Earthquake Risk Assessment Based on Vs30 Mapping in Napa Valley

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Background

In 2014 an unexpected 6.0 magnitude earthquake hit Napa Valley Fault.

Seismic waves travel at different velocities in different rock densities. Based on the velocity of seismic waves in the Vs30 mapping, their site classification can be determined.

The site classifications are A, B, C, D, E, & F. Site A has the highest rock density, while F has the lowest rock density. A higher rock density can experience less risks during an earthquake.

In Vs30 mapping, the determined shear wave velocity are plotted in the first 30 meters of the location. The shear wave velocities are collected by geophones using the HVSR (Horizontal to Vertical Ratio) which is a passive seismic method using microtremors already present in the environment.

Our goal is to assess the risks present in the Napa Valley area based on the seismic wave velocities that predict what type of rock is below the surface.

Methodology

Collecting Data with Geophones:

1.Turn on geophones and perform "huddle test" by planting them on the ground and letting them connect to Bluetooth and Wi-Fi.
2. Plant geophones on mapped areas to collect data.
3. Wait at least 60 minutes to collect data.
4. Assess the data collected by the geophones through Vs30 mapping.

Determining the AVs30 value for a location:

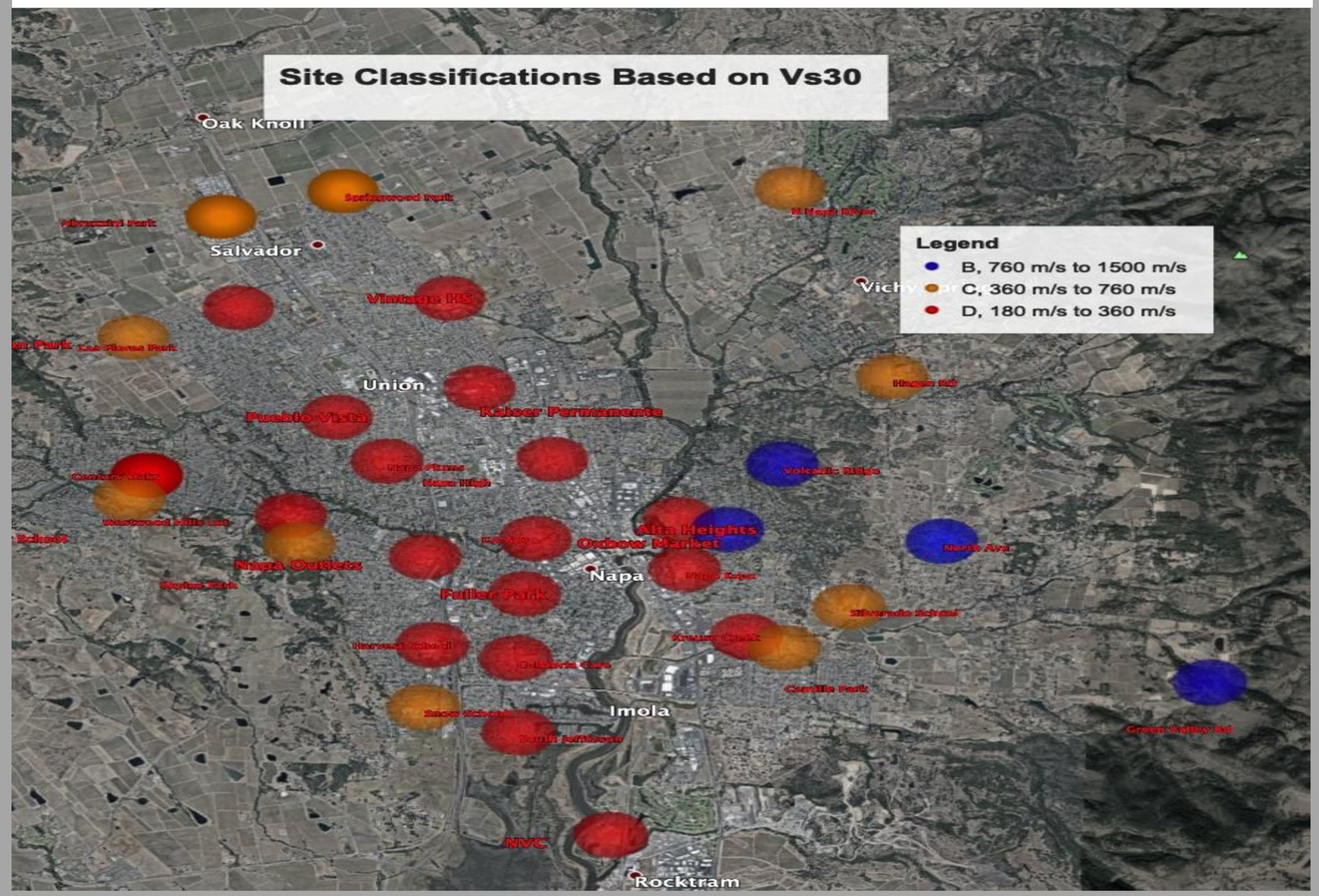
1. Process data collected by geophones.
2. Convert frequency graph to phase velocity map.
3. Pick the highest strength channel in the velocity map. Create its dispersion curve.
4. Create a depth model of the first 30 meters. Plot s-wave vs. Depth graph.
5. Determine the AVs30 of a site based on the depth model graph.

Creating Site Classifications Map:

1. Assess the AVs30 map: https://seisimager.com/GeophysicalDatabase/show_project_map.php?project_id=84.
2. Determine the site classifications of a location based on their AVs30 value.
3. Plot a point on the location based on their site classification (blue=B, orange= C, & red= D).

Results

Most southwest Napa locations have a site classification of C & D.
Site Cs have very dense soil and soft rocks. Site Ds have stiff soil.



Conclusion

Since most of Napa has a site D classification that shows a lower rock density, more shaking and damages due to earthquakes will be experienced.

Due to the geology of Napa, it can be seen why southwest Napa has lower rock density as it is between mountains.

Based on the results, we can utilize the rock densities map as a guide for retrofitting buildings in the future.

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