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Semi-controlled earthquake-generation experiments in South African gold mines (2010)

Hiroshi Ogasawara^{1*}, R Durrheim², M Nakatani³, Y Yabe⁴, A Milev⁵, A Cichowicz⁶, H Kawakata¹, O Murakami¹, M Naoi³, H Moriya⁴, T Satoh⁷, Research Group⁸

¹Ritsmeikan U. (SATREPS), ²Witwatersrand Univ., ³ERI univ. Tokyo, ⁴Tohoku Univ., ⁵CSIR, ⁶Council for GeoScience, ⁷AIST, ⁸SeeSA, SATREPS

We report on the research activity in FY2010 for a 5-year project to monitor in-situ fault instability and strong motion in South African gold mines. The project has two main aims: (1) To learn more about earthquake preparation and generation mechanisms by deploying dense arrays of high-sensitivity sensors within rock volumes where mining is likely to induce significant seismic activity. (2) To upgrade the South African national surface seismic network in the mining districts. This knowledge will contribute to efforts to upgrade schemes of seismic hazard assessment and to limit and mitigate the seismic risks in deep mines.

As of February 2011, 45 boreholes totalling 1.9 km in length had been drilled at project sites at Ezulwini, Moab-Khotsong and Driefontein gold mines. Several dozen more holes are still to be drilled. Acoustic emission sensors, strain- and tiltmeters, and controlled seismic sources are being installed to monitor the deformation of the rock mass, the accumulation of damage during the preparation phase, and changes in dynamic stress as the rupture front propagates. These data will be integrated with measurements of stope closure, stope strong motion, seismic data recorded by the mine-wide network, and stress modelling. Preliminary results will be reported at IUGG meeting.

The project is endorsed by the Japan Science and Technology Agency (JST), Japan International Cooperation Agency (JICA) and the South African government. The contributions of Seismogen CC, OHMS Ltd, AngloGold Ashanti Rock Engineering Applied Research, Gold Fields Seismic Department and the Institute of Mine Seismology are gratefully acknowledged.

Keywords: South African gold mines, Closed distance from hypocenters, Earthquake & AE, Strain & Tilt, Dynamic rupture process, Transmitted electric wave