Hydrogeochemical processes and contamination of groundwater in Tapihue alluvial basin, Central Chile

SOFÍA LÓPEZ[1*], PAMELA CASTILLO[1], BRIAN TOWNLEY[1]

[1]Department of Geology, University of Chile, Plaza Ercilla 803, Santiago, Chile (*correspondence: slopezurzua@gmail.com)

Tapihue basin, located in the region of Valparaiso, is characterized by wine-growing activity. The basin is filled by alluvial and coluvial deposits. The lithologies of sediments are intrusive rocks as tonalite, granodiorite and aplite.

In the present study, we try to understand the geological processes and anthropogenic influence that control the hydrogeochemistry of groundwater.

Rain, irrigation and groundwater samples were collected during two seasons (winter and summer) and analyzed for physicochemical parameters, mayor and trace elements. Also soil and rock samples were taken for XRF analysis.

Chemical analysis show that HCO_3^-, Ca^{2+}, Mg^{2+}, Na^+ and Cl^- are the major ions in groundwater. The dominant hydrogeochemical facies is Ca-HCO_3 in irrigation and groundwater. Hydrogeochemical data suggests that chemical weathering of rock forming minerals is the dominant factor controlling groundwater chemistry. Particularly, anorthite and albite weathering, are responsible for Ca^{2+}, Na^+ and HCO_3^-, while weathering of biotite and amphibole explains Mg^{2+} content. Negative values of CAI indicate chloro-alkaline disequilibrium, Ca^{2+} and Mg^{2+} in water are exchanged with Na^+ and K^+ in minerals from host rock. This is likely due to the abundance of clay minerals: kaolinite, illite and smectite.

Contamination derived from agriculture is another factor influencing water chemistry. Agrochemicals are the source of SO_4^{2-}, Cl^- and NO_3^- in water, since in the area there is no natural source of these ions. Also between winter and summer an increase in pH and in SO_4^{2-}, Na^+, Cl^-, Br, Cr and Zn concentration is observed. Rainwater has higher concentrations of Al, Cu, Mn, and Zn than groundwater, indicating atmospheric pollution. A possible source could be Ventanas Refinery located 60 km NW of the basin and/or aplication of agrochemicals by airway.

Saturation index of minerals was calculated taking into account analysis of XRF on soil and rock. Water is in equilibrium with quartz and albite, undersaturated with respect to anorthite, and oversaturated with respect to kaolinite, illite, smectite (rich on Mg^{2+}), zeolite, K-Feldespar and phosphate minerals like hydroxyapatite and whitlockite.

Acknowledgements: This work was supported by CORFO and I+D Consorcio Vinos de Chile.