Methodology of sub-sampling and consolidating soft lacustrine sediment using Al-core channels

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Continental paleoenvironmental changes have been recorded in the lake sediment with very little disturbance for a long time. From the sediment in lake Baikal, Russia, one hundred-thousand years cycle was detected as the dominant gracial-intergracial cycle (Colman et al., 1995). Recently, Prokopenko et al. (2001) confirmed this cycle after a new data with higher spatial resolution of 2cm (temporal resolution of 450 year). The present purpose of this study is to read out environmental changes with higher time resolution less than ten-thousands year cycles, from lacustrine sediments in lake Baikal, Russia and lake Hovsgol, Mongol. In the beginning, we tried to develop the method of sub-sampling from long soft lacustrine sediment cores for analysis with higher-spatial resolution. These sub-samples were checked by X-ray fluorescence analysis through making vertical profiles of elements.

Fig. 1 shows the flow of above procedures from Al core channel preparation to checking the hardened sub-samples. (1).Al-core channel bender and Al-core channels, (2).sub-sampling, (3).hardening of soft sediment sub-samples, (4).elemental distribution maps (2D-XRF images) by Scanning X-ray microscope (SXAM), (5).transformation of these data into 1D-elemental profiles with a image processing program, Lamination Tracer (LT), (6).elemental profiles for checking above procedures.

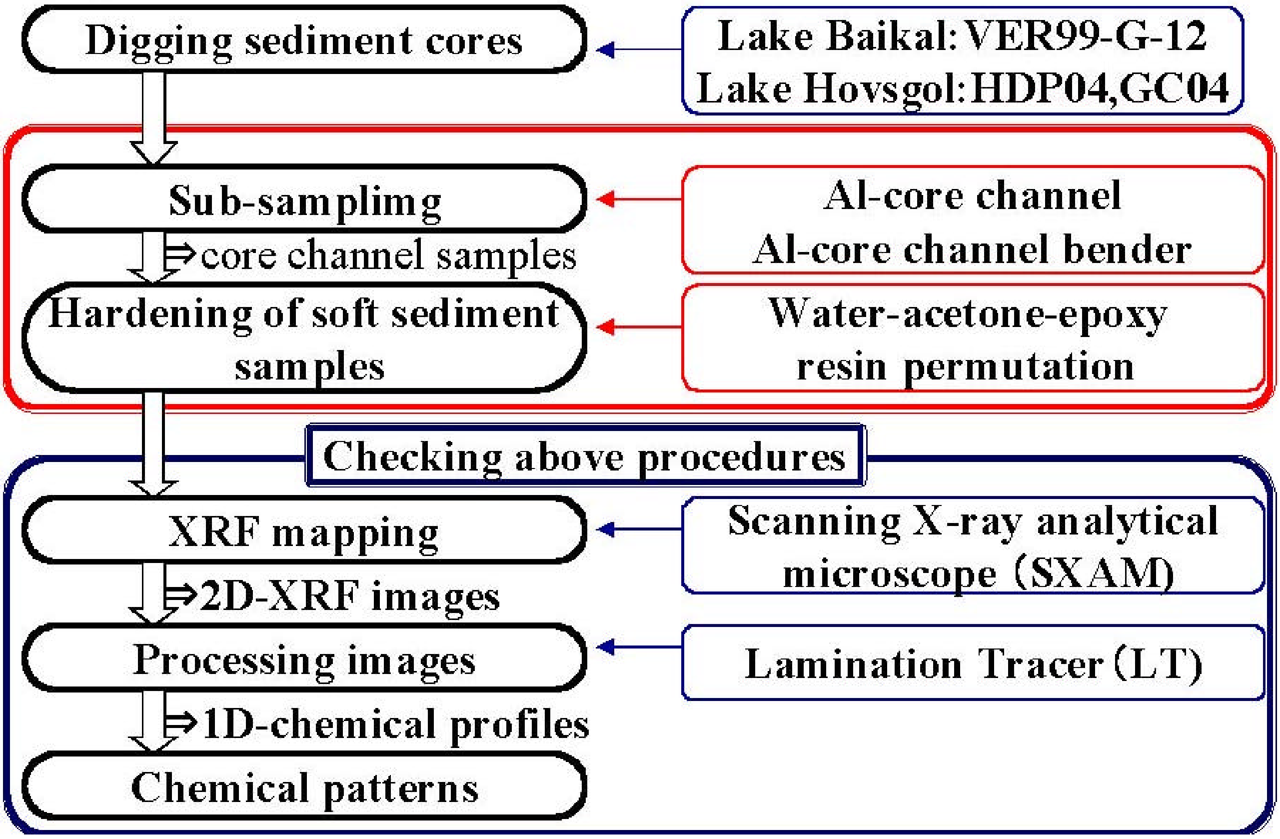
Al-core channel (here, 100mm long, 10mm wide and 8mm high) is essential for continuous sub-sampling of soft sediment cores. Al, as the material of the channel, looked best for the succeeding procedures for the dehydration of sub-samples without destroying the stratified structure. Al-core channels were prepared with small pieces of cut plates and the newly made Al-core channel bender Sub-sampling was done from lake Baikal core, VER99-G-12 (4.7m) and lake Hovsgol cores, HDP04 (4.6m) and GC04 (0.6m).

Core channel samples are hardened following whom (Tiljander et al., 2002) by water-acetone-epoxy resin permutation. In this process, pore water in sediment is, at first, permutated with acetone as a mediator Samples are soaked in acetone for dehydration. After that, epoxy resin is infiltrated into samples replacing acetone under low pressure. Epoxy resin is hardened on the hot plate (60 degrees). In the end, the hardened samples are polished by diamond cutter and diamond rap disk without polishing powder contamination.

XRF mapping images are made with a SXAM. Then, 1D-elemental profiles (0.4mm/pixel) are produced by averaging the XRF intensity along isochronal lines on the XRF images using LT, which much improves S/N ration of the result. Vertical elemental profiles were discussed about VER99-G-12, HDP04, and GC04. As a result, in the each profiles of VER99-G-12 and HDP04, peaks of S and Fe, Mn, and Ti are detected. And in the profiles of GC04, peaks consisted of S and Fe, peaks of Mn are found. The above elemental patterns are all reflected less than 1-2mm chemical concentrations. We confirmed existence of minute minerals in sediment by using the above procedures.

However, long periodical cycles in the elemental profiles in this study can not be discussed because the difference of resin content might bring the fluctuation of the measured XRF intensity. In future, processes to compensate this effect should be developed to get trustworthier high- spatial-resolution profiles. We plan to read out paleoenvironmental changes for about million years with high spatial resolution, which means high time resolution, in the middle of Asian continent.

Figure.1



Digging sediment cores
Lake Baikal: VER99-G-12
Lake Hovsgol: HDP04,GC04
Sub-samplimg
⇒core channel samples
Al-core channel
Al-core channel bender
Hardening of soft sediment samples
Water-acetone-epoxy resin permutation
Checking above procedures
XRF mapping
⇒2D-XRF images
Scanning X-ray analytical microscope (SXAM)
Processing images
Lamination Tracer (LT)
⇒1D-chemical profiles
Chemical patterns