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STRATIGRAPHY OF THE SANTA FE GROUP, NEW MEXICO

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ABSTRACT

THE TYPE AREA of the Santa Fe Group is the region north of Santa Fe, New Mexico, between the Sangre de Cristo Mountains on the east and the Jemez Mountains on the west. This area was part of Hayden's 1869 type section of the Santa Fe marls, which was later called the Santa Fe Formation by Bryan, Smith, Cabot, Denny, and others. Bryan (1938, p. 205), following part of Hayden's original description, mentioned the area north of Santa Fe as the type locality of the Santa Fe Formation, but Denny (1938, 1940b) first formally designated a specific type locality for the Santa Fe Formation as given above. Kottlowski (1953, p. 144) first suggested that the Santa Fe Formation be elevated to group rank. Spiegel and Baldwin (1963, p. 38) proposed an extension of the term Santa Fe Group to include all the sedimentary and volcanic rocks related to the Rio Grande trough, with a range in age from middle(?) Miocene to Pleistocene(?).

The present report proposes to restrict the use of Santa Fe Group to the rocks of the type and contiguous areas. The middle Miocene to middle to upper Pliocene deposits of the type area, heretofore undifferentiated, are divided among five members of the Tesuque Formation, and the Chamita Formation. This division of the group is based on the results of field and laboratory studies since 1924 by the Frick Laboratory of the American Museum of Natural History. The two formations from lowermost to uppermost are: (1) Tesuque Formation and (2) Chamita Formation. Formal names are proposed for the members of the Tesuque Formation.

Deposits of the Tesuque Formation, which is the lowest formation of the Santa Fe Group as here recognized, are divided into five members: (1) the Nambé Member, (2) the Skull Ridge Member, (3) the Pojoaque Member, (4) the Chama-el rito Member, and (5) the Ojo Caliente Sandstone. Fossils collected from the Nambé and Skull Ridge members range in age from medial to late Miocene. The Pojoaque, the Chama-el rito, and the Ojo Caliente Sandstone have produced a large collection of early Pliocene mammalian fossils. These members are lithologically distinct, and, although they may have been deposited through the same general period of time, the beds are advisedly separated as members rather than as facies.

The Chamita Formation, which is the uppermost formation of the Santa Fe Group, represents deposits from a markedly different sedimentary environment compared with the underlying Ojo Caliente Sandstone. Moreover, fossils of medial Pliocene age have been collected from the beds of the formation, with even a few fossils indicative of an early part of the late Pliocene.

Type sections of the Nambé and Skull Ridge members of the Tesuque Formation have been designated in the thick belt of alluvial-fan deposits exposed between Nambé Creek and the Santa Cruz River. The type section of the Pojoaque Member of the Tesuque Formation lies north of the Pojoaque River, northwest of Pojoaque, New Mexico. Most of the sediments of the Pojoaque Member were derived from the predominantly granitic rocks of the Sangre de Cristo Range; these were part of a great system of coalescing alluvial fans arranged along the mountain front. At the same time that the Pojoaque Member was being deposited, as shown by the extensive collection of fossils obtained from each member, another system of alluvial-fan deposits was being built along the northern and northwestern part of the type area of the Santa Fe Group. These volcanic rocks are herein named the Chama-el rito Member of the Tesuque Formation. They were derived from volcanic rocks of the San Juan region of northern New Mexico, and southern Colorado and are lithologically distinct from those of the Pojoaque Member, which are essentially granitic in origin. Although the Chama-el rito was deposited through a long period of time, as is shown by the presence of *Brachyrus* in a locality near Abiquiu, New Mexico, which indicates an equivalence with a part of the Skull Ridge Member, the greatest part of the member was deposited at the same time as the Pojoaque Member. In the area between Battleship Mountain and the Sacred Spring, the uppermost beds of the Chama-el rito are observed to overlie beds of the Pojoaque Member.

The Ojo Caliente Sandstone has been assigned member status and is composed of about 450 feet of light gray to light pinkish gray, colian, soft, friable sandstone. These beds interfinger at the base with the Chama-el rito Member and obviously represent a marked change in sedimentary environment. The southernmost good exposure of the Ojo Caliente Sandstone is on Battleship Mountain where it is no more than 40 feet thick and overlies Chama-el rito beds. The Ojo Caliente Sandstone has been extensively reworked into the basal beds of the overlying Chamita Formation. In some parts of the area, this reworking superficially resembles interfingering, but it is quite different, and also indicates a distinctive change in sedimentary environment.

Beds of the Chamita Formation are lithologically different from all others in the type area of the Santa Fe Group; they overlie the Ojo Caliente Sandstone, and, moreover, they contain fossil mammals that show them to be the latest beds of the Santa Fe Group in the type area. The type section of the Chamita Formation lies 2 miles northwest of the San Juan Pueblo.

The total thickness of the Santa Fe Group, as restricted in this report, is at least 4500 feet and may be as much as 4800 feet. These figures were obtained by our measuring correlated fault blocks in the type area. The thicknesses assigned to the ideal sections of members or formations have been the basis for the estimates.

The sediments of the Santa Fe Group include alluvial-fan and eolian deposits, including conglomerates, gravel, loosely consolidated sandstones, siltstones, volcanic ash, bentonites, tuffaceous deposits, conglomeratic sandstones, intraformational breccias and conglomerates, concretions of various kinds, calcareous and cherty strata, and a small amount of clay. Interbedded volcanic flows are few and of small extent.

Strata of the Santa Fe Group were deformed by high-angle, normal, strike faults during the post-Santa Fe deformation. The faults are closely spaced, and the strata in the resultant fault blocks in the Espanola Valley commonly dip westward 3 to 10 degrees. Maximum dip may be as much as 30 degrees. North of Black Mesa dips may be easterly.

Detailed correlations in the Tesuque Formation were made from studies of the stratigraphic position of 38 differentiable volcanic-ash beds. Ash beds are particularly useful as horizon markers in the Skull Ridge Member. Small groups of volcanic-ash strata were used in comparable correlations in the Pojoaque Member of the Tesuque Formation. Two distinctive tuffaceous zones are useful for correlations in the Chamita Formation.

About 1000 feet of gray sandstone deposits in the Jemez Creek and Northern Ceja del Rio Puerco localities, southwest of the type area of the Santa Fe Group, were described by the senior author in 1906 as the Zia Sand Formation. These beds formerly had

been included in the Santa Fe Formation, but were separated on lithologic criteria, supported by evidence from contained fossils, which were demonstrated to be early to medial Miocene in age—more precisely, equivalent within the framework of the North American Land-Mammal provincial classification to late Arikareean—Harrison Formation equivalent to late Hemingfordian—Sheep Creek Formation (equivalent in age).

The Rio Grande depression was formed in at least two distinct periods of deformation, one prior to the deposition of the Santa Fe Group and the other post-Santa Fe Group in age. The outlines of the two deformations closely but not exactly coincided. In the earlier structural basin the El Rito Formation and the Galisteo Formation were the first Tertiary deposits to be laid down. A widespread period of volcanism resulted in the deposition of three formations composed of volcanic debris, as follows: (1) Abiquiu Tuff, (2) Picuris Tuff, and (3) Espinazo Volcanics. These were followed by more than 4000 feet of sediments assigned to the Santa Fe Group that are lithologically distinct and obviously are from entirely different provenances. The Santa Fe overlapped the original structural basins, as is shown by the thick blocks of Santa Fe sediments caught in footwall blocks along some of the bounding faults of the present Rio Grande depression.

After the post-Santa Fe deformation, previously isolated sedimentary basins along the original structural depression were integrated by a through-flowing perennial river—an ancestral Rio Grande. Tremendous volumes of sediments were removed from the Rio Grande depression, and the present complex geomorphology of the type area of the Santa Fe Group remains merely as a fragmentary record of important Pleistocene events.