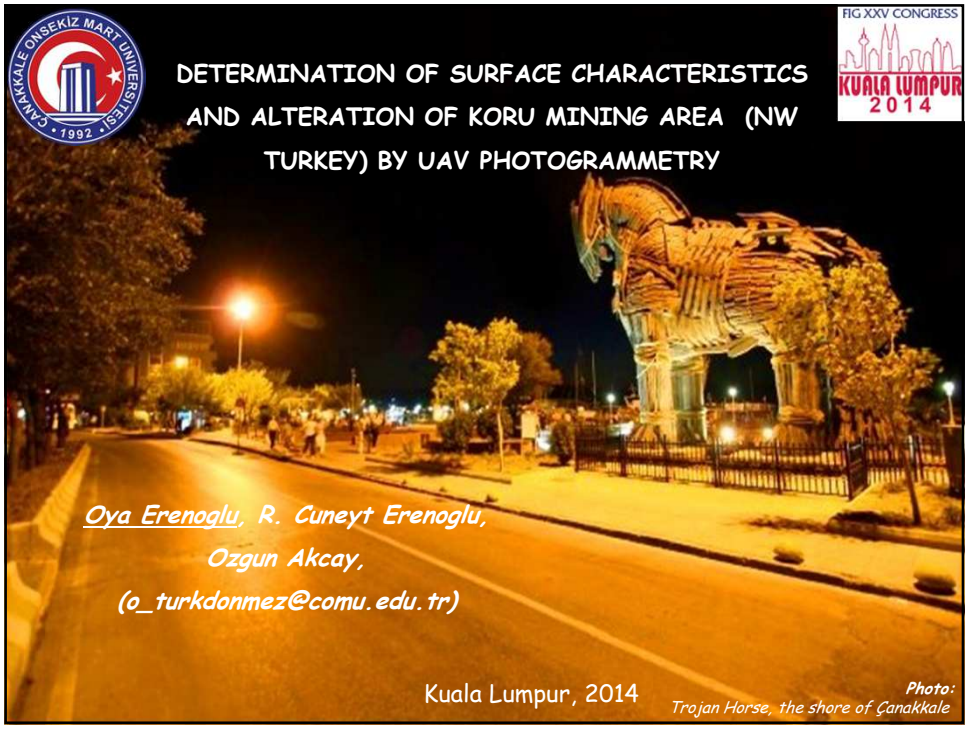

DETERMINATION OF SURFACE CHARACTERISTICS AND ALTERATION OF KORU MINING AREA (NW TURKEY) BY UAV PHOTOGRAMMETRY

FIG XXV CONGRESS KUALA LUMPUR 2014

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Kuala Lumpur, 2014

Photo: *Trojan Horse, the shore of Çanakkale*

OUTLINE

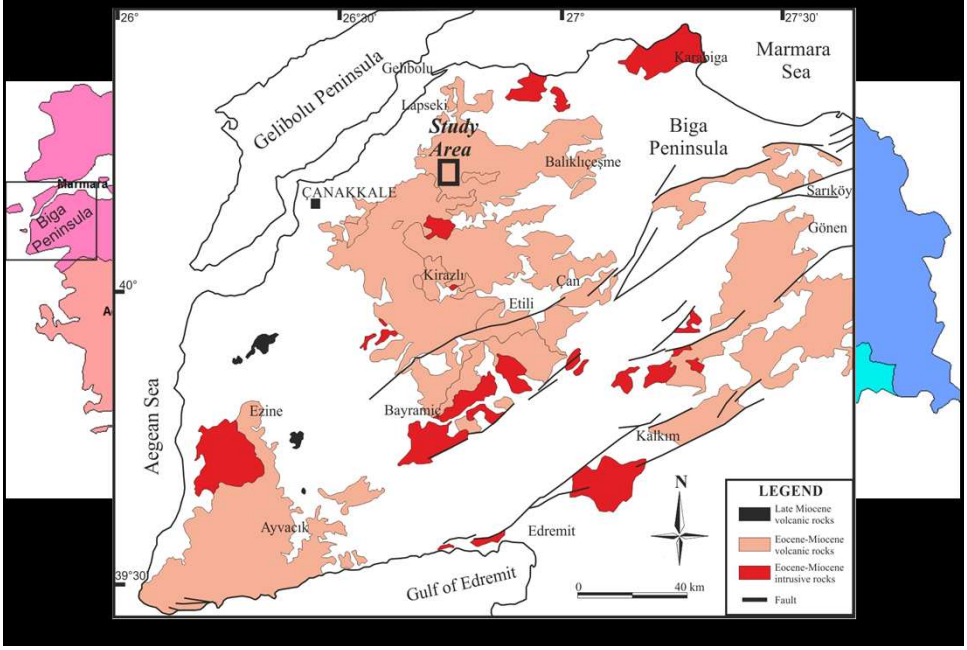
- Aim of the Study
- Location of the Study Area
- Geological Setting
- UAV & Photogrammetric Processing
- Surface Characteristics and Alteration
- Conclusions

Photo: Çanakkale Bosphorus

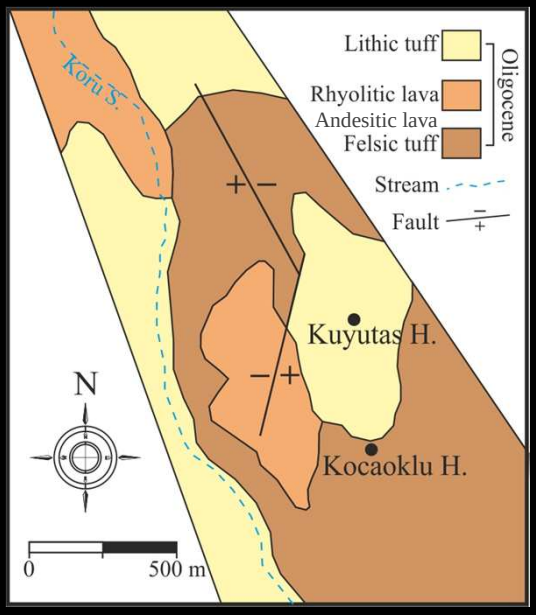
AIM OF THE STUDY

- To test usability of Unmanned Aerial Vehicles (UAVs) technology for different branches in geology, such as mineralogy, and mining exploration.
- To classify the type of different rocks.
- To compare results from UAV with conventional geological field observations!

STUDY AREA

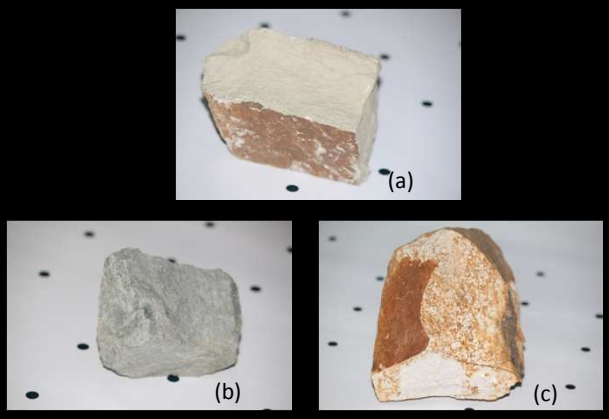


GEOLOGICAL SETTING



Geological map of study area

GEOLOGICAL SETTING



Taken rock samples from the study area;
(a): Rhyolitic lava.
(b): Andesitic lava.
(c): Rhyolitic tuff.

MOTIVATION

- As mentioned before, geological settings are conventionally mapped using field observations.
- Our focus is to adopt UAV technology for obtaining surface geology and alteration characteristics.
- To do it, we performed a case study in Korudag Mining Area, Çanakkale, Turkey.
- Korudag Region is a high characteristic area for geological classification using UAV method.

UAV TECHNOLOGY

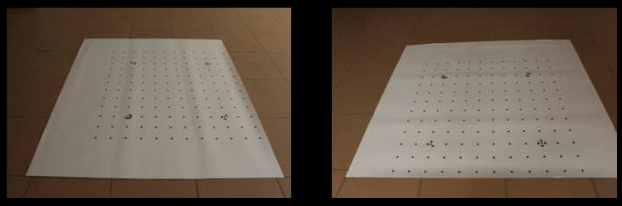
Nowadays, the unmanned aerial vehicles are ready to fly with the platforms, professionally built in-house, directly.

They can be also used for numerous applications in mining and geology for the remote and accurate scanning technologies.

CAMERA CALIBRATION

Camera calibration was accomplished using the Photomodeller software.

We estimated the coordinates of the principal point (x_P and y_P), focal length (c) and the radial lens distortion parameters using the b/w-coded targets for automatic measurements.

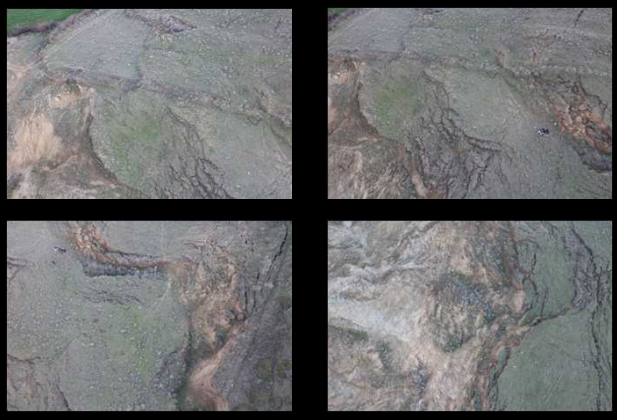


b/w-coded targets for automatic measurements using the Photomodeller camera calibration for estimation of the interior orientation parameters.

IMAGE ACQUISITION

- A set of UAV-acquired photographs covering the whole mining area in Koru (Lapseki/Çanakkale) village were taken.
- All photographs were taken manually using shooter of remote controller and First Person View (FPV) flying mode.
- In a first in-situ flight planning step, the desired area and suitable locations for starting and landing were chosen.
- Then the multicopter was launched to the maximum flight altitude of about 70 m. At this location the UAV was hovered for about 45 seconds.
- Note that the pilot initiated vertical landing.
- After each flight, we downloaded and checked the covered area of the acquired photographs on-site.

IMAGE ACQUISITION



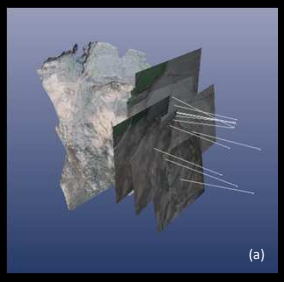
Some examples of taken aerial photos by UAV

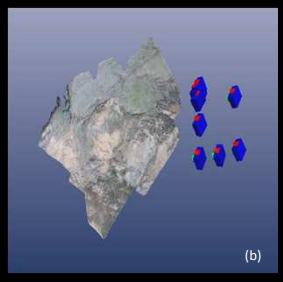
UAV PHOTOGRAMMETRIC PROCESSING

In order to produce digital surface model, we processed the data using PhotoModeler Scanner software.

The photographs of the entire mining area (manually pre-selected by criteria like image quality and covered area size) were computed to digital surface models.

First, all photographs were processed to get the image planes from UAV photos and camera positions, see Figures (a) and (b), respectively.

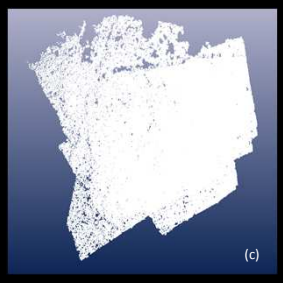


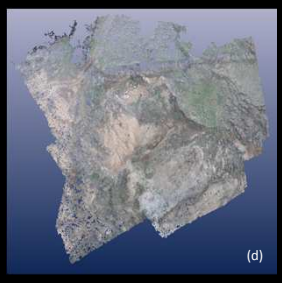


UAV PHOTOGRAMMETRIC PROCESSING

Then, these data were supplied to the patch based multi view stereo procedure of the software which finally computed a dense point cloud for all supplied photographs.

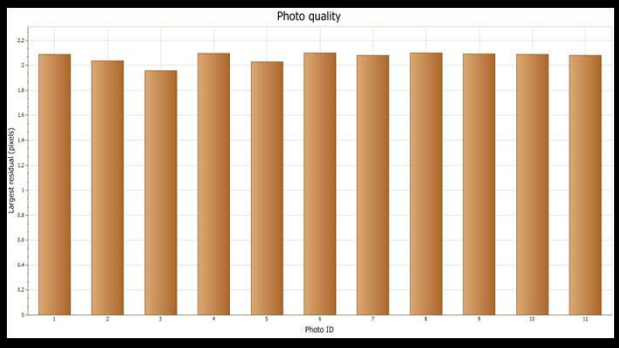
Thereby, we obtained 3D digital surface model including point cloud with single color and point cloud with exact color from photo as seen in Figures (c) and (d).





UAV PHOTOGRAMMETRIC PROCESSING

Furthermore, the largest residual for each photo clearly shows photo quality production of digital surface models during software process.



Largest residual vs photo id

DETERMINATION OF SURFACE CHARACTERISTICS

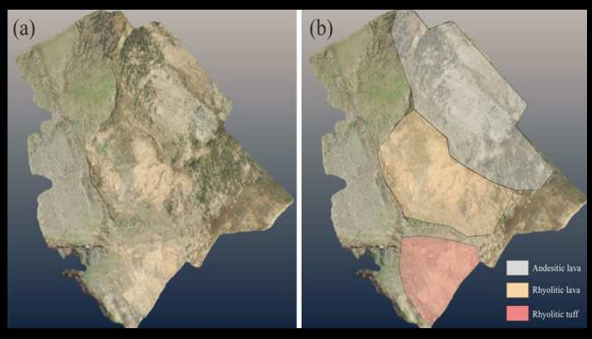
- In study area, we get some rock samples from the region. The photos of rhyolitic lava, andesitic lava and rhyolitic tuff have been given in this presentation, previously.
- A histogram is a graph that can help us evaluate a digital image. Histograms can be found on digital cameras and in computer software.
- We used Photomodeler software. From the RGB histograms of these rocks, the values are regionally averaged for the actual RGB colors (Lichti, 2005, Bachmann et al., 2010, Buckley et al., 2010).
- The average RGB values of the rocks are obtained.

DETERMINATION OF SURFACE CHARACTERISTICS

Figure (a) shows the 3D surface models using UAV data.

Finally, we searched for 3D surface models according to the averaged RGB colors of sampled rocks in order to classify surface characteristics of the study area.

The matched areas are covered with related colors. Figure (b) indicates good matching for landing classifications. Moreover conventional geological field observations also confirm this.

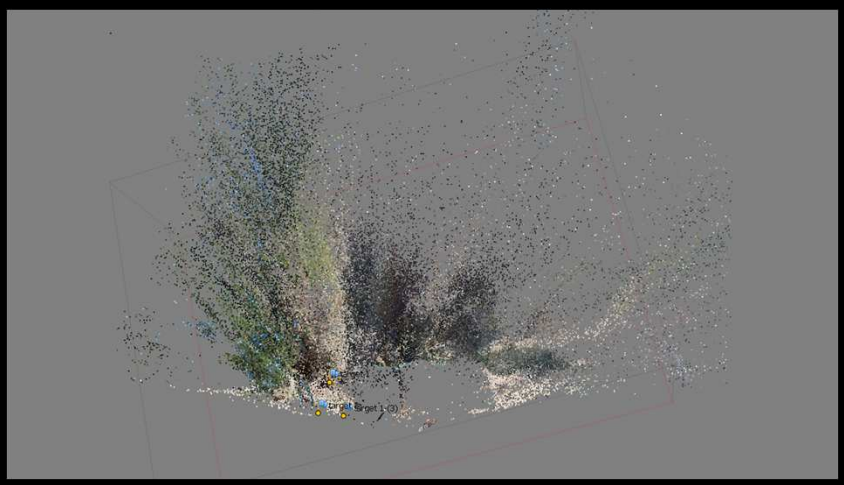


DETERMINATION OF ALTERATION

- The alteration in study area are mostly iron oxide, chloride, argillic and sulphiric.
- In order to determine of alteration on geological surface, we performed a terrestrial photogrammetry campaign by taking photos.

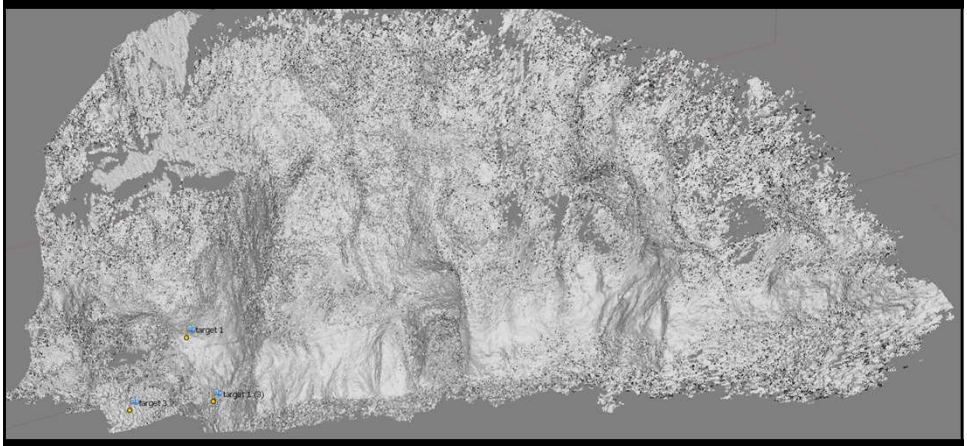
DETERMINATION OF ALTERATION

Point Cloud from PhotoModeler Scanner software :



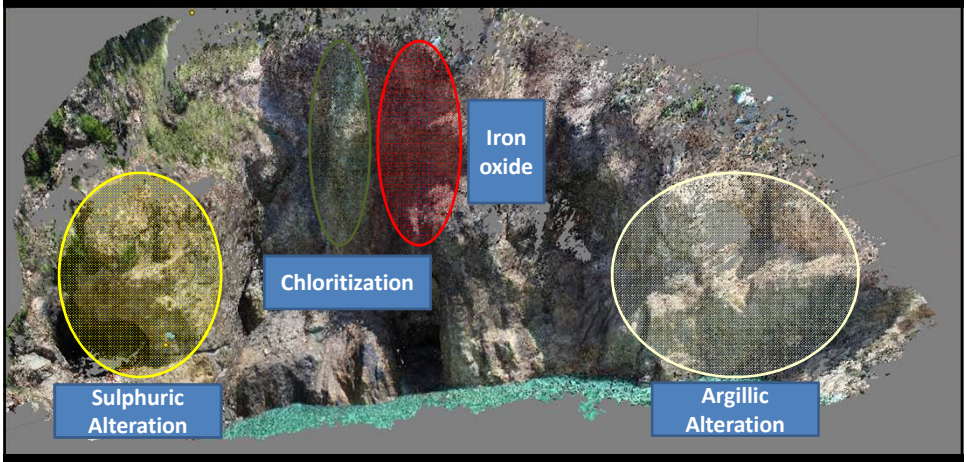
DETERMINATION OF ALTERATION

White Cloud:



DETERMINATION OF ALTERATION

3D model with exact color from photo



* For determination, the average RGB values of the alteration are used.

CONCLUSIONS

- In this study, for surface characterization, we showed that a low-cost UAV-based remote sensing approach reveals high-resolution digital surface models.
- To do it, aerial and terrestrial photos were taken, and their RGB values are compared with each other.
- Finally, the matched areas, e.g. rhyolitic lava, andesitic lava and rhyolitic tuff, are successfully determined, classified and zoned.
- We propose to use the UAV remote sensing for classifying geological characterization.
- As a future work, we plan to extend this approach using geological spectrometer tools for increasing inner reliability of the used approach.