

# Crystal mush formation, timescales, and unrest: a combined study of olivine crystals and their hosted melt inclusions

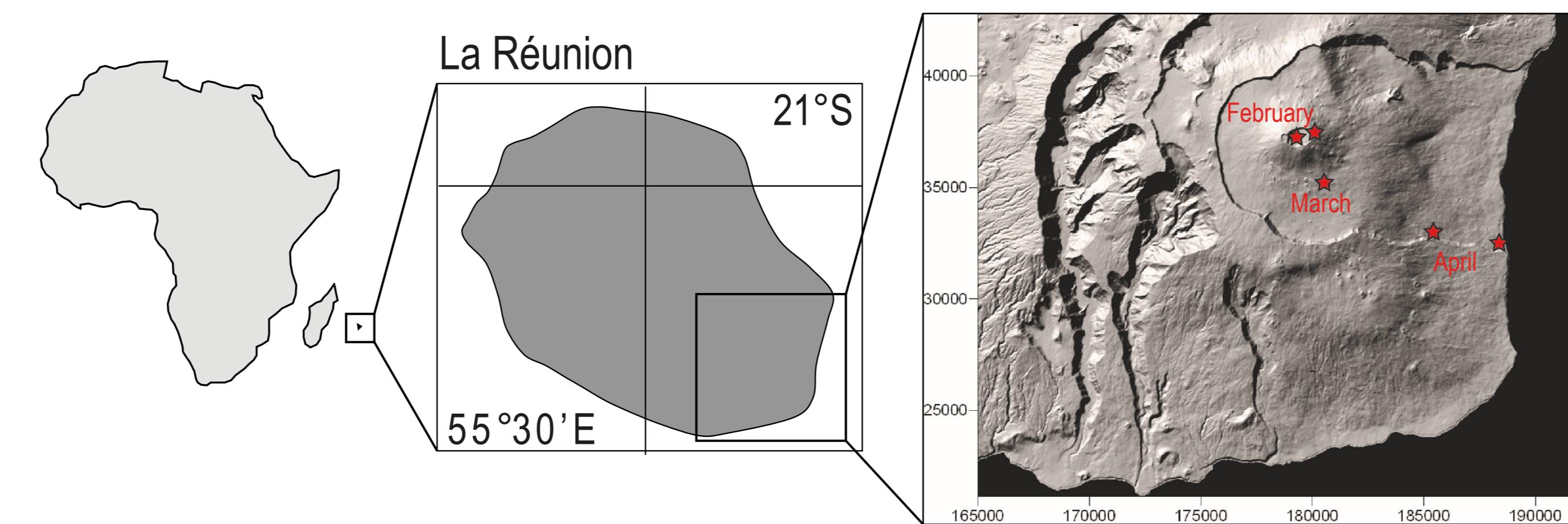
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## 1. MOTIVATION

- \* The processes that occur prior to eruption, their timescales and locations within the plumbing system are still poorly known. This is in part because melt inclusions (MIs) and crystal zoning are typically studied independently and are not correlated with monitoring data.
- \* Here we combine MIs, crystal zoning and monitoring studies of the 2007 caldera-forming eruption of Piton de la Fournaise to disclose the magmatic processes and their timescales.
- \* We show that the olivine crystals from pre-caldera and post-caldera samples mainly track lateral transport of shallow magma that is related with deformation and seismicity.

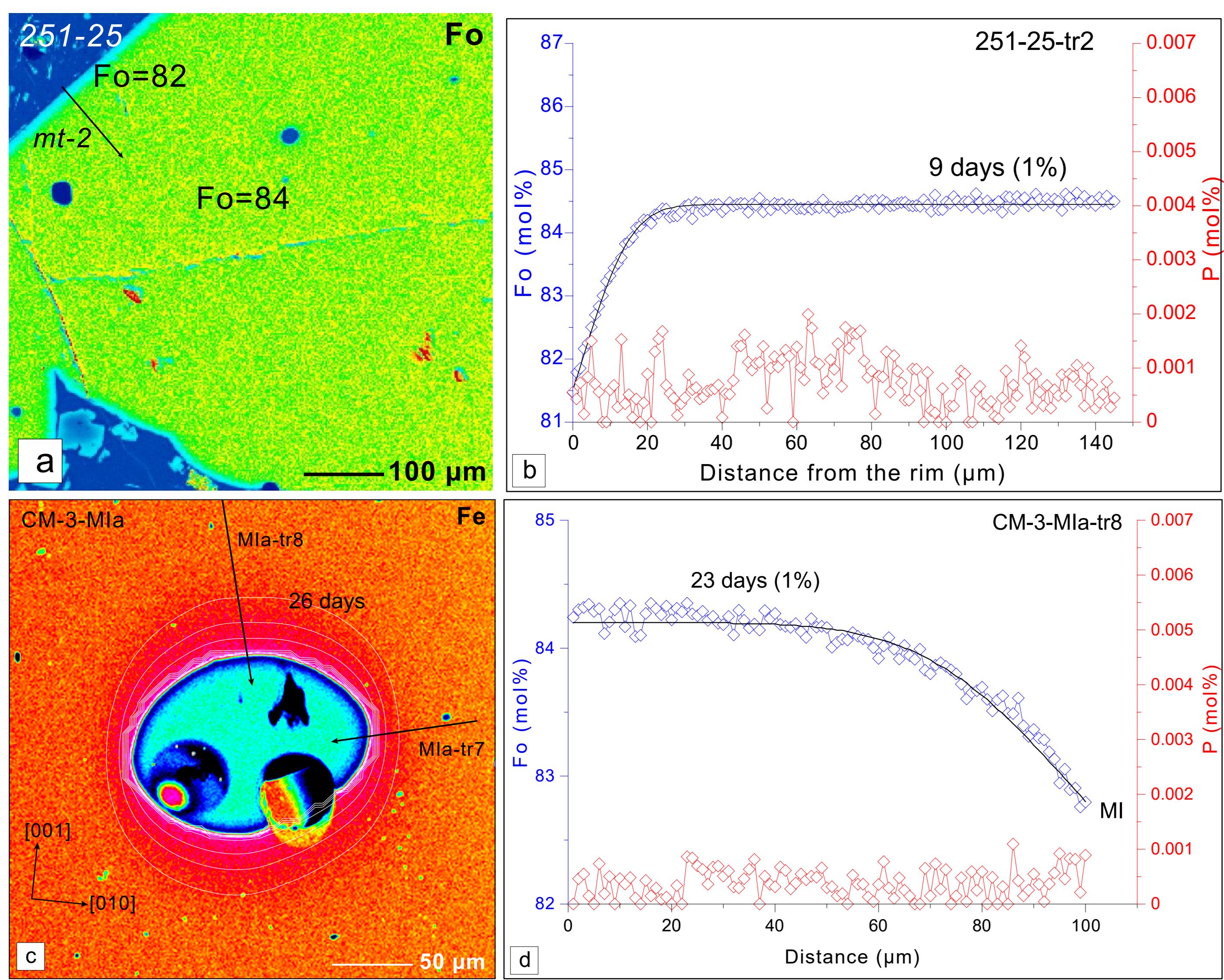
## 2. GEOLOGICAL SETTING and SAMPLES



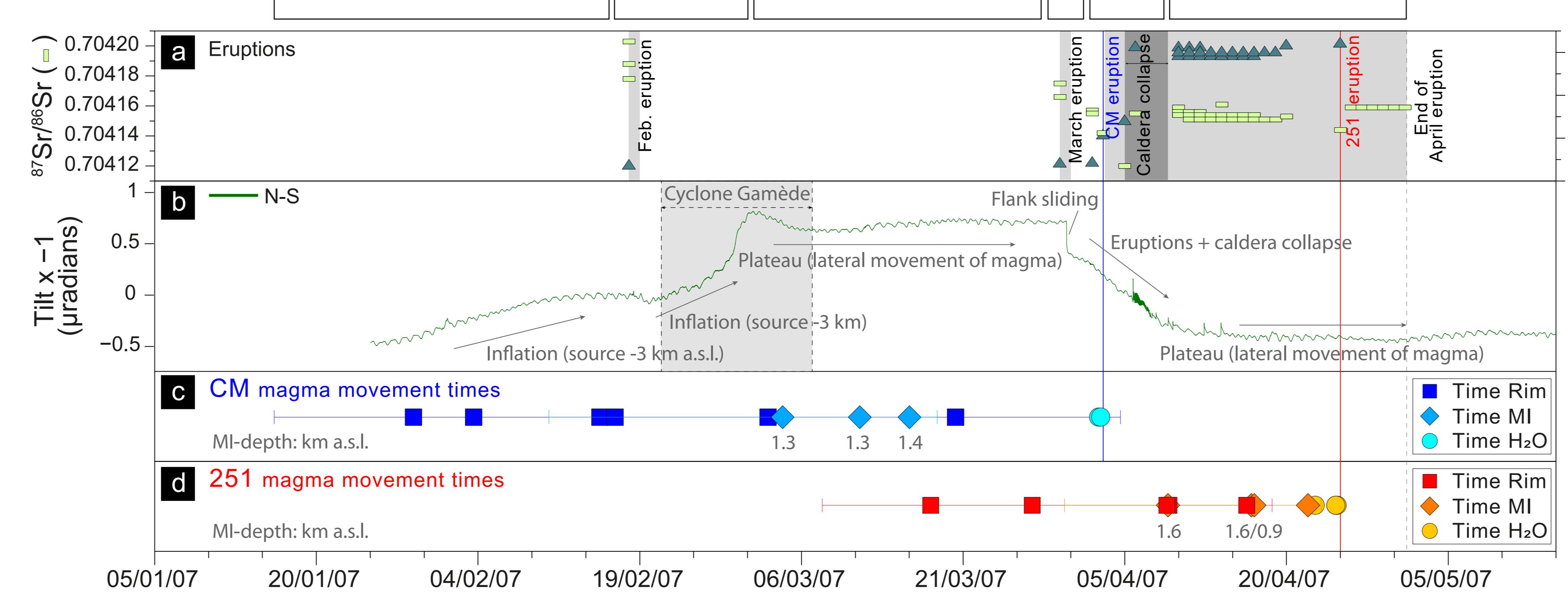
2007 eruption at Piton de la Fournaise (PdF; Fig. 1):

- \* one of the largest eruptions (>200 Mm<sup>3</sup> of magma)
- \* 18-19 February: aphyric basalts
- \* 30-31 March: aphyric basalts
- \* 2 April–1 May: main eruptive phase in duration and volume on the SE flank
  - \* 2-4 April: Pre-caldera collapse tephra (2-4 April 2007) (olivine-basalts) → CM-samples
  - \* 5 April: summit caldera collapse (abrupt increase in crystal content)
  - \* 25 April: Post-caldera collapse lava (crystal-rich oceanites) → 251-samples

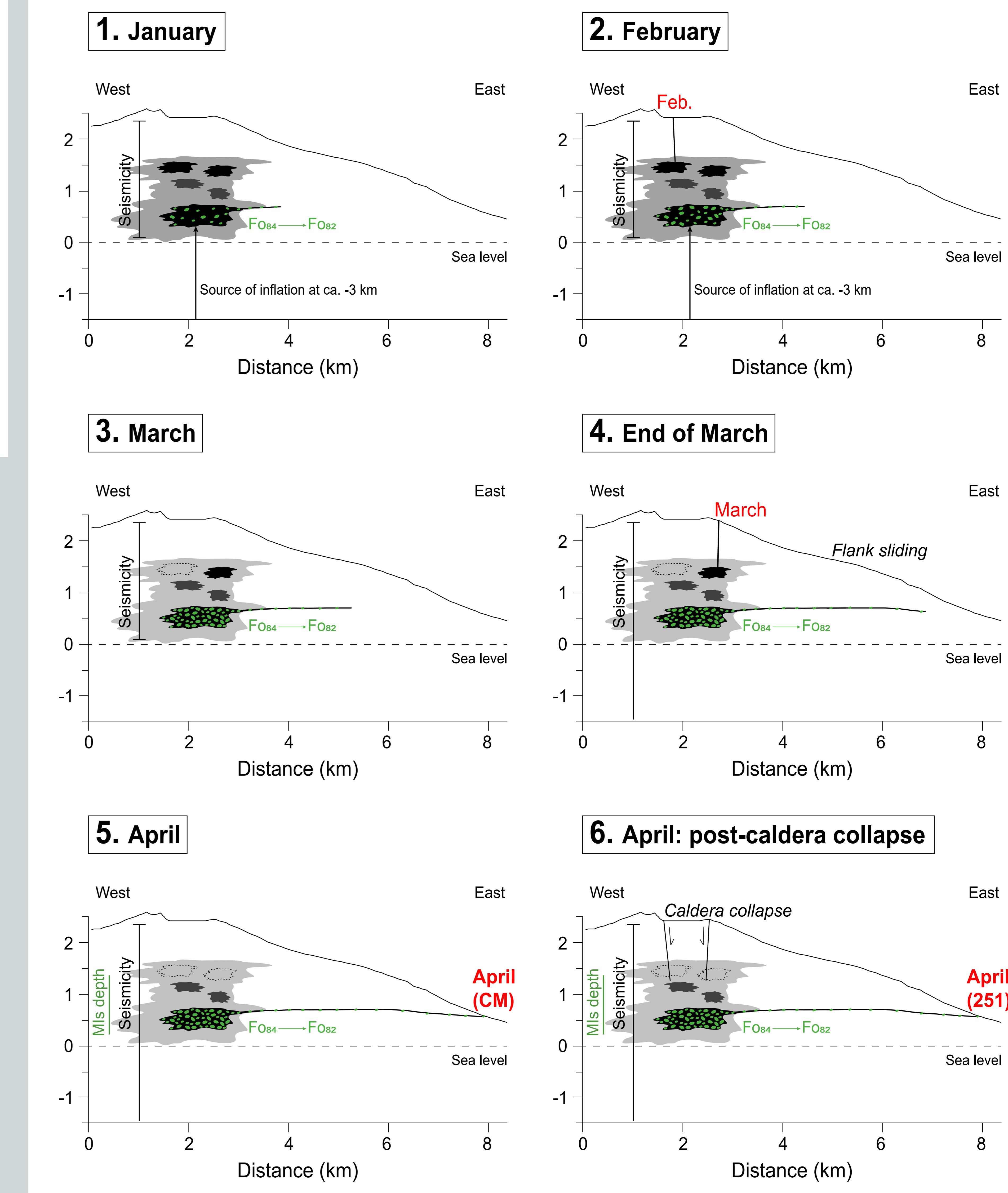
## 3. RESULTS: Crystal Zoning



## 5. DISCUSSION: Integration of petrological with monitoring data



## 6. MODEL



## This DISPLAY in 1 MINUTE:

- \* The combination of olivine and melt inclusions (MIs) studies with the geochemical and geophysical data provides a new framework for the interpretation of the plumbing system and the pre- and syn-eruptive processes.
- \* The timescales calculated from the normal zoning of the olivine evidence continuous movement from the crystal mush due to a new intrusion at deeper level. Olivine crystals do not record magma mixing with the new intrusion.
- \* Olivine crystals erupted in April record the lateral transport of magma as normal zoning during the previous three months, and this match with the early inflation.
- \* MIs from pre-caldera samples follow a degassing trend, while post-caldera MIs display a water re-equilibration. The magma decompression related to caldera collapse may cause the water re-equilibration in the olivine crystals.

## 4. RESULTS: Message from Volatiles

