

# Texture and composition of olivine and plagioclase crystals from the 2011 eruption of Axial Seamount: Implications for magmatic processes at a mid-ocean ridge volcano

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## 1) Introduction

- Axial Seamount is an active submarine volcano located at the intersection between the Juan de Fuca spreading center and the Cobb hotspot in the northeast Pacific, roughly 490 km off the coast of Oregon (Figure 1)
- Axial volcano has been closely observed using state of the art ocean bottom pressure and tilt sensors and seismic hydrophones to monitor seafloor deformation and seismic activity associated with pre-eruptive magmatic dynamics
- Axial erupted most recently in 1998, 2011, and 2015
- This poster aims to investigate magmatic processes behind the 2011 eruption by analyzing the texture and composition of olivine and plagioclase crystals found in the lava

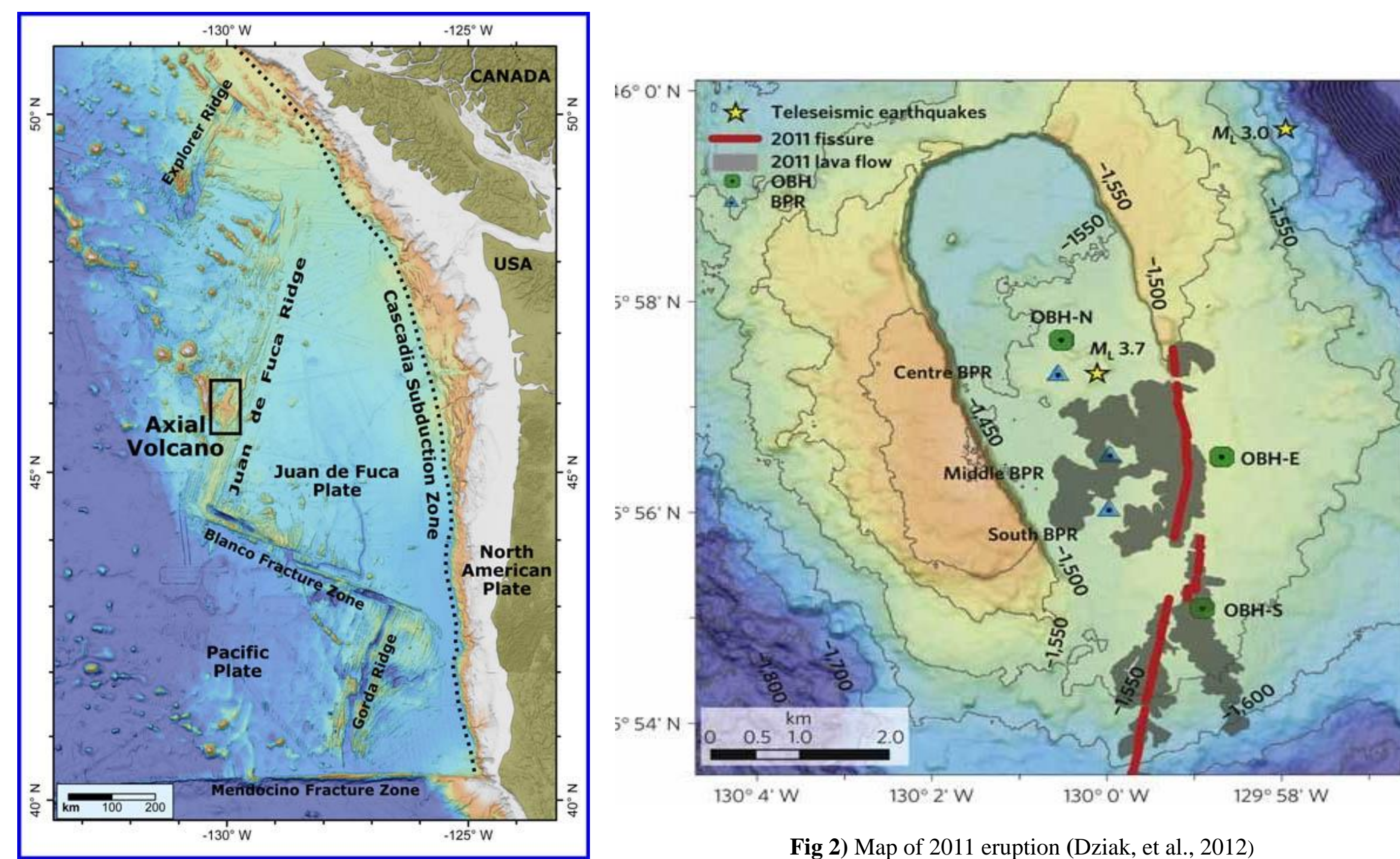


Fig 1. Map of Axial Seamount (W. Chadwick., 2012)

Fig 2) Map of 2011 eruption (Dziak, et al., 2012)

## 2) The 2011 eruption at Axial Seamount

- On 6 April 2011 Axial erupted along the southern rift zone (Figure 1)
- The eruption was preceded by a steady increase in seismicity rate
- The eruption lasted for ~ 6 days, emplacing a volume of  $99 \times 10^6 \text{ m}^3$  of lava and covering an area of  $10.2 \times 10^6 \text{ m}^2$  (W. Chadwick., 2012; Clague et al., 2018)
- The 2011 lava has a typical mid-ocean ridge basalt composition, with a glass MgO content of 7.1-7.6 wt%, and it contains sparse olivine and more abundant plagioclase crystals (Clague et al., 2018)

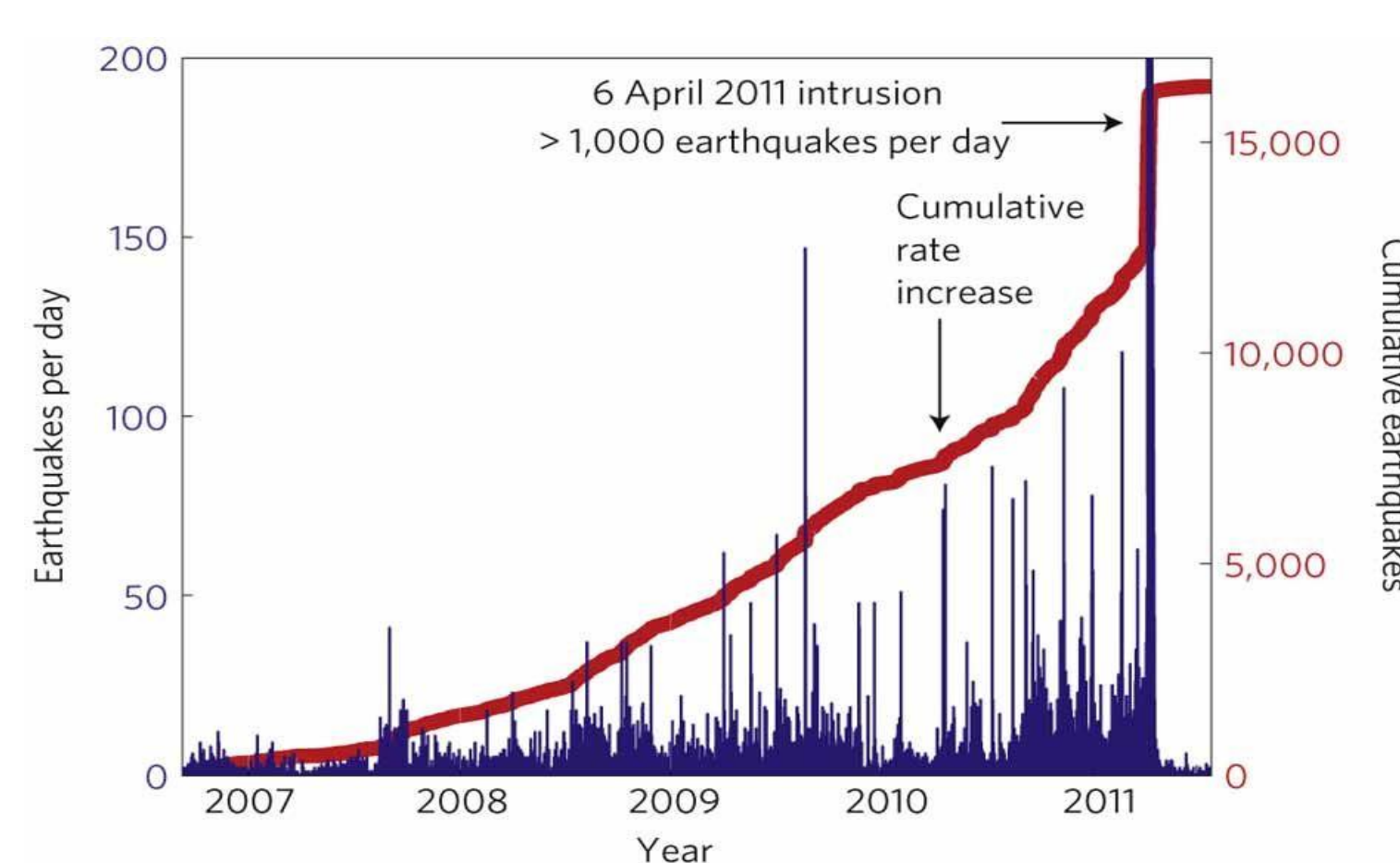


Fig 3) Earthquakes per day (blue) and cumulative earthquakes (red) leading up to 2011 eruption (Dziak, et al., 2012)

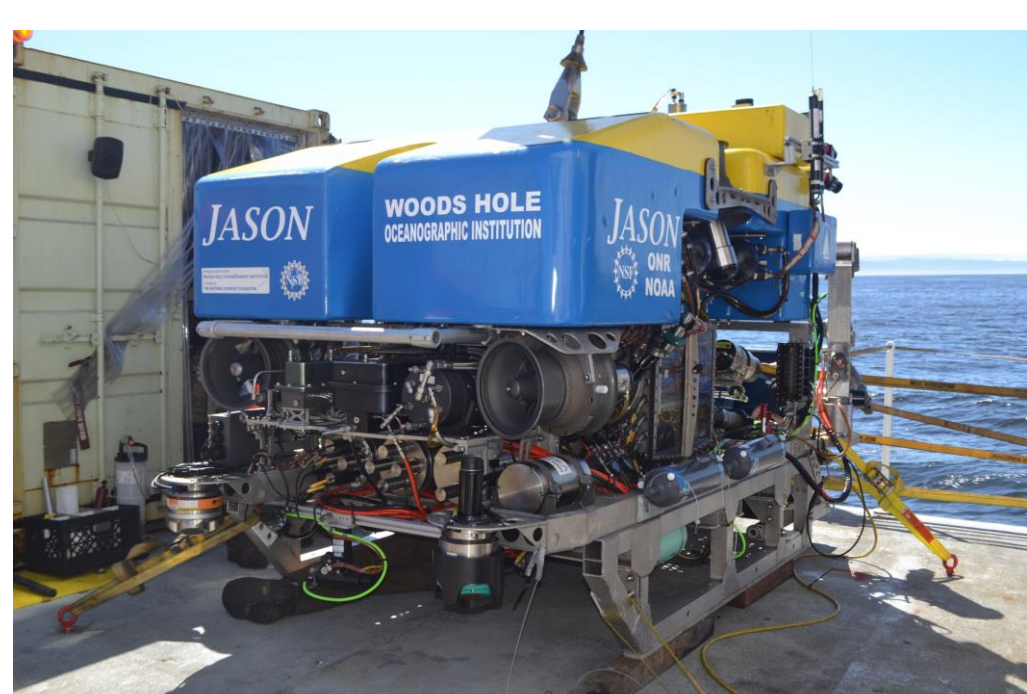


Fig 4) Remotely operated Vehicle Jason was used during deep sea expeditions during Visions '17



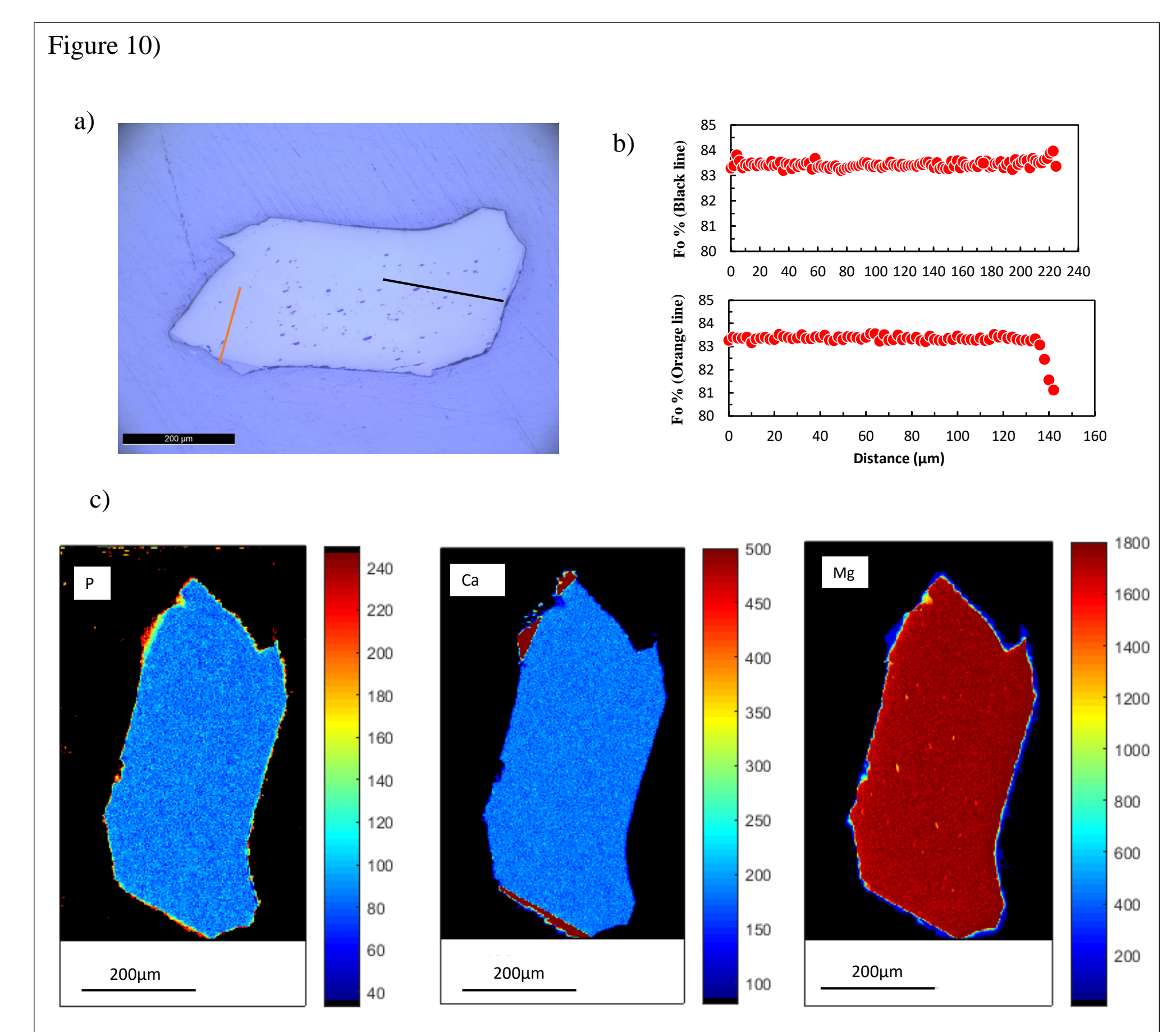
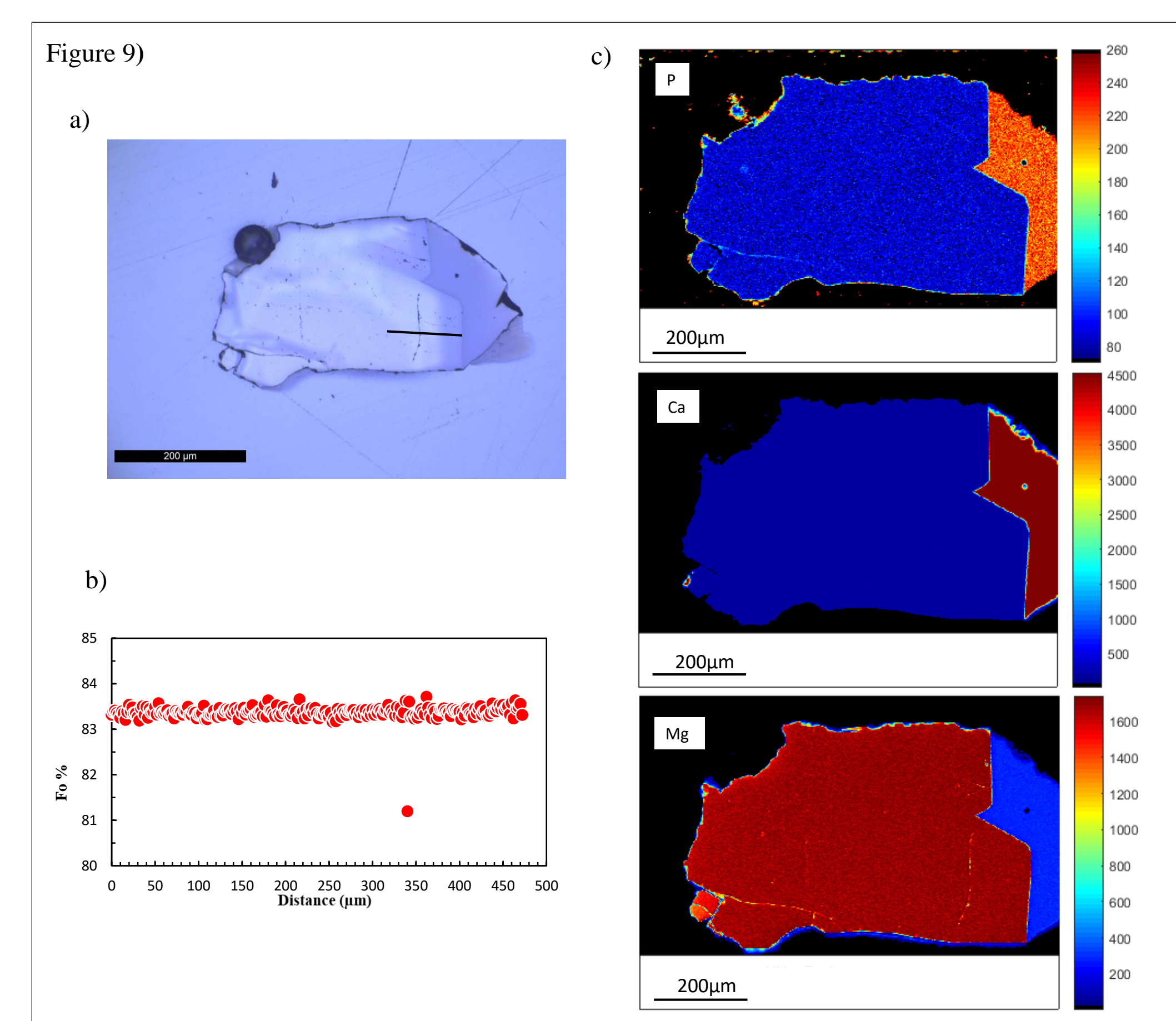
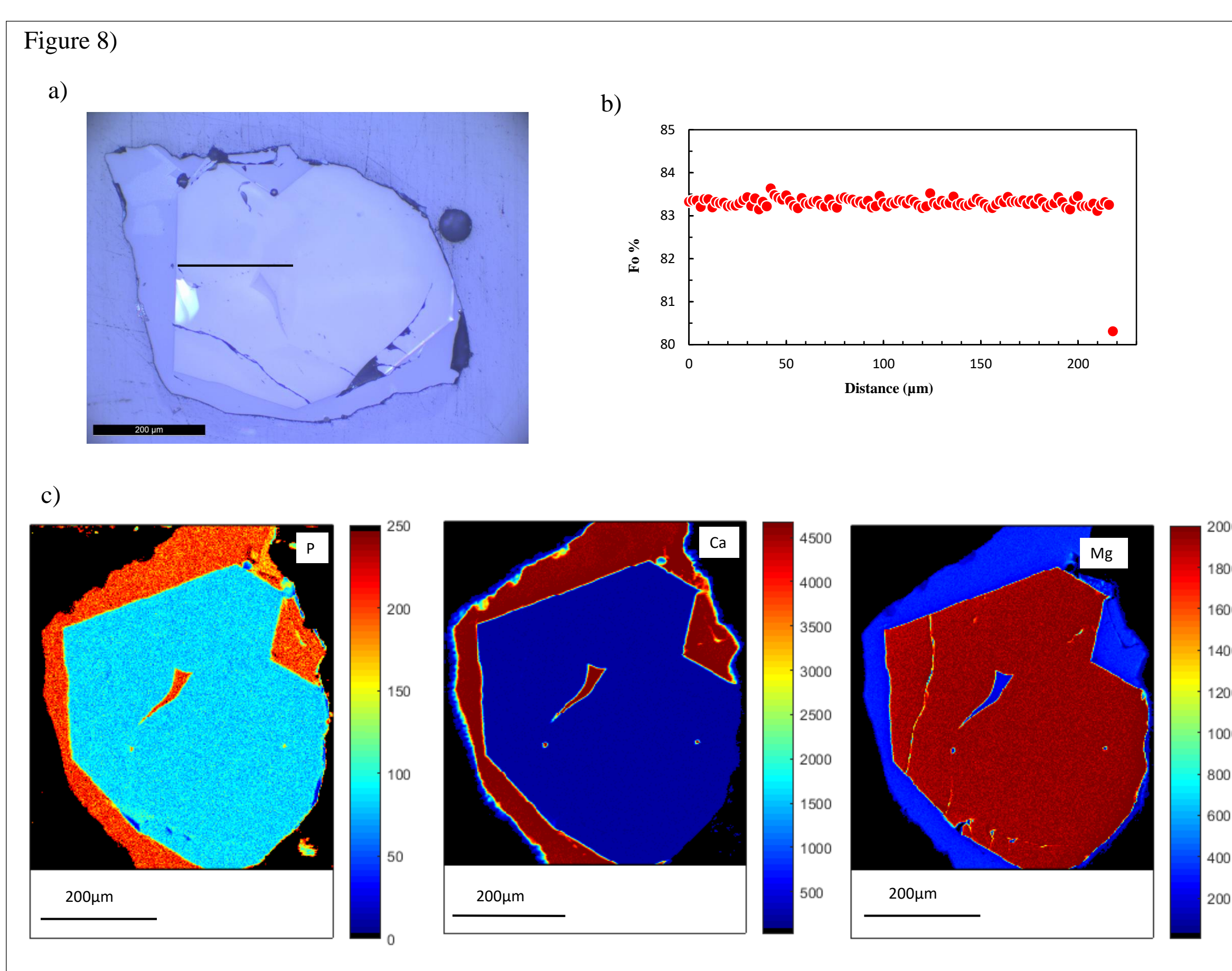
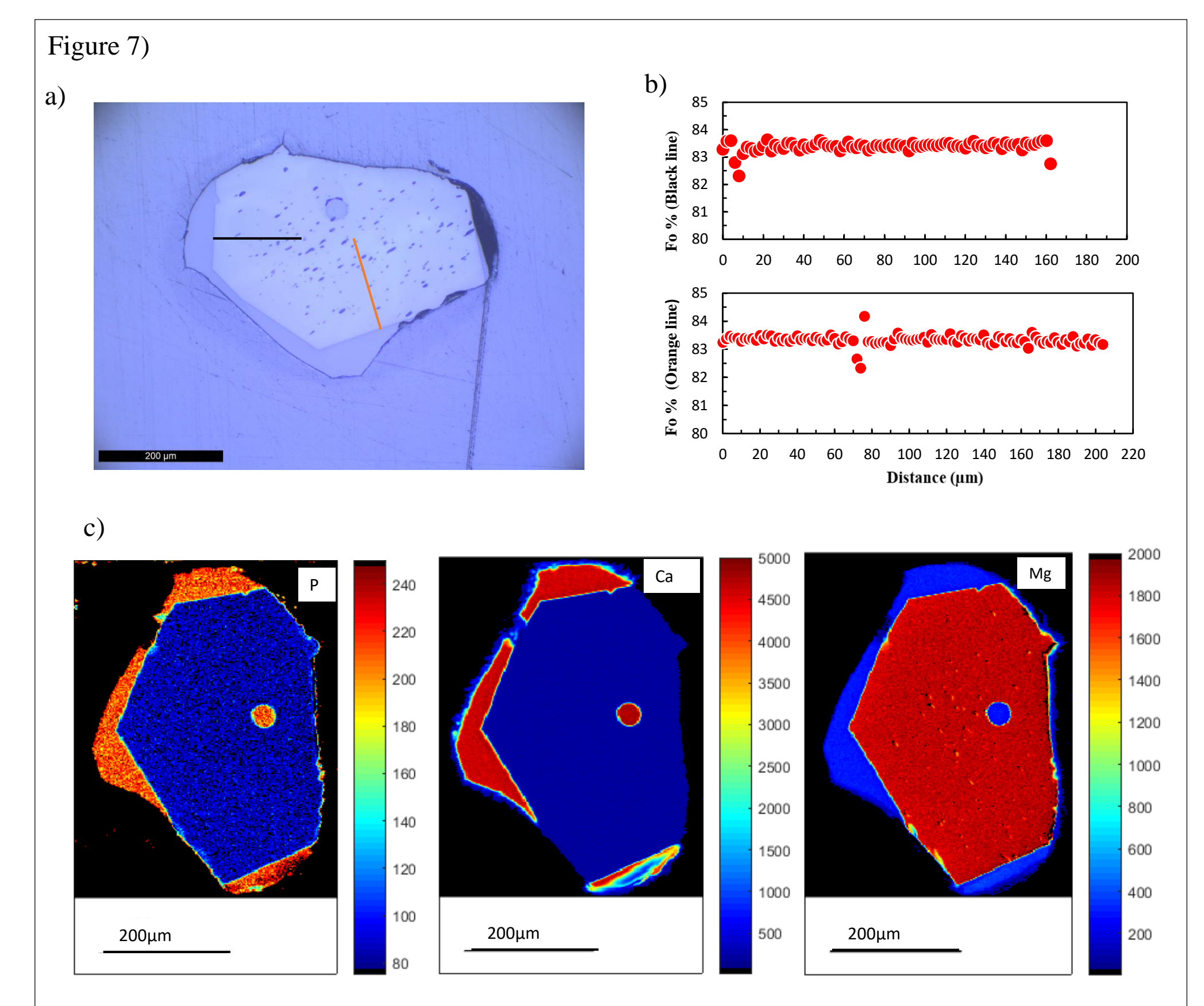
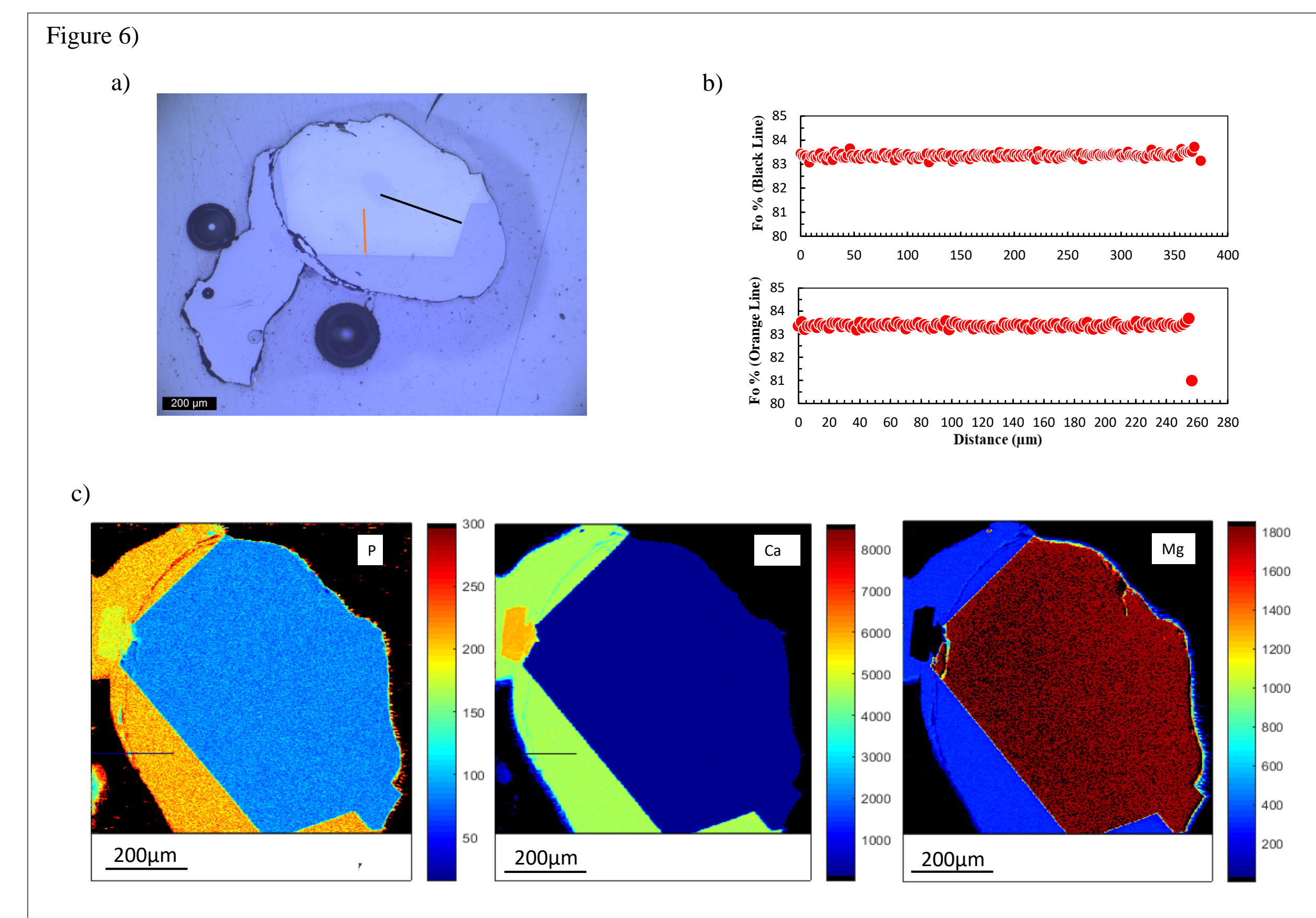
Fig 5) Sample from 2011 eruption; Glassy textural crust accompanied with vesicular characteristics. Sample to the right shows textbook pahoehoe texture

## 5) Conclusions

- Texture and composition of olivine and plagioclase crystals are consistent with simple evolution and relatively homogeneity of the 2011 magma
- Lack of phosphorus zoning in olivine crystals suggests slow crystal growth rate throughout
- Plagioclase, on the other hand, appear to record final cooling/quenching of the magma as a dendritic/ low An% overgrowth rim

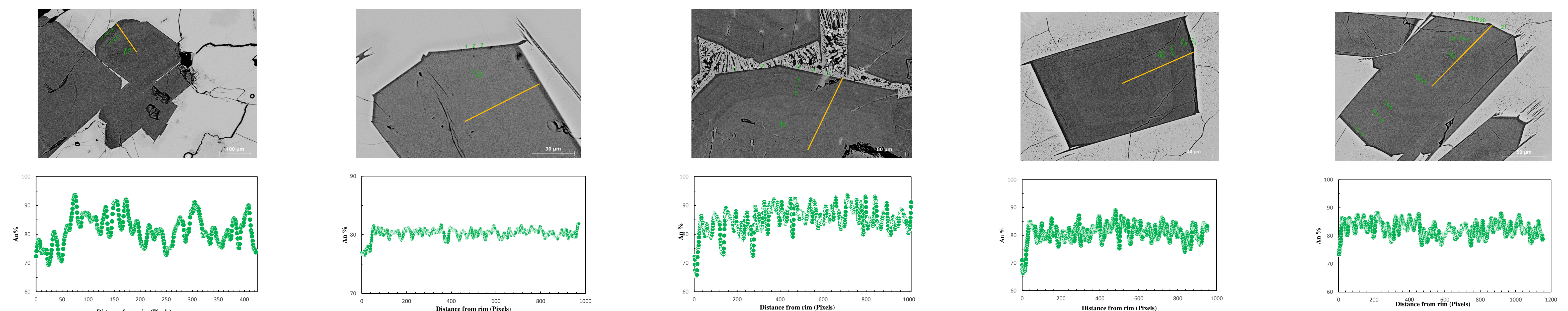
## 3) Olivine

- 5 olivine crystals were analyzed using X-ray mapping and point analyses in energy dispersive spectroscopy mode on an electron probe microanalyzer (EPMA)
- in Figures 6 to 10, panel a) shows a reflected light photomicrograph, b) shows the Fo% of olivine along the core-rim traverse(s) labeled in a), and c) shows the X-ray intensity maps for P, Ca, and Mg (color coded intensity in counts)
- The 2011 olivines show well-developed crystal faces and are completely homogeneous in all major and trace elements and have an average Fo% (100 x molar Mg/(Mg+Fe)) of  $83.4 \pm 0.7$



## 4) Plagioclase

- Backscattered electron images (BSE) of plagioclase crystals obtained on a scanning electron microscope (SEM)
- BSE image grayscale was calibrated to An% (100 x mol Ca/(Ca + Na + K)) using SEM point analyses and ImageJ freeware
- Plagioclase crystals are euhedral, weakly oscillatory zoned and display a low An% rim (dark) showing dendritic texture indicating late-stage rapid growth
- Mean core and rim compositions are  $82.6 \pm 1.8 \text{ An\%}$  and  $72.6 \pm 4.1 \text{ An\%}$ , respectively



## References

- Chadwick, W. S., et al. "Seafloor Deformation and Forecasts of the April 2011 Eruption at Axial Seamount." *Nature Geoscience*, 2012, pp. 474–477., doi:10.1038.
- Dziak, R. P., et al. "Seismic Precursors and Magma Ascent before the April 2011 Eruption at Axial Seamount." *Nature Geoscience*, vol. 5, July 2012, pp. 478–482., doi:10.1038.
- Clague, David A, et al. "Chemical Variations in the 1998, 2011, and 2015 Lava Flows From Axial Seamount, Juan De Fuca Ridge: Cooling During Ascent, Lateral Transport, and Flow." *Geochemistry, Geophysics, Geosystems*, 3 Sept. 2018., doi:10.1029/2018GC007708.

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