Pb-Zn SKARNS K02

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Modified for Yukon by A. Fonseca
Refer to preface for general references and formatting significance.
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IDENTIFICATION

SYNONYMS: Pyrometasomatic or contact metasomatic Pb-Zn deposits.

COMMODITIES (*BYPRODUCTS*): Pb, Zn, Ag (*Cu, Cd, W, Au*).

EXAMPLES **(Yukon): Mount Hundere (Sa Dena Hes 105A 012; Ritco; 105A 013)**; (British Columbia - *Canada/International*): Piedmont (082FNW 129), Contact (104P 004), *Groundhog (New Mexico, USA), Darwin (California, USA) San Antonio, Santa Eulalia and Naica (Mexico), Yeonhwa-Ulchin deposits (South Korea), Nakatatsu deposits (Japan), Shuikoushan and Tienpaoshan (China).*

GEOLOGICAL CHARACTERISTICS

CAPSULE DESCRIPTION: Galena and/or sphalerite-dominant mineralization genetically associated with a skarn gangue.

TECTONIC SETTING: Along continental margins where they are associated with late orogenic plutonism. Pb-Zn skarns occur at a wide range of depths, being associated with subvolcanic aphanitic dykes and high-level breccia pipes, as well as deep-level batholiths. In British Columbia, some Pb-Zn skarns are found in oceanic island arcs where they form distally to larger calcic Fe or Cu skarn systems.

AGE OF MINERALIZATION: Mainly Mesozoic, but may be any age. In British Columbia, the 80 Pb-Zn skarn occurrences identified have a wide age range; over 40 % are Early to mid-Jurassic, 22 % are Cretaceous, and a further 17 % are Eocene-Oligocene in age. **In Yukon, the majority of lead-zinc skarn occurrences are associated with mid-Cretaceous plutonic rocks.**

HOST/ASSOCIATED ROCK TYPES: Variable; from high-level skarns in thick limestones, calcareous tuffs and sediment to deeper level skarns in marbles and calcsilicate-bearing migmatites. Associated intrusive rocks are granodiorite to leucogranite, diorite to syenite (mostly quartz monzonite). Pb-Zn skarns tend to be associated with small stocks, sills and dykes and less commonly with larger plutons. The composition of the intrusions responsible for many distal Pb-Zn skarns is uncertain.

DEPOSIT FORM: Variable; commonly occurs along igneous or stratigraphic contacts. Can develop as subvertical chimneys or veins along faults and fissures and as subhorizontal blankets. Pb-Zn skarn deposits formed either at higher structural levels or distal to the intrusions tend to be larger and more Mn-rich compared to those formed at greater depths or more proximal.

TEXTURES: Igneous textures in endoskarn. Coarse to fine-grained, massive granoblastic to mineralogically layered textures in exoskarn.

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ORE MINERALOGY (Principal and *subordinate*): Sphalerite ± galena ± pyrrhotite ± pyrite ± magnetite ± arsenopyrite ± chalcopyrite ± bornite. Other trace minerals reported include *scheelite, bismuthinite, stannite, cassiterite, tetrahedrite, molybdenite, fluorite, and native gold*. Proximal skarns tend to be richer in Cu and W, whereas distal skarns contain higher amounts of Pb, Ag and Mn.

ALTERATION MINERALOGY: Exoskarn alteration: Mn-rich hedenbergite (Hd30-90, Jo10-50), andraditic garnet (Ad20-100, Spess2-10) ± wollastonite ± bustamite ± rhodonite. Late-stage Mn-rich actinolite ± epidote ± ilvaite ± chlorite ± dannermorite ± rhodochrosite ± axinite. Endoskarn alteration: highly variable in development, and in many of the distal Pb-Zn skarns the nature of the endoskarn is unknown. However, Zn-rich skarns formed near stocks are often associated with abundant endoskarn that may equal or exceed the exoskarn (Einaudi et al., 1981). Endoskarn mineralogy is dominated by epidote ± amphibole ± chlorite ± sericite with lesser rhodonite ± garnet ± vesuvianite ± pyroxene ± K-feldspar ± biotite and rare topaz. Marginal phases may contain greisen and/or tourmaline.

ORE CONTROLS: Carbonate rocks, particularly along structural and/or lithological contacts (e.g. shale-limestone contacts or pre-ore dikes). Deposits may occur considerable distances (100-1000 m) from the source intrusions.

ASSOCIATED DEPOSIT TYPES: Pb-Zn-Ag veins (I05), Cu skarns (K01) and Cu porphyries (L03, L04). In B.C. small Pb-Zn skarns occur distally to some Fe (K03) and W (K04) skarns.

COMMENTS: Pb-Zn skarn occurrences are preferentially developed in: (1) continental margin sedimentary rocks of the Cassiar and Ancestral North America terranes, (2) oceanic island arc rocks of the Quesnellia and Stikinia terranes, and (3) arc rocks of the Wrangellia Terrane. Their widespread terrane distribution partly reflects their formation as small distal mineralized occurrences related to other skarns (notably Cu, Fe and W skarns), as well as some porphyry systems. British Columbia is endowed with some large and significant Pb-Zn reserves classified as manto deposits (Nelson, 1991; Dawson et al., 1991). These deposits lack skarn gangue, but are sometimes grouped with the Pb-Zn skarns.

EXPLORATION GUIDES

GEOCHEMICAL SIGNATURE: Pb, Zn, Ag, Cu, Mn, As, Bi, W, F, Sn, Mo, Co, Sb, Cd and Au geochemical anomalies.

GEOPHYSICAL SIGNATURE: Generally good induced polarization response. Galena-rich ore bodies may be marked by gravity anomalies whereas pyrrhotite-rich mineralization may be detected by magnetic surveys. CS-AMT may also be a useful exploration system.

OTHER EXPLORATION GUIDES: Thick limestones distal to small granitoid stocks; structural traps and lithological contacts; exoskarns with low garnet/pyroxene ratios.

ECONOMIC FACTORS

GRADE AND TONNAGE: Pb-Zn skarns tend to be small (<3 Mt) but can reach 45 Mt, grading up to 15 % Zn, 10 % Pb and > 150 g/t Ag with substantial Cd. Cu grades are generally < 0.2 %. Some deposits (e.g. Naica (Mexico) and Falun (Sweden)) contain Au. The 80 British Columbia Pb-Zn skarn occurrences are generally small and have had no major metal production. **The Sa Dena Hes deposit in Yukon had proven and probable reserves of 3.9 Mt (pre-production) grading 3.9% Pb, 12.7% Zn, and 58 g/t Ag prior to mining.**

IMPORTANCE: Important past and current producers exist in Mexico, China, U.S.A (New Mexico and California), and Argentina. No large productive Pb-Zn skarns have been discovered in B.C.

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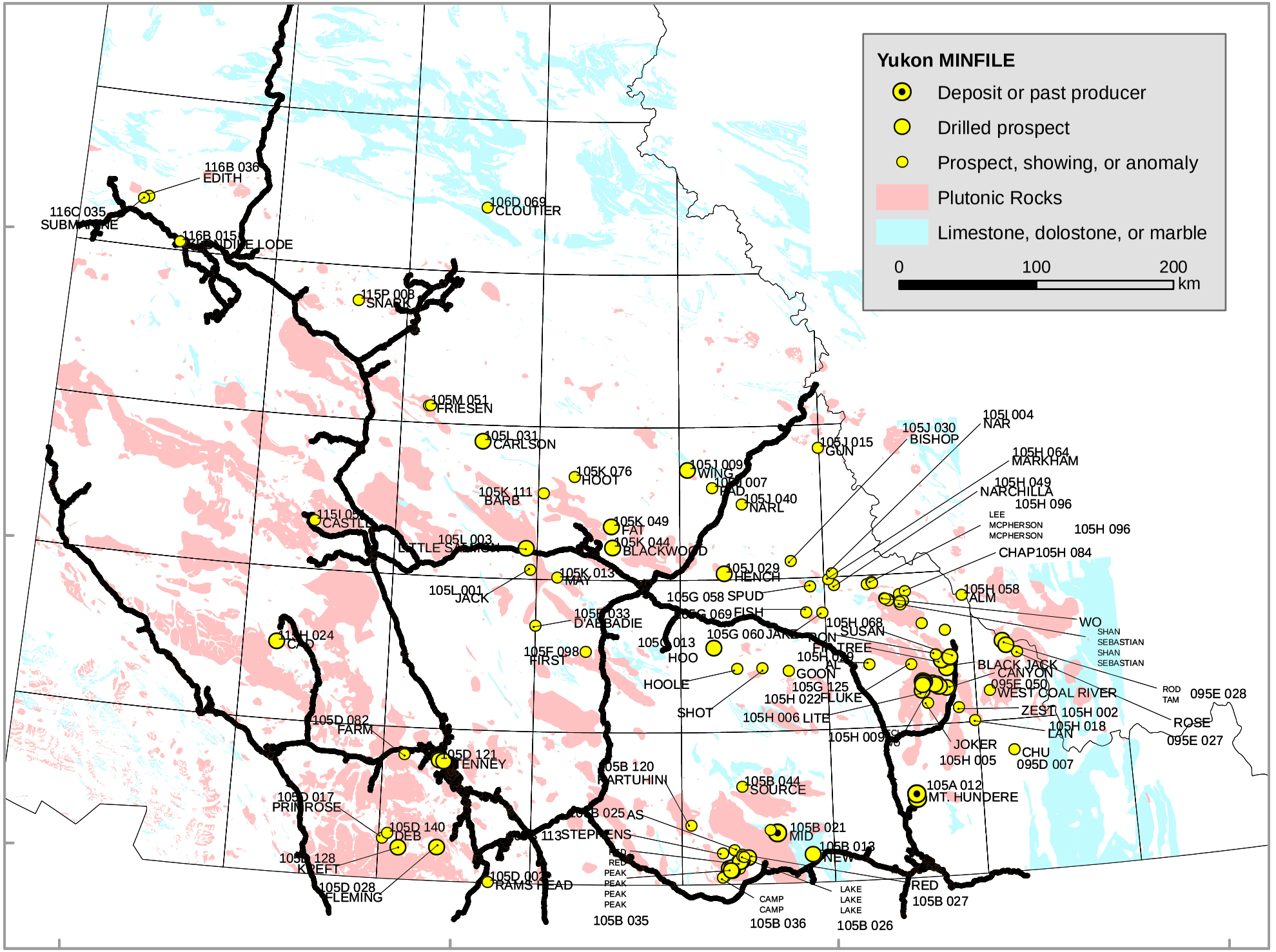
K02 - Pb-Zn Skarns - BC and Yukon deposits

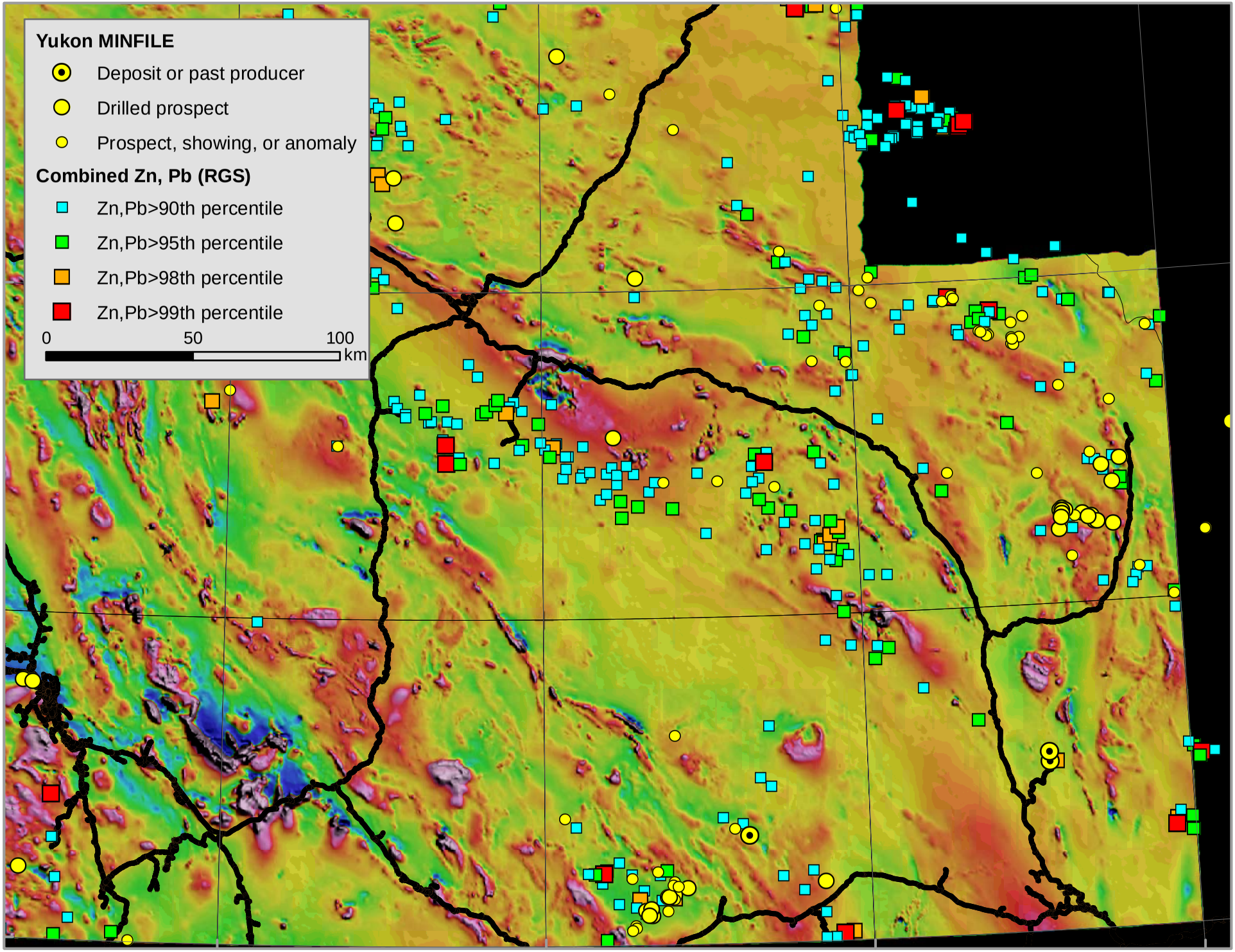
Deposit	country	tonnes	Ag (g/t)	Pb (%)	Zn (%)
CALEDONIA	CNBC	68 001	6.04	0.06	7.45
SMITH COPPER	CNBC	83 906	1.69	3.70	12.50
MT. HUNDERE (Ritco)	CNYK	2 440 000	44.90	1.10	12.60
MT. HUNDERE (Sa Dena Hess)	CNYK	2 900 000	65.00	8.40	12.90

Yukon MINFILE

MINFILE	NAMES	STATUS
105A 012	SA DENA HES, MT. HUNDERE	UNDERGROUND PAST PRODUCER
105A 013	RITCO, NORTH HILL, MT. HUNDERE, SA DENA HES	UNDERGROUND PAST PRODUCER
095E 012	HEATHER, TAM, SUD, ROD	DRILLED PROSPECT
095E 028	GRISWOLD, HEATHER, KEY, TAM, RIO	DRILLED PROSPECT
105B 013	KUBIAK, NEW, HAT	DRILLED PROSPECT
105B 026	ATOM, CRESENT LAKE	DRILLED PROSPECT
105B 027	BAR, DAN, WINDOW	DRILLED PROSPECT
105B 028	BOM, STQ, BOUND	DRILLED PROSPECT
105B 029	MUNSON, TBMB	DRILLED PROSPECT
105B 035	GODDART, DEAR, PEAK	DRILLED PROSPECT
105D 128	KREFT	DRILLED PROSPECT
105G 013	HOO	DRILLED PROSPECT
105G 125	GOON	DRILLED PROSPECT
105H 005	FLIP	DRILLED PROSPECT
105H 006	DC, DAY, EGG, TOBY, SUZANNE, LITE, TIE	DRILLED PROSPECT
105H 008	MIKO, MON, MARINA	DRILLED PROSPECT
105H 009	GLENNA, LAKE, CU, ACE, ECL, MARG, ARM	DRILLED PROSPECT
105H 011	MAX	DRILLED PROSPECT
105H 024	CANYON	DRILLED PROSPECT
105H 028	BLACK JACK	DRILLED PROSPECT
105H 029	FIR TREE	DRILLED PROSPECT
105H 050	LEE, PRIMO	DRILLED PROSPECT
105I 004	NAR	DRILLED PROSPECT
105J 009	RIDDELL, BOX, WING	DRILLED PROSPECT
105J 029	HENCH	DRILLED PROSPECT
105K 044	BLACKWOOD	DRILLED PROSPECT
105L 003	LITTLE SALMON	DRILLED PROSPECT
105L 031	CARLSON	DRILLED PROSPECT
105B 022	AURORA, TOUCHDOWN	PROSPECT
105D 140	DEB, ROSE	PROSPECT
105G 069	HARMAN, IRENE, FISH	PROSPECT
105H 018	GALE, LAN	PROSPECT
105H 031	RON	PROSPECT
105H 033	BROD	PROSPECT
105J 030	MARYLOU, BISHOP	PROSPECT
105K 013	THOMAS, LIL, MAY	PROSPECT
105L 001	LOKKEN, JACK	PROSPECT
106D 069	CLOUTIER	PROSPECT
116B 036	ROAL, MANOA, GALENA, EDITH	PROSPECT
095D 007	CHU	SHOWING
095E 050	WEST COAL RIVER	SHOWING
105B 031	MOD, BOUND	SHOWING
105B 036	SCREW	SHOWING
105B 044	IRVINE, ANGIE, COM, SOURCE	SHOWING
105B 113	STEPHENS	SHOWING
105B 120	KARTUHINI	SHOWING
105D 017	PRIMROSE	SHOWING
105D 082	FARM	SHOWING
105G 058	SPUD	SHOWING
105G 060	JAKE	SHOWING
105G 061	HOOLE	SHOWING
105G 119	SHOT	SHOWING
105H 010	STEELE, ELSA, ACE, ECL, MAR, WO, SCHEE, INN	SHOWING
105H 019	MAY, PJ, KAY, APEX, FRAN, AL, JA LO	SHOWING
105H 022	FLUKE	SHOWING
105H 037	TOY	SHOWING
105H 064	MARKHAM	SHOWING
105H 089	WO	SHOWING
105H 092	SHAN	SHOWING
105H 093	SEBASTIAN	SHOWING
105H 094	MT. BILLINGS	SHOWING
105H 096	MCPHERSON	SHOWING
105J 015	GUN	SHOWING
105J 040	NARL	SHOWING
116C 035	SUBMARINE, ROUGH NECK KID	SHOWING
105B 025	HIDDEN	ANOMALY
105K 076	HOOT	ANOMALY
105H 058	ALM	UNKNOWN



Map of Yukon showing Pb-Zn skarn occurrences and the distribution of plutonic and carbonate rocks



Map of southeast Yukon showing Pb-Zn skarn occurrences, Pb-Zn regional geochemistry and regional magnetics