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Noble gases as tracers for groundwater input in to a large high-altitude Lake – Nam Co Tibet

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Nam Co (30°42′ N, 90°33′ E; 4712 m a.s.l.) is one of the biggest high-altitude, slightly saline lakes on Earth and comprises a deep central basin (max. depth ~100 m) and a shallower eastern basin (max. depth ~59 m). Previous studies indicate the lake is strongly influenced by groundwater–lake interactions. Recent assessments of water balance suggests lacustrine groundwater discharge may contribute up to ~25% of the lake's annual water input [1].

Terrestrial groundwater is commonly supersatured in atmospheric gases (e.g., excess air), whereas surface waters are generally found to remain close to atmospheric equilibrium [2]. Contrary to this expectation, noble gas analyses from the central basin of Nam Co reveal a pronounced excess air signal at 50 m water depth, with ΔNe oversaturation reaching up to 30%. Moreover, water at this depth exhibits a detectable ^{3}H-^{3}He age, i.e. the residence time since the water last equilibrated with the atmosphere, while in shallower and deeper regions no tritiogenic ^{3}He can be measured. The feature of a maximum ^{3}H-^{3}He age in the middle of the water column is remarkable for a lake subject to strong seasonal mixing.

These combined noble gas and tritium results provide direct evidence for (possible) groundwater discharge into Nam Co**.** We attribute this signal to inflow of permafrost-derived groundwater into the eastern basin, followed by lateral redistribution toward the central basin via horizontal, density-driven currents. This finding demonstrates an active subsurface hydrological connection between permafrost aquifers and the interior of Nam Co, with implications for water column stratification and the solute budget of its water mass.

[1] Ren, W., et al. (2025), *Journal of Hydrology*, *662*, 133956.

[2] Brennwald, M. S., et al. (2013), Springer Berlin Heidelberg.