Watch Out!

Understanding geomorphology of the sea cliffs at the Scripps Coastal Reserve to make recommendations on erosion hazards to the community

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Introduction

The University of California Natural Reserve System manages the Scripps Coastal Reserve (SCR) located in La Jolla associated with the University of California San Diego (UCSD). The SCR is a conservation area servicing different biohabitats, researchers, students and public users.

A common problem the SCR faces are people going off trail and being at the edge or base of the cliff which are locations where the cliff is less stable. For people to understand why these actions are life threatening or harmful they need to have a base knowledge of the geology and erosion mechanisms controlling the bluffs.

Since the University of Regents obtained the land in 1987, there were invasive species eradications, closing off Sumner trail due to trampling and failed efforts of back filling the trail to prevent cliff face erosion. The SCR has experienced landslides and mass wasting events that are very likely to persist in the future.

The main objective of this project is to make recommendations of areas in the reserve that should be more protected based on cliff retreat data and areas of the cliff prone to failure. In addition the reserve users will be educated about the geomorphology of its sea cliffs through developing new templates for signage and making this content available on the SCR's website to facilitate making reserve users aware of their actions and conscious about their safety when visiting.

Geology of the Reserve

Formation	General Description
Ardath Shale	• ~50 Ma, deposited in deeper water on the continental slope • Fine grained, fissile olive-gray silty sediment and sandy layers • Hard layers of molluscan fossils on the beach •(Kennedy and Moore, 1971)
Scripps	• ~ 48 Ma, deposited on shallower continental slope • Light tan-brownish medium-grained sandstone and sandy siltstone • Poway cobble channels with clasts originating from Sonora, Mexico, vary in thickness and is a defining characteristic (Abbott, 1999). • High energetic events • (Kennedy and Moore, 1971)
Linda Vista	• ~1.5 Ma, deposited in shallow marine environment, marine terrace • Reddish brown sandstone, conglomerates, concretions and hard cap rocks • Abbott, 1999).

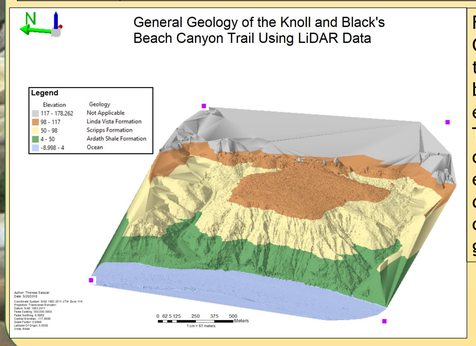

Figure 1: Geology of the reserve based on elevation. The gray color shows extrapolated data not considered geology.

Results

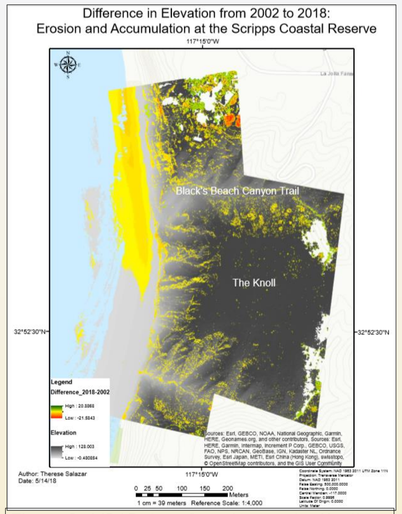

Figure 2: LiDAR data focusing on the Knoll and Black's Beach Trail demonstrate a general erosion rate occurring at about 0.16m/yr.

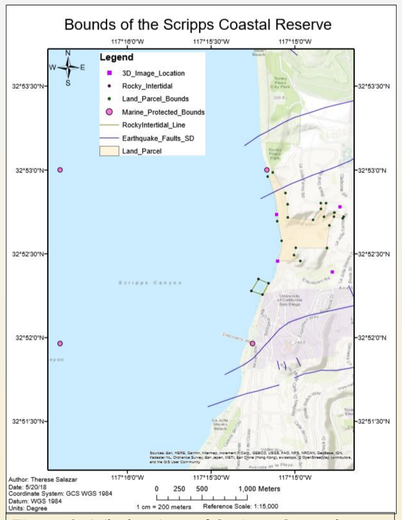

Figure 3: Whole view of Scripps Coastal Reserve- marine and land parcels.

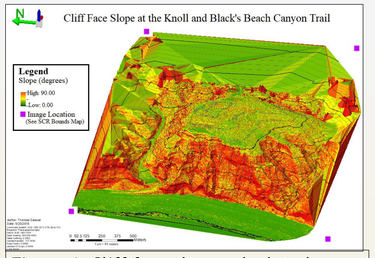

Figure 4: Cliff face slope calculated through ArcGIS. Steeper cliffs means more prone to failure and landslides.

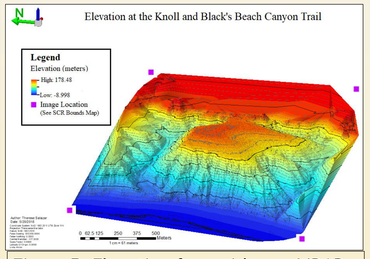

Figure 5: Elevation from airborne LiDAR.

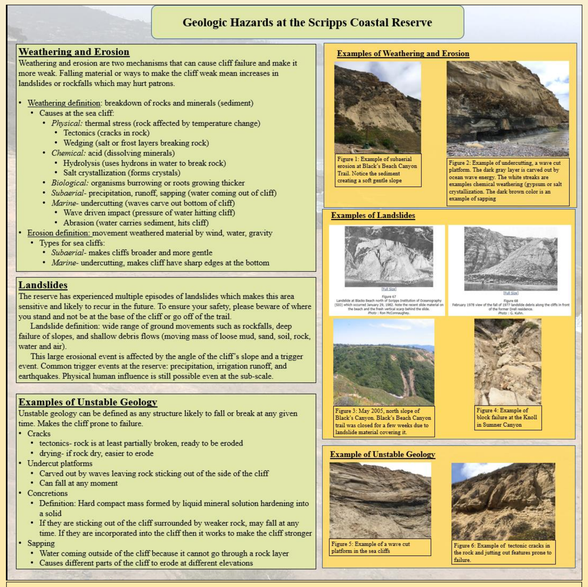

Figure 6: Template for Black's Beach Canyon Trail signs educating users about geologic hazards that exist in the cliffs and staying safe.

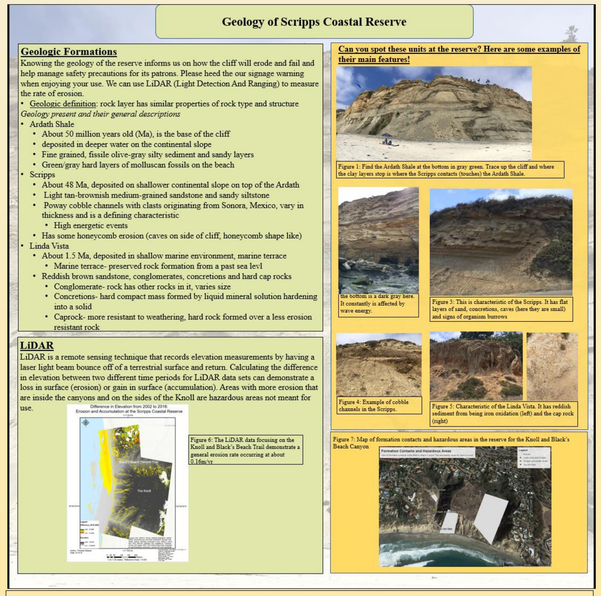

Figure 7: Template for Black's Beach Canyon Trail signs educating users about the importance of geology and LiDAR.

Materials and Methods

Maps
- Maps were generated using ArcGIS with ArcMap or ArcScene or Google Earth
- Airborne LiDAR from SIO researchers

Geomorphology Information
- Read literature, complied information from other classes
- Go to site and observe features listed in template

Conclusions

- Standing directly at the base of the cliff, going off trails or sitting on edge of cliffs:
  - dangerous due to erosional processes, landslide susceptibility and cliff failure mechanisms.
  - Protect failure prone areas
- The beach and the sub canyons have shown the most change throughout the reserve.
- The trails, being away from the base of the bluffs and interbedded stable geology help support the SCR's access
  - Harder layers to erode- Scripps and Linda Vista
  - Linda Vista is generally the most resistant
  - Easiest to erode- Ardath Shale

Figure 8: Rocky intertidal cliffs are relatively stable because the Miocene dike, concretions and left over block failures act as a natural blockage.

- Not all erosion is bad.
  - Acceptable cliff retreat delivers sand to the beach
  - Dissipate wave energy preventing further cliff retreat.
- Landslides have occurred in the past and are to be considered in the future
  - Influenced by the Rose Canyon fault and precipitation or irrigation addition.
- Change and erosion at the reserve is inevitable but understanding possible future effect of cliff retreat can better prepare management of areas and efforts made at the reserve.
- Sea level rising based on climate predictions
  - Significant amounts of the cliff face are predicted.

References

1. Abbott, P. (1999). Rise and Fall of San Diego: 150 Million Years of History Recorded in Sedimentary Rocks. Sunbelt Publications.
2. Kennedy, M., Moore, G. (1971). Stratigraphic Relations of Upper Cretaceous and Eocene Formations, San Diego Coastal Area, California. *American Association of Petroleum Geologists*, 55(1971) p. 709-922.

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