

NATURAL NITRATE OCCURRENCE IN CLOSED BASINS IN SOUTHWESTERN UNITED STATES

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ABSTRACT

Expanding development of groundwater supplies in the closed basins of the southwestern United States has led to increasing reports of high nitrate levels in the water. Many of these nitrates appear to be from natural sources. Data indicate that playa areas have substantial quantities of nitrogen that is mobilized to water supplies. Documented areas include Clark and Lyon Counties in Nevada where water supplies have been adversely impacted with nitrate levels reaching 100 mg/l as N. Several other playa areas have soil nitrate levels up to 20,000 mg/kg. Field and laboratory studies are progressing on the origin and process of concentration of nitrogen in the playa areas. Potential sources include solution and transport from bedrock, fixation from the air by organisms and photochemical reactions, and old buried shallow lake deposits of organic or evaporite material. Better understanding of the occurrence of natural nitrates is necessary in order to assess the impacts of man on present and future development of groundwater supplies.

INTRODUCTION

A potentially major groundwater quality problem has been recognized with expanding development of water from closed basins in the arid to semi-arid southwestern United States. There has been increasing reports of high nitrate concentrations in the groundwater in areas with little or no previous development. Many nitrate levels exceed the U.S. drinking water standard of 10 mg/l as N. The origin of the nitrates in the groundwater and soil are believed to be natural.

In this paper four areas in Nevada (Fig. 1) are briefly described where it is believed that the source of nitrogen in the soil and/or groundwater is from natural sources. The areas are Las Vegas Valley and Nevada Test Site (NTS) in Southern Nevada and Washoe Valley and Fort Churchill in Northern Nevada. Potential sources of nitrogen include solution and transport from bedrock, fixation from the air by organisms and photochemical reactions, and buried

shallow lake (playa) deposits of organic or evaporite material.

RESULTS

The problem of high nitrate concentrations in groundwater first became apparent in the Gilcrease Ranch area of Las Vegas Valley in 1972. By 1977 over 40 homes in a 17 km² area had nitrate concentrations in the well waters up to 125 mg/l as N (ref. land 2). Several sources were considered including nitrogen fertilizer, septic system and animal corral leachate, and natural organic or evaporite materials. After extensive groundwater and soil sampling and analysis it was concluded that the most likely source of nitrates was the natural sources. Nitrate concentrations in the soil were up to 1400 mg/kg. Tables 1 and 2 present representative groundwater quality and soil chemistry data including samples with high and low nitrate concentrations.

The second area was Fort Churchill State Historical Monument in Lyon County Nevada. The well supplying water to the monument contained as much as 18 mg/l NO₃⁻-N (Table 1). Initially the Monument's septic system was suspected as the source of nitrates. Investigations (ref. 3) concluded that the nitrates were most likely coming from natural deposits associated pluvial lake conditions in the past. Other wells in the area had acceptable water quality. It seemed that the monument's well was located at a site of potential organic accumulation under pluvial conditions.

A third documented area is New Washoe City on the east side of Washoe Lake, just south of Reno, Nevada. As the area developed it was discovered that the groundwater did not meet drinking water standard for several constituents including nitrates (ref. 4). The groundwater was being developed from unconsolidated deposits associated with Washoe Lake. The source of the nitrates again was presumed to be natural. Nitrate levels were up to 18 mg/l NO₃⁻-N.

Very high nitrate levels were discovered in the playa sediments on the NTS (ref. 5). Concentrations up to 20,000 mg/kg were reported. Later sampling at other locations on the NTS indicated higher nitrate concentrations were associated with the playa areas than with the non-playa areas (Table 2). There are no reported high nitrate concentrations in well waters on NTS.

The results from the four areas has spurred research efforts into the source and mechanism of concentration of the nitrates in the desert environment. Possible sources include solution and transport from bedrock to concentration as an evaporite deposit, fixation from the air by organisms and photochemical reactions, and buried organic material. Field and laboratory studies are progressing on the origin and process of concentration. A better understanding of the occurrence of natural nitrates is necessary to assess the impacts of man on present and future development of groundwater supplies.

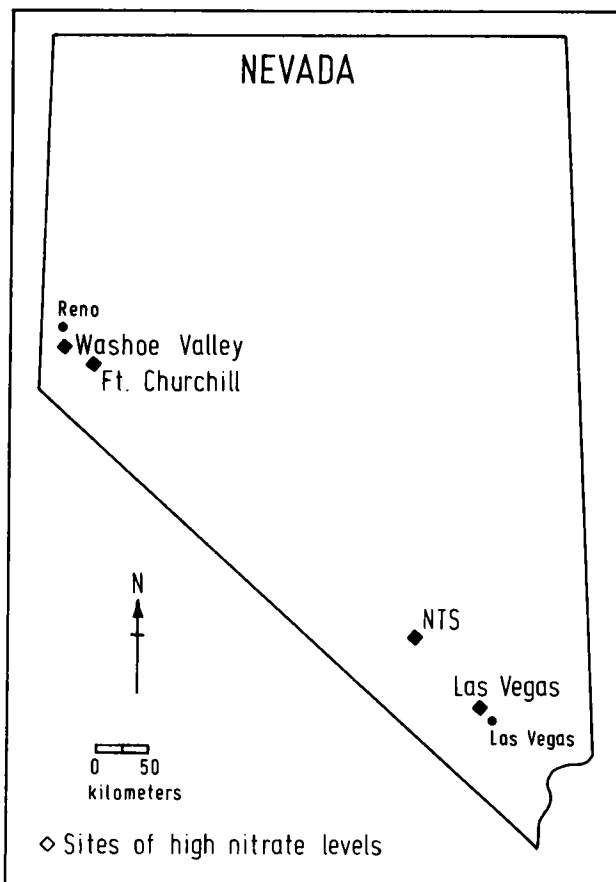


Fig. 1. Location map of natural nitrate occurrences in Nevada.

TABLE 1

Representative groundwater quality

Location	T (°C)	TDS (mg/l)	NO ₃ -N (mg/l)
Las Vegas	16	1500	125
	16	240	1
Fort Churchill		1200	18
		340	0.2
Washoe Valley	15	185	16
	13.5	165	.5

TABLE 2

Representative soil nitrates

Location	Depth (m)	NO ₃ ⁻ (mg/kg)	Setting
Las Vegas	.3	750	Spring mound deposit
	1.5	1400	Desert soil
NTS	.3	20000	Playa
	.3	3000	Playa
	.3	200	Non-Playa

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