What Seismic Imaging tells us about the mysteries of the Tannwald Basin

Dr Gerald Gabriel
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A mutual interest in geological and geophysical processes within the Quaternary epoch motivated Drs Gerald Gabriel and Thomas Burschil at the Leibniz Institute for Applied Geophysics (LIAG) to study overdeepened valleys and basins, using seismic imaging to gain a better understanding of the evolution of these societally highly relevant structures in the entire Alpine region.

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What is seismic imaging?

Seismic imaging is a powerful tool used in geology and geophysics to create images of the Earth’s subsurface. It involves the use of elastic waves, which propagate through the Earth, to understand the geological structures beneath the surface. These waves are generated by natural processes such as earthquakes or by artificial means like seismic surveys.

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What is seismic imaging?

Seismic imaging is the process of using seismic waves to create images of the Earth’s subsurface. It is a fundamental technique in geophysics, used to investigate the structure and composition of the Earth below the surface. Seismic imaging can be used to study the subsurface geology of regions like the Tannwald Basin, where overdeepened valleys and basins have formed due to glacial activity.

Seismic imaging is particularly useful for understanding the subsurface geology of regions like the Tannwald Basin, where overdeepened valleys and basins have formed due to glacial activity. It allows geologists to create detailed images of the Earth’s subsurface, which can provide insights into the history and development of these geological structures.

How does seismic imaging work?

Seismic imaging involves the generation of seismic waves, which are then reflected or refracted by geological structures in the subsurface. These waves are detected by sensors placed on the Earth’s surface, and the data collected is processed to create an image of the subsurface.

There are different types of seismic waves, each with its own characteristics and uses. P-waves (primary waves) are fast and compress the Earth, while S-waves (secondary waves) are slower and cause the Earth to shear. These waves provide different information about the subsurface, allowing geologists to create a comprehensive picture of the geological structures.

How is seismic imaging used in the Tannwald Basin?

Seismic imaging is crucial for understanding the geological structures in the Tannwald Basin. It helps to identify the location and extent of overdeepened valleys and basins, as well as the geological processes that formed them. Seismic imaging is also used to determine the depth and thickness of sedimentary layers, which can provide insights into the history of the region.

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What are the benefits of seismic imaging?

Seismic imaging offers several benefits, including:

1. High resolution images of the subsurface: Seismic imaging can create detailed images of the Earth’s subsurface, allowing geologists to understand the geological structures and processes that have shaped the region.
2. Understanding geological processes: Seismic imaging can provide insights into the geological processes that have formed overdeepened valleys and basins, such as glacial erosion and sedimentation.
3. Locating potential resources: Seismic imaging can help locate potential resources, such as oil and gas, and other valuable minerals.

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The analysis of the seismic data is a major step forward for a new proposal under the umbrella of the International Continental Scientific Drilling Program (ICDP) called DOVE (Drilling Overdeepened Alpine Valleys). The new data obtained from the geophysical survey combined with the previous borehole studies have allowed a new borehole drill site to be chosen for the Tannwald Basin; further complementary borehole sites are suggested for other regions in the Alps. As part of this ICDP proposal, existing data will be reinterpreted against the background of geophysical characteristics, by combining the seismic data with the results of the drilling activities. The new findings from the Tannwald Basin may also suggest additional target-oriented pre-site surveys elsewhere. The advances in the methodology and hypotheses derived from this project will then be applied to other overdeepened structures in the Alps. Combining the multiple data sets from all investigation sites will allow for a clearer picture to be built of the Quaternary sedimentation and deposition changes over the entire Alpine region.

“The seismic data itself will certainly provide important information about the structures and also the evolution of the Tannwald Basin”

Dr Gerald Gabriel

What to expect in the future

Analysis and interpretation of the seismic data acquired at the Tannwald basin is to be explored further. In addition to the analysis of this site, there are plans to use seismic imaging at a secondary location (Lienz Basin, Austria) as well as potentially introducing 3-D, multi-component analysis into the seismic surveying.

A key test will be to start drilling cored boreholes within the basin to enhance and broaden the scientific approach and to confirm the seismic interpretation. One of Drs Gabriel and Burschil’s aims is to gather a clearer picture of the structures of the valley. So far, five P-wave, two SH-wave and one multi-component reflection seismic profiles have been acquired to investigate the sediment succession in detail. Cross-lines have also been recorded to study the 3-D effects and to test if the SH-wave characteristics can be determined.

The combination of the two gives the best results. Further analysis of the multi-component data will give new information about anisotropy of the deposits due to the glacial overprint and tectonics.