

Capitan Reef Complex Structure and Stratigraphy

December 2009

Errata

Revisions to certain text, tables, and figures regarding changes in nomenclature of the Carlsbad Limestone and the Artesia Group

An inconsistency is apparent in the final draft of this report regarding the designation and inclusion of the Carlsbad Limestone and equivalents of the Capitan Reef Complex in the vicinity of the Guadalupe Mountains of Texas and New Mexico. The Capitan Reef Complex outcrop extent was much wider on the Texas side of the border than the New Mexico side of the border. In the submitted report, DBS&A used the available GIS geology datasets from Texas (Van Horn-El Paso GAT sheet by Dietrich and others, 1983) and New Mexico (Anderson and others, 1997; Scholle, 1980, 1992). Neither the geologic nomenclature nor the mapped extent of the some of the surface geology in these two sets of sources matched at the border. Errata Figure 1 is an enlargement of the submitted Capitan Reef Complex outcrop along the Texas-New Mexico border that illustrates the issue.

The TWDB was concerned that this issue could present a problem when a groundwater model of this region is constructed. However, from about the Texas-New Mexico state line to approximately 5 miles northeast of Carlsbad Caverns, the Capitan Reef Complex occurs above the water table (personal communication, Steve Finch, John Shomaker and Associates, Inc., December 4, 2009); therefore, the adjustments documented herein are likely to be most applicable to the delineation of potential recharge zones rather than aquifer extent.

The Capitan Reef Complex outcrop as illustrated in Errata Figure 1 includes the Goat Seep, Capitan, and Carlsbad Limestones, as defined by King (1948) and Dietrich and others (1983), on the Texas side of the state line. The Carlsbad Limestone is not delineated as a geologic unit in New Mexico. The re-definition and/or nomenclature change of the Carlsbad Limestone as defined by Hiss (1975), Meissner (1972), and Hill (1996) was not implemented in the submitted report. Other geologic units, such as the Capitan Limestone and the Victorio Peak Limestone are continuous across the state line. We conclude that this discrepancy is due to mapping resolution and scale and differences in geological nomenclature between the two states.

Hiss (1975, p.136), based on Meissner (1972), defines the Capitan aquifer (assumed to be equivalent to the Capitan Reef Complex) as “. . . a lithosome that includes the Capitan and Goat Seep Limestones and most or all of the Carlsbad facies [carbonate] of the Artesia Group.” The Artesia Group includes, in descending order, the Tansill, Yates, Seven Rivers, Queen, and Grayburg Formations. According to Hiss (1975), the Capitan Limestone is the lateral equivalent of the Tansill, Yates, and Seven Rivers Formations,

and the Goat Seep Limestone is the lateral equivalent of the Grayburg and Queen Formations. Hiss (1975, p. 83) also notes that “The lithologic character of rocks within the Artesia Group and the formations within the Artesia Group cannot be ascertained from the name of the unit because of the prominent facies changes that occur in this sequence of sedimentary rocks.”

The Carlsbad Limestone (the geologic unit not delineated in New Mexico) nomenclature was defined by Meinzer and others (1926) and Lang (1937), as referenced in Hiss (1975), to include near-shelf dolomites and thinner interbedded sandstones above the Queen Formation and below the Castile Formation (or Tansill, Yates, and Seven Rivers Formations).

Hiss (1975, p. 137) details his process of defining the isopach thickness of the Capitan Aquifer (or Capitan Reef Complex) as follows:

“The tops and bases of the Capitan aquifer were determined primarily on the basis of the vertical extent of the relatively ‘clean’ carbonate as indicated by the low gamma-ray activity levels shown on the electrical logs and the general stratigraphic position. Lithologic logs, oil field scout tops, reports of lost circulation, and other information were used whenever available to confirm these picks. Zones containing 50 percent or less of interbedded back or fore-reef lithofacies (carbonates) were arbitrarily included with the Capitan aquifer as a matter of convenience.”

This same approach was used by DBS&A as described in Sections 4.4 and 4.5 of the report.

The revised interpretation of the isopach thickness of the Capitan Reef Complex in the vicinity of the Guadalupe Mountains is illustrated in Errata Figure 2, based on Hiss (1975), Meissner (1972), Hill (1996), Anderson and others (1997), and Scholle (1980, 1992). We note the following regarding the revised interpretation:

1. No subsurface well information is available in the Guadalupe Mountains to determine the percent thickness of carbonate intervals within the Artesia Group near the New Mexico side of the state border. The southern extent of Hiss’s (1975) subsurface interpretation of the Capitan Reef Complex in New Mexico is illustrated in Errata Figure 3, as is the available subsurface well data in Texas used for this study.
2. Hiss (1975) does not include a geological map of the base of the Capitan Reef Complex, but he does include a top elevation surface and estimated thickness. The DBS&A team used this information to interpolate the base elevation surface as described in Section 4 of the report.
3. Because subsurface well data required to confirm carbonate thickness percentage of the Artesia Group in New Mexico near the state line are not available, the DBS&A team assumed that the total thickness of the Artesia Group outcrop within the Capitan Reef Complex outline presented in Errata Figure 2 includes

lithology with 50 percent or more carbonate rocks (Hiss, 1975) and is therefore considered part of the Capitan Reef Complex. This is the most appropriate approach at this time, given existing studies and available information, to respond to the TWDB's requirement that the geographic extent of the Capitan Reef Complex be in agreement across the state line in the relatively local Guadalupe Mountains area.

The following revisions to the final report are also noted based on the revised definition of the Carlsbad Limestone Group, as requested by TWDB.

Figures: In Figures 1, 2, 5, 7, 10, 17, 18, 19, 20, 21, 22 and 23, revise the Capitan Reef Complex outcrop in the Guadalupe Mountains to the Errata Figure 2 outcrop.

In Figure 4, replace the "Carlsbad Group" with "Carlsbad Group Equivalent Artesia Group"

In Figure 8, Under "Explanation" and "Overlying Units," the text for the dark medium blue symbol should be changed from "Capitan Outcrop with overlying Quaternary deposits" to "Capitan Outcrop with Artesia Group and overlying Quaternary deposits."

In the Legend of Figure 12, remove "Carlsbad Limestone" from the Capitan Reef Complex and assign Carlsbad Limestone areas in the figure to the Artesia Group.

Table 1: Under the Guadalupe Mountains column, modify the Capitan Reef Complex to be equivalent to only the Capitan Limestone and the Goat Seep Limestone. Replace the Carlsbad Limestone with "Carlsbad Group Equivalent Artesia Group" under the Capitan Reef Complex designation.

Text: **Section 3.1**, Stratigraphy, second sentence: Revise to read, "The Capitan Reef Complex combines the Goat Seep, Carlsbad Group Equivalent Artesia Group, and the Capitan and Glass Mountain equivalent (Tessey and Vidrio) carbonate rocks (Hiss, 1975; King, 1930; Hill, 1996, 1999) and grades into adjacent fore-reef and back-reef facies."

Section 3.1.4, Capitan Reef Complex, first sentence: Revise to read, "For all practical purposes, the Capitan Reef Aquifer (Table 1) is defined as Permian carbonate reef-forming rocks that include the Goat Seep, Carlsbad Group Equivalent Artesia Group, and Capitan and Glass Mountain equivalent (Tessey and Vidrio) carbonates (Hiss, 1975; King, 1930; Hill, 1996, 1999)."

Section 3.1.5, Artesia Group, second and third sentences: Replace with, "The older Carlsbad nomenclature was replaced by the Artesia Group (Hiss, 1975; Meissner, 1972; Hill, 1996), and depending on the percentage of carbonate in these formations, they may locally be included as part of the Capitan Reef Complex."

Section 4.2, Geology and fault data sources, end of second paragraph: Add, “The Carlsbad Group nomenclature as used in the Van Horn-El Paso GAT sheet (Dietrich and others, 1983) was revised by Hiss (1975), Meissner, (1972), and Hill (1996) to the Artesia Group. This nomenclature change improved the geological formation match of the Capitan Reef Complex outcrop across the Texas-New Mexico border in the Guadalupe Mountains.”

Section 4.3, Stratigraphic interpretation, first paragraph, third sentence: Revise to read, “Hiss (1975) considered the Capitan Reef Complex to include the Goat Seep, Capitan, Carlsbad, and Artesia Group limestone equivalents, where present on the reef margin.”

Section 4.6, Generalized hydraulic communication characteristics of the geologic formations or groups, second paragraph, fifth bullet (“The undifferentiated Artesia Group), second sentence: Modify to read, “These undifferentiated Artesia Group formations include interbedded dolomite, gypsum, clays, and silts and can locally range from being semi-confined to having moderate hydraulic communication.”

Section 4.8, seventh paragraph, second sentence: Revise to read, “The true thickness was determined using GIS based on the dip of the Capitan Reef Complex, which ranges from 1 to 15 degrees, . . .”

Additional References

Green, G. N., and Jones, G. E., 1997, The Digital Geologic Map of New Mexico in ARC/INFO Format: Open-File Report OFR 97-0052, U.S. Geological Survey, Denver. Available at <<http://pubs.usgs.gov/of/1997/ofr-97-0052>>.

Kelley, V. C., 1971, Geology of the Pecos County, southeastern New Mexico: New Mexico Bureau of Mines & Mineral Resources, Memoir 24, 78 p.

Meissner, F. F., 1972, Cyclical sedimentation in mid-Permian strata: *In* Elam, J. G., and Chuber, Stewart, eds. Cyclic sedimentation in the Permian Basin, second ed.: West Texas Geology Society, Pub. 72-18, p. 203-232

Scholle, P. A., 1980, 1992, Generalized geologic map of the Guadalupe Mountains and surrounding areas. <<http://geoinfo.nmt.edu/staff/scholle/graphics/permdiagr/GuadGeolMap.html>>.



Allan Standen, P.G. No.1227
Daniel B. Stephens & Associates, Inc.

