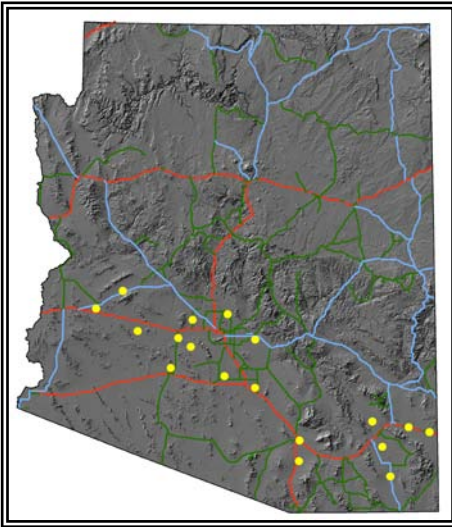


Land Subsidence and Earth Fissures in Arizona

Land Subsidence

Land subsidence has been occurring across Arizona since the 1940's. Thousands of people live in active land subsidence areas and are unaware. Most of the time, there is no clear and identifiable sign that land subsidence has occurred in an area. Areas in Maricopa and Pinal Counties have subsided more than eighteen feet since 1940.



Active Land Subsidence Areas in Arizona Based on ADWR InSAR

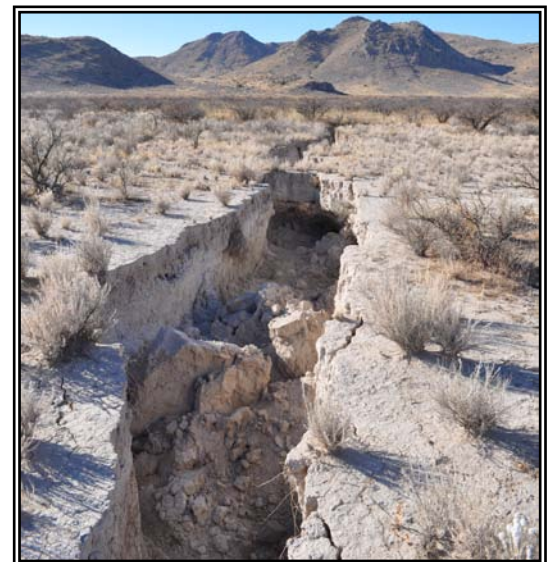
Land subsidence in the basins of Arizona is generally due to compaction of the alluvium caused by lowering of the water table. As the water table declines, pores in the alluvium once held open by water pressure are no longer supported and collapse. Collapse and subsequent lowering in elevation of the land surface is defined as land subsidence. This subsidence is generally not recoverable. If this subsidence occurs over areas of bedrock, differential subsidence can occur.

Differential subsidence is when adjacent areas subside at different rates. Bedrock will not compress like the surrounding alluvium, creating a subsurface platform. Differential subsidence occurs where shallow bedrock and deep bedrock are adjacent to each other, creating a zone of differential change in surface elevation. Because of these different amounts of subsidence, tension can build in the alluvium layer at this differential subsidence zone, forming an earth fissure.

Earth Fissures

Earth fissures are cracks at or near the earth's surface that are the result of differential subsidence. Earth fissures start out as small cracks and may not be visible on the surface. They grow and widen from surface water flowing into the crack, eroding material from the sides.

Earth fissures have caused millions of dollars in property and infrastructure damage, damaging pipelines, roads, canals, flood retention structures, bridges, buildings, and private property. There are unanswered questions about how earth fissures interact with groundwater pollution.



Earth Fissure near the Sulphur Hills in Cochise County that opened up after a Monsoon Storm in July 2010

Land Subsidence and Earth Fissures in Arizona

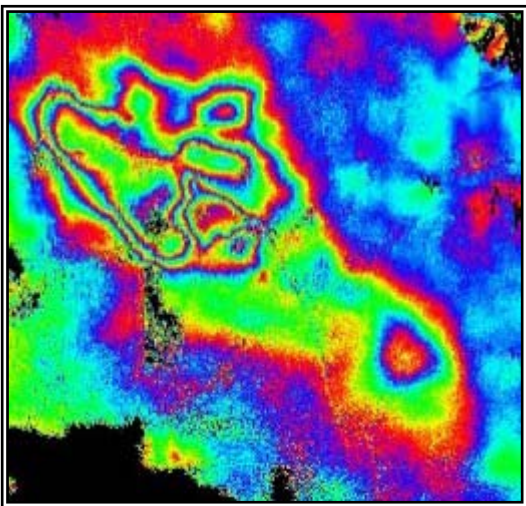
Earth Fissure Monitoring and Mapping

Earth fissures are identified by using on the ground and aerial monitoring techniques. The Arizona Geological Survey (AGS) started an intensive earth fissure mapping program in 2006. The goal of this program is to survey and record each known earth fissure around the State and provide this data to the public.



Warning Sign Located In Cochise County

Land Subsidence Monitoring



Hawk Rock Area 2004 - 2008 Interferogram

Land subsidence has been detected over the years using surveying techniques such as differential leveling and high accuracy Global Positioning System (GPS) surveying. In the early 1990's scientists began to use Synthetic Aperture Radar (SAR) and interferometric processing (InSAR) to detect land surface elevation changes. InSAR has been developed into a highly reliable land subsidence monitoring technique that has been utilized by ADWR since 2002. ADWR has identified numerous subsidence features around the State and continues to monitor the extent and rates of these features on an annual basis.

Land subsidence maps were developed by ADWR using archived and current InSAR data with the goal of providing hydrologists, geologists, water managers, and the public the most accurate land subsidence data.

Impacts of Land Subsidence and Earth Fissures

There are many consequences of land subsidence and earth fissures: Elevation and slope change affecting the natural flood plain drainage, flow within canals and drains, damaging intermodal infrastructure (roads, bridges, railways, etc), damaging water retention and retarding structures (dams, levees, floodways, etc), and damaging private property (homes, driveways, fences, etc).



A House in Nevada Damaged by Land Subsidence and an Earth Fissure

ADWR is also part of the Arizona Land Subsidence Group which was jointly created by the geological and engineering communities as a venue for discussing the state of knowledge regarding subsidence of Arizona's alluvial basins.