

# QUATERNARY PERMAFROST-FLUVIAL AND LACUSTRINE SEDIMENTS DEPOSITED DURING GLACIAL INTERVALS IN THE WATER SINKS DEPRESSION, A PROMINENT KARST SINKHOLE IN SILURIAN-DEVONIAN LIMESTONE, HIGHLAND COUNTY, VIRGINIA

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## Abstract

In Highland County, Virginia, karst sinkholes filled with mud, sand, and gravel are common in the Silurian Tonoloway Limestone and overlying Silurian-Devonian Helderberg Group. One such sinkhole is the Water Sinks depression, the southern part of which extends for ~1.6 km along the east side of U.S. Route 609 and is named the Pancake Field. The Water Sinks depression contains terraces at five distinct elevations above sea level: 610.2 meters (m); 612.6 m; 614.5 m; 615.7 m; and 620.3 m. On the east side of the Pancake Field, intermittent streams (Sinking Creek) that flow into the Water Sinks depression have exposed a ~15 m high cut bank in the highest elevation terrace. This cut bank reveals various 0.03–3 m-thick beds of clay, silty clay, sandy clay, gravelly clay, sand, gravelly sand, and sandy gravel. Some of the clay beds are laminated. The beds of mixed grain sizes are very poorly sorted, with gravel sizes of 2–30 mm diameter. In 2020, four optically stimulated luminescence (OSL) ages were obtained by the U.S. Geological Survey (USGS) from sediments at this cut bank. At 3.65 m below the top of the cutbank, one sample (USGS OSL sample WSC-4) from a bed of sandy gravel yielded an OSL age of  $15,670 \pm 650$  years. At 5.46 m below the top of the cutbank, one sample (USGS OSL sample WSC-3) from a bed of medium sand yielded an OSL age of  $19,070 \pm 790$  years. At 7.99 m below the top of the cutbank, one sample (USGS OSL sample WSC-2) from a bed of pebbly clay yielded an OSL age of  $19,990 \pm 1,040$  years. At 13.14 m below the top of the cutbank, one sample (USGS OSL sample WSC-1) from a bed of medium sand yielded an OSL age of  $79,550 \pm 6,650$  years.

The OSL ages suggest that these sediments accumulated during glacial intervals when this site was south of the glacial front and is thought to have been affected by permafrost. The three younger OSL ages (~21,000–15,000 years) are correlated with the last glaciation or marine isotope stage (MIS) 2, whereas the oldest OSL age (86,200–72,900 years) is correlated with MIS 5b (glacial sub-stage). The beds of poorly sorted sand and gravel are interpreted as fluvial deposits (flood-pulse sediments deposited during spring thaw), whereas the clay beds are interpreted as lacustrine deposits that accumulated when various nearby cave entrances were blocked and water ponded at the Pancake Field.

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