Geophysical Research Abstracts
Vol. 15, EGU2013-13156, 2013
EGU General Assembly 2013


# Experiences and issues with the implementation of microscreen multilevel groundwater samplers in glaciofluvial aquifers in Southern Norway

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The investigation of hydrochemical heterogeneities in groundwater systems is an indispensible tool to obtain information about chemical stratifications within an aquifer, and to gain a better understanding of natural weathering processes, hydrochemical evolution paths, and contaminant transport. Furthermore, it is highly topical since a detailed knowledge about the three-dimensional distribution of chemical groundwater composition is supposed to provide an important means for investigating the effects of a changing environment (climate change, changes in land use, population growth, and the effects of increasing human activities). However, an everlasting issue in hydrogeological studies lies in the limited vertical representativeness of groundwater samples obtained from production wells or conventional observation wells. Samples obtained from longer screened intervals can unwontedly blur the actual hydrochemical zoning and heterogeneity within an aquifer. In order to obtain more reliable information on the vertical distribution of solute concentrations and groundwater quality parameters, the use of an appropriate multilevel sampling technique can be the optimal choice.

The investigation of point water samples collected at one to two meters distances rather than samples from longer screened intervals enables for the acquisition of detailed vertical profiles of groundwater chemistry. However, the benefits of obtaining this advanced level of detailedness are contingent on the minimization of vertical cross contaminations between the different samples, and the effectiveness of a multilevel sampling installation is thus based on the premise of only negligible vertical flow contributions.

Many different multi level water sampling systems have been proposed in hydrogelogical sciences. However, the suitability of a specific multilevel sampler design is strongly dependent upon the intended application and local requirements. Example given, in formerly glaciated regions like Scandinavia many of the most important groundwater resources are situated in glaciofluvial sediments, which are commonly characterised by a high degree of heterogeneity (very coarse to very fine material). This significantly reduces the number of suitable drilling techniques and imposes several restrictions with regard to the connection of filter elements to the surrounding aquifer, and the vertical isolation between the different sampling levels (hole seal quality and vertical flows). Another important mater is the general ease and the cost of installation (which clearly depends on the local availability of certain drilling techniques and services, and the availability of material for well construction).

We summarize our experiences gained by using various setups of small volume multi-level samplers with microscreens in unconsolidated sedimentary aquifers at two different experimental sites in S-Norway. Experiments were conducted during year 2010 and 2011 in fine to coarse grained glaciofluvial deposits in the eastern part of the Gardermoen / Øvre Romerike Aquifer (Ullensaker), and in coarse grained glaciofluvial deposits at the Granli waterworks (Kongsvinger). Installations were performed using different drilling techniques (5/4 inch Pionjär handheld drilling equipment, geotechnical drilling rig percussion drilling, and 163 mm ODEX drilling). Samples were extracted by using a multi channel peristaltic suction pump under low flow rates. The suitability of different types of tubing and filter materials has been investigated by checking for unwanted leaching of inorganic compounds.