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Complimentary sources of earthquake data – a unique situation

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This project stemmed from the recommendations in Chapter 1 of the South African Presidential Mine Health and Safety Audit in 2008 where it was recommended that the mining seismological data and the national data be integrated.

During phase 1, 25 seismograph stations were installed in and around the Klerksdorp-Orkney-Stilfontein-Hartbeesfontein (KOSH) mining region due to the fact that it had experienced the largest mining related earthquake (magnitude 5.3) in the country in 2005. Now of course the largest mining related earthquake occurred in August 2014 with a magnitude of 5.5, but it occurred yet once again in the KOSH mining region.

This installation of dense stations on the surface within a mining region is a first for the country, if not for the world. The country now has a unique situation where data from an event can be recorded at distances of 500km by the South African National Seismograph Network, at distances of 4km by the KOSH network and at distances of 100m by the mining networks. The data can be used for not only hazard at the stope, but hazard within the region and thus trends can be identified in order to assist in the investigation and mitigation of seismic related accidents.

The earthquake on 5 August 2014, provided an ideal opportunity for collaboration and comparison between the KOSH and mining networks, especially since each network has its own unique challenges such as the capability of the equipment installed within the networks.

The locations of the earthquakes, as well as other spectral parameters, obtained by each network were investigated. Many of the parameters were very similar, such as the estimated Mw magnitudes from both the networks. Similarly, the scalar seismic moments offered by both networks are comparable, but with a tendency to underestimate by the mine network in comparison to the KOSH network. In addition, the radiated seismic energy estimated by both networks follow the same trends, however, in the range varying from 10^3 to 10^{12} J, significant scattering of the estimated energy value is observed.

When considering the corner frequencies offered by both the networks, the observation is that they are significantly different. This could be attributed to the different instrumentation or applied processing. This difference is also observed when summarising the processing of spectral parameters by the networks because it is usually presented as the relationship between the scalar seismic moments versus the corner frequencies.

The spatial patterns of seismicity associated with the aftershocks of the magnitude 5.5 earthquake were compared and both networks reveals a very similar pattern, however, the mine network delineates the fault with a higher accuracy but both networks offer the same distribution on a plan view and with depth intersection.