FATE AND WATER IMPACTS OF PRODUCED WATER OPERATIONS AT OSPER SITES, OSAGE COUNTY, OK: MAJOR UNRESOLVED ISSUES

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For the last five years and as part of a multidisciplinary group of about 20 scientists, we have been investigating the transport, fate, natural attenuation and ecosystem impacts of inorganic and organic compounds in releases of produced water and associated hydrocarbons at the Osage-Skiatook Petroleum Environmental Research (OSPER) sites, located in NE Oklahoma. Approximately 1.0 ha of land at both OSPER "A" (inactive lease) and "B" (active lease) sites, are visibly affected by salt scarring, tree kills, soil salinization, and brine and petroleum contamination. Geochemical data collected from nearby oil wells show that the produced water source is a Na-Ca-Cl brine (~150,000 mg/L total dissolved solids), with relatively high concentrations of Mg, Sr, and NH4, but low SO4 and H2S. Groundwater and surface water impacts are being investigated using a variety of methodologies, including detailed chemical and isotope analyses of water from repeated sampling of close to 100 boreholes, 1–71 m deep. Results show plumes of high salinity water (2,000-30,000 mg/L TDS) in both sites that intersects Skiatook Lake and extends beyond the visibly impacted areas. No significant amount of liquid petroleum was observed in these plumes, but organic acid anions, BTEX and other VOCs are present.

There are several major issues that are still not satisfactorily resolved. These include:

1) What are the distinguishing chemical and isotopic markers of uncontaminated local groundwater?
2) What are the water-mineral-bacterial interactions that lead to very high sulfate (>5,000 mg/L) concentrations in contaminated groundwater?
3) How much salt is removed by surface runoff and other natural processes?
4) How does the brine flow through relatively thick (3-6 m) shale and siltstone beds?