APPLICATION OF ERT AND IP FOR IMAGING BURIAL PITS AT MUNITIONS REMEDIATION SITES

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The U.S. Army Corps of Engineers (USACE) Huntsville Center (HNC) collected geophysical data at 2 former Army installations undergoing munitions remediation, Umatilla Chemical Depot (UMCD) and Pueblo Chemical Depot (PCD), to evaluate Electrical Resistivity Tomography (ERT) and Induced Polarization (IP) methods for imaging munitions burial pits and trenches. The HNC team collected ERT/IP data over saturated response areas (SRA) at both sites. The resulting models correlate with ground truthed pit and trench depths at PCD, and we await excavation results from UMCD to confirm actual depth of contamination. Due to the presence of unexploded ordnance USACE used nonintrusive and safety supported intrusive electrode placement to conform to site safety requirements. Nonintrusive methods consisted of placing the stainless-steel electrode flat on the ground surface weighted by a saturated bentonite clay-filled bag making contact perpendicular to the direction of the transect. This combination of intrusive and nonintrusive methods resulted in data with high signal-to-noise ratios. The AGI SuperSting R8 was used to collect DC resistivity data at UMCD, using 56 electrodes at 0.5 m spacing running a dipole-dipole strong-gradient array. UMCD is known to have numerous pits across the site where the surface expression is indistinguishable from areas saturated with only shallow surface debris. Two SRAs identified in the EM-61 full coverage data were selected to be surveyed using ERT. The first SRA transect data modeled a large unnatural low-resistivity anomaly approximately ~2 m depth by 8.5 m width which can be interpreted as a large metal filled pit, in contrast to the second SRA transect model which showed no such low-resistivity feature. Contrasting results of the data collected at two surficially similar SRAs highlights the investigatory benefits of these methods during site characterization. The trenches located at PCD were previously characterized and depth/content data were used to assess model accuracy and aid interpretation. The ERT survey at this site resulted in highly resistive anomalies associated with the known location of the burial pits. This unexpected result is thought to be associated with the disposal methods used at this site, in particular the ash deposits from the burn material which were well documented in the previous characterization study. Variations in historical disposal methods between the UMCD and PCD sites is suspected to be the primary contributor in the contrasting ERT results. The results of the IP surveys at PCD were encouraging as the single pit that was surveyed produced a highly accurate model when compared to the known horizontal and vertical ground truth. The Iris Instruments Syscal Pro Switch was used to collect the IP data at PCD, using 36 electrodes at 1 m spacing. Multiple IP surveys were collected over the same pit and a comparative analysis was performed to analyze the potential benefits of varying IP injection time settings and differences in array performance. The increased model resolution of the longer, 1.5-hour, IP survey with an injection time setting of 4-seconds (s) was outweighed by the significant time-savings accrued when performing the 45-minute survey with shorter IP injection time window of 2 s. As expected, combining dipole-dipole and Wenner-Schlumberger reciprocal data produced the best results, but depending on project needs and time constraints pit and trench depth estimates can be obtained using only a dipole-dipole array.