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Significance of aluminum phosphate-sulfate minerals associated with U unconformity-type deposits: The Athabasca basin, Canada

Stéphane Gaboreau,[1,2,*] Michel Cuney,[3] Dave Quirt,[4] Daniel Beaufort,[1] Patricia Patrier,[1] and Régis Mathieu[5]

[1]Laboratoire HydrASA CNRS-UMR 6532, Université de Poitiers, bât de Géologie, 40 Avenue du Recteur Pineau, 86022 Poitiers-Cedex, France
[2]ERM SARL, Laboratoire-Bureaux, Université de Poitiers, bât de Géologie, 40 Avenue du Recteur Pineau, 86022 Poitiers-Cedex, France
[3]CREGU UMR G2R 7566, Université Henri Poincaré, Nancy I, BP 23-F54 506 Vandoeuvre les Nancy cedex, France
[4]COGEMA Resources Inc., P.O. Box 9204, Saskatoon, SK S7K 3X5, Canada
[5]COGEMA-BUM-DEX, 2 rue Paul Dautier, BP 4, F 78141 Vélizy Cedex, France

Abstract

Aluminum phosphate-sulfate (APS) minerals formed around the Athabasca unconformity-type deposits and those from their Australian counterparts are chemically very similar showing the same continuum between the diagenetic Sr-rich APS minerals of the barren sandstones and the LREE-rich composition of the APS minerals in the hydrothermally altered sandstone. The P- and LREE-rich compositions were controlled by the transport and the redistribution of P and LREE elements released from the dissolution of phosphate minerals (principally monazite) in the basement rocks and in the basin during the syn-ore alteration processes.

The S/Sr ratio measured in the APS minerals from unaltered sandstone away from the unconformity and any mineralization is preserved during the syn-ore alteration processes suggesting that the fluids involved in both the deep burial diagenetic processes and the syn-ore alteration system were derived from a similar diagenetic reservoir in both the Athabasca and Kombolgie regions.

The trioctahedral chlorite host-rock alteration around the Australian basement-hosted U deposits, as compared to the illite and sudoite associated with the Athabasca basement-hosted, along with the more LREE-rich APS compositions in the Australian deposits, suggests that the pH and oxygen fugacity (f_{O_2}) of the syn-ore fluids differed in the alteration systems of the two regions at the time of the U deposition.

Keywords: APS minerals, florencite, goyazite, svanbergite, unconformity-type uranium deposits, Athabasca basin, clay minerals, geochemistry