

## Natural protection against groundwater pollution by nitrates in the Central Valley of Chile

JOSE LUIS ARUMI<sup>1</sup>, RICARDO OYARZÚN<sup>1</sup> & MARCO SANDOVAL<sup>2</sup>

<sup>1</sup> Department of Water Resources, Universidad de Concepción, Avenida Vicente Méndez 595, Chillán, Chile  
[jarumi@udec.cl](mailto:jarumi@udec.cl)

<sup>2</sup> Department of Soils, Universidad de Concepción, Avenida Vicente Méndez 595, Chillán, Chile

**Abstract** The Central Valley of Chile is a zone of intensive agricultural activity. Historically, in this zone, large amounts of fertilizers have been applied and low technological level irrigation methods have been used. Contrary to what might be expected, the existing aquifers in the Central Valley do not contain significant nitrate that could be associated with agricultural activity. This situation leads one to infer the existence of favourable conditions for the occurrence of natural attenuating processes such as denitrification. Favourable conditions may be related to the particular soil and climatic conditions, and/or the structure and dynamics of the existing aquifers.

**Key words** agriculture; Chile; denitrification; groundwater; nitrate

### Protection naturelle contre la pollution des eaux souterraines par les nitrates dans la Vallée Centrale du Chili

**Résumé** La Vallée Centrale du Chili est une région d'activité agricole intensive. Au fil de l'histoire, de grandes quantités de fertilisants ont été introduites et des méthodes d'irrigation de bas niveau technologique ont été utilisées dans cette région. Contrairement à ce que l'on pourrait supposer, les aquifères présents dans la Vallée Centrale ne présentent pas de teneurs significatives en nitrates, qui pourraient être reliées à l'activité agricole. Cette situation conduit à penser que certaines conditions favorisent des processus naturels d'atténuation, comme la dénitrification. Ces conditions favorables peuvent être liées à des caractéristiques pédologiques et climatiques particulières, et/ou à la structure et à la dynamique des aquifères concernés.

**Mots clefs** agriculture; Chili; dénitrification; eaux souterraines; nitrates

## INTRODUCTION

On the global scale, nitrate is the chemical pollutant that exhibits the largest distribution in groundwater. Recently, a significant increase in nitrate-nitrogen content has been detected in many aquifers, in particular those in developing countries that underlie intense agricultural production (Spalding & Exner, 1993; Jacinthe *et al.*, 1999; Rao & Putanna, 2000).

Agriculture has been recognized as the main anthropogenic source responsible for high nitrate-nitrogen content in groundwater (Korom, 1992; Spalding & Exner, 1993). Given the possible negative effects of nitrate ingestion on human health, such as methaemoglobinaemia in infants or the occurrence of gastric cancer (Spalding & Exner, 1993; Canter, 1997; Rao & Putanna, 2000), there is a need for better understanding and mitigation of nitrate pollution in groundwater worldwide.

In Chile, potential nitrate contamination of groundwater has special relevance, because Chile has been the only world producer of natural nitrate since the end of the 19th century. The naturally occurring nitrate comes from the rich nitrate fields of