



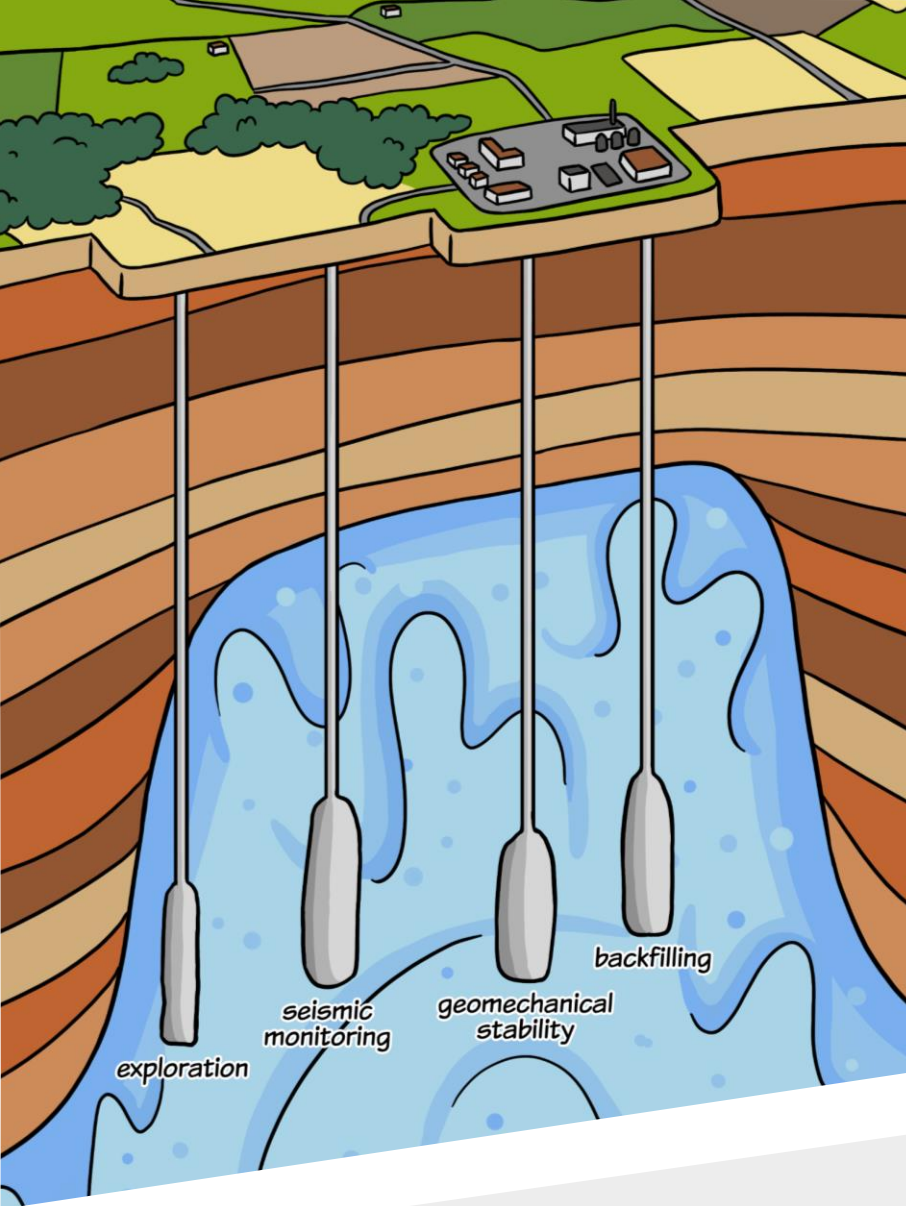
Leave the tricky stuff to us.  
Benefit from our support services for

## **SALT CAVERNS**

- ▶ Seismic imaging of steep diapir flanks
- ▶ Seismic monitoring for a safe operation
- ▶ Geomechanical stability calculations
- ▶ Backfill design concepts for end of life

[www.k-utec.com](http://www.k-utec.com)

**K-UTEC**  
SALT TECHNOLOGIES



Salt caverns are instrumental for solution mining and the underground storage of natural gas, oil and hydrogen. K-UTEC supports salt cavern operators with **four specialist services** which are essential for a safe and effective operation. As a salt technology company with more than seven decades of experience we are the partner of choice to take care of some of the tricky tasks in salt cavern operations.

We have found a way to **geophysically explore** and image the salt flanks of diapirs by way of VSP (vertical seismic profile) and hybrid seismic. After our geophysical survey, you will know exactly how close your cavern is located to the edge of the salt diapir.

We support salt cavern operators with **seismic monitoring**. K-UTEC informs the operator immediately when an instability of the cavern is registered. Our team monitors your cavern around the clock worldwide. This allows operators to take early mitigation action, avoiding accidents and operational interruptions.

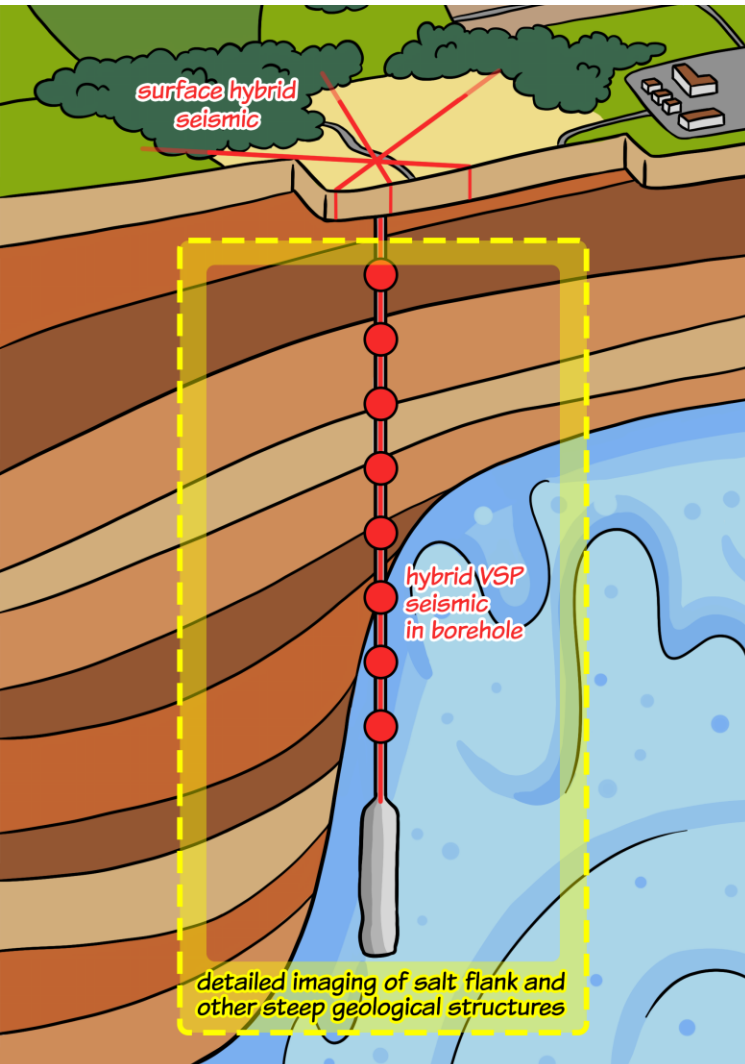
We make sure your caverns stay stable. Our experts carry out **geomechanical calculations** to ensure the operation stays safe and the cavern roofs hold. K-UTEC keeps an eye on stress and strain to avoid trouble.

Once the salt cavern has fulfilled its duty, it needs to be stabilized. We are experienced in **backfilling caverns** and mines. K-UTEC will find the right material, binders and concept for you to infill the subsurface void, stabilizing it long-term, and avoiding unwanted future subsidence effects.





## SALT FLANK EXPLORATION



Steep salt flanks are notoriously complicated to image with standard geophysical methods. However, a good understand of the exact outer and internal geometry of the salt body is necessary to allow effective planning of cavern leaching. Clearly, the cavern should always keep a healthy safety distance to the edge of the salt body.

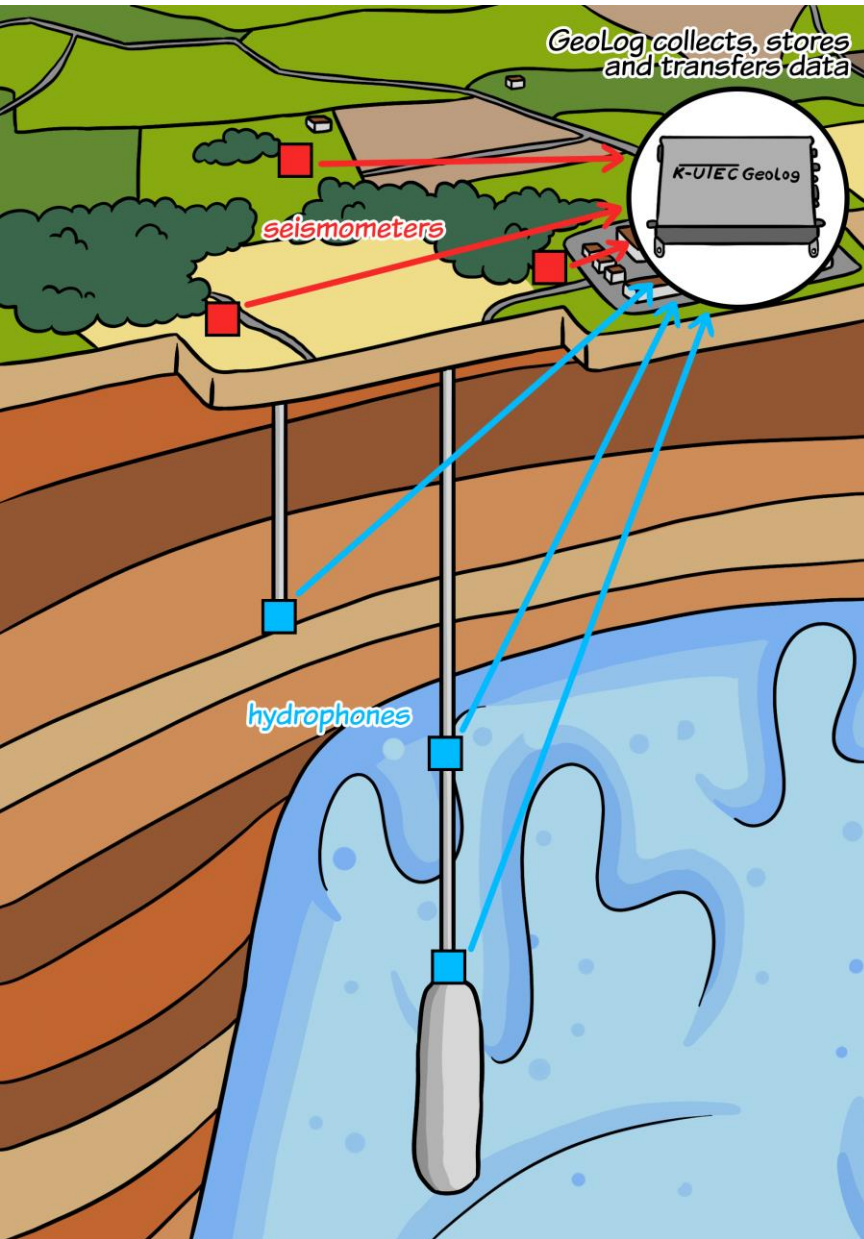
K-UTEC is applying innovative combined hybrid VSP and surface seismic to image the internal structures and flanks of diapirs in great detail. This methodology combines the strengths of several techniques which results in a much improved three-dimensional mapping of the salt body, when compared to standard approaches.

Speak to us when you are in doubt of your salt cavern and diapir geometry. We are happy to talk you through respective reference cases which document the great potential of this technology for salt cavern operators

*photo:*  
VSP measurements in a salt cavern



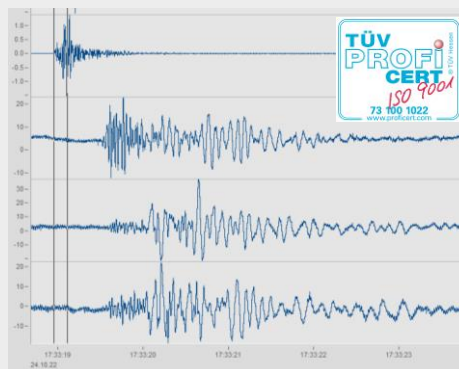
# SEISMIC MONITORING



The **geomechanical stability** of salt caverns needs to be **monitored**. In geologically simple regions, occasional surface levelling or satellite-based elevations changes may be sufficient. In geologically more complex settings, the monitoring has to be carried out using a set of **seismometers** and **hydrophones**.

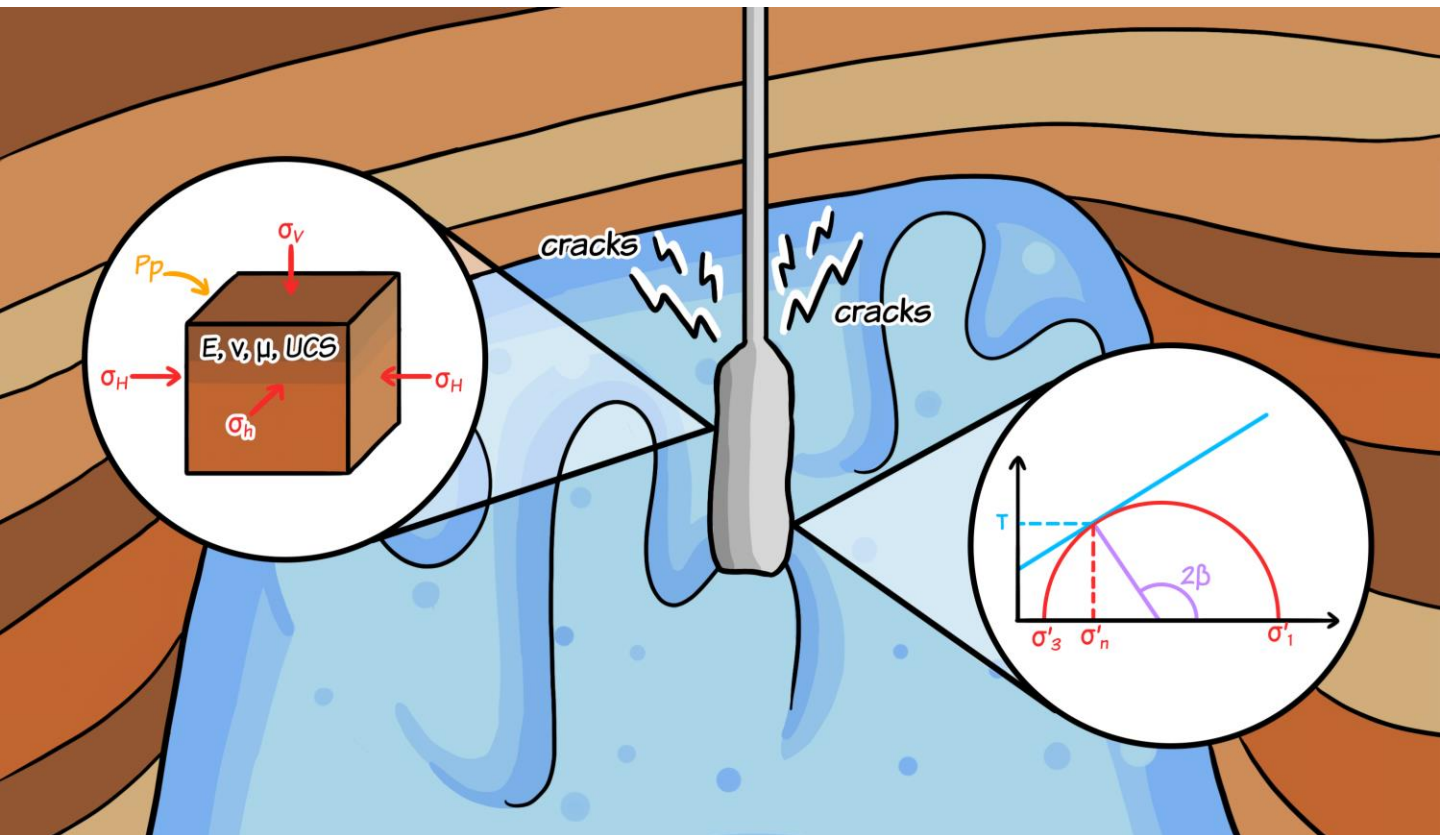
Unstable parts of caverns are prone to stress buildup and movements, leading to elevated levels of microseismicity. Triangulation of the measured seismograms allows the precise **localization** of the **geomechanical troublespot**. The information from seismic monitoring allows salt cavern operators to take action before accidents and damage happen.

K-UTEC plans, builds, installs and operates 24/7 **seismic monitoring** systems around the world. Systems are adapted to clients' exact needs, taking all relevant circumstances into account.





## GEOMECHANICAL STABILITY



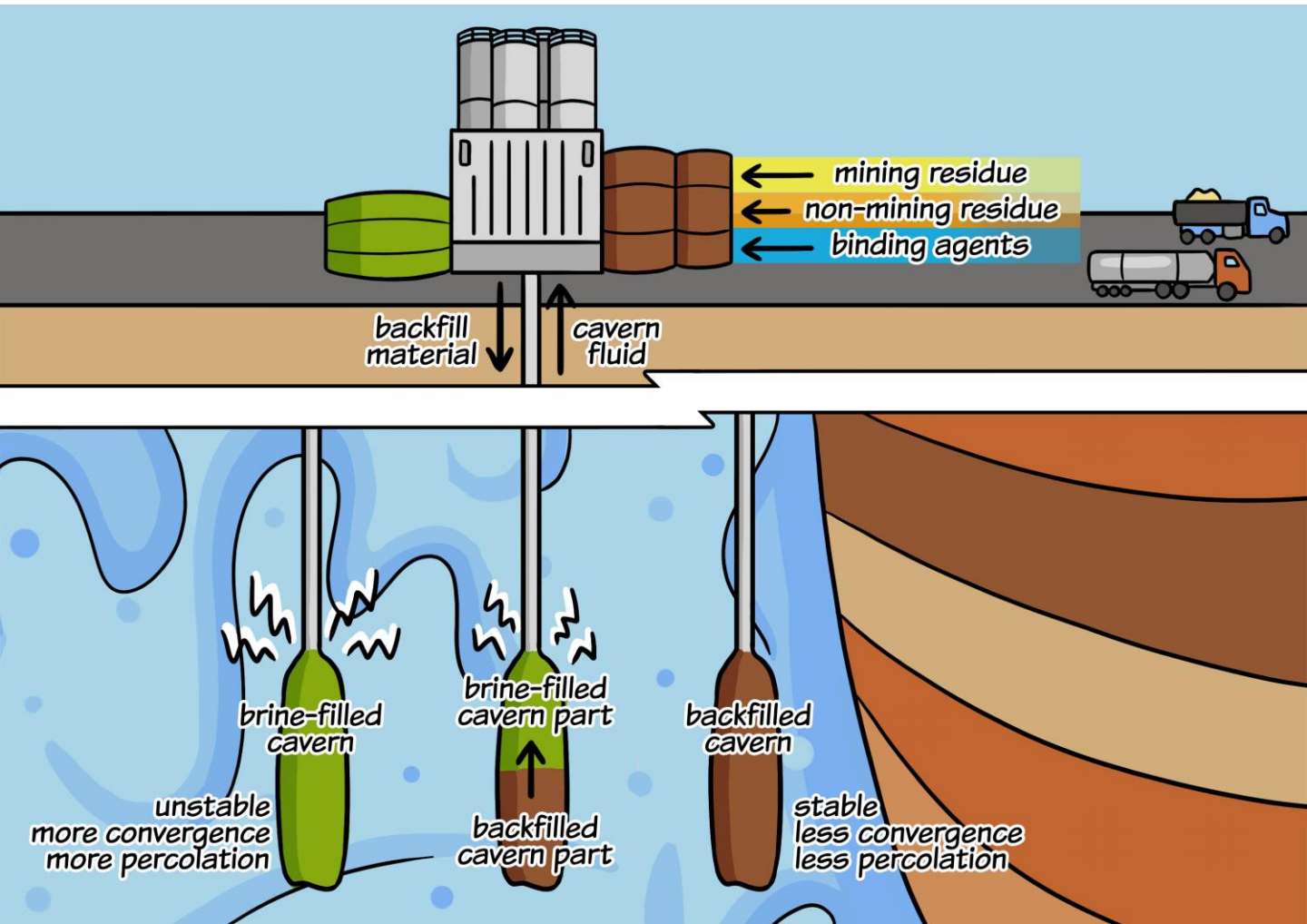
The stability of salt caverns has to be periodically assessed over their life time. In particular the roof section needs to be evaluated to **avoid failure and collapse**. If an upward migrating cavity reaches the rock-soil interface, large subsidence craters and **sinkholes** may form at the surface causing significant damages and even personal injury. K-UTEC has the expertise to perform analytical calculations to estimate subsidence, tilt, strain and curvature on the surface above the caverns.

Along with our network partners, K-UTEC carries out **geomechanical calculations** of the **stress and strain** regime of salt caverns to ensure a safe operation and stable subsurface conditions. This includes a thorough analysis of geological conditions, creep processes and in situ measurements to evaluate the geomechanical stability.

K-UTEC's experts and partners help to define the most suitable cavern engineering parameters. A **regular geomechanical checkup** of the salt cavern reduces operational risks and avoids accidents. We also support operators in the initial planning stages of salt cavern fields by calculating the optimum sizes, geometries and distribution of new salt caverns for each site in light of geomechanical stability criteria.



# BACKFILL



Once caverns come out of service, some of them need to be stabilized to avoid future collapse. K-UTEC has many years of experience in backfilling and stabilization of salt mines. We develop **innovative backfill concepts** and support operators in feasibility and design studies of cavern backfill. K-UTEC designs backfill recipes using **residues from mining and non-mining activities**, including industrial waste from incineration plants, and **primary or secondary binding agents**. K-UTEC has a dedicated **laboratory** for the chemical and physical testing of backfill materials.



## CONTACT US

### Salt Flank Exploration

Sandro John

Phone: +49 3632-610-172

[Sandro.John@k-utec.com](mailto:Sandro.John@k-utec.com)



### Seismic Monitoring

European Geologist Thomas Schicht

Phone: +49 3632-610-187

[Thomas.Schicht@k-utec.com](mailto:Thomas.Schicht@k-utec.com)



### Geomechanical Stability

Dr. Christian Jakob

Phone: +49 3632-610-174

[Christian.Jakob@k-utec.com](mailto:Christian.Jakob@k-utec.com)



### Backfill

Robert Quensel

Phone: +49 3632-610-144

[Robert.Quensel@k-utec.com](mailto:Robert.Quensel@k-utec.com)







## K-UTEC: WHERE INNOVATION MEETS TRADITION

We work worldwide, supported by a network of international partners. Our homebase is in Sondershausen in central Germany, a place with more than 135 years of salt and potash mining history. Our campus (white buildings) is located in direct neighbourhood of the historical Petersenschacht, a shaft that was built in 1910 to enlarge the local potash mine. K-UTEC is a renowned and innovative service provider for the global mining and natural resources industry founded in 1951.



[www.k-utec.com](http://www.k-utec.com)

**K-UTEC**  
SALT TECHNOLOGIES