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# Examination of Global River Systems Using Stable Isotope Methods

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Stable isotopes ($\delta^2$H and $\delta^{18}$O) have been used for many years to understand how precipitation is transformed into flow in rivers. However, because of a lack of an integrated data set, there has not been a global assessment of stable isotopes in river systems. The IAEA has recently compiled river stable isotope data from around the world in its Global Network of Isotopes in Rivers (GNIR), which now makes an initial global comparison of river isotope data feasible. GNIR contains over 17,500 records of stable isotopes and tritium from rivers on every continent except Antarctica. Data from about 550 river sampling stations are included. Rivers from the southern hemisphere are not as well represented as the northern hemisphere. However, many of the key rivers in Africa, Australia, and South America are included. Preliminary review of the GNIR stable isotope data shows a clear latitude effect where rivers over about 30ºN tend toward more negative $\delta^{18}$O values than other latitudes. The average river water from GNIR has $\delta^{18}$O and $\delta^2$H values of -8.8 ‰ and -68 ‰ respectively. This average plots near the global meteoric water line indicating the tight linkage between river waters and precipitation. Minimum and maximum $\delta^{18}$O values are -34.0 ‰ from the Tuul River, Mongolia and 7.2 ‰ from the Vaal River, South Africa. Minimum and maximum $\delta^2$H values are -264 ‰ from the Tuul River, Mongolia and 15 ‰ from the Bani River, Mali. The wide range of stable isotope values reflects the large variation in global climate conditions. We are currently examining river isotope distributions to understand a given river's relationship to precipitation inputs and/or degree of processing within the basin (e.g., evaporation or mixing). Ratios of average monthly $\delta^{18}$O/average yearly $\delta^{18}$O values from selected rivers in GNIR such as the Euphrates, Danube, Parana, Red, and Ticino, have revealed key features related to seasonality and changes in flow conditions along a river's course, such as the effects of dams and reservoirs. This kind of normalization can be used to better understand how to efficiently monitor river systems for land use or climate change impacts, and facilitates comparison of multiple river systems.