Conceptual Model Development, Remediation, and Reactive Transport Modeling at Hanford: The U.S. DOE's Largest Legacy Waste Site

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The Hanford site, which lies along the Columbia River in south-central Washington state, is the U.S. Department of Energy's largest legacy waste management site. The waste materials were derived from the reprocessing and extraction of Pu from irradiated U-fuels from 1940-1980. Hanford is located in a semiarid area, and has a variable thickness vadose zone (5-75 m) that overlies an unconfined aquifer that discharges to the Columbia River. Copious amounts of radioactive and chemical contaminants of highly variable mobility (e.g., ^{3}H, ^{129}I, ^{99}Tc, ^{60}Co, ^{90}Sr, ^{137}Cs, $^{234,235,236,238}U$, $^{239,240}Pu$, Cr) have been released to Hanford's vadose zone through intentional discharges of low concentration wastewaters to countless cribs, retention basins, and trenches; and accidental releases of concentrated high level wastes from massive underground storage tanks. Numerous vadose zone and groundwater plumes of different type and character exist. Some of these discharge directly to the Columbia River or threaten to do so in the future.

The site is currently undergoing one of the largest environmental remediation campaigns ever attempted. The scientific, engineering, and logistical challenges are enormous and complex. Remedial decisions are being based, in part, on projections of future in-ground behavior (e.g., reactive transport calculations) using models of different types and sophistication. In this presentation we will show examples of some of Hanford's more challenging and scientifically vexing environmental problems, and discuss conceptual geochemical and hydrologic models being developed to drive improved reactive transport calculations. The varied uses of reactive transport models will be identified as well as their data and information needs. Unavoidable uncertainties will be discussed that limit their more widespread use and acceptance. Recommendations will be provided on how to best integrate scientifically credible reactive transport modeling into remedial decisions at the complicated Hanford site.