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Effects of Basin-Scale Fluid Flow and Diagenesis on the Evolution of Formation Waters in the West-Central Part of the Alberta Basin, Canada

The origin and evolution of formation waters were investigated in the west-central part of the Alberta Basin in Canada, with the aim to determine how these waters were affected by fluid flow and diagenesis. The major ion chemistry of formation waters from various aquifers throughout the entire stratigraphic succession was used to identify: a) how deep meteoric water has penetrated into the subsurface, and to what extent it has flushed connate formation waters, b) areas of cross-formational flow and mixing, where intervening aquitards are weak or missing, and c) processes that influence and alter formation water chemistry. Elucidation of these issues helps to better understand the interaction of different flow systems in the Alberta Basin and to characterize the evolution of formation waters with respect to the basin history.

Using mainly salinity and Na/Cl distributions, the formation waters can be divided into four main groups: 1) Tertiary-Upper Cretaceous - mainly meteoric water, 2) Lower Cretaceous - various degrees of mixing between seawater and meteoric water, 3) Jurassic-Mississippian - evaporated seawater that was altered by halite dissolution and dolomitization, and 4) Devonian-Cambrian - evaporated seawater that underwent a high degree of water-rock interaction (dolomitization, halite dissolution), and albitization of feldspar. Mixing of these waters is inhibited by the combination of competent intervening shale aquitards and weak flow-driving mechanisms in the deep parts of the stratigraphic succession.