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Fluid-rock interaction: a mineral deposits perspective

PILAR LECUMBERRI-SANCHEZ[1], **BENJAMIN M. TUTOLO**[2] AND SHAUN BARKER[3]

[1]University of Alberta
[2]University of Calgary
[3]University of British Columbia

Presenting Author: benjamin.tutolo@ucalgary.ca

The distribution of many elements in Earth is controlled by fluid-rock interaction, and the ultimate record of these interactions are the mineral deposits they leave behind. The dominant fluids in Earth are silicate melts at depth and aqueous fluids at shallower crustal conditions. This presentation, based on the Treatise on Geochemistry chapter of the same name, describes recent advances and frontiers in quantification of water-rock interaction from a numerical and analytical perspective. We begin by discussing recent advances in the development of thermodynamic, kinetic, and reactive transport models to evaluate water-rock interactions. With this foundation, we then discuss the various analytical techniques that can be used to analyze minerals and fluids contained within mineral deposits, and link these data sets to the required inputs for geochemical and reactive transport models of these processes. Finally, we discuss the broad and diverse range of mineral deposits on which these combined techniques are now offering insights. Finally, we discuss frontiers in thermodynamic modelling, analytical geochemistry, and genetic models, and particularly highlight the ways in which new numerical and analytical techniques are being developed to meet the challenge of deposits created by atypical fluids, such as those dominated by hydrocarbons, other volatiles, low-density water vapor, and ionic liquids.