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1 Emplacement and assembly of shallow plutons through multiple magma pulses, Henry mountains, Utah

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The mid-Tertiary intrusions from the Henry Mountains (Utah, USA) were assembled from amalgamation of multiple horizontal sheet-like magma pulses, in the absence of regional deformation. The three-dimensional pluton geometries are exceptionally well preserved and include: (1) a highly lobate sill, (2) a laccolith; and (3) a bysmalith (a fault-bounded, piston-like laccolith). Individual intrusive sheets are recognized on the margins of the plutons by stacked lobate contacts, and within the plutons by both intercalated sedimentary wallrock and formation of solid-state fabrics. Finally, conduits feeding these plutons were mostly sub-horizontal and pipe-like, as determined by both direct observation and geophysical modeling.

The pluton geometries, in aggregate, are interpreted to reflect the time evolution of an idealized upper crustal pluton. These plutons initiate as sills, become laccoliths, and eventually piston-like bysmaliths. The emplacement of multiple magma sheets was rapid and pulsed; the largest intrusion was assembled in less than 100 years through amalgamation of numerous pulses. We interpret the magmatic fabrics as recording the internal flow of the sheets "frozen in" by fast cooling rates in the upper crust. Be-

cause there are multiple magma sheets, fabrics can vary vertically as different sheets are traversed. These plutons provide unambiguous evidence that some plutons are emplaced in multiple pulses, and that pluton assembly can be highly heterogeneous in both space and time. The features diagnostic of pulsed assembly we observe in these small plutons can be easily destroyed in larger intrusions, especially in tectonically active regions.