Fluid characteristics of a quartz-carbonate vein in the Canadian Rocky Mountains

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Abstract

Different vein generations can be identified within a hand specimen of a quartz-carbonate vein system from the Rocky Mountains. Textural analysis of thin sections reveals a relative age of the veins. Analyses of calcite minerals of the older vein yield relatively low SrO contents of 0.22 wt% with little variation and relatively low MgO contents of 0.43 wt%. The calcite of a younger vein contain SrO contents ranging from 0.18 to 0.41 wt% and higher MgO contents ranging from 0.58 to 0.64 wt%. Melting temperatures of ice of primary fluid inclusions in calcite range between -3.7 to -4.2°C and -2.1 to -2.7°C for the older and younger vein, respectively.

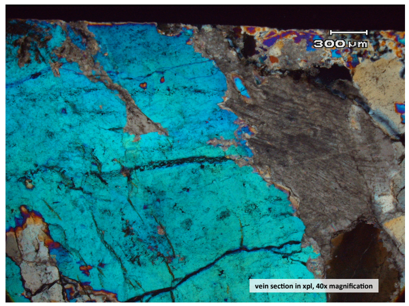
Introduction

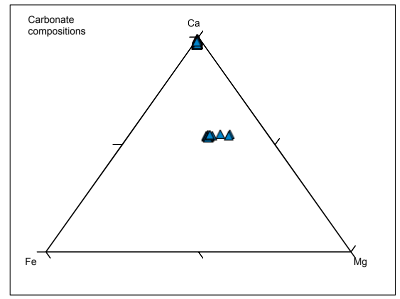
This study aims to characterize the origin of fluids involved in the emplacement of a vein system located in the Southern Canadian Cordillera, east of the Rocky Mountain Trench, located between Golden and Field BC, Canada. Previous studies propose deeply convected meteoric waters to play a primary role in the vein formation. This interpretation, however, is based on bulk rock isotope analysis, which can be problematic because primary and secondary fluid inclusions are analyzed from a bulk sample [1].

Late meteoric fluid infiltration along faults will potentially interact with the wall rock and create fluid inclusions carrying the isotopic signatures of meteoric fluids [2]. We analyzed carbonates, established textural phase relations, and performed microthermometry on primary fluid inclusions of calcite and quartz [3]. Next steps of this study will include isotope analysis of selected fluid inclusions.

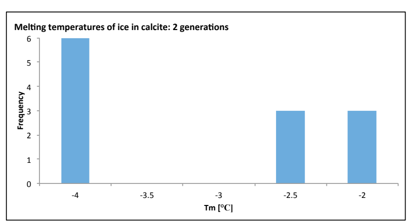
Results

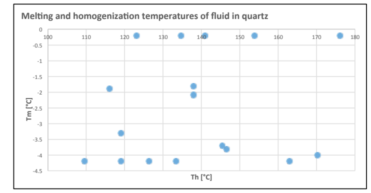
Two vein generations can be observed in thin section: a relatively older carbonate vein is cross-cut by a quartz-carbonate vein, displaying sharp contacts. The sedimentary wall rock contains clusters of pyrite and is rich in apatite and monazite and has sharp contacts to the veins. Carbonates from the two veins display different compositions: calcite of the older vein has a SrO content of 0.22 wt% with little variation and the calcite of the younger vein yields a range from 0.18-0.41 wt%.

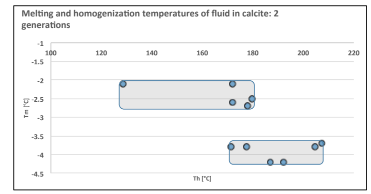


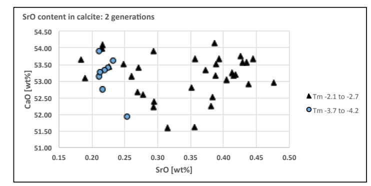


Primary fluid inclusions in calcite and quartz were selected for microthermometry. In general, the fluid inclusions in quartz and calcite have a liquid and a vapor phase at room temperature. Overall, the fluid inclusions were rather small in size and difficult to analyze. Only one melting point of the ice was observed. Quartz for the most part displayed signs of deformation and only grains embedded by calcite seemed to have truly primary inclusions. Fluid inclusions in calcite of the different vein generations have different melting temperatures (Tm). The older carbonate vein has lower Tm between -3.7 to -4.2°C, whereas the younger calcite contains fluids that melt between -2.1 to -2.7°C. Homogenization temperatures seem to range from mid to high (171-207°C) for the older calcite with the lower Tm, and tend to be low to mid-range (128-179°C) for the younger calcite (more data is required). Tm for quartz are problematic due to deformation and display a wide range.









Conclusions

Textural analysis of thin sections is crucial for the selection of minerals for further analysis. Bulk sample isotopic analysis seems problematic for two reasons a) because fragments of older mineral grains can get incorporated into a younger vein, and b) because primary and secondary fluid inclusions are analyzed. We found two vein generations with consistently different melting temperatures and hence salinities: the older carbonates with a generally low SrO content of 0.22 wt% contain a fluid with a salinity of 6.01-6.74 wt% NaCl and the younger carbonates with varying SrO contents contain a fluid with a salinity of 3.71-4.49 wt% NaCl [4]. Isotopic analysis of selected inclusions will be the next step.

References

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[2] Kyser and Kerrich, 1991, The Geochemical Society, Special Publication No. 3

[3] e.g. Bodnar, 2003, Mineral. Assoc. Canada, Short Course 32

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