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Deformation Structures associated with the emplacement of high level intrusions: A study of Trachyte Mesa Intrusion, Henry Mountains, Utah

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Most studies of sill and laccolith complexes have focused on the internal architecture and thermal effects of these intrusions, while few have looked in detail at host rock deformation structures associated with their emplacement. Various sill and laccolith emplacement mechanisms have been proposed (e.g. radial growth/ bulldozing, and two-stage growth), each with their own distinct deformation style. Compressional structures likely dominate during radial growth (bulldozing) emplacement, while extensional structures are more likely to form during two-stage growth emplacement.

In this study we focus on deformation structures (faults, deformation bands and joints) associated with emplacement of Tertiary sills and laccolith intrusions in the Henry Mountains, Utah. Trachyte Mesa, the most distal satellite intrusion to the Mt. Hilliers intrusive centre, is an elongate (NE-SW) laccolith concordant with the Entrada sandstone it intrudes. The intrusion is comprised of multiple, stacked intrusive sheets. Two structural transects across the northwest lateral margin have identified distinct structural domains within the host rock that reflect both temporal and kinematic variations in deformation. Three deformation phases are identified, interpreted to be pre-, syn- and late-emplacement structures. A background set of deformation bands (phase 1), trending oblique to the intrusion margin, is apparent across the entire area. A second set of deformation bands (phase 2) overprint the early phase. These are characterised by conjugate deformation bands that parallel the intrusion margin, and increase in intensity and spacing towards the intrusion. Within this same zone a series of calcite filled normal faults, striking parallel and perpendicular to the intrusion margin, are apparent. Due to their spatial, kinematic and overprinting relationships we interpret these to be linked to the emplacement of the intrusive body. Overprinting all other structures, are two sets of tensile joints (phase 3), often infilled with calcite crystals. These occur over the top surface and lateral margin of the intrusion. Similar to phase 2 faults, these joints strike both parallel and perpendicular to the margin of the intrusion. Phase 2 and 3 structures both indicate extensional strain normal to the intrusion margin, which is consistent with a two-stage growth mechanism for the overall intrusion. Furthermore, the presence of calcite precipitation indicates that these structures have acted as good conduits for fluids.

Deformation structures associated with emplacement of sills, laccoliths and dykes have the potential to affect fluid flow through a porous sandstone reservoir, which may have important implications in fields such as hydrocarbon reservoir deliverability and CO_2 sequestration. Assuming deformation structures are intrinsically linked to the emplacement mechanism, predictions about fluid flow around intrusive bodies may be possible, i.e. enhancement (two-stage growth) or suppression (radial growth) of fluid flow.