A life of a fault: from birth to death

Yasuhiro YAMADA*, Yusuke OHSHIMA, Toshifumi MATSUOKA
Department of Earth Resources Engineering, Kyoto University, Japan

We performed analogue model experiments to look at a fault from its birth to death. This is to examine the process of strain concentration that initiates a fault (shear zone) in the experimental material, and also to examine the development and terminating process of the fault.

The deformation rig is a simple shortening box (1000 mm long, 300 mm wide, 200 mm deep), commonly used for thrust models, and the material is loosely packed dry sand (ca. 0.2 mm diameter) of 30 mm thickness. Since the fault spacing was almost the same during the preliminary experiments, we targeted the forth thrust from the moving wall to avoid the edge effect. During the shortening (0.2 mm/min), we took digital photography in every 15 sec. The pixel size is approximately 0.005 mm and has enough accuracy to detect any motion of each sand grain. The digital photography was then analyzed with DIC (digital image correlation) technique (Yamada et al, 2010).

The life of the fault can be classified into three stages; initiation stage, development stage, and termination stage. The initiation stage can be characterized by formation of minor short-life shear zones, which generate a broad shear zone as a whole. The width of the shear zone becomes narrow to be a single fault at the end of this stage. The material that forms the shear zone shows dilation in this stage. The development stage can be characterized by fluctuations in the volume and compartmentalization within the shear zone. The fluctuation of the material volume becomes minor in the termination stage and displacement along the fault terminates at the end.

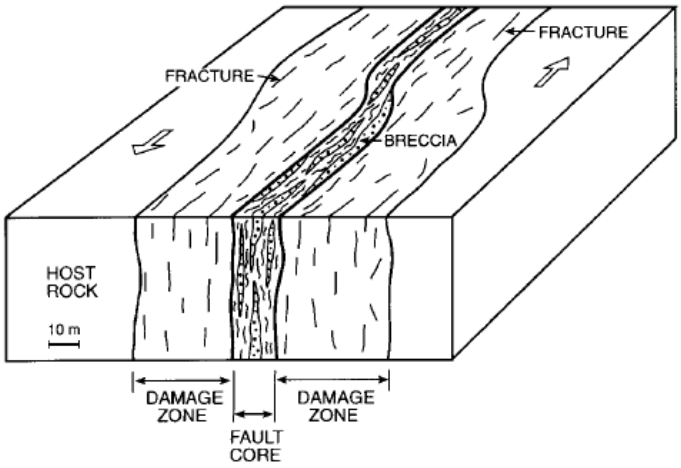
The structure generated by the experiment is a narrow focused fault formed in a broad shear zone. This can be correlated to the structural geometry observed in a shear zone, consisted of a fault core and damage zone (Gudmundsson et al, 2001). By analogy with the experimental results, the damage zone may be generated during the initiation process as a broad shear zone, and the fault core may be formed during the development stage within the damage zone.

References

Gudmundsson, A., Berg, S.S., Lyslo, K.B., Skurtveit, E., 2001. Fracture networks and fluid transport in active fault zones. Journal of Structural Geology 23, p. 343-353.

Yamada, Y., Yamashita, Y., Yamamoto, Y., 2010. Submarine landslides at subduction margins: Insights from physical models. Tectonophysics. 484, p. 156-167. doi:10.1016/j.tecto.2009.09.007.

* Corresponding author: yamada@earth.kumst.kyoto-u.ac.jp



Simplified structure of a shear zone (Gudmundsson, 2001)