"Where are all the Pawnee Area Earthquakes Originating?"

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Abstract:
On September 3rd, 2016 the largest earthquake in Oklahoma recorded history was felt across most of the Mid-Continent region, as reported by Channel 9 news of Oklahoma City. The location of the epicenter was quickly determined by the U.S.G.S and O.G.S. Since then, hundreds of seismometers have recorded continued earthquake activity. Over 1,200 epicenters have been recorded in the Pawnee Epicenter Area accurately measuring the magnitude, location and depth of each epicenter.

Many man hours, efforts and money has been spent attempting to identify the origin of these epicenters. From analysis of the seismicity data recorded, opinions of the origins and trends of the epicenters has been as varied as the epicenters themselves. We built a velocity model by integrating a sonic log from the surface to the top of the Arbuckle with a model estimating velocities below the Arbuckle to estimate time to depth conversions to 64,000 feet.
An OGS relocated earthquake dataset, suggests that less than 5% of the epicenters occurred above 8,000 feet. Geologic information below 8,000 feet in the Pawnee area is unknown Precambrian sub-metarhyolite. Therefore, 95% of the epicenters are measured 8,000 feet to 32,323 feet originating below the top of the known metarhyolite, probably in Proterozoic Eon age.

With the combined data, effort and work by the Oklahoma Geological Survey, Oklahoma State University and GTSeis along with the generous donation of 3D seismic data images from Silverthorne Seismic, the subsurface origin of each epicenter has been identified. The origin and cause of 95% of the epicenters in the Pawnee area correlate to deep, probably Proterozoic fault plate movements. Much work needs to be done in the future to better define and understand the cause and trends of each plate movement epicenter in the Pawnee area.

2022 Pawnee Area Epicenters
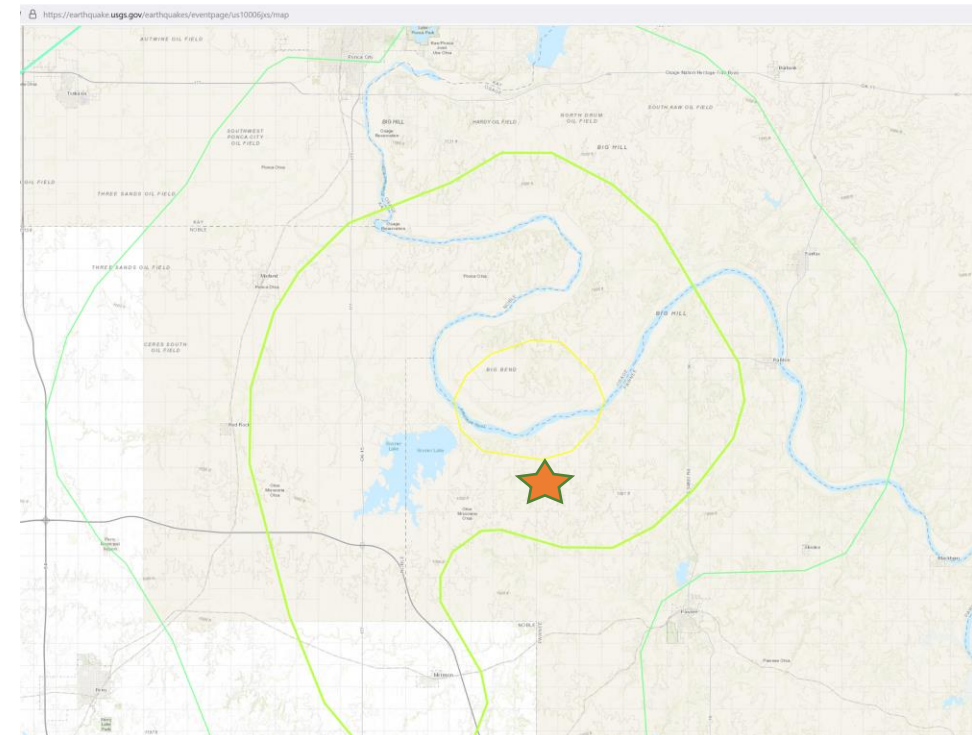# Where are the Earthquakes Originating?
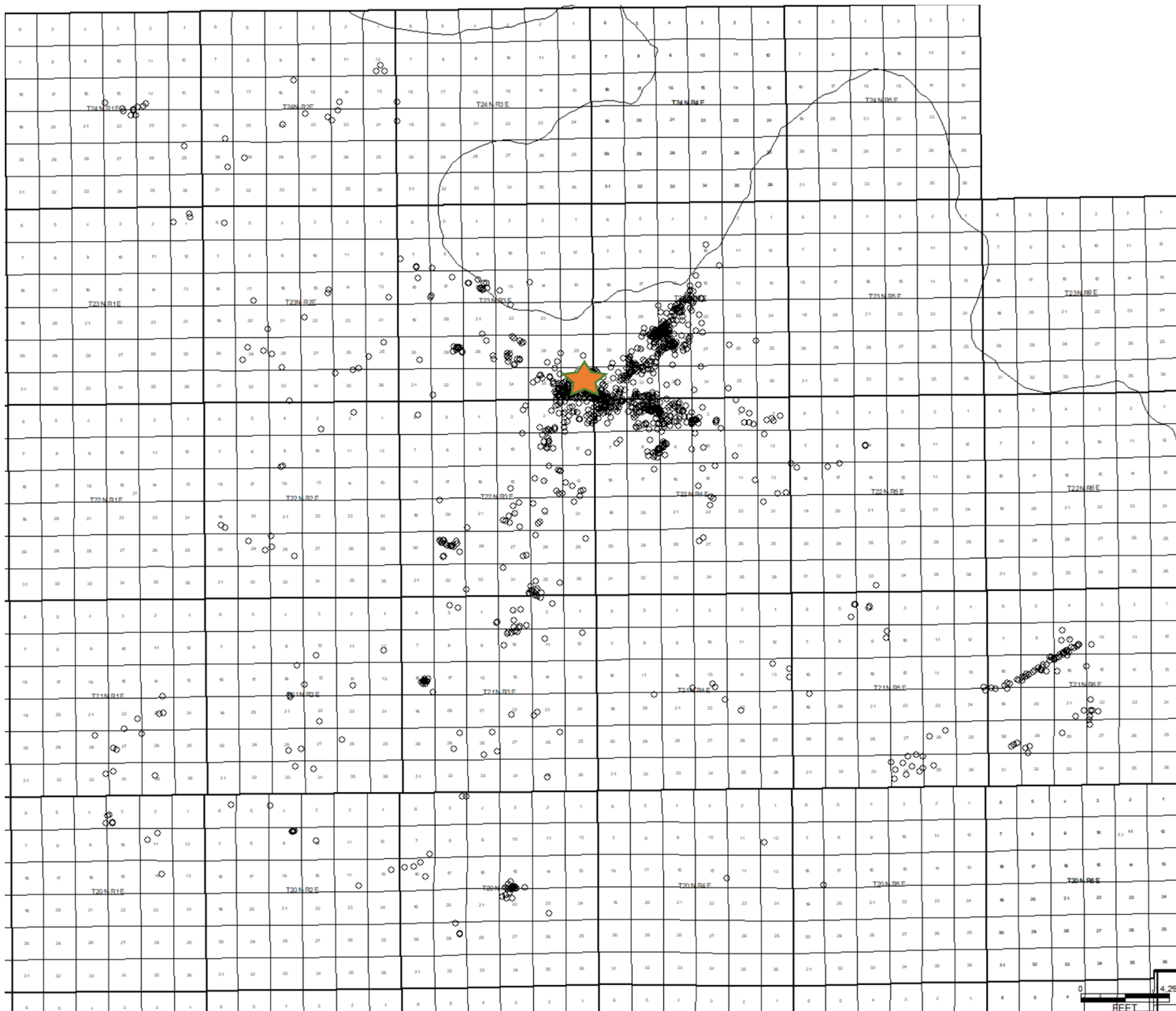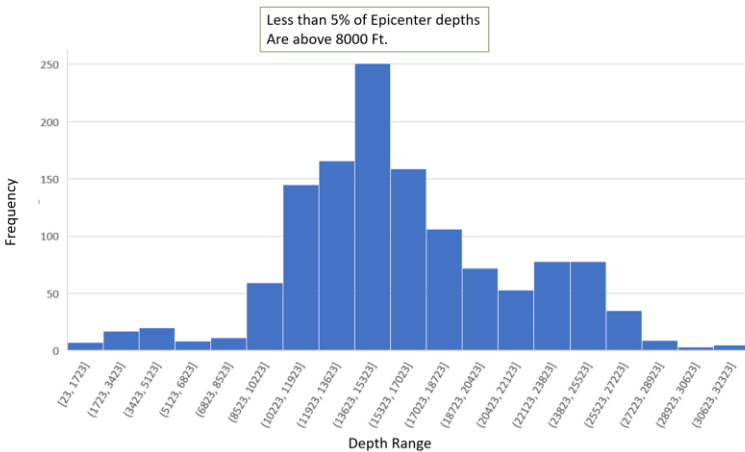

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Pawnee Epicenter Area
1281 epicenters recorded
as of June 2022

3D Seismic Data Volume With
Epicenters and Faults Correlated

Arbuckle

Reagan sand Cambrian/Metarhyolite Pre-Cambrian

Fault Green

Fault Yellow

Pawnee Earthquake Epicenter 19022 Ft.

Fault Blue

Fault Orange

Arbuckle

Reagan sand Cambrian/Metarhyolite PreCambrian

Fault Green

Fault Yellow

Fault Blue

Fault Orange

Time Slice at 25,000 Ft.

2280000

2290000

2300000

2310000

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