

Snow accumulation changes during last 2,850 years from varved sediments of Lake Mikuri, central Japan

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In summer of 2003, we took 1.9m and 0.7m long varved sediment cores (MKR1 and MKR2) from Lake Mikuri (Mikuriga-ike), one of crater lakes around Tateyama Volcano, central Japan. These sediments are composed mainly of alternating thin beds of light gray clay-sized clastic layer and dark gray silt-sized organic layer including many frustules of diatom with a lot of ice-rafted sand grains and tephra intercalations.

Sedimentological features recognized that dark gray lamina consisting of microplankton and higher plant origin organics and detritus are accumulated in open water season. No detrital materials have flown into lake in winter, light gray fine-grained clastic lamina including frustules of only benthic diatom species has formed with low rate of sedimentation. We could get 2850 couplet of dark-light layers equal to varves by lamina counting. These varve chronology was verified by several time-markers of ^{14}C age and historical documented tephra layer.

Our purpose is to clarify decadal to centurial climatic changes in central Japan during last 2850 years, because we could take varved sediments with no breaks. Also, to clarify age when human impacts occurred and reason why human activity extended to higher mountain area are other purpose in this article.

Proxy of water level changes in crater lake sediments is shown by magnetic susceptibility, because low level caused flowing volcanic and magnetic materials into center of lake from crater wall consisting of lava flow deposits. But there were little inputs of detritus into coring site locating center of lake in high stand of water level.

Low susceptibility values indicate high-stand period of lake-level without oldest period, because pyrite showing non-magnetic mineral precipitated. Also, contents of ice-rafted debris appeared when susceptibility decreased. Ice-rafted grains seem to form that land ice including IRD discharged to lake when snow was melting. Ice-rafted debris contents are controlled by amount of snow accumulation, because floating ice originated land ice accumulating on the slope of crater wall. In fact, we can recognize discharge of land ice every summer. Increasing of susceptibility means snow fall increasing and quick melting of ice.

Last 2850 years changes of susceptibility suggest that recovery of climate started from about 1700 years BP without 1300 years BP and 300-100 years BP. We could recognize Kofun Cold Period, Medieval Warm Period and Little Ice Age, defined by Fukusawa (1995).

As another analysis, we carried out determining of organic carbon and phosphorus flux, indicating eutrophication index by human impacts, in varved sediments of Lake Mikuri. Gradational increasing of organic matter flux have started from 1500 years BP with abrupt increasing spike of 90-45 years BP. According to historical documents, mountain climbing for sight-seeing to Tateyama Volcano became to be very active since 1910's. Increasing of organic matters is possible to reflect human impacts. Also, the sudden rise of mountain climbing since 1500 years BP was supported by gradational warming.

Based on varve thickness and varve counting, we could investigate rate of sedimentation since 265 years BP. Abrupt increasing spikes of accumulation rates are recognized in 1830's, 1880's, 1910's and 1960's. Sedimentation rate of 1760's and 1780's have increased, because IRD were included. Historical documents suggest that epoch-making events of mountain tourism to Tateyama Volcano occurred in 1838 for mountain religion beliefs, 1883 for starting of modern alpinism, 1918 for group climbing of students and 1964 for construction of mountain railway and motorway. Increasing of tourist seems to cause increasing rate of sedimentation. However, low rates since 1978 were results for conservation of nature by local government policy, providing Tateyama field with septic tanks of hotel and mountain trails.