FLOW PATTERNS AND RECHARGE PROCESS IN ALLUVIAL FANS: A CASE STUDY OF THE SEMI-ARID PUNATA FAN IN BOLIVIA

Andres GONZALES AMAYA [1]

[1] *Enginering Geology, Lund University, Box 118, Lund SE 22100, Sweden, andres.gonzales@tg.lth.se*

Alluvial fans are generally located in arid and semi-arid zones, and they have the nature of having permeable layers where water can be stored, thus, they can be important sources of water supply. For sustainable management of groundwater, however, knowledge of origin, recharge process, flow direction and mineralization is needed. The overall aim of this study is to show the efficiency of using three different hydrochemical methods for providing information and propose a hydrogeological model of the groundwater recharge, flow patterns and chemical evolution in alluvial fans. The Punata alluvial fan is used as a case study.

There are available many methods for studying hydrogeological processes in groundwater, however the use of one single method sometimes is not enough for having a complete hydrogeological characterization. This study used the integration of three different methods: 1) major ion chemistry and chemical weathering process, 2) Stable isotopes (deuterium and oxygem-18), and 3) statistical analysis (Hierarchical Cluster Analysis and Principal Component Analysis). This study included a total of 45 samples. The samples come from two different sources: groundwater and surface water. The samples from groundwater are located within the Punata alluvial fan, while the latter are distributed along water bodies in the neighboring basins. The samples were spatially distributed in order to take into consideration all the possible recharge sources.

The analysis of the $\delta^{18}O$ and $\delta^{2}H$ concentration in water samples assisted in identifying that groundwater in the Punata alluvial fan is mainly recharged by heavy flash floods, rather than precipitation or rivers base flow. The multivariate statistical and hydrochemical analysis indicated that weathering of carbonated rocks contributed to the increase of Ca^{2+} concentration, and that there is an increase of Cl^{-} and TDS concentration in the middle and distal part of the fan. these changes in the ion concentrations leads to established that groundwater flow is from the East to the West and Northwest of the fan.

The results from this study has implications for the knowledge of hydrogeological processes in alluvial fans in general in that it shows that the integration of hydrochemistry, stable isotopes and multivariate statistical can be useful tools for characterizing such processes. The integration of the results might contribute in the making of policies for sustainable groundwater management in alluvial fans.