Anthropogenic lithium in river and tap water

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The use of lithium (Li) has dramatically increased during the last two decades due to the proliferation of mobile electronic devices and the diversification of electric-powered vehicles. Lithium is also prescribed as a medication against bipolar disorder. While Li can exert a toxic effect on living organisms, few studies have investigated the impact of anthropogenic inputs on Li levels in the environment. Here we report Li concentrations and Li isotope compositions of river, waste and tap water, and industrial products from the metropolitan city of Seoul. Results show that the large increase in population density in Seoul is accompanied by a large enrichment in aqueous Li. Lithium isotopes evidence a major release from Li-rich materials. Water treatment protocols are also shown to be inefficient for Li. Our study therefore highlights the need for a global Li survey and adequate solutions for minimizing their impact on ecosystems and city dwellers.

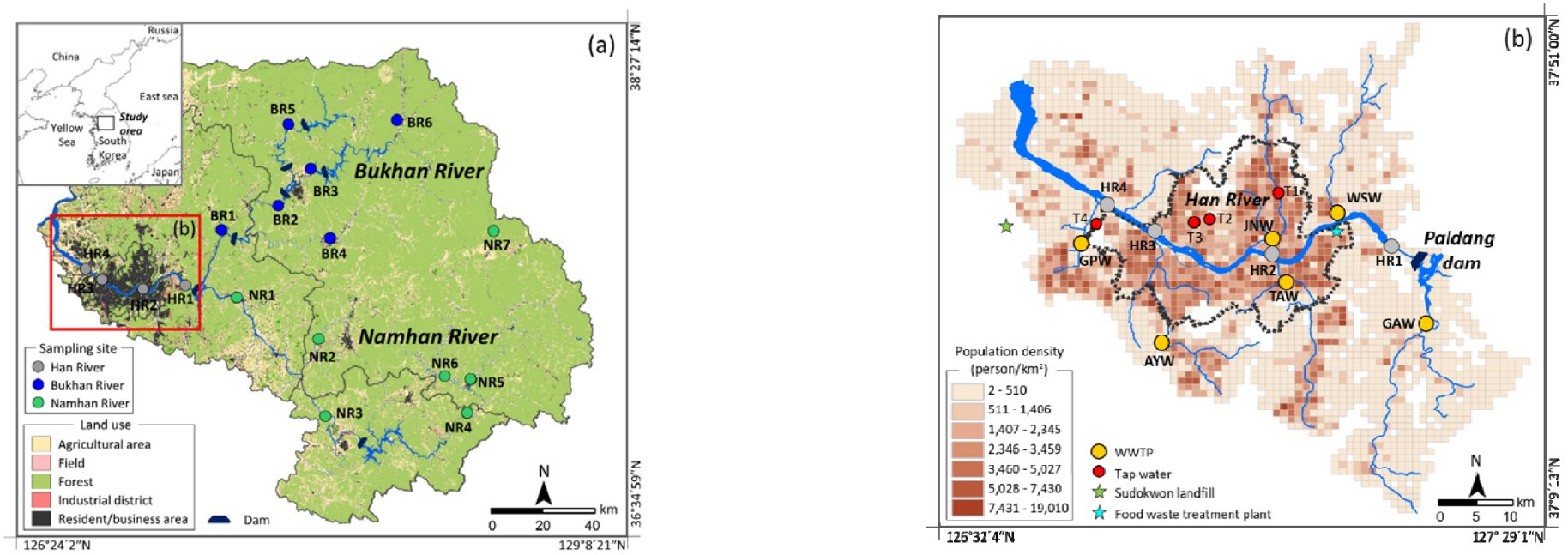

Figure 1. Map of the study area. Study area showing land use and population density (A) and sampling sites (B). Gyeongan (GAW), Wangsuk (WSW), Tan (TAW), Jungnang (JNW), Anyang (AYW), and Gulpo (GPW) display the location and name of wastewater treatment plants at which the wastewater was collected. Note that the HR4 site is located at ~30 km distance from the coastline.

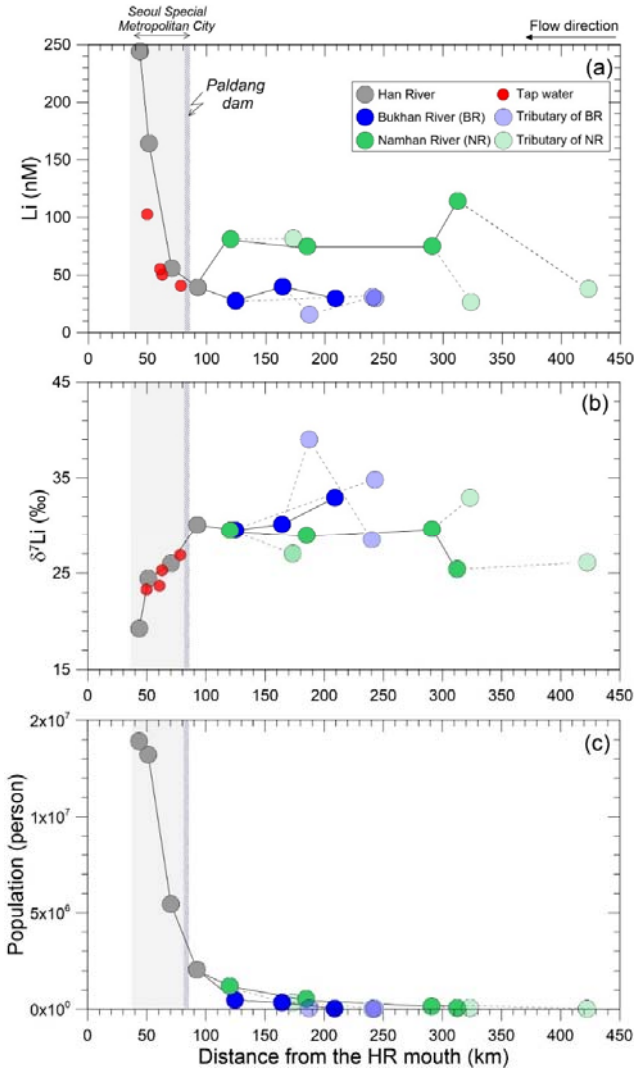

Figure 2. Relationship between Li concentration, Li isotope composition and population. Spatial variation in Li concentration (A) and Li isotope composition (B) measured in sampled river water and tap water as a function of the distance from the Han River mouth. Variation of population living in the HR basin (C) as a function of the distance from the Han River mouth. Half-transparent circles represent the tributary of each river.

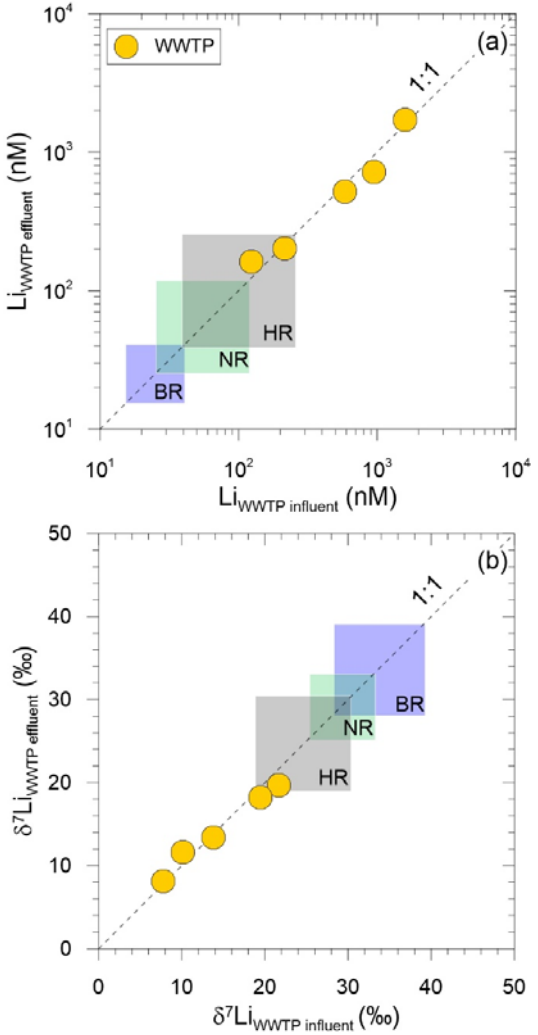

Figure 3. Relationship between Li concentration and Li isotope composition in wastewaters. Li concentrations (A) and Li isotope compositions (B) of wastewater flowing in (influent) and flowing out (effluent) of wastewater treatment plants (WWTP, yellow circles). For comparison, the range of values obtained for the Han River and tributaries are also given (in squares).

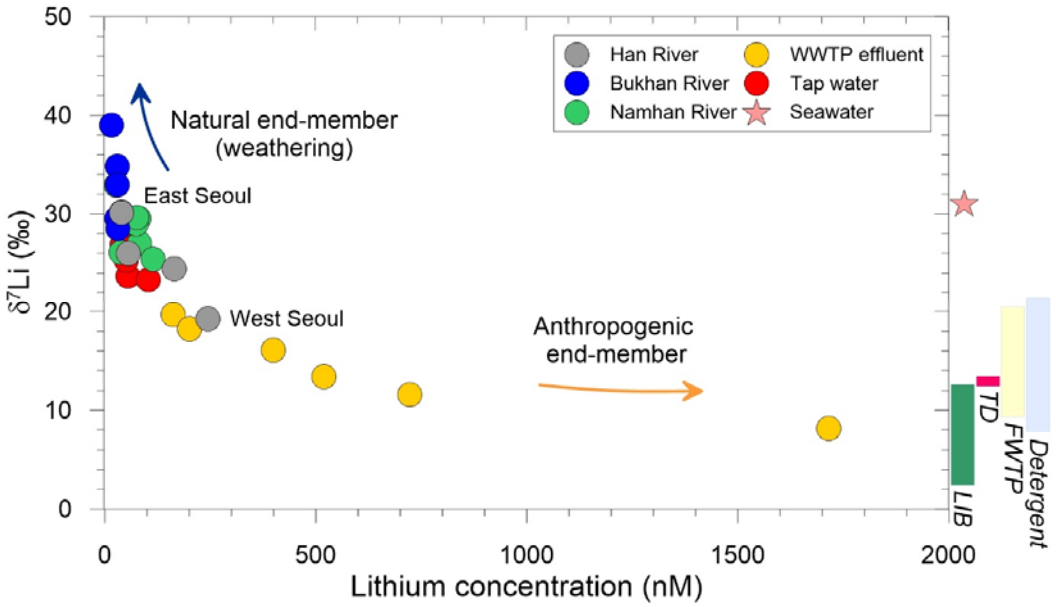

Figure 4. Li concentrations versus Li isotope compositions for samples analyzed in this study. Wastewater (yellow) plots towards a Li-rich anthropogenic end-member, while the Han River tributaries (BR in blue and NR in green), sampled upstream of the basin, plot towards a natural end-member, consistent with fractionating mechanisms during water-rock interactions (soil/rock weathering). The Han River crossing Seoul from east to west (in grey) evolves progressively towards the anthropogenic end-member represented by wastewaters and by the various Li-rich materials. LIB, TD and FWTP represent secondary Li-ion battery (LB), therapeutic drug (TD) and food waste treatment plant (FWTP), respectively. Tap water (in red) follows the same trend and is consistent with the HR water from which it is sourced.