EAG-GS 2014 Outreach Program to Africa

Lecture Abstract:
Groundwater dating: the isotopic toolbox

Pierre Deschamps, CEREGE, UMR AMU-CNRS-IRD-Collège de France, France. deschamps@cerege.fr

In many parts of Africa, particularly in the Saharan and Sahelian areas, groundwater plays a central role in sustaining ecosystems and enhancing global water and food security. This generally high-quality fresh water resource is largely distributed and constitutes a major source of water for domestic and agricultural activities of sedentary and nomadic African populations.

The strategic importance of groundwater will probably increase in the near future owing to the combined effects of climate change and of increasing water demands deriving from population growth and agricultural irrigation. Predicted climate change will indeed impact the hydrological cycle and surface water availability as more frequent and intense climate extremes (droughts and floods) increase variability in precipitation and soil moisture. In order to adopt adequate policies to ensure sustainable use and management of groundwater, sound and comprehensive information on the amount and renewability of existing resources are required. It is therefore crucial to better assess aquifer hydrogeology and its dynamics, including the movement, origin and age of groundwater.

Isotopic methods have proven to be of great potential to provide the hydrogeological information required to rapidly and effectively evaluate and map groundwater resources. These tracers have often provided original information not available using other techniques, especially because they afford some degree of integration of both the temporal and spatial degree of the recharge. For several decades, the community of geochemists has expended tremendous effort to develop a toolbox of geochemical and isotopic tracers covering time spans from a few months up to a million years. This toolbox is now widely used to address aspects such as recharge rates and mechanisms, flow rate estimation in aquifers and finally resource renewability. It allows investigation of aquifer systems at different spatial scales, from the unsaturated zone to the large sedimentary basins. Quantified recharge rate, groundwater age and residence time assessed by these tracers provide highly relevant information for validating conceptual flow models of groundwater systems and calibrating numerical flow models.

During the course, we will introduce the major tracers of the geochemists toolbox used for groundwater dating (^{3}H, ^{3}H-^{3}He, CFC, SF6, ^{14}C, ^{36}Cl,…) and will present some examples of their applications to recharge rate and groundwater age assessments. A special emphasize will be given to groundwater resources in Africa, especially on the Sahara–Sahel region, where the question of the renewability of the resource is pivotal. In this area, the groundwater used to sustain rapid economic development is mainly old water, recharged over thousands to millions of years.