SYN-TECTONIC FORMATION OF GIANT PORPHYRY COPPER AND INTRUSION-RELATED ORE DEPOSITS IN LINEAR BELTS BY DECOMPRESSION FLUID SATURATION OF REGULARLY SPACED DIAPIRIC PLUTONS ASCENDING FAULT RAMPS WITHIN THE ANTICLINAL HINGE OF THE FRONTAL CORDILLERAN FOLD AND THRUST BELT

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A regional genetic model is proposed for the origin of linear belts of porphyry Cu-Mo deposits including the giant deposit at Butte, Montana and a spectrum of smaller geochemically varied intrusion-related (Au, Ag, Cu, W, and Mo) deposits occurring south west of Butte within the Pioneer Mountains defined herein as the Butte-Pioneer Mountains Mineral Belt. A linear belt with a regular spacing of about 7 km extends through the Pioneer Mountains from the Divide District on the north ending at Bannack on the south. All of these ore deposits including the Quartz Hill, Cannivan Gulch, Hecla, Argenta, and Bannack Districts, many of which are localized within dome structures, occur along a single north-south trending regional anticlinal hinge of the frontal (easternmost) anticline of the Cordilleran fold and thrust belt of Sevier (Late Cretaceous) age. Regional interpretation combined with new geological mapping integrates structural, magmatic, and hydrothermal processes into a set of a numerical process-based models consistent with an idealized east-west cross section published by Kalakay and others (2001) addressing problems associated with syncompressional pluton emplacement centered on the need to make room for magma in environments where crustal shortening, not extension, occurs on a regional scale. Their cross section asserts that pluton emplacement in syncompressional environments could be facilitated at the top of frontal thrust ramps as composite tabular bodies where pluton emplacement was accommodated by: (1) a magma feeder zone created along the ramp interface; (2) providing "releasing steps" at ramp tops that serve as initial points of emplacement and subsequent pluton growth; and (3) localizing antithetic back-thrusts that assist in pluton ascent. The assertion that "releasing steps" in fault-propagation folds could provide space or zones of lower pressure aiding magma ascent is supported by Finite Element Modeling (FEM) by Nemcok and Henk (2006) of an analogous fold-and-thrust belt explored for oil in the Western Carpathians Mountains showing the existence of an overall mean stress decrease inside the thrust sheet anticlines. Besides facilitating magma ascent, we infer that these localized lower pressure zones may also provide a mechanism for inducing magmatic water saturation thus converting the potentiality of water saturation and magmatic-hydrothermal mineralization into a near inevitability and explaining the ubiquitous mineralization and alteration of many of the plutons in the Butte-Pioneer Mineral Belt. Besides the commonality of magmatic water saturation in the ore-forming plutons, we also propose here a mechanism that explains the regular spacing of mining districts. From aerially extensive buoyant ribbon-like layers presumed at depth along thrust fault flats, our calculations show diapiric ascent occurring at regular spacing determined by Rayleigh-Taylor instabilities. Ascent of magma up along trust ramps into the anticlinal hinge zone supplies an additional component of hydrostatic head that pushes the melt up-dip, which feeds the diapir more easily, allowing it to rise more quickly from the source and hence, escape crystallization. In the absence of diapiric ascent, magmas would otherwise tend to rapidly cool and crystallize lacking enough thermal inertia to remain liquid in the form of a dike or sill.