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GENERAL GEOHYDROLOGY OF THE PAJARITO PLATEAU

by

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INTRODUCTION

The Pajarito Plateau, twenty miles northwest of Santa Fe in north-central New Mexico, forms an apron of volcanic and sedimentary rocks around the eastern flanks of the Jemez Mountains (Fig. 1). The plateau slopes gently eastward from the mountains toward the Rio Grande where it terminates in steep slopes and cliffs formed by down cutting of the river. It is dissected into a number of narrow mesas by south-eastward trending intermittent streams.

The main aquifer lies at depth of 600 to 1200 ft beneath the surface of the plateau in rocks of the Santa Fe Group. This is the only aquifer in the area capable of municipal and industrial water supply.

GEOLOGY

The plateau is formed by rocks of the Santa Fe Group of middle(?) Miocene to Pleistocene(?) age, and volcanic rocks of Pliocene and Pleistocene age (Griggs, 1964). The Santa Fe Group comprises the Tesuque and the Puye Formations and the basaltic rocks of Chino Mesa. These formations crop out along the eastern margin of the Pajarito Plateau.

The Tesuque Formation consists of friable to moderately well cemented light-pinkish-gray to light-brown siltstone and sandstone that contains lenses of conglomerate and clay. Some basalt flows are interbedded in the unit. The sedimentary rocks were derived from two sources. The lower part of the formation consists principally of fine arkosic quartz sand derived from source areas east of the Rio Grande. The upper part consists of very coarse arkosic quartz sand, latitic gravels, and volcanic detritus, derived from sources both east and west of the Rio Grande (Griggs, 1964).

The Puye Formation is a poorly consolidated conglomerate channel-fill deposit overlain by a fanglomerate composed of volcanic debris. The channel-fill deposits are gray and consist of fragments of quartzite, schist, gneiss, and granite, ranging in size from sand to boulder. The fanglomerate is generally gray and consists of pebbles and cobbles of rhyolite, latite, quartz latite, and pumice, in a matrix of silt and sand. Sorting is poor, but lenses of fairly well sorted pumiceous siltstone and water-laid pumice are present within the fanglomerate. The rocks were derived from flows associated with the volcanic rocks of the Jemez Mountains.

Basaltic rocks of Chino Mesa consist of basalt and basalt breccia that overlie the Puye Formation along the Rio Grande and interfinger with the conglomerate to the west beneath the Pajarito Plateau (Fig. 2). The basalt, which thickens southward along the river and thins westward, originated from volcanic vents near Chino Mesa (Fig. 1).

Major volcanic units in the area are the Tschicoma Formation of Pliocene age and the Bandelier Tuff of Pleistocene age.

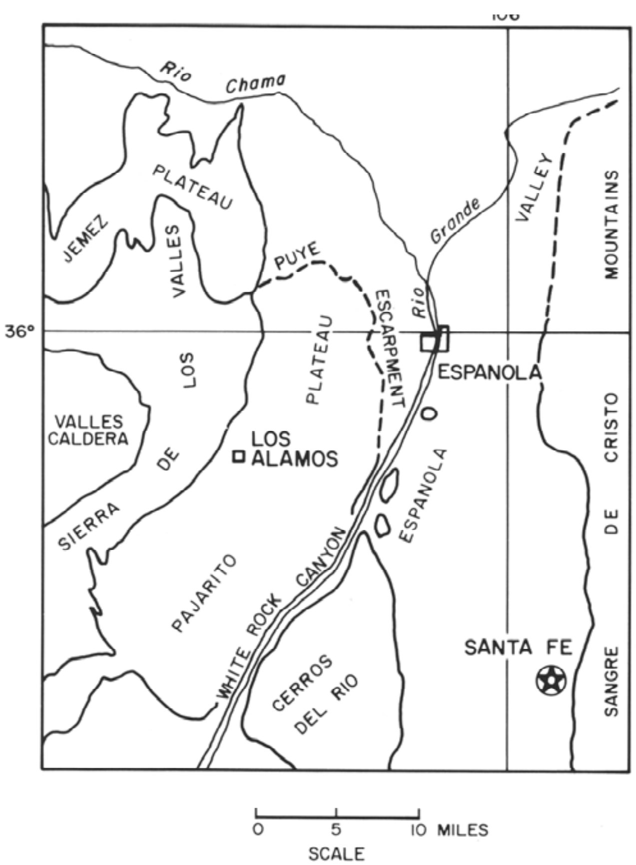

Figure 1. Geographic features in the vicinity of the Pajarito Plateau.

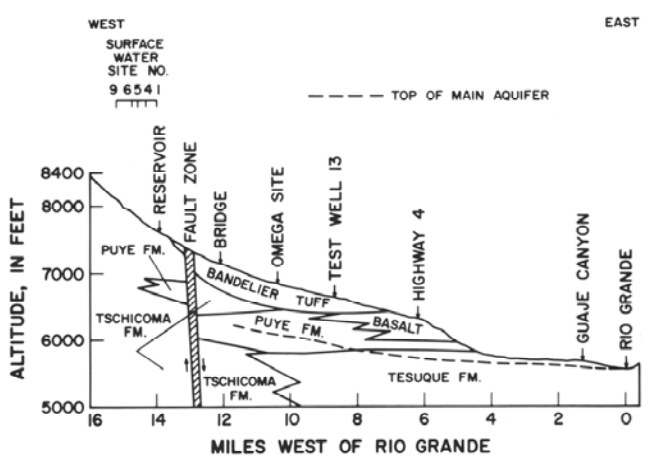

Figure 2. East-west geologic section through the Pajarito Plateau.

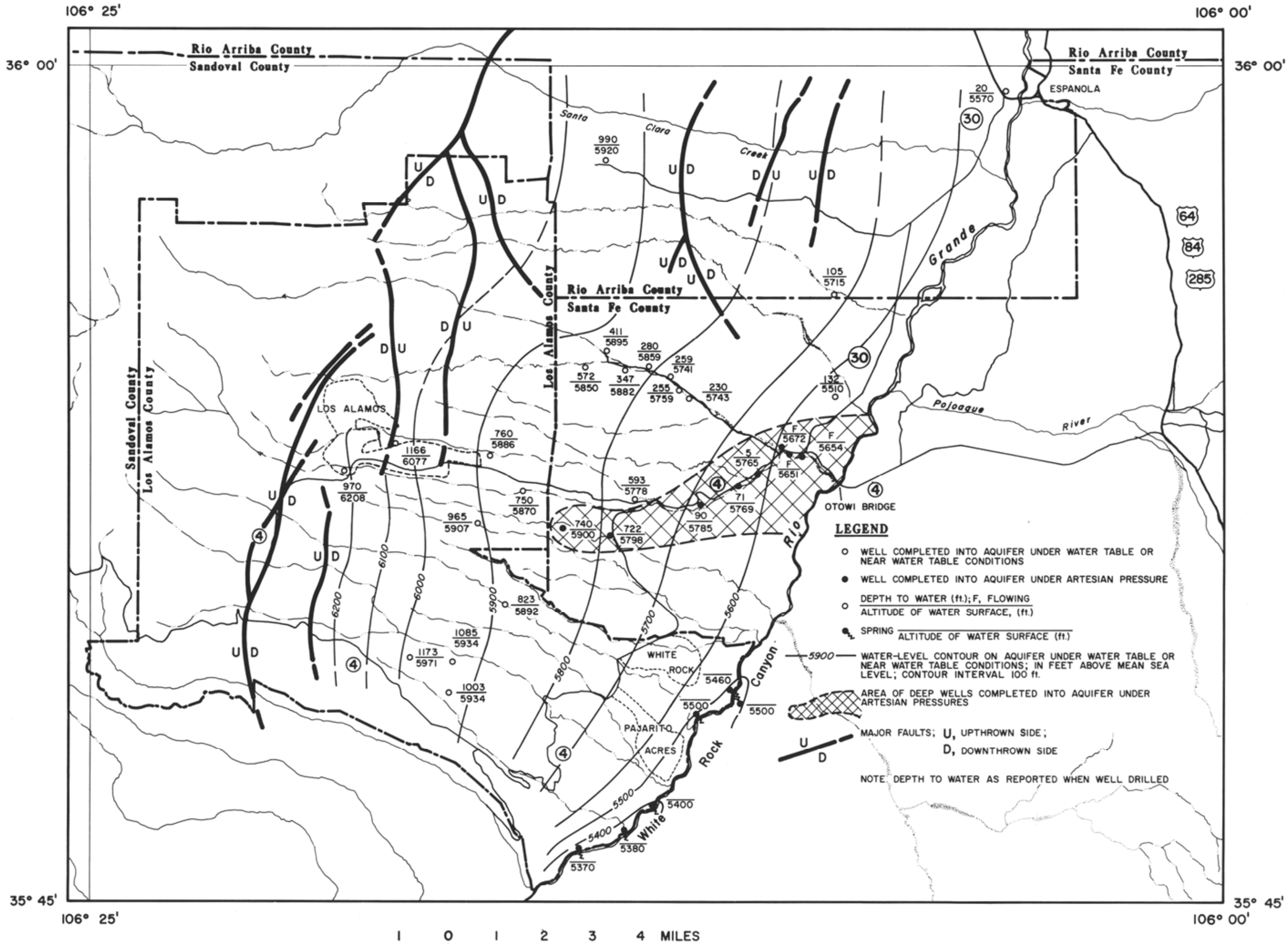

Figure 3. Generalized contours on top of main aquifer.

The Tschicoma Formation forms the mountains of the Sierra de los Valles, and is present in the subsurface beneath the western edge of the plateau (Fig. 2). It was extruded through and overlies the Tesuque Formation. The Tschicoma volcanics are composed of latite, quartz-latite flows, and pyroclastic rocks. The Tschicoma Formation is overlain by the Bandelier Tuff along the flanks of the mountains. The Bandelier Tuff, a series of ash flows and ash falls of rhyolitic tuff, caps the Pajarito Plateau and unconformably overlies the Puye Formation and basaltic rocks of Chino Mesa in the central and eastern parts of the plateau.

The Tschicoma Formation, the Bandelier Tuff and basaltic rocks of Chino Mesa contain only small amounts of water which are perched above the main aquifer. The main aquifer is in the lower part of the Puye Formation and Tesuque Formation in the western and central part of the plateau and within the Tesuque Formation along the eastern edge of the plateau.

HYDROLOGY

The upper surface of the main aquifer rises westward from the Rio Grande through the Tesuque into the lower part of the Puye Formation beneath the central and western parts of the plateau (Fig. 2). The water in the aquifer moves from the major recharge area in the Valles Caldera eastward toward the Rio Grande where a part is discharged into the river through seeps and springs (Fig. 3).

The major recharge area for the aquifer is the intermountain basins formed by the Valles Caldera. The upper parts of the sediments in the basins are lacustrine deposits of clay, sand, and gravels (Conover and others, 1963), which are underlain by volcanic debris resulting from the collapse of the caldera. Sediments and volcanics in the basin are highly permeable and are saturated. The basin fill material recharges the main aquifer in sediments of the Tesuque Formation.

Minor amounts of recharge may occur in the deep canyons containing perennial streams on the flanks of the mountains. The intermittent streams in canyons which are cut into the plateau add little if any recharge to the main aquifer.

Gradient on the surface of the aquifer averages about 60 feet per mile beneath the plateau in the Puye Formation with the depth to water decreasing along with the gentle slope of the surface of the plateau from about 1200 feet to the west to about 600 feet to the east. The gradient of the aquifer steepens to about 100 feet per mile along the eastern edge of the plateau as the water in the aquifer moves into the less permeable sediments of the Tesuque Formation. The aquifer is under water table conditions in the western margin of the plateau and is artesian along the eastern edge and along the Rio Grande (Fig. 3).

The Rio Grande is the principal area for ground water discharge from the main aquifer. A gain in stream flow of the river as it passes through White Rock Canyon was first described by Spiegel and Baldwin (1963). Cushman (1965) estimated that the 11.5 mile reach of the canyon below Otowi Bridge receives a discharge from the main aquifer of 4300 to 5500 acre-feet annually.

The first water-supply wells for Los Alamos municipal and industrial supply were developed along the eastern edge of Pajarito Plateau in 1947. These wells are completed in the main aquifer and consist of six wells in the Los Alamos Canyon field and seven wells in the Guaje Canyon field. Well depth ranges from 870 to 2000 feet (Purtymun and Herceg, 1972).

Aquifer tests of wells located in the eastern well field, which penetrate about 1600 feet of the fine grained sediments of the Tesuque Formation, indicate an average coefficient of transmissibility of 20,000 g/d/ft of the aquifer (Cushman, 1965). These wells yield an average of 500 gpm with a specific capacity of 8 gpm/ft of drawdown.

The partial saturation of the coarse volcanic debris of the Puye Formation and coarse volcanic debris and arkosic sands of the Tesuque Formation has also led to the development of high yield wells for municipal and industrial supply in the central part of the Pajarito Plateau (Purtymun and Cooper, 1969). Three wells in the Pajarito field were developed from 1965 through 1968. These wells range in depth from 2300 to 2550 feet. The three wells have produced more than 40 percent of the 4700 acre-feet of water used at Los Alamos since 1968.

Aquifer tests of wells on the plateau indicate a coefficient of transmissibility range from 40,000 to 320,000 g/d/ft of the aquifer which includes an average of 250 feet of Puye Formation and 1550 feet of the Tesuque Formation. High yield wells in this area average 1000 gpm with a specific capacity of about 35 gpm/ft of drawdown.

The chemical quality of water may vary within the well fields due to local conditions within the aquifer. In general the quality of water is good; total dissolved solids range from about 200 mg/l to less than 500 mg/l. Silica concentrations range from 35 to 80 mg/l while total hardness (as $CaCO_3$) ranges from 25 to 100 mg/l.

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