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Determining the physical processes behind four large eruptions in rapid sequence in the San Juan caldera cluster (Colorado, USA)

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Large, explosive volcanic eruptions can have both immediate and long-term negative effects on human societies. Statistical analyses of volcanic eruptions show that the frequency of the largest eruptions on Earth ($> \sim 450$ km^3) differs from that observed for smaller eruptions, suggesting different physical processes leading to eruption. This project will characterize the petrography, whole-rock geochemistry, mineral chemistry, and zircon geochronology of four caldera-forming ignimbrites from the San Juan caldera cluster, Colorado, to determine the physical processes leading to eruption. We collected outflow samples along stratigraphy of the three caldera-forming ignimbrites of the San Luis caldera complex: the Nelson Mountain Tuff (>500 km^3), Cebolla Creek Tuff (~ 250 km^3), and Rat Creek Tuff (~ 150 km^3); and we collected samples of both outflow and intracaldera facies of the Snowshoe Mountain Tuff (>500 km^3), which formed the Creede caldera. Single-crystal sanidine $^{40}Ar/^{39}Ar$ ages show that these eruptions occurred in rapid succession between 26.91 ± 0.02 Ma (Rat Creek) and 26.87 ± 0.02 Ma (Snowshoe Mountain), providing a unique opportunity to investigate the physical processes leading to a rapid sequence of large, explosive volcanic eruptions. Recent studies show that the average flux of magma is an important parameter in determining the frequency and magnitude of volcanic eruptions. High-precision isotope-dilution thermal ionization mass spectrometry (ID-TIMS) zircon geochronology will be performed to determine magma fluxes, and cross-correlation of chemical profiles in minerals will be performed to determine the periodicity of magma recharge that preceded these eruptions. Our project intends to combine these findings with similar data from other volcanic regions around the world to identify physical processes controlling the regional and global frequency-magnitude relationships of volcanic eruptions.