Digital Outcrop Modeling of The Eocene Rus Formation; Implications to Sedimentology and Structural Geology, Saudi Arabia

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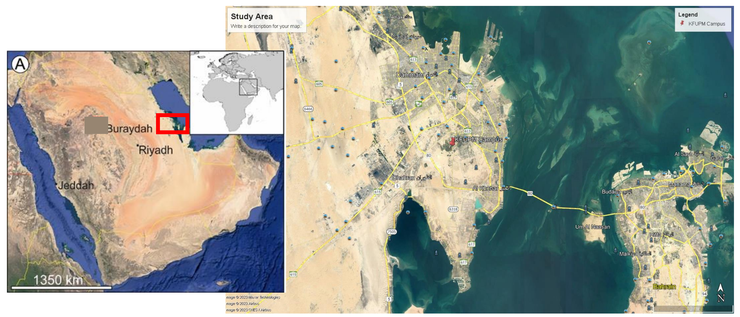
EGU_16415

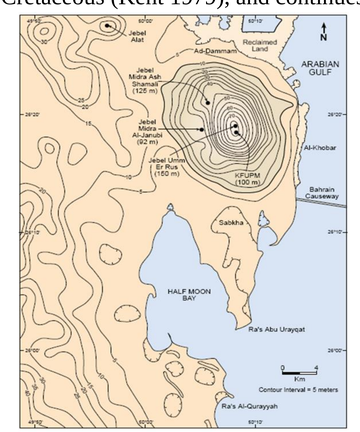
EGU General Assembly 2023

Introduction

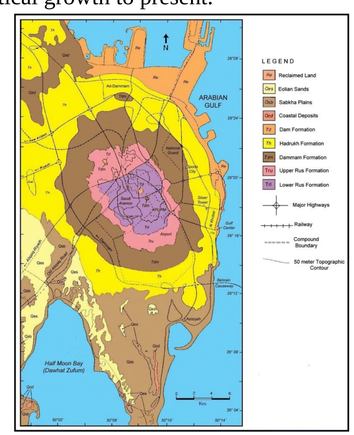
- The King Fahd University of Petroleum & Minerals (KFUPM) campus features good exposure of the Eocene Rus Formation. This region, which is referred to as the Dammam Dome's apex, is what caused the Rus Formation's primary and secondary deformations.
- The Dammam Dome, located in the eastern part of the Arabian Platform.
- Consists of the first and main hydrocarbon structural trap found in the Eastern Province of Saudi Arabia.
- Despite the fact that these structures attracted numerous researchers and produced high-quality documentation and published work, a variety of data covering all the outcrops on the KFUPM campus is still lacking.
- The study area is KFUPM campus.



- Dammam dome is a result of a subsurface salt diapirism that is related to Hormuz salt body.
- Much of the eastern part of the Phanerozoic sequence of the Arabian Platform is underlain by the Infracambrian Hormuz Salt.
- The movement of Hormuz salt starts in late Jurassic and the first surfacing was in Cretaceous (Kent 1979), and continues vertical growth to present.



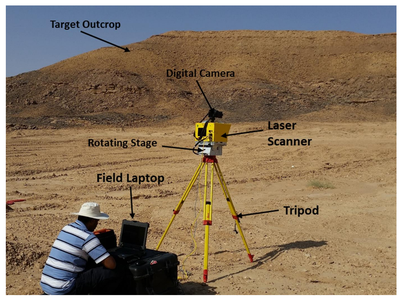
Topographic Map of the Dammam Dome (Weijermars 1999)

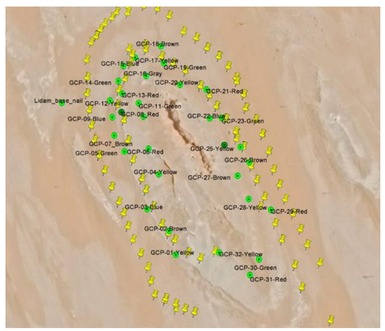


Stratigraphy of the Dammam Dome (Al-Malki et al., 2015)

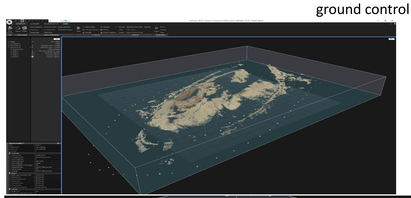
Material and Methods

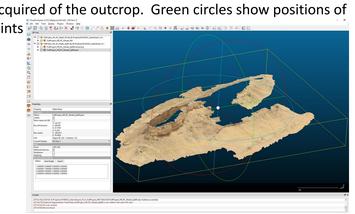
- In this study, 10 outcrops were used, and for each outcrop, high-resolution 3D photographs were captured together with sedimentological and structural data.
- The outcrops range in height from 5 to 7 meters, in width from 200 to 400 meters, and most of them include at least three distinct sets of fractures.
- The bed-by-bed sedimentological information includes lithology, grain size, texture, sedimentary structures, and fossils.
- The structural data also includes the thickness of the beds as well as the strike and dip of a representative number of fractures.
- To be used in the digital models, the images and all of the obtained data were geo-referenced.
- A new 3D outcrop model visualization and analysis tool has been created in-house, by the remote sensing team in KFUPM, with a focus on the ability to load and show massive outcrop model datasets in fully georeferenced coordinates (either in colored point cloud or textured TIN-mesh formats).
- Sedimentological and structural analysis tools have been created to do interactive study & annotation of the outcrop.

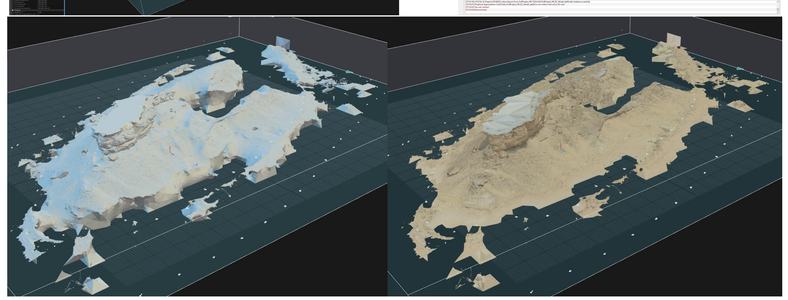




Yellow push-pins show standing positions where photographs were acquired of the outcrop. Green circles show positions of ground control points



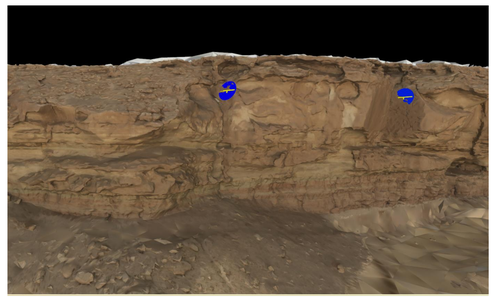




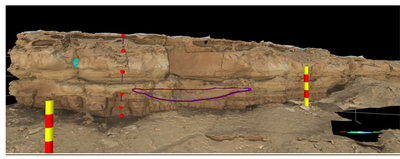
initial alignment of photos in RealityCapture software

Results

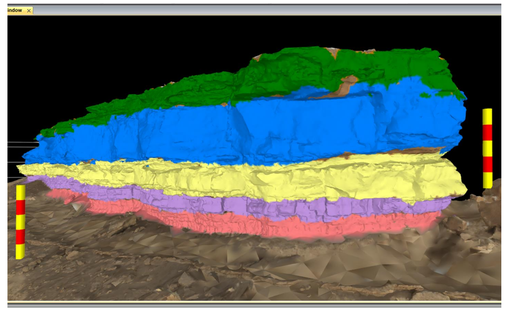
- All of the data from each outcrop were combined to form the results of this study, and the structural measurements were validated with an accuracy of +/- 5 degrees only for the measures of strike and dip.
- The boundaries between layers have been delineated as polylines on the digital model and also some structural and statistical measurements have been done on the model.
- Thickness of facies has been measured using ArcMap.

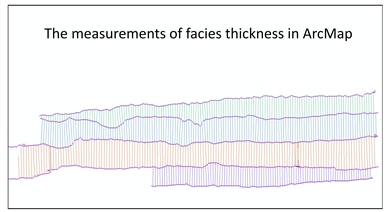


Strike and Dip measurements of the fractures in VRGS software



Some Interpretations done by using VRGS software





Conclusions and Recommendations

- The workflow of the construction of the 3D digital model of the Rus Formation included acquisition (by high resolution camera and GCPs); processing (by Reality Capture software) and interpretation (by ArcGIS and VRGS softwares).
- The Rus Formation digital models were also used to teach undergraduate students cutting-edge technologies and to bring the field into their desktops.
- Future plans and proposals call for integrating digital models with geophysical data such as seismic and GPR to increase value and benefits.

Acknowledgments

The authors would like to acknowledge the support provided the Geosciences Department and the College of Petroleum Engineering and Geosciences at KFUPM for their support under start-up fund project of outcrop reservoir analogs in Saudi Arabia.