



Department of Earth Sciences

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# Volcano Distribution in the Chaîne des Puys

## 1. Background

Recent work at Durham [1-3] has shown that most arc volcanoes are grouped into segments that describe great circles on the surface of the Earth (Fig. 1), which refines many textbook models of arc curvature. A recent MSc project suggests that the Hawaii-Emperor seamount chain might be similarly segmented [4].

This project will use the same spatial recognition techniques [1-4] to investigate the Chaîne des Puys monogenetic volcanic field, France. A strong, overall, north-south alignment is apparent but there also appears to be smaller scale segmentation.

***This project will use GIS, location information and literature to address the following questions:***

- What is the pattern of Chaîne des Puys segmentation?
- Is segmentation related to basement geology?
- Are volcanology and composition of the eruptive products related to segmentation?

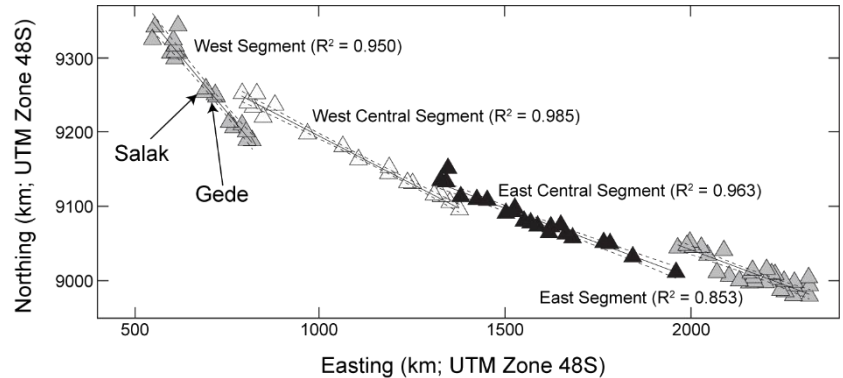
The study will use the Chaîne des Puys, a cradle of volcanology and for which there is substantial prior knowledge regarding locations, basement, and petrogenetic mechanisms [5 and references therein].

## 2. Aims and methods

The project will quantify spatial distribution of Chaîne des Puys volcanoes [5] using approaches developed at Durham [1-4] to:

- 1) Develop a comprehensive GIS database of volcanoes edifices in the Chaîne des Puys.
- 2) Develop a quantitative analysis of the database using the Hough Transform approach [1,2].
- 3) Investigate how properties such as spacing of volcanoes, edifice volumes, and edifice morphology, relate to segmentation.

The first aim will be to determine how well the Hough Transform approach can be applied to a relatively small monogenetic field. Prior work has focussed on larger magmatic structures where segments span hundreds of kilometres. Second, how does segmentation relate to basement geology, which is better exposed than in the oceanic and arc environments previously studied [2-4]? Third, the spacing of edifices and their deviation from segments will also be explored in conjunction with



**Fig. 1 Segmented alignment of Sunda Arc volcanoes [1] with R-squared of fits indicated. This project will seek similar quantification of a monogenetic volcanic field.**

the styles and volume of eruption, and the composition of magmas produced [5].

## 3. Scientific benefits

Monogenetic volcanic fields are enigmatic in that they can occur in many tectonic settings; associated with rifts (such as the Chaîne des Puys), subduction zones, or continental interiors. Establishing patterns of segmentation in this well-known example will provide a framework for applying to understand other, more-complex monogenetic fields.

## 4. Training

- The student will receive training in the use of spatial analysis techniques to investigate volcano distributions.
- Through the research the student will develop skills and understanding in relating volcano morphology to regional tectonic patterns.
- Writing and presentation skills will develop through supervision and weekly volcanology group meetings.
- There will be opportunities to demonstrate to undergraduate students.

## References & reading

- [1] Pacey, Macpherson, McCaffrey (2013) *Earth Planet. Sci. Lett.* 369-370, 24-33.
- [2] Andikagumi, Macpherson, McCaffrey (2020) *J. Geophys. Res. Solid Earth* 125, e2019JB017391.
- [3] Andikagumi (2020) PhD Thesis, Durham University. 244 pp.
- [4] Smith, A. (2024) MSc Thesis, Durham University. 163 pp.
- [5] Merle et al (2023) *Géologie de la France* 1, 1-22.