

Large copper and gold systems of Kazakhstan and Tienshan: Geodynamics and metallogeny revisited

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Major porphyry Cu–Au/Mo deposits are distributed over almost 5000 km across central Eurasia, from the Urals Mountains in the west to north-eastern China. These deposits were formed during multiple magmatic episodes from the Ordovician to the Jurassic. They are associated with magmatic arcs within the extensive subduction–accretion complex of the Altaid and Transbaikali–Mongolian orogenic collages that developed from the late Neoproterozoic, through the Palaeozoic, to the Jurassic intracratonic extension. The arcs formed predominantly on the Palaeo-Tethys Ocean margin of the proto-Asian continent, but also within back-arc basins (Seltmann et al., 2014).

In the western Altaids (syn. Central Asian Orogenic Belt, CAOB), the Paleozoic accretionary belts of Kazakhstan and of the Northern, Middle and Southern Tienshan as well as suture-/shear zones and sedimentary basins of dominantly Permo-Triassic formation age establish central Asia, beside its hosted well-known world-class mine camps, as an emerging major commodity basket including undiscovered deposits under cover or undeveloped mineral potential still pending to be unlocked.

Significant porphyry Cu–Au/Mo deposits and intrusion-related Au deposits formed during the early Paleozoic in Kazakhstan (e.g., Bozshakol Cu–Au, Koksai Cu–Au; Vasilkovskoe Au stockwork) and Kyrgyzstan (Taldy Bulak porphyry Cu–Au); during Silurian to Devonian (e.g., Nurkazgan Cu–Au in Kazakhstan); Devonian in the Urals-Zharma arc (e.g., Yubileinoe Au–Cu in Russia); Carboniferous in the Kazakh-Mongol arc (e.g., Taldy Bulak-Levoberezhny Au in Kyrgyzstan; Kounrad Cu–Au porphyry and Aktogai Group of Cu–Au porphyry deposits in Kazakhstan); Carboniferous in the Valerianov-Beltau-Kurama arc (e.g., Kal'makyr–Dalnee Cu–Au porphyry in Uzbekistan; Benqala Cu–Au in Kazakhstan) – based on a review of published (Seltmann et al., 2014) and new CERCAMS age data.

In result of post-collisional extension and orogenic collapse each accretionary cycle (early, mid, late Paleozoic) is concluded by the formation of major lode Au deposits representing “orogenic-style” (and intrusion-related gold systems, IRG) as well as “Carlin-style” formations (Au associated with Sb-Hg mineralisation). These are often associated with alkaline, dominantly shoshonitic intrusions and related to major shear zones, often of trans-crustal nature, tapping deep reservoirs through tectonic pumping related to rapid uplift and decompression, that aid focused fluid flow driven by elevated thermal gradient. The peak gold mineralisation in the CAOB (comprising the vast majority of the known gold endowment) took place around the Carboniferous-Permian boundary at ~305-290 Ma, referred to as “jackpot” event. It is represented by famous mineral systems including Muruntau, Amantaytau, Kumtor, Bakyrchik

orogenic gold deposits, Zharmitan (IRG), Kochbulak (mesothermal gold), Dzhezkazgan (sedimentary copper), Khaidarkan, Kadamjai (auriferous Sb-Hg deposits).

In addition to the tectonic, geologic and metallogenic setting and distribution of the main Cu and Au mineral systems (porphyry Cu–Au/Mo, orogenic Au, sedimentary copper) within the CAO, the setting, geology, alteration and mineralisation of these deposits listed above is re-assessed based on new geochronological and isotope data (U-Pb zircon ages, Re-Os ages, Sr-Nd-Hf-Pb isotope data).

References:

Seltmann, R., Porter, T.M., Pirajno, F., 2014, Geodynamics and metallogeny of the central Eurasian porphyry and related epithermal mineral systems: A review, *J. Asian Earth Sciences*, 79, p.810 - 841.