

An Expanded Lava Creek Tuff Eruption

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Reinvestigation of the Lava Creek Tuff (LCT; 1000 km³, 0.63 Ma) has provided new insights into Yellowstone's younger supereruption. In the Sour Creek resurgent dome (SCD), remapping has uncovered four new, visually distinct ignimbrite units with ⁴⁰Ar/³⁹Ar ages analytically indistinguishable from the LCT eruption age. The largest unit contains scoria, a feature not observed in any mapped LCT deposits. Another new unit is a lithic-breccia deposit, found beneath and co-eruptive with the scoria-bearing ignimbrite. The breccia contains LCT-age ignimbrite intraclasts, demonstrating a time break within the eruption sequence that is unresolvable by geochronology. These intraclasts are geochemically linked to nearby mapped LCT member A. The lithic breccia, coupled with welding intensity variations found in the southern part of the SCD, provide evidence for eruptive sources significantly west of the currently mapped caldera boundary. Mapped faults attributed to resurgence on the SCD display no offset to those of younger faulting in the region, suggesting that the resurgent dome is not resurgent on the scale previously proposed. Taken together, we instead argue that a major structural feature, potentially representing the structural caldera boundary, lies well inboard of the currently mapped boundary and that the SCD area lies outside the Yellowstone caldera. Based on the Yellowstone River location and high ³He/⁴He values occurring west of the SCD, we postulate this locus is a major fault zone associated with eruption of these newly defined LCT units. In our larger reassessment of the LCT, we find also little evidence for phenocrystic amphibole, the distinguishing feature proposed between mapped members A (amphibole-bearing) and B. In contrast, we find that only 3 of ~150 samples examined contain amphibole, and these are solely from material mapped as member B. Our work implies that the LCT is not two separate sheets from a single chamber, but instead consists of distinct lobes that were systematically tapped from multiple separate magma bodies over an extended period. In this regard, the older Huckleberry Ridge supereruption offers comparisons, but in the LCT the physical and mineralogical differences between the stratigraphically and geographically defined lobes are more subtle.