PORPHYRY Sn L06

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Refer to preface for general references and formatting significance.
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IDENTIFICATION

SYNONYM: Subvolcanic Sn

COMMODITIES (*BYPRODUCTS*): Sn (*Ag, W*)

EXAMPLES: (British Columbia - *Canada/International*): *Mount Pleasant (New Brunswick, Canada), East Kemptville (Nova Scotia, Canada), Catavi, Chorolque and Cerro Rico stock (Bolivia), Ardlethan and Taronga (Australia), Kingan (Russia), Yinyan (China), Altenberg (Germany).*

GEOLOGICAL CHARACTERISTICS

CAPSULE DESCRIPTION: Fine-grained cassiterite in veinlet and fracture stockwork zones, breccia zones, and disseminated in porphyritic felsic intrusive rocks and associated country rocks.

TECTONIC SETTING: Zones of weak to moderate extension in cratons, particularly post orogenic zones underlain by thick crust, possibly cut by shallow-dipping subduction zones.

GEOLOGICAL SETTING: High-level to subvolcanic felsic intrusive centres in cratons; multiple stages of intrusion may be present. **In Yukon, prospective porphyry stocks and dykes of the Ross Assemblage were emplaced along the crustal-scale Tintina Fault.**

AGE OF MINERALIZATION: Paleozoic to Tertiary. **Porphyry Sn prospects in Yukon are related to the mid-Cretaceous Selwyn Plutonic Suite, particularly the Seagull Batholith, and to porphyry stocks in the lower Tertiary Ross assemblage.**

HOST/ASSOCIATED ROCK TYPES: Predominantly genetically related intrusive rocks and associated breccias, but may also include related or unrelated sedimentary, volcanic, igneous and metamorphic rocks. Genetically related felsic intrusive rocks are F and/or B enriched and are commonly porphyritic. Tuffs or other extrusive volcanic rocks may be associated with deposits related to subvolcanic intrusions.

DEPOSIT FORM: Deposits vary in shape from inverted cone, to roughly cylindrical, to highly irregular. They are typically large, generally hundreds of metres across and ranging from tens to hundreds of metres in vertical extent.

TEXTURE/STRUCTURE: Ore is predominantly structurally controlled in stockworks of crosscutting fractures and quartz veinlets, or disseminated in hydrothermal breccia zones. Veins, vein sets, replacement zones may also be present.

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ORE MINERALOGY (Principal and subordinate): Cassiterite, *stannite, chalcopyrite, sphalerite and galena. Complex tin- and silver-bearing sulphosalts occur in late veins and replacement zones.*

GANGUE MINERALOGY: Pyrite, arsenopyrite, löllingite, topaz, fluorite, tourmaline, muscovite, zinnwaldite and lepidolite.

ALTERATION MINERALOGY: In the Bolivian porphyry Sn deposits, sericite + pyrite ± tourmaline alteration is pervasive; in some deposits it surrounds a central zone of quartz + tourmaline. Sericitic alteration is typically bordered by weak propylitic alteration. In other deposits (*e.g.*, Ardlethan, Yinyan), central zones are characterized by greisen alteration consisting of quartz + topaz + sericite; these zones grade outward to quartz + sericite + chlorite alteration.

WEATHERING: Oxidation of pyrite produces limonitic gossans. Deep weathering and erosion can result in residual concentrations of cassiterite in situ or in placer deposits down slope or downstream.

ORE CONTROLS: Ore minerals occur in fracture stockworks, hydrothermal breccias and replacement zones centred on 1-2 km^2, genetically related felsic intrusions.

GENETIC MODEL: Magmatic-hydrothermal. Large volumes of magmatic, highly saline aqueous fluids under pressure strip Sn and other ore metals from temporally and genetically related magma. Multiple stages of brecciation related to explosive fluid pressure release from the upper parts of small intrusions result in deposition of ore and gangue minerals in crosscutting fractures, veinlets and breccias in the outer carapace of the intrusions and associated country rocks. Mixing of magmatic with meteoric water during waning stages of the magmatic-hydrothermal system may result in deposition of some Sn and other metals, particularly in late-stage veins.

ASSOCIATED DEPOSIT TYPES: Sn veins (I13), Sn-polymetallic veins (H07).

COMMENTS: Some of the deposits listed (*e.g* , Taronga, East Kemptville) are not "subvolcanic" but they are similar to some porphyry Cu deposits with regard to their large size, low grade, relationship to felsic intrusive rocks and dominant structural control (ie., mineralized veins, fractures and breccias).

EXPLORATION GUIDES

GEOCHEMICAL SIGNATURE: Sn, Ag, W, Cu, Zn, As, Pb, Rb, Li, F, B may be anomalously high in host rocks close to mineralized zones and in secondary dispersion halos in overburden. Anomalously high contents of Sn, W, F, Cu, Pb and Zn may occur in stream sediments and Sn, W, F (topaz) and B (tourmaline) may be present in heavy mineral concentrates.

GEOPHYSICAL SIGNATURE: Genetically related intrusions may be magnetic lows (ilmenite- rather than magnetite-dominant); contact aureole may be magnetic high if pyrrhotite or magnetite are present in associated skarn or hornfels zones. Radiometric surveys may be used to outline anomalous U, Th or K in genetically related intrusive rocks or in associated altered and mineralized zones.

OTHER EXPLORATION GUIDES: Sn (-Ag) deposits may be zoned relative to base metals at both regional (district) and local (deposit) scales.

ECONOMIC FACTORS

GRADE AND TONNAGE: Tens of millions of tonnes at grades of 0.2 to 0.5% Sn.
Mount Pleasant (New Brunswick): 5.1 Mt @ 0.79% Sn; East Kemptville (Nova Scotia): 56 Mt @ 0.165% Sn; Catavi (Bolivia): 80 Mt @ 0.3% Sn; Cerro Rico stock, Bolivia: averages 0.3% Sn; Ardlethan (Australia): 9 Mt @ 0.5% Sn; Taronga (Australia): 46.8 Mt @ 0.145% Sn; Altenberg, (Germany): 60 Mt @ 0.3% Sn; Yinyan (China): "large" (50 - 100 Mt?) @ 0.46% Sn

ECONOMIC LIMITATIONS: Low grades require high volumes of production which may not be justified by demand.

IMPORTANCE: A minor source of tin on a world scale; when it was in production, East Kemptville was the major producer of tin in North America.

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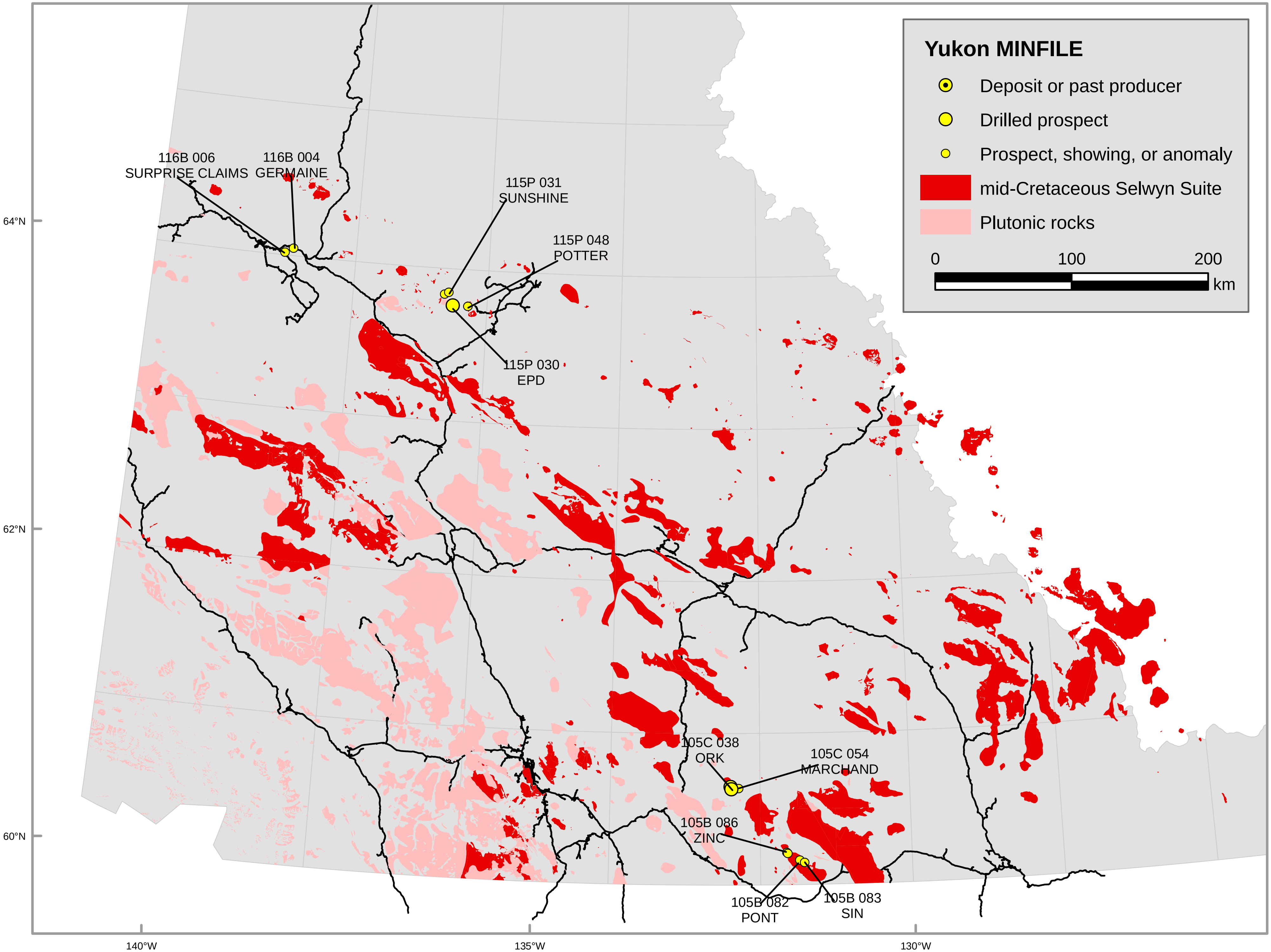
L06 - Porphyry Sn - World Deposits

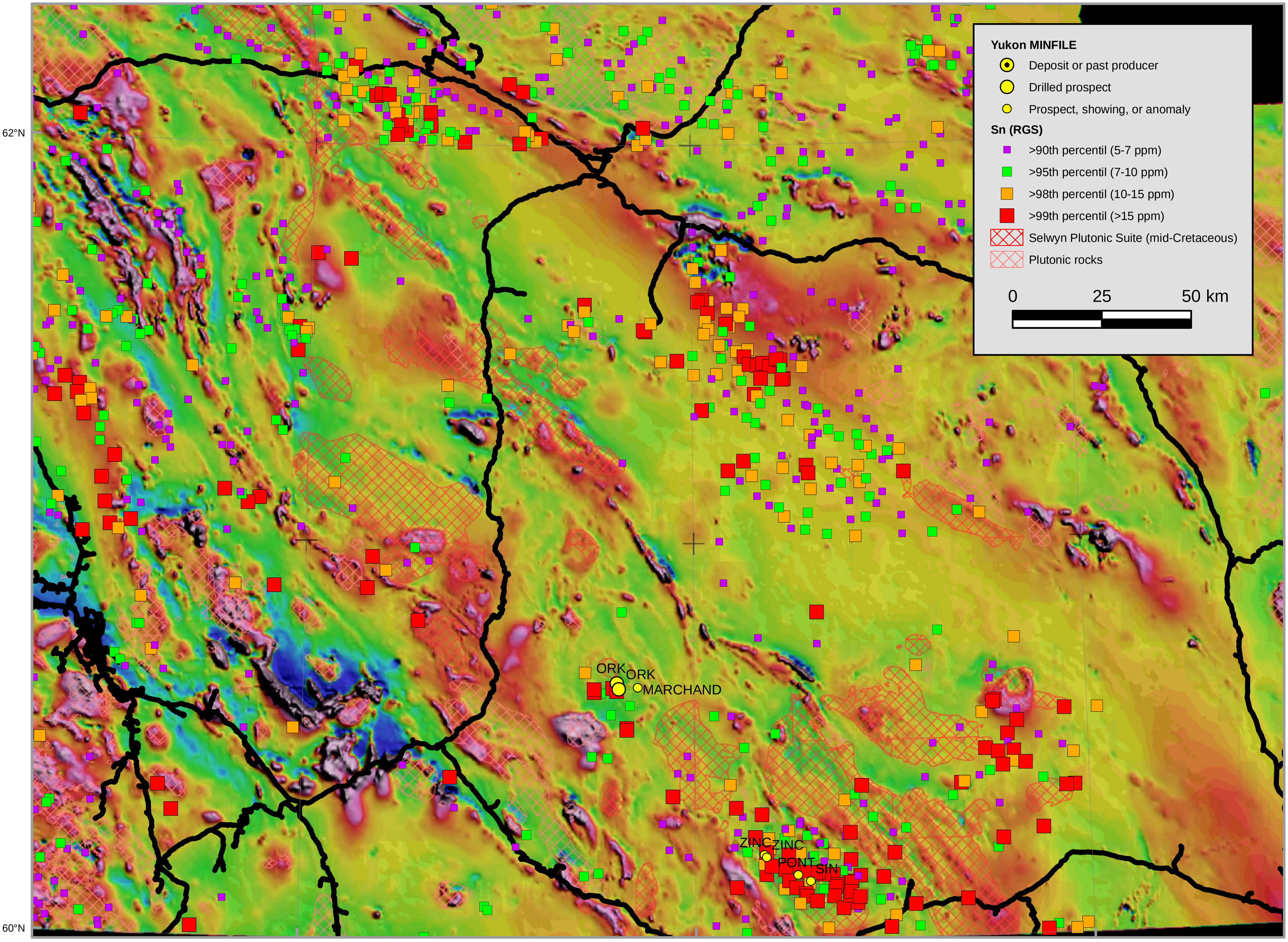
deposit	country	tonnes	Sn %
Mount Pleasant	CNNB	5 100 000	0.79
Ardlethan	AUST	9 000 000	0.5
Taronga	AUST	46 800 000	0.145
Yinyan	CHNA	50 000 000	0.46
East Kemptville	CNNS	56 000 000	0.165
Altenberg	GERM	60 000 000	0.3
Catavi	BOLI	80 000 000	0.3

Yukon MINFILE

MINFILE	NAMES	STATUS
116B 004	GERMAINE	DRILLED PROSPECT
105B 083	SIN	SHOWING



Map of Yukon showing porphyry Sn occurrences, the distribution of all plutonic rocks and the distribution of Selwyn suite plutonic rocks



Map of south central Yukon showing porphyry Sn occurrences, regional magnetics and Sn regional geochemistry