ATLAS Cavern Deformation
Nearly 20 years of geodetic monitoring

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02.11.2022
Cavern shape is dynamic and it is important to monitor its evolution

1. Why do we monitor the caver?
2. Methodology of measurements
3. Floor vertical and horizontal movements
4. Wall perpendicular movements
5. What is a lesson for surveyors?
Object of monitoring

- SD1 2155
- SDX1 3178
- PX15 2122
- PM15 2126
- USA15 3125
- UX15 3126
- US15 2127

ATLAS Cavern Deformation:
- Depth: 35 m
- Dimensions: 53 x 30 m
- Earth pressure: 7000 t
- Depth: ~100 m
Motivation of cavern monitoring

- Accuracy requirements
- Future project and upgrade
- Safety of underground cavern
- Mechanical adjustment design
- Detector ageing
Network and equipment

Important aspects of measurement methodology:

• Survey monuments

• Coordinates system

• Datum and deep references

• Technique evolution
The civil engineering predictions

ATLAS base slab movements:

- 2.0 mm down before ATLAS installation
- 5.5 mm down due to ATLAS installation
- 1.0 mm/year up caused by ground pressure
- < 1.0 mm/year up to stabilisation period
Base slab vertical movement

The difference of height epoch MAR22 - MAR21
Statistic (mm): Min = -0.02, Max = 0.12, Mean = 0.03

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28 October 2022
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Base slab **vertical movement** - Centre and corners

The average vertical movement of points in the centre and the corners of the ATLAS base slab

- **Blue line** represents points in the center B0+5, B0+8, B0-5, B0-9, A11+5, A11-5, C12+5, C12-5
- **Orange line** represents points in the corners A22-15, A23+10, C22-15, C23+1
Base slab horizontal movement

Horizontal displacement of the points on the floor diff = MAR22 - MAR21
The scale of ellipses and arrows - 1:5000
Wall perpendicular movement

Y-direction displacement on the USA wall diff = MAR21 - DEC18
Statistic (mm): Min = -0.07, Max = 0.43, Mean = 0.15
Lessons for future measurement

No effective absolute reference over 20 years

Unavoidable reference network adaptation

Measurement not only for construction follow-up and adjustment
Conclusion

Why is the monitoring?

Safety and effectiveness of the ATLAS detector

What are the cavern movements?

5.0 mm heave in the center over 20 years

0.15 mm/year heave from 2009 on

14.6 mm max displacement of the wall

What is the lesson learned?

Stability of reference points and conception change