LabEx OSUG@2020

Observatoire des Sciences de l'Univers de Grenoble

Ce projet est soutenu par le Laboratoire d'Excellence OSUG@2020 (ANR10 LABX56) financé par le programme d'Investissements d'Avenir lancé par l'Etat et mis en oeuvre par l'ANR.

Titre du projet :

Volet : International

Porteur du projet : Svetlana Byrdina

Laboratoires impliqués : ISTerre, ITB, CVGHM

Bilan du projet pour l'année/la période

Bilan d'activité *(1 page max)*

Studies of the hydrothermal system and alteration on Indonesian volcanoes Merapi and Papandayan.

Papandayan volcano in West Java, Indonesia, is characterized by intense hydrothermal activity manifested by numerous fumaroles at three craters or Kawah, i.e. Mas, Manuk and Baru (figure 1). The latter was created after November 2002 phreatic eruption. Since 2011, numerous volcano-tectonic B events are encountered and the volcano was set on alert status on several occasions. The purpose of the present study is to delineate the structure of the summital hydrothermal system from ERT, Self-Potential (SP), soil temperature and gas concentrations in the soil (CO2 and SO2) data (figure 1 c). This combination of geophysical and geochemical methods allows identification of the weak permeable zones serving as preferential pathways for hydrothermal circulation and potential candidates to future landslides or flank collapses. Our 3-D ERT model (figure 2) is compared to the results of the seismic study of long-period seismicity recorded during the volcanic unrest in 2011 (Syahbana et al, 2014). The conductive body imaged in figure 2 and 3 coincides well with the most probable locations of the shallow LP seismicity confirming the hypothesis that these LP events are generated by shallow hydrothermal fluid flow.

This study uses also Induced-Polarization (IP) laboratory data to characterise and to quantify the degree of alteration of the volcanic rocks (as shown by e.g., Revil et al, 2013, 2017). The rock and soil samples from two Indonesian volcanoes, Merapi and Papandayan were used in laboratory analyses at ISTerre for petrophysical and complex resistivity parameters at the sample scale. The idea is to compare the resistivity structures of both volcanoes that are characterized by very different styles of activity ('wet' hydrothermal Papandayan and 'dry' explosive-effusive style of Merapi volcano with almost no sign of hydrothermal system). This work is in progress.

References

A. Mazot and A. Bernard, "Insight into the hydrothermal of Papandayan volcano, Indonesia" in Water-Rock Interaction vol. I, edited by R.B. Wanty and R.R. Seal II (Balkema, 2004), pp. 163–166.

D.K. Syahbana, C. Caudron, P. Jousset, T. Lecocq, T. Camelbeeck, A. Bernard and Surono, Journal of Volcanology and Geothermal Research 280, 76–89 (2014).

Illustrations - avec légende et crédit *(à envoyer également séparément)*

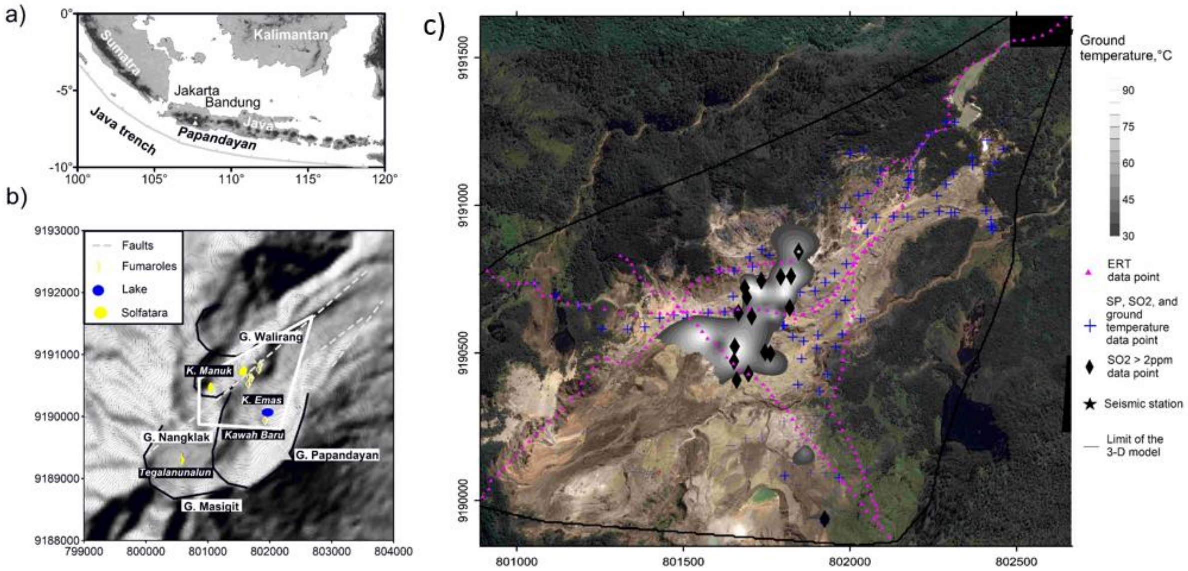

Figure 1. Location of the study area. A) Papandayan volcano b) Main craters and location of the ERT survey (white polygon), c) Aerian photo Location of ERT profiles (magenta triangles), data points with SO2 concetration exceeding 2 ppm (yellow diamonds), and ground temerapure contour map showing temperatures exceeding 30° C at a depth of 40 cm.

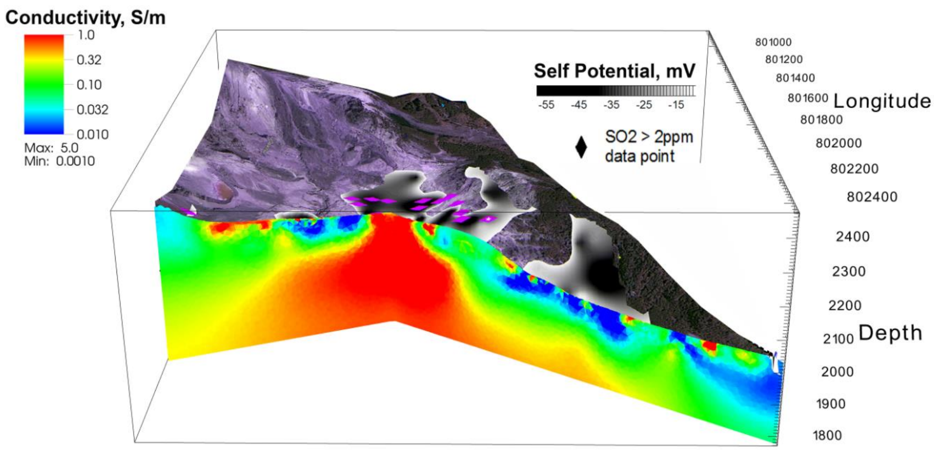

Figure 2. 3-D ERT model combined with the SP contour map of Self-potential (only SP low is shown to stress the correlation between the fumarole location and low values of the SP). Shallow conductive body (red-yellow) imaged by ERT modelling shows the extent of the hydrothermal area that reaches the surface at K Emas fumarole field.

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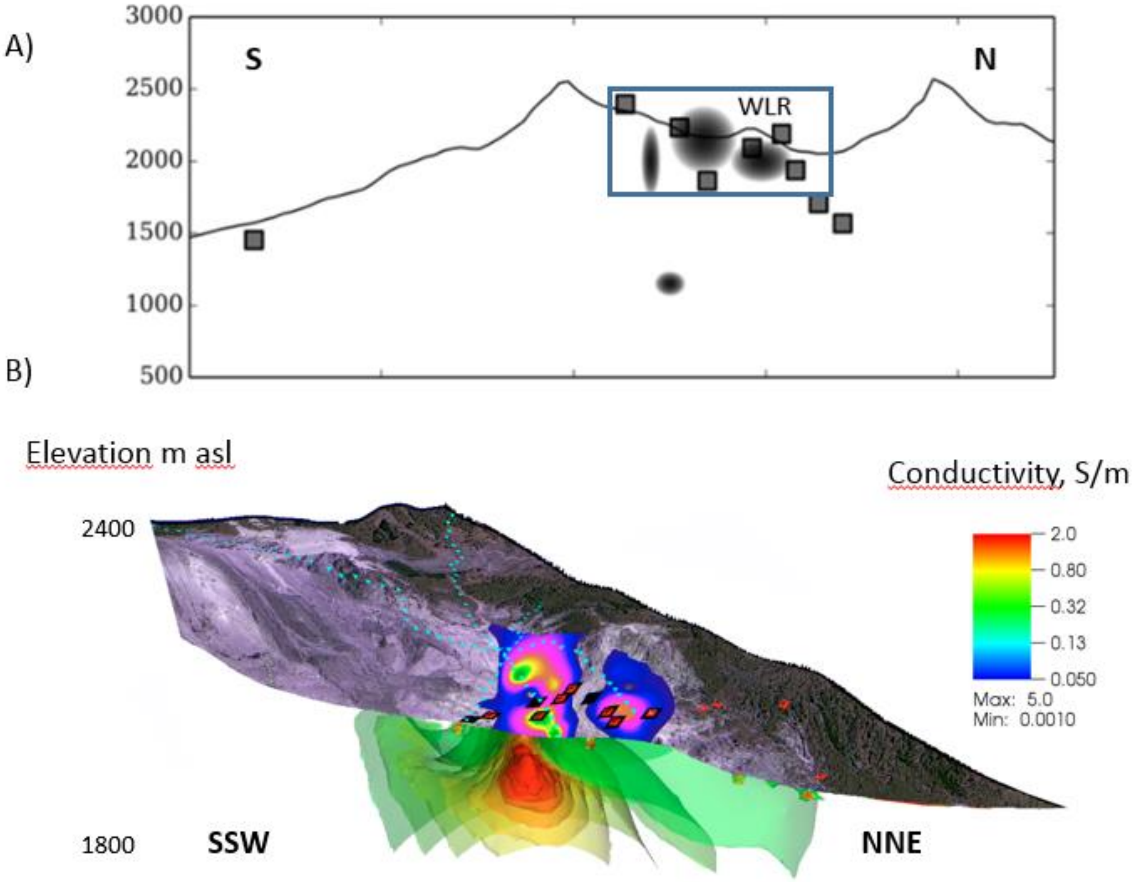

Figure 4. Comparison with seismic study by . Syahbana et al, (2014) dedicated to localization of long period seismicity. A) Source locations of LP events using a 3-D non-linear hypocenter localization algorithm. The probability density function (PDF) where darker grays indicate the most probable source locations. Gray squares indicate seismic stations operated during the unrest period. Blue rectangle shows the extent of the 3-D ERT model shown in B. B) Iso-values of electrical conductivity in NNE-SSW direction show the cross-section of the hydrothermal system that coincides with the most probable LP locations represented in A.

Production scientifique *(articles scientifiques, actes de congrès…)*

- Byrdina S., H, Grandis, J. Vandemeulebrouck, et al, Shallow resistivity structure of Papandayan volcano, to be submitted to JVGR
- Soueid Ahmed A., et al, 3D electrical conductivity tomography of volcanoes, to be submitted to JVGR

Bilan financier succinct *(avec suivant les cas : co-financements éventuels, équipements achetés, missions, recrutements divers, fonctionnements divers…)*

The ERT results were produced by our Indonesian partners with no financial participation for ISterre. The budget was spent on small equipment sent to Indonesia, on the fieldwork to collect and analyze the rock and soil samples from Indonesia; congress expenses. We benefitted from a co-funding BQR Sud : 2000 € Labex, 1500€ BQR

Sample expedition	260 €
Fieldwork expenses	240 €
Stage M2, one month gratification	555 €
Stage L2 gratification	280 €
Participation at EGU 2017	1300 €
pH and temperature sensors	230 €
small equipment for isolation amplifier	370 €
small equipment (talky-walkies)	193 €

Total : 3662 €

Annexes si besoin ou lien sur des sites existants et pérennes jusqu'à la fin du Labex (2020)