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Fluid Flow in Strike-slip Fault Regimes: a Co-Dynamic Model for Petroleum Fluid Formation, Movement, and Deposition by Analogy with Porphyry Metal Deposits

Faults are not merely passive conduits and seals that statically receive and trap fluid sometime after their formation. Rather, fluid formation, movement, and deposition within any fault system is characteristically an active process that co-dynamically conjoins fault kinematics with fluid generation, flow, and accumulation. In strike-slip fault settings, porphyry metal deposit analogs (Carlin North Trend of Nevada) indicate a synkinematic relationship between strike-slip fault movements, the emplacement of pluton gold sources, and the release of gold-bearing fluids into wedge-like stratigraphic traps. The most economic traps involve the intersection of favorable stratigraphy with the footwall of P-shear conduits. Where this stratigraphy is blocked in its updip portions by other faults that mark changes in dip domain or juxtapositions with unfavorable stratigraphy, a wedge-like "trap" is formed that can be associated with especially high grade gold accumulations (e.g., Meikle mine). Similar configurations may trap large accumulations of petroleum in strike-slip fault environments (e.g., Jonas gas field in northwest Wyoming). In both cases, the fluids utilized a curved path in moving from the P-shear conduit to the stratigraphic wedge. The curved trajectory appears to be characteristic of fluid migration in both porphyry metal and petroleum accumulations related to wrench fault tectonism. Fluid movement from high pressure to low pressure trap sites results in fractionation and compositional zonation for both mineral and petroleum situations. Fluid movement and its fractionation are necessary products of interactively coordinated kinematics within the strike-slip fault system and, more importantly, specifically predict economic targets.