Comparative geomorphometric analysis of scoria cones of Chaîne des Puys (France) and Sierra Chichinautzin (Central México)

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Amongst all volcanic edifices, the most studied for their geomorphology are probably monogenetic scoria cones. They show relatively simple symmetrical forms, so they can be described easily. They are distributed in fields, where the morphology evolves over many millions of years, rendering them indicators of geologic, geomorphologic and climatic change. The traditional descriptive methods have been replaced over the past decades by quantitative analysis through the help of digital terrain models (DTMs) that allow calculating morphometrical parameters in a more straightforward and accurate way. The most meaningful parameters in such analysis are external slope, aspect, area, cone-and-crater height/width, and total volume.

Our goal is to examine scoria cone fields around the world to relate the age of the cones and their lithological composition to their morphometric parameters. Our current study is a part of this effort; the two study areas are: Chaîne des Puys (France) and the central-eastern part of the Sierra Chichinautzin (Mexico). In Chaîne des Puys we have data from 26 cones and domes with ages from 8 ka to 64 ka. The studied part of the Sierra Chichinautzin (for which high-resolution DTM is available) contains 152 cones with ages from Holocene to Middle Pleistocene. The study was carried out using high-resolution LiDAR DTMs varying between 0.5 m (Chaîne des Puys) and 5 m (Sierra Chichinautzin) in horizontal resolution. We calculated average parameter values (e.g. slope, aspect, area, elevation) from the LiDAR using our recently developed methodology.

Cones were grouped by age and the morphometrical parameters of cones of different age groups were compared. According to the results of Mann-Whitney test, the differences between the parameters of populations of some age groups were found to be statistically significant. In these two areas we found some clear relations between erosion (shape) and age. In case of Chaîne des Puys the youngest age group is significantly different from the older groups, on the other hand, in Sierra Chichinautzin the oldest group is different from the youngers. The greatest separation is shown by the distribution of average slope values.