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Holocene East-Asian monsoon variability recorded in varved sediments of Lake Sihailongwan (NE China)

G. Schettler(1), J. Mingram(1) and L. Qiang(2)

(1) GeoForschungsZentrum Potsdam, Germany, (2) Institute of Geology and Geophysics, Chinese Academy of Sciences Beijing, China (schet@gfz-potsdam.de)

Annually laminated sediments recovered from the maar lake Sihailongwan (42˚17'N, 126˚36'E, Quaternary Long Gang volcanic field, Mingram et al. 2004) record regional palaeohydrological change and influx of dust from remote source areas. In Lake SHL, net accumulation of biogenic silica (F-bSiO_2) is positively correlated with inflow of nutrient-rich groundwater. Since groundwater inflow is mainly fed by seepage of summer monsoon rainfall, balanced F-bSiO_2 values document changes in summer monsoon strength (Schettler et al. 2006a,b). Based on varve counting and detailed geochemical and sedimentological analyses, palaeochanges in F-bSiO_2 and in aeolian siliciclastic influx are quantified at decadal scale resolution. Changes in aeolian influx and in dust characteristics are discussed in the context of the derived palaeohydrological reconstruction.

SHL sediments document major millennial scale variability, and minor changes of summer monsoon rainfall at century scale. Groundwater inflow peaked after a Younger Dryas like climatic deterioration. For a nearly 2,000 years period summer monsoon rainfall was above its mean between 8,000 and 2,000 varve yrs BP. Overall drier conditions prevailed between 9,500 and 8,000 varve yrs BP. Between 8,000 and 2,000 varve yrs BP summer monsoon rainfall reached an absolute maximum around 7,900 varve yrs BP and gradually decreased onto minima around 6,400 and 4,900 varve yrs BP. Distinct re-increase in summer monsoon rainfall after 4,500 varve yrs BP was interrupted by a dry interval (4,000 - 3,600 varve yrs BP) followed by a long wet episode lasting until 2,250 varve yrs BP.

During the dry period between 9,500 and 8,000 varve yrs BP dust influx gradually decreased and was characterised by relatively higher silt contents, implying enhanced

dust influx by dry-deposition. Between 8,000 and 2,000 varve yrs BP siliciclastic aeolian influx did not reach its previous level. Mid Holocene sedimentation (7,250 - 4,850 varve yrs BP), characterised by distinct century-scale variability in summer monsoon rainfall, documents a positive correlation between rainfall and dust influx reflecting more efficient removal of mineral aerosols for increased rainfall at an overall high dust concentration over the Asian continent. Aeolian siliciclastic influx remarkably peaked at the beginning and at the end of the dry interval between 4,000 and 3,600 varve yrs BP. Particularly, with re-increase of the summer monsoon strength after 3,600 varve yrs BP, SHL sediments document temporal dust influx of different geochemical provenance.

Balanced flux rates between AD 1790 and AD 1953 document c. 2.6 times higher Al_2O_3 flux and 1.7 times higher F-bSiO_2 than for mean sedimentation between 8,000 and 2,000 varve yrs BP. The proportion of wet deposited clay-sized debris increased in the historic period. In particular, increased influx of clay-sized particles implies that other source regions became important. This interpretation is sustained by changes in the isotope characteristics of SHL sediments. The latter probably reflects human impact in remote areas.

References

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