Distinctly light layers in the Quaternary sediments of the Japan Sea as a possible indicator of millennial-scale variability of East Asian winter monsoon

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We have demonstrated that millennial-scale variability of East Asian summer monsoon (EASM) has been recorded as alternation of dark and light layers in the Quaternary sediments of the Japan Sea, and that it linked with North Atlantic climatic variability through AMOC at least during the last 1.45 Ma with stronger AMOC corresponding to stronger EASM and deposition of marine organic carbon (MOC) rich dark layer. On the other hand, not so much is known about millennial-scale variability of East Asian winter monsoon (EAWM) and its relation with EASM variability.

Here we demonstrate that orbital to suborbital-scale changes in Br concentration (Proxy of MOC) show variations similar to quartz grain size variations of Chinese loess (Sun et al., 2006) since 0.93 Ma with lower MOC peaks corresponding to larger quartz grain sizes suggesting stronger EAWM. Correlation between Br and quartz grain size became less clear between 1.5 and 0.93 Ma, and correlation almost disappeared before 1.5 Ma.

The suborbital (multi-millennial)-scale signals of EAWM in the Japan Sea sediments and Chinese loess tend to coincide with IRD peaks in the North Atlantic (Hodell et al., 2016) especially since 1.8 Ma, suggesting EAWM intensified when North Atlantic was covered by ice bergs and AMOC intensity was significantly reduced.

Centennial to millennial-scale variability of low Br concentration is also observable in the Japan Sea sediments, whereas it is not clear in quartz grain size record of Chinese loess possibly due to slower accumulation rates for Chinese loess. Thus distinctly light (low Br) layers potentially records centennial to millennial-scale variability of EAWM.

Possible mechanism that link EAWM and low Br concentration will be examined based on comparison between Br concentration and IRD record of the Japan Sea sediments.

Keywords: East Asian winter monsoon, millennial-scale variability, Br content, Quaternary

