Fractal clustering of vents and depth of fluid reservoirs

Seminario
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Abstract:

Deformation (seismicity) and magmatism (volcanism) are spatially associated along plate boundaries. Transport of magma from lower crustal?upper mantle reservoir regions to its final level of emplacement mainly occurs through magma filled fracture networks (i.e. connected dykes and sills).

Such a tight spatial and genetic relationships between volcanoes and fractures suggest that the properties of spatial distribution of fractures (fracture networks) can be applied also to the spatial distribution of volcanic vents.

Here I present a methodology for analysing spatial distribution of monogenetic basaltic vents in volcanic fields by accounting for their self-similar clustering.

The assumption are: i) monogenitc vents are univocally linked to a dike (i.e. fluid filled fracture), ii) vents are points in the portion of the fracture network connecting the site of magma storage at depth (reservoir) with the surface, iii) vent clustering is approximate by power law distribution, iv) the undergoing process can be modelled by the Percolation Theory.

Being all natural systems finite, the self-similar clustering of vents occurs within a specified length range defined as size range and bounded by characteristic cut-off lengths. Comparing vent clustering with independent geophysical (gravity, seismic, and seismology) and geochemical (mineral chemistry) data sets for several volcanic fields a clear linear relationship between the depth of the main magma storage (reservoirs) and the upper cut off of the size range is observed.

This approach has been used also in mud volcanoes in Azerbaijan and is going to be applied for studying volcanism in Mars and Mercury.

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