

Structure of Puy de Dôme volcano (Chaîne des Puys, France): towards a revised model

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Puy de Dôme : 1st experimental test site for the TOMUVOL* project

Criteria for this choice :

- simple and open outline
- ... but complex internal structure
- proximity from the Clermont laboratories (~ 8 km ; 20 min drive)



*TOMUVOL : Tomography with Muons for Volcanoes

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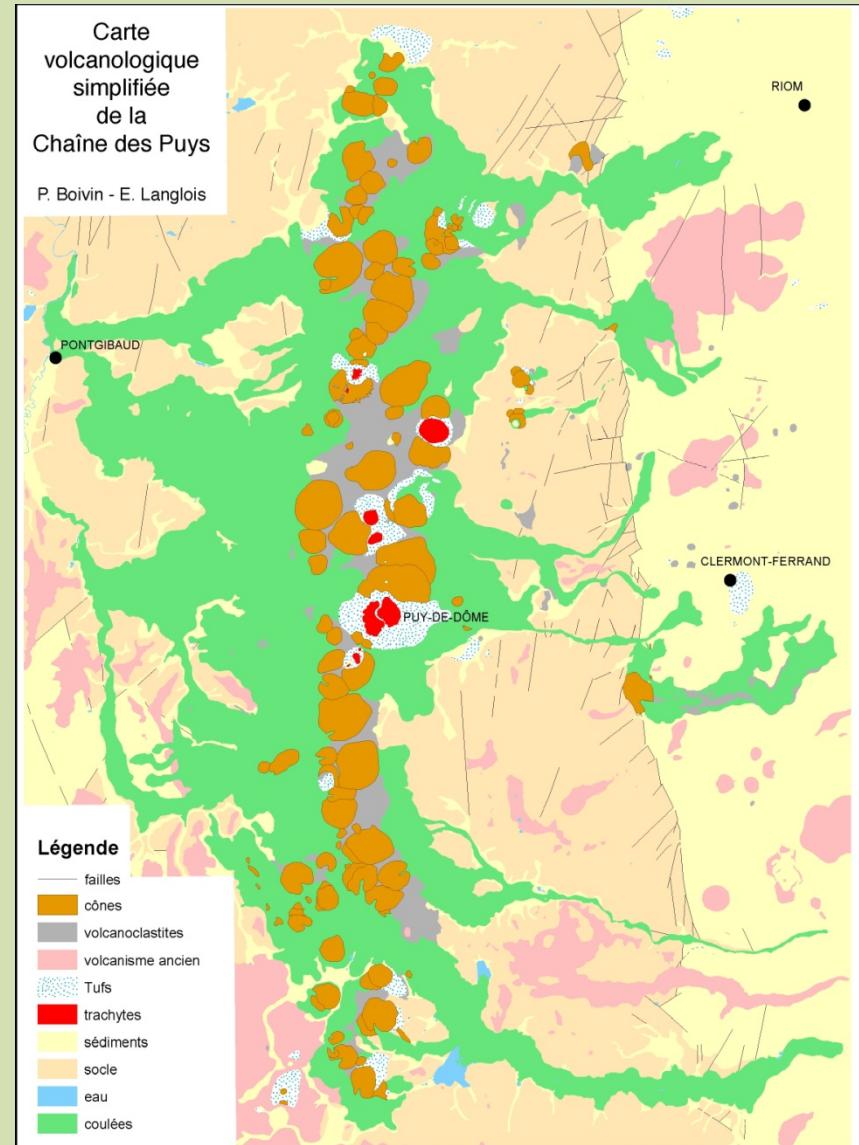
Aim of the present talk : expose the geological baseline and the issues



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Chaîne des Puys :

- Small intraplate volcanic field
- ~80 single monogenetic volcanoes
- Continuous petrographic series from basic to acidic magma



Morphologies of volcanoes controlled by :

- Magma nature**
- Eruption dynamics**
- Preexisting relief**
- Presence (or absence) of sub-surface water**

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Fluid magma (basaltic s.l.): cone, crater and long lava flows

Pariou, ~ 10 ka



Viscous magma (trachytic): lava - dome

Cliersou, 13-15 ka



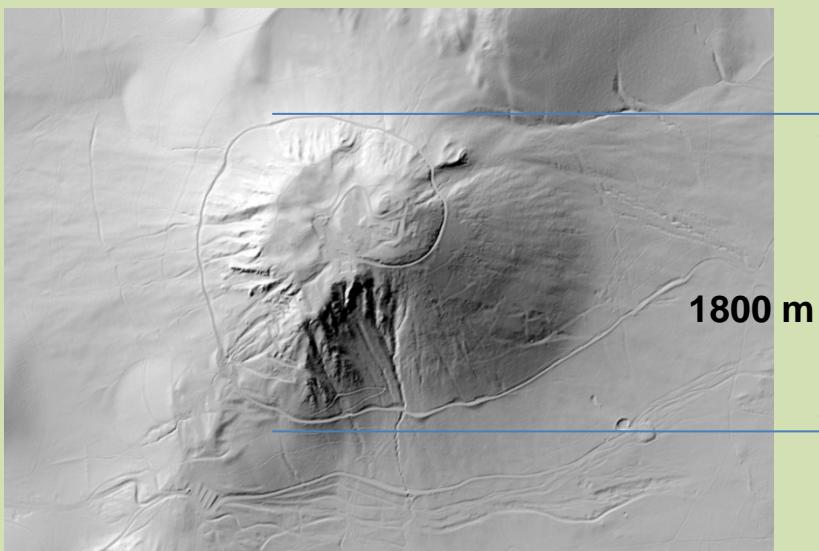
A case study : Puy de Dôme

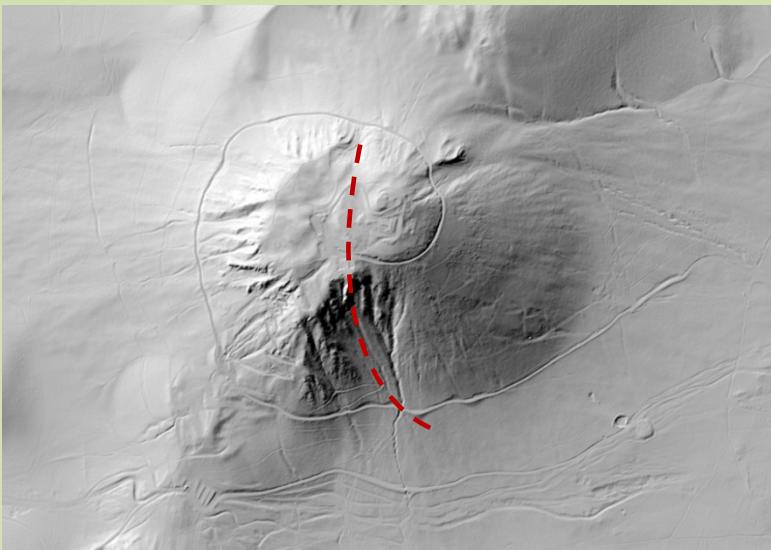


Lidar survey © CRAIG – GEOPHENIX 2012
Scientific control by P. Labazuy

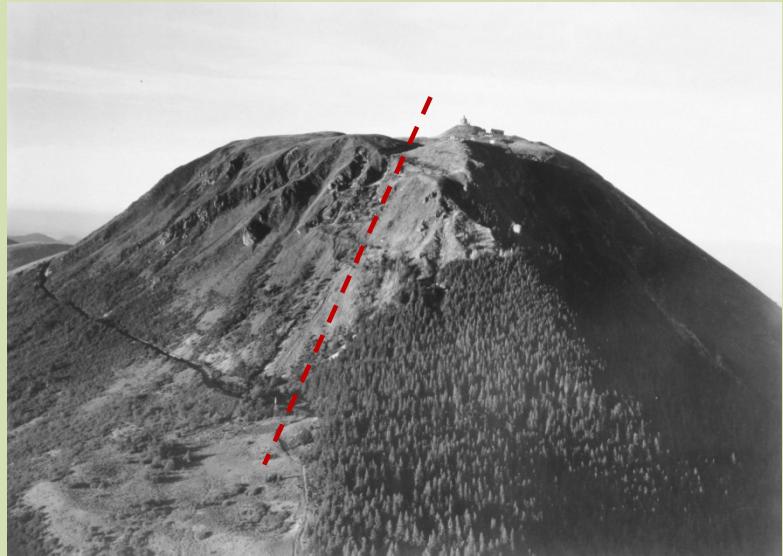
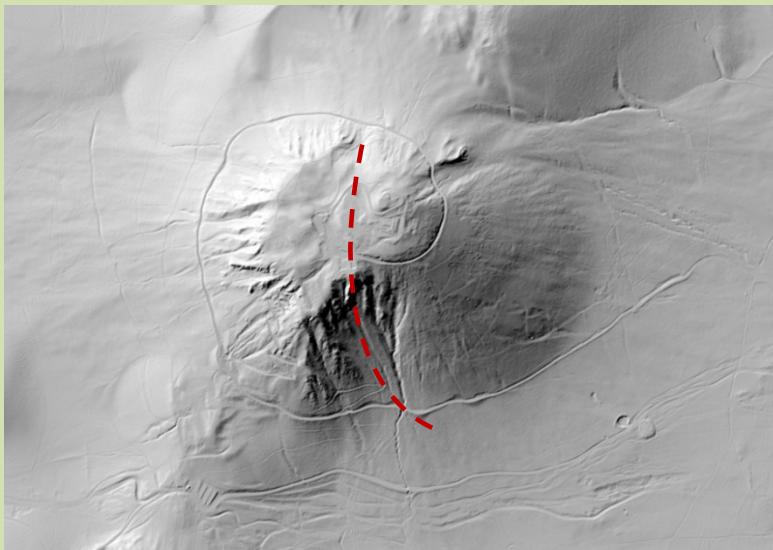


Magma: trachyte (~ 67 % SiO₂)

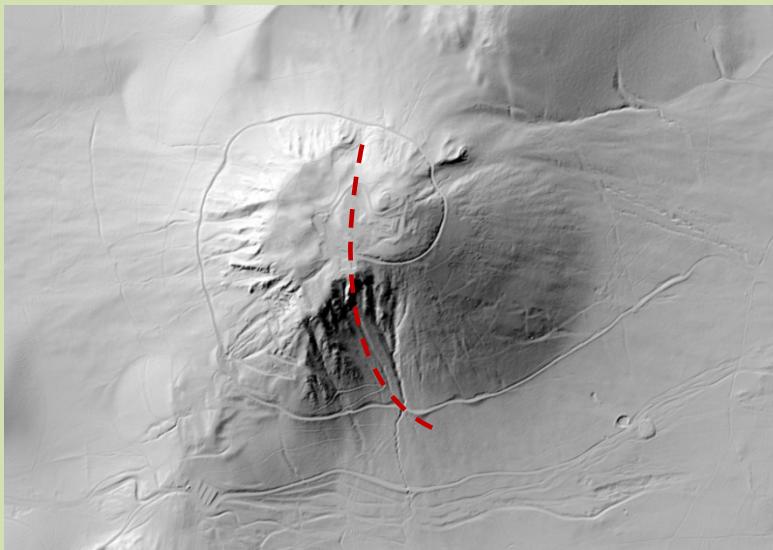




Seems to be composed of two distinct edifices



Western edifice : bristle lava dome with ridges and pinacles



Anak Ranaka , indonesia



Western edifice : bristle lava dome with ridges and pinacles

© A. Gourgaud



Ash-and-block flow in the slopes

Eastern edifice:

Regular cone, the basis of which is covered by thick layers of deposits

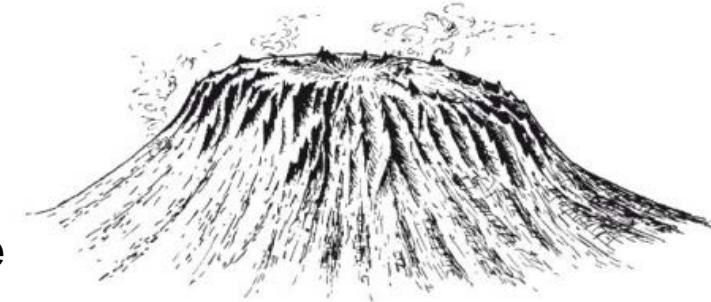


Ash-and-block flow at the foot

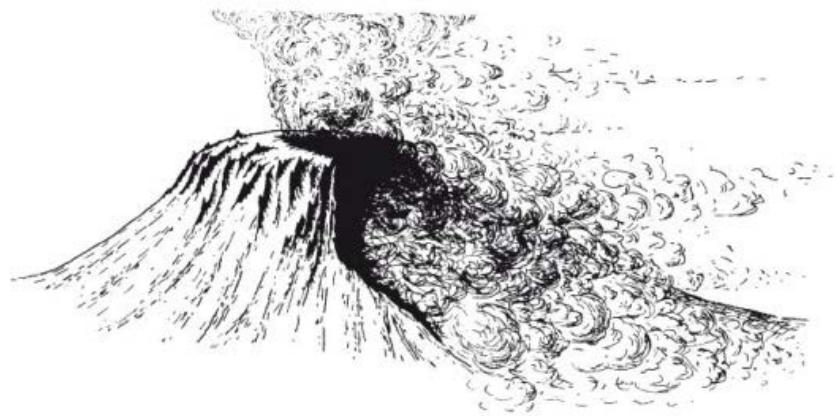


Proposed interpretation (before 2004)

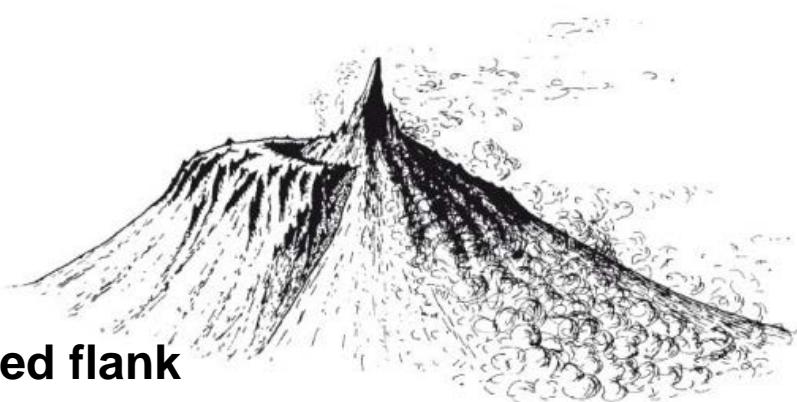
1 11 ka ago: construction of the dome



2 Flank collapse

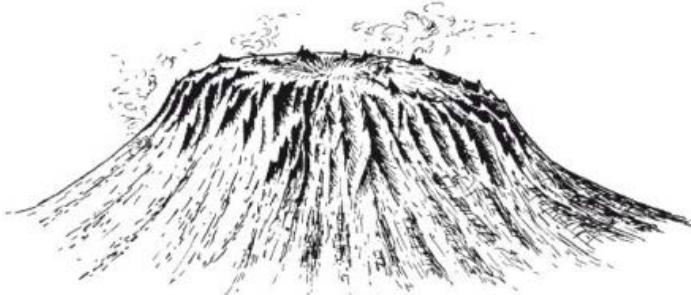


3 Erection of a new dome in the opened flank

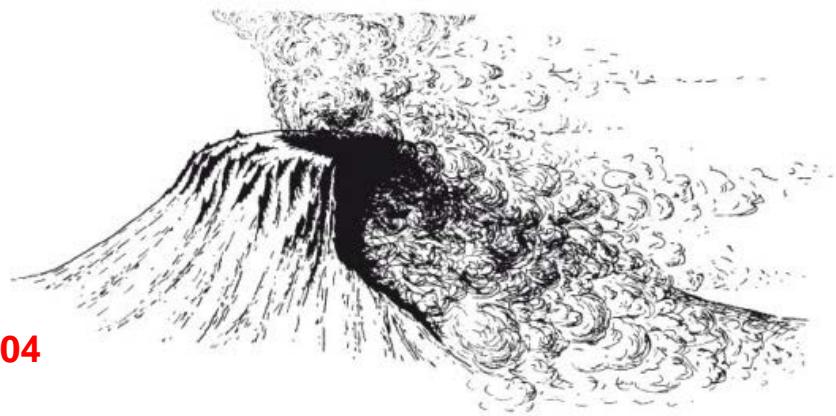


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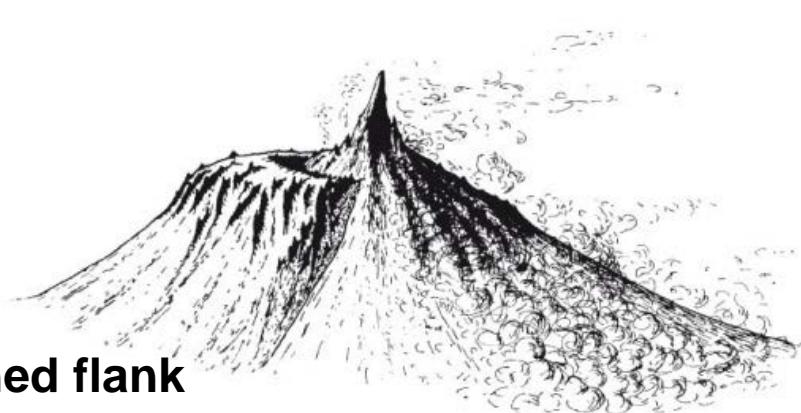


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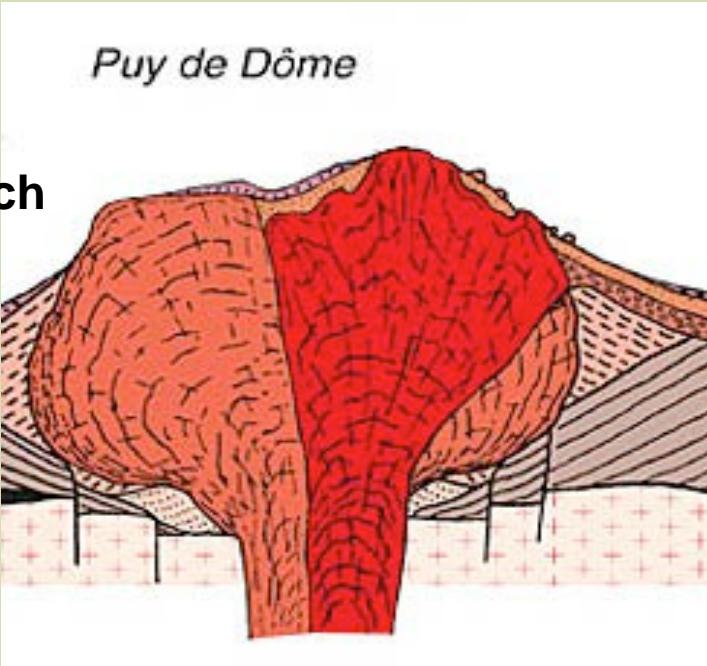


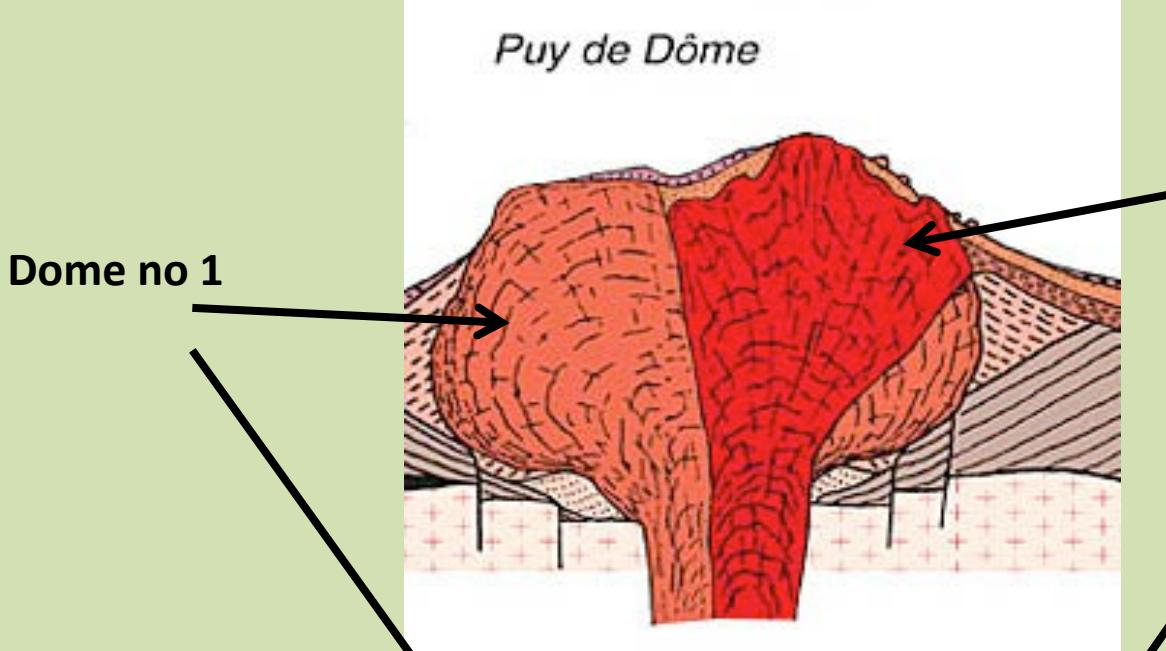
Historical example : Montagne Pelée 1902-1904

3 Erection of a new dome in the opened flank



Oversimplified sketch





New data (since 2004)



Excavations → new outcrops → new questions





* Kilian is a neighbour volcano

**Unknown
tephra**



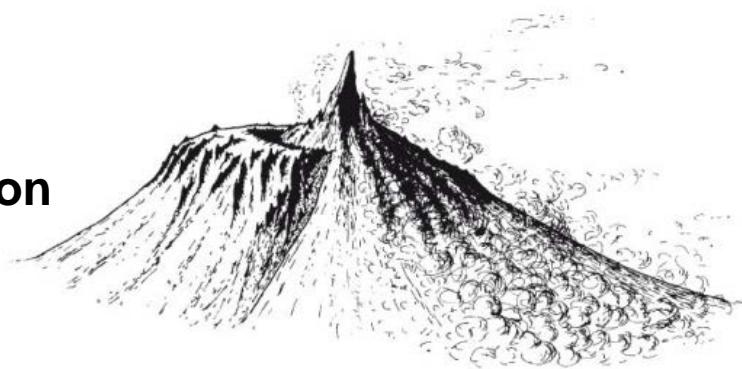
**Puy de Dôme lava mixed with allogeneous
lithics and various country rocks.**

**Grain size distribution + lithics →
phreatomagmatic eruption of Puy de Dôme itself**

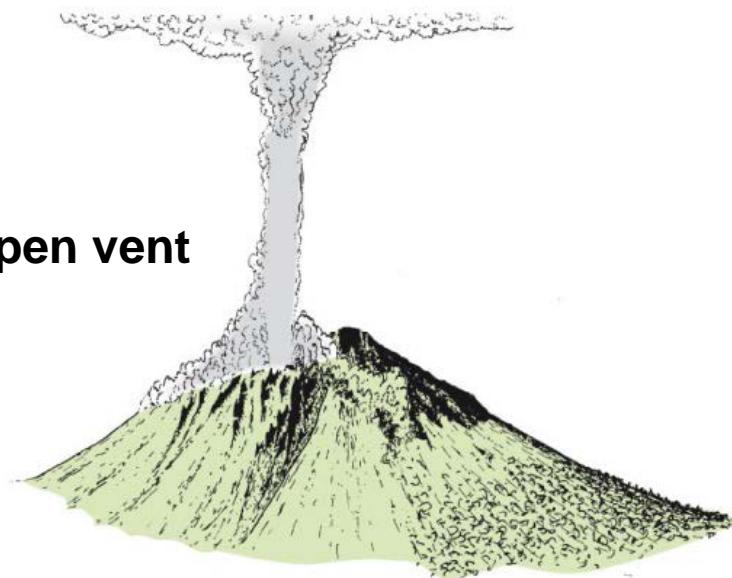
Radiocarbon → Age ~ 10.7 ka

Interpretation - continued

3 11 ka: end of main eruption

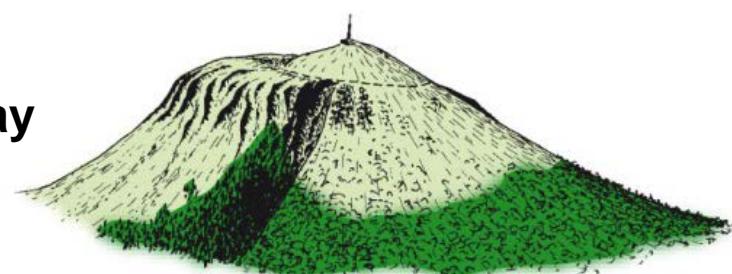


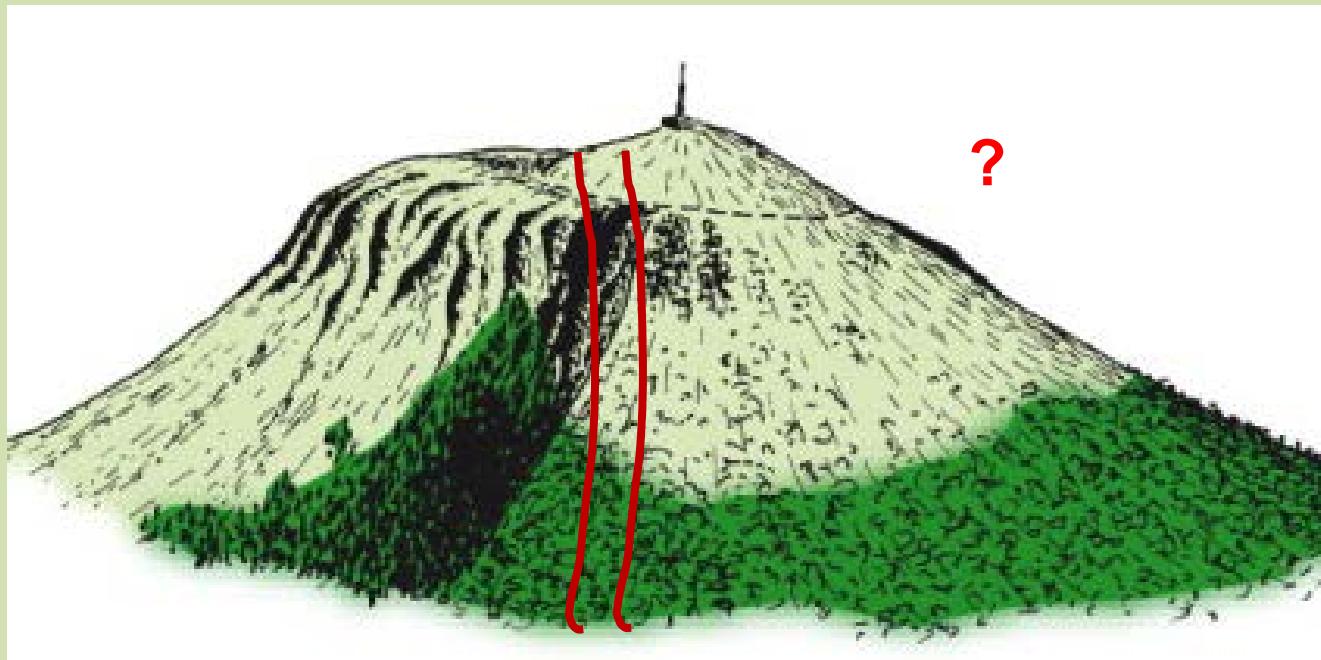
4 10.7 ka: summit eruption through an open vent

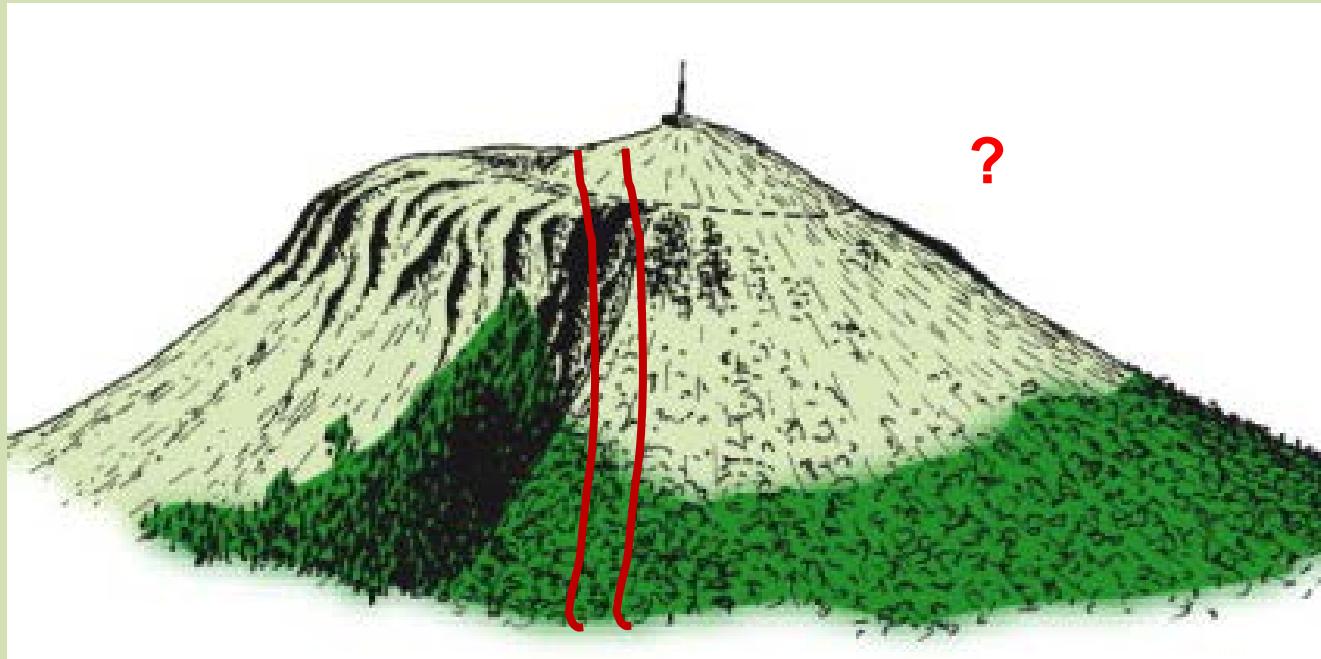


5 9.45 ka Kilian eruption
(not represented here)

6 Today







**Multicolored lapilli: trachytic lapilli
altered by hydrothermal and
fumarole action**



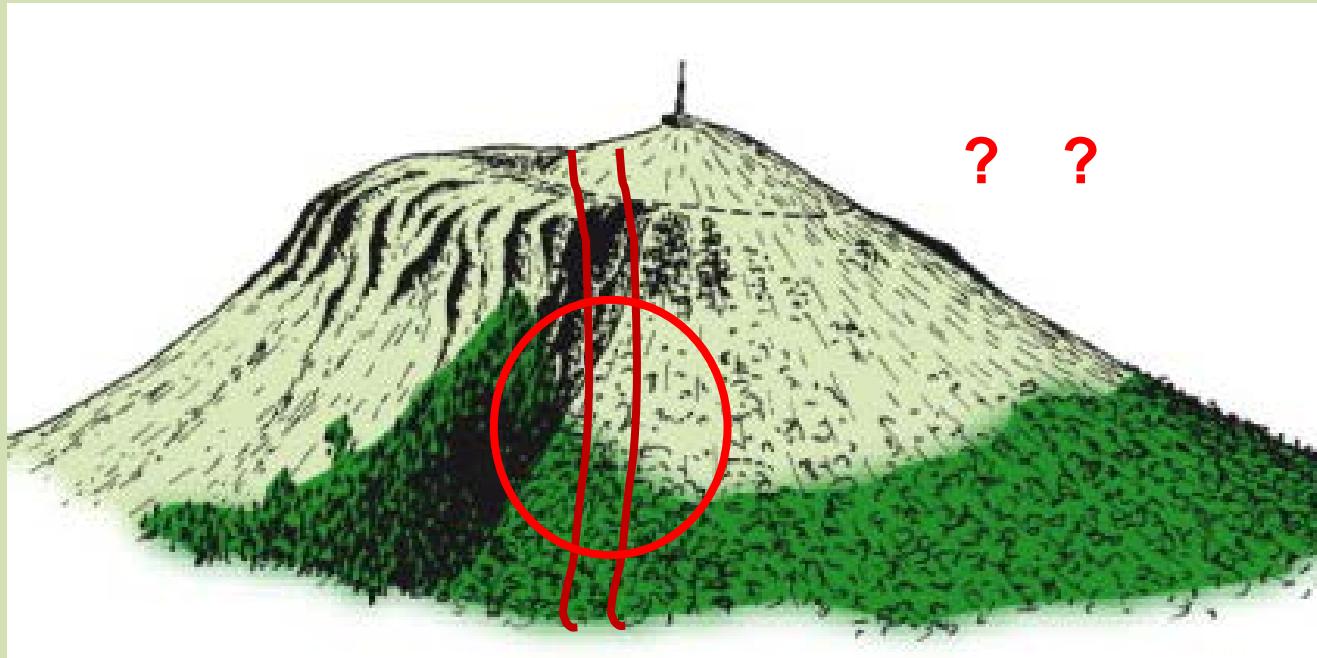
Evidence for fumarole activity along fissures atop the dome



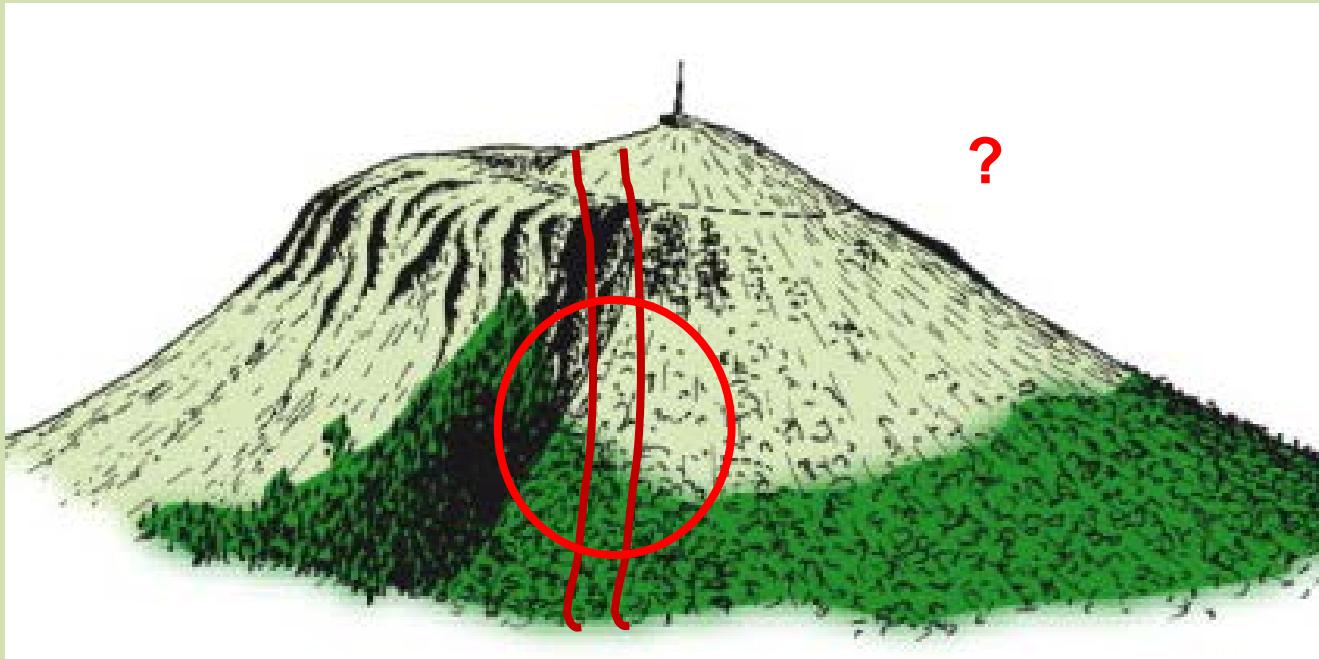
Staining and silicification of the lava



Fumaroles connected with past hydrothermalism in the dome ?



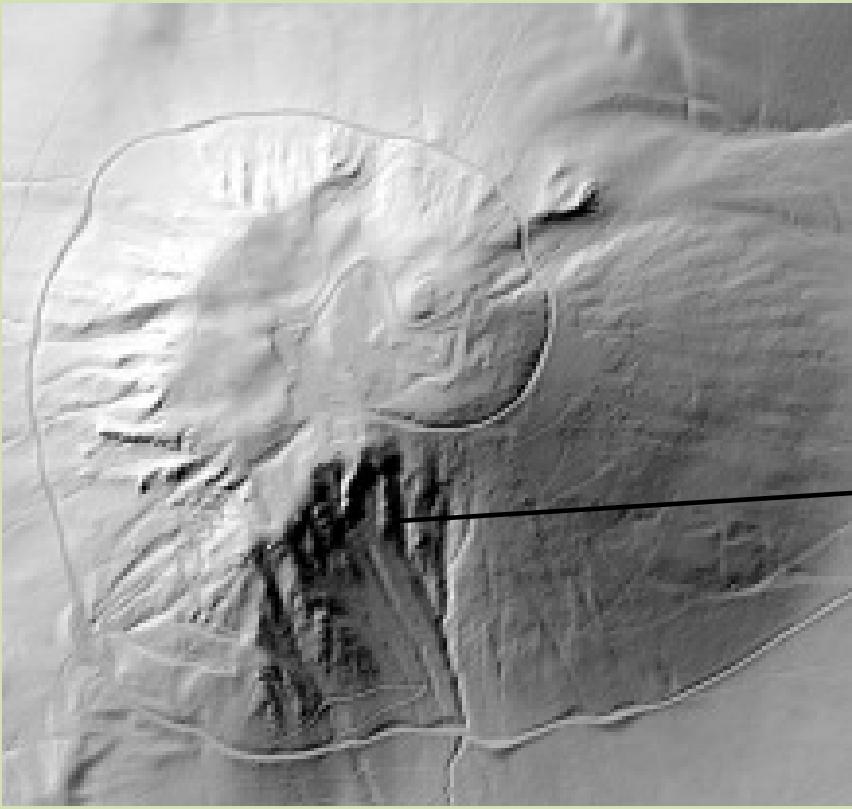
**Late eruption triggered or enhanced by water absorbed
in the bulk of the porous dome ?**



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in the bulk of the porous dome ?**

Historical example : La Soufrière lava dome (Guadeloupe), 1690 AD

A new puzzling observation



**Long and thick slabs of massive lava laying on the southern flank
(looking different in shape from the western ridges)**

**Marks
suggest linear elongation**

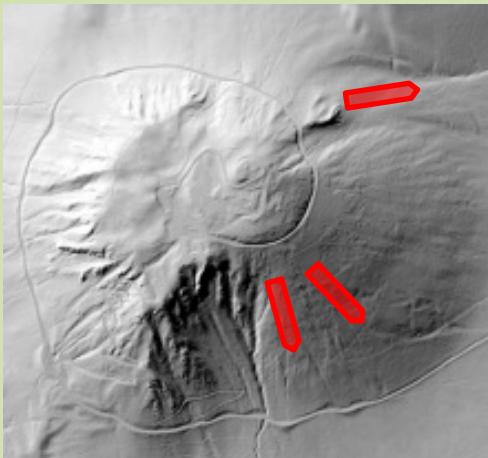


**The slabs lay on loose
deposits of ashes**



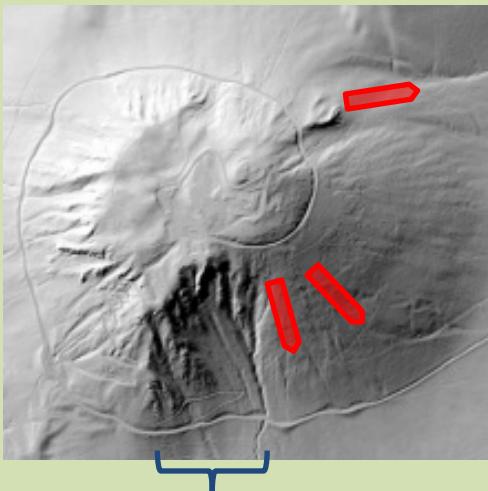


Did Puy de Dôme produce real lava flows ?





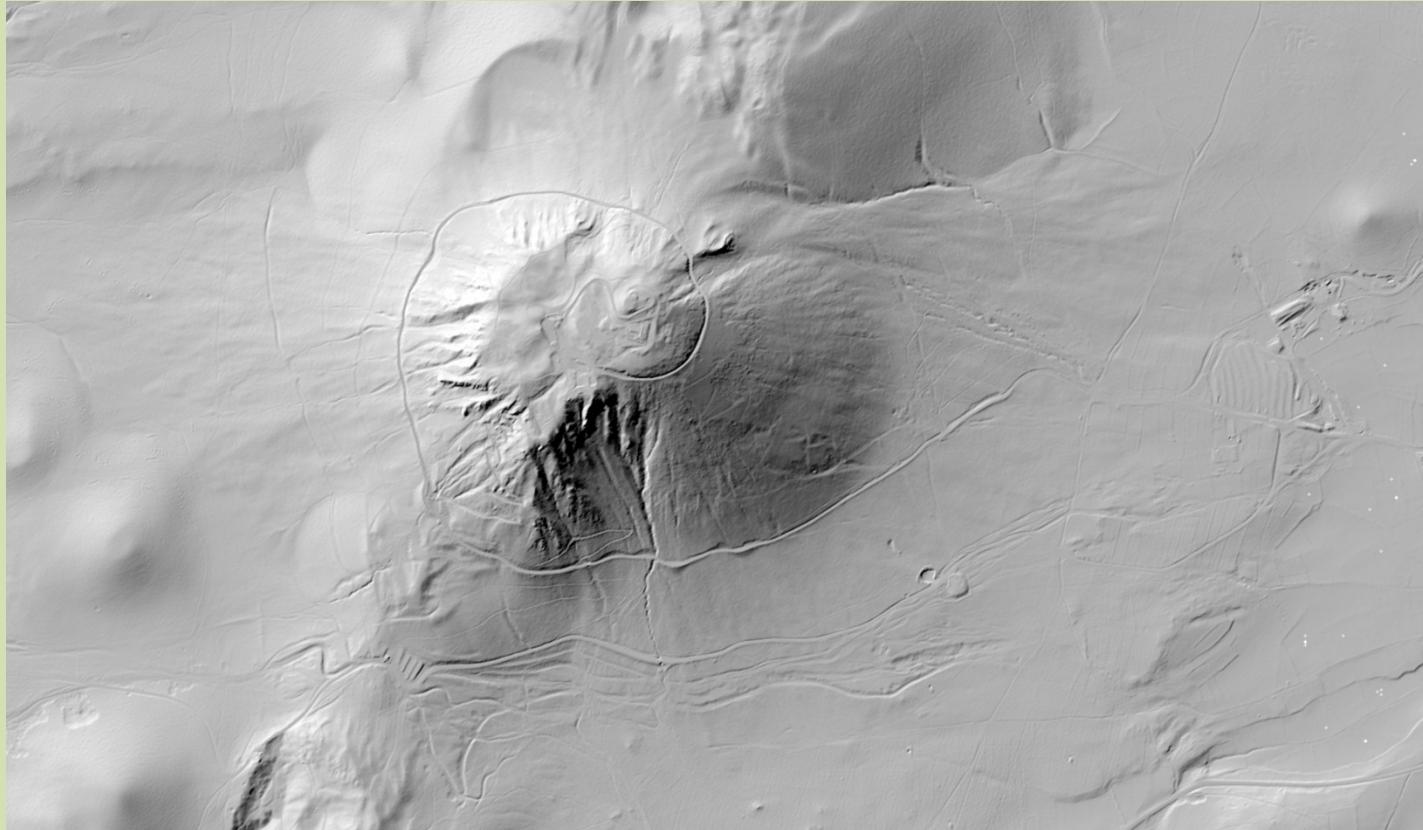
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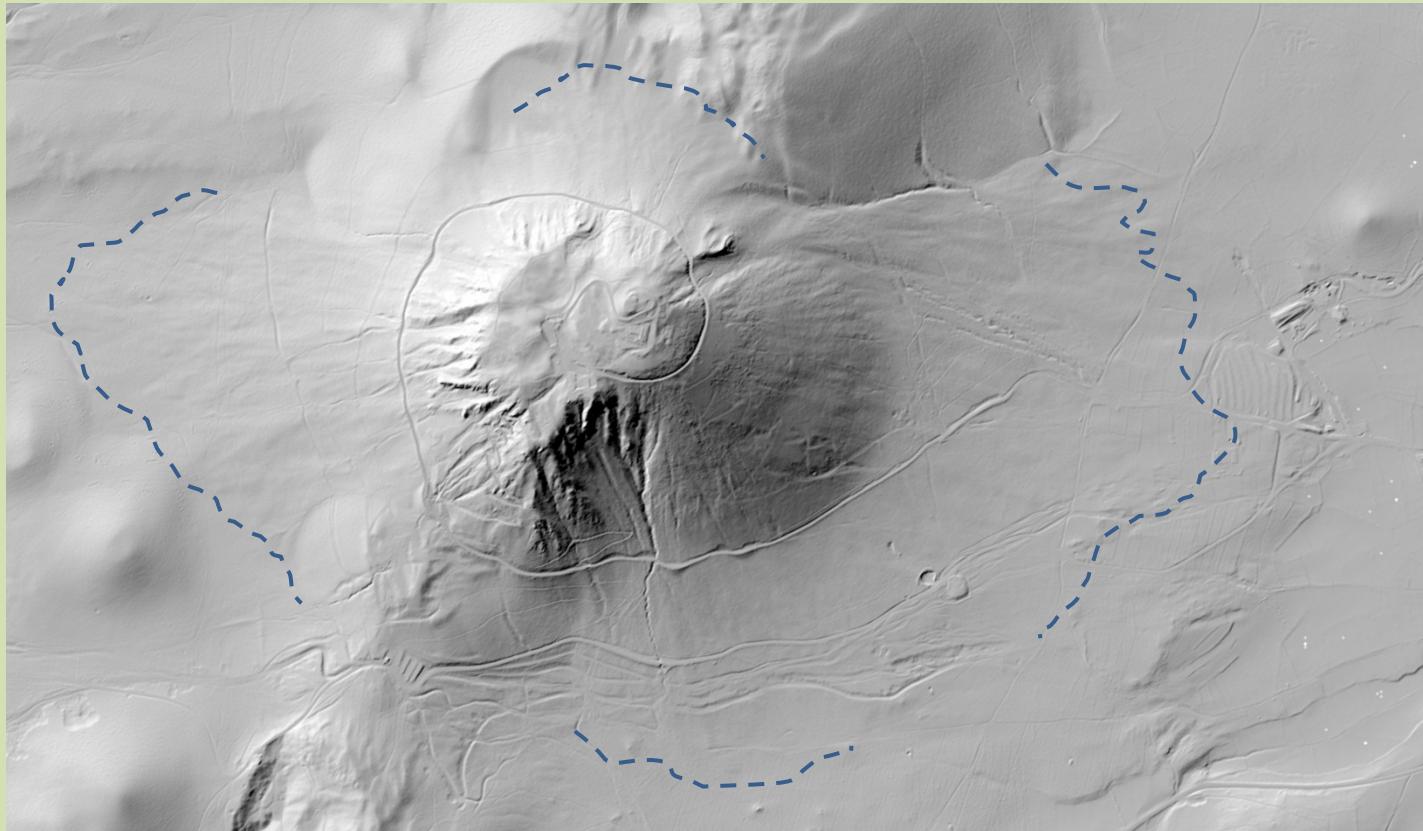
Scar produced by collapse of the lava flows



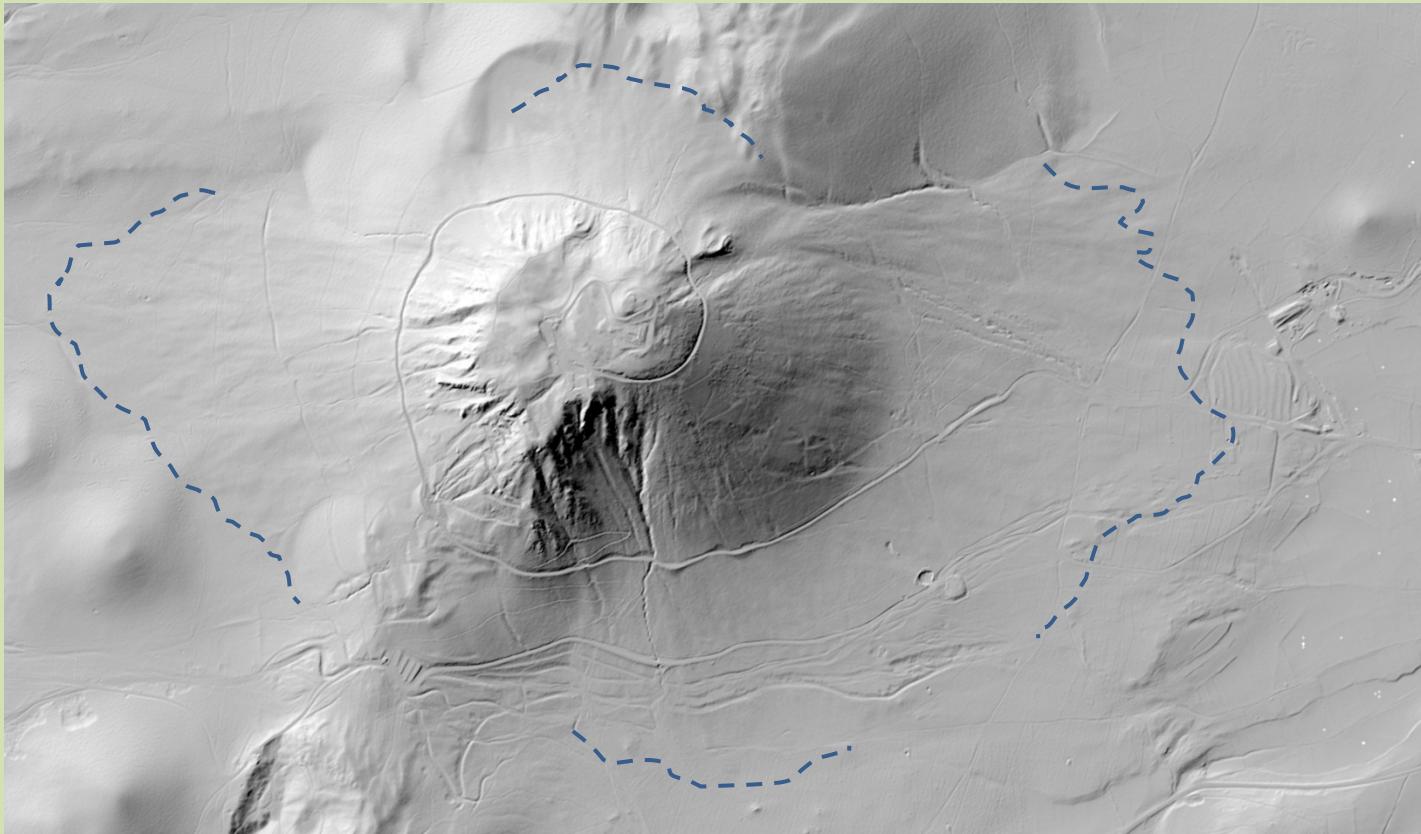
Last: limits of the ash-and-block flows



LiDAR survey © CRAIG – GEOPHENIX 2012, Scientific control by P. Labazuy



**Limits not significantly larger on the eastern part of the volcano
than on its western part**



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than on its western part**

**Does not support the hypothesis of an important flank collapse
(as on the classical Puy de Dôme model)**

Conclusions

History of Puy de Dôme more complex than for a simple lava-dome.

Former dual dome model is questionned

→ **Geophysical investigation wanted for elucidating its inner structure**

→ **Reciprocally, Puy de Dôme volcano is a good target for testing the geophysical methods, including muon tomography**

Thank you for your attention

Puy-de-Dôme, end of XIXth century



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