Tectonic events recorded in the varved sediments of Lake Suigetsu, Fukui, central Japan

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Lake Suigetsu, Fukui prefecture, central Japan, is one of 5 tectonic lakes located in the San’ en triangle (e.g. Okada et al., 2010) partitioned by the Mikata and Hiruga Faults of the Mikata Fault Zone in a north-south direction and the Kumagawa Fault in a west-east direction (Nakata and Imaizumi, 2002; Okada, 2012). Lake Suigetsu preserves annually laminated sediments over the last ca.70 kyr (Nakagawa et al., 2012) with a significant number of event layers (Schlolaut et al., 2014). The sediment is one of the best-dated annually laminated materials in the world (e.g. Staff et al., 2011; Bronk Ramsey et al., 2012). Theoretically, the sediments have the potential to provide one of the most precise and highly resolved records of tectonic events in the world. In this study, we reconstructed a very detailed history of fault movements from changes of sedimentation rate in off-fault records using the new core drilled in 2014 (SG14) and the previously obtained and well-dated core (SG06).

The SG14 core was obtained from a point ~320 m to the east of the SG06 coring site funded by the Fukui Prefecture. The SG14 core is composed of overlapping segments recovered from four nearby boreholes to ensure continuity of the whole archive. We also took high-resolution photographs of the sediment section on the coring site before any oxidation could take place. On the basis of these high-resolution photographs, we recognised more than 300 event layers in the SG14 core and precisely correlated them to their counterparts in the SG06 core. This enabled us to transfer the high-quality SG06 chronology to the SG14 core and compare sedimentation rate changes of both cores in an exceptionally high resolution and precision for the last ca. 50 ka.

The result showed semi-cyclic step changes in the difference of the sedimentation rate at least three times over 50,000 years. That is, the relative sedimentation rate drastically increased at the eastern side of the lake, closest to the fault (SG14), after gradually increasing at the western side near the depositional centre of Lake Suigetsu (SG06). These cyclic step shifts were not synchronous with thick and very characteristic event layers such as turbidites. These findings suggest that: (i) the cyclic step changes in differential sedimentation rate demonstrate direct records of the deformation events due to slips of the Hiruga Fault, and (ii) much thicker turbidites that are seen in the lake’ s sediment (at least not all of them) were not always induced by the near fault’ s movement.

We propose that the following sequence best explains the mechanism responsible for these subtle changes in sedimentation rates: 1. the eastern side of the lake was lifted relatively, due to a reverse-fault slip of the Hiruga Fault; 2. the sedimentation rate increased relatively at the eastern site of SG14 because of sediment focusing nearer the fault; 3. subsequently, the sediment focusing occurred further from the fault; 4. the sedimentation rate gradually increased at the western SG06 coring site located near the lake’ s depocentre; 5. the eastern site (SG14) was relatively lifted by the fault again, and the same sequence repeated for a number of times. These results are consistent with the subsidence events related to the activity of the Mikata Fault Zone estimated in the nearby Lake Mikata, located to the south of Lake Suigetsu (Ishimura et al., 2010). In summary, we have reconstructed a precise and highly resolved record of fault movements. The detailed ages as well as the typical recurrence period will be reported at this conference.

Keywords: Lake Suigetsu, Sedimentation rate, tectonic event, varved sediments

