

# Slip-rate Estimation of Active Fault by Luminescence Dating on Deformed River Terraces at Tsaotun, Central Taiwan

Ya-Wen Chen

F90224212

2003/11/21

## Abstract

This study carried out optical stimulated luminescence (OSL) ages of the tectonic-disrupted terraces at Tsaotun, where the 1999 earthquake fault (i.e., Chelungpu) runs through. Over there, a number of investigations have been done, but it is still difficult to evaluate the slip-rate and recurrence interval without age control. For the purpose of understanding neotectonic behavior of the Chelungpu fault, the ages of the terraces are imperative to be determined.

Radiocarbon dating is unlikely applied in fluvial coarse deposits due to the syndepositional carbonaceous materials are easy to be decomposed. Alternatively, OSL dating is therefore tried on sandy layers intercalated within massive gravel deposits found at Tsaotun. All the terraces developed at Tsaotun are identified as strath terraces, indicating the depositional age is very close to the surface age that is the best constraint in deriving the long-term slip rate of the related active fault. Three samples are collected and presented. In this study only the fraction of coarse quartz, i.e., 90-150  $\mu\text{m}$ , is sieved out and tested by the Single-Aliquot Regenerative (SAR) dose protocol with 36 aliquots for each. Considering the incomplete bleaching during quick deposition, the OSL/TL and OSL/OSL ratios are applied to normalization in each aliquot and to approach the true  $D_e$ . Dose rate is derived by ICP-MS and XRF analyses. For confirmation of the residual luminescence signals in the fluvial sediment, the modern samples collected in Wuhsi were also measured using the same protocol.

Based on the results of modern samples, we found that the residuals are inevitable in younger samples, especially in the river reach where debris flow is dominant. On the contrary, the samples older than 10 ka will be slightly influenced because the age error covers the residual uncertainty. The OSL age of the terrace samples in the hanging wall is dated ca. 24 ka, which has been corrected for poorly-bleaching problem. Comparing to the ages collected down hole in the footwalls, we found out vertical displacements of ca. 72 m and 43 m, has been cumulated by the slips of main and back thrust. Thus, the long-term slip rates of the main and back thrust are 2.7-3.3 m/ka and 1.8-2.2 m/ka, respectively.

---

陳雅雯 民國 91 年進入台大地質科學系博士班就讀，主要研究興趣在於第四紀沉積環境與螢光定年法。

## References

- Aitken, M. J., 1998. An Introduction to Optical Dating. Academic Press, London, 267p.
- Chen, Y.G., Chen, Y.W., Chen, W.S., Zhang, J.F., Zhao, H., Zhou, L.P. and Li, S.H., 2003 Preliminary results of long-term slip rates of 1999 earthquake fault by luminescence and radiocarbon dating. *Quaternary Science Reviews* 22, 1213-1221.
- Chen, Y.G., Chen, W.S., Wang, Y., Lo, P.W., Lee, J.C. and Liu, T.K., 2002. Geomorphic evidence for prior earthquakes: Lessons from the 1999 Chichi earthquake in central Taiwan. *Geology* 30(2), 171-174.
- Cheng, P.H., Yang, C.H., You, J.I., and Shieh, J.S., 2002. An electric resistivity study of the Chelungpu fault in the Tsaojun area, Central Taiwan. *TAO* 13, 375-386.
- Ho, C.S., 1982. Tectonic evolution of Taiwan. *Ministry of Economic Affairs*, Taipei, Taiwan, R.O.C., 126pp.
- Ho, C.S., 1988. An introduction to the geology of Taiwan: Explanatory text for the geologic map of Taiwan. *Ministry of Economic Affairs*, Taipei, 2nd ed., 164p.
- Jain, M., Murray, A.S., and Bøtter-Jensen, L., 2003. Optically stimulated luminescence dating: How significant is incomplete light exposure in fluvial environments? *Quaternaire* (Submitted)
- Li, S.H., 1994. Optical dating: insufficiently bleached sediments. *Radiation Measurements* 23, 563-567.
- Li, S.H., 2001. Identification of well-bleached grains in the optical dating of quartz. *Quaternary Science Reviews* 20, 1365-1370.
- Murray, A.S. and Wintle, A.G., 2000. Luminescence dating of quartz using an improved single-aliquot regenerative-dose protocol. *Radiation Measurements* 32, 57-73.
- Ota, Y., Huang, C.Y., Yuan, P.B., Sugiyama, Y., Lee, Y., Watanabe, M., Sawa, H., Yanagida, M., Sasaki, S., Suzuki, Y., Hirouchi, D., and Taniguchi, K., 2001. Trenching study at the Tsaojun site in the central part of the Chelungpu fault ,Taiwan. *Western Pacific Earth Sciences* 1, 487-498.
- Prescott, J.R. and Hutton, J.T., 1988. Cosmic ray and gamma ray dosimetry for TL and ESR. *Nuclear Tracks Radiation Measurements* 14, 223-227.
- Roberts, R.G., Galbraith, R.F., Yoshida, H., Laslett, G.M. and Olley, J.M., 2000. Distinguishing dose populations in sediment mixtures: a test of single-grain optical dating procedures using mixtures of laboratory-dosed quartz. *Radiation Measurements* 32, 459-465.
- Stokes, S., Bray, H.E. and Blum, M.D., 2001. Optical resetting in large drainage basins: tests of zeroing assumptions using single-aliquot procedures. *Quaternary Science Reviews* 20, 879-885.