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Open seismic hardware: a step towards accessibility in mineral exploration

Arnaud Mercier, Geology and Geological Engineering department, Université Laval

Summary

The depth of mineral exploration targets is increasing and so is the scrutiny of mining operations and their impacts on the environment. In the context of a global transition to clean energy the mineral industry will need to provide means to explore and extract deeply seated mineral resources while respecting the environment. We consider that the best way to increase the efficiency of mining projects is to increase our understanding of deposits through geophysics. Our contribution to these efforts is to introduce affordable and lightweight seismic instruments that can be deployed easily by researchers and explorers in order to stimulate and democratize research in the field of seismic imaging in mineral exploration.

In theory, the ability of VSP surveys to image volumes of Earth around the borehole hole (3D-VSP) should provide information proximal to the borehole that is at a resolution and a scale that cannot be achieved with other geophysical imaging methods. In practice, however, we have found that the development of VSP imaging in mining is struggling because surveys are expensive to carry out and require special expertise.

The VSP instruments currently available fall into two categories. The first is the high-end solution proposed by the oil and gas industry which exceeds all the requirements for mineral exploration. These tools are generally designed for larger diameter oil and gas wells and might not be usable for mining applications. They are also very expensive to deploy which increases the financial risk. The second category is single level tools that are intended to operate at shallow depth and are most often used for zero-offset VSPs.

The guideline for our Open Seismic hardware initiative is to design an open source VSP tool that is modular and can be reused or adapted by other research group for their purposes. This contribution will describe the engineering choices and design criteria used in the design of our borehole seismograph and sensor package. The current VSP tool is designed to operate in boreholes that are NQ or larger. The design uses a standard single conductor winch, commonly found in the mineral industry, to deploy the VSP tool chain and establish the telemetry with the tool.

We expect that this Open Seismic Hardware initiative will underpin many future borehole seismic imaging endeavours and may also help support development in passive seismic monitoring in fields such as geotechnics and engineering where the deployment of traditional VSP tools was prohibitively expensive.