

USING WATER CHEMISTRY TO EVALUATE THE SOURCE OF WATER TO WETLANDS AND SEEPS

HydroFocus, Inc. has successfully utilized the naturally occurring variations in the oxygen and hydrogen composition of water to differentiate water sources in seeps, wetlands, ponds and groundwater.

Stable Isotopes in Water

Hydrogen and oxygen isotopes occur naturally and combine to form water molecules. Standard laboratory procedures are employed to quantify the isotopes of hydrogen (deuterium) and oxygen (O-18) in water samples. These isotopes are not radioactive, and are therefore called “stable isotopes”. Deuterium and O-18 have heavier atomic masses than the predominant and lighter hydrogen and oxygen molecules, and are therefore called “heavy isotopes”.

The temperature, altitude, and distance from the ocean affect the isotopic composition of precipitation. As storm clouds move inland from the ocean, the heavier isotopes (deuterium and O-18) condense preferentially leaving less of the heavy isotopes in the clouds that travel across the state (Figure 1). Precipitation that occurs further inland and at higher elevations has a lower relative amount of the heavier isotopes than does the precipitation that occurs near the ocean.

Isotope data is reported using delta notation (δ) and is expressed in a deuterium and O-18 diagram (Figure 2). The isotopic composition of water is reported as negative numbers relative to a standard (Standard Mean Ocean Water).

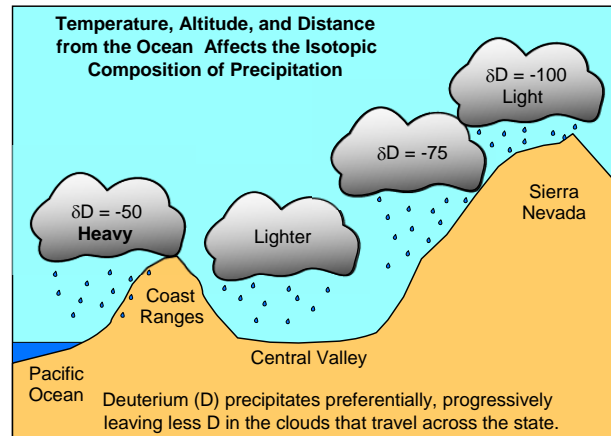


Figure 1.

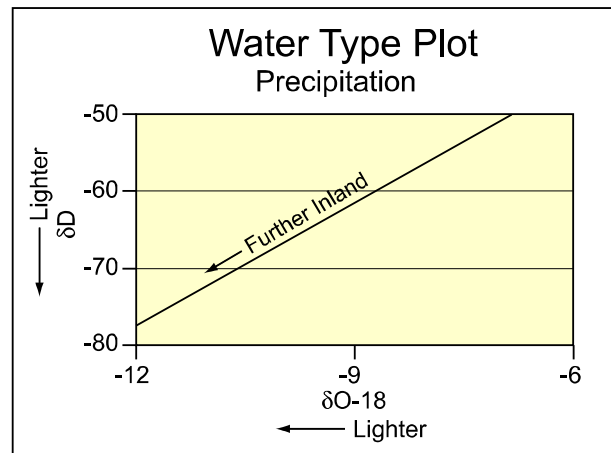


Figure 2.

The isotopic composition of precipitation becomes lighter (delta values become more negative) as the clouds move inland and the quantity of deuterium and O-18 declines. Laboratory results from water samples that have a light isotopic composition plot closer to the origin than results from water samples that have a heavy isotopic composition. On several projects where there is uncertainty about sources of water, HydroFocus, Inc. has utilized the isotopic signature in water samples collected in seeps, wetlands and

ponds to differentiate local precipitation from water imported to an area.

Case Study – Nevada Irrigation District

The Nevada Irrigation District provides water to parts of Nevada and Placer counties near the cities of Grass Valley, Auburn, and Lincoln. This water is imported to delivery areas from higher elevations in the Sierra Nevada through a series of canals and pipelines. Occasionally, seeps form the canals occur that may cause canal failure and disrupt services. The District needs to identify the source of these seeps so they can take appropriate corrective measures to maintain canal integrity. Also, leaks from canals and other surface water features receiving canal water can result in the formation of wetlands.

Water in the seeps and wetlands may come from canal leakage or shallow groundwater flow. HydroFocus, Inc. utilized stable isotopes to determine the source of water in seeps and wetlands along a length of Nevada Irrigation District’s open canal. To do this, we collected water samples from the seeps and wetlands, the canal, and small nearby streams. Water samples from the streams represented local recharge. We then analyzed the isotopic composition of the samples and determined that the imported water in the canal was significantly different from nearby stream water samples. Groundwater is recharged from local precipitation, and has an isotopic composition that is similar to nearby stream water.

An isotope diagram (Figure 3) shows that the seepage samples plot between the stream water and imported water samples. This indicates that the seepage samples were a mixture of both local and imported water. The amount of local water in the seepage is proportional to the distance from

the points representing local water samples on the isotope diagram.

Using the information shown on the isotope diagram, we determined that 67% to 88% of the seepage was local water. Therefore, most of the water seeping from beneath the canal was locally derived groundwater that originated upslope of the canal. The District then routed groundwater flow away from the impacted canal section to reduce seepage and stabilize the canal. HydroFocus, Inc. has applied this technique to several seeps and wetlands in the Nevada Irrigation District service area and in other areas of California.

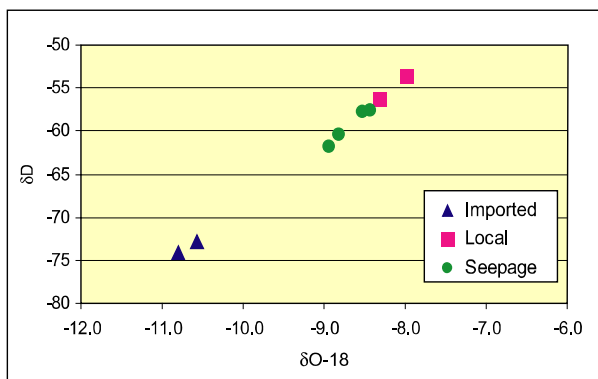


Figure 3.

Summary

Stable isotopes are utilized to differentiate local and imported water sources. HydroFocus, Inc. employs the technique to identify water sources and their relative contribution to wetlands seeps, leaks, ponds, and groundwater. The resulting information helps water purveyors more effectively manage and maintain their operations.

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