

Quartz optically-stimulated luminescence dating of AD 869 Jogan tsunami deposit

TAMURA, Toru^{1*} ; SAWAI, Yuki¹ ; ITO, Kazumi¹

¹Geological Survey of Japan, AIST

Optically-stimulated luminescence (OSL) dating, as applicable to the sediment grain directly, has a potential to provide an effective way to establish the chronology of tsunami deposits. AD 869 Jogan tsunami is one of the oldest tsunamis recorded in a historical document in Japan. Deposit of the Jogan tsunami thus offers an opportunity to check the reliability of OSL dating to a deposit older than 1,000 years, which may be prehistoric elsewhere. We applied the quartz OSL dating to a sand layer formed by the Jogan tsunami found in a geoslice sample obtained from the Sendai plain, Japan, to compare resultant OSL ages with the depositional age. The sediment succession consists of beach-dune sand, lower peat, the Jogan tsunami deposit, upper peat, pre-2011 paddy soil, and the 2011 tsunami deposit, in ascending order. A standard Single Aliquot Regenerative (SAR) protocol was applied to large aliquots of 180-250 μm fraction of two samples from the beach-dune sand, and four samples from differing levels of the Jogan tsunami deposit to obtain equivalent dose ($D_{e,bulk}$). OSL decay curves are dominated by the medium component, and thus for two samples from the Jogan deposit the fast OSL component was isolated to be used for determining the equivalent dose ($D_{e,fast}$). All samples show unimodal distribution of $D_{e,bulk}$ with relatively low overdispersion 11-22 %, suggesting that sediment grains were well bleached before burial. Using $D_{e,bulk}$, OSL ages of the tsunami deposit was underestimated by 30-40 %, and even the beach-dune sand was dated younger than AD 869. $D_{e,fast}$ in contrast resulted in a robust age estimate with a slight underestimation. Pulsed annealing test shows that the bulk OSL signal is thermally unstable. The medium component OSL, isolated from the bulk signal, is clearly truncated in the natural OSL decay curve compared to regenerated ones, which is considered as the main source of the underestimation. Such unfavourable influence of the medium OSL component has been commonly reported in tectonically active regions, which are also prone to tsunami, and thus should be considered with caution in dating tsunami deposits.

Keywords: tsunami, luminescence dating, Jogan earthquake, tsunami deposit, Sendai Plain, chronology