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Structural controls and geochemistry of hydrothermal fluid flow in an exhumed accretionary prism, Otago Schist, New Zealand

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This study examines the structural controls, geochemistry and sources of hydrothermal fluid flow within the Otago Schist of New Zealand, a regionally extensive belt of metamorphic rocks that represents an exhumed Mesozoic accretionary wedge formed on the Gondwana margin. Arrays of quartz-calcite veins are found throughout the Otago Schist, where they are often associated with brittle-ductile fault zones, joints and gold mineralisation. Different generations of veins have previously been linked to dewatering within the Mesozoic accretionary prism and underlying slab, or to Cenozoic fluid flow events related to the evolution of the young Alpine orogenic system. Most of the now exposed vein systems formed at depths of several km's to mid-crustal levels. However, on the wave-cut platform at Bruce Rocks near Dunedin, circulation of hydrothermal fluids lead to extensive en-echelon vein networks within greenschist-facies metasedimentary host rocks, probably within several hundred meters of the paleo-surface. Field observations show that the youngest phase of deformation and fluid flow resulted in the formation of multi-generational hydrothermal breccias that are millimeters to meters thick. The breccias contain angular clasts of host rocks within carbonate- and sulfide-bearing cement. The breccias are surrounded by alteration halos that contain iron oxides and carbonate and extend for at least several meters. These attest to percolation of CO_2-bearing fluids from the breccias in to the wall rocks. Smaller hydrothermal breccia intruded along pre-existing fractures and faults, whereas the larger (> metre scale) breccias deformed and penetrated the host rocks. Samples from Bruce Rocks are being analyzed by optical microscopy, SEM and LA-ICP-MS to characterize the mineralogy and element distribution that occurred during fluid flow. We expect LA-MC-ICP-MS in-situ Sr isotope analysis to be conducted within the next six months to enable the hydrothermal fluid source and/or degree of wall rock reaction to be ascertained. These hydrothermal breccias therefore provide insight into the structural controls and element mobilization in hydrothermal vein systems formed in the shallowest levels of an orogen.