Precise Geodetic and Astronomic Measurements at the Geomagnetic Observatory Trafelberg (GMO)

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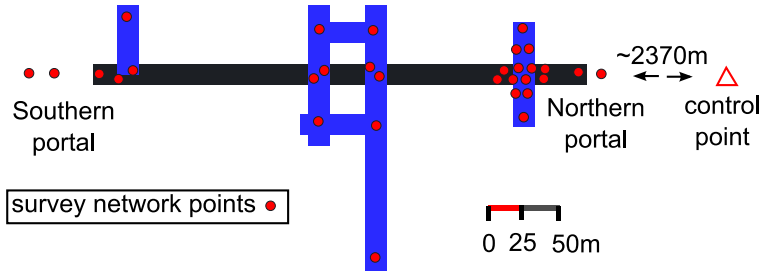
The knowledge of astronomical orientation is necessary for geomagnetic observations. Also the stability of the observatory building has to be checked by using geodetic methods. That is the reason for stabilizing a network of geodetic benchmarks in and above the gallery of the GMO. The heights of the benchmarks are determined by precise levelling, the positions above using GPS and inside using a precise theodolite. The astronomical orientation was fixed by target boards (in German "Mire").



Topics:

- Determination of the azimuth for the orientation of the magnetometer
- Determination of the azimuths to target boards ("Miren") inside and outside the gallery
- Primary fixing of benchmarks to verify the stability of position und height

Procedure:

Nonmagnetic vertical benchmarks of fillister headed aluminium were used inside the gallery, outside there were stabilized brass benchmarks. The distant objective ("Fernmire" at "Bettelmannkreuz") is made of a 2m metallic rod in a concrete base about 2.4 km north of the gallery.

Heights: The heights were determined using a digital levelling equipment Trimble-DiNi03. The levelling network is linked with the levelling benchmarks of the Seismic-Gravimetric-Observatory (SGO) and with the precise levelling network of the BEV. 52 new benchmarks were stabilized (42 inside, 10 outside). The levelling length of the loop through the gallery and back above is about 1600 m. The loop error amounts 0.15 mm.

Positioning: The global position was done twice at two points by GPS measurements over 24 hours. The network was optimized using the program system PANDA (**P**rogram for **A**djustment of geodetic **N**etworks and **D**eformation **A**nalysis) for simulation. The measurements were carried out using the precise theodolite Trimble S8 with two sets in both circle plains.

Azimuth: The determination of the azimuth will be done by astronomical observation of the Polaris on three benchmarks: southern portal, northern portal and distant objective ("Bettelmannkreuz"). That makes two bidirectionally measured azimuths: Gallery axis => long-term objective and northern portal => long-term objective. These measurements were carried out using the theodolite Kern-DKM2A. Two survey points are still not finished.

Results:

Heights: 52 benchmarks, levelling length ~ 1600 m, loop error 0.15 mm

Survey network:
Points: 33
Observations:
Distances: ~230
Angles: horizontal ~250, vertical ~250
Reached accuracy:
Semi major axis of error ellipse of network points between 0.3 and 0.7 mm

Azimuth southern to northern portal ± 1.3"

This task was a very interesting challenge and enabled us to test the technical feasibility under laboratory conditions.

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