

## ICDP Drilling project to probe seismogenic zones of M2.0-5.5 earthquake in deep South African gold mines - Commencement of drilling.

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The International Continental Scientific Drilling Program (ICDP) approved our proposal to drill into and around seismogenic zones where critically-stressed faults initiated ruptures at depth. The drilling targets include four ruptures equivalent to M2.0, 2.8, 3.5, and 5.5 earthquakes that dynamically and quasi-statically evolved in 2.9 Ga hard rock in the Witwatersrand basin, South Africa. A major advantage of our proposed project is the large quantity of high-quality data recorded by existing dense seismic arrays, both on surface and near-field underground, in three deep gold mines. Additionally, the great depths (1.0 to 3.3 km from surface) at which drilling starts reduces costs significantly and allows a larger number of holes to be drilled with the available budget. Flexibility in the drilling direction will also allow us to minimize damage to the borehole or the drilled cores. With ICDP funds, we will conduct full-core drilling of 16 holes at ranges of 50 to 750 m to recover both solid and fractured material in and around the seismogenic zones. This will be followed by core and borehole logging. Additional in-hole monitoring of rock deformation, ground motion, hydrology and geomicrobiology will be supported by co-mingled funds. We will also determine the 3D stress tensor near the collars of the holes using an overcoring technique that has been optimized for the highly-stressed ground and the working conditions found in deep South African mines. The measurement of the differential stress is based on the assumption that anisotropic variation in the diameter of the recovered core is caused by elastic expansion after drilling.

The M5.5 earthquake that took place near Orkney, South Africa on 5 August 2014 offers a special opportunity to compare models of the spatio-temporal evolution of both the main rupture and the aftershock activity determined by the inversion of ground motion measurements with direct observations.

Drilling will commence in early 2017.

Keywords: ICDP, Seismogenic zones, Deep South African gold mines