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Title: EXPLORATION FOR EPITHERMAL GOLD DEPOSITS: POTENTIAL CAUSES OF MINERALIZED VERSUS BARREN SYSTEMS

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Abstract: Epithermal systems are common in the less-eroded portions of volcanic arcs and rifts, as they are formed within ~1 km of the paleosurface by hydrothermal systems driven by intrusions. The wide range of characteristics reflects a position either proximal to or distal from the causative intrusions. 1) Quartz veins with common adularia, and fine colloform banding and other textures, indicate that boiling fluid deposited Au from bisulfide complexes. The veins can cover a large area, up to several or 10s km^2; the alteration halo width depends on host-rock permeability. Some have bonanza grades of Au in narrow bands; sulfide minerals are sparse and independent of Au, dominated by pyrrhotite, arsenopyrite, and other low sulfidation (LS)-state minerals. Strong anomalies in As, Sb, and Hg reflect the low-T environment, particularly where there is evidence of paleosurface, e.g., sinters and blankets of steam-heated kaolinite-alunite-cristobalite. By contrast, 2) residual quartz cores to structural feeders, mushroomed into lithocaps where lithologic permeability allows, have halos of quartz-alunite alteration with kaolinite, dickite, pyrophyllite, etc.; the leached, residual cores and halos of advanced argillic alteration indicate a highly reactive early fluid, proximal to an intrusive center. In many systems, only the residual quartz and advanced argillic halo is present, whereas fewer systems have a strong overprint of silicic alteration, i.e., silica addition to form a massive silicic rock that may have a vuggy texture; several 10s ppb Au, to 100 ppb or more, can be introduced during leaching and initial silicic plus pyrite alteration. In even fewer systems there is later introduction of high sulfidation (HS)-state enargite plus late tennantite, chalcopyrite and Au.

Why are most epithermal systems, despite typical characteristics, not mineralized to a significant extent? The abundance of Au in the fluid of LS deposits is proportional to H_2S concentration. Deposits in Nevada and around the world are associated with bimodal rhyolite-basalt magmatism; since H_2S solubility in basalts is at least 20x greater than felsic rocks, whether or not there is a basaltic H_2S contribution may determine the total Au able to be transported by the fluid, and thus the amount available to precipitate if fluids are focused and boiling. By contrast, the strong magmatic signature of HS deposits, and relation to the phyllic stage of underlying porphyry systems, suggests that poorly developed phyllic stages may limit a potential ore-fluid contribution to the

lithocap. Alternatively, since lithocaps form at various distances above the causative intrusion, where hydraulic gradients prevent the phyllic fluid from rising to the level of the lithocap, HS mineralization of an otherwise typical lithocap will not occur; however, there may be lateral flow to distal intermediate-sulfidation veins at some level between the barren lithocap and the top of the porphyry, 1-5+ km distant.