Generating false negatives and false positives for As and Mo concentrations in groundwater due to well installation

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Understanding the source, transport and fate (i.e., cycling) of potential contaminants in groundwater systems relies on the acquisition of ‘representative’ groundwater samples, which should reflect the ambient water quality at a given location. However, installation of a well for sample acquisition has the potential to perturb groundwater conditions to a point that may prove to be detrimental to the monitoring objective. Following installation of 20 monitoring wells in close geographic proximity in central Florida, opposing concentration trends for As and Mo were observed. In the first year after well installation As and Mo concentrations increased in some wells by a factor of 2, while in others As and Mo concentrations decreased by a factor of up to 100. Given this relatively short period of time, a natural change in groundwater composition of such magnitude is not expected, leaving well installation itself as the likely cause for the observed concentration changes. Hence, initial concentrations were identified as ‘false negatives’ if concentrations increased with time or as ‘false positives’ if concentrations decreased. False negatives were observed if concentrations were already high, i.e., the As or Mo were present at the time of drilling. False positives were observed if concentrations were relatively lower, i.e., As or Mo were present at low concentrations of approximately 1 to 2 µg/L before drilling, but then released from the aquifer matrix due to drilling. Generally, As and Mo were present in the aquifer matrix in either pyrite or organic matter. Thus, introduction of an oxidant into an anoxic aquifer through use of an oxygen saturated drilling fluid served as the conceptual model for decreasing concentrations, while mixing between drilling fluid and groundwater (i.e., dilution) was used for increasing trends. Conceptual models were successfully tested through formulation and application of data-driven reactive transport models, using the USGS code MODFLOW in conjunction with the reactive multicomponent transport code PHT3D.