AOB Seminar

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場　　所: 地震・噴火予知研究観測センター　別館第 1 会議室

講演題目&要旨：

Mechanics of the 2004 M2.2 earthquake along the Pretorius fault, TauTona mine, South Africa (PAGEOP, 2011)

Vincent. Heesakkers[1], Shaun Murphy[2], David Lockner[3] and Ze'ev Reches[1]

Abstract—The 2004, M2.2 earthquake in TauTona mine ruptured the Archean Pretorius fault that has been inactive for at least 2 Ga, and was reactivated by the mining at ~3.6 km depth. The analysis is based on structural mapping, rock mechanics experiments, numerical modeling, and in-situ stress measurements at focal depth. This Archean cataclasite of the Pretorius fault was pervasively sintered and cemented to become brittle and strong, and thus, it was expected that the fault zone will fail similarly to an intact rock body, e.g., by array of tensile fractures. However, the study revealed a few puzzling features of the M2.2 rupture-zone: (1) the earthquake ruptured four, non-parallel, cataclasite bearing segments of the ancient Pretorius fault-zone; (2) slip occurred almost exclusively along the cataclasite-host rock contacts of the slipping segments; and (3) the local in-situ, static stress is not favorable to slip along any of these four segments, and slip could occur only if the friction coefficient was very low, below 0.12. We conducted rock mechanics experiments on the fault-rocks and host-rocks at relevant confining pressure (up to 120 MPa), and found a strong mechanical contrast between the quartzitic cataclasite zones, with elastic-brittle rheology, and the host quartzites, with damage, elastic–plastic rheology. The finite-element modeling of a heterogeneous fault-zone with the measured mechanical contrast indicates that the slip is likely to reactivate the ancient cataclasite bearing segments at the contact between the cataclasite and the host quartzitic rock (as

observed) due to the strong mechanical contrast. We propose that the earthquake slip was facilitated by very intense dynamic weakening as observed in high-velocity friction experiments.

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Slip sequences in laboratory experiments as analogs of earthquakes associated with a fault edge (PAGEOP, 2011)

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Abstract- We explore experimentally how fault edges may affect earthquake and slip dynamics, as faults are intrinsically heterogeneous with common occurrences of jogs, edges and steps. In the presented experiments, shear loads are applied to the edge of one of two flat blocks in frictional contact that form a fault analog. We show that slip occurs via a sequence of rapid rupture events that initiate from the loading edge and are arrested after propagating a finite distance. This event succession extends the slip size, transfers the applied shear across the block, and causes progressively larger changes of the contact area along the contact surface. This sequence of events dynamically forms a hard asperity near the loading edge and largely reduces the contact area beyond. These sequences of rapid events culminate in slow slip events that precede a major, unarrested slip event along the entire contact surface. We show that the 1998 M5.0 Sendai and 1995 Off-Etorofu Earthquake sequences may correspond to this scenario

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