SPATIAL AND TEMPORAL CHANGES OF WATER QUALITY OF TSUNAMI AFFECTED AREAS IN THE SOUTHWESTERN COAST: SRI LANKA

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The December 2004 tsunami made a tremendous damage in the coastal areas of Sri Lanka. Seawater either inundated domestic open dug wells, or entered to aquifers via infiltration of flooded and ponded water. High salinity of groundwater was the immediate effect noted but many contaminants such as heavy metals, nutrients, microbiological pollutants could have contaminated groundwater without any physical indication. Present work therefore aimed at the study and examination of (a) temporal and spatial variations of water quality, (b) mode of occurrences of plumes of saltwater in the subsurface (c) the recovery rate of the groundwater quality and (d) chemical and mineralogical changes of soils in a tsunami affected area in the Southwestern coast of Sri Lanka.

A representative and repetitive sets of water samples were studied during seven occasions from December 2005 to December 2008. Heavy metals, nutrients, pH, electrical conductivity, salinity, total dissolved solids, dissolved oxygen, turbidity and temperature of the water samples were determined. Two dimensional resistivity imaging of subsurface across the tsunami boundary was carried out to observe subsurface. A laboratory experiment was carried out to simulate soil-saline water interaction and XRD analysis was done to identify the mineralogical compositions.

The nutrient levels and heavy metal concentrations in the affected groundwater were low and predominantly below the detection limits, indicating that effect of tsunami inputs with regard to these parameters was not significant. Some wells (with low salinity) showed a predominantly increasing trend of salinity with time and then a decreasing trend. Higher salinity wells on the other hand showed predominantly decreasing salinity trend with time. Electrical conductivity too showed the same behavior. Other physical parameters did not show systematic geographic or time wise variations.

Resistivity imaging across the tsunami boundary revealed a gradual improvement of groundwater quality with time due to direct infiltration of rain water and flushing by fresh lateral groundwater from unaffected inland areas. This process however, appears to be extremely slow. Water quality recovery also appears to be hindered by the influence of permanent saline/brackish surface water bodies present in the area.

Soil interacted with saline water appeared to absorb Na^{+}, Ca^{2+}, Mg^{2+} and K^{+} ions of seawater and release Fe^{2+}, Al^{3+}, and Mn^{2+} into the aqueous phase. The amount of Fe^{2+} and Al^{3+} increases with increasing contact time and the salinity of water. The changes of pH and discoloration of groundwater noted in the affected area can be attributed to releasing of these two ions from the salinized soils.

The XRD analysis of affected soils revealed that the smectite group clays can accommodate more dissolved ions from saline water into their structures whereas kaolinite clay mostly rejected them. Lateritic soils comprising smectite clays and the bog soil have absorbed more ions from seawater while releasing Fe^{2+} and Al^{3+} ions. The Cation Exchange Capacities (CEC) of soils increased with the increasing of contact time of saline water and the initial levels of CEC of soil.