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AGPA: Integrating field Geology and Geophysics for Planetary Analogues

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The exploration of Solar System bodies relies heavily on remote sensing and mapping [e.g. 1]. The approach is complemented by in-situ analyses and sample return. The combination of cross-validating data is of great importance for planetary landing site data analysis as well as for planetary analogues [e.g. 2-4]. Integrating remote sensing and geophysical data can prove useful to constrain surface and subsurface structure of planetary landing sites and their terrestrial analogue counterparts [5-7].

The 2017 ESA astronaut training campaign extension PANGAEA-X [3, 4] hosted several experimental suites. One of them is AGPA [5], standing for **A**ugmented field **G**eology and Geophysics for **P**lanetary **A**nalogues.

AGPA comprises a flexible suite of remote sensing and geophysical experiments including drone photogrammetry and LIDAR [6] as well as geo-electrics [7] and active, passive seismic [8] investigations. AGPA also supported the integration of training data collection and analogue field geology procedures with geophysical in-situ and remote sensing. The resulting technique and data combination is synergistic and can be applied to both science and operational aspects.

Sub-centimetric surface imaging and topographic reconstruction of the main analogue site [6] was obtained. The resulting models, integrating both stereogrammetry and ground-based LIDAR proved useful for the morphometric characterisation of surface materials and structures as well as for constraining the shallow subsurface geometry of vents (Figure 1). These data are being integrated with traditional cave surveying datasets, in order to produce a comprehensive surface-subsurface model.

Subsurface structures and not directly accessible lava tubes have been investigated through concurrent use of surface imaging and subsurface sounding (Figure 2). Results include constraining the position and size of lava tubes (Figure 3) and cross-validation with in-tube lidar as performed by various teams during the PANGAEA-X campaign [see 3].

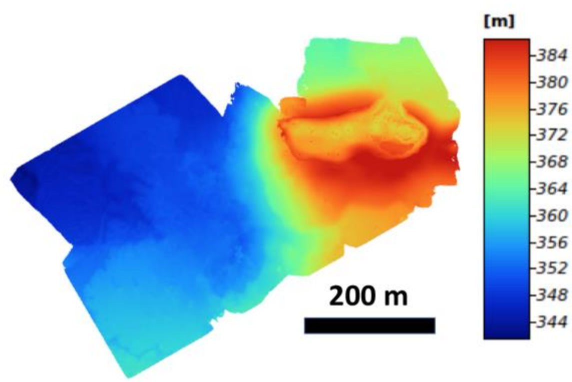

Figure 1: Exemplary result of drone-based stereogrammetric reconstruction of the Tinguaton cone topography [6]

The integrated use of both surface imaging and subsurface geophysics can be synergistic [5], useful for cross-validation and improved geologic interpretation. The approach can be applied on a planetary analogue target, such as lava tubes, or future planetary cases, such as Lunar or Martian landing sites with the need to characterise, map and explore the subsurface, e.g. through lava tubes, collapses and caves.

AGPA raw data are progressively available on public repositories such as Zenodo [9]. Datasets, both raw and processed are going to be shared on public data repositories too, in order to support cooperation, data re-use and reproducibility. The data discovery and access of planetary analogue data is possible via EuroPlanet VESPA (Virtual European Solar and Planetary Access) [10], to be further expanded. The approach could be used also within similar activities [e.g. 11]

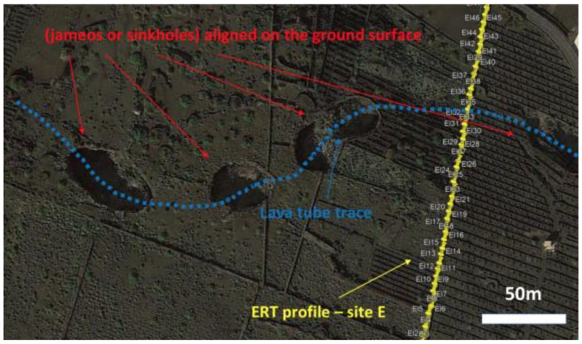

Figure 2: Location of one of the geo-electric profiles over a lava tube system (background imagery Google Earth) [7].

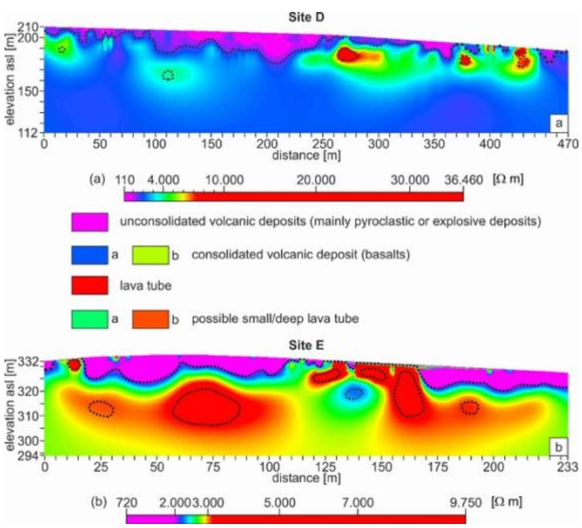

Figure 3: Geo-electric imaging of lava tubes. Surface topography surveyed with RTK-GPS [7].

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