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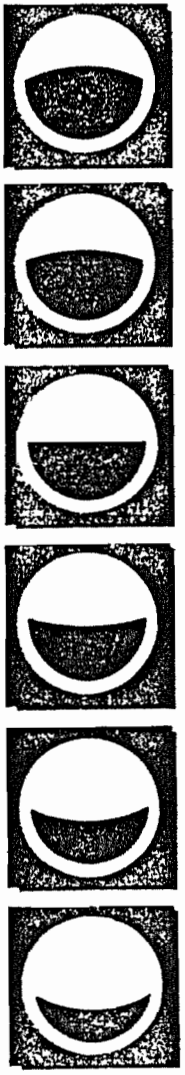

SOBREEXPLOTACIÓN DE ACUÍFEROS

AQUIFER OVEREXPLOITATION

Abril / *April* 1991
Islas Canarias, España / *Canary Islands, Spain*

ACTAS
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Tomo I
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A CASE OF POSSIBLE OVEREXPLOITATION AT SAN LUIS POTOSI, MEXICO

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ABSTRACT. The Aquifer system of the Valley of San Luis Potosi that has been exploited up to now, consists of two aquifers: a shallow one formed by granular material and a second one composed of fractured volcanic rocks, granular material of different origins and double permeability tuffs. Basement undifferentiated rocks consist mainly of impervious carbonated and intrusive volcanic rocks. Significant volumes of thermal water originated by regional flow underneath, circulate through the second aquifer. However, as very scarce information on the hydrodynamics of the second system is available, a mathematical model with linear sources was implemented. The strength of the sources was adjusted using thermal and geochemical information. The model was finally calibrated on the basis of piezometric and other hydrometric information available.

1. INTRODUCTION.- The City of San Luis Potosí is the Capital of the state of the same name. It has a population of around one million and it is the most active industrial and comercial center of the state. It receives most of its water supply from an aquifer system which underlies the City and surrounds it. Its geographical location is southwest of the San Luis Potosi State. Superficially, it is a closed basin which includes the capital of the State. The area of the basin is about 1900 km^2.

In a previous study [IG.UNAM, 1988] the aquifer system was defined integrating geological, hydrogeochemical, hydrogeological and geophysical data. A conceptual model may be summarized as follows:

1. A shallow aquifer consisting of granular material with a thickness between 80 to 90m.
2. A very low permeability clay unit with a non-uniform extension at the center of the Valley. It has a thickness of about 70-100m.
3. A second aquifer composed of:
   a) Granular material of different origins (sands, gravels, clays and tuffs)
   b) Fractured volcanic rocks

c) Double permeability tuffs.
The thickness under exploitation in this aquifer varies between 100 to 350m. However, its total thickness, as estimated by a gravimetric survey, is around 1.5km.
d) Undifferentiated basement is composed mainly of carbonated and/or intrusive volcanic rocks.

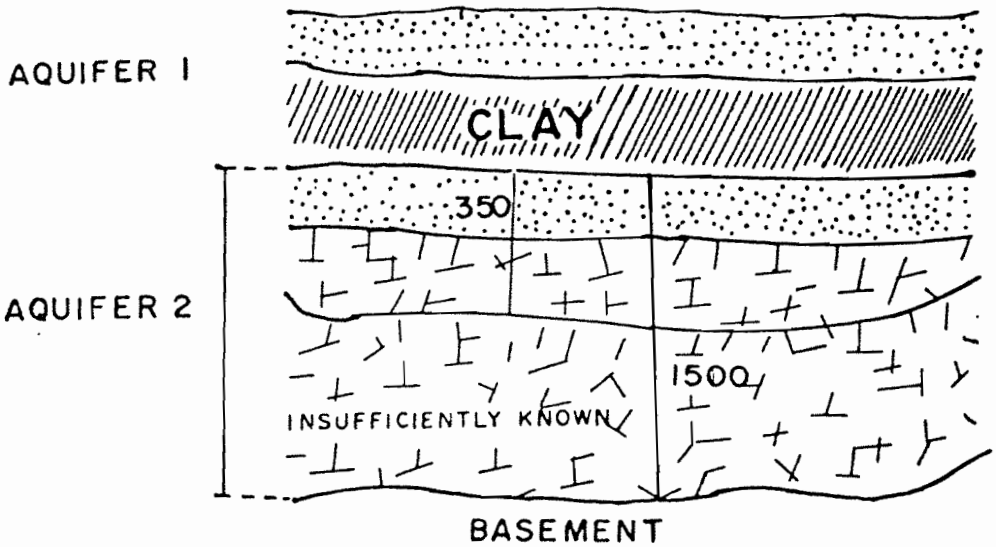
The aquifer system receives rain water through infiltration in the highlands of the basin. Hydrogeochemical studies suggest that this water travels to a depth of about 1.5 to 1.9km., where it reaches a calculated temperature of around 80°C. Based on geological, geophysical and hydrogeochemical evidence, it was concluded that pumping ($2.8m^3/s$) has induced upward flow which accounts for around 70% of the recharge of the second aquifer. Such thermal flow comes from underneath in fractured areas.

2.METHOD OF THE STUDY.- Information on the bottom part of the second aquifer does not exist. Also, due to time as well as economic limitations, to obtain additional information was outside the scope of this study. Taking into account this fact and the particular hydrogeological regimen described before, a special procedure was used. The second aquifer was conceptualized as an aquifer system made of three distinct hydrologic units, which can be described succinctly as follows:

"An upper aquifer which is the unit under exploitation, and which is underlayed by a (connecting) layer of vanishing primary permeability but which is fractured at some areas through which it connects the upper aquifer with the third and deepest unit of this system. The latter being an aquifer whose piezometric head has remained unchanged during the exploitation of the system."

The three-dimensional MOD-FLOW computational model [Mc Donald and Harbaugh, 1988] was used, to implement this conceptual model. The upper unit, which is under exploitation, was simulated by two layers of cells. The storage capacity of the connecting layer was neglected and vertical flow was considered exclusively, there. The deepest aquifer unit was simulated as a non-active layer of cells, in which the constant head conditions were imposed.

Using mainly geothermal and geochemical information, the horizontal area with vertical recharge was defined on a map of the aquifer and an index expressing the proportion of thermal water that is being extracted at each place within this region, was introduced.



STRUCTURE OF AQUIFER

The vertical hydraulic conductivity (actually K_v/b) was then adjusted, using the above mentioned index. This left only one parameter to be determined, in order to have the sources fully defined. This was obtained equating the predicted withdrawal from the region with the observed one. Finally, a standard horizontal calibration of the model was performed.

3.CONCLUSIONS.- Satisfactory agreement between the observed and predicted behavior was obtained, indicating that the procedure may be useful to improve the predictive capacity in systems with insufficient information, in situations similar to that treated in this case study.

Another relevant conlusion was that lack of knowledge about an aquifer system, may lead to a false overexploitation diagnosis.

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