QUANTIFICATION OF THE SPATIAL RELATIONSHIPS BETWEEN FAULTS AND VOLCANOES

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The perception that faults and volcanoes are genetically linked is widely held in the geologic community. It derives from the qualitative observation that most volcanoes and volcanic fields are spatially associated with faults, as well the occurrence of volcanic eruptions that are preceded or accompanied by seismic events (e.g., 1980 eruption of Mt. St. Helens). Characterizing the relationships that exist between faults and volcanoes is a substantial task, but a first step is the quantification of spatial relationships.

We have initiated an investigation into the spatial relationship between faults and volcanoes in ten volcanic fields from the U.S. and Mexico, for which the map distribution of vents and faults is well known. For each field we have measured the average spacing between faults and the distance and direction to the nearest fault for each volcano/vent. Additionally, using the coordinates for each volcano/vent we have employed a nonparametric density estimator to evaluate the spatial intensity of vent distributions.

The results of this study indicate that less than 5% of vents in all fields are located within 0.5 km from faults. Rather, most vents (~60% for many fields) are clustered near the median distance between faults. In other words, vents appear to concentrate away from faults. The Camargo volcanic field of Chihuahua, Mexico is excellent example of this observation. The Camargo field is comprised of 261 vents spread across two horsts and a full graben. Approximately 77% of the vents are located on the horst blocks suggesting very limited interact between the melt and structures, even at depth. The Big Pine volcanic field of east-central California is a major exception to the observation that vents cluster away from vents. There, most of the vents in the field are located right on faults on both sides of Owens Valley.

Assessments of the spatial intensity of vents do suggest that the overall distribution of vents is, in some instances, transverse to the orientation of apparent vent alignments and structures. For example, on the Eastern Snake River Plain, the long axes of high intensity clusters subparallel the plain axis and essentially normal to structures beyond and volcanic rift zones within the plain. This is taken to reflect the geometry of the melt source region and its dominance over near-surface structures.

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