Application of Environmental Isotope Variations to a Groundwater Study in Ecuador

by B.R. Payne

INTRODUCTION

The Isotope Hydrology Section provdes consultants and laboratory services for applying isotope techniques to hydrological problems in Member States This intervention of the Agency may be as a sub-contractor for other organizations of the United Nations system in their execution of large scale UNDP projects, as part of a Technical Assistance project or as a demonstration to a national hydrological organization under the Advisory Services Programme of the Agency. An example of this Agency activity is the study made in Ecuador in 1976/77 in collaboration with the national hydrological organization and the FAO which was the executing agency for the project. This study was part of a project to identify the means for improving agricultural production by irrigation with groundwater Isotope techniques were used to assess the relative importance of infiltration from the River Chimbo and local rainfall as sources of recharge to the groundwater. A knowledge of this is important in connection with the estimate of the available water resources for irrigation.

The project area, located about 20 km east of Guayaquil just south of the Equator, extended from Bucay at an elevation of 320 m where the River Chimbo leaves the Andes mountains, to Yaguachi in the western extremity covering an area of about 2000 km^2.

The area consists of sediments built up during late Pliocene-Quaternary Results of a geophysical survey indicated 300—400 m of saturated aquifer in the east which decreases going away from the mountains. Rainfall is limited to a six months period in the year and amounts to about 2000 mm

THE ISOTOPE APPROACH

The River Chimbo drains water from the higher elevations of the Andes. Since rainfall at higher elevations contains less of the isotopes deuterium and oxygen-18 it was to be expected that the water infiltrating from the river would contain smaller amounts of these isotopes than the rain falling directly on the project area

The stable isotope values of these two potential sources of recharge were estimated from water samples taken from the river and from wells where the possibility of a contribution of river water could be considered negligible.

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Shallow groundwater from wells was sampled at the end of 1976 and the beginning of 1977. All samples were measured for their isotopic composition in the Isotope Hydrology Laboratory at the Headquarters of the Agency.

THE FINDINGS

The measured isotopic values of the samples of shallow groundwater were compared to the values estimated for the two potential sources of recharge. In general the greatest contribution by water infiltrated from the river was found in the shallow groundwater sampled close to the river. However, in some areas the influence of river water extended some kilometres away from the river. Looking at the shallow groundwater over the whole project area a statistical treatment of the data indicated that about 75–85% of the shallow groundwater originated from the infiltration of precipitation falling directly on the project area. A few groundwater samples taken from deeper wells suggested that this proportion may well be much less at greater depth. A firm conclusion on this point was not possible because of the limited number of wells available for sampling

CONCLUSION

A problem such as the one described is not easily solved by more conventional methods. On the other hand isotope technique based upon the natural labelling of the water itself provide a valuable means of identifying the actual transfer of water of a particular origin from one place to another. The principal limitations of the method are not due to the technique, but rather to the availability of meaningful samples from known depths.