USING WATER CHEMISTRY TO EVALUATE WATER SOURCE

HydroFocus, Inc. utilizes the naturally occurring variations in the oxygen and hydrogen composition of water to differentiate water sources. These different chemical forms (isotopes) can help differentiate local precipitation from imported water. HydroFocus, Inc. has utilized the isotopic differences to identify the relative proportions of local and imported water in seeps, leaks, 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 are heavier than the predominant and lighter hydrogen and oxygen molecules in water, 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 towards the Sierra Nevada, the heavier isotopes (deuterium and O-18) condense and fall as precipitation 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).

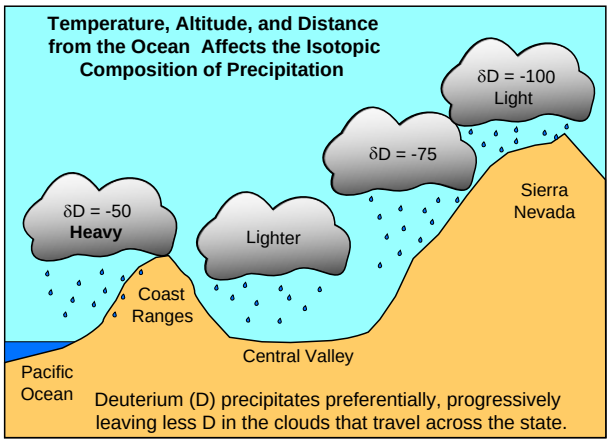

Figure 1.

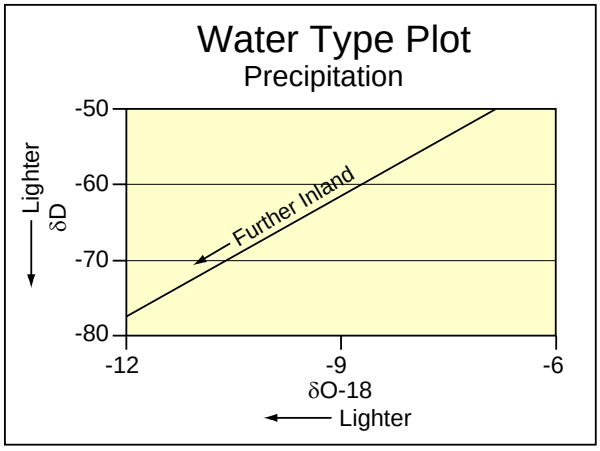

Figure 2.

The isotopic composition of precipitation becomes more negative (lighter) 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. HydroFocus, Inc. utilizes these isotopic signatures to differentiate local precipitation from imported water that precipitated further inland and at higher elevations. The isotopic composition is used

to estimate the percentage of local and imported precipitation in a water sample.

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 from higher elevations in the Sierra Nevada to the service area through a series of canals and pipelines. Occasionally, seeps form along the canals 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.

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

An isotope diagram (Figure 3) shows that the seep 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 proportion of local water in the seepage is proportional to the distance from the local water samples on the isotope diagram.

Using the information 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 in the Nevada Irrigation District service area and in other areas in California.

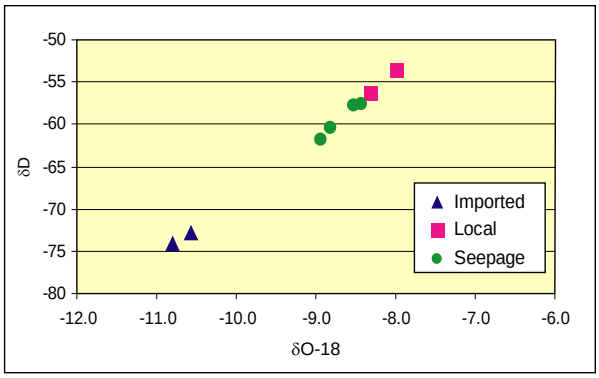

Figure 3.

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 seeps, leaks, ponds, and groundwater. The resulting information helps water purveyors more effectively manage and maintain their operations.

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