FORECASTING THE IMPACT OF CLIMATE CHANGE ON WATER SUPPLIES USING GROUNDWATER RESIDENCE TIMES

Lapworth D.J,[1] MacDonald A.M,[2] Darling W.G,[1] Gooddy D.G,[1] Bonsor H.C,[2]

[1] British Geological Survey, Wallingford, OX10 8BB, UK; djla@bgs.ac.uk

[2] British Geological Survey, Edinburgh, EH9 3LA, UK; amm@bgs.ac.uk

Keywords: groundwater, climate change, rural supplies, residence times

This paper describes the methodology and preliminary results of the West Africa hydrogeological case study undertaken during 2010. Due to the near absence of monitoring data in Africa to assess performance of water supplies to past climate variability, it is clear that a different approach is required to understand the vulnerabilities of relatively 'young' (less than ~100 years) groundwaters that currently form the most reliable and accessible sources of water for much of Africa. Over the last 20 years the use of a suite of environmental tracers has proved to be an important tool to understanding groundwater processes, complimenting modelling and other established hydrogeological methods.

In this study groundwater residence times from rural supplies were assessed in both high storage (Cretaceous sediments) and low storage (Precambrian basement) aquifers, across 4 different climate zones in a sampling transect extending from the wet climate of southern Nigeria (1800-2000 $mm.y^{-1}$) to the semi-arid climate of central Mali (<400 $mm.y^{-1}$). The figure below shows the locations of the 4 case study areas. Groundwater residence times were assessed through the use of multiple tracers: chlorofluorocarbons (CFCs), sulphur hexafluoride (SF_6) and tritium, recharge processes were assessed using stable isotopes (^{2}H and ^{18}O) and a chloride mass balance approach. The purpose of the case study was to identify how vulnerable 'young' rural groundwater water supplies may be to climate change, however, studies of this type may also contribute to understanding the effects of landuse change, contaminant transport and overexploitation on groundwater resources in Africa. Initial results from the groundwater residence time tracers and stable isotopes indicate that overall the shallow groundwaters sampled in the basement and sedimentary aquifers were found to be more coupled to recent rainfall and recharge. Mean residence times (MRT) were found to be >30 years for 80% of sites.