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Accommodating structures and deformation associated with the emplacement of high level magmatic intrusions, Henry Mountains, Utah

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High-level sill and laccolith complexes form an important part of volcanic plumbing systems in which magma is emplaced as a series of sub-horizontal tabular sheet-like intrusions. Few studies of these intrusion types have looked in detail at the host rock, emplacement-related deformation structures, and how the additional volume of rock is accommodated within the crust, i.e. the 'space problem'. The aim of this study is to develop an understanding of the stages of emplacement and the internal textural evolution of Tertiary sills and laccoliths in the Henry Mountains. We have carried out kinematic and geometrical studies of emplacement-related structures in the host rocks. This work is supplemented by micro-scale textural and geochemical studies of plagioclase feldspar and amphibole phenocryst populations within the intrusions. Fabric studies recognise micro-structural fabrics (associated with accommodating structures) from magmatic fabrics (associated with magma flow). Crystal size distribution (CSD) studies help constrain the crystal:molten rock ratio and mechanical properties of the intruding magma, in addition to helping identify individual magma pulses.

Fieldwork to date has focused on two satellite intrusions to Mt. Hilliers: Trachyte Mesa (the most distal intrusion; simple geometries); and Maiden Creek (closer to Mt. Hilliers; more complex geometries) both of which are emplaced into the Entrada Formation sandstone. Preliminary results highlight the importance of shear zones in accommodating the extra volume of magma at depth.

Trachyte Mesa is an elongate (NE-SW) laccolith comprised of multiple, stacked intrusive sheets. Semi-brittle shear fabrics (Riedel shear fractures) can be identified on the top surface of the intrusion. Furthermore, sub-horizontal shear zone fabrics can also be observed adjacent to the frontal propagating tip of individual intrusive sheets, e.g. at the northwest lateral margin of Trachyte Mesa.

A well-developed shear zone was also identified above the Maiden Creek intrusion. Maiden Creek is a sill with a complex elliptical shape and several finger-like lobes. Detailed outcrop studies across two neighbouring lobes have identified a sub-horizontal shear zone which may be traced from the top of each intrusive lobe. This shear zone separates low/ moderately-deformed sandstones above from highly deformed sandstones below and between the two lobes, hence acting as a detachment zone. Fabrics (stretched plagioclase phenocrysts) within the igneous rock, seen on the top surface of the intrusive lobes directly beneath this shear zone, support the timing of the shear zone being contemporaneous with emplacement of the intrusive lobes. The shear zone appears to have played a critical role in accommodating the volumetric changes associated with magma emplacement.