

The Long-Term Hydrologic Cycle: Stable Isotope Clues for Fluid Pathways in Earth's Crust

Dr. Gregory J. Holk

Department of Geological Sciences, California State University, Long Beach

The circulation of aqueous fluids through the Earth's crust has profound effects on its geologic evolution, the formation of ore deposits, the migration of hydrocarbons from source to sites of accumulation, and the storage of groundwater resources. Major crustal-scale fault zones and crustal heat distribution both play a major role to determine fluid pathways. Case studies that showcase the interplay between crustal thermal evolution and the permeable zones, such as major crustal shear zones, are presented to demonstrate the importance of fluids on the tectonic evolution of the Earth's crust and the formation of ore deposits. These studies include: (1) the role of water in the magmatic and tectonic evolution of metamorphic core complexes at the Southern Omineca Belt, British Columbia (Holk and Taylor, 2007) and the southern White Pine Range, east-central Nevada, (2) metamorphic fluids and the evolution of the Cretaceous-Paleocene subduction zone complex in southern California with a focus on large-scale infiltration of metamorphic fluids generated during shallow subduction into the Eastern Peninsular Ranges Mylonite Zone (Holk et al., 2006) and the generation of these fluids from the Catalina and other subduction-related schists, (3) a 1 billion year fluid evolution of sedimentary basins that host the world's largest uranium deposits (Holk et al., 2003), and (4) Archean submarine hydrothermal systems associated with felsic caldera systems that host massive sulfide deposits (Holk et al., 2008).

References

- Holk, G.J., Kyser, T.K., Chipley, D., Hiatt, E.E., and Marlatt, J. (2003) Mobile trace elements and Pb-isotopes during late-stage evolution of Proterozoic sedimentary basins hosting uranium deposits. *Journal of Exploration Geochemistry*, v. 80, p. 297-320.
- Holk, G.J., Taylor, H.P., and Gromet, L.P. (2006) Stable isotope evidence for large-scale infiltration of metamorphic fluids generated during shallow subduction into the Eastern Peninsular Ranges Mylonite Zone (EPRMZ), Southern California. *International Geology Review*, v. 48, p. 209-222.
- Holk, G.J., Taylor, B.E., Galley, A.G. (2008) Oxygen isotope mapping of the Archean Sturgeon Lake caldera complex, Northwestern Ontario, Canada. *Mineralium Deposita*, v. 43, p. 623-640.
- Holk, G.J., and Taylor, H.P. Jr. (2007) $^{18}\text{O}/^{16}\text{O}$ studies of regional metamorphism, anatexis, extensional magmatism, meteoric-hydrothermal activity, and ore deposition in the Valhalla metamorphic core complex, British Columbia. *Economic Geology*, v. 102, p. 1063-1078.