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Volcano Distribution in the West Eifel Monogenetic Field

1. Background

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 West Eifel monogenetic volcanic field, Germany. A broad north-west to south-east alignment is apparent but there also appears to be smaller scale segmentation.

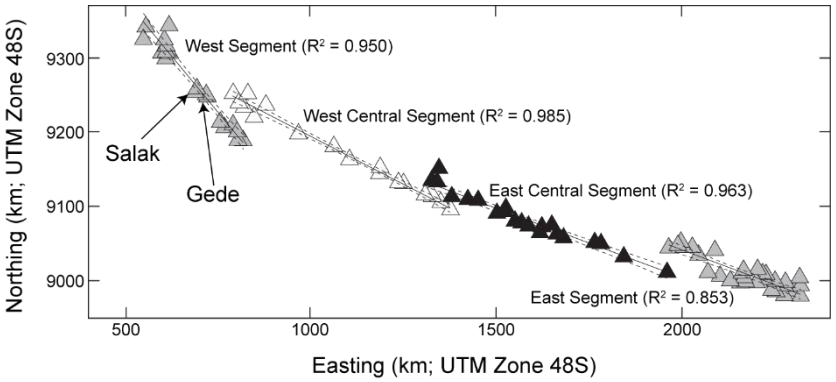

Fig. 1 Segmented alignment of Sunda Arc volcanoes [1] with R-squared of fits indicated. This project will seek similar quantification of a monogenetic volcanic field.

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

- *What is the pattern of West Eifel segmentation?*
- *Is segmentation related to basement geology?*
- *Are volcanology and composition of the eruptive products related to segmentation?*

The study will use the West Eifel volcanic field for which there is substantial prior knowledge regarding locations, basement, and petrogenetic mechanisms [5 and references therein].

2. Aims and methods

The project will determine and quantify spatial distribution of West Eifel volcanoes [5] using approaches developed at Durham [1-4] to:
1) Develop a comprehensive GIS database of volcanoes edifices in the West Eifel field.
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 moderate sized, elongate 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 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 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, subduction zones, or continental interiors (such as the West Eifel). Establishing patterns of segmentation in this well-known example will contribute to a framework of understand for application to more-conplex monogenetic fields.

4. Training

- The student will receive training in the use of spatial analysis techniques to investigate volcano dsitributions.
- 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 (2024) MSc Thesis, Durham University. 163 pp.
[5] Schmincke (2007) In: *Mantle Plumes* (ed. Ritter & Christensen) 241-322.