

Water-rock interaction and groundwater salinity in large sedimentary basins: an inverse modeling approach

PHILIPPE NÉGREL¹, ROMAIN MILLOT²,
EMMANUELLE PETELET- GIRAUD³, ELINE MALCUIT⁴
AND AGNÈS BRENOT⁵

1BRGM, 45060 Orléans, France, p.negrel@brgm.fr

2BRGM, 45060 Orléans, France, r.millot@brgm.fr

3BRGM, 45060 Orléans, France, e.petelet@brgm.fr

4CFG Services, 45060 Orléans, France, e.malcuit@cfg.brgm.fr

5BRGM, 69626 Villeurbanne, France, a.brenot@brgm.fr

This study focuses on the groundwater in large Eocene aquifers sedimentary system (SW France) with the main goals of investigating the influence of rock weathering and quantifying the inputs from each of several end-members (i.e silicate, carbonate, evaporite) by using an inverse method approach of budget equations. The Eocene aquifer, composed of sandy Tertiary sediments alternating with carbonate deposits, is a multi-layer aquifer being artesian to the west of the district and confined with piezometric levels around 250 m depth to the east of the district. The Eocene aquifer system is made up of at least five aquifers: Paleocene (P), Eocene Infra-Molassic Sands (IMS), Early Eocene (EI), Middle Eocene (EM), Late Eocene (ES).

The Total Dissolved Solids (TDS, the total mineralization of water calculated by summing cations and anions) have large variations between 74 and 2513 mg/l. Variations within the same aquifer are also significant, from 74 up to 1253 mg/l in the Paleocene aquifer; from 255 up to 1033 mg/l in the middle Eocene aquifer and from 230 up to 2513 mg/l in the Eocene infra-molassic sand. The highest mineralization is generally encountered in water draining evaporite formations (gypsum and/or halite) as evidenced in the southern part of the aquifer. The spatial distribution of the TDS values indicates several places having salinities > 1000 mg/l.

A mixing model for the major ions was formalized, and constrains added on the source reservoirs that correspond to the identified end members in the groundwater. We test this model using an inversion scheme that allowed to calculate the proportions of major ions (Na, Ca, Mg...) derived from rain and from silicate, carbonate and evaporite weathering. From the mass balance point of view, the global contribution of each end-member was obtained by summing the individual contribution of each element. Carbonate inputs dominate the groundwater chemistry, evaporite often plays the second major role, rainwater inputs are always negligible and silicate inputs may be important in some parts of the system.