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GEOLOGIC STRUCTURE PATTERN OF GRANT COUNTY, NEW MEXICO

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This paper delineates and names for reference and discussion the major geologic structures in Grant County, New Mexico. The structures described are all large and well known, but the relation of each to the others is not everywhere clear; only a few have been named. Each includes many lesser structures, most of which have yet to be studied and none of which will be described here.

The structure pattern of Grant County is complex, involving as it does the transition from the structures of the Colorado Plateau Province in the northern part of the county to those of the Basin and Range Province in the southern part. The transition zone, not sharply defined, is characterized by widespread, intensive, recurrent normal faults and by local gentle folds. Both the faulting and the folding commonly were accompanied by local intrusions of igneous rock and by widespread extrusion of volcanic rocks.

The transition zone between Colorado Plateau and Basin and Range structures is a northwest-trending structural belt 50 to 60 miles wide that includes most of the county (Inset map, fig. 1). The zone is part of the Deming axis (Turner, 1962, p. 60) which may be considered a part of the Texas lineament described by Kelley (1955, p. 61) as "—marking roughly the southern boundary of the Plateau along the Mogollon Rim —one of the largest, longest, and most prominent of the transverse lineaments on the North American continent."

The term "lineament" means different things to different people. For the purpose of this report a lineament is considered to be a topographic line, structurally controlled, of considerable extent, and generally including more than one structure. Linear structures (including fault systems, grabens, and uplift zones that may include one or more ranges) which are divergent from a recognized lineament may be considered sub-lineaments.

Divergent from the Texas lineament, and constituting a major structural feature in New Mexico, is a fault system and associated structures that extend from the vicinity of Deming, in Luna County, northward beyond Grant County to the Plains of San Augustin, a distance of about 110 miles. Involved in this system of faults, domes, and uplift is the Black Range, and the Cooks, Cuchillo, and Luera Ranges (off map); the Florida Mountains may also be involved. This system, here named the Black Range sub-lineament, forms a part of the west margin of the Rio Grande trough.

The large, elevated, wedge-shaped area lying between the Texas lineament and the Black Range sub-lineament forms the major structural unit of Grant County and is here named the Gila block; it forms the south end of what Kelley has called the Mogollon segment of the Colorado Plateau (Kelley, 1955, p. 58). The Gila block in some respects is more closely related to Basin and Range structures than to the structures of the Colorado Plateau, although it is not a definite part of either structural province.

The western part of the Gila block has been uplifted and tilted slightly to the east by a system of normal faults that trend northwest along the west side of the Big Burro, Red Rock, Summit, and Big Lue Mountains. The name "Burro uplift" has been used previously on maps, and by numerous writers to designate that part of the Gila block that constitutes the Precambrian mass of the Big Burro Mountains. The name is extended (on the basis of exposures of intrusive rocks of Precambrian age northeast of Virden and in the Clifton-Morenci area) to include the upland areas that lie between the Big Burro Mountains and the Clifton-Morenci area.

The eastern edge of the Gila block has been uplifted, folded, faulted, and tilted along the trend of the Black Range sub-lineament. Kuellmer's cross section (1954, pl. 1) through the Black Range indicates that domes and folds are the important structural determinants in this part of the Gila block; and the structure therefore is named the Black Range arch.

The tilted fault-block structures in the Big Burro Mountains and Black Range would seem to relate the Gila block clearly with Basin and Range structure, but the relation changes progressively to the north into Catron County, where the block becomes an integral part of the Datil volcanic field, which is a recognized part of the Colorado Plateau.

The Gila block has been deformed by many lesser structures most of which are faults associated with the larger uplift structures that define the block, but some of which are associated with and result from regional warping and intrusions of igneous rocks (Paige, 1916, p. 10). The relation of the intrusions and warping to the faulting is not everywhere clear. Some major struc-

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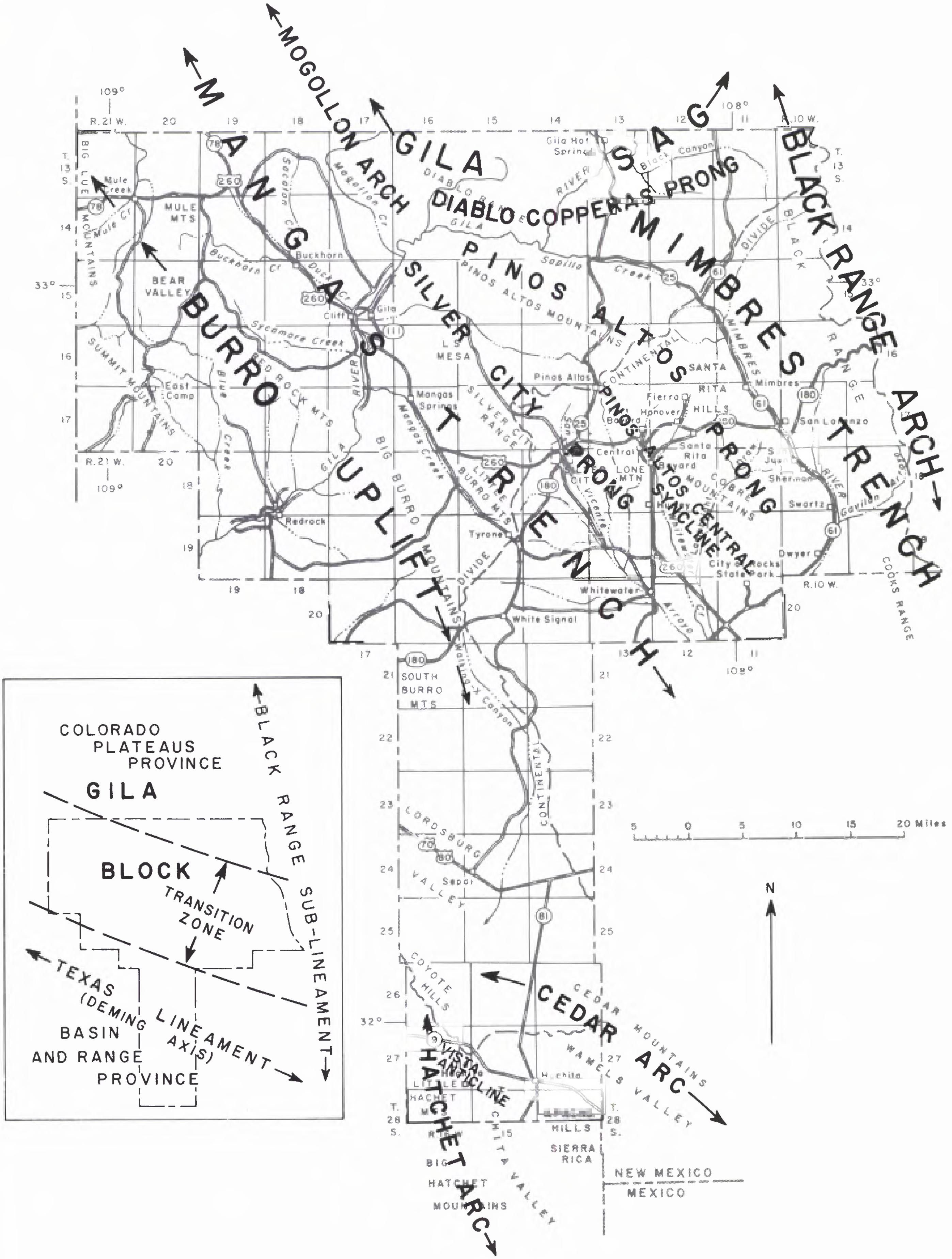

FIGURE 1

Geologic structural elements in Grant County, New Mexico tures disintegrate into several smaller units, change character, and continue in their new form for long distances; the Mogollon Mountains are part of such a structure.

The Mogollon Mountains, the highest in southwestern New Mexico, lie mostly in Catron County but extend southeastward into Grant County. The mountains are a domed and faulted structure here named the Mogollon arch. The Mogollon arch is analogous to the Black Range arch. Fergusons' (1927, pl. 2) sections show the west-dipping limb of the arch in the vicinity of Mogollon, but the east limb has not been mapped. The eastward-dipping limb of the structure is visible from adjacent high terrain.

The Mogollon arch, continuous for some 25-30 miles in Catron County, terminates at the south end by branching into three distinct faulted structures that extend far into Grant County. These structures are here named the Silver City prong, the Pinos Altos prong, and the Diablo Copperas prong. The Silver City prong is marked by a series of prominent but not continuous fault blocks that form the southeast-trending Silver City Range and Lone Mountain. The Pinos Altos prong is marked by a prominent chain of fault blocks that form the southeast-trending Pinos Altos Mountains, Santa Rita Hills, and Cobre Mountains. The Diablo Copperas prong is a complexly faulted arc of blocks that form an easterly-trending chain of ridges running from the Diablo Range through Copperas Peak to the Black Range (Elston, oral communication, 1965).

The valleys containing Duck Creek, Mangas Creek, and San Vicente Arroyo form a major linear feature of Grant County that is structurally controlled. This structure is here named the Mangas trench. It is a sub-lineament that divides the Gila block into two nearly equal parts. Whether or not the Mangas trench is a true graben with faults along both sides, or a half-graben, has not been determined. The eastern side of the trench is well-marked by the normal faults trending along the west side of the Mogollon arch and the Silver City prong. The west side of the trench is well-defined topographically by the Big Burro Mountains, but evidence of fault control is lacking except locally. Conglomerate has been faulted down against granite on the east side of the Big Burro Mountains near Tyrone. Hewitt (1959) and Elston (1960) have mapped, along the northeast side of the Burro uplift, normal faults downthrown to the east, that parallel the Mangas trench. Other faults possibly are concealed along the west side of the trench beneath the valley fill or undetected in the granitic basement rock.

The valley system containing Sapillo Creek and the Mimbres River is also a linear feature that is structurally controlled; it is here named the Mimbres trench. The relation of the Mimbres trench to the Black Range arch is the same as the relation of the Mangas trench to the Burro uplift, and the structures are analogous.

The west side of the Mimbres trench is marked by the prominent system of normal faults that form the steep east-facing front of the Pinos Altos prong. The east side of the trench is well-defined, topographically by the Black Range but, like the west side of the Mangas trench, there is little evidence of fault control except locally. Kuellmer (1954, pl. 1) mapped normal faults, downthrown to the west, paralleling the trench, but nearer to the crest of the Black Range than to the valley.

A broad synclinal structure, first described by Paige (1916, p. 10) and named the Pinos Altos-Central syncline by Lasky (1936, p. 49), lies between the west side of Silver City Range and the east side of the Pinos Altos and Cobre Mountains. The syncline, some 16 miles wide and 1,500 feet deep (Ordonez, Baltosser, and Martin, 1955, p. 12), trends northwest; the northern end terminates in the vicinity of Pinos Altos. The plunge is gently southeastward and the structure, being older than the bolson fill, disappears under the gravel. The western limb is not seen south of Lone Mountain but the eastern limb, which comprises the Cobre Mountains, continues south to about the county line. The floor of the syncline has been domed locally by intrusive rocks and broken by faulting.

The structure of the Gila block north of the Diablo Copperas prong is characterized by centripetally dipping beds of sedimentary and volcanic rocks that form a large basin some 65 to 75 miles across. Only the southern rim of this basin, here named the Gila sag, lies in Grant County. Dips are gentle toward the center of the basin, generally not more than 10°, and commonly less than 5°. Elston has called attention to the similarity of certain features of the Gila sag to features of lunar craters. (See abstracts of papers presented at the annual meeting, May 1965, this guidebook.)

The Lordsburg Valley, a broad, elongated northwest-trending structure, separates the transitional structures of the Gila block from the purely Basin and Range structures to the south. The structure of the bedrock under the valley fill is not known, but an irregular and probably highly-faulted bedrock surface can be inferred from the occurrences of isolated exposures of rocks of Paleozoic age east and southeast of Separ, and because wells near these exposures have been drilled to depths of hundreds of feet without reaching bedrock. Records of oil-test wells drilled in Hidalgo and Luna Counties show that the bolson fill may be at least 1,800 feet deep near Lordsburg, and 2,800 feet deep near Deming (Dixon, Baltz, Stipp, and Bieberman, 1954, p. 30).

The mountain ranges and valleys south of Lordsburg Valley are block-fault structures, only the northern ends of which extend into Grant County. The Coyote Hills, the Little Hatchet Mountains in Grant County, and the Big Hatchet and Alamo Hueco Mountains (off map) south of the Grant County line, are part of a large arcing system of closely related fault structures; the whole system is here named the Hatchet arc. The Cedar Mountains and the Carrizalillo Hills (off map) form another arcing fault-block system, here named the Cedar arc, that appears to be the counterpart of the Hatchet arc. The pattern of exposures and the attitude of beds in the two systems indicates an interrelation that is yet to be determined.

The Apache Hills and associated Sierra Rica, which lie mostly east and south of the Grant County line form a separate complexly faulted block structure about midway between the Hatchet and Cedar arcs. Dips in the Sierra Rica are generally southwest, and those in the Apache Hills are mostly northeast, suggesting a faulted dome structure within a larger dome structure represented by the Hatchet and Cedar arcs. Hachita Valley and Wamel Valley are thus structural troughs lying between the Hatchet Mountains to the west and the Cedar Mountains to the east, with the Apache Hills and Sierra Rica in the middle.

The axis of the Vista anticline (Lasky, 1947, p. 40), if projected from the Little Hatchet Mountain southeast across Hachita Valley, would pass along the approximate trace of the line of dip reversal running through the Apache Hills and Sierra Rica.

Rock strata in the Coyote Hills, and at the north end of the Little Hatchet Mountains dip northeastward at angles as large as 70°. The strata may flatten under the alluvial fill. As the strata in the Cedar Mountains also dip to the northeast, it is inferred that major fault structures are buried beneath the valley fill. Recent basalt flows overlying valley fill east and north of Hachita may mark the general location of at least one such buried structure.

A concealed fault, buried beneath the valley fill, and extending along the west side of Hachita Valley south of Old Hachita, can be inferred from the structure of the Little Hatchet Mountains as mapped by Lasky (1947, pl. 1).

The depth to the bedrock at most places in Hachita Valley is known from wells to be at least several hundred feet. An oil-test well in the NW¼ sec. 8, T. 27 S., R. 15 W. penetrated 1,070 feet of valley fill, at which depth the test was abandoned.

The names applied to the structural elements described above were chosen to indicate both location and character. New and more appropriate names may be proposed for these structures as more detailed studies are made and the studies perhaps reveal other relationships not presently clear. Meanwhile, it is hoped that the names selected and defined in this discussion will prove useful as terms of reference for future investigations and will be found generally acceptable.

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