Caldera life cycles in the YSRP province, Idaho, USA

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Scientific drilling within the Yellowstone–Snake River Plain (YSRP) province has documented, to a significant extent, the silicic and basaltic volcanic history of the YSRP, which has allowed us to evaluate how the Yellowstone hotspot interacted with the continental crust and sub–lithospheric mantle and assess how large igneous provinces are constructed. Yet only a few places have recovered both SRP–rock types that could answer outstanding questions related to the life–cycles of caldera complexes. The Sugar City geothermal test well, however, preserves a record of volcanism at a strategic location connected to the life, death, and resurrection of the Heise caldera complex. This location provides an ideal place to compare the origins of polygenetic and monogenetic lava fields, as well as, provide a glimpse into the caldera forming and post–caldera volcanism of the eastern Snake River Plain. Major and trace element data from basalts reveals distinct groups, with a pronounced change after emplacement of the Huckleberry Ridge tuff. Sugar City basalts also display a complex history of compositions that reflect the two dominant compositions observed within the YSRP, i.e., non–evolved olivine tholeiite and Craters of the Moon–evolved type. These two eruptive suites provide a means to assess the effects of magma ascent paths, possibly with little interaction with the upper crust. Sugar City silicic rocks, on the other hand, have all of the classical characteristics of A–type granites, including high concentrations of alkalis, as well as high concentrations of incompatible elements and especially those with high field strength such as Nb, Ta, Zr, and Th. We provide a general model that satisfies all the available data and highlight patterns that trace the evolution of the caldera's life, decline and eventual death, and resurgent volcanism during the Pleistocene. This work, in connection with previous field studies, and geochemical and isotopic studies makes the Heise caldera complex one of the best studied caldera centers within the YSRP province.