Surveying Austin Chalk for Karst Features

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Formation of Austin Chalk

Austin Chalk (AC) is a type of calcium carbonate mudstone common throughout Texas. It was formed 80 million years ago when a shallow inland sea bisected North America and covered most of Texas (Ward, 2006).

Fig 1.1

The AC is found in several distinct layers of mudstone, that were laid down when micro-organism in the cretaceous sea died and sunk to the sea floor (Ward, 2006).

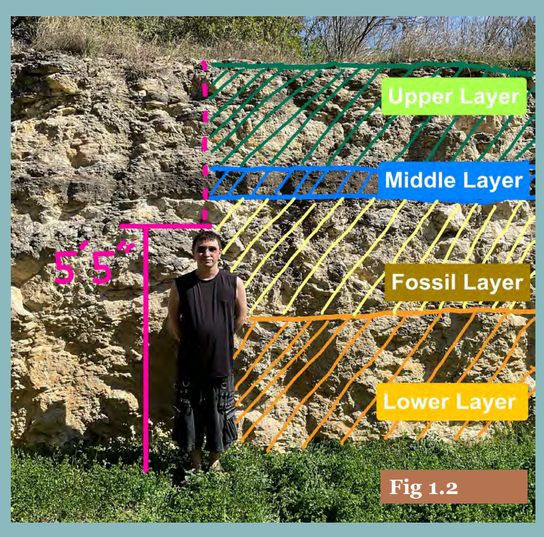

Fig 1.2

Characteristics of Exposed Austin Chalk on NVC

Upper Layer

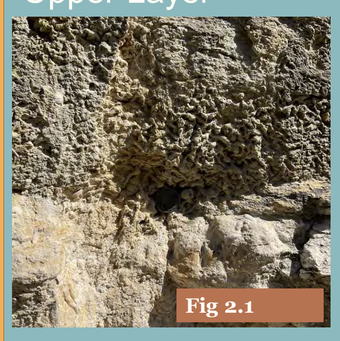
Fig 2.1

- Dark grey appearance
- Highly bioturbated, meaning tunneled by marine life in soft sediment (Loucks et al., 2021).

Middle Layer

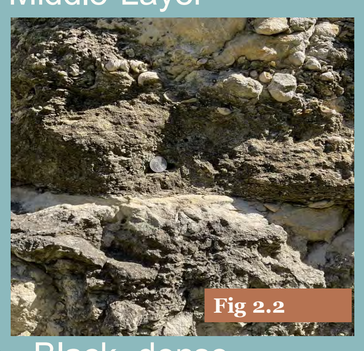
Fig 2.2

- Black, dense, and highly cemented.
- Imbedded with marine shells.
- Easily delineated from the other layers (Loucks et al., 2021).

Fossiliferous Layer

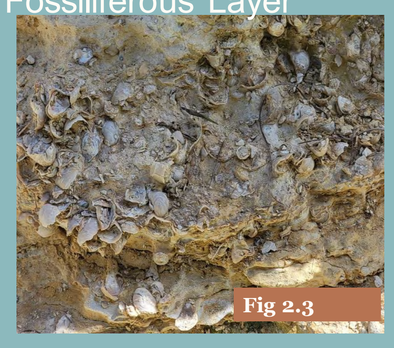
Fig 2.3

- Highly organic layer imbedded with marine shells.
- The fossils are sorted due to short term changes in the environment.
- Common fossils are cretaceous oysters and bivalves (Loucks et al., 2021).

Lower Layer

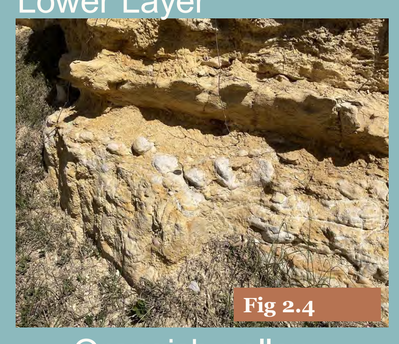
Fig 2.4

- Orangish yellow appearance.
- Organic-matter-rich mudstone.
- Powdery texture like drawing chalk.
- Imbedded with chert nodules (Loucks et al., 2021).

1. Karst features in the AC can be found as dry caves formed during chemical erosion.
1. The AC is made of calcium carbonate, a chemical that is easily dissolved by acidic rainwater.
2. This rainwater enters the ground and raises the ground water table.
3. Groundwater flows through pores, cracks, and faults within the rock slowly dissolving the rock and expanding the hollow spaces within.
4. Over time these hollow spaces become large, interconnected caverns called caves.
5. Within the AC, the ground water lowered, and these caves emptied of water transforming into dry caves.(Plummer et al., 2022)

What Are Karst Features? And Their Dangers

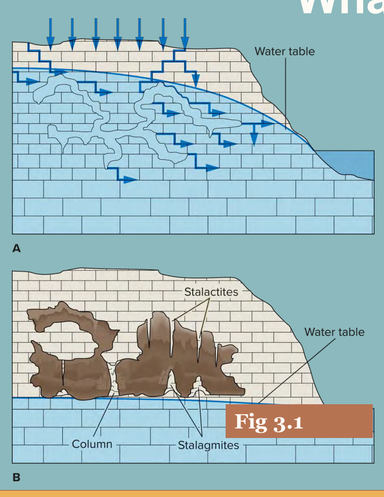

Fig 3.1

- Robber Baron cave depicted in figure 3.2, is a dry cave that was formed in the AC.(Robber Baron Cave Science 2019)
- These underground caves can be massive compared to humans.
- Caves like these can be found near the surface and cause problems for engineers.


Fig 3.2

- Being so close to the surface, these caves can collapse during or after construction projects. They can also fill with toxic gas that can seep into nearby buildings. These hazards influence how and why karst features are surveyed before engineering projects

Subsurface Discovery

- LiDAR technology is the use of laser light on an aircraft to map and define vast regions on the ground with accuracy and precision. This method has been very useful in identifying and locating sink holes due to their distinct footprint in the ground which can be an indicator of karst(“Karst Sinkhole Detecting”2019)

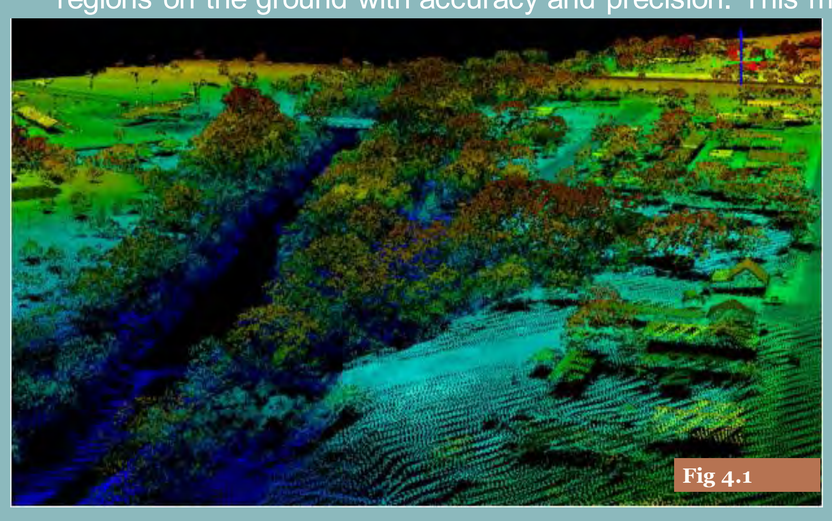
Fig 4.1

- Ground-penetrating radar is the process of sending radio electromagnet signals to map subsurface terrain and features. Signals reflected off surfaces underground can be distinguished by their dielectric constant and associated with their water content. Researchers can then use coefficient tables to identify what features are present such as the water table and karst development ("Application of Ground"1993).

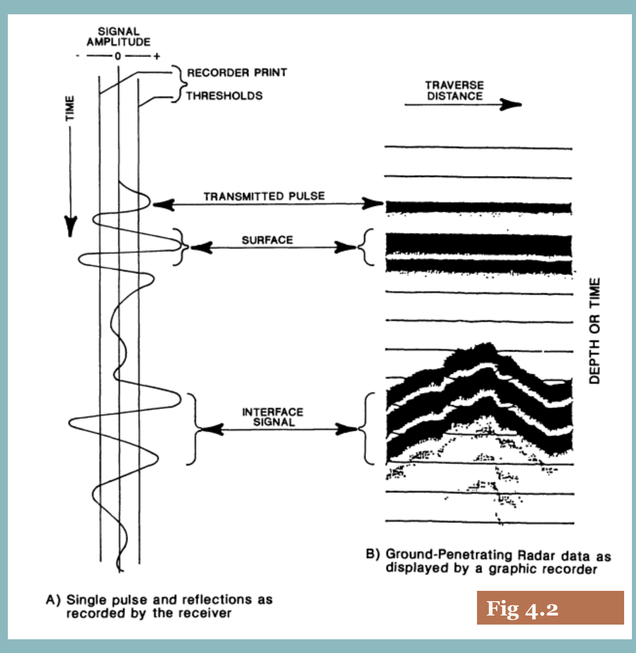

Fig 4.2

Methods Used for Investigating Karst Features

- Bedrock surface mapping is a tool used to identify low spots within an area by inserting probe points until refusal or any method used for geophysical mapping such as Ground Penetrating Radar or Electromagnetics (Proper Investigative Techniques for Shallow Bedrock 2012). Since water flows at bedrock within a karst basin, it is a great indicator of the depth within a system.

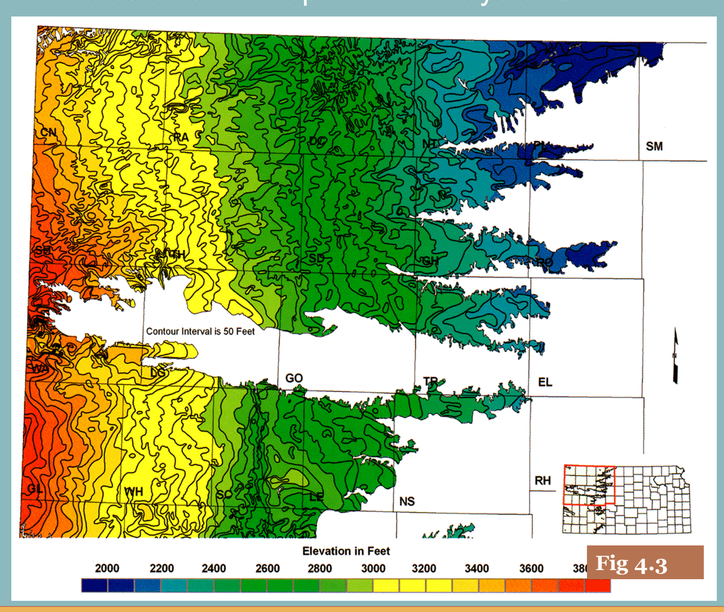

Fig 4.3

- Dye tracing is a method that involves inserting dyes at a known karst site to track any potential pathways connected to the system (Proper Investigative Techniques in Karst 2011). While dyes may be an indicator of how long the interconnected pathways are, it does not show how deep and expansive a karst system is.


Fig 4.4

- A vapor intrusion study can identify potential pockets of air that can be contaminated by volatile organic compounds inside conduits that are not filled with water (Proper Investigative Techniques in Karst 2011). Investigators need to determine what type of VOC's are present, screen for soil and air concentration levels, and identify potential paths of least resistance expanding the known karst system ("OWSER Technical" 2015).

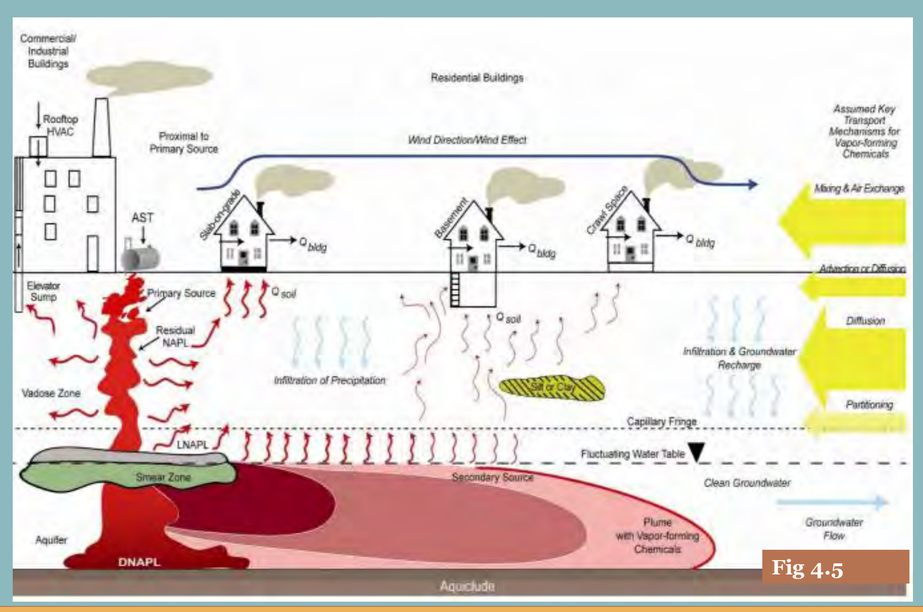

Fig 4.5

Figure Captions

1.1 Map of the Cretaceous Western Interior Seaway
1.2, 2.1-2.4 Taken by Joshua Guzman and Bryan Vance
3.1 Cross section of karst features
3.2 Photo from Robber Baron Cave (https://www.tcmacaves.org/preserves/robberbaron/)
4.1 The display of a point cloud that covers a small portion of the City of Albuquerque
4.2 Simulation of a reflected pulse as recorded by the receiver and displayed by a graphic recorder,
4.3 Bedrock surface elevation beneath the Ogallala aquifer
4.4 Physical science technician Marc Ohms pours dark red rhodamine WT dye into Highland Creek (https://www.nps.gov/articles/000/dye-tracing-wind-cave.htm)
4.5 Illustration of Key Elements of the Conceptual Model of Soil Vapor Intrusion

References and Acknowledgements

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