

# Gallery of Geology

## Late Pennsylvanian phylloid algal mound complex near Socorro, New Mexico

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Figure 1. Photograph of the algal mound near Ojo de Amado in Socorro County. The light band at the cliff base is 1.5–2.0 m thick and composed of phylloid algal floatstone, which we interpret as the algal mound facies. The darker limestone overlying the mound core and forming most of the cliff represents the flank bed facies. View is to the north. Photograph by Joe Cancellare.

Algal mounds are common in late Paleozoic sedimentary successions, particularly in Late Carboniferous (Pennsylvanian) and Early Permian carbonates deposited in tropical, shallow marine environments. Most of these organic buildups are skeletal mounds formed by phylloid algae. These algae grew leaf-like blades that baffled carbonate sediment. During the late Paleozoic, phylloid algae grew in dense meadows and, in some places, their dense growths trapped lime muds to form mounds. Late Paleozoic mounds in New Mexico have been described primarily from the southern part of the state. They are particularly well studied in Pennsylvanian–Permian strata in the Sacramento Mountains and San Andres Mountains, which were laid down in the late Paleozoic Orogrande basin (e.g., Toomey et al., 1977; Cys and Mazullo 1977; Mazullo and Cys 1979; Toomey and Cys 1979; Bowsher 1986; Toomey 1991; Soreghan and Giles 1999).

In central and northern New Mexico, algal mounds are very rare within the late Paleozoic succession (Toomey 1980; Lucas et al., 2009, 2014, 2016). Here, we highlight a phylloid algal mound complex within the Late Pennsylvanian (Missourian) Tinajas Member of the Atrasado Formation of Socorro County, in central New Mexico. The mound is located near Ojo de Amado in the hills approximately 9 km northeast of Socorro.

The mound at Ojo de Amado is exposed in an east-west direction, is cut by a fault in the west, and thins to about 2.8 m to the east over a distance of approximately 65 m. The exposure represents only the lateral part of a much larger mound; the central part lay to the west (to the left in Figure 1) but is not exposed because of displacement along the aforementioned fault. The mound complex shows clear zonation into different limestone facies (Figure 2). The bedded limestone underlying the mound facies represents the basal bioclastic micritic pile (bioclastic mudstone and wackestone facies), which is

overlain by the massive mound core. Within the mound core are several facies. At the base, the relatively thin, light-colored stratum of phylloid algal floatstone (algal mound facies) was probably much thicker to the west. The wavy bedded limestone overlying the algal mound facies is composed of bioclastic wackestone and may represent the flank-bed facies. The indistinctly bedded to massive limestone on top is composed of wackestone and grainstone and is interpreted as the capping bed facies. The flank bed facies above the algal mound facies thins toward the east to a thickness of approximately 2 m, and the overlying capping bed facies pinches out to the east over a distance of approximately 30 m. The capping bed facies has a subaerially exposed top. Where the mound structure is thickest, the capping bed facies is overlain by reddish mudstone that contains limestone nodules. Where the mound complex pinches out to the east, the flank-bed facies is 2.8 m thick and overlain by gray shale.

According to Wilson (1975), an ideal late Paleozoic buildup is composed of seven microfacies or facies types: (1) basal bioclastic micrite pile, (2) algal-plate-micrite core, (3) crestal boundstone of foraminifers, encrusting algae and *Tubiphytes*, (4) organic veneer, (5) flank beds of tubular foraminiferal debris, (6) marine talus breccia (rare) and (7) capping beds of shoal grainstone with dasycladaceans and gastropod shells.

Four of these typical facies are clearly developed at the Ojo de Amado mound complex, where the initial accumulation started with a basal bioclastic micrite pile composed of bedded bioclastic mudstone and wackestone. The overlying algal mound limestone facies represents the algal-plate-micrite core facies, which is a mound-like accumulation of phylloid algae and micrite. Commonly, this algal plate micrite core is composed of an algal bafflestone. At Ojo de Amado, the phylloid algal thalli are not in life position but mostly are broken, toppled in-situ or have been transported over very short

distances. According to Wilson (1975), the algal core facies (bafflestone) generally formed below wave base in quiet water as much as 2.5 m deep, where the phylloid algae trapped lime mud. We did not observe the crestal boundstone facies that formed when platy algae grew up into the active wave base. This facies may be absent because the exposed mound at Ojo de Amado represents only the lateral part of the mound complex. We also did not observe the organic veneer, but this may be because of limited exposure of the mound core, which can only be examined on one of its weathered sides.

Extensive flank beds form when the mound remains at or close to wave base for a considerable time (Wilson 1975). This facies commonly includes small mobile foraminifers, fusulinids, tubular encrusting foraminifers and other skeletons of organisms from the mound top. The wavy bedded bioclastic limestone overlying the algal mound facies at Ojo de Amado is characteristic of the flank-bed facies.

According to Wilson (1975), the capping bed facies, composed of shoal grainstone, forms after construction of a ramp or platform by the the combination of core and flanking beds overriding the top of the mound flank bed facies during a period of stabilized sea-level. At Ojo de Amado, the top of the capping bed facies displays evidence of subaerial exposure, particularly the limestone nodules (caliche?) in the overlying reddish mudstone (Fig. 2). Subaerial exposure in the Late Pennsylvanian stopped the growth of this carbonate mound, and mid-late Quaternary erosion of the western Quebradas has created this illustrative modern-day exposure that can be readily visited from the Socorro area.

The algal mound is located about 400 m south of Ojo de Amado, at and around UTM 332327E, 3775292N (zone 13, datum: NAD 27). It can easily be reached by a short walk south from the Quebradas Road where it overlooks the Ojo de Amado.

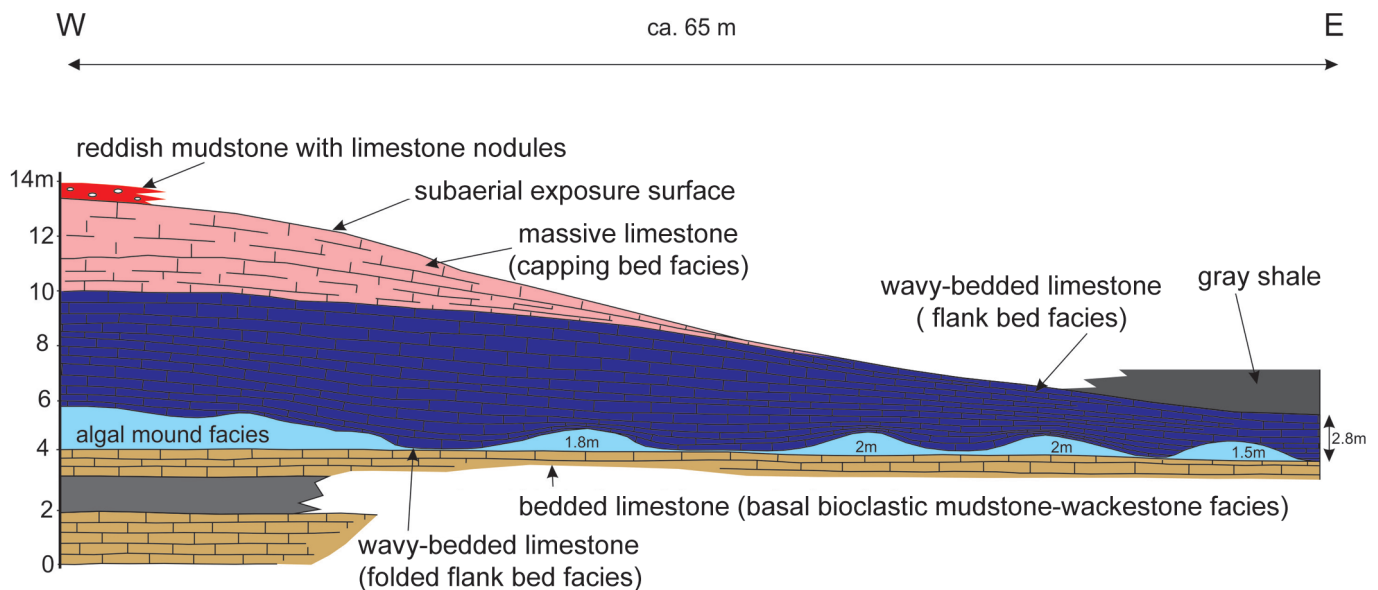


Figure 2. Cross-section through the Ojo de Amado mound complex showing the different facies. View is to the north, similar to Figure 1.

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