Installation of the supergradiometers vertical sensor by the LSR GmbH

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The purpose of the supergradiometer is to measure changes in 3D space in the Earth's magnetic field via external influences. To do this, a number of external prerequisites need to be fulfilled; on the one hand, no magnetic materials can be introduced, and another requirement is a large spatial spread in all directions. For this purpose, multiple highly sensitive magnetometers from the Canadian producer GEM were positioned in the Conrad Observatory tunnel system. Alongside the horizontally aligned sensors, there should also be a sensor sunk into the 200m deep borehole. This is where LSR GmbH for special technical solutions came into play.

As the localisation of the sensor proved more difficult than anticipated for various reasons, we – the company LSR GmbH from München – were called in. The first obstacle to overcome was the large dead weight of the 27mm thick and 300m long multifunctional special cable. The cable itself was unsuitable for carrying its own weight; therefore we encased it in a liquid-crystal polymer (LCP, Vectran) fibre. Such fibres are exceptionally inert and their tensile elongation is very small. The cable could then be lowered safely using a supporting device while holding its own weight and without stretching.

Figure 1: The sensor electronics, which finally remains in a distance of 7 m above the supergradiometer sensor, is lowered into the bore hole.

A particular challenge was the choice of materials, as all types of magnetic influences had to be avoided. In addition, all materials had to withstand the predominant humidity of 100% in the tunnel, along with being resistant to the acting tensile forces and to avoid a change in position. Otherwise, this would of course have a negative effect on the measurements.

The sinking of the measuring system, consisting of the sensor and its electronics, took place by means of a hoist similar to an electrically operated cable reel constructed especially for this purpose. Mounted on bidirectional movable slides, it was possible to lower the sensor safely over the whole distance into the borehole.
The sensor electronics, containing a measuring amplifier, were built into a special case coupled to the thread. Due to this, the whole structure could be lowered without problems.

Figure 2: The winch system with LCP encased sensor cable shortly before lowering the sensor.

Aside from the technical challenges, we found the cooperation with the researchers. Especially inspiring, they gave us fascinating insights into their research and made it tangible. While we brought basic knowledge of the natural sciences, getting to really know the complexity of their research was a particular experience. The extremely high sensitivity of the installed sensors in the order of “femto-tesla” will probably remain a mystery to most people.

It was therefore an honour for us to be able to work in the services to natural science and to provide a small contribution.

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