Generalized Models of Porphyry Copper Deposits: Anatomy, Alteration Zoning and Lithocap Development

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Stephen Nano, a "Qualified Person" under National Instrument 43-101, has reviewed and approved the scientific and technical information in this presentation.

Generalized Porphyry Copper Model – Anatomy and Alteration Zoning

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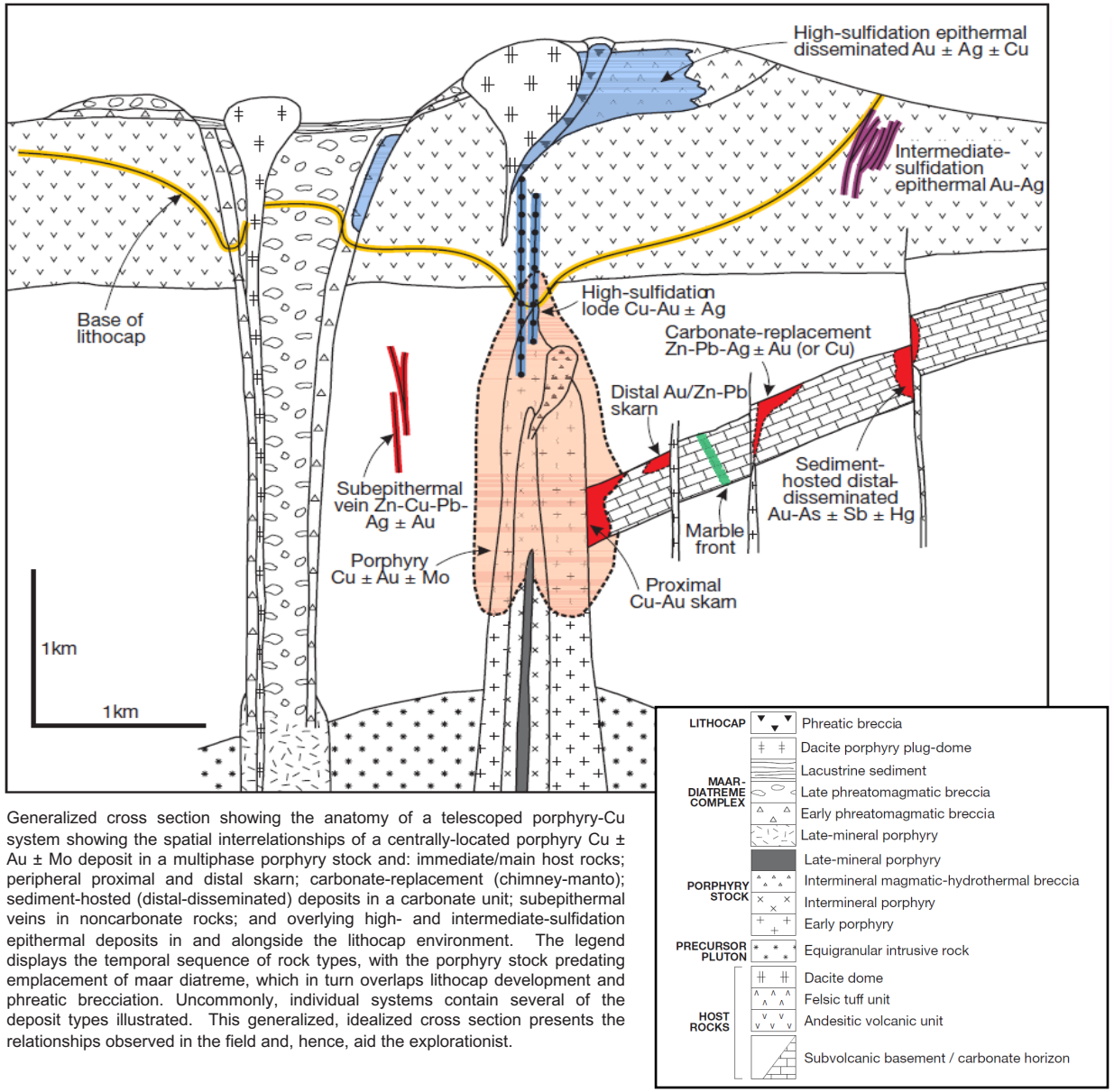
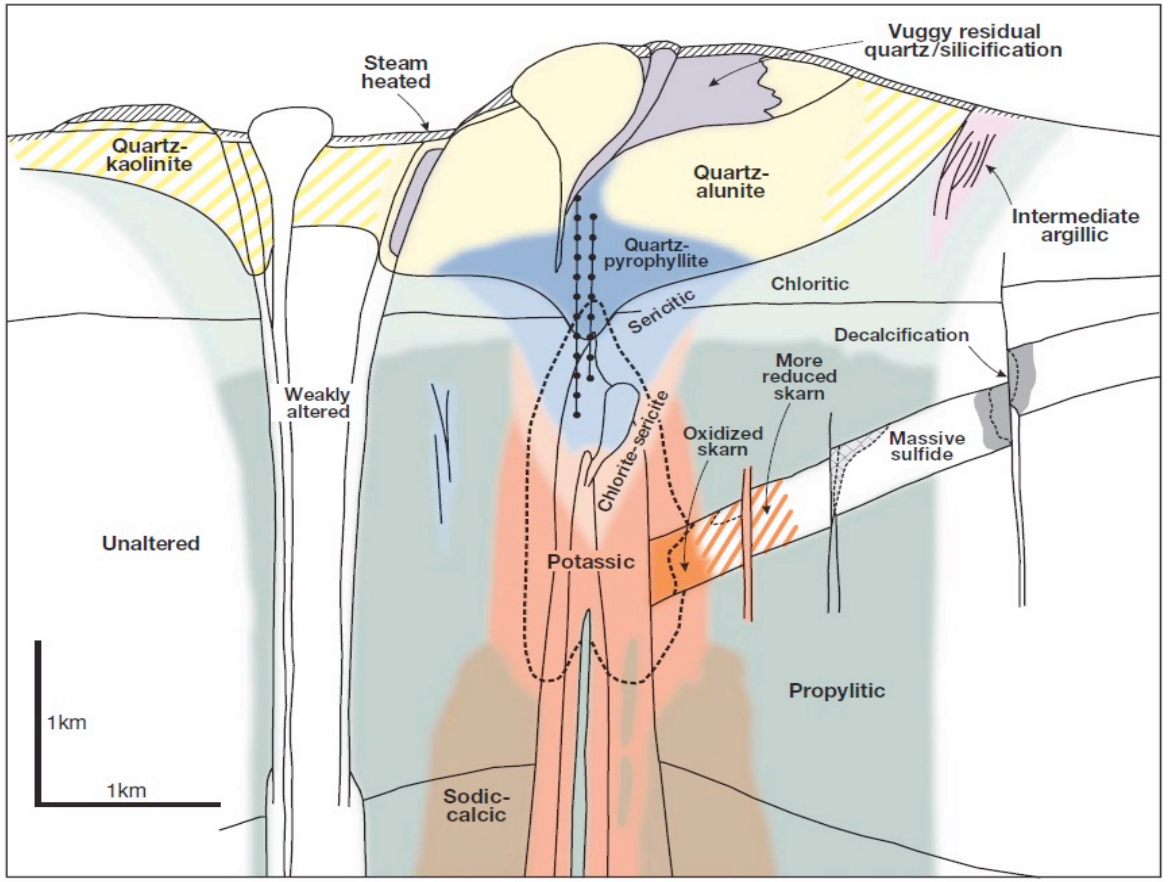
Anatomy of Calc-alkalic Porphyry Copper and Related Mineralization



Generalized cross section showing the anatomy of a telescoped porphyry-Cu system showing the spatial interrelationships of a centrally-located porphyry Cu ± Au ± Mo deposit in a multiphase porphyry stock and: immediate/main host rocks; peripheral proximal and distal skarn; carbonate-replacement (chimney-manto); sediment-hosted (distal-disseminated) deposits in a carbonate unit; subepithermal veins in noncarbonate rocks; and overlying high- and intermediate-sulfidation epithermal deposits in and alongside the lithocap environment. The legend displays the temporal sequence of rock types, with the porphyry stock predating emplacement of maar diatreme, which in turn overlaps lithocap development and phreatic brecciation. Uncommonly, individual systems contain several of the deposit types illustrated. This generalized, idealized cross section presents the relationships observed in the field and, hence, aid the explorationist.

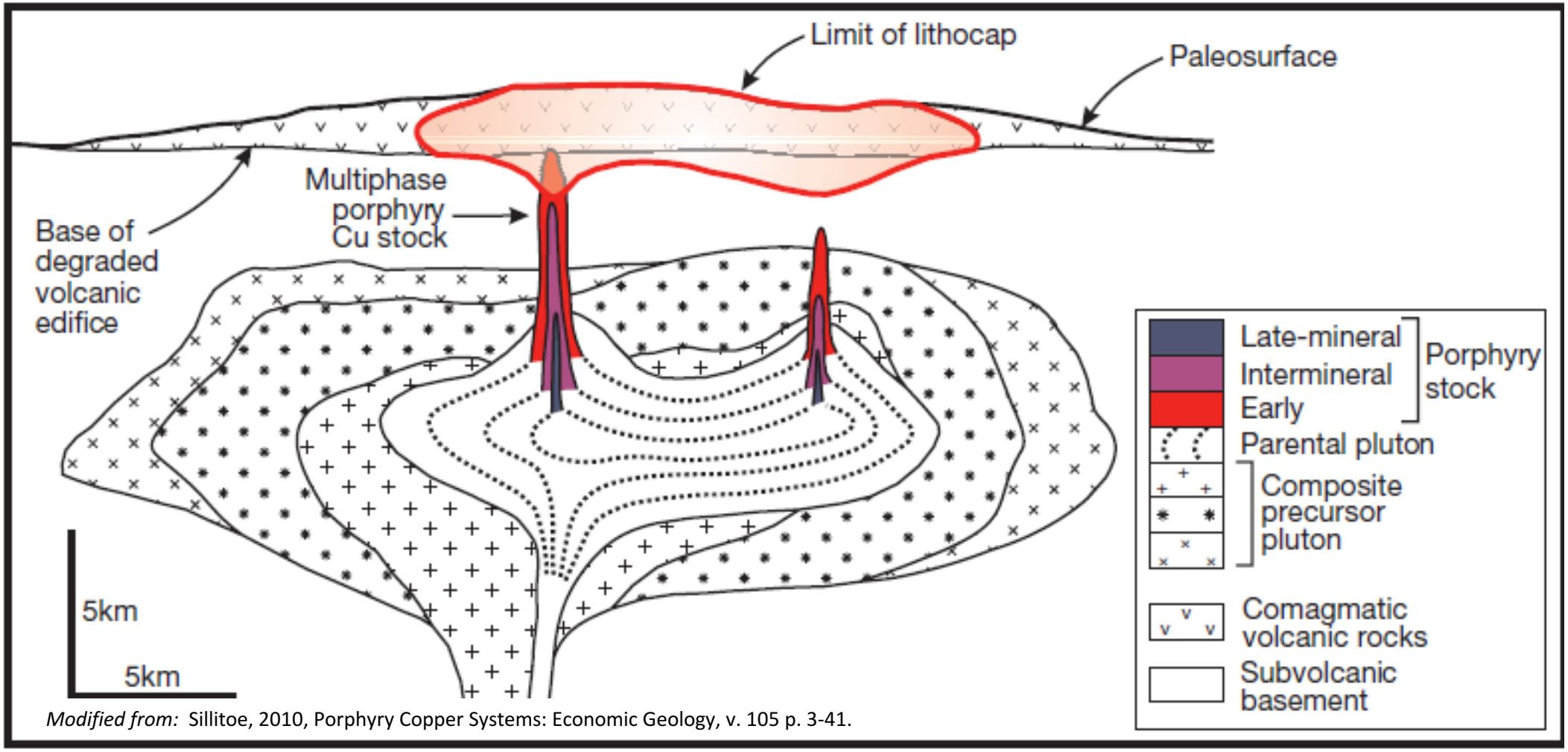
Alteration Zonation Patterns in Calc-alkalic Porphyry Systems



Generalized cross section of the alteration-mineralization zoning pattern for telescoped porphyry-Cu deposits, based upon the geologic and deposit type-template. Note that shallow alteration-mineralization types consistently overprint deeper ones. Volumes of the different alteration types vary markedly from deposit to deposit. Sericitic alteration may project vertically downward as an annulus separating the potassic and propylitic zones as well as cutting the potassic zone centrally, as shown. Sericitic alteration tends to be more abundant in porphyry Cu-Mo deposits, whereas chlorite-sericite alteration develops preferentially in porphyry Cu-Au deposits. Alteration-mineralization in the lithocap is commonly far more complex than shown, particularly where structural control is important.

Modified from: Sillitoe, 2010, Porphyry Copper Systems: Economic Geology, v. 105 p. 3-41.

Generalized Porphyry Copper Model – Lithocap Development



Modified from: Sillitoe, 2010, Porphyry Copper Systems: Economic Geology, v. 105 p. 3-41.

Cross section showing spatial relationships between porphyry-Cu stocks, an underlying pluton, overlying comagmatic volcanic rocks, and the lithocap. The precursor pluton is composite, multiphase, whereas the parental pluton is shown as a single body in which the concentric dotted-lines mark its progressive inward consolidation. The early, inter-mineral, and late-mineral phases of the porphyry-Cu stocks, which span the interval during which the porphyry-Cu deposits formed, originate from increasingly greater depths in the progressively crystallizing parental chamber. The overlying volcanic sequence is a stratovolcano (could also be a dome complex), partially eroded prior to porphyry-Cu formation. The lithocap alters the volcanic pile as well as uppermost-parts of the underlying rocks. Note that subvolcanic basement rocks host much of the porphyry-Cu mineralization of the left stock, whereas the mineralization associated with the right stock is mainly enclosed by two-phases of the precursor pluton.