SUBSURFACE DISTRIBUTION OF PRODUCED-WATER SALTS AT U.S. GEOLOGICAL SURVEY OSPER SITE "B", OSAGE COUNTY, OKLAHOMA"

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Oil production at the U. S. Geological Survey (USGS) Osage-Skiatook petroleum environmental research site "B" in Osage County, Oklahoma has been continuous since 1937. Three salt scars are present at the surface, extending from their respective upslope pit and/or tank battery produced-water sources down to the edge of Skiatook Lake, a recreational, flood-control, and water-supply reservoir filled in the mid- to late-1980s. Since early 2001, 39 holes ranging in depth from 2 to 51 feet have been drilled as part of USGS site investigations.

Site B sits on the toe of a hill and on terraces formed by two flanking small streams. Surficial sediments on the hillslope consist primarily of several inches of colluvium comprised of mixed sand, weathered shale, and small sandstone blocks. The terraces are capped by a thin layer of eolian sand overlying as much as 7 feet of intertonguing clayey to sandy colluvium and sandy to cobbly alluvium. Underlying the surficial sediments is bedrock consisting primarily of dark gray to black marine shale with minor siltstone and thin (1-3 inches) jointed or fractured sandstone layers. Two sandstone beds (1.1 and 2.7 feet thick) are present on the hillslope near the main tank battery. The section dips 1–2 degrees westward and the shale is weathered grayish orange to olive gray in the upper 7–16 feet with deepest weathering on the hillslopes.

Adjacent to and downslope from the three pit and tank battery sources, the surface eolian sand layer is largely eroded and the colluvium and alluvium are variably contaminated with produced water salts. Salt contamination of the colluvium and alluvium extends well beyond the visible surface scars, underlies areas where vegetation persists at the surface, and extends into sediments below the lake. Below the onshore surficial sediments, the shale and minor interbedded sandstone are also saline to depths as much as 16 feet, with greatest salt penetration on the hillslope portions of the site. Pervasive contamination with salt does not presently exceed the depth of weathering; however, several deeper holes encountered thin sandstones containing highly saline water apparently derived from produced-water sources at the site. Such waters might infiltrate these deep, thin sandstones via fractures that penetrate the shale bedrock.

Observations at Site B indicate that, at sites where produced-water releases have taken place over long periods of time, even relatively impermeable shale bedrock can become significantly affected by salt contamination.