Research brief
A summary of the paper "Natural archives of long-range transported contamination at the remote lake Letšeng-la Letsie, Maloti Mountains, Lesotho"

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Lake sediments and wetland peats provide valuable archives of changes in anthropogenic inputs into natural ecosystems. Sediments of remote mountain lakes are particularly useful because contaminants in these settings are solely derived from atmospheric deposition. This study presents the first historical record of contamination for Lesotho, a hydrologically important region in southern Africa, exporting about 35% of the water used in the Gauteng/Mpumalanga urban-industrial complex in South Africa.

Lake sediment and wetland cores were collected from Letšeng-la Letsie, a remote mountain lake in the Maloti Mountains of Lesotho, impounded in 1968. The lake and wetland cores provide records extending back 85 ± 16 and 119 ± 23 years respectively. These were analysed for atmospheric contaminants, including trace metals and metalloids (Hg, Pb, Cu, Ni, Zn, As), spheroidal carbonaceous fly-ash particles (SCPs), stable nitrogen isotopes and organic pollutants including polycyclic aromatic hydrocarbons (PAHs) and persistent organic pollutants (POPs).

Contaminant levels were found to be low (Figure 1). Most trace metal and organic contaminant concentrations were below the consensus threshold effect concentration for effects on sediment-dwelling organisms. SCP fluxes were similar to fluxes in remote mountain lakes of Europe and North America. Peak Hg concentrations in Letšeng-la Letsie sediments were equivalent to those reported from remote lakes on the Tibetan Plateau and lower than Hg concentrations in lake sediments in the Rwenzori Mountains in Uganda, the Rocky Mountains in the United States and in central Alaska.

There were increasing trends in mercury, fly-ash particles, high molecular weight PAHs and total PCBs levels since the 1970s (Figure 1). The contaminants showing some recent enrichment

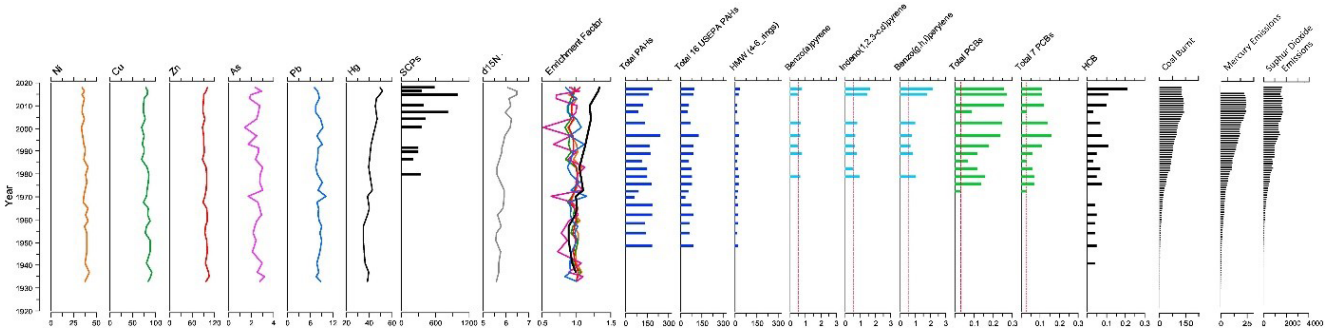

***Figure 1**: Trace metal, SCP and $\delta^{15}N$ concentrations, trace metal enrichment factors, total PAHs, total 16 USEPA PAHs, total high molecular weight (HMW) PAHs, selected individual HMW PAH concentrations, total PCBs, total PCB7 concentrations, and total HCBs for the lake sediment cores for Letšeng-la Letsie. Trace metal concentrations are μg g^{-1} except for Hg which is in ng g^{-1}. SCP concentrations are 'per g dry mass of sediment' (g DM^{-1}). $\delta^{15}N$ concentrations are per mil (‰). PAH, PCB and HCB concentrations are in ng g^{-1}. Vertical red dotted lines are analytical limits of detection. Adapted from Rose et al. (2020).*

are likely derived from long-range transport of products of coal combustion for power generation and other industrial processes on the South African Highveld. Back trajectory analysis showed that long-range transport to southern Lesotho from the industrialised Highveld occurs in association with anticyclonic conditions, evidence of which was also found by Piketh et al. (2002) at Ben Macdhui in the Eastern Cape. Transport from industrialised regions is infrequent, accounting for the low contaminant levels.

This evidence of atmospheric deposition of contaminants from sources over 400 km away in a remote mountain ecosystem suggests that further research is required into transport pathways and fate of Highveld pollutants, and the potential impacts on Afromontane systems.

References

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