Lateral and vertical mapping of salinity along the coast of Ghana using Electrical Resistivity Tomography: the case of Central Region

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Seawater intrusion into coastal aquifers is known to cause water quality concerns in communities along the coast all over the world. Studies are therefore usually conducted along coastal regions to map the extent of sea water intrusion to help in identifying appropriate locations for groundwater abstraction. This will ensure that agencies responsible for groundwater development in such areas will be able to provide water with the desired quality. These studies for mapping salinity have usually involved the sampling water from discrete point sources and determining the electrical conductance and chloride ion concentrations. Sampling from a few discrete locations may not reflect the spatial complexity of the subsurface geological conditions. To be able to characterize the spatial extent (both in lateral and vertical directions) of sea water intrusion adequately and effectively will require drilling of several observation wells along the coast, which are very expensive. A quick and cost effective way of mapping sea water intrusion and evaluating the spatial distribution of the saline water problem in groundwater management in coastal aquifers is by utilizing electrical resistivity measurements. In this study, the electrical resistivity tomography technique was used to delineate both the lateral and vertical distribution of salinity in some coastal communities in the Central Region of Ghana. The survey was conducted using the multiple-gradient array and the multi-electrode ABEM Lund Imaging System along traverses from the coastline into the communities. 2-D resistivity pseudo-sections showed a unique resistivity distribution within each community, influenced by the underlying local geology and seawater intrusion. Low resistivity layers (< 50 Ωm), which may be associated with saline water saturated geologic formations, are observed within almost all the communities investigated, at both deep and shallower depths. The study also shows that, seawater intrusion may have reached over 5 km in-land into freshwater aquifers in the coastal communities, and need to be considered in coastal groundwater management models.