

Dolomitization of the Palaeozoic Successions in the Huron domain of southern Ontario, Canada: A record of Fluid Compartmentalization and Evolution

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As part of an ongoing investigations into the suitability of the Paleozoic sedimentary rocks of southern Ontario for siting a deep geological repository (DGR) for used nuclear fuel, carbonate paleogenesis is being investigated as a proxy for detecting potential anisotropy that may hinder the effectiveness of the geological barrier surrounding a DGR. As part of Ontario Power Generation's low and intermediate level nuclear waste DGR; a previous investigation of the occurrence of strata bound dolomite layers within Paleozoic-age formations at the Bruce nuclear site in Ontario Canada, provided a site-specific analogue to examine fluid migration and rock-formation barrier integrity at geological timescales. Results showed that hydrothermal alterations were minimal, burial-related and lacked isotopic signatures associated with fault-controlled diagenesis as observed in other regions southern Ontario. Results from this previous work program were used to expand the work from site-specific to regional scale, to determine if the conditions observed at the Bruce nuclear site are consistent across the Huron Domain of southern Ontario. Core samples from multiple deep boreholes within the Huron Domain of southern Ontario were analyzed for petrographic, stable and Sr isotopic composition, fluid inclusion microthermometry and major, trace and REE to characterize diagenetic history, fluid composition and sedimentary provenance. Results suggest that diagenesis is predominantly uniform across the Huron domain, driven by Paleozoic orogenesis. Paleozoic formations display few signs of significant vertical connectivity beyond formation tops, except in rarely occurring zones containing highly localised heterogeneity (faults). The results of this study demonstrate a lack of evidence to support the presence of pervasive faulting within Huron Domain region of Southern Ontario.