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Mineral exploration models from simple fiction to complex reality

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Refining mineral exploration models and how to get them "from fiction to reality" may significantly increase the resource, leading to discovery of new ore bodies / deposits and reduce exploration costs. This presentation will feature examples from several case studies:

1) **Rudny Altai VHMS deposits and orogenic gold mineralization**: Some of the profitable gold mined in the Devonian Cu-Zn-Pb (Ag-Au) deposits of Rudny Altai is supposedly related to overprinting mineralisation of Permian age orogenic style, related to monzonitic dikes and intersecting shear zones. Rather than following the massive sulphide seams, tracking the gold credit requires a paradigm shift towards understanding the kinematic controls of emplacement of late- to post-collisional dikes, stocks and crosscutting structures.

2) **Continuum model for rare metal deposits** (case studies from Zinnwald/Cinovec and Eibenstock – Gottesberg / Erzgebirge; Mount Pleasant / Canada): whereas timing of fluid-buffered greisen formation is structurally controlled by ductile / brittle transition and brittle failure (sudden decompression, focused fluid flow), the earlier melt-buffered ore-bearing system may enrich dispersed ore elements (HFSE such as Nb, Ta, ...) to economic levels in the evolved host granite – historically often neglected and only realised by smelter credits.

Other mineral systems show in space and time the development of several interconnected deposit types where a single exploration model would not lead to success: the Mount Pleasant deposits combine features of Sn-W-base metal sulfide mineralisation of porphyry breccia type, followed by greisen stockwork and rare metal granite intrusions at depth.

The (plutonic) 325 Ma Eibenstock tin granite in Western Erzgebirge (Germany) got assigned a historic 300 kt tin potential but in fact it is just the Sn host, whereas most of the tin mineralisation is related to 310-315 Ma porphyry stocks & pipes (Bolivian style) hidden at depth. Wrong exploration model was used and paradigm change means that a previously 300m productive extension of tin potential is now open at depth with a vertical extension of up to 4000m!

3) **Main commodity versus by-product credit**: Speculative descriptive genetic models historically assigned one of the largest undeveloped tin deposits in the world to “metamorphogenic remobilisation of stratabound / stratiform Riphean massif sulphides”. Field surveys and assessment of documentation however revealed that there is a controlling shear zone that exhibits an alteration halo of granitophile elements (topaz, Rb, Cs, Be, W, Nb, Ta) and at depth a transition into a greisen stockwork in the surrounding of a tin granite. A verification attempt of drill core logs referring vaguely to "metasomatites" turned out to contain relic features and shadow textures of intersecting tin porphyries (that were reportedly drilled at depth). Assays and resource calculations of the latest exploration campaign focused on a very limited number of main elements but ignored a by-product potential doubling the expected ROI of the deposit.