Multistage Fault-Related Dolomitisation of the Middle Cambrian Mount Whyte and Cathedral Formations: Insights Into the Tectonic and Diagenetic History of the Western Canada Sedimentary Basin

Jack E. Stacey[1], Ardiansyah I. Koeshidayatullah[1], and Cathy Hollis[1]

[1]School of Earth and Environmental Sciences, University of Manchester, Manchester, Greater Manchester, United Kingdom.

ABSTRACT

The differentially dolomitised Devonian carbonates of the Western Canada Sedimentary Basin (WCSB) have been extensively studied due to their importance as prolific hydrocarbon reservoirs. There are known to be multiple phases of dolomitisation, including so-called hydrothermal dolomitisation, which occurs along major faults within the WCSB. Dolomitised outcrops of the Middle Cambrian Mt Whyte and Cathedral Formations exhibit comparable textures to the Devonian and are used here as analogues, to determine the processes responsible for the formation of these dolomite bodies. The outcrops are located near Whirlpool Point, northwest of Banff National Park, Alberta. The main structural elements in the area are NE/SW trending normal faults inherited from the Precambrian basement. The Mt. Whyte Fm. overlies the coarse-grained siliciclastics of the Gog Group, followed by the Cathedral Fm. and capped by the Stephen Fm. (Burgess Shale). Both formations contain non-stratabound bodies of dolomite, 10s of metres or more in diameter, proximal to faults. Whereas the Mt. Whyte Fm. has an apparently homogeneous texture in outcrop, and is dominated by planar, subhedral replacive dolomite in thin section, the Cathedral Fm. exhibits high degrees of fracturing, brecciation and zebra dolomite formation. Correspondingly, petrographic studies indicate well-developed multi-stage saddle dolomites in the Cathedral Fm., whereas the Mt. Whyte Fm. only contains a single-phase saddle dolomite. The WCSB has undergone a complex structural history, including three major orogenic events. Current models interpret fault controlled dolomitisation of Cambrian and Devonian strata to be related to the Laramide (Late Cretaceous-Eocene) Orogeny, but may also be influenced by the Antler Orogeny (Devonian-Carboniferous). This new study will assess the importance of prior dolomitisation and structural complexity on the location of fault-controlled dolomite geobodies through time, and the various morphologies of the dolomite-limestone contact. Initial observations indicate that Cambrian and Devonian dolomite bodies are proximal to faults, show an abrupt transition into calcite, and overlie siliciclastic and basement aquifers, sharing similar features with global examples of fault-controlled dolomite reservoirs. Therefore, this study should provide greater insight into the controls on the occurrence of these deposits.