Geologic Map of the Las Vegas Quadrangle, San Miguel County, New Mexico

By

Steven J. Skotnicki

May, 2003

New Mexico Bureau of Geology and Mineral Resources
Open-file Digital Geologic Map OF-GM 72

Scale 1:24,000

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801 Leroy Place, Socorro, New Mexico, 87801-4796

Geologic Map of the Las Vegas 7.5' Quadrangle, San Miguel County, New Mexico

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Includes 8-page text, and 1:24,000 scale geologic map.

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INTRODUCTION

The City of Las Vegas sits at the old juncture between the north-south Spanish Empire and the east-west American Empire (Las Vegas Chamber of Commerce). Poised at the confluence of two major streams, Gallinas Creek and Arroyo Pecos, the area has been a locus of trade since at least the early 16th century. The chance meeting between a band of Missouri traders led by William Becknell and a battalion of Mexican soldiers under the command of Captain Pedro Ignacio Gallego near Puerto del Norte ('the northern door') in 1821 led to the opening of the Santa Fe Trail. Although weathered, ruts from wagons heading west on the Trail can still be seen today near the northern boundary of the quadrangle. In 1879 the Atchison Topeka and Santa Fe Railroad reached Las Vegas and drastically reduced the travel time from the east. Old wagon roads were widened and improved in the beginning of the 20th Century to accommodate the growing demand for roads suitable for automobile travel, eventually leading to the building of Interstate Highway I-25.

The Las Vegas 7.5' quadrangle was mapped concurrently with mapping immediately to the north in the Las Vegas NW 7.5' quadrangle (Lisenbee, 2003). Fieldwork was carried out during October of 2002.

THE DAKOTA SANDSTONE

The type section for the Dakota Group is in northeastern Nebraska, named by Meek and Hayden (1861) for rocks in Dakota County. Mateer (1987) gives a detailed summation of previous studies in the Dakota Group and points out that because of facies changes the sedimentology of the Dakota is quite variable on a regional scale. He also points out that the term "Dakota Sandstone" is more a colloquial term than it is a formal designation.

One of the best exposures of the Dakota in the Las Vegas area is in the I-25 highway road-cut immediately east of Romeroville, in the southwest part of the quadrangle (see photo in figure 10 of Mateer, 1987). Here the Dakota can be subdivided into three different units: (1) a lower, thick-bedded sandstone unit, (2) a middle, thin, 1-2 meter-thick, dark, thin-bedded shale interval (the Pajarito Shale: Gilbert and Asquith, 1976; Mateer, 1987), and (3) an upper medium- to thin-bedded sandstone unit. These three units were not mapped separately in the field. The middle shale horizon is not visible everywhere the Dakota was mapped in the field area. The upper sandstone unit, however, is commonly slightly darker orange and finer-grained than the lower thick-bedded sandstone unit. The upper sandstone commonly caps mesas and sheds dark detritus.

Gilbert and Asquith (1976) indicate that the transition from the upper sandstone unit into the overlying Graneros Shale is gradational, but S. Lucas (written communication, to Mateer, 1987) states that the contact is sharp. The contact was observed more thoroughly in this study. Dark shale rests in sharp contact on dark orange sandstone of the Dakota. However at least two and locally three thin, dark orange quartz-sandstone beds each up to 10 cm thick are interbedded with dark shale in the lowermost 1-2 meters of the Graneros Shale.

THE GREENHORN LIMESTONE

The Greenhorn Limestone is composed of interbedded dark shale and light gray limestone in beds several centimeters to several tens of centimeters thick. Hattin (1987) described the shale-limestone couplets as rhythmites which are apparently time-parallel over a large area of the Midwest. The Greenhorn Limestone was deposited in the Late Cretaceous Interior Seaway in relatively deep water possessing poor circulation. The limestones are predominantly micrite and contain some darker gray fossils of *Inoceramus* and *gryphaea*. In thin-section much of the limestone is composed of foraminifera tests, calcispheres, fecal pellets, and some organic matter (Hattin, 1987). Hattin (1987) described abundant bioturbation.

The Greenhorn caps the slightly west-dipping plateau east of the city of Las Vegas. Here, the best exposures are along the bluffs on the east side of Gallinas Creek. A few other good exposures are marked on the map. One such exposure is in a cut about one mile north of the city, apparently to divert the creek through the hill to create space for development. This exposure is also shown in figure 4b of Hattin (1987, p. 238). Rock units were very difficult to map within the city of Las Vegas itself. Most exposures have been either modified or covered over. However, locally light gray rectangular blocks of the Greenhorn Limestone are exposed in driveways or can be seen weathering out of front yards.

STRUCTURE

Syncline

Uplift of the Sangre de Cristo Mountains during west-directed compression during the Laramide orogeny has folded all of the exposed Mesozoic formations into a narrow syncline. The hinge-line of the syncline trends approximately north-south very close to the eastern side of Crestone Ridge. The syncline is asymmetric. Its eastern limb dives at most 8° westward under the city of Las Vegas. Its western limb is much steeper with dips as steep as 38° to the east. Crestone Ridge itself is held up by the resistant Dakota and Morrison Formations. The center of the syncline contains the Graneros Shale and remnants of the Greenhorn Limestone. Gallinas Creek and Arroyo Pecos preferentially followed the center of the syncline and have subsequently eroded down into these less resistant formations.

Jointing

Jointing is very pervasive in the Mesozoic sedimentary rocks. It is more obvious in the more competent rocks such as the Dakota sandstone and the Greenhorn Limestone. Jointing is nearly perpendicular to bedding, is near-vertical (except where the rocks have been folded), and is spaced commonly 10 to tens of centimeters apart. Joints are preferentially aligned N10°E. Alvis Lisenbee (pers. comm.) suggested that the pervasive jointing may be the result of regional upwarping during the Laramide.

LANDSCAPE DEVELOPMENT

An older level of stream gravels caps hills in the northeastern part of the map area. These older gravels (map unit QTc) sit at about 6800 feet and are composed of subrounded to well rounded pebbles and cobbles derived mostly from Proterozoic intrusive rocks exposed in the Sangre de Cristo mountains to the northwest. Only a few meters thick these gravel deposits form flat terraces that are slightly inclined to the northwest. The projection of this ancient surface to the northwest rises up over the current top of Creston(e) Ridge. Hence, this terrace level formed when the paleo-Gallinas Creek flowed at or above 6800 feet and erosion had not yet removed any material below this level. The remnants of this older terrace level are capped by dense, laminar caliche (Stage IV) up to 2 meters thick where exposed in workings. This caliche has been mined for use in cement and most of the original caliche cap on these remnants has been stripped away. Good exposures of this caliche cap are at UTM N3937400, E485800. The high level of these remnants and the extensive caliche development implies very old age. Without more precise data the deposits are here designated as probably late Tertiary or early Pleistocene deposits.

Subsequent entrenchment of Gallinas Creek and Arroyo Pecos has removed about 400 feet of older material and created a series of incised terraces. These terraces have been mapped as early Pleistocene (map unit Qor), middle Pleistocene (map unit Qmr) and late Pleistocene (map unit Qlr) terraces based on their relative position in the landscape (i.e., their height above the modern stream channel). Curiously, the older terrace deposits all appear to be consistently coarser-grained than the youngest Holocene terrace deposits (map unit Qy). Exposures along the modern entrenched arroyos indicated that the Holocene deposits also locally contain abundant subrounded to rounded pebbles, but overall these younger deposits contain fewer larger clasts and more abundant silt and fine sand. The reason for this difference is unclear but it may be tied to fluctuations in climate and subsequent erosion rates in the Pleistocene and Holocene (Peizhen et al., 2001).

Thick soil development, particularly on the Graneros Shale and shale-rich members of the Carlisle Shale, has obscured outcrops and made mapping in these areas difficult. An effort was made to determine what rock type lay beneath these soils because exposures in stream-cuts indicated that soils were no thicker than about 2 meters at least locally. The amount of clay development on slopes indicates that these soils are at least Late Pleistocene in age and probably older.

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