The Semi-controlled Earthquake-generation Experiment in South African Deep gold mines in 2003

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Since 1992, we have been attempting to monitor the entire life span of an earthquake at the closest proximity of hypocenter in South African gold mine (e.g. Iio 1995; Ogasawara et al. 2002; three more presentations at this meeting). After 2002, 15 Japanese members visited South Africa to directly observe seismic sources underground at five mines (Ogasawara et al. 2002 JSS Fall), and developed three new experimental sites with a help of T. Ward who had experienced Shift Boss, Rescue Captain, and Senior Rock Mechanist (Ogasawara et al. 2002 Joint Meeting; Iio et al., Kawakata et al., Kato et al. 2002 JSS Fall). However, underground visits were not enough to fully understand gold mining underground and associated seismicity. In 2003, 10 members stayed mining district relatively longer to supervise drilling and installation, in situ observe hypocenters and carry out rock experiment. Among them, Ogasawara, Takeuchi and Nakatani stayed longest (4-5 months), who began with clearing Heat Tolerance Screening (30 min steps in hot and humid), taking safety course to have full-time underground access permission. During an 8-month period from April to November 2003, they experienced rock flow and associated seismicity just in front of them underground. We report on our activity at two new sites.

At Tau Tona site 2.9 km deep, two faults (light gray in Figure) intersects thin-tabular gold reef (patterned brown) dipping 20 degree to southeast, throwing up the reef by couples of tens of meters. Stress concentrates around mined area (black) or destress slot (red) to protect service tunnel (yellow), inducing intense seismicity (light blue sphere; M = 1 - 2; from Mar to Aug 2003). We experienced difficult drilling. We planned drilling of 10 - 27 m long (60 - 112 mm diameter) to install 8-component intelligent recoverable Ishii strainmeter newly developed, triaxial seismometer and conventional Ishii strainmeter for continuous, permanent monitoring. On 24 Jun, we installed the recoverable strainmeter because of little core-disking or borehole-breakout at a depth of installation. However, on 18 Jul, we realized not co-axial overcoring, resuming co-axial overcoring. Meanwhile, stress concentrated further and rapidly, resulting in borehole-breakout throughout the hole. Then drilling was frequently stuck with small rock pieces and the life of drilling bit reduced considerably down to 10-20 cm. The roof of the drilling pit descends inelasticity by ten and several cm, accompanied by an M2.1 event at an 80m distance. We have tried hard until November, when we realized again not co-axial overcoring, letting us give it up. Nevertheless, we successfully installed two triaxial strong ground motion meters (SGMM; A and B in figure) and a 3-component Ishii strainmeter (A). We attempted ASR monitoring and DSCA stress measurement. Because of humidity and security problem, we took core up to the surface, but no significant ASR was monitored. As the core was nearly disked, it was not easy to carry out DSCA either.

Mponeng new site 3.1 km deep had little stress concentration because of little progress in mining around. 19 holes were drilled smoothly, delineating complicated 3-D geology within Pretorius fault zone several tens of meters wide by logging cores and holes (Nakatani next talk). Multi-disciplinary monitoring will start with two 3-component strainmeters, three SGMM, two fault displacement meters and precise thermometer array at the site, surrounded by five seismometers 200 m apart each other. Orientated cores good for DSCA were recovered, being tested in the near future.

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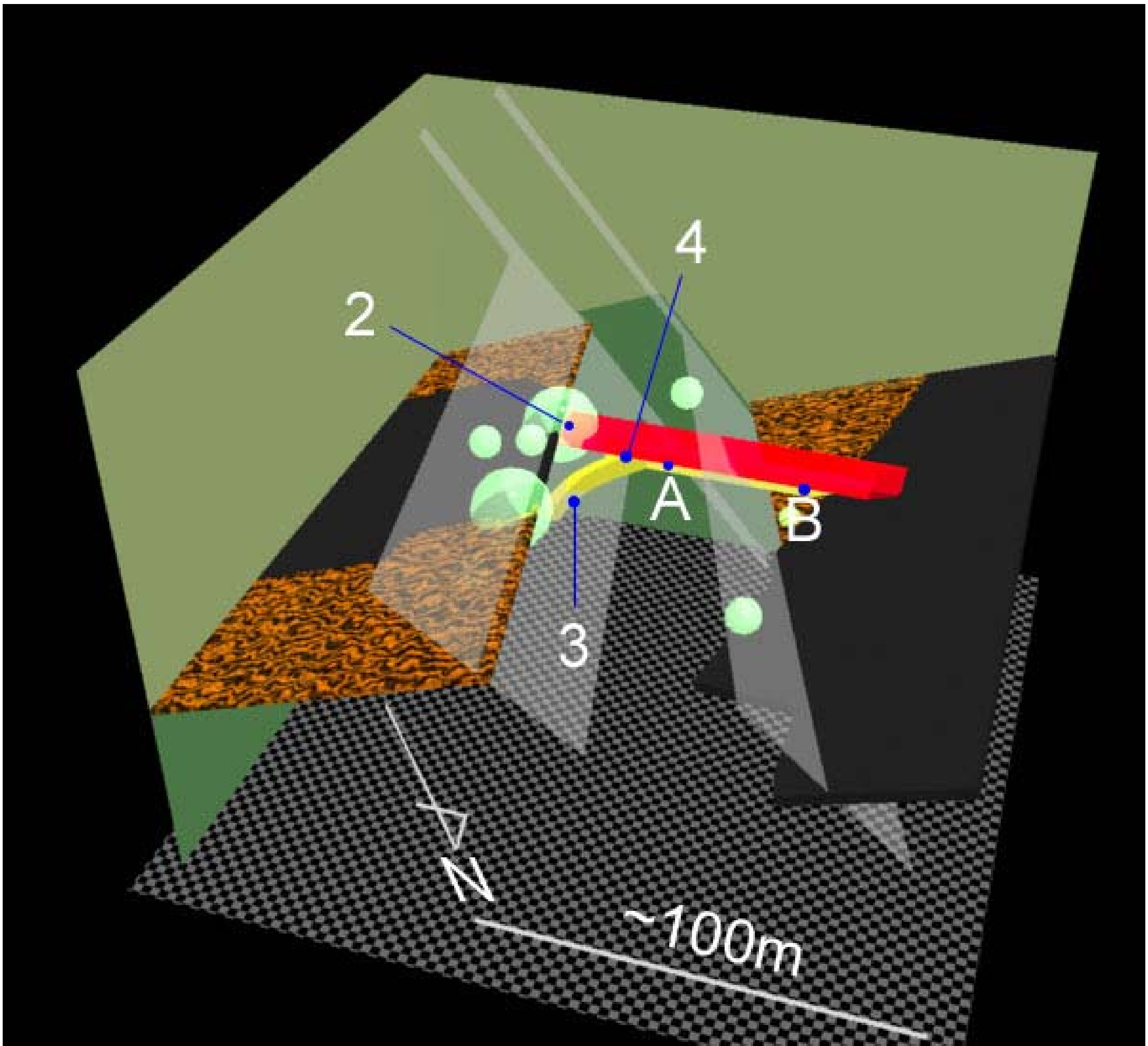

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