USING GEOPHYSICS TO UNDERSTAND THE SHALLOW GEOLOGIC FRAMEWORK OF THE NATIONAL MALL AND MEMORIAL PARKS IN WASHINGTON, D.C. AND MAP THE TREND OF A QUATERNARY FAULT

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The Adams Mill fault is a high-angle reverse fault that thrusts Piedmont bedrock ~2.4 meters over an unconsolidated gravel deposit at the original entrance of the Smithsonian National Zoological Park in Washington, D.C. The fault was exposed more than 100 years ago in a road cut near the intersection of Adams Mill Road NW and Clydesdale Place NW, but the region is aseismic, and the gravel was presumed to be millions of years old, therefore, the fault was never considered to be a serious seismic hazard. However, in 2017 the USGS obtained a luminescence age of 451 ± 34 ka for the faulted gravel, but the fault could be significantly younger. Early 20th century construction projects have revealed several other faults in the city, including the 18th and California Street NW, the Calvert Street faults. Furthermore, United States Geological Survey (USGS) drilling in the late 20th century identified near-surface sediments with increased displacement with depth, interpreted as evidence of multiple episodes of faulting. These faults are aligned along the same strike, and a USGS map published in 2017 shows them as one continuous fault connecting the Rock Creek Shear Zone to the Stafford Fault System, traversing under several important National Monuments and buildings that include the White House and the Washington Monument.

Dozens of geophysical surveys using electrical resistivity tomography (ERT), ground penetrating radar (GPR), and refraction microtremor seismic (ReMi) were acquired in downtown Washington D.C. to map the subsurface, locate the Adams Mill fault, if possible, and test how these methods worked in a highly urbanized environment. The GPR and ERT surveys conducted at the National Zoo and Washington Monument clearly show the fault in multiple east-west profiles. Near the Adams Mill fault exposure at the Zoo, multiple GPR profiles show what appear to be additional faults with less displacement, suggesting the Adams Mill fault is part of a larger fault zone. If fault slip was distributed across multiple faults, the magnitude of the resulting earthquake could be larger than expected for the observed 2.4 m of displacement.

The 2011 M_w 5.8 Mineral, Virginia earthquake had an epicenter 125 km away, yet caused approximately $300 million in damage to Washington, D.C, demonstrating how well seismic energy is transmitted and amplified through coastal Plain sediments. Consequently, the Adams Mill fault could pose a considerable seismic hazard to the city that was previously unknown.