Geophysical Research Abstracts
Vol. 14, EGU2012-875-1, 2012
EGU General Assembly 2012

Understanding the impact of high temperature processes on soil properties

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High temperature processes such as in situ smouldering and thermal remediation processes can achieve rapid removal of organic contaminants from soils in much shorter time periods than traditional remediation technologies. Remediation goals tend to focus on the removal of contaminants and do not consider the end state of the soil. Exposure to elevated temperature causes changes to physical soil characteristics and has been linked to undesirable effects such as erosion and subsidence.

High temperatures affect the particle size distribution, mass loss, mineralogy and permeability of the soil. The particle size decreases with increasing temperature due to a mobilisation of fines. Likely to be due to the bond of fines to the sand grains being affected by temperature. Mass loss and silica sand mineralogy show links to temperature. For temperatures above 500°C the mass loss exceeds the initial moisture content of the soil, which is linked to the dehydration reaction of iron-oxides and other mineral changes. The iron-oxide reaction is also reflected in a colour change of the silica sand from yellow to red with increasing temperature. Dynamic properties of soil such as permeability seem to be affected by treatment type rather than temperature alone. Soil exposed to smouldering remediation showed an increase of permeability by an order of magnitude in comparison to heat-treated and untreated soils.

These results for silica sand as a simple model soil show that soil properties are affected by temperature to various degrees which can lead to a change in dynamic behaviour. It is therefore important to move from a simple model soil, such as silica sand to a more complex realistic model soil. This study therefore compares the above mentioned results for silica sands with sandy clay loam. Due to the content of silt and clay-sized particles the particle size distribution is more affected by aggregation due to fusion of silt and clay-sized particles with increased temperatures. Mass loss and mineralogy changes are dependent on the initial mineralogy of the soil but similar relations have been found. This study suggests that elevated temperatures affect soil properties. Monitoring during and after remediation is advised.