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Multiple phases of diagenetic fluid flow and hydrocarbon migration in the Montney Formation: Fluid inclusion and stable isotope evidence

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Summary

The Montney Formation in Alberta and British Columbia, Canada is an early Triassic siltstone currently in an active diagenetic environment at depths greater than 1,000 m, but with maximum burial depths potentially exceeding 5,000 m (Ness, 2001). It has undergone multiple phases of burial and uplift and there is strong evidence for multiple generations of hydrocarbon maturation/migration. Understanding the origin and history of diagenetic fluids within these systems helps to unravel the chemical changes that have occurred since deposition.

Many cores taken near the deformation front display abundant calcite-filled fractures including vertical or sub-vertical, bedding plane parallel (beefs), and brecciated horizons with complex mixtures of vertical and horizontal components. We analyzed vertical and brecciated horizons to assess the timing and origin of fluid flow and its implications for diagenetic history of the Montney Fm. Aqueous and petroleum bearing fluid inclusions were observed in both vertical and brecciated zones; however, they did not occur in the same fluid inclusion assemblages. Petroleum inclusions occur as secondary fluid inclusions (e.g. in healed fractures and along cleavage planes) alongside primary aqueous inclusions indicating petroleum inclusions post-date aqueous inclusions and suggest multiple phases of fluid flow is recorded within these fractures. Raman spectroscopy of aqueous inclusions also display no evidence of petroleum compounds supporting the absence or low abundance of petroleum fluids during the formation of aqueous fluid inclusions. Pressure-corrected trapping temperatures (>140°C) are likely associated with the period of maximum burial during the Laramide orogeny based on burial history modelling. Ice melt temperatures of aqueous fluid inclusions are consistent with 19% NaCl equiv. brine and eutectic temperatures (-51°C) indicate NaCl-CaCl2 composition. Combined use of aqueous and petroleum fluid inclusions in deeply buried sedimentary systems offers a promising tool for better understanding the diagenetic fluid history and helps constrain the pressure-temperature history important for characterizing economically important geologic formations.

Theory / Method / Workflow

Results, Observations, Conclusions

Novel/Additive Information

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References

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