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Multi-proxy anthropogenic signals revealed from lacustrine records in China

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As the largest developing country, China has experienced dramatic industrialization transformation since 1950s. Well studied lakes located in various geographic units across China contain abundant information of both global impacts and the regional response. Though, rich lacustrine sediments can further provide a detailed record for human-environment interaction history, the systematically studied potential trans-continental comparable Anthropocene reference lacustrine sections are still sparse and sporadic.

Here we report some preliminary results of several markers in lacustrine records signaling the human activities, particularly, the industrialization process in China. Sporadic lacustrine records have shown an increasing trend in heavy metals such as Cu, Pb, and Zn and spheroidal carbonaceous particle (SCP) in eastern China since 1950. Pb isotopes also present dramatic changes at that time, indicating increased industrial activities. Some organic components, such as organic carbon, nitrogen, and phosphorus and the stable isotopes of C and N, demonstrate large changes (e.g. organic components concentration increase) in eastern China, suggesting the impacts from both agricultural and industrial activities. A relatively systematic investigation was carried out on the lacustrine records in China covering the last 150 years. We focused on the variations of black carbon (BC), char, soot, PAHs, and OPAHs, which are mainly from combustion sources. BC and char fluxes varied randomly, for they can be influenced by both local biomass burning and industrial activities. However, the fluxes of PAHs, and OPAHs, and especially of soot, the combustion condensates mainly from atmospheric deposition in lacustrine sediments, presented an overall increasing trend and a sharp increase occurred mainly at $\sim$1950 in eastern China due to the industrialization. A 6-7 times increase in the fluxes of soot over post-1950 in Huguangyan Maar Lake and Chaohu Lake in eastern China has also been identified, which correlate well with the historical variations of black carbon emission inventory in China. From eastern to western China, the timing of the quick increase in soot fluxes shifts from the 1950s to the late 1970s and 1980s, which is mainly associated with the timing changes of the industrial activities in different regions of China. The results suggest that in spite of some consistent change patterns of widespread airborne contaminants such as soot across China, local hydrologic, land use changes, and other human activities within the catchment cannot be ignored.

Multi-proxy reconstructions will be essential for disentangling natural and anthropogenic signals in lacustrine sediments. With further intercomparable proxy, particularly, those widespread airborne signals, such as and BC, soot, PAHs, OPAHs and radiogenic fallout such as 129I, as well as profiles of excess 210Pb,137Cs combined with varve counting which will allow reliable precise chronology to be established, potential Anthropocene GSSP candidate can unprecedentedly be lacustrine. Among all these lacustrine records, Maar Lake sediments with its unique advantages of annual varve deposition containing atmospheric deposition, make it an ideal Anthropocene GSSP candidate.