vein and stockwork
      - Porphyry Au

- Porphyry Cu (±Au)
- Porphyry Cu-Mo (±Au, Ag)
- Porphyry Mo (±W, Bi)
- Porphyry Sn

III. Deposits related to alkaline intrusions

A. Carbonatite-related deposits

- Apatite carbonatite
- Fe-REE carbonatite
- Fe-Ti (±Ta, Nb, Fe,Cu, apatite) carbonatite
- Phlogopite carbonatite
- REE (±Ta, Nb, Fe) carbonatite

B. Alkaline-silicic intrusions related deposits

- Alkaline complex-hosted Au
- Peralkaline granitoid-related Nb-Zr-REE
- Albite syenite-related REE
- Ta-Li ongonite

C. Alkaline-gabbroic intrusion-related deposits

- Charoite metasomatite
- Magmatic and metasomatic apatite
- Magmatic graphite
- Magmatic nepheline

Deposits related to extrusive rocks

IV. Deposits related to marine extrusive rocks

A. Massive sulfide deposits

- Besshi Cu-Zn-Ag massive sulfide
- Cyprus Cu-Zn massive sulfide
- Korean Pb-Zn massive sulfide
- Volcanogenic Cu-Zn massive sulfide (Urals type)
- Volcanogenic Zn-Pb-Cu massive sulfide (Kuroko, Altai types)

B. Volcanogenic-sedimentary deposits

- Volcanogenic-hydrothermal-sedimentary massive sulfide Pb-Zn (±Cu)
- Volcanogenic-sedimentary Fe
- Volcanogenic-sedimentary Mn

V. Deposits related to subaerial extrusive rocks

A. Deposits associated with mafic extrusive rocks and dike complexes

- Ag-Sb vein
- Basaltic native Cu (Lake Superior type)
- Hg-Sb-W vein and stockwork
- Hydrothermal Iceland spar
- Ni-Co arsenide vein
- Silica-carbonate (listvenite) Hg
- Trap related Fe skarn (Angara-Ilim type)

B. Deposits associated with felsic to intermediate extrusive rocks

- Au-Ag epithermal vein
- Ag-Pb epithermal vein
- Au potassium metasomatite (Kuranakh type)
- Barite vein
- Be tuff
- Carbonate-hosted As-Au metasomatite
- Carbonate-hosted fluorspar
- Carbonate-hosted Hg-Sb
- Clastic sediment-hosted Hg±Sb
- Epithermal quartz-alunite
- Fluorspar vein
- Hydrothermal-sedimentary fluorite
- Limonite from spring water
- Mn vein
- Polymetallic (Pb, Zn±Cu, Ba, Ag, Au) volcanic-hosted metasomatite
- Polymetallic (Pb, Zn, Ag) carbonate-hosted metasomatite
- Rhyolite-hosted Sn
- Sulfur-sulfide (S, FeS_2)
- Volcanic-hosted Au-base-metal metasomatite
- Volcanic-hosted Hg
- Volcanic-hosted U

Volcanic-hosted zeolite

Deposits related to hydrothermal-sedimentary sedimentary processes
- VI. Stratiform and stratabound deposits
  - Bedded barite
  - Carbonate-hosted Pb-Zn (Mississippi valley type)
  - Sediment-hosted Cu
  - Sedimentary exhalative Pb-Zn (SEDEX)
- VII. Sedimentary rock-hosted deposits
  - Chemical-sedimentary Fe-Mn
  - Evaporate halite
  - Evaporate sedimentary gypsum
  - Sedimentary bauxite
  - Sedimentary celestite
  - Sedimentary phosphate
  - Sedimentary Fe-V
  - Sedimentary siderite Fe
  - Stratiform Zr (Algama Type)
- VIII. Polygenic carbonate-hosted deposits
  - Polygenic REE-Fe-Nb deposits (Bayan-Obo type)

Deposits related to metamorphic processes
- IX. Sedimentary-metamorphic deposits
  - Banded iron formation (BIF, Algoma Fe)
  - Banded iron formation (BIF, Superior Fe)
  - Homestake Au
  - Sedimentary-metamorphic borate
  - Sedimentary-metamorphic magnesite
- X. Deposits related to regionally metamorphosed rocks
  - Au in black shale
  - Au in shear zone and quartz vein
  - Clastic-sediment-hosted Sb-Au
  - Cu-Ag vein
  - Piezoquartz
  - Rhodusite asbestos
  - Talc (magnesite) replacement
  - Metamorphic graphite
  - Metamorphic sillimanite
  - Phlogopite skarn

Deposits related to surficial proceses
- XI. Residual deposts
  - Bauxite (karst type)
  - Laterite Ni
  - Weathering crust Mn (±Fe)
  - Weathering crust and karst phosphate
  - Weathering crust carbonatite REE-Zr-Nb-Li
- XII. Depositional deposits
  - Placer and paleoplacer Au
  - Placer diamond
  - Placer PGE
  - Placer Sn
  - Placer Ti-Zr
  - REE and Fe oolite

Exotic deposits
- Impact diamond

Table 2. Size categories for lode mineral deposits. Adapted from Guild (1981). The *small* category may include occurrences of unknown size. Units are metric tons of metal or mineral contained, unless otherwise specified.

Metal	World Class >	Large >	Medium >	< Small
Antimony		50,000	5,000	
Barite ($BaSO_4$)		5,000,000	50,000	
Chromium (Cr_2O_3)		1,000,000	10,000	
Cobalt		20,000	1,000	
Copper	5 million	1,000,000	50,000	
Gold		500	25	
Iron (ore)		100,000,000	5,000,000	
Lead	5 million	1,000,000	50,000	
Magnesium ($MgCO_3$)		10,000,000	100,000	
Manganese (tons of 40% Mn)		10,000,000	100,000	
Mercury (flasks)		500,000	10,000	
Molybdenum	500,000	200,000	5,000	
Nickel	1 million	500,000	25,000	
Niobium-Tantalum (R_20_5)		100,000	1,000	
Platinum group		500	25	
Pyrite (FeS_2)		20,000,000	200,000	
Rare earths (RE_20_3)		1,000,000	1,000	
Silver		10,000	500	
Tin		100,000	5,000	
Titanium ($Ti0_2$)		10,000,000	1,000,000	
Tungsten	30,000	10,000	500	
Vanadium	30,000	10,000	500	
Zinc	5 million	1,000,000	50,000	

REFERENCE CITED

Guild, P.W., 1981, Preliminary metallogenic map of North America: A numerical listing of deposits: U.S. Geological Survey Circular 858-A, 93 p.