Aerosol spatial scales in observations and models: Implications for the aerosol direct effect

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Consideration of variability in aerosol spatial and temporal distributions are prime concerns in developing sampling strategies for future satellite missions. Previous studies suggest homogeneity in tropospheric aerosol spatial distributions at scales of about 200 km. These studies, however, did not have access to the extensive global data sets of aerosols from the past decade of EOS observations, and so their conclusions on aerosol spatial scales must be viewed as tentative. In the first part of this study we evaluate what the global distribution of aerosol optical depth looks for different spatial sampling strategies. We sample MODIS observations at their native swath width, along a satellite-subpoint track like what the APS would have observed, and at an intermediate swath width similar to what MISR observes. We investigate the convergence of the aerosol optical depth statistics for all cases. In the second part of this study we employ these sampling strategies on the results of the NASA GEOS-5 global aerosol model to investigate the implications for computed aerosol direct radiative forcing.

Missed connection: Ignimbrite seeking plutonic relationship

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New U-Pb zircon geochronologic data for rocks from the Southern Rocky Mountain volcanic field demonstrate a distinct disconnect between the timing of ignimbrite eruption and plutonism. In both the Questa and Aetna calderas, only discontinous dikes yield the same ages as ignimbrites. The dominant volume of exposed plutonic rocks was assembled either before or after the ignimbrite events.

Geochronology for rocks in the Questa and Aetna calderas demonstrate that the largest exposed plutons (the Rio Hondo and Mt. Princeton, respectively) were assembled incrementally. Data for the Rio Hondo pluton indicate a magma accumulation rate of 0.0003 km^3yr^{-1} for the exposed portion of the pluton. Data for the Mt. Princeton pluton indicate an accumulation rate of 0.0009 km^3yr^{-1}. Both rates are comparable to rates published for other plutons, and orders of magnitude too slow to accumulate large eruptible magma volumes. Extrapolation of the accumulation rate for the Rio Hondo pluton over the 8.5 m.y. history of the volcanic field yields an estimated volume of plutonic rocks comparable to the volume under the field indicated by geophysical studies. We propose that the bulk of the plutonic rocks beneath the volcanic center accumulated during periods of low volcanic effusivity (the waxing and waning stages of caldera formation), and that most of the magma generated during caldera formation erupted. Furthermore, because the oldest portion of the Rio Hondo pluton is the granitic cap exposed beneath a gently dipping roof contact, the roof granite cannot be a silicic liquid fractionated from the deeper (younger) portions of the pluton. Instead, the data suggest that the variation in composition of the pluton is inherited from the lower crustal source. We suggest that if magma flux is high enough, zoned ignimbrites can be formed by evolution of the melt compositions being generated at the source. Thus eliminating the “need” for large shallow magma chambers and plutons in support of ignimbrite evolution.

If the intrusive equivalents to the ignimbrites are limited to dikes, and the plutonic rocks crystallized over the history of the fields, then the plutonic record of the ignimbrite stage of caldera formation is sparse. This predicts that the plutonic record will be dominated by waxing and waning stage magmatism, and the volcanic record will be dominated by ignimbrite stage magmatism.