ID: 104

INTERACTION BETWEEN GROUNDWATER AND WETLANDS, CAUSED BY OPEN PIT MINING IN SOUTHEAST BUENOS AIRES, ARGENTINA

E. BOCANEGRA.
Universidad Nacional de Mar del Plata. Instituto de Geología de Costas y del Cuaternario. Mar del Plata, Argentina.
E-mail address: emilia.bocanegra@gmail.com

M. QUIROZ LONDOÑO.
Instituto de Geología de Costas y del Cuaternario – Instituto de Investigaciones Marinas y Costeras. Mar del Plata, Argentina.

J. DEL RÍO, M. FARENGA
Universidad Nacional de Mar del Plata. Instituto de Geología de Costas y del Cuaternario. Mar del Plata

Abstract: This paper proposes to characterize the interactions between groundwater and the anthropogenic wetlands resulting from mining activities in Buenos Aires province, Argentina. The methodology consisted of measuring levels, hydrochemical and isotopic sampling, and construction of diagrams. Wetlands located on quartzites have a higher level than the groundwater in the transition zone to the porous aquifer. Wetlands have an isotopic enrichment relative to groundwater, suggesting the occurrence of evaporation processes. The origin of wetlands is water from the fractured aquifer whose thickness corresponds to the quarry face, and also from runoff.

1. INTRODUCTION

The production of aggregates from mining is one of the main socio-economic activities of peri-urban areas of Mar del Plata, head of the General Pueyrredón County in the southeast of Buenos Aires Province, Argentina (Figure 1). From the hydrogeological point of view, the exposed rock formations are quartzites (Balcarce Formation) arranged in horizontal layers with a thickness between 0.30 and 1 meter. These layers are affected by systems of high-grade fractures, crossed by faults with NE-SW [1], which constitute a system of low permeability. Overlying these rocks, there is a sequence of silty-like loess Quaternary sediments. These constitute the Pampean aquifer, source of water supply to urban, agricultural and industrial purposes.

In the peri-urban area, 18 quarries have been developed since 1960 as a result of mining activity. In 8 of them (Pétrea, Paso de Piedra, Don Mariano, La Gloria, Minera, Cerámica, Silex y Castillo), (Figure 1), the existence of wetlands has been ascertained, whose surface varies between 2100 and 14000 m^2 and their depth ranges from 6 to 12 m.

Wetlands located in areas of quarries are facilitators of local development, by providing various services to human welfare, including the provision of water for mining, development of aquaculture for the rehabilitation of environmental liabilities resulting from mining activity, and cultural services (tourism, landscape, identity and sense of belonging) [2].

The aim of this work is to characterize the wetlands – groundwater interactions in the fractured / porous media transition of peri-urban areas, and establish the importance of these water bodies as a source of recharge to the main aquifer.

2. METHODOLOGY

A water sampling was conducted in 6 wells and 2 wetlands in summer 2013 and in 4 wells and 3 wetlands in spring 2014, for the determination of physicochemical parameters and content of stable isotopes ^{2}H and ^{18}O. Information on groundwater levels was collected and physicochemical analysis in the study area were performed. Chemical and isotope hydrology diagrams were used.

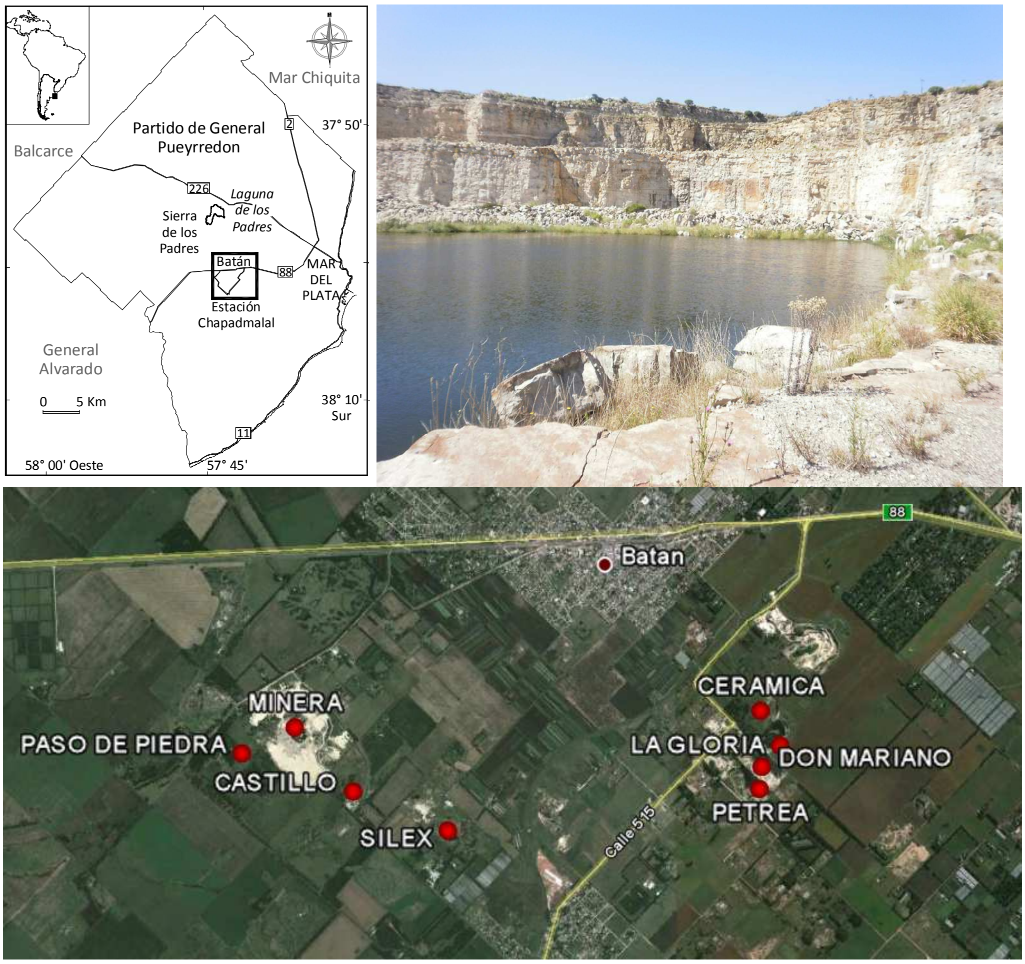

Figure 1. Location map

3. RESULTS

The flow patterns indicate that wetlands resulting from mining activities in quartzites rocks have a higher level than the groundwater in the transition zone to the porous aquifer; a level in a wetland of up to 24 m above the water table has been recorded in a well located within 200 m of the wetland (Figure 2). The flux passing through the fractured aquifer recharges the porous aquifer. This flow has been estimated in an average annual contribution of 5 hm^3 [3] through the numerical simulation of the aquifer for supply of Mar del Plata.

Ion analysis establishes two types of water: calcium - magnesium bicarbonate or sodium bicarbonate. The electrical conductivity varies in a range between 1720 µs/cm and 142 µs/cm, with mean value of 854 µs/cm in groundwater and 221 µs/cm in wetlands. The conductivity increases as the topographic heights decrease, associated to water recharge and transit areas [4].

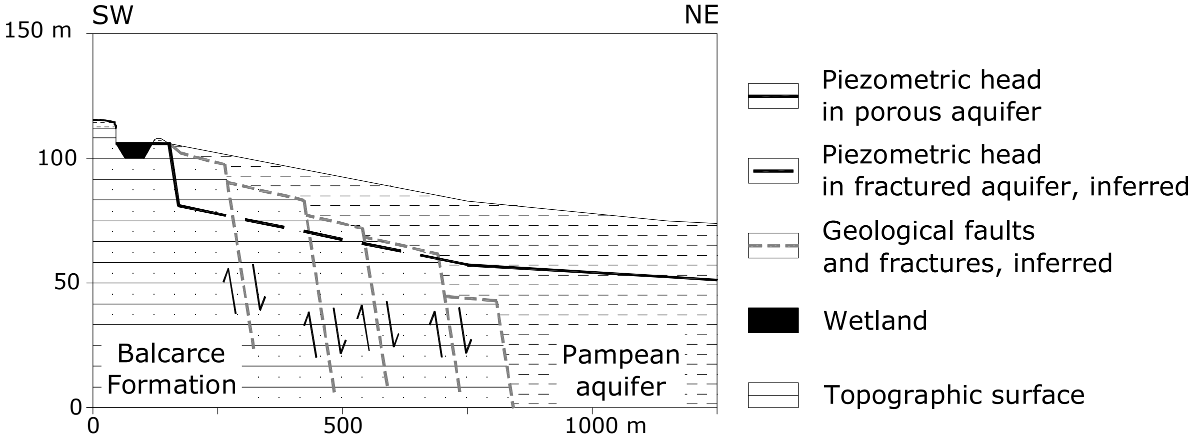

Figure. 2. Flow diagram in the fractured – porous media transition

The isotopic composition shows that groundwater is practically on the local meteoric line (Figure 3), suggesting that rain water is the source of recharge. In spring wetlands have a certain isotopic enrichment relative to groundwater; in summer, they are strongly evaporated. The mean values of the isotopic contents are shown in Table 1.

The relationship between concentration of Cl^- and $\delta^{18}O$ is shown in Figure 4. Groundwater presents homogeneous isotopic values, but an increase of Cl^- in the direction of flow. Wetlands, isotopically enriched, show a low Cl^- content, similar to groundwater from wells in quarries.

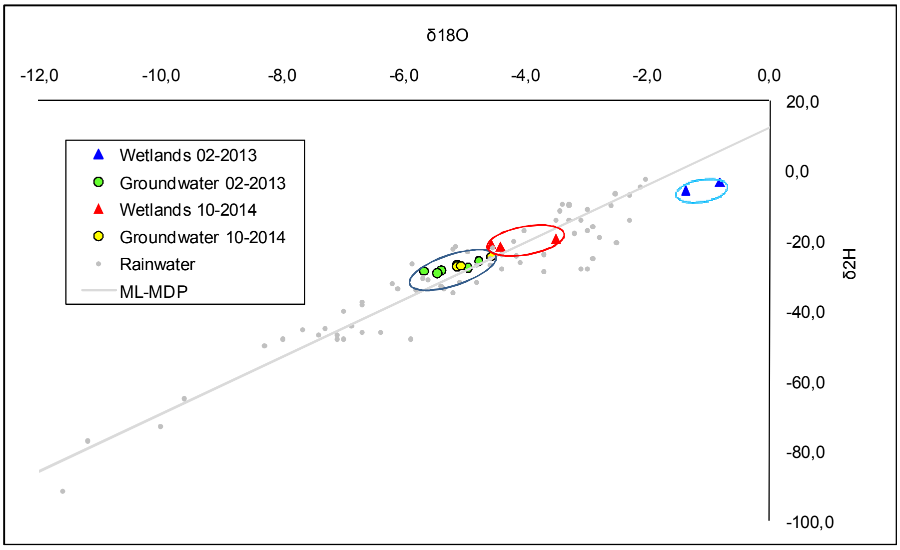

Figure. 3. Diagram δ^2H vs. $\delta^{18}O$ of groundwater and wetlands

4. CONCLUSIONS

The origin of wetlands is water from the fractured aquifer whose thickness corresponds to the quarry face. Runoff is another source of wetlands. Studies including seasonal isotopic monitoring will allow quantifying the mass balance. The flux passing through the fractured aquifer recharges the porous aquifer.

The functional model of the environment shows that anthropogenic wetlands are supporting productive activities such as intensive aquaculture, and sites of social recognition for their amenity associated to recreation. Concerning the groundwater, it has a direct role as a water source.

Table 1. Mean isotopic contents

	Rain water	**Groundwater**	**Wetlands 10-2014**	**Wetlands 02-2013**
δ^2H	-29,85	-27,41	-20,6	-4,48
$\delta^{18}O$	-5,03	-5,12	-4,17	-1,09

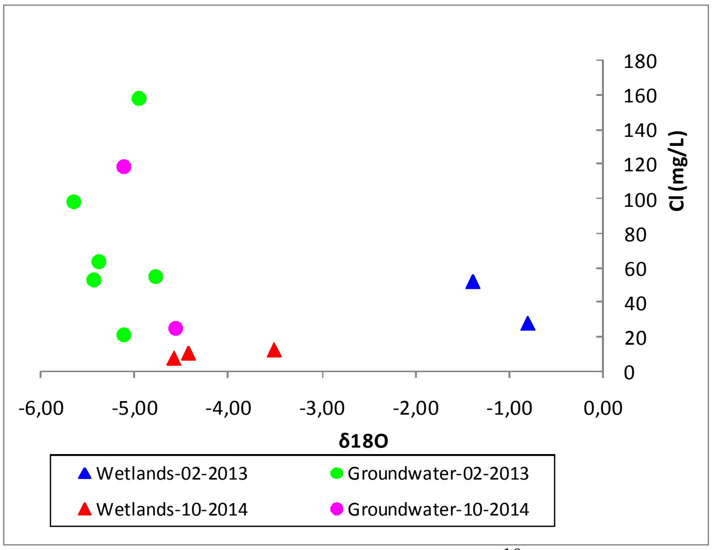

Figure 4. Relationship between concentration of Cl^- and $\delta^{18}O$

REFERENCES

[1] TERUGGI, M., KILMURRAY, J. Tandilia. Geología de la provincia de Buenos Aires. Relatorio, *VI Cong. Geol. Arg. Bahía Blanca*, (1975). 55-77.

[2] BOCANEGRA E., DEL RÍO, J. L., QUIROZ LONDOÑO, O. M, FARENGA, M. Caracterización de las interacciones humedales antrópicos- aguas subterráneas-ser humano en canteras de áridos del sudeste bonaerense. 2º Congreso Argentino de Áridos. Cámara de la Piedra de la Provincia de Buenos Aires. (2014). 12 pp

[3] BOCANEGRA, E. Estrategias de gestión del acuífero de Mar del Plata. Modelo conceptual y simulación numérica. Tesis Doctoral. Facultad de Ciencias Exactas, Ingeniería y Agrimensura. Universidad Nacional de Rosario. (2011). Unpublished.

[4] QUIROZ LONDOÑO, O. M., MARTÍNEZ, D. E., DAPEÑA, C., MASSONE, H. Hydrogeochemistry and isotope analyses used to determine groundwater recharge and flow in low-gradient catchments of the province of Buenos Aires, Argentina. *Hydrogeology Journal*, 16 (6), 1113-1127. (2008).