Characterization of the tephra deposit associated with the 2021 eruption of Cumbre Vieja (La Palma)

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[3]Instituto Volcanológico de Canarias (INVOLCAN), Canary Islands

[4]Instituto Tecnológico y de Energías Renovables (ITER), Canary Islands

[5]Department of Earth and Environmental Sciences, University of Manchester, United Kingdom

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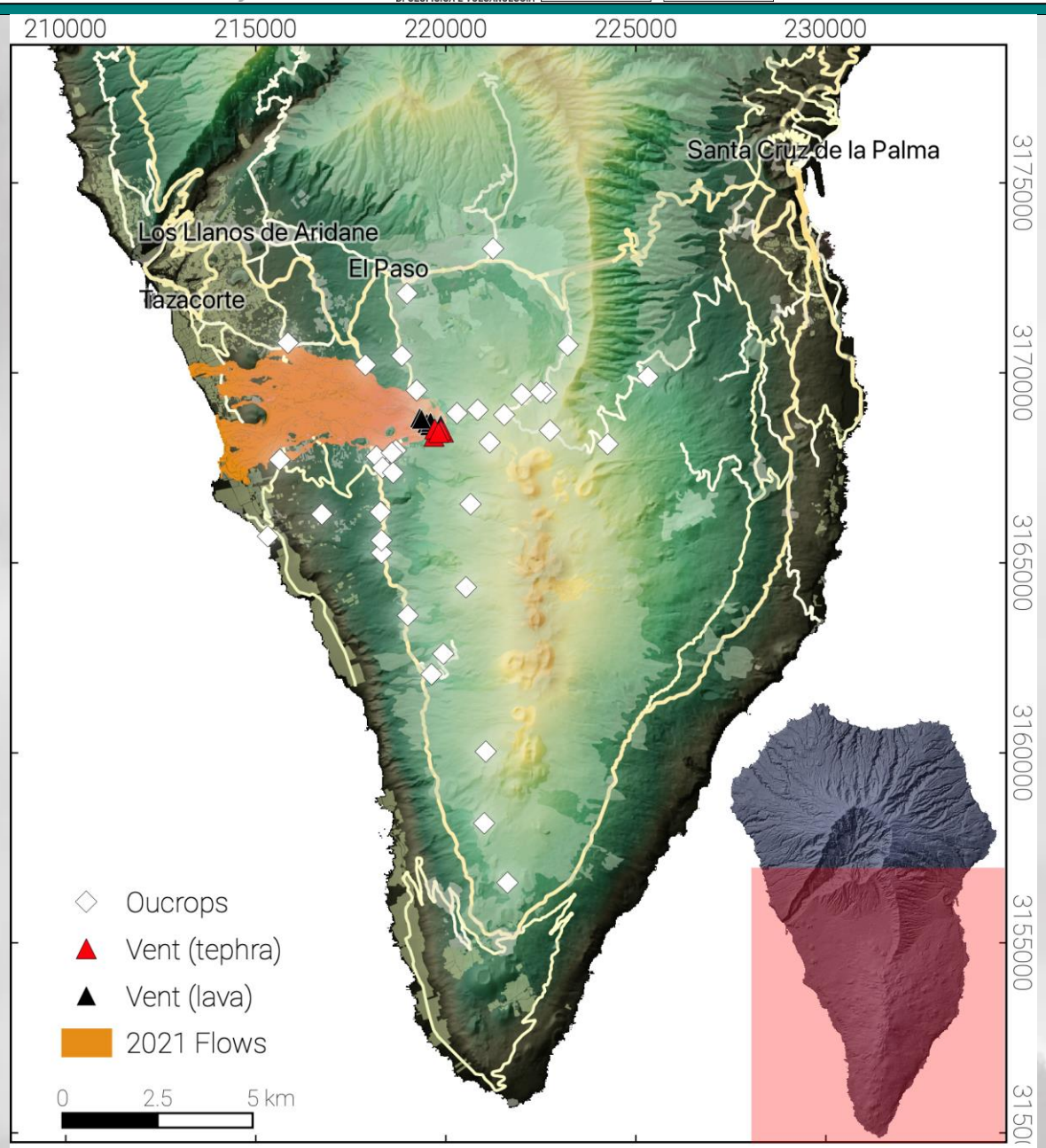
[7]Department of Earth and Environmental Sciences, Ludwig-Maximilians-University, Germany

Main objectives:

- Identify main stratigraphic units and associated eruptive phases
- Determine associated erupted volumes

Main campaigns:

- October-November 2021
- February 2022



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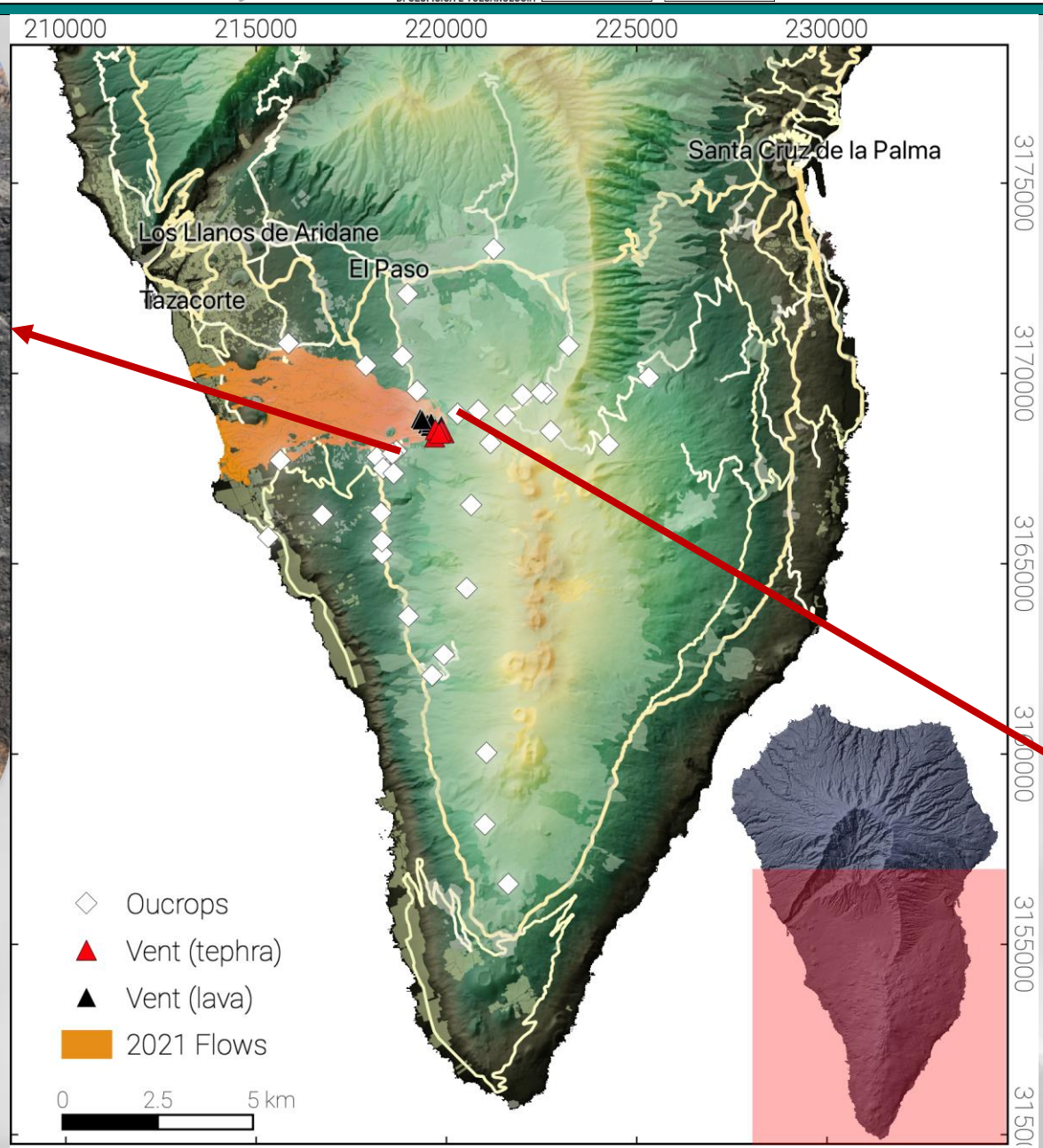

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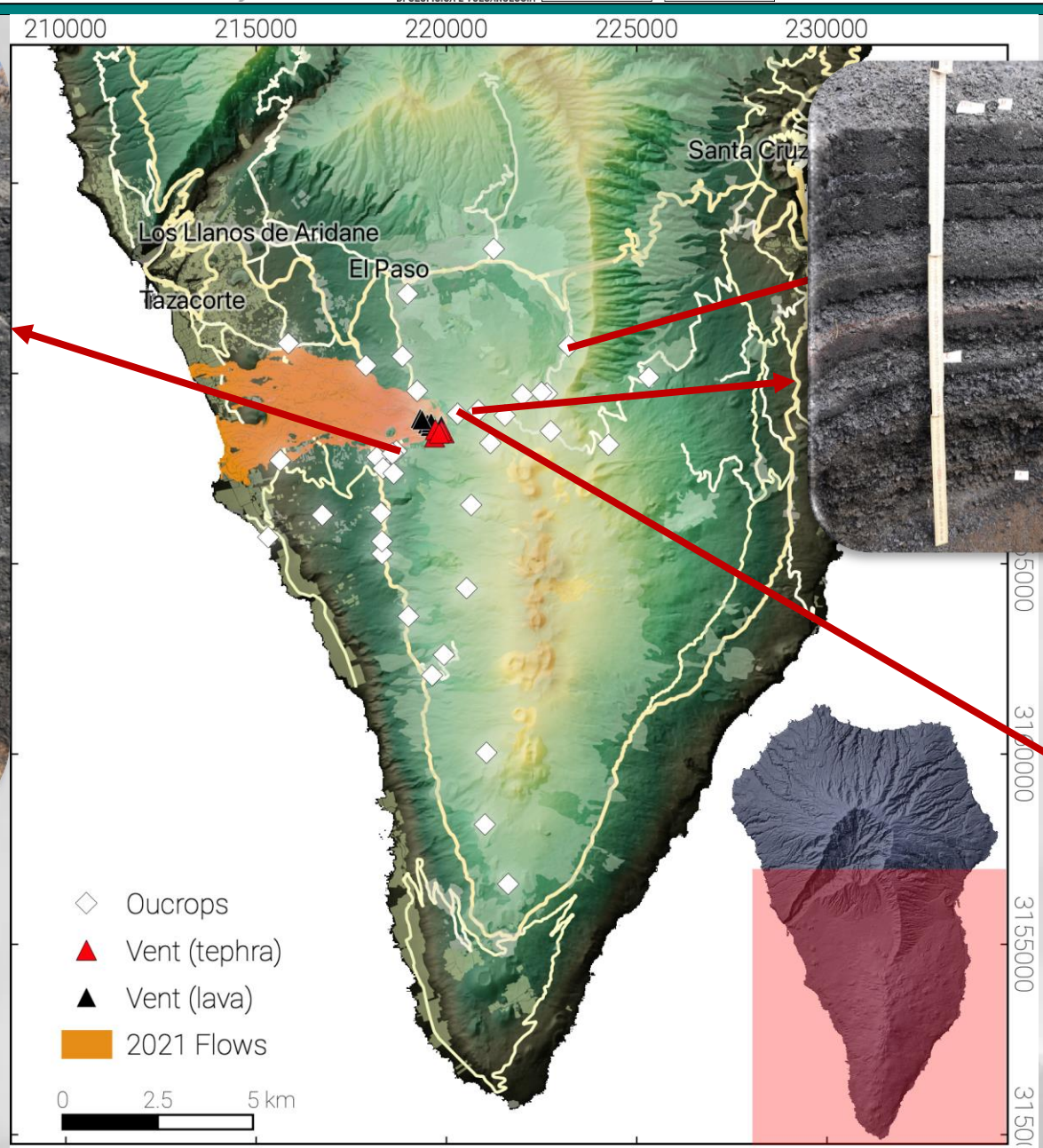

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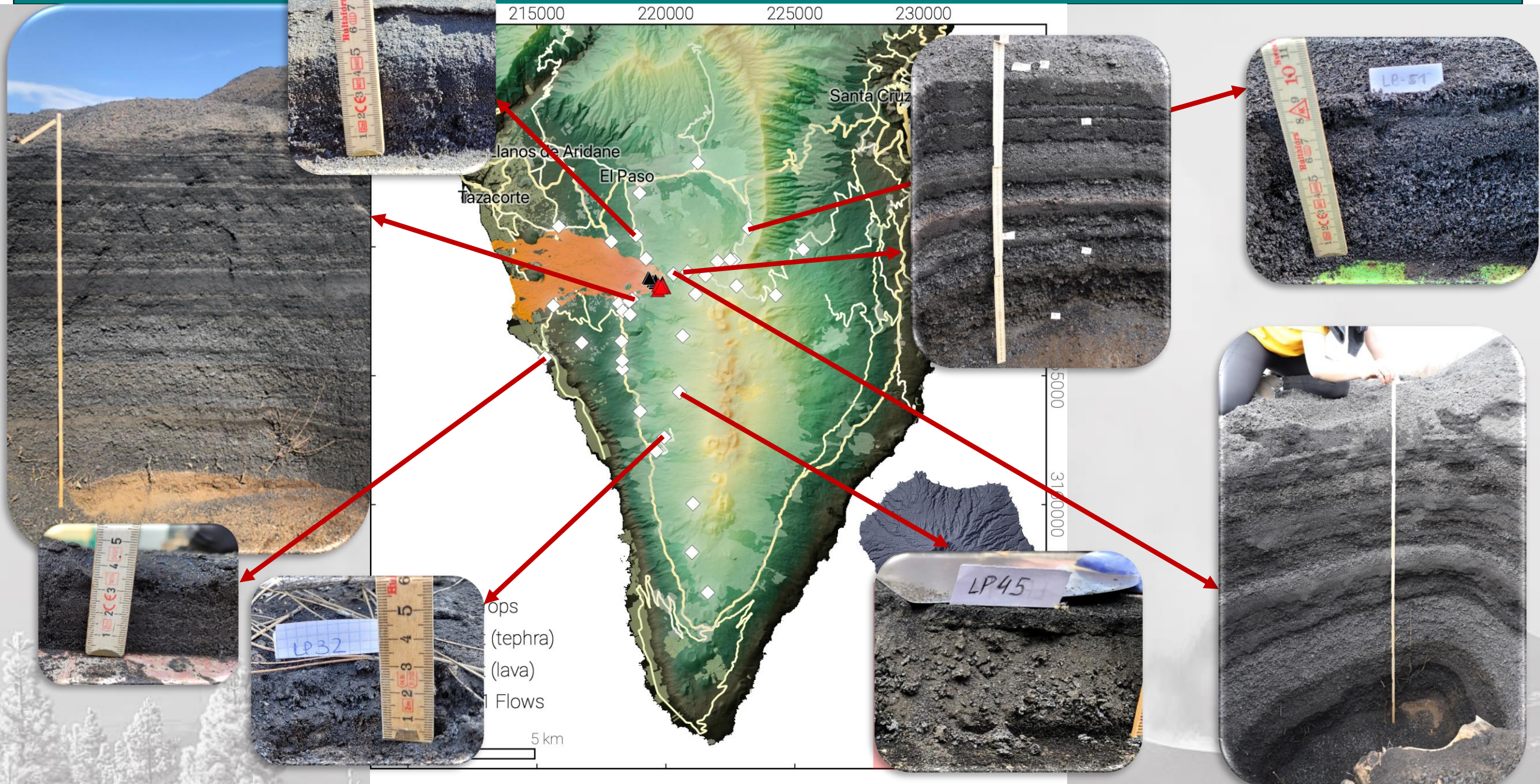
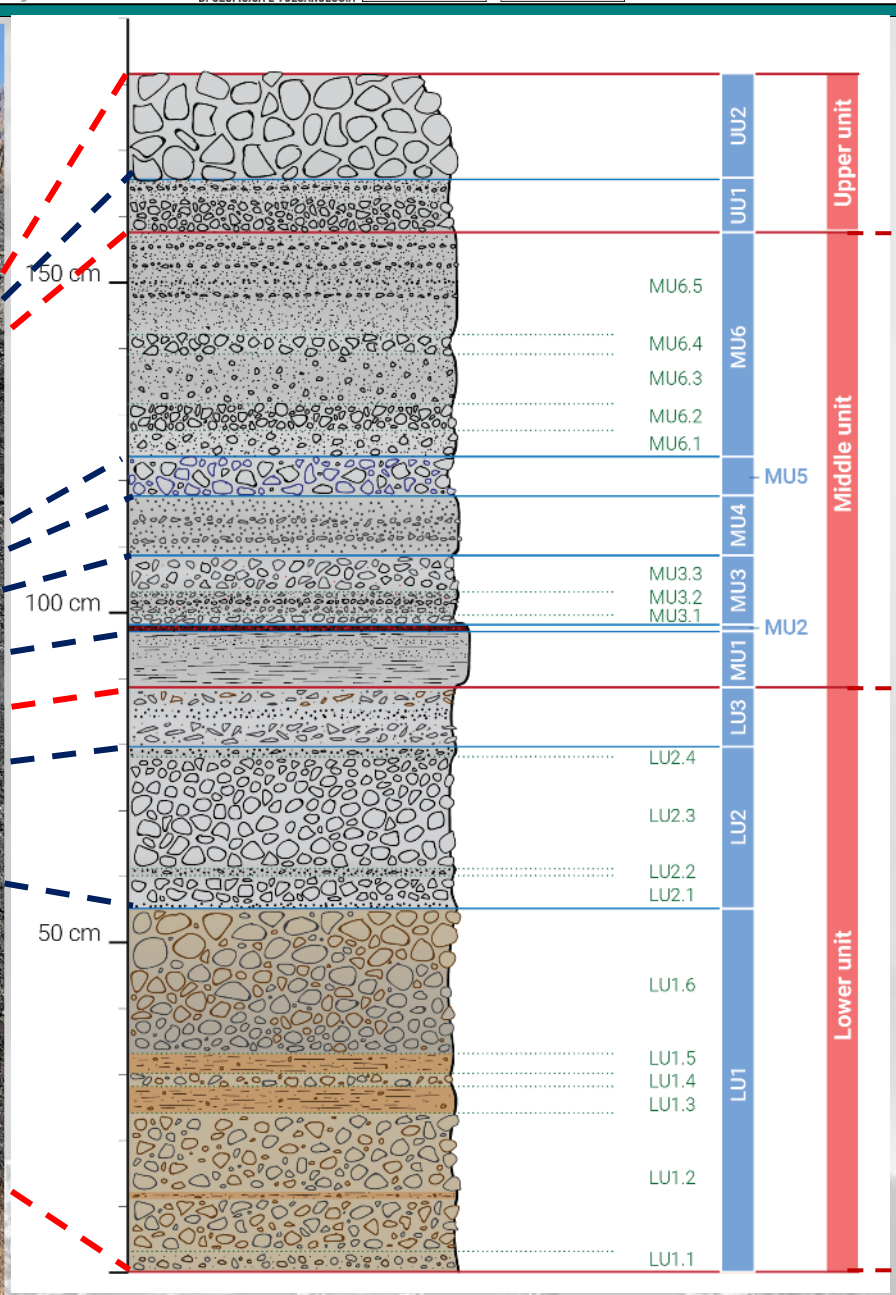
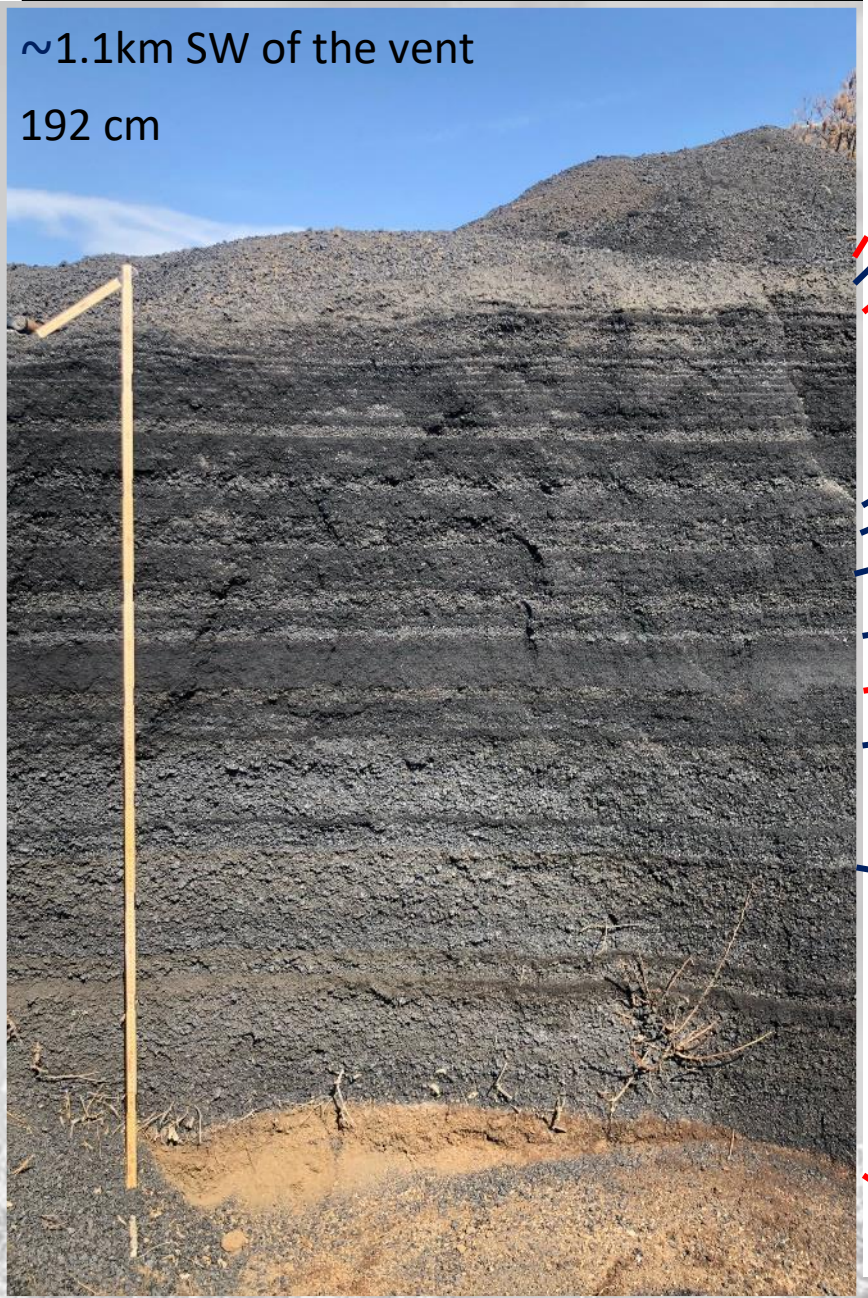


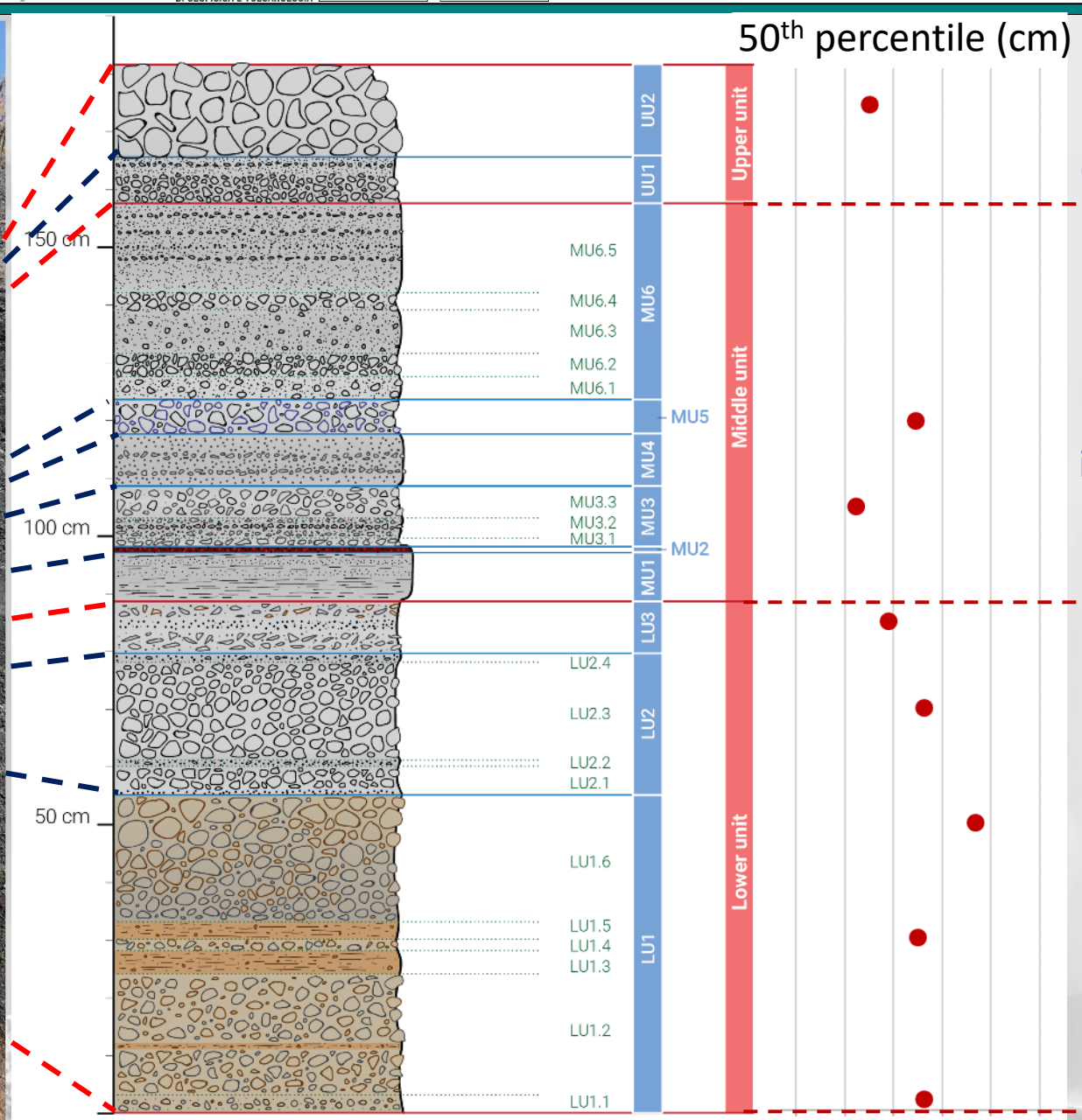


UPPER UNIT
(mostly lapilli-size unit)

MIDDLE UNIT
(fine to coarse ash dominated unit with intercalation of lapilli layers)

LOWER UNIT
(lapilli-size dominated unit with intercalation of fine to coarse ash layers)

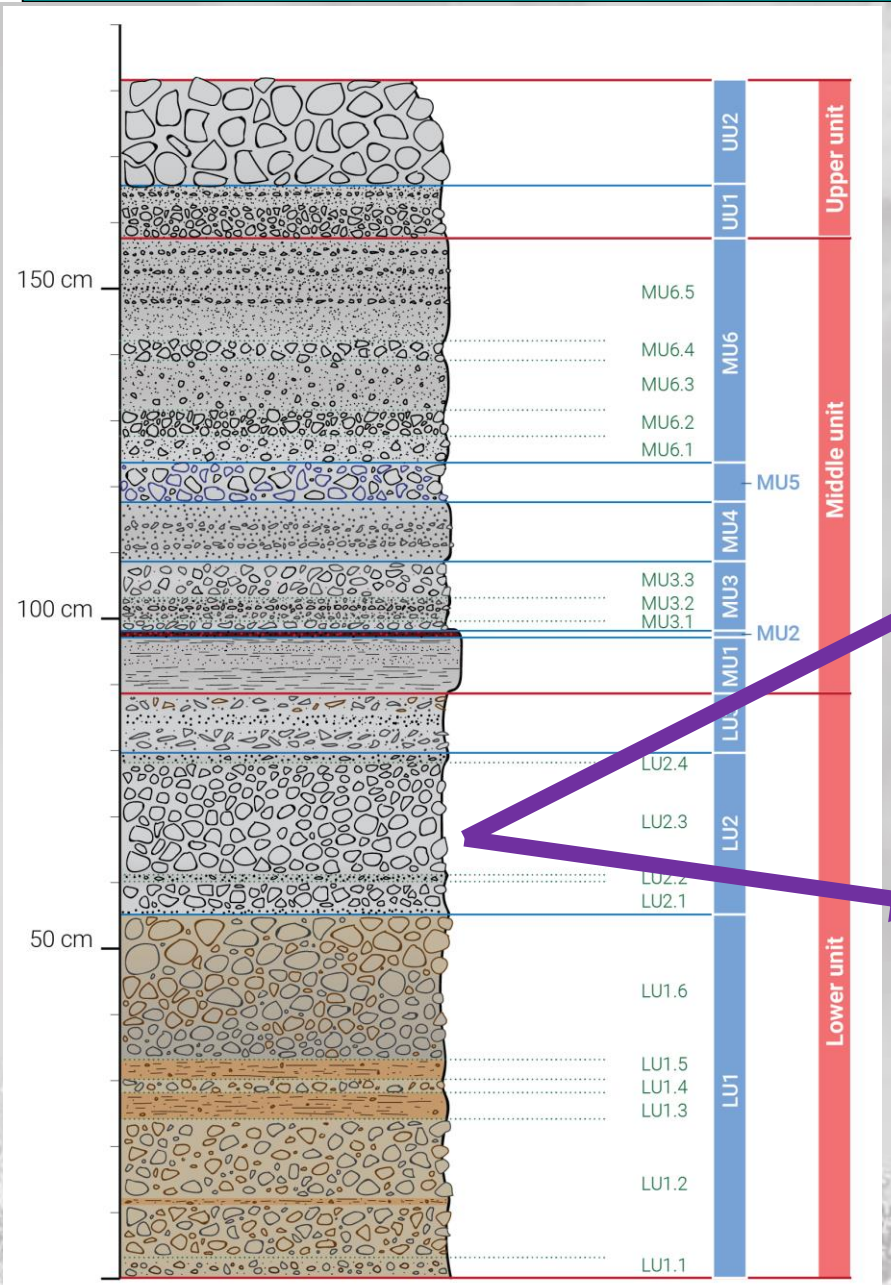




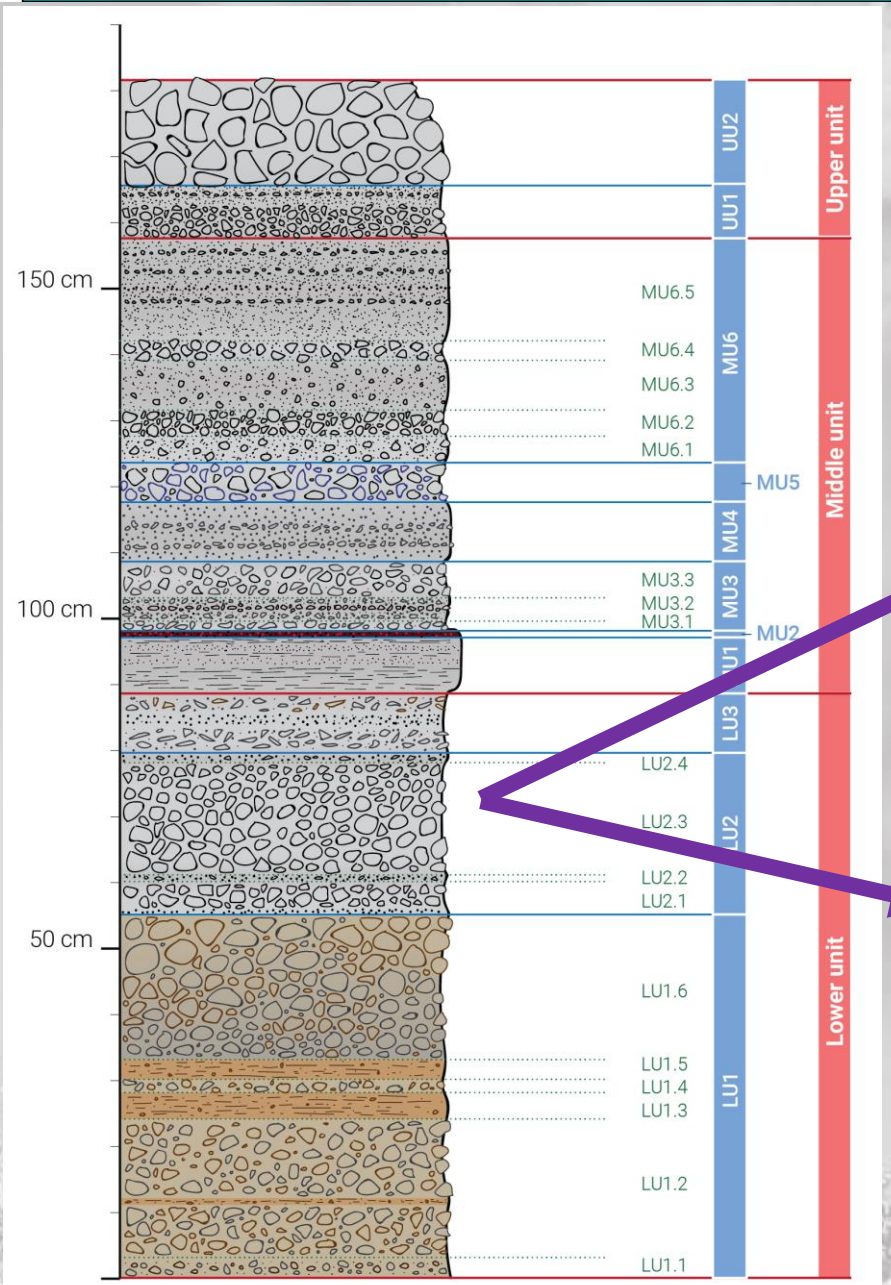
UPPER UNIT
(mostly lapilli-size unit)

MIDDLE UNIT
(fine to coarse ash dominated unit with intercalation of lapilli layers)

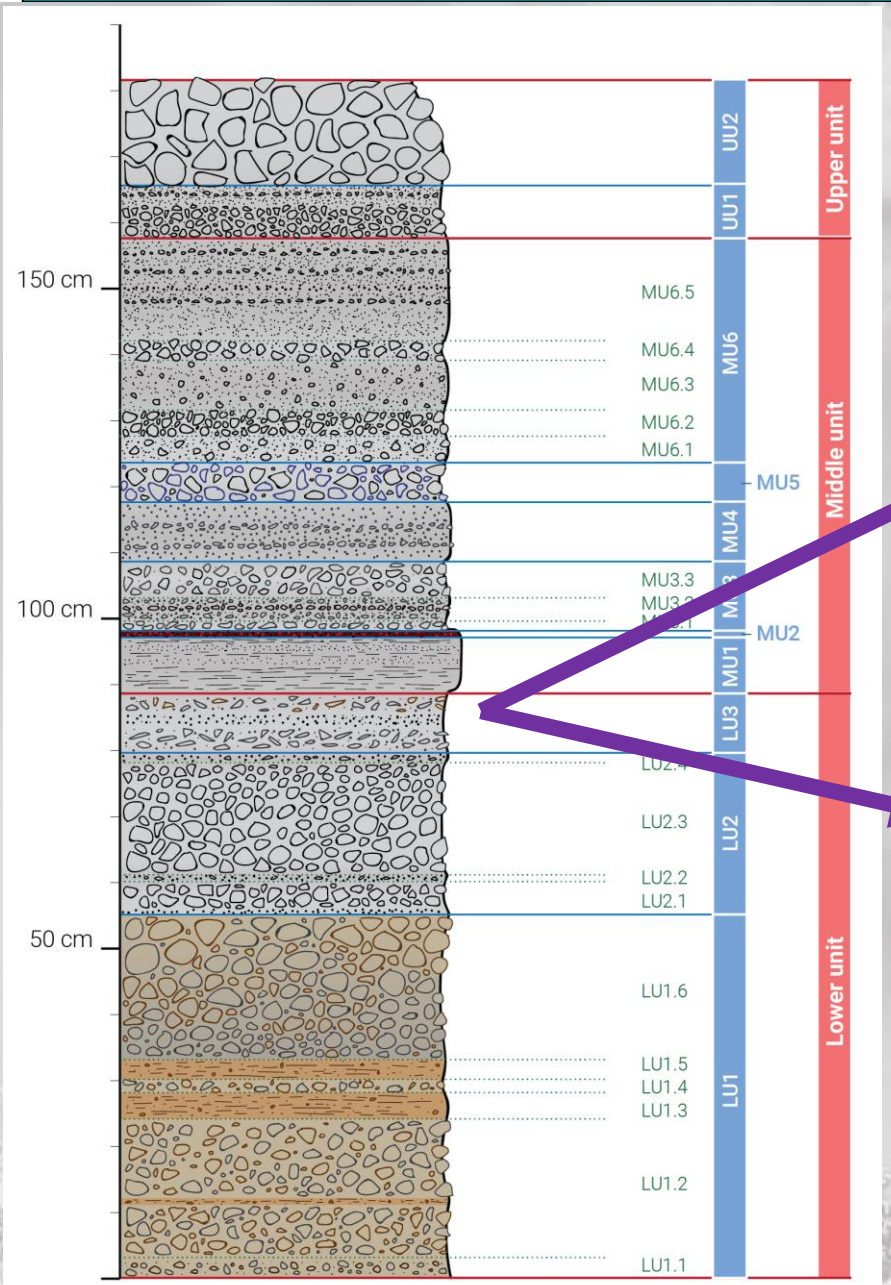
LOWER UNIT
(lapilli-size dominated unit with intercalation of fine to coarse ash layers)



3 October (La Laguna – NW from vents)

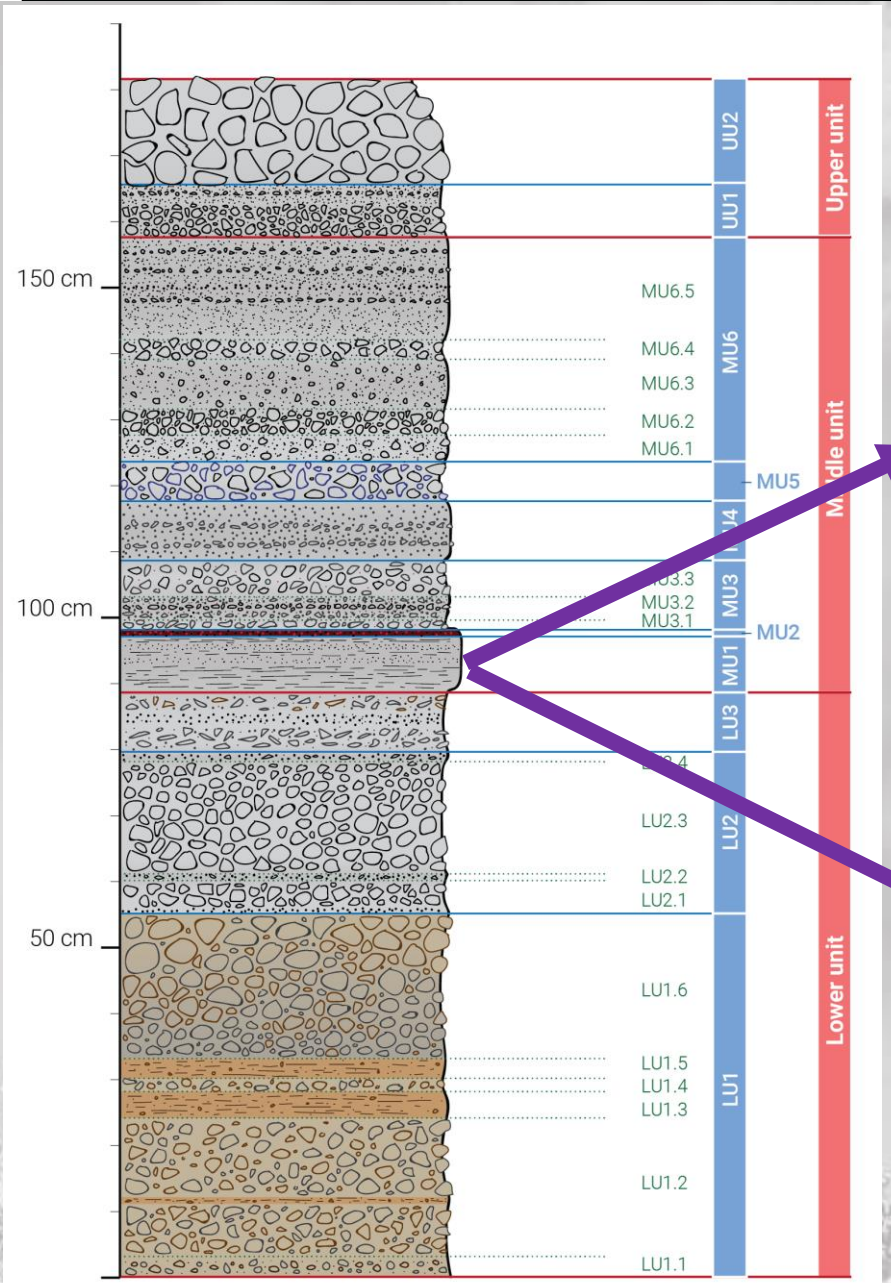


5-8 October (Las Manchas – SW from vents)

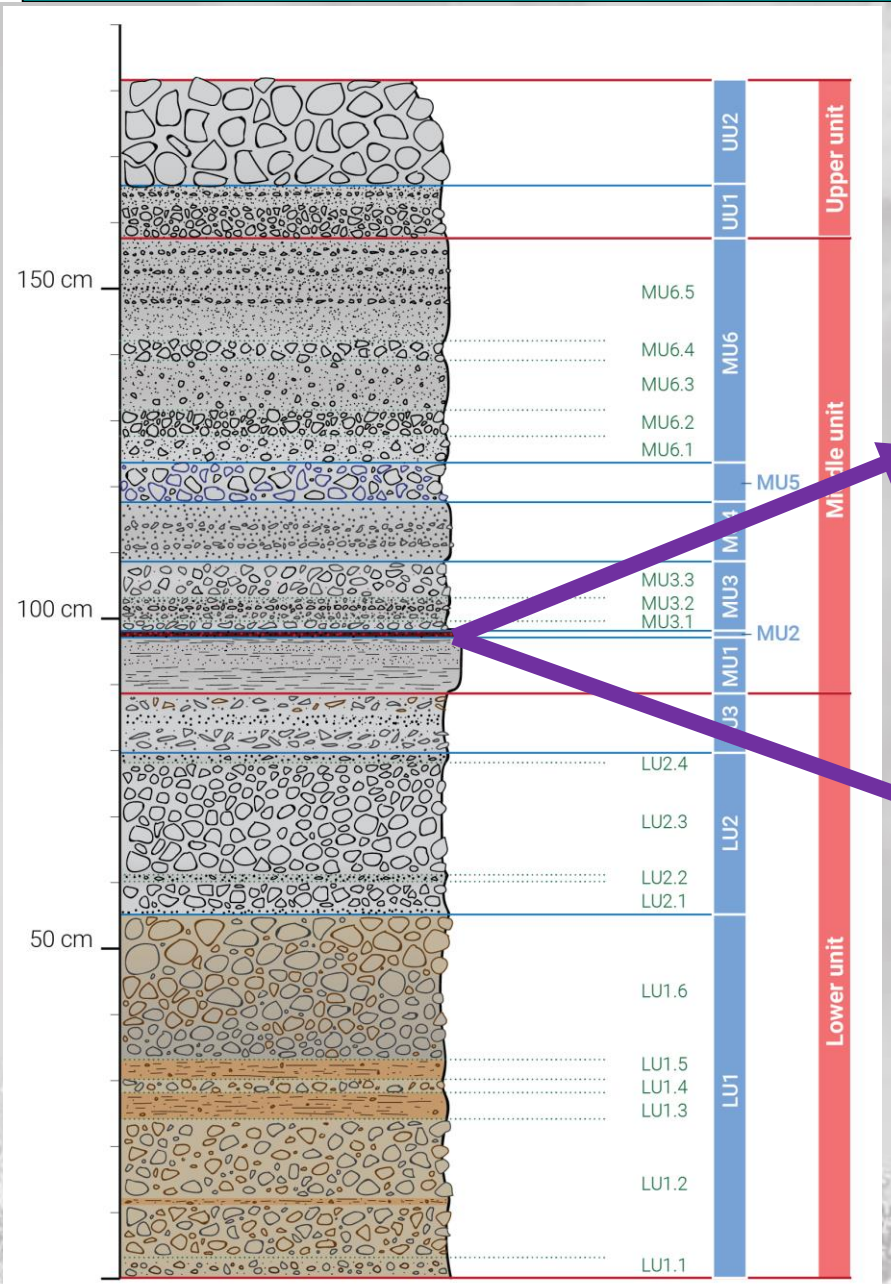

150 cm
100 cm
50 cm
UU2
UU1
Upper unit
MU6.5
MU6.4
MU6.3
MU6.2
MU6.1
MU6
MU5
MU4
MU3.3
MU2
MU1
Middle unit
LU3
LU2.4
LU2.3
LU2
LU2.2
LU2.1
LU1.6
LU1.5
LU1.4
LU1.3
LU1.2
LU1.1
LU1
Lower unit


9-10 October

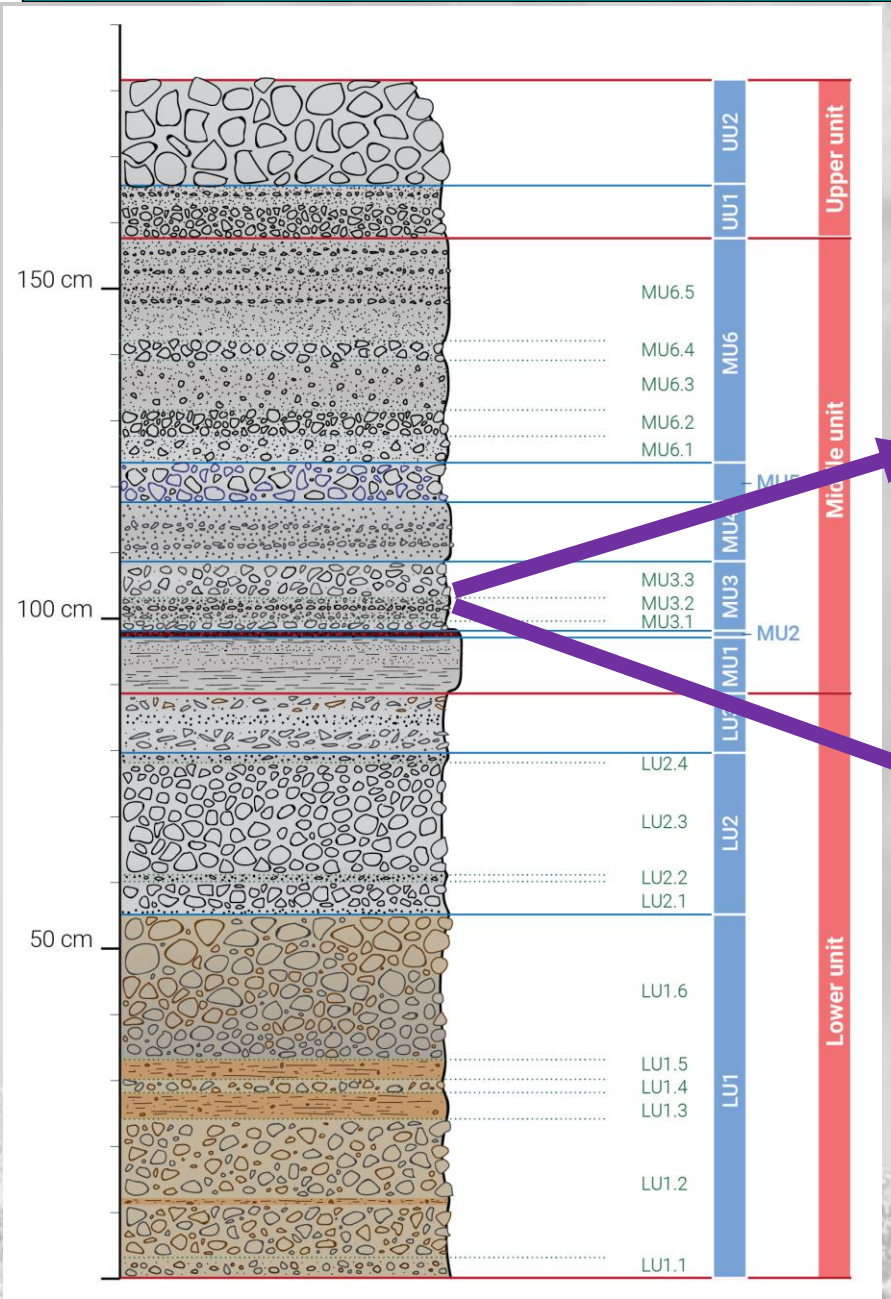

9-10 October (Las Manchas – SW from vents)



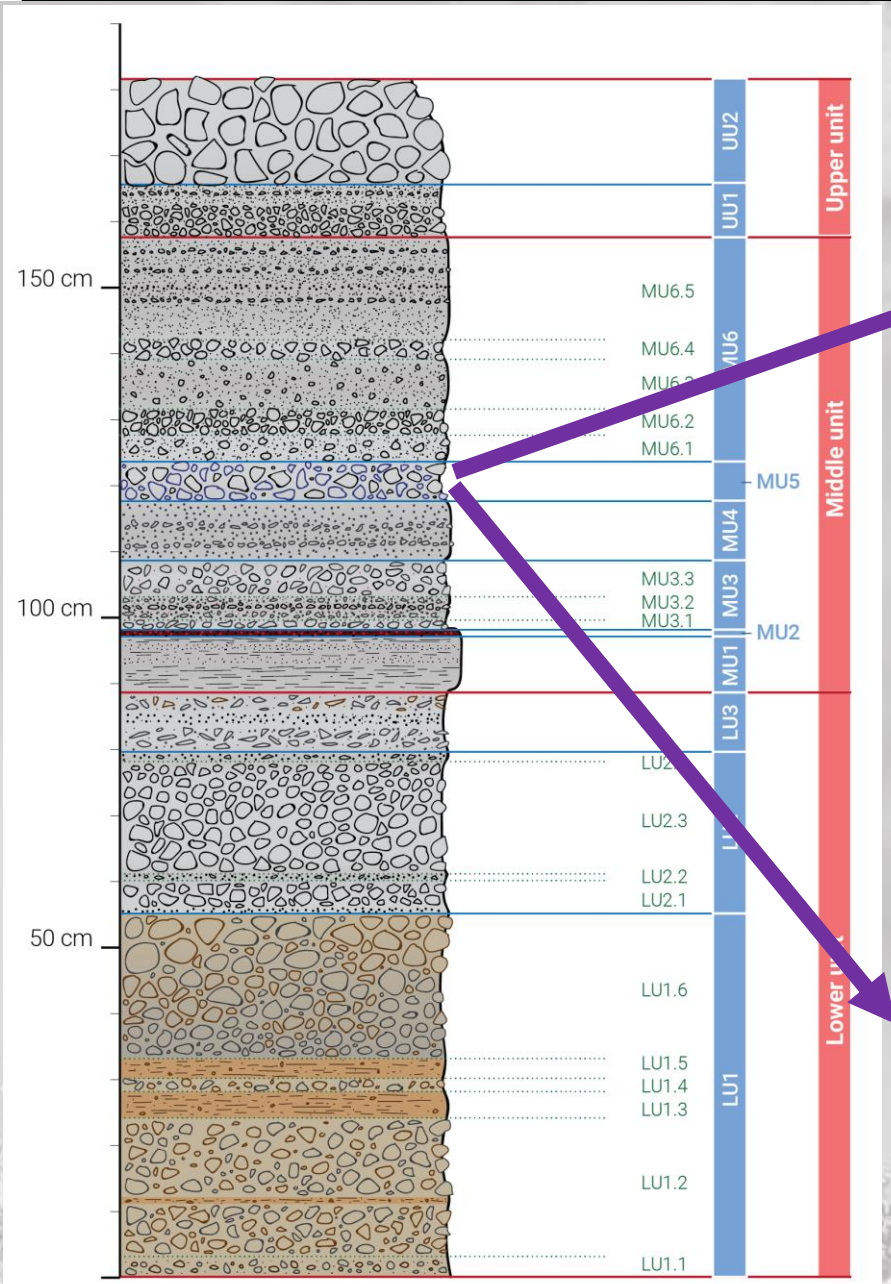
11 October (Las Manchas – SW from vents)



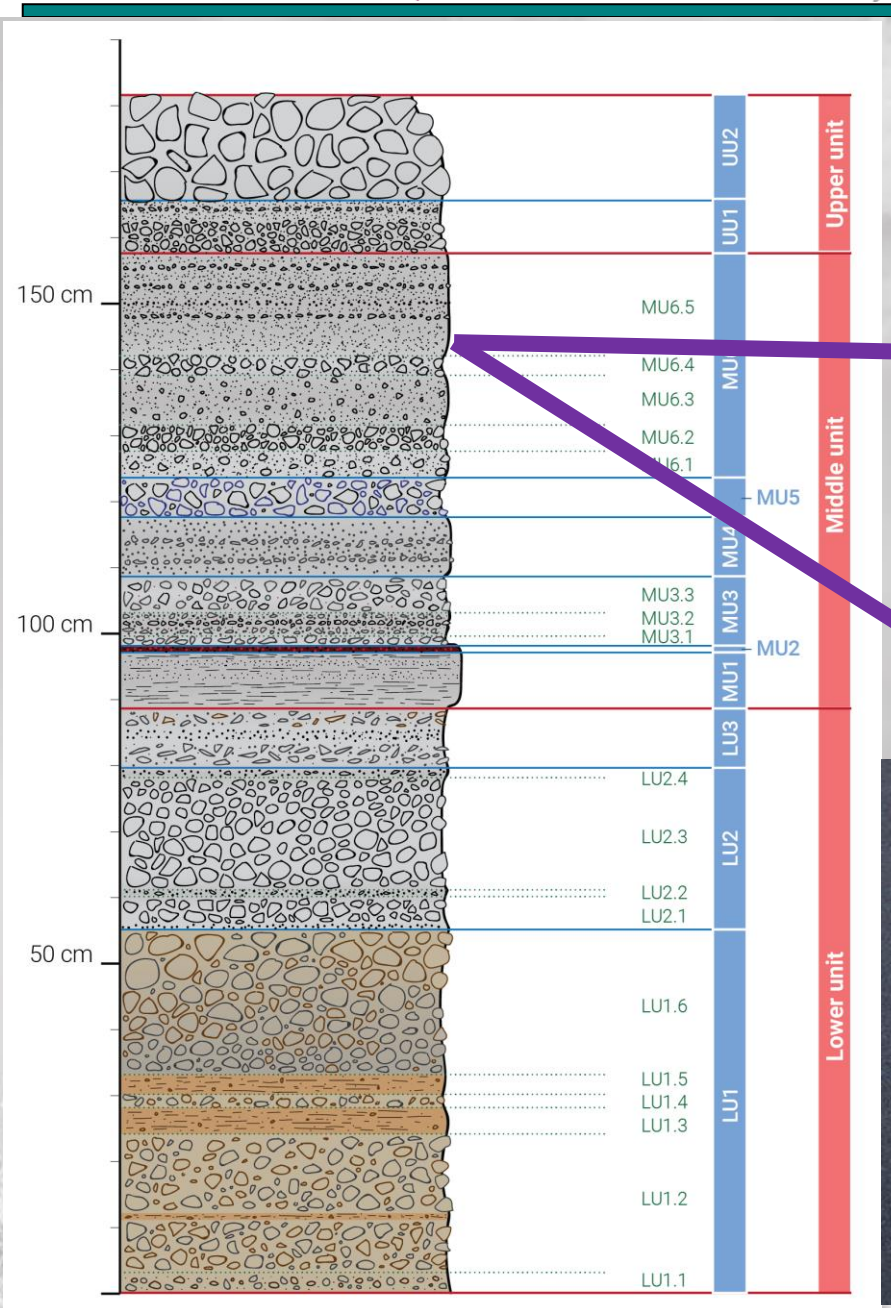
14-16 October (Mirador Llano del Jable – E from vents)



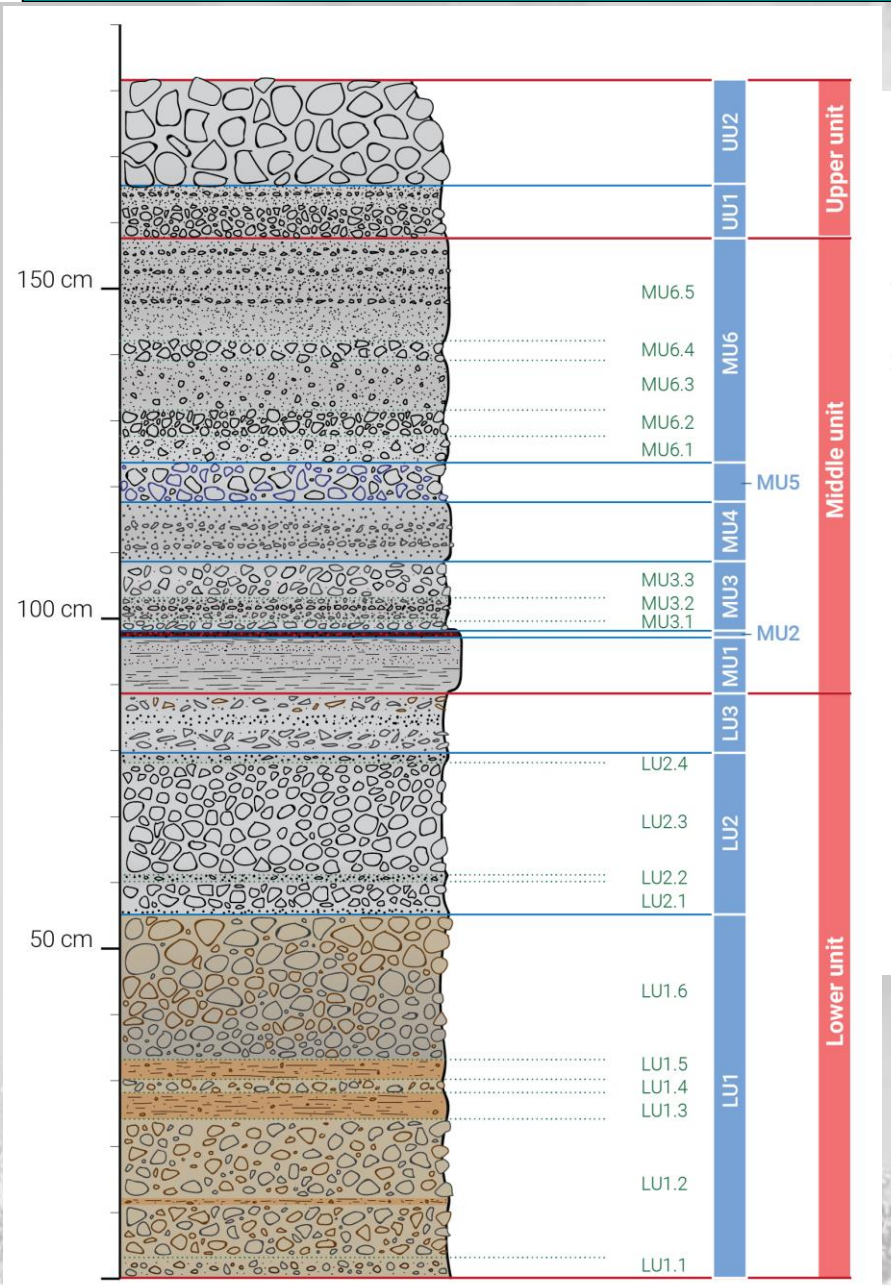
18 October (Las Manchas – SW from vents)



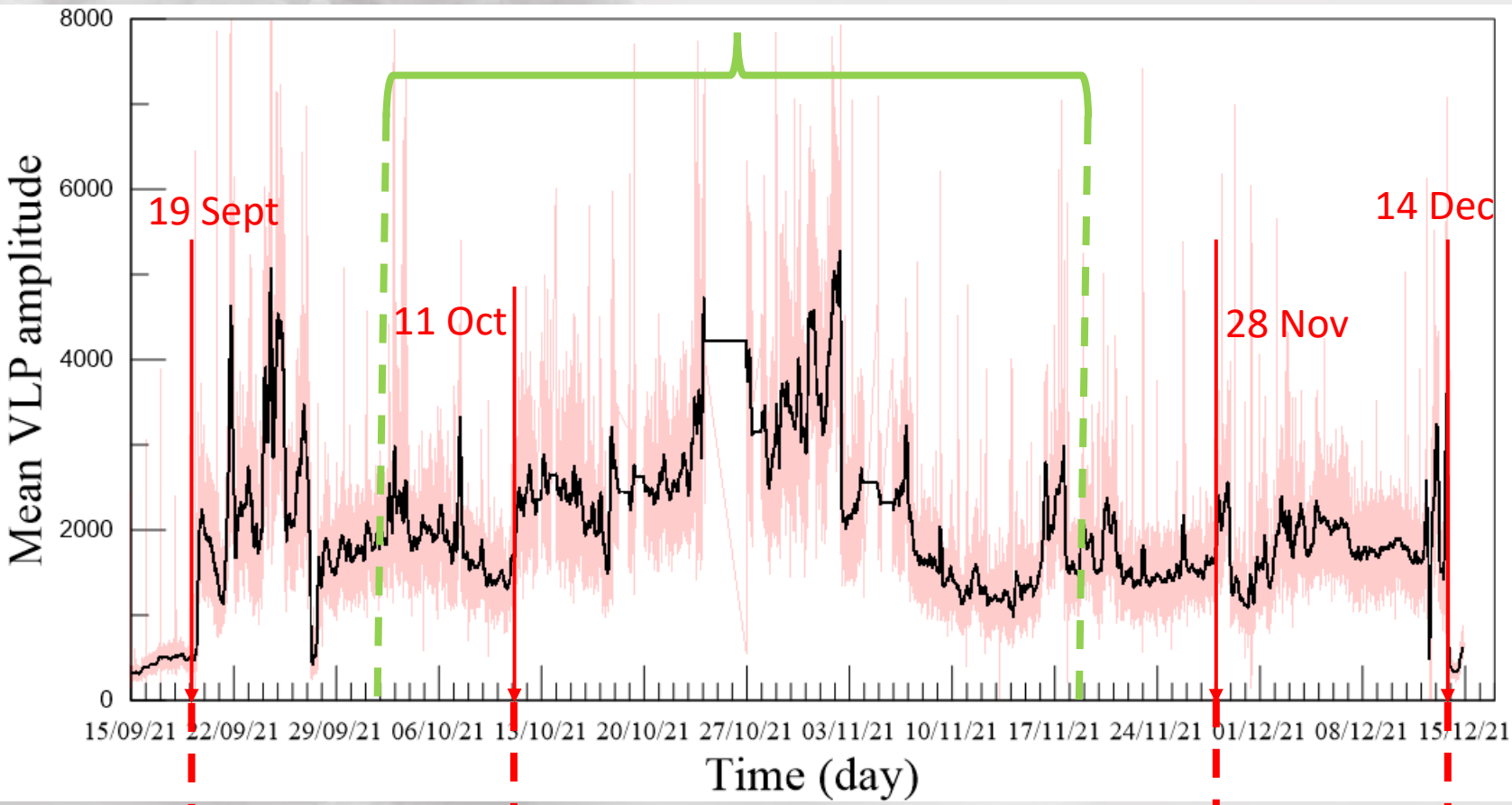
26-28 October (Las Manchas – SW from vents)



14 November(Tajuya – NW from vents)

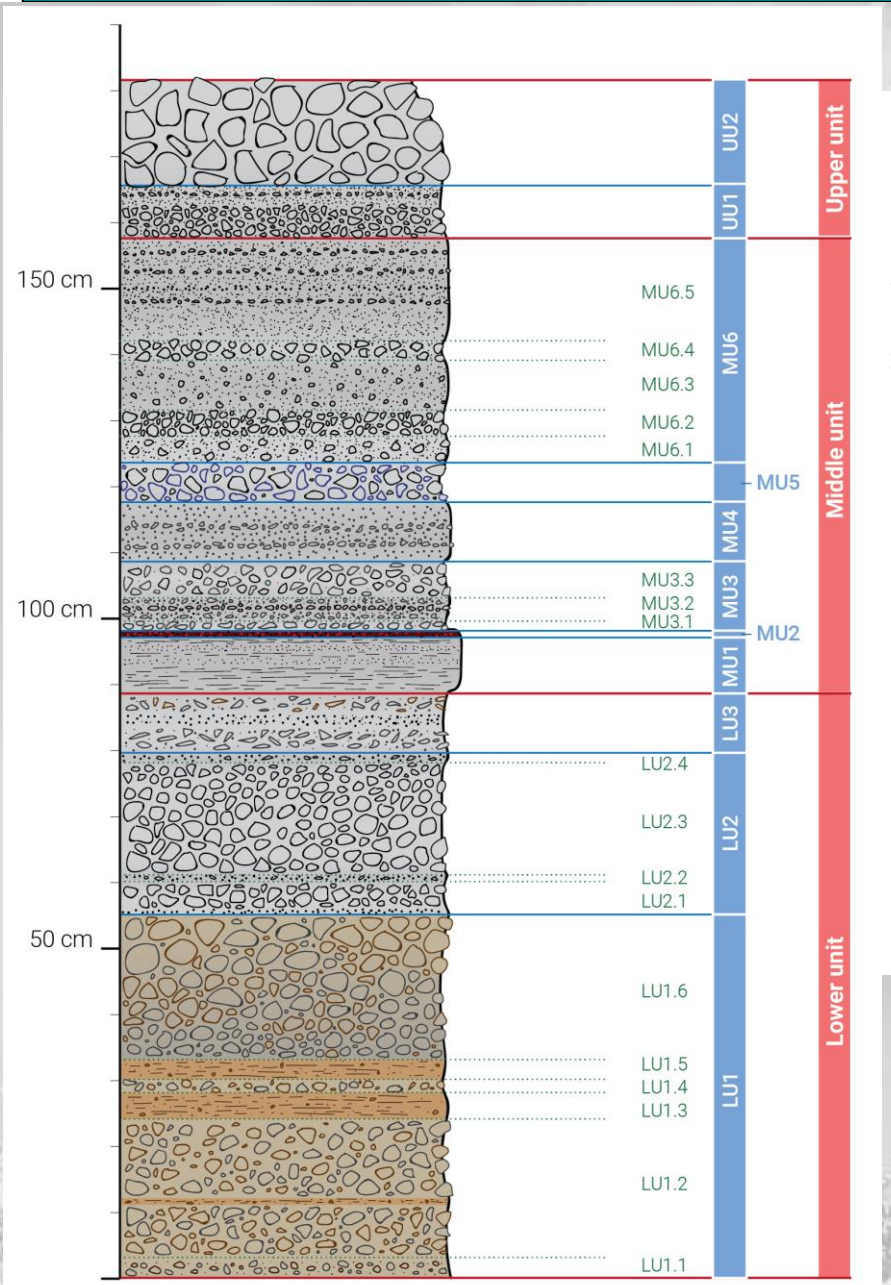


FIELD SAMPLING

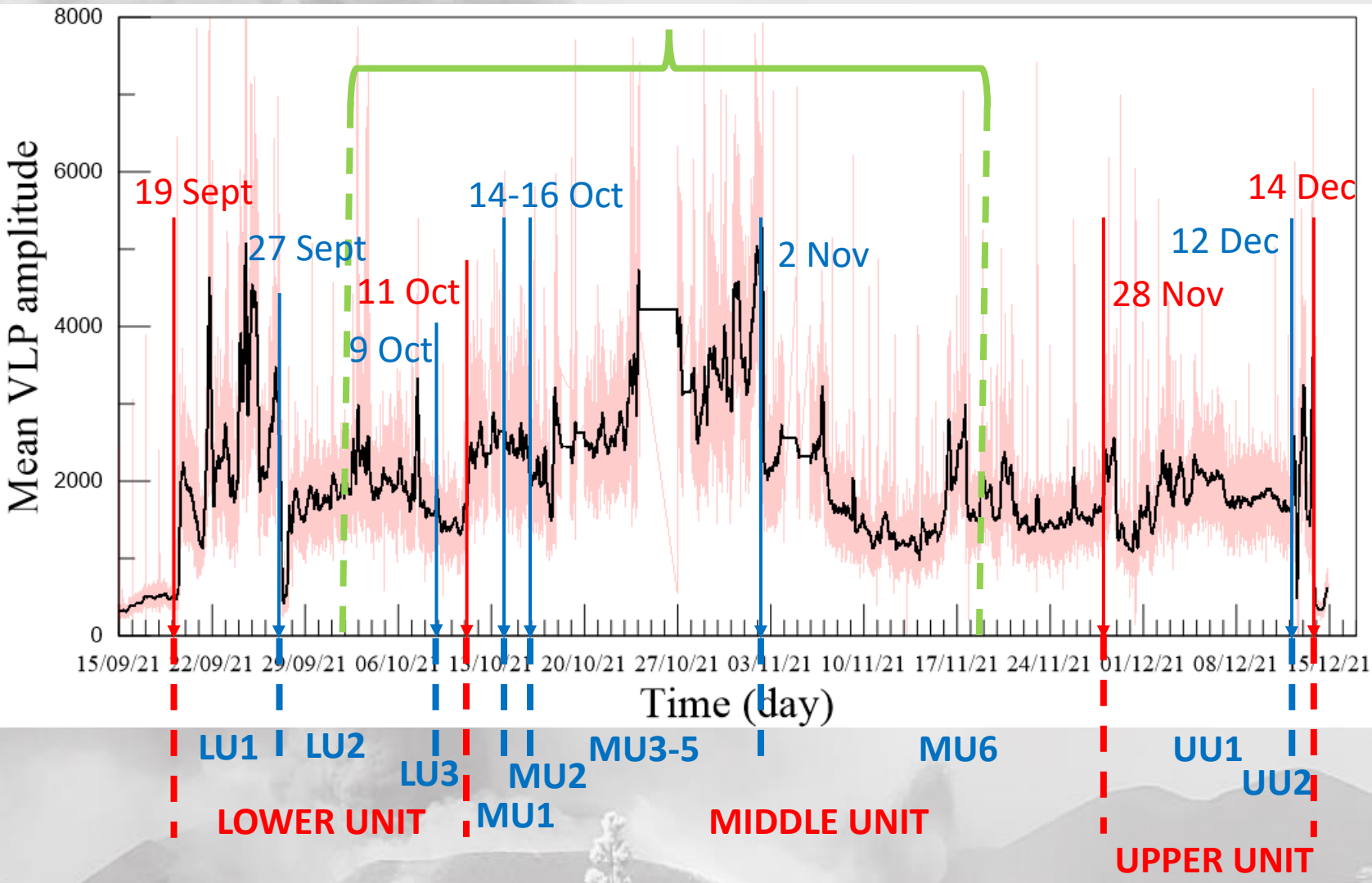


LOWER UNIT **MIDDLE UNIT** **UPPER UNIT**

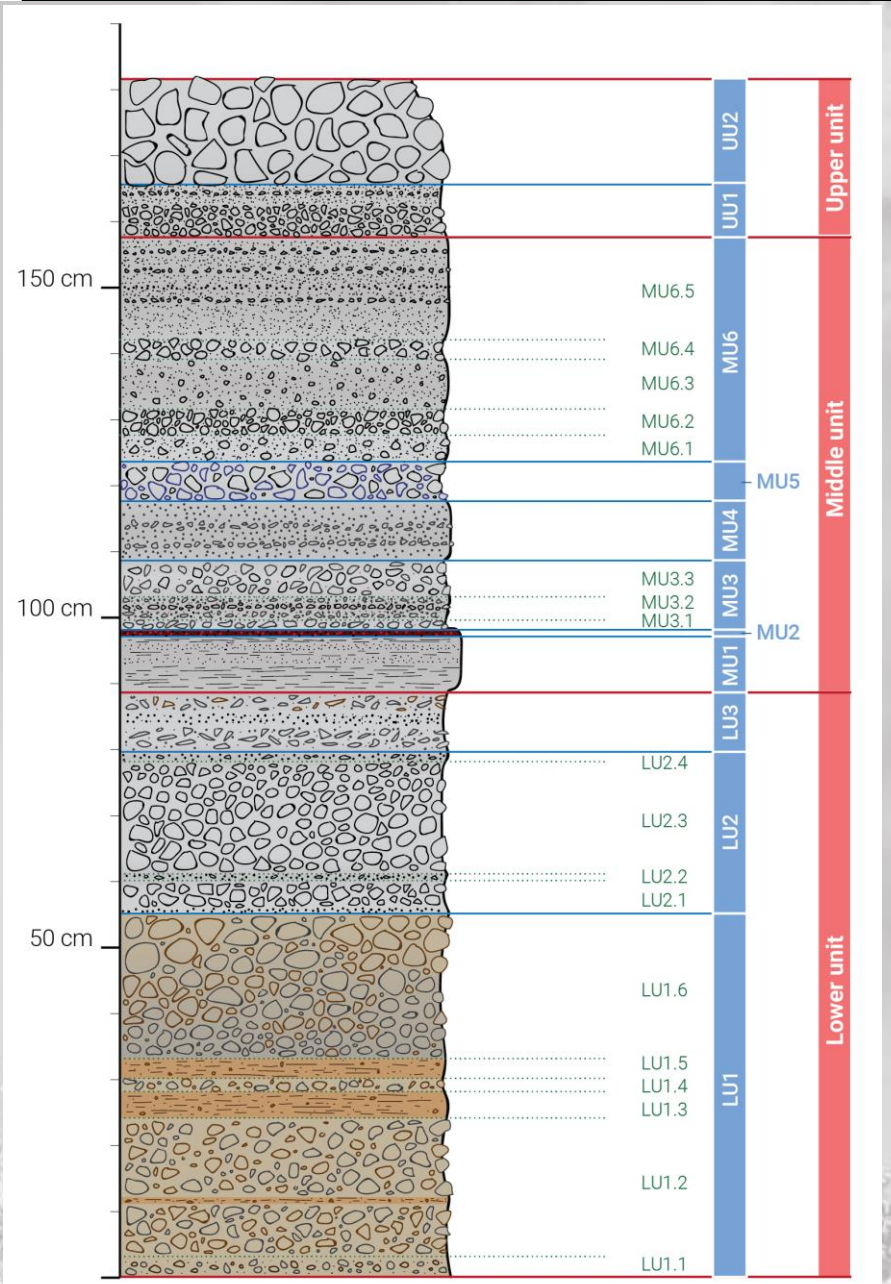
4-hr running average of tremor data (PTAB station) (Courtesy: Luca D'Auria)

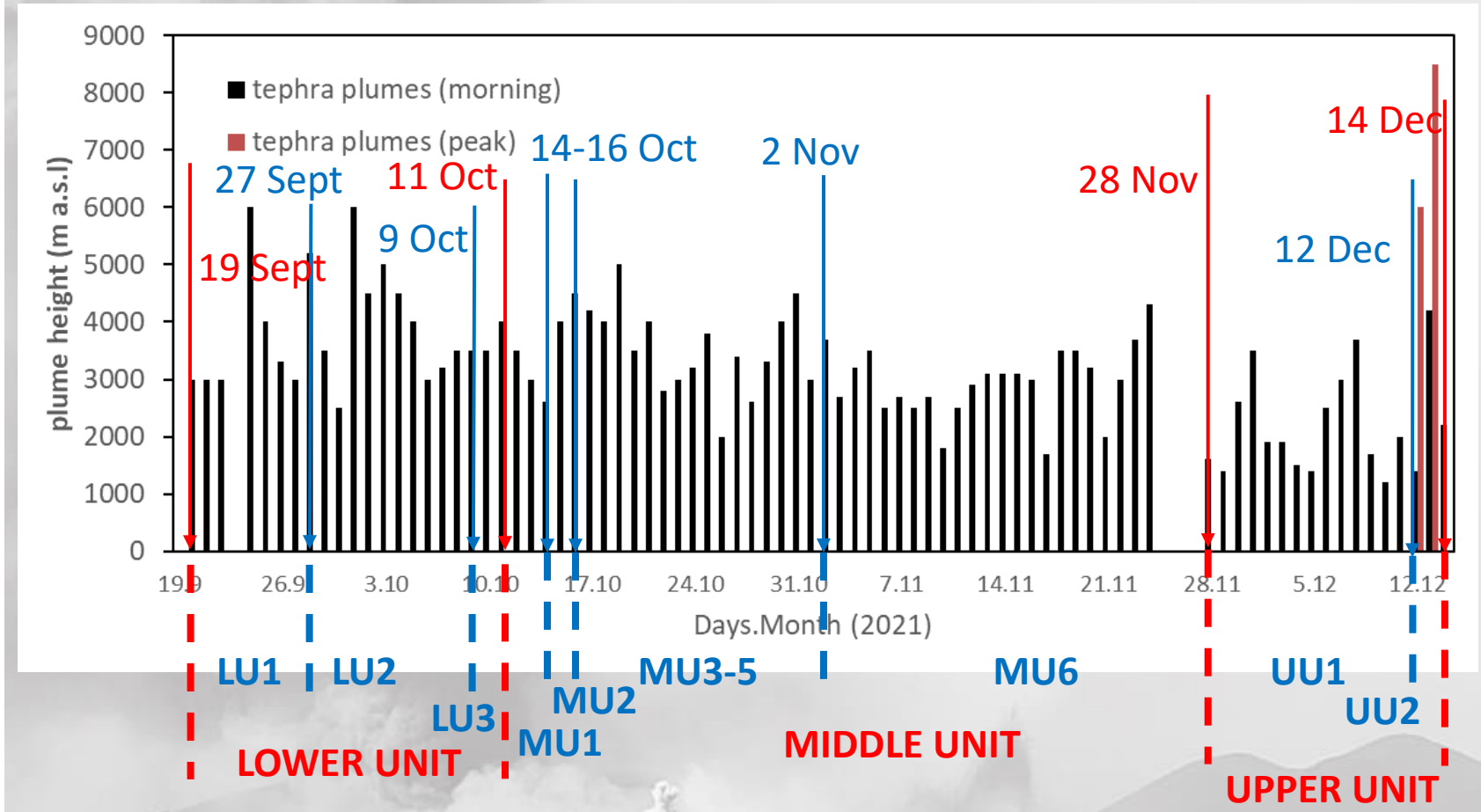


FIELD SAMPLING

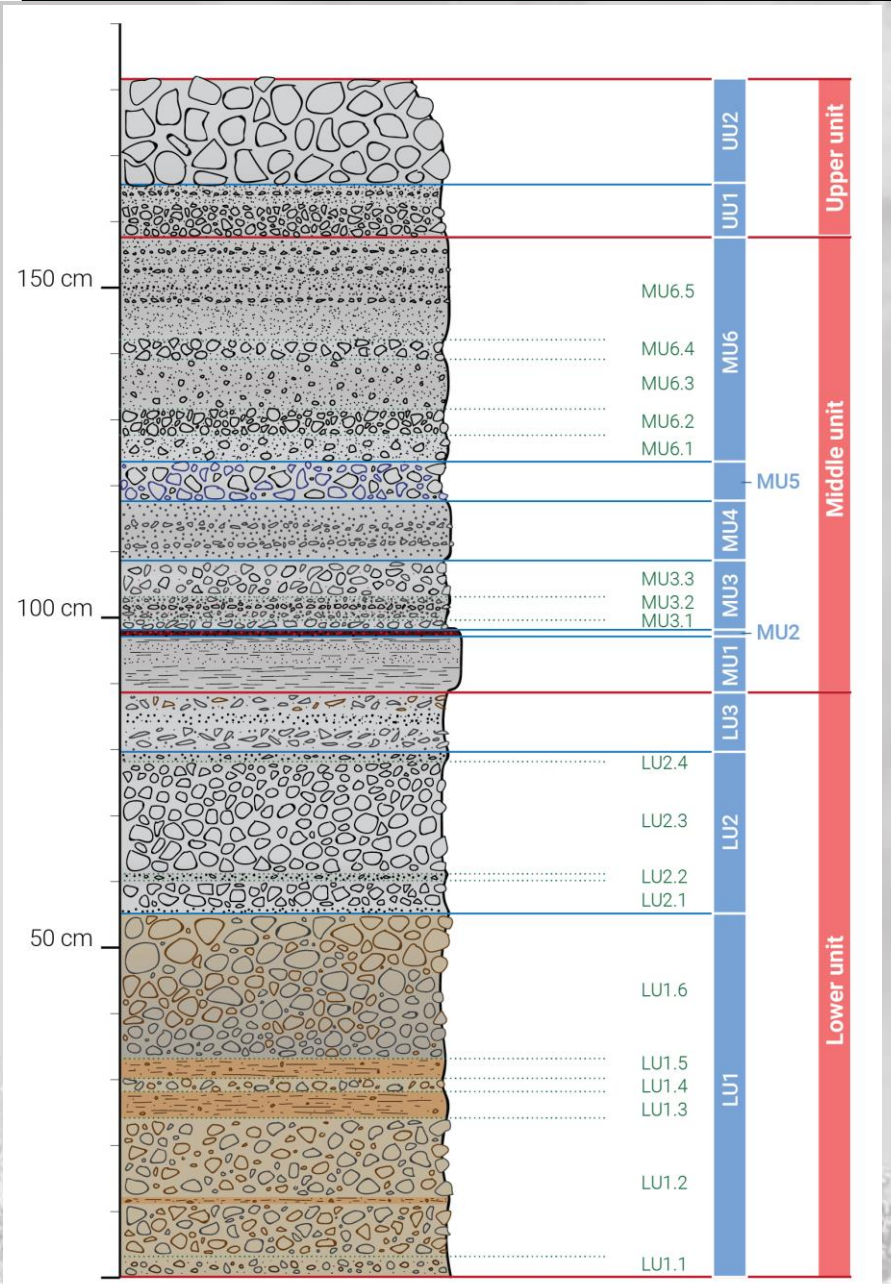


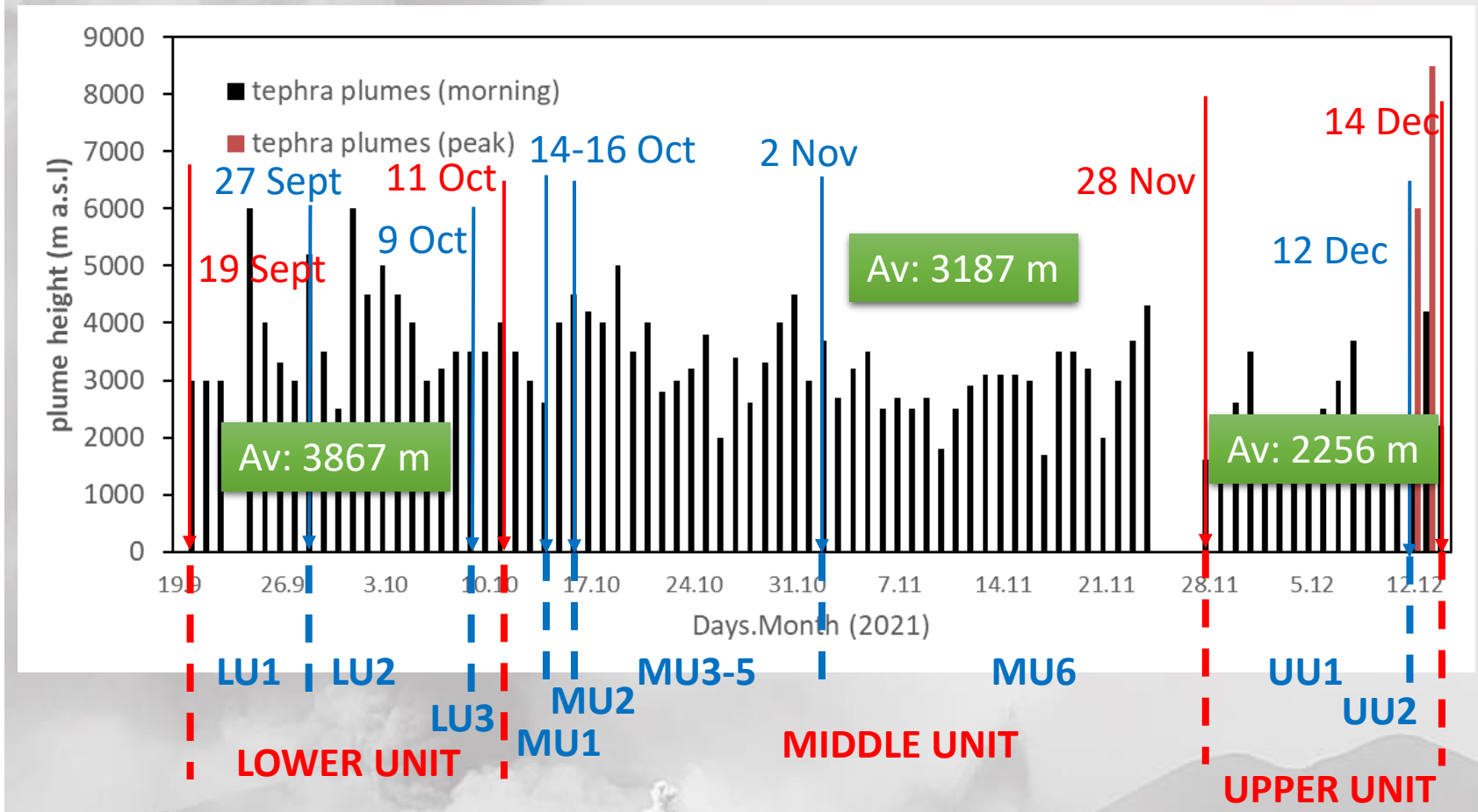
4-hr running average of tremor data (PTAB station) (Courtesy: Luca D'Auria)





Plume heights from PEVOLCA reports
https://www.gobiernodecanarias.org/infovolcanlapalma/pevolca/





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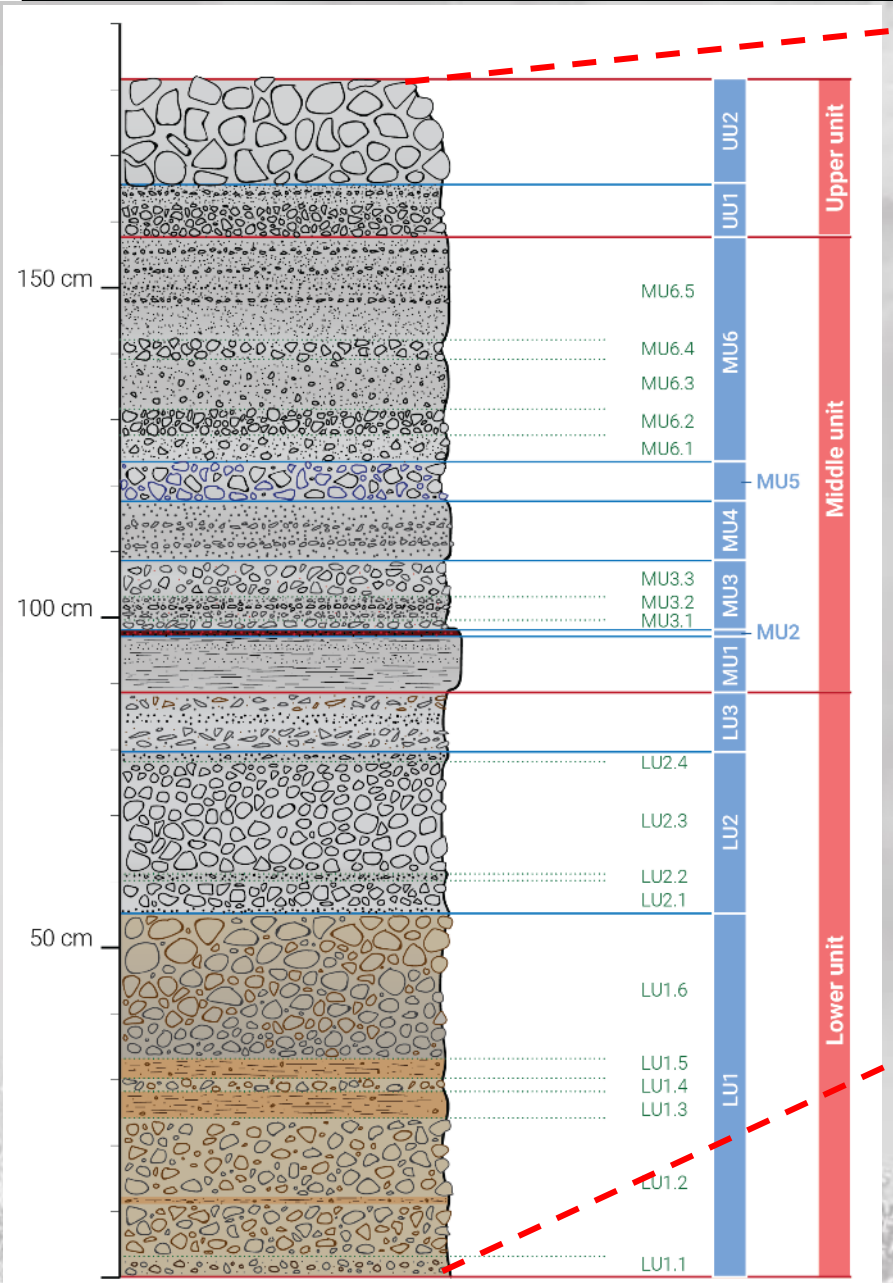
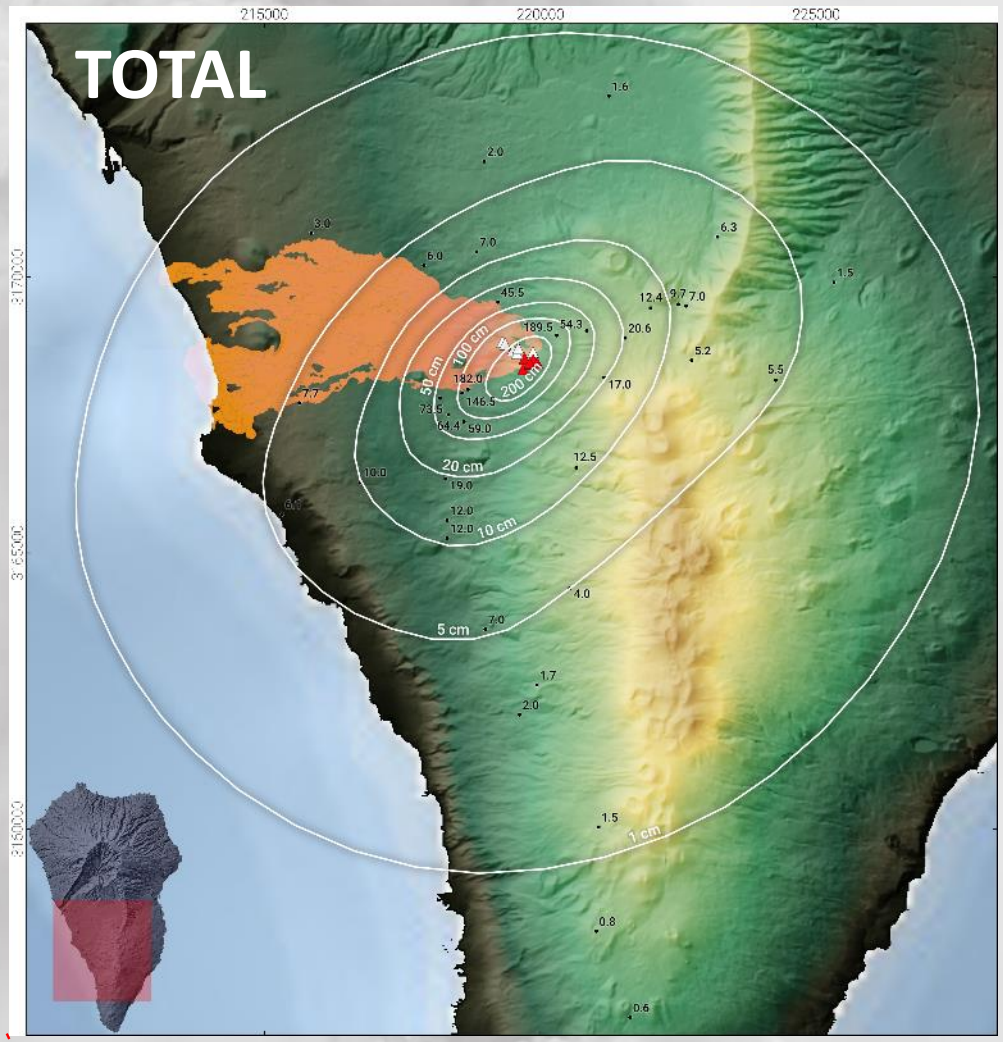
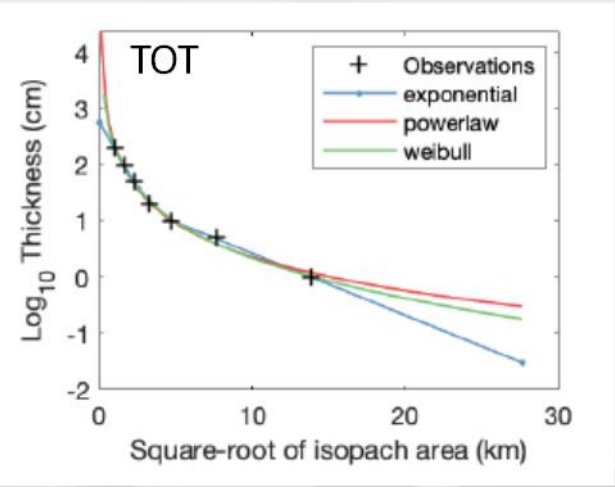
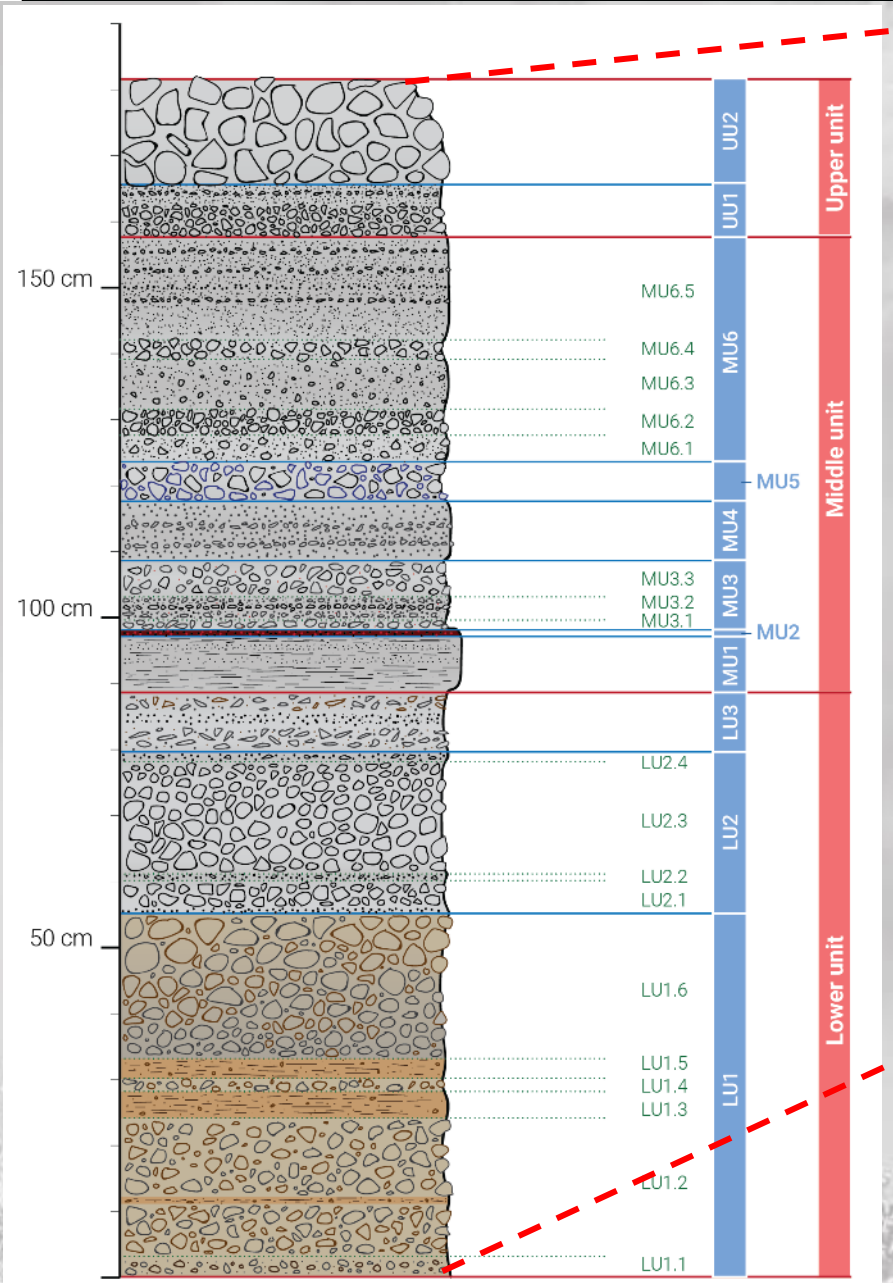


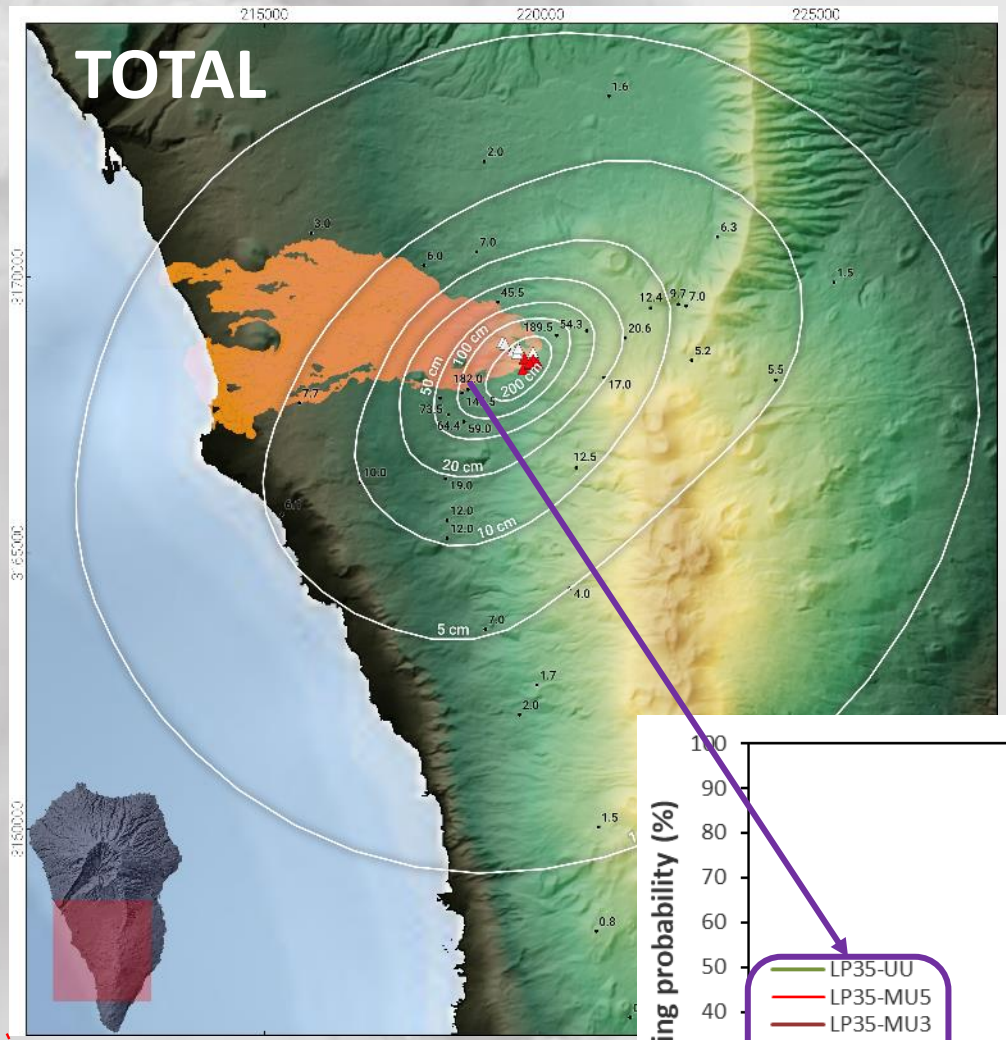


Main features:

- Tephra deposit elongated NE-SW
- Rapidly decreasing tephra deposit thickness (from ~200 cm ~1 km from vents to ~5 cm ~5 km from vents)
- Volume: $2.3 \pm 0.5 \times 10^7$ m^3







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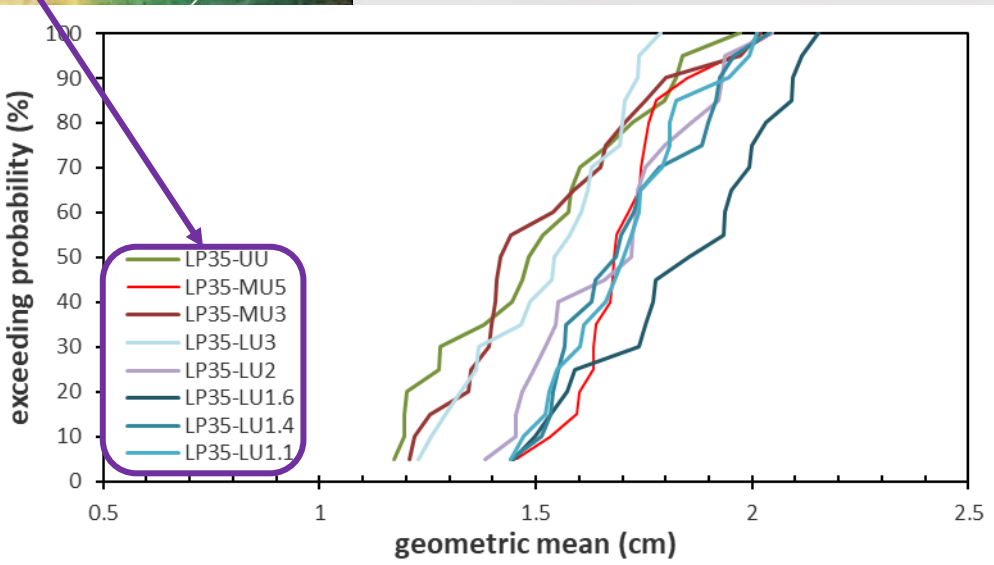
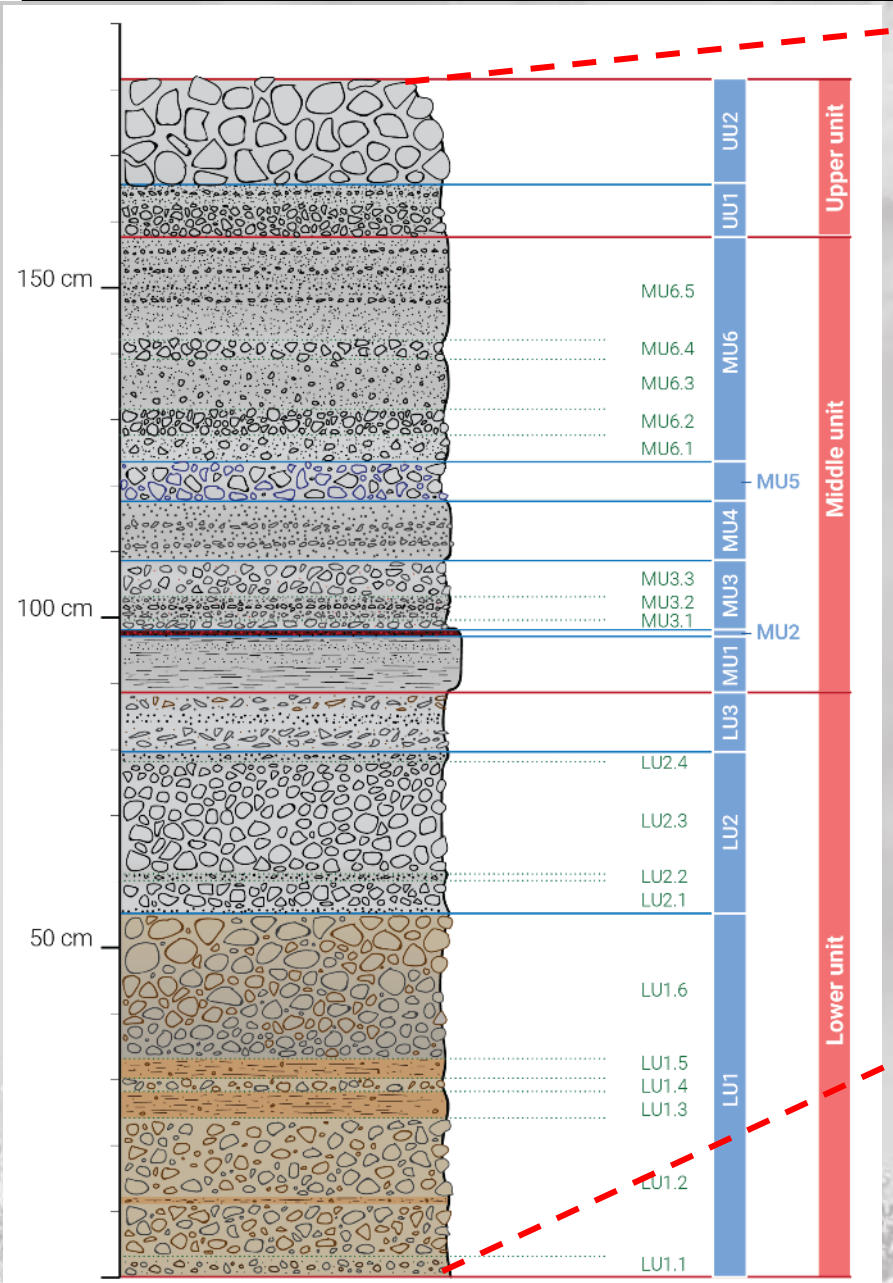
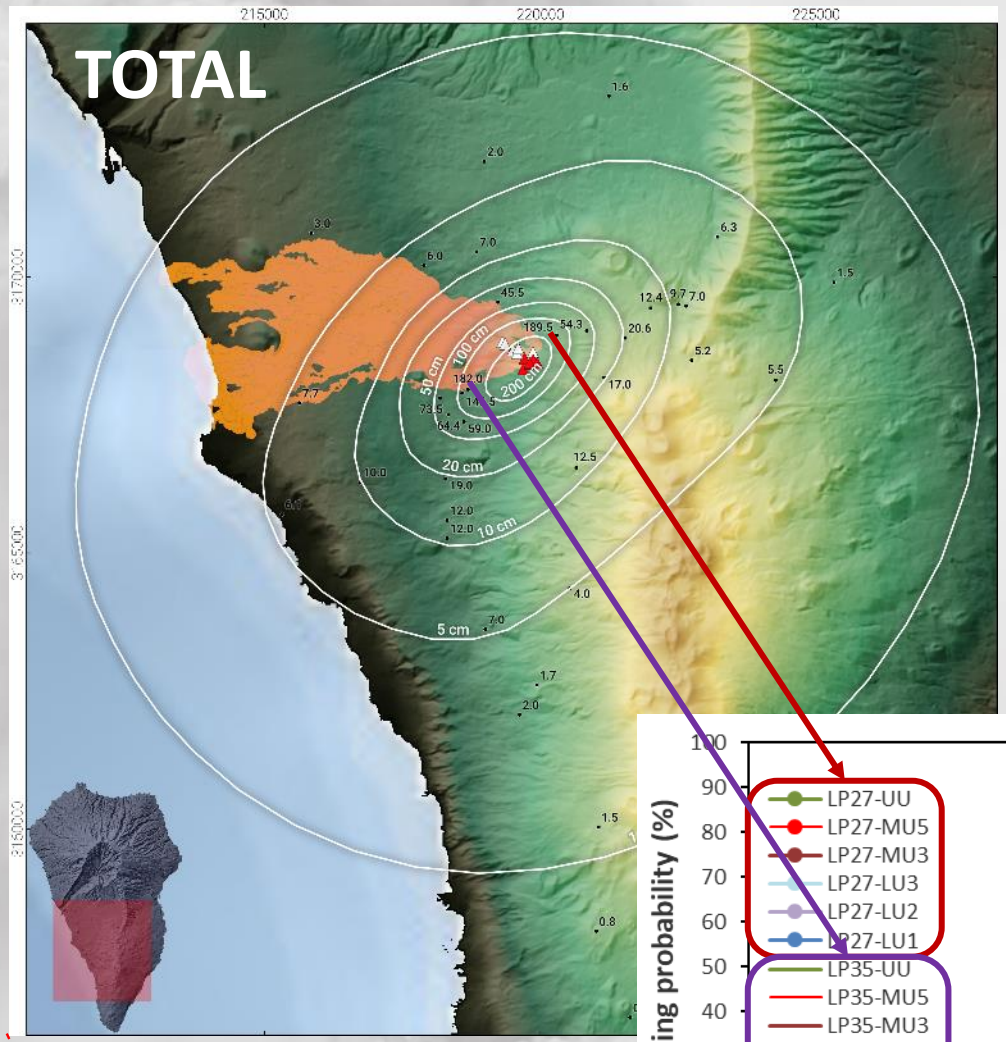
- Similar grainsize NE and SW of vents







Main features:

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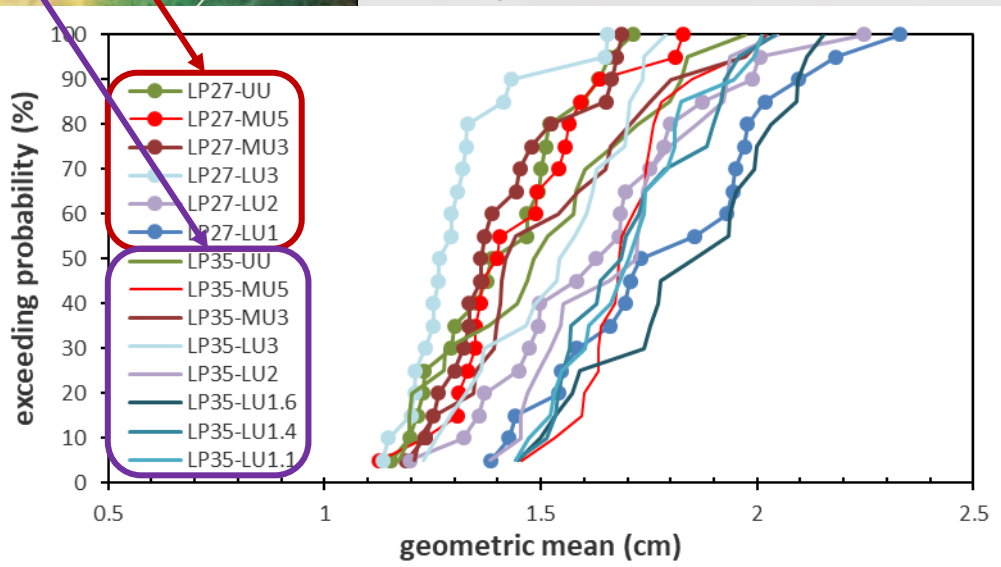
- Volume: $2.3 \pm 0.5 \times 10^7$ m^3
- Similar grainsize NE and SW of vents (50th perc.= 1.3-1.9 cm)



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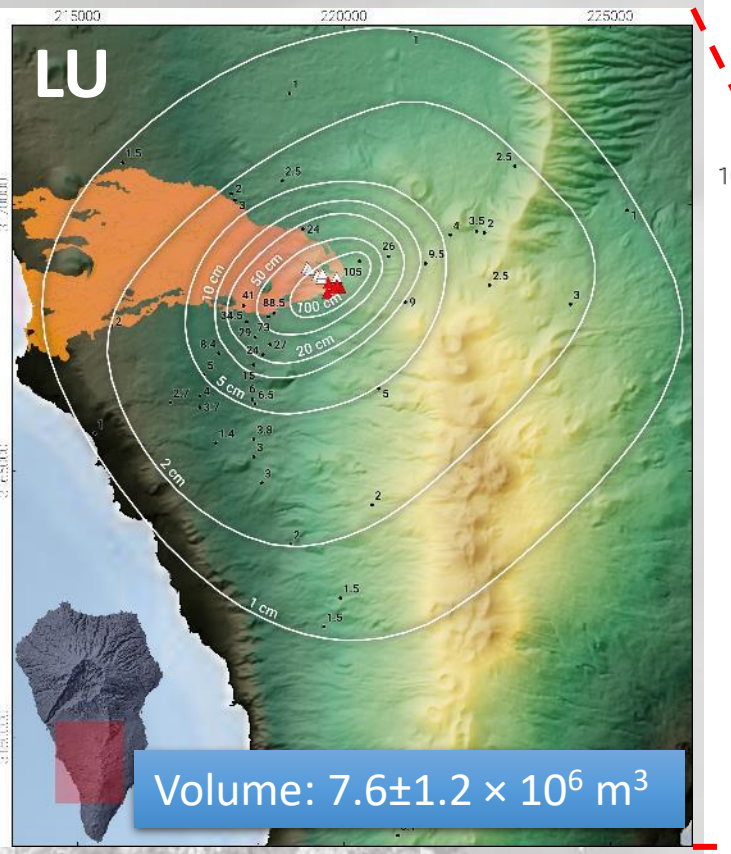
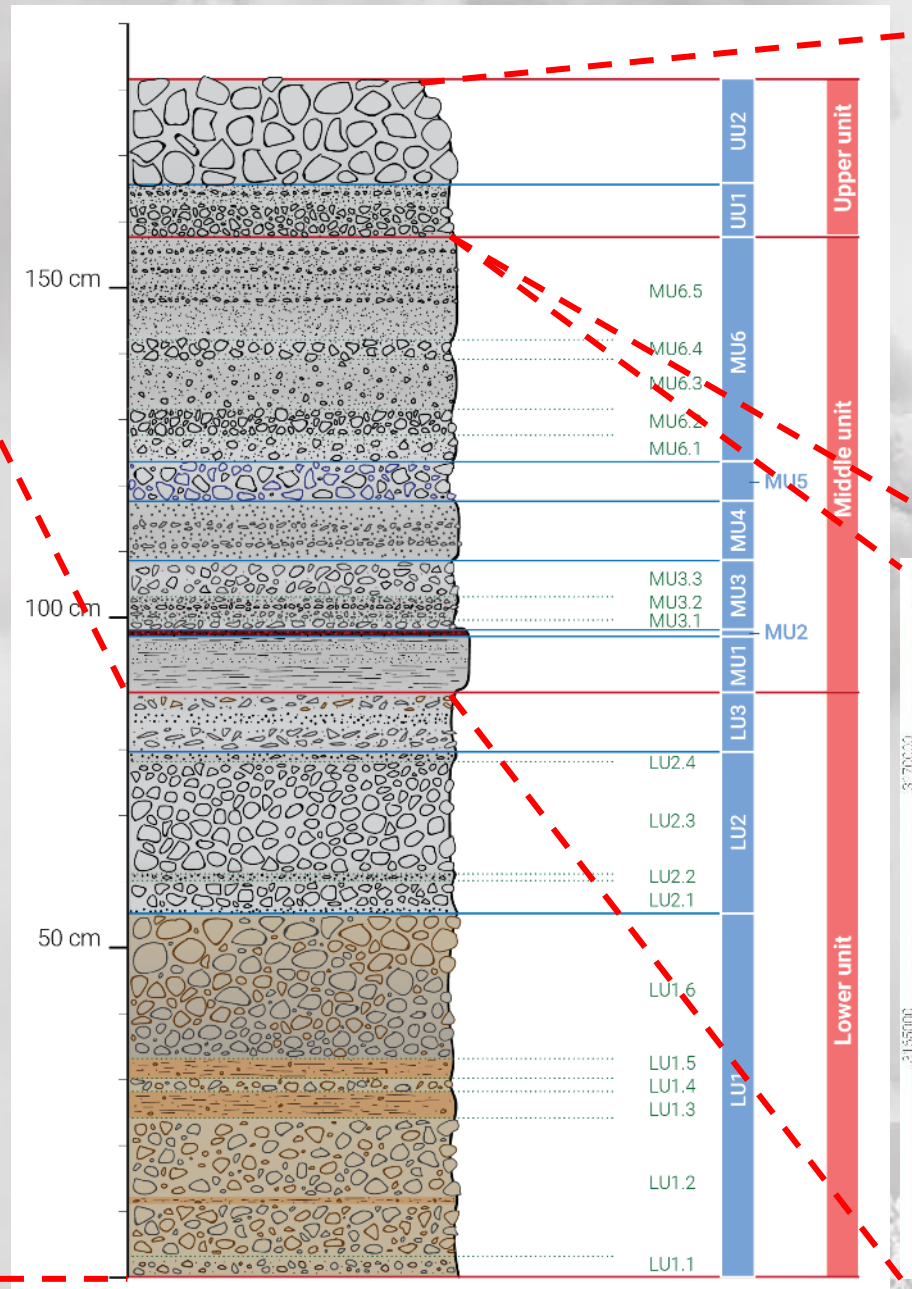
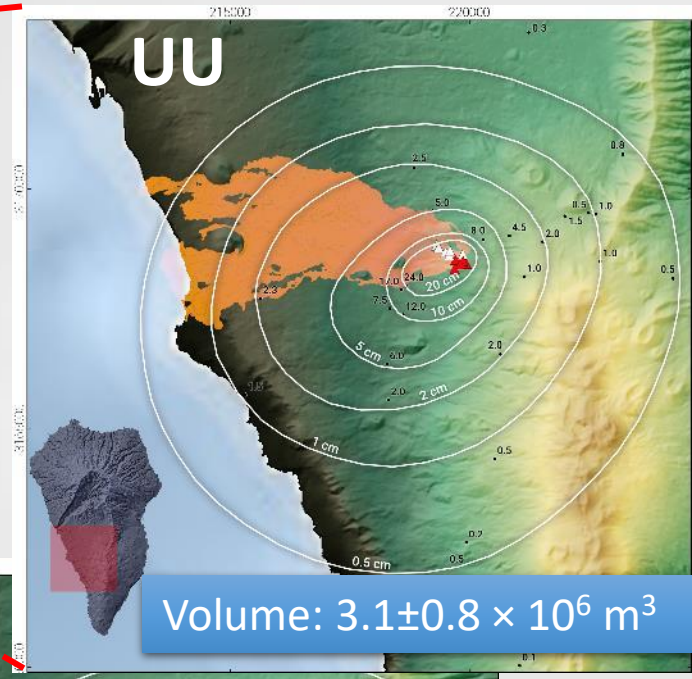
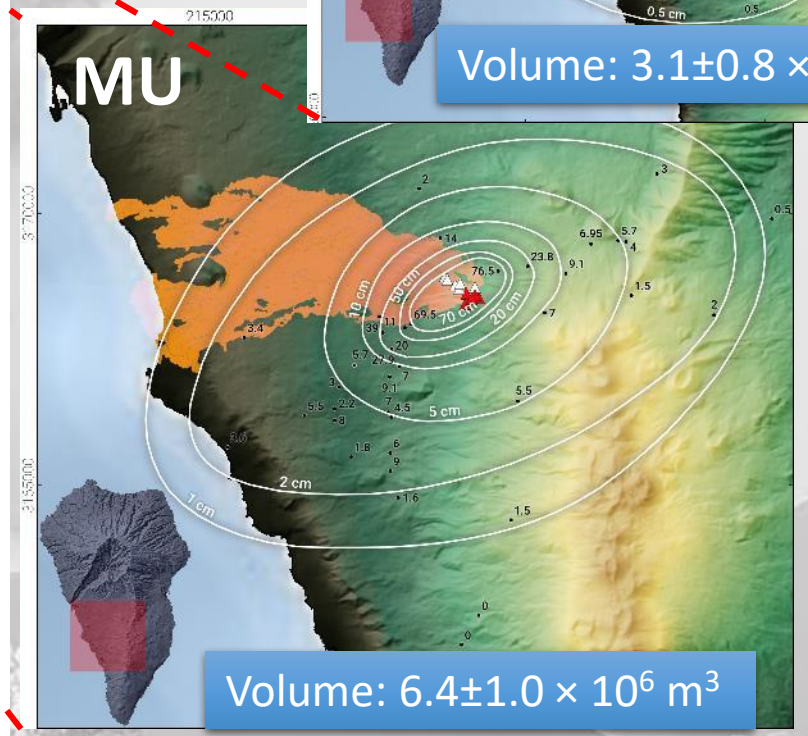


Volume: 7.6±1.2 × 10^6 m^3

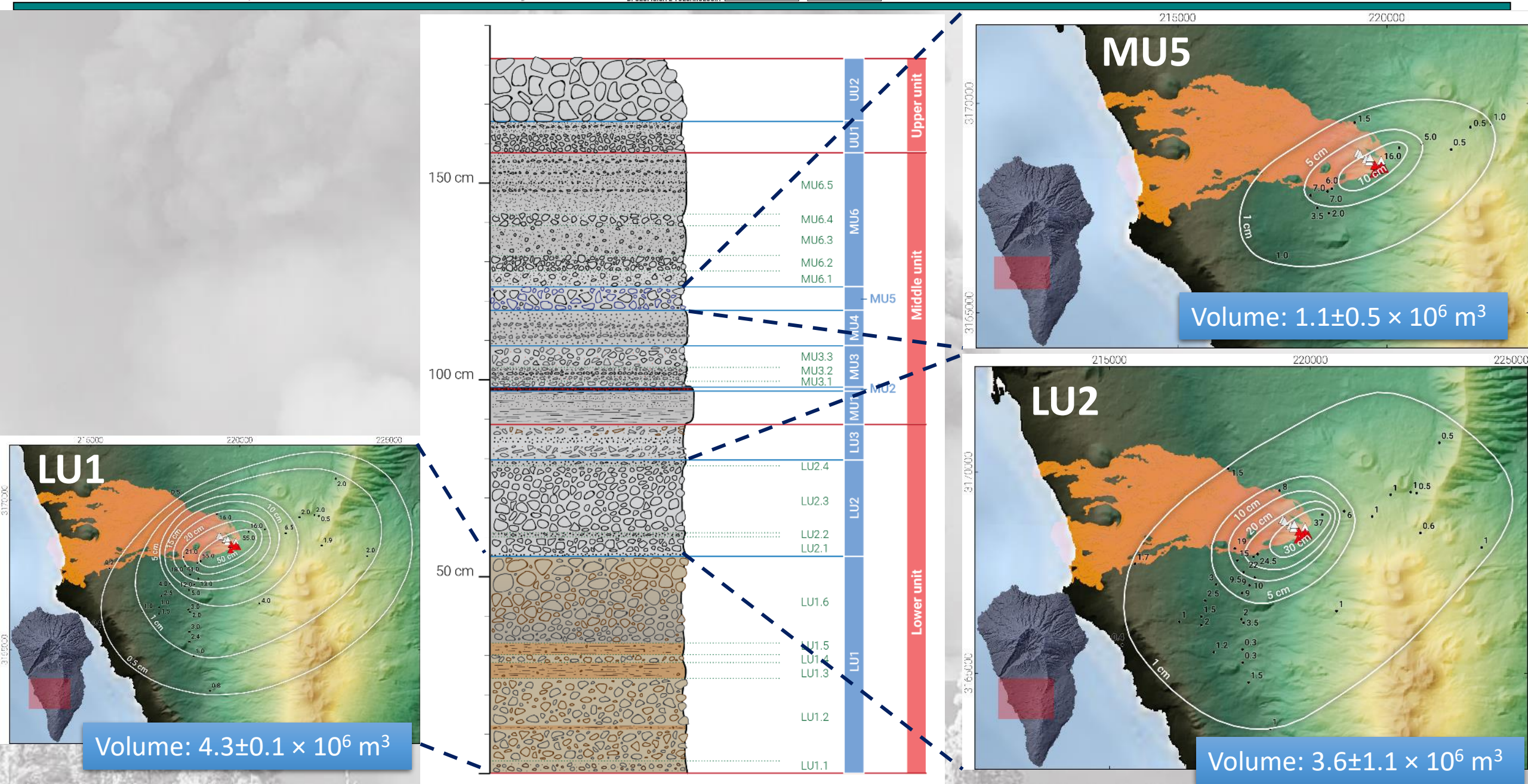




Volume: 3.1±0.8 × 10^6 m^3



Volume: 6.4±1.0 × 10^6 m^3


150 cm
100 cm
50 cm
UU2
UU1
MU6
MU5
MU4
MU3
MU2
MU1
LU3
LU2
LU1
Upper unit
Middle unit
Lower unit
MU6.5
MU6.4
MU6.3
MU6.2
MU6.1
MU3.3
MU3.2
MU3.1
LU2.4
LU2.3
LU2.2
LU2.1
LU1.6
LU1.5
LU1.4
LU1.3
LU1.2
LU1.1
MU5
Volume: 1.1±0.5 × 10⁶ m³
LU2
Volume: 3.6±1.1 × 10⁶ m³
LU1
Volume: 4.3±0.1 × 10⁶ m³

Conclusions

- 2021 Cumbre Vieja eruption → hybrid eruption characterized by multiple active vents associated with different eruptive style (effusive – lava flows; explosive – strombolian, lava fountains, ash emissions)
- 3 main stratigraphic units (Lower Unit, Middle Unit, Upper Unit) subdivided into 11 layers and 18 sublayers identified based on colour, grainsize, and componentry
- Total deposit as well as individual units and layers mostly elongated NE-SW (similar grainsize NE and SW for most layers: 50th perc.= 1.3-1.9 cm)
- Volume of total tephra deposit: $2.3 \pm 0.5 \times 10^7$ m^3
- Volume of individual units between $3\text{-}8 \times 10^6$ m^3