

Attitude of fault surfaces inferred

**Pw-** Wild Cow Formation. Upper Pennsylvanian to Lower Permian (?). Approximately 180 m (600 ft) of the Wild Cow Formation is partially exposed in the map area. Outcrops are largely restricted to limestone ledges and resistant sandstone beds; exposures of shale are limited to roadcuts and the walls of arroyos.

Moyos Limestone and Wild Cow Formation generally correspond to the earlier, lithostratigraphic concept of lower gray limestone and upper arkosic limestone members of the Madera "Formation". Myers (1988) determined that most of the Los Moyos Limestone lies within the fusulinid zone of *Beedeina*, indicating that the unit is correlative to Desmoinian strata of the mid-continent. The overlying Wild Cow Formation lies within the zone of *Triticites*, and was subdivided by Myers (1973) into three members. The three members in ascending order are the Sol se Mete, Pine Shadow, and La Casa. Each of the three members conceptually consists of a basal sequence containing clastic beds, which grade upward into carbonate shelf limestones. Regional correlation of fusulinid assemblages in the Wild Cow Formation suggest that the Sol se Mete is correlative to Missourian, the Pine Shadow lower Virgilian, and the La Casa upper Virgilian to Wolfcampian strata of the mid continent (Myers, 1988, Fig. 4). As noted by Myers (1973), the Los Moyos and Wild Cow Formations are probably equivalent to the Gray Mesa and Atrasado Members, respectively, of the Madera "Formation" as defined by Kelley and Wood (1946) in the vicinity of the Lucero uplift. Recent recommendations to simplify the stratigraphic nomenclature of Pennsylvanian rocks in New Mexico (Kues, 2001) suggest that the formation names Los Moyos and Wild Cow may eventually be abandoned in favor of the names Gray Mesa and Atrasado, which have precedence. Subdivision of the Madera Group on the geologic map uses the nomenclature of Myers (1973). Only the basal beds of the La Casa Member of the Wild Cow Formation are exposed in the map area, thus, unresolved issues related to the stratigraphy of the uppermost beds of the Madera (e.g. Lucas et al., 2000) are not addressed in this

**Pwc-** La Casa Member. Approximately 25 m (80 ft) of the La Casa Member is exposed in the northwestern part of the map area. These basal beds are predominantly clastic sediments, although thin (<5 m thick) intervals containing limestone beds are present. Inflated forms of *Triticites*, which characterize fusulinid assemblages in the La Casa Member (Myers, 1988, Plates 8-12), exist in stratigraphically higher beds just to the north of the map area (sec. 13, T9N, R5E) in a sequence of interbedded shale and nodular-weathering limestone. The basal clastic beds of the La Casa Member in the northwestern map area contain beds of resistant, gray-, red-, and yellow-weathering arkosic sandstone and sandy siltstone, and overlie ledge-forming limestone beds of the upper part of the Pine Shadow

**Pwp-** Pine Shadow Member. Approximately 60 to 90 m (200 to 300 ft) thick. The upper 25 to 30 m (80 to 100 ft) generally consists of ledge-forming limestone beds and calcareous shale, with relatively thin, poorly exposed clastic interbeds. These clastic interbeds thicken and coarsen laterally in the map area, and locally appear to be the dominant lithology. The upper limestone interval is underlain by two to three, comparatively thick (up to 10 m or more) clastic intervals separated by beds of ledge-forming limestone. The Kinney brick quarry (sec. 18, T9N, R6E), known for its abundant fish and terrestrial plant fossils, is located in one of the clastic intervals within the lower part of the Pine Shadow Member. The base of the Pine Shadow Member over much of the northwestern part of the map area is marked by a red- to yellow-weathering, arkosic sandstone, up to several meters thick, that generally lies on ledge-forming limestone beds of the upper Sol se Mete Member. This sandstone bed appears to be absent towards the east. Large pieces of petrified wood and limestone beds containing abundant fusulinids are commonly present above the basal contact in the map area.

**Pws-** Sol se Mete Member. Approximately 75 to 105 m (250 to 350 ft) thick. The upper 12 to 18 m (40 to 60 ft) of the member contains several-meter-thick, ledge-forming limestone beds. Underlying deposits contain a higher proportion of limestone and fewer thick sandstone beds than the lower part of the overlying Pine Shadow Member. Poorly exposed clastic intervals in the unit are generally difficult to trace for long distances, although a green- to yellow-weathering sandstone bed occurs approximately 18 m (about 60 ft) below the top of the unit that can be identified over much of the western part of the map area. In comparison to overlying and underlying units, the abundance of fusulinids is relatively low in the Sol se Mete Member in the map area. Limestone beds containing abundant chert are not as common as in the underlying Los Moyos Limestone. A few meters of clastic deposits, locally consisting of conglomeratic sandstone commonly mark the

**Pm-** Los Moyos Limestone. Middle Pennsylvanian. Approximately 150 to 180 (500 to 600 ft) thick. The Los Moyos Limestone is characterized by ledge-forming beds of cherty limestone, separated by comparatively thin shale beds, with minor sandstone. Ledgeforming limestone beds in the unit are typically more closely spaced than in the overlying Sol se Mete Member of the Wild Cow Formation. The contact with the underlying Sandia Formation is poorly exposed in the map area, suggesting that limestone beds of the Los Moyos Limestone grade downward into shale beds of the uppermost Sandia Formation.

**Ps-** Sandia Formation. Middle Pennsylvanian. Approximately 35 m (120 ft) or more exposed in the map area; unit apparently thins locally to approximately 25 m (80 ft) or less in the vicinity of exposed Proterozoic rocks. The basal beds of the unit in the map area consist of brown pebbly sandstone, and directly overlie Proterozoic crystalline rocks. Poor exposures of green-weathering silty sandstone are present above the basal sandstone beds, and overlying units, presumably dominated by shale, are commonly covered by blocks of limestone derived from the overlying Los Moyos Limestone.

# Proterozoic

**Xqs-** Exposed crystalline rocks in the map area consist of gray- to red-weathering quartzite, and brown-weathering, schistose, metasedimentary rocks. Primary fabric consisting of centimeter-scale cross bedding is preserved in the quartzite. Isoclinal folding of foliation is apparent in the schist. The distribution of outcrops and the apparent thinness of the overlying Sandia Formation in the vicinity of the outcrops suggest localized areas of relatively high relief just prior to burial by the Sandia Formation.

**Xu-** Proterozoic crystalline rocks, undifferentiated (cross-sections).

## **References Cited**

Hacker, L.W., 1977, Soil survey of Bernalillo County and parts of Sandoval and Valencia Counties, New Mexico: USDA Soil Conservation Service, 101 p.

- Kelley, V.C., and Northrop, S.A., 1975, Geology of Sandia Mountains and Vicinity, New Mexico: New Mexico Bureau of Mines and Mineral Resources, Memoir 29, 135
- Kelley, V.C., and Wood, G.H., 1946, Lucero uplift, Valencia, Socorro, and Bernalillo Counties, New Mexico: U.S. Geological Survey, Oil and Gas Investigations Preliminary Map 47.
- Kues, B.S., 2001, The Pennsylvanian System in New Mexico- overview with suggestions for revision of stratigraphic nomenclature: New Mexico Geology, v 23, p. 103-
- Lucas, S.G., Wilde, G.L., Robbins, S., and Estep, J.W., 2000, Lithostratigraphy and fusulinaceans of the type section of the Bursum Formation, Upper Carboniferous of south-central New Mexico, in, Lucas, S.G., ed., New Mexico's Fossil Record 2: New Mexico Museum of Natural History and Science, Bulletin 16, p. 1-13.
- Myers, D.A., 1973, The upper Paleozoic Madera Group in the Manzano Mountains, New Mexico: U.S. Geological Survey Bulletin 1372-F, 13 p.
- Myers, D.A., 1988, Stratigraphic distribution of fusulinid foraminifera from the Manzano Mountains, New Mexico: U.S. Geological Survey Professional Paper 1446, 65 p. Read, C.B., Wilpolt, R.H., Andrews, D.A., Summerson, C.H., and Wood, G.H., Jr., 1944,
- Geologic map and stratigraphic sections of Permian and Pennsylvanian rocks of parts of San Miguel, Santa Fe, Sandoval, Bernalillo, Torrance, and Valencia Counties, north-central New Mexico: U.S. Geological Survey, Oil and Gas Investigations Preliminary Map 21.