The petrogenetic link between volcanic and plutonic rocks of the Organ Mountains caldera, USA

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Examining a volcanic or plutonic system alone to identify geochemical and physical processes occuring in the magma plumbing can be limiting in the petrogenetic information that can be obtained. Volcanic materials preserve snapshots of magma reservoir processes, while plutons represent an average of accumulated products of various processes during prolonged magmatism. Investigating a tilted caldera system where volcanic and plutonic rocks are exposed is of great advantage as hypotheses can be directly tested and the system can be looked at as a whole. Questions we address are: 1) Are physically and temporally connected volcanics and plutons petrogenetically related? 2) Which magma processes in the reservoir or source are responsible for the compositional variation in erupted and intrusive materials? And 3) at which time scales and volumes do these magma processes operate?

We are examining a tilted section in the Organ Mountains, NM, USA, where ~36 Ma volcanic and plutonic rocks are exposed. The volcanic package is composed of three major ignimbrites ranging from a crystal-poor, high-SiO_2 rhyolite at the base to a crystal-rich, low-SiO_2 rhyolite at the top with an estimated eruption volume of 500-1,000 km^3. The ignimbrites are pre-dated by andesite lavas and post-dated by trachyte lavas. The main intrusion is the Organ Needle pluton (ONP) composed of quartz-monzonite to granodiorite at the base transitioning into a syenite at the top.

Our whole rock Sr, Nd and Pb isotope data suggest that the source for all magmas is identical (i.e., mixture of mantle and Precambrian crust) and that host rock assimilation took place. Trace element data indicate a fractionate-cumulate relationship of the ignimbrites with the ONP, which agrees with rock textures revealing the presence of 0.5-3 km feldspar cumulates (syenite) at the top of the pluton. The lavas are the least differentiated units with no apparent plutonic equivalent exposed. Our present data suggest that only the voluminous ignimbrites originated from a fractionating, yet open system ONP reservoir that was likely refilled between eruptions. Mineral scale trace and isotope analyses and new U/Pb zircon geochronology and geochemistry are underway to test these initial conclusions, explore if we can pinpoint which magma processes caused the different eruption styles and from where, and further characterize the geochemical link between volcanics and plutons in the Organ Mountains caldera.