Skarn deposits of China

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Skarn deposits are one of the most common deposit types in China, with >352 skarn deposits reported in the literature, ~22% of skarns publically reported in the world . They are China's major source for Sn (8.3 Mt, or ~94% of China's total Sn resources), W (6.3 Mt; ~80%), B >21 Mt B2O3; >50%), and high grade Fe (~57%) and Cu ores, important source for Cu (34 Mt; ~34%), Zn-Pb (67 Mt; ~29%), Mo (4.0 Mt; ~14%), Au (1,621 t; ~14%), Ag (35,314 t; ~14%), and Fe (2,658 Mt; >3%), Be, Bi, Cd, Co, Cr, Ga, In, Nb, Ta, Re, Sb, U, jade, quartz crystal, diopside, wollastonite, and fluorite.

Iron mainly occurs in Fe-only skarns (~75%) but also occurs in all other skarn types (2-7% of total Fe each) including reduced Sn skarns, as magnetite/mushketonite is common in many skarns. Copper mostly occurs in Cu skarns (71%) and Sn skarns (19%); the rest in Au skarns (6%), W skarns (2%), and Zn-Pb skarn (1%). Gold is mostly in Au-Cu skarns with various Au/Cu ratios (96%) and Zn-Pb skarn (4%). Molybdenum mostly occurs in Mo skarns (80%), W skarns (10%) and Cu skarns (8%). Most of the Zn-Pb is not in Zn-Pb skarns (25%) but in Sn skarns (63%). The rest of the Zn-Pb is in Au skarns (6%), W skarns (5%); with trace amounts in Fe and Mo skarns. Sn dominantly occurs in Sn skarns (93%) and W skarns (7%), whereas W dominantly occurs in W skarns (90%) and Mo skarns (8%). W-Mo and Sn do not occur together in significant amount. The only exception is big – the Shizhuyuan skarn with 0.5 Mt Sn, 0.6 Mt W and 0.2 Mt Mo.

Ca-skarns are more common than Mg-skarns, with boron-bearing skarns all Mg-skarns. The skarn formation followed the typical processes, starting with thermo-metamorphic skarns (calc-silicate hornfels and reaction skarns), then hydrothermal prograde skarn and subsequent retrograde alteration and mineralisation. New LA-ICP-MS single fluid inclusion analysis confirmed that metals have high concentrations in prograde fluids but the metal deposition only occurs at lower temperatures. Several metal zoning patterns have been documented, e.g. proximal Sn outwards to Cu then Zn-Pb, or Cu/Mo outwards to Zn-Pb. Gold occurs at both proximal and distal locations. Skarns are thicker at intrusion-carbonate contact. Outwards the system may follow bedding-parallel faults or lithological boundary continuously for >3 km, e.g. at Beiya.

Spatially the skarns are distributed in several clusters. 142 deposits have been dated. The 36 older skarns (~210-830 Ma) are dominantly in western China, except for 3 in eastern China. They occur in several subgroups: ~830 Ma (n=1; Dapingliang Cu skarn); 480-420 Ma (n = 8), 383-371 Ma (n=3), 323-305 Ma (n=6), and 262-210 Ma (n=18). Most of the skarns formed during 199-98 Ma (n=86), particularly in the period 169-130 Ma (n=62), all in eastern China. The third cluster of skarns are younger, 93-15 Ma (n=20), and they all occur in and along the SE edge of the Tibet plateau. This cluster can be further divided into three groups. The clusters correspond to major tectono-magmatic events.