Structural Analysis of the Hyde-Macraes Shear Zone Hosted Gold Deposit, Aotearoa-New Zealand

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Shear zones play an important role in the formation of hydrothermal ore deposits by acting as major conduits for metal-bearing fluids. Deformation enhances porosity and permeability within shear zones, allowing fluids to migrate and accumulate in the Earth's crust. Despite the significance of shear zones in the formation of ore deposits, the processes controlling fluid flow through actively deforming rocks remain poorly understood, largely due to the complex feedback between deformation and fluid migration.

This research focuses on the Hyde-Macraes Shear Zone (HMSZ) in New Zealand's South Island, which hosts the economically significant Macraes gold deposit. Although the lithology and mineralisation of the deposit are well-documented, few have considered how evolving structures within the shear zone control fluid flow and ore deposition. In deforming shear zones, structures that localise mineralisation evolve progressively with increasing strain, influencing where and how fluids are concentrated. Rocks within HMSZ have undergone a complex structural evolution, with quartz-rich and quartz-poor lithologies deforming differently during shearing, creating variations in stress distribution. Since fluids preferentially migrate from high to low pressure zones, this structural evolution likely influenced the formation of fluid pathways. Understanding the relationship between different structures and mineralisation is crucial for understanding fluid flow and ore formation processes.

To understand this relationship, we present 3D reconstructions of Computed Tomography (CT) scans showing the distribution of ore minerals relative to key structural features in the shear zone such as folds, foliation, and shear bands. These results show where auriferous and sulfide-bearing fluids accumulated throughout the HMSZ, highlighting the structural settings most favourable for mineralisation. Our findings contribute to a better understanding of the feedback between deformation and fluid flow in shear zones, with implications for the exploration of structurally controlled ore deposits.