KANSAS GEOLOGICAL SURVEY
OPEN-FILE REPORT 2002-12

SUBSIDENCE FEATURE ON U.S. HIGHWAY 50 AT VICTORY ROAD
NEAR HUTCHINSON, KANSAS
Seismic Survey Overview and Conclusions

by

Kansas Geological Survey
(for the Kansas Department of Transportation, District 5)

Disclaimer

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(Press Release)

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Surface monitoring of the sinkhole at the intersection of U.S. 50 with Victory Road in Reno County began in 1998 when the depression measured about 1 ft below construction grade. Routine elevation surveys conducted since that time have documented average subsidence rates of around 10 inches per year resulting in a cumulative drop of about 3.5 ft in the highway since construction. The current sinkhole is centered about 100 ft northwest of the intersection, possesses a very symmetric, 300 ft wide bowl-like shape, and pools water most of the year.

High-resolution seismic reflections were used to map the upper 250 m of the ground surface around and below the sinkhole. Two approximately one-mile seismic reflection profiles crossed at the intersection of the highway and county road. The seismic data allowed the mapping of key rock layers in the upper 1000 ft, an estimate of surface and subsurface growth potential and rates, and the identification of rock units with structural characteristics that might put vehicle traffic at risk by threatening highway stability. The high signal quality and resolution of these seismic reflection data permitted detection, delineation, and evaluation of all the major rock units associated with the sinkhole.

At this location over the last million or so years groundwater has created voids in the 400 ft deep, 135 ft thick Permian-aged Hutchinson Salt member of the Wellington Formation. Rocks above the salt have collapsed into these voids. Mechanisms and gross chronology of structural failures interpreted on seismic sections indicate initial subsidence and associated rock failure occurred as accumulated stress on roof rocks spanning salt voids exceeded the strength in roof rock. A chimney-like feature, narrowing upward from its widest point at the top of salt, formed as a result of this roof rock failure. As the downward movement (settling, relaxation) of sediments into this chimney feature slowed after initial formation, gradual subsidence of sediments both within and bounding this chimney feature continued, advancing the surface expansion of the bowl-shaped depression. The rate of destabilization and failure as well as the load-bearing potential of the rock layers above zones of dissolution strongly influence the original subsidence geometries and dimensions as well as the subsequent reactivation of subsidence.

This sinkhole is likely related to the reactivation of natural salt dissolution processes responsible for a 1000 ft wide, sediment-filled sinkhole that first formed around a million or so years ago. If salt dissolution has begun again at this site—anthropogenic or natural—it is not possible with these data alone to definitively identify a fluid source or pathway. However, with the relative positions of this modern sinkhole and the paleo-subsidence feature, and proximity of the nearest disposal well with a history of fluid containment problems, this sinkhole is most likely the result of natural processes. Besides the obvious disruption to the road system, the breach in the confining properties of the bedrock resulting from this most recent subsidence might provide a new pathway between the fresh waters of the Equus Beds and the more brackish Permian waters.

With a subsidence history at this site potentially extending back over 1 million years, it is unlikely the processes will end within the next millennium. Surface subsidence will likely continue at a gradual rate along the northern and eastern edges of the current sinkhole for some time into the future. Until the highway started sinking at this location sometime before the 1998 elevation survey, little if any subsidence seems to have been active throughout the last 500,000 years. This long period of inactivity followed by the localized, rapid (3 ft in four years) subsidence observed at this site suggests other small sinkholes could form over the next several years above this or other similar paleofeatures in this area. Sufficient bridging and under-compacted rock layers still exist beneath this sinkhole to sustain the current subsidence rate of around 1 ft/yr for several years to come.