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Dakota Sandstone-Tres Hermanos relationship, southern San Juan basin area

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DAKOTA SANDSTONE - TRES HERMANOS RELATIONSHIP SOUTHERN SAN JUAN BASIN AREA

BY

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This paper discusses the relationship of the Dakota Sandstone and the Tres Hermanos Sandstone between the Grants area and the Defiance monocline immediately east of Window Rock, Arizona. Since the Discovery of uranium in the Grants area in 1950, thousands of drill holes, perhaps as many as 100,000, have penetrated the Dakota Sandstone between the Puerco fault belt and the Gallup area. It has been the practice of most geologists and drillers who have examined the cuttings and logs from these holes to place the top of the Dakota Sandstone at the base of the lowest tongue of the Mancos Shale while attaching the name Tres Hermanos or "Mancos Sand" to one or more sandstones above the Dakota. The result is that the top of the sandstone called "Dakota" in the Grants area is approximately 300 feet lower stratigraphically than the top of the Dakota Sandstone in the Window Rock area and this boundary is inconsistent with the top of the Dakota Sandstone applied in other parts of the San Juan Basin.

The stratigraphic information available from the electric logs of numerous drill holes across the southern part of the San Juan Basin shows that the Dakota Sandstone of present usage in the Grants area is not present in the Gallup area. The overlying three units of the Tres Hermanos Sandstone merge westward to form a single, thinner unit to which the name Dakota Sandstone should be applied.

The Dakota and Tres Hermanos terminology presently applied in the southern part of the San Juan Basin has its origin with Hunt (1936, p. 39) who described the Dakota Sandstone east of Mount Taylor as a buff-tan sandstone attaining a maximum thickness of 75 feet but locally absent. In the overlying 300 feet of the Mancos Shale are the three prominent sandstones to which Hunt applied the name Tres Hermanos. Hunt suggested that the Dakota Sandstone west of Mount Taylor is at the horizon of one of his Tres Hermanos Sandstones.

Dane (1960a, p. 48) remarked that the name "Dakota Sandstone" has been applied in the southern part of the San Juan Basin to only part of what is elsewhere called Dakota, and he recognized that part of the section overlying the Dakota Sandstone joins with and becomes part of the Dakota in other areas of the San Juan Basin.

Owen (1966), noting the inconsistant placement of the boundary between the Mancos Shale and the Dakota Sandstone, proposed to change the nomenclature to include the type Tres Hermanos Sandstone in the Dakota. Owen pointed out that the type Tres Hermanos Sandstone of Herrick (1900) can be traced northward into the uppermost of the three sandstone units that comprise Hunt's Tres Hermanos Sandstone, and that the type Tres Hermanos and the sandstone tongues below it merge northward with the main body of the Dakota Sandstone.

It should be noted that Owen and Dane are in serious disagreement on several points, particularly as to which unit of Hunt's Tres Hermanos Sandstone actually merges with the Tres Hermanos Sandstone defined by Herrick. Dane (1959, p. 87) correlates the No. 2 or middle sandstone of Hunt with the type Tres Hermanos. Further disagreement exists in connecting the Tres Hermanos with the Dakota to the north. Dane (1960b, p. 67) noted that the upper part of the Dakota Sandstone on the eastern side of the San Juan Basin is approximately equivalent to sandstone No. 1, the lowermost of Hunt's three sandstone units.

Moench and Schlee (1967, p. 23) in discussing the Cretaceous stratigraphy of the Laguna district, avoided the use of the name Tres Hermanos by referring to Hunt's three sandstone units as lower, middle and upper sandstone units in the lower part of the Mancos Shale.

Line A-A' shown on Figure 1 is an electric log cross-section utilizing a random sample of the drill holes between the locality of Ambrosia Lake and the Defiance monocline east of Window Rock, Arizona. The reference line is the top of the uppermost Tres Hermanos Sandstone. The characteristic section of Hunt consisting of the Dakota Sandstone and the three overlying Tres Hermanos Sandstone units is clearly shown in the right hand log. Moving westward to section No. 9, the Dakota Sandstone and overlying No. 1 and No. 2 units of Hunt's Tres Hermanos rapidly merge into one homogeneous unit.

Hunt's Dakota Sandstone thins rapidly westward from the base due to the westward onlapping Cretaceous shoreline. The sandy character gradually changes to a predominantly shale lithology with thin sandstone interbeds. In section 6 and 7 this shaly character can be seen in the lower 75 feet of the Dakota. Immediately west of section 6 Hunt's Dakota Sandstone pinches out. The lower and middle units of Hunt's Tres Hermanos continue westward as a single unit and form a persistent lower member of the Dakota Sandstone.

The upper sandstone retains its separation from the underlying mass of the Dakota to the vicinity of the Defiance monocline where the intervening shale begins to assume a sandy character. It then becomes practically in-

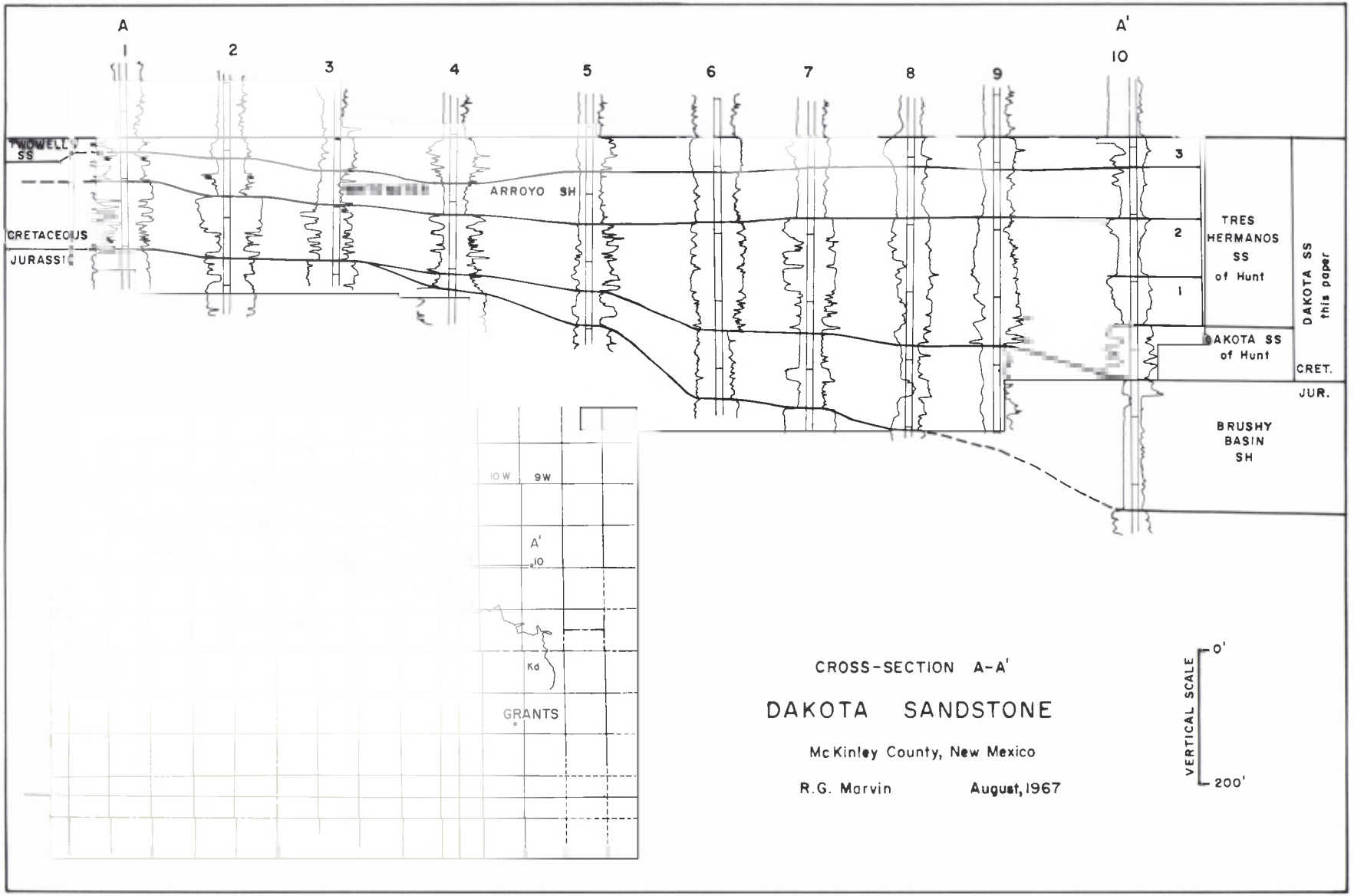


FIGURE 1
Electric log cross section between Defiance Monocline (A) and Ambrosia Lake (A′).

separable from the underlying sandstones although Owen (1966, p. 1027) states that it can be recognized as far north as Toadlena.

In the Gallup area the Dakota interval consists of three distinct units. The lower unit, 80 to 100 feet thick, consists of medium- to coarse-grained, carbonaceous, conglomeratic sandstone interbedded with dark gray shale and coal. Overlying the lower member is a prominent tongue of the Mancos Shale, about 60 feet thick, for which Owen (1966, p. 1026) proposed the name Whitewater Arroyo Shale Member of the Dakota Sandstone. The upper unit of the Dakota is fine- to medium-grained, calcareous, glauconitic sandstone about 50 feet thick containing *Gryphaea newberryi* at its top. To this sandstone Pike (1947, p. 35) applied the name Twowells Sandstone Lentil of the Mancos Shale.

The lower member of the Dakota Sandstone in the Gallup area is comprised of Hunt's No. 2 sandstone and probably all of sandstone No. 1.

The Whitewater Arroyo Shale can be correlated from the Gallup area eastward into the Mount Taylor area where it occupies the interval between the Tres Hermanos No. 2 and No. 3 sandstones. Northwest of Gallup the Whitewater Arroyo Shale thins and is rapidly replaced by sandstone suggesting that the shoreline of that particular transgression lay across the Defiance Uplift. Near Window Rock the Whitewater Arroyo Shale is composed of nearly equal parts sandstone and shale.

A water well drilled in the center of the Gallup syncline 18 miles south of Gallup offers a clue to the direction of the shoreline in Dakota time. The thickness of the Whitewater Arroyo Shale in the water well corresponds to that found between section number 4 and 5 indicating a shoreline trend of N. 25° - 30° E. No effect on the thickness of the Whitewater Arroyo Shale by the Zuni Uplift is indicated.

The Twowells Sandstone Lentil is the same sandstone as the uppermost Tres Hermanos of Hunt. The probable equivalence of the Twowells and the Tres Hermanos Sandstone has been suggested many times but the literature is ambiguous in regard to the precise relationship of these units. Pike has been credited with having made the correlation (Dane, 1957, p. 97) and (Owen, 1966, p. 1026); however, Pike was referring to a sandstone he measured near Atarque which he believed to be stratigraphically lower than the Twowells. Pike considered the Twowells to be a lentil in the Mancos Shale extending from near Black Rock northward to approximately U.S. Highway 66, a distance of not over 40 miles. Pike did however, speculate that the Tres Hermanos Sandstone is a tongue of the Dakota Sandstone (Pike, 1947, p. 93).

Dane (1960a, p. 50) stated that he believed the Twowells and the Tres Hermanos are the same sandstone but presumably he was referring to the No. 2 sandstone unit of Hunt's since his statement followed an earlier paper (Dane, 1959, p. 87) in which he correlated the No. 2 sandstone with the type Tres Hermanos.

Owen (1966, p. 1026) noted that the Twowells is possibly the same sandstone as the No. 3 (upper) sandstone unit of Hunt's Tres Hermanos but lacked sufficient evidence to unequivocally tie the two sandstones together. The abundance of subsurface data through the southern San Juan Basin leaves no room for doubt as to the equivalence of these units.

Owen's proposal that the upper boundary of the Dakota be raised to include the uppermost Tres Hermanos Sandstone is in concurrence with the opinion of this writer. The change would eliminate the nebulous meaning attached to the present use of the name Dakota and allow the contact to be consistently drawn across the southern San Juan Basin. In addition, the contact would be more nearly correlative with the top of the Dakota in the northern part of the San Juan Basin.

The abundant drill hole data now available indicates that Pike's Twowells Sandstone Lentil is in fact a widespread sandstone unit covering all of the southern part of the San Juan Basin. In view of the lack of agreement on the correlation between Hunt's Tres Hermanos and the type Tres Hermanos defined by Herrick, it is here proposed that the member of the Dakota Sandstone overlying the Whitewater Arroyo Shale be named the Twowells Member of the Dakota Sandstone.

If it can be definitely shown that the type Tres Hermanos is equivalent to Hunt's No. 2 sandstone, the name Tres Hermanos could be applied to that member of the Dakota below the Whitewater Arroyo Shale. The Tres Hermanos Member would then include, in addition to Hunt's No. 2 sandstone, his Dakota and lower Tres Hermanos units.

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