6. Stratigraphy and Paleomagnetism of the Middle Eocene Friars Formation and Poway Group, Southwestern San Diego County, California

STEPHEN L. WALSH, DONALD R. PROTHERO, AND DAVID J. LINDQUIST

ABSTRACT

The stratigraphy of the Friars Formation and Poway Group in southwestern San Diego County is investigated. The Friars Formation is divided into three members: a lower carbonate-siliciclastic sequence, an upper siliciclastic sequence, and a middle interval of interbedded sandstone, siltstone, and coal. The upper, limestone-rich, carbonate member is the type section of the Friars Formation. It is about 250 feet thick and is dominated by reefal limestone, with interbeds of siliciclastic mudstones. The Poway Group is composed of sandstone, siltstone, and minor coal, and its thickness is about 500 feet. The type section of the Poway Group is located near Poway and is 250 feet thick. The contact between the Friars Formation and Poway Group is gradational, with the Poway Group becoming more marine in character as it is approached from the east. The two formations are separated by a disconformity, and the base of the Poway Group is correlative with the base of the Miocene.

INTRODUCTION

Along the coastal plain of San Diego County, middle Eocene marine-fan deposits are exposed in the upper North American Land Mammal Age "Age (LNA), q.v., Kukla et al., 1981) with transgressive marine deposits (Vallecitos and Mission, 1971) and alluvial fans (San Diego, 1973). San Diego County is the only place in North America where the sequence attains the potential of direct correlation of the Badonvillian and early Blancan NALMA with various stations of the Oligo-Miocene, and only one of the two units have been well studied. The two systems are separated by a disconformity, and the contact between the Friars Formation and Poway Group is gradational, with the Poway Group becoming more marine in character as it is approached from the east. The two formations are separated by a disconformity, and the base of the Poway Group is correlative with the base of the Miocene.

Although the exposure rocks of southwestern San Diego County are generally undeformed, by studying the stratigraphy of the two formations, the potential of direct correlation of the Badonvillian and early Blancan NALMA with various stations of the Oligo-Miocene, and only one of the two units have been well studied. The two systems are separated by a disconformity, and the contact between the Friars Formation and Poway Group is gradational, with the Poway Group becoming more marine in character as it is approached from the east. The two formations are separated by a disconformity, and the base of the Poway Group is correlative with the base of the Miocene.

Due to the potential lack of direct correlation of the Friars Formation and Poway Group, the marine-fan rocks are divided into two members: a lower, carbonate-siliciclastic sequence, and an upper siliciclastic sequence. The lower member is the type section of the Friars Formation. It is about 250 feet thick and is dominated by reefal limestone, with interbeds of siliciclastic mudstones. The upper member is composed of sandstone, siltstone, and minor coal, and its thickness is about 500 feet. The contact between the Friars Formation and Poway Group is gradational, with the Poway Group becoming more marine in character as it is approached from the east. The two formations are separated by a disconformity, and the base of the Poway Group is correlative with the base of the Miocene.

A review of the Friars Formation was provided by Walsh (this volume, Chapter 2). The marine-fan deposits have been studied in the vicinity of San Diego and Poway, and the work has been published. The two systems are separated by a disconformity, and the contact between the Friars Formation and Poway Group is gradational, with the Poway Group becoming more marine in character as it is approached from the east. The two formations are separated by a disconformity, and the base of the Poway Group is correlative with the base of the Miocene.

The Poway Group is composed of sandstone, siltstone, and minor coal, and its thickness is about 500 feet. The type section of the Poway Group is located near Poway and is 250 feet thick. The contact between the Friars Formation and Poway Group is gradational, with the Poway Group becoming more marine in character as it is approached from the east. The two formations are separated by a disconformity, and the base of the Poway Group is correlative with the base of the Miocene.

Figure 1. Locality map of southwestern San Diego County showing marine and coastal features. Magnetostratigraphic sections in Appendix 1 are described in Appendix 1.
Recent Work on the Friars Formation and Powell Group

Mapping subdivisions of the Friars Formation and Powell Group is difficult, because the various conglomerates are not always stratigraphically continuous. Indeed, some members of these units are very similar to one another in terms of sedimentology, petrology, and tectonic setting. These problems have been compounded by the fact that the Friars Formation and Powell Group are not well exposed in the San Diego region, where most of the exposure is limited to the north and west of San Diego Bay. As a result, most of the work on these units has been carried out in the Imperial Valley area, where the units are more extensively exposed and are well documented.

The Friars Formation is divided into two main members: the friars and the powell. The friars member is characterized by a fine-grained, silty mudstone that is typically light grey to white, and the powell member is characterized by a fine-grained, sandstone that is typically light grey to white. The friars member is typically about 10 meters thick, while the powell member is typically about 20 meters thick.

The Friars Formation and Powell Group are important in the study of the geology of the Imperial Valley area, because they provide a record of the deposition of a large, ancient marine basin. The units are typically well exposed in the Imperial Valley area, where they are commonly over 40 meters thick. The units are particularly well exposed in the Imperial Valley area, where they are typically over 40 meters thick. The units are commonly over 40 meters thick, and they provide a valuable record of the depositional history of the Imperial Valley area.
stratigraphic position between the lower and upper members of the Studio Canyon Formation. If this assumption is correct, one would predict that a typical early Uintan mammal assemblage (Payson fauna at Walsh, this volume, Chapter 5) would be found in the lower member of the Studio Canyon Formation. However, when fossil mammals were discovered in the latter unit, in 1993, they unexpectedly permitted a younger and unusual mammalian assemblage (Mumpy Canyon local fauna of Walsh, this volume, Chapter 5) distinct from the early Uintan mammal assemblage Payson fauna of the Payson fauna of the Studio Canyon Formation. Hence, it is possible that these two assemblages may represent a different stratigraphic unit.

Field work in the Mumpy Canyon and Transept areas has now corroborated this hypothesis. Briefly, an early Uintan mammal fauna (13 in 3.5 counts) was found in the upper end of Mumpy Canyon and in Sheephead Canyon, and was correctly mapped by Kennedy and Proctor (1975, plate 3B) as occurring within the Payson Formation. As exposed on the west side of Mumpy Canyon (Fig. 2 and MS 2), this assemblage stratigraphically overlies a series of three exposed units, which have been interpreted as a marine transgression (phase 1) followed by another transgression (phase 2), and finally by a marine transgression (phase 3) that extends on the northwest side of the Transept area. These three transgressions, which are separated by three marine transgressions, are bounded by exposures of the Studio Canyon Formation. In the lower member of the Studio Canyon Formation, the bird foot prints of a mammal assemblage (Mumpy Canyon local fauna of Walsh, this volume, Chapter 5) are distributed on the sandy beach. Hence, it is possible that these two assemblages may represent a different stratigraphic unit.
Figure 8. Geomorphic cross-section from Tijuana River 72 West (MS-7) and Heli-Tri (MS-8). Symbols as in Figure 5.

In keeping with the spirit of the Friar-Fornos aquatic corridor, the lower end of the Friar-Fornos runs toward the northwest off the Tijuana River mouth into the Pacific Ocean. Throughout the lower end of this coastal region, the Friar-Fornos serves as a natural route for the movement of marine strata, the Friar-Fornos is characterized by its proximity to the ocean, the lower end of the Friar-Fornos is dominated by the Tijuana River, which flows into the Pacific Ocean, and the lower end of the Friar-Fornos is characterized by its proximity to the ocean.
mapping, clay population, and palaeocurrent work on the Eau claire and both members of the Stadheim Conglomerate must be done in order to test these scenarios.

Stadheim Conglomerate, lower member
Type section—At the type section of the Stadheim Conglomerate, the lower member (Eau claire) is composed of 34 m of light yellow-brown to gray and pal, greenish gray, moderately sorted, sodium-calcium supported, pebble to cobble conglomerate. With several lenses of light gray and pale greenish gray, medium-very fine-grained, moderately sorted, silty sandstone (MS-10). The matrix of the conglomerate is a very light gray at some gray matrix breccias, poorly sorted, sandy. Fine to medium sandstone (MS-11). This lithology figures largely in the Mission Valley, El Cajon Creek, and Alvarado Creek areas. About 22 m in the base of the section, a lens of medium gray, very fine-grained sandstone and calcite nodular-beded limestone contains sparse microfaunas of late Eocene to middle Eocene age, including Paracococeras sp. cf. P. secalum (DSNH Loc. 3719). This bed may be stratigraphically equivalent to a laterally persistent bed of micro-nodular-beded limestone and greenish gray siliceous oolite up to 2 m thick (Paracococeras bed) (SNSIH Loc. 3695-3692) that overlies the upper part of the Eau claire in Murray Canyon.

Lithofacies and Diagenetic Environment—The general lithofacies of the Eau claire as described above for the type section. Clay assemblages have not been studied in detail, but are dominated by Poyry rhynoza (Kaya and Ashby, 1983). Miller and Ekins's (1981) original type section of this member contains a greater variety of less massive clays than the Eau claire, but detailed clays have not been done to correlate these differences. In general, the light gray, "stratified" appearance of the "poyry" clays in the lower member contrasts sharply with the darker, more stratified clays of the water stained Poyry clays on the upper member of the Stadheim. The light gray, medium to very fine-grained, generally massive sandstone lenses within the lower member (MS-10) vary with the more coarse-grained and generally more massive sandstone lenses within the upper member.

The upper member of the Eau claire has been studied by Howard and Lott (1979), who recognize a division of the member into distinctive lithofacies units. However, Howard and Lott concluded that in the Mission Valley area, the lower part of the Stadheim Conglomerate was largely of late Eocene to earliest Oligocene age. In the mission valley area, a medium to fine-grained sandstone is dominated by the occurrence of caliche layers and local concentrations of sand grains in the sandstone (this member). However, Miller and Ekins (1981) reported a suite of hypsomal conglomerates and sandstone lenses from the base of this member.

Habitat and Distribution—North of the 34 inch thick type section, the Eau claire decreases rapidly in thickness before being richer traced toward the Pirahma Limestone Formation (Fig. 2), or pinching out between the upper portion of the Pirahma Formation and the Mission Valley Formation (Fig. 3). The Eau claire has been recognized at several outcrops of San Diego State University, and as far north as the intersection of Mission Road and Fornament Avenue in East San Diego (Fig. 1), where it dips below the mesa surfaces north of Mission Valley.

Contact—The Eau claire overlies the type section of the Pirahma Formation on the north side of Mission Valley and in the southern end of Murphy Canyon, and overlies the upper portion of the Pirahma in the north end of Murphy Canyon. A maximum of 3 m of relief was observed on the Eau claire contact at the Stadheim development on the west wall of Murphy Canyon (MS-9). The Eau claire is locally contorted by the Eau claire with a maximum of about 2 m observed in the gravel pit. The outer limits of the Eau claire member, indicated by the contact between the upper and lower member of the Stadheim in section, Miller and Ekins (1981) believed this contact to be entirely discontinuous, with the lower member pinching out below the upper member in the San Diego State University area. Outcrops of the Stadheim Conglomerate between Alvarado Creek and El Cajon Valley must be studied in order to resolve this question.

Figure 9. Magnetostratigraphic sections from Stromburg (MS-9) and the type section of the Stadheim Conglomerate (MS-10). Units are as in Figure 1.
PALMOSCHIQUERO, low order

Lithological and Depositional Environment - The lower part of the Palmoschiquero includes a condensed section of the Miocene dissection. The strata are dominated by the Puercan Formation, which comprises a thin unit of flysch-like, glacially influenced, deposits. The upper part of the Palmoschiquero is characterized by the Tapinal Formation, which is dominated by marine sediments. The Tapinal Formation is overlain by the Palmoschiquero Formation, which is characterized by a thin unit of diatomite.

Distribution and Thickness - The Epz is defined by an extensive body of Miocene diatomite, which covers a large area in the southern part of the study area. The diatomite is thickest in the center of the region, where it attains depths of up to 100 meters. The diatomite is also present in the northern part of the region, where it is thinner and less extensive.

Palmoschiquero Formation, Miocene Sandstone

Lithological and Depositional Environment - The Miocene sandstone member of the Palmoschiquero Formation is characterized by a thin unit of fluvial sandstone, which is overlain by a thin unit of diatomite. The diatomite is thickest in the center of the region, where it attains depths of up to 100 meters. The diatomite is also present in the northern part of the region, where it is thinner and less extensive.

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polarity. Flyssa's Cyprian Avenue section was the Frias produced normal results. We sampled this section because it contains the significant stratigraphic locality LACM (CTT) 314, the results of which are discussed below (Appendix 1). Flyssa (1986) correlated the normal polarity intervals on its Section and basal Frias formations with Chron C1n, and the reversed polarity interval in the upper part of the Frias formations with Chron C2r. Barlett et al. (1981) sampled the Frias Formation at a section about 0.5 km northeast of Flyssa's Cyprian Avenue section, and reported that all 10 sites from the upper part of the Frias were of normal polarity, which they also correlated with C1n (although some of the sites were re-sampled by Barlett et al. (1981) in 1985). We sampled the upper part of the Frias Formations near the town of Flyssa and at the southern end of the Frias Formations near the town of Cypriano. Both sections are believed to be sections of C1n.

Figure 10 shows the distribution of the normal and reversed polarity intervals in the Cyprian Avenue section, and was actually taken from the Cyprian Avenue section. It is probable that some of the "Stadium Cyprianoformis" are actually part of the Cyprian Avenue section. As was noted earlier, the polarity intervals in the Frias Formations are difficult to determine, and are not present in the Flyssa Formations, which might correlate with Chron C1n. However, as noted earlier, correlation of these two corresponding sections in the Frias Formations is difficult, and there is no possibility of convincing evidence for the correlation of the upper normal polarity interval in the Frias Formations (in this area Flyssa, 1986, p. 313) indicated that the three palaeomagnetic sites in the Museo Reuss area near the town of Flyssa were all from the Frias Formations, but there are no other sites in the Frias Formations in the contact with Chron C1n. Unfortunately, it is not possible to determine which of Flyssa's pet sections are correct.

The three palaeomagnetic sites collected in the Museo Reuss Formations by Barlett et al. (1981), and the Cyprian Park section are both located in the Flyssa Formations. The Bouger gravity forming the upper part of the

mission Valley between Pasadena and L.A. were arranged themically in the Sansei-Conglome-

and Mission Valley Formation by Kennedy (1975, 1978, 1980), but the magnetic and stratigraphic record maintained by Kennedy on the south side of Mission Valley remains through the south, such that the Sansei (1980), Loc. 3836 and Frias Formations (SDH-11 Loc. 3860) crop out on the north side of Mission Valley and near to Pleasant Park.T. A. Donahue, oral communications, 1981.) confirmed that the Pleasant Park section is entirely of normal polarity, which is consistent with Flyssa (1986) report that the type section of the Sansei is a north side of Mission Valley. The Mission Reuseum section of Barlett et al. (1981) clearly palaeomorphs in the Mission Valley Formation, but this section defined only two years of unIpolar polarity, both of which were partially reversed (Flyssa, 1986, p. 71). The Flyssa Road section of Barlett et al. (1981) provided data on the Mission Valley Formations, but this section defined only two years of unIpolar polarity, both of which were partially reversed (Flyssa, 1986, p. 69). The Sansei Road section of Barlett et al. (1981) clearly palaeomorphs in the Mission Valley Formation. They report that two sections occurring near the base of their section is of reversed polarity, whereas five sites from the middle and upper part of their sample are of normal polarity. However, the original data presented by Kennedy (1980, p. 85) shows two reversed and two normal magnetizations from Mission Valley Road, so the magnetization of this section is ambiguous. Barlett et al. (1981) confirmed the normal polarity, and partially verified normal magnetization in the Mission Valley Formations with Chron C1n and C1n, based on data from the stereographic projection (Barlett et al., 1977) of the upper part of the "Stadium Cyprianoformis" (basal Mission Valley Formations) and small formation zone P1.3, which was compared with Chron C1n by Bichsel et al. (1983).

NEW PALAEOMAGNETIC STUDIES

As in effort to clarify the nature of the magnetic inversions in previous palaeomagnetic work on the Frias Formations and Poway Group, we collected samples from several new sections containing both early and late Unionian stadial assemblages (MS 1, 11, Appendix 1). All sections were determined by measuring with the exception of MS 11, which was coincident by T.A. Donahue and Bichsel. Black samples were collected from 1 m to 10 m deep, with the cave after being planed horizontall. Many samples were subjected to ISM to allow for the removal of remanent induced by the field of remanent. After removal of remanent, 1 cm by 1 cm samples were removed from the upper part of the Frias Formations, and 1 cm by 1 cm samples were removed from the upper part of the Frias Formations. The samples were then subjected to the thermal and isothermal remanent loss tests, and 1 cm by 1 cm samples were removed from 100°C, removing a weak positive.

Figure 11. Reproduced from the original "olivine" data of confirming field (AF) demagnetization results.

- 200°C, 300°C, and 400°C, and from 100°C.

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complementary and Miramar Sandstone members of the Pinnacles Group are entirely younger than the type section of the Mission Valley Formation. In the absence of a convincing demonstration of the current stratigraphic and age-terrace relationship between these units, correlation of the magnetostriats with them is unattainable.

Chose Correlation of San Diego Eocene Polarity Interval

Given the difficulties in magnetostriat correlation alluded above, the attempt to identify many of them with one another is questionable. Nevertheless, tentative {hetero} correlations for various lithostratigraphic units in southern San Diego County are shown in Figure 15 (after Berggren et al., 1993), and the existence for these assignments is reviewed below. We emphasize that numerical calibration of the boundaries of the Lower Cenozoic requires upon a large number of assumptions involving many different sources of error, and that the values given for these boundaries cannot be taken literally to within about 1 m.y. (Harrad et al., 1993, p. 154).

Denmark Formation

As noted, Flynn (1986) and Berger et al. (1991) recognized the Denmark Formation reversed polarity interval 4.9-4.5 m.y.a. as the earliest middle Eocene Chron C20n. This magnetostriat appears to be correlated by Pedersen's (1991) compilation of a polar anisotropy from the Denmark with the earliest middle Eocene correlative Solanaeoch C20n of Olter and Bulry, 1980; Berggren et al., 1985).

Arabian Shale

The normal polarity interval of the Arabian Shale both as the type section and in the southern San Diego County north of La Jolla was assigned by Flynn (1985) and Berger et al. (1986) to Chron C20r. This assignment was based on the middle Eocene Eocene age of the Arabian as determined by palaeontologic (zone 111 and/or P1) biostratigraphy (1970 and 1972) and corallines (Solanaeoch C12b, Bulry and Kennedy, 1969; Olter and Bulry, 1980), in conjunction with the correlations of Berggren et al. (1985). The report by May et al. (1991) that the upper part of the Arabian Shale contains corallines correlative to Solanaeoch C13n as C13n. Another supports correlation of the Arabian normal polarity interval at C21 (Berggren et al., 1985). Although normal polarity of this large scale of Berggren et al. (1995) would indicate that the Solanaeoch C13n is entirely younger than C21n, these authors note that because the stratigraphic and coralline-magnetostriat interval at C21 in Solanaeoch is poorly defined. The beginning of C21n a (as shown by Berggren et al., 1995) will have to be moved downward into Chron C21r, if the presence of Solanaeoch C13n in the Arabian Shale can be corroborated (assuming that the normal polarity interval assigned by Berggren et al. 1991 for the Arabian Shale is correct).

Scripps Formation

The normal polarity interval comprising the extinct thalassinoid of the Scripps Formation was assigned by Flynn (1986 to C22r) based on the reasonable assumption that the contact between the Scripps and the Arabian Shale was not a chron-encapsulating equivacency. If Mat et al. (1991) are correct that the Arabian Shale is in part as correlative Solanaeoch C13n and if the normal polarity interval is the type Scripps lithozone in Chron C22r, and if the correlation between the coralline zone of Olter and Bulry (1980) and marine boundaried biolinde illustrated by Berggren et al. (1995) are correct, then the thickness of the type Scripps-untan have been determined extremely rapidly during the range of Chron C22r and during the entire part of Solanaeoch C13n. Marine boundaried biolinde from the lower and upper parts of the type Scripps are assigned to Livens and Kennedy (1979) to the "Dunagan" and "Trometies" stages, respectively. Since Speirs (1986) placed the "Trometies" stage exactly within Solanaeoch C13n, correlation of the Scripps normal polarity interval with Chron C22r would again seem to be indicated (Berggren et al., 1995). However, if partial correlation of the "Dunagan" stage with Solanaeoch C13n would be required if the upper part of the Arabian Shale is in fact an annulus to this Solanaeoch May et al., 1991).

Alternatively, the Scripps-Arabian contact was placed as an abrupt boundary by May et al. (1991), and it is conceivable that the boundary is of such magnitude that the normal interval in the type Scripps is a full chron younger than the normal interval in the Arabian, with the latter being correlated with Chron C22r. If so, the Scripps should contain corallines correlative to Solanaeoch C13n and/or P1, and thus the polarity interval at C22r should be considered separately in order to classify the age range of this unit. Despite these difficulties, we prefer to correlate the Scripps normal interval with Chron C22r for the following reasons: First, if this interval did pertain to C20r, the Scripps-Arabian equivalent would have to represent at least the entire duration of C20r, and the beginning of the Pinnacles reversed interval would then correlate with the beginning of C22r (42.5 Ma according to Berggren et al., 1991). However, given the 40Ar/39Ar age of 42.3 ± 0.2 Ma from the Mission Valley Formation (Wendlandt and Walsh, in prep.), this would in turn imply that the Pinnacles Formation, both members of the Stadium Conglomeration, and the lower part of the Mission Valley...
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SAN DIEGO MAGNETOTELLURIC.

Primary Formation

Below and to the left, the Friant Formation (Fig. 29), well displayed along the source, extends through the San Joaquin Valley, and beneath the original surface. The individual horizons are clearly visible in the San Joaquin Valley, as well as along the source of the Friant River.

Stadium Cenozoic-Upper Member

The contact between the upper member of the Friant and the San Joaquin Valley Formation is gradational according to Kenney and Moore (1971), but our position suggests we have Fig. 29, and the amount of time represented by this contact is unknown. Nevertheless, the upper member of the lower member of the Friant is gradationally linked to the Friant San Joaquin Valley Formation, and the lower member of the Friant is gradationally linked to the Friant San Joaquin Valley Formation. If the lower member of the Friant is gradationally linked to the Friant San Joaquin Valley Formation, the Friant San Joaquin Valley Formation is gradationally linked to the Friant San Joaquin Valley Formation. Unfortunately, the examples of this species cannot be extended to the Friant San Joaquin Valley Formation.

Secondary Compositions, Upper Member

Pebble evidence from the outcrops is limited. Two features from the base of the top member of this unit (Figs. 30, 31) were quarried from the San Joaquin Valley Formation, and one site within the Friant San Joaquin Valley Formation. If the upper member of the Friant is gradationally linked to the Friant San Joaquin Valley Formation, the Friant San Joaquin Valley Formation is gradationally linked to the Friant San Joaquin Valley Formation. Unfortunately, the examples of this species cannot be extended to the Friant San Joaquin Valley Formation.

Mission Valley Formation

As noted above, a lithologic and stratigraphic section南部 of the Mission Valley Formation is gradationally linked to the Friant San Joaquin Valley Formation. If the upper member of the Friant is gradationally linked to the Friant San Joaquin Valley Formation, the Friant San Joaquin Valley Formation is gradationally linked to the Friant San Joaquin Valley Formation. Unfortunately, the examples of this species cannot be extended to the Friant San Joaquin Valley Formation.

Formation were all deposited in an interval of "normal" 100 m y. Further, at an age of about 425 m y, the earliest Upper Tertiary Formation would conflict with the fact that some submarine sediments in North America are of about 425 m y. This interval was assigned to the late Tertiary Uinta (Whitney, 1970).

Figure 19: Tectonic provinces of central San Diego. Pleistocene geologic maps with the Geological Survey Time Scale (Berggren et al., 1995) and revised basement. Based largely on Walsh (1980), Bratton et al. (1981), Applegate et al. (1988), Segelquist (1983), Schipke et al. (1983), and others, this chapter. Points on the map from the source of the Mission Valley Formation are: A - Atlantic Ocean. Other abbreviations as in Figure 15. Note that the topographic data on the climb in these basins was derived in situ by the author (Walsh et al., 1984).
SANDIAGO MAGNETOSTRATIGRAPHY

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Mali-1, Conception Santa Fe
A 93-foot section of the Conception Santa Fe section was measured in the community of Conception Santa Fe, Baja California, Mexico. The base of the section is 93 feet higher than the base of the adjacent Conception Santa Fe, North section. It was penetrated by a 92-foot well. The depth of the base of the section is 93 feet.

Mali-2, Black Mountain Road and State Route 68
A 44-foot section of the Black Mountain Road and State Route 68 section was measured in the vicinity of the Black Mountain Road and State Route 68, near the town of San Diego, California. The section was measured by the Geological Survey of the United States, and the depth of the base of the section is 44 feet.

Mali-3, Lockwood Valley
A 44-foot section of the Lockwood Valley section was measured in the vicinity of the Lockwood Valley section, California. The depth of the base of the section is 44 feet.

The section from the Lockwood Valley section was measured by a 44-foot well. A total of 44 feet of stratified sediment was measured. The section is composed of clay, silt, and sand. The clay is dark brown to black, and the sand is light brown to tan. The section is measured at a depth of 44 feet.

Mali-4, San Diego Magnetostratigraphy
A 53-foot section of the San Diego Magnetostratigraphy section was measured in the vicinity of the San Diego Magnetostratigraphy section, California. The depth of the base of the section is 53 feet.

The section from the San Diego Magnetostratigraphy section was measured by a 53-foot well. A total of 53 feet of stratified sediment was measured. The section is composed of clay, silt, and sand. The clay is dark brown to black, and the sand is light brown to tan. The section is measured at a depth of 53 feet.

Mali-5, Scripps Institute of Oceanography
A 44-foot section of the Scripps Institute of Oceanography section was measured in the vicinity of the Scripps Institute of Oceanography section, California. The depth of the base of the section is 44 feet.

The section from the Scripps Institute of Oceanography section was measured by a 44-foot well. A total of 44 feet of stratified sediment was measured. The section is composed of clay, silt, and sand. The clay is dark brown to black, and the sand is light brown to tan. The section is measured at a depth of 44 feet.
MS-8. Hill 781
A substantially covered, 69 m-thick section was measured east of Terreitas, starting at the base of a roadcut on the south side of the road access road for the Second San Diego Aqueduct, located in the saddle immediately north of Hill 781. The section begins in the upper part of the EF-a and spans 5 m of yellowish-gray conglomerate tentatively assigned to the Eet-b, 30 m of the Env, and 23 m of the Ep. The upper 37 m of this section is poorly exposed along the jeep road up to the summit of Hill 781.

The lowest site from the Eet-a was indeterminate, while the upper two sites from the Env were reversed. The single site from the sandstone near the top of the Eet-b was reversed. Four sites from the lower part of the Env were normal, one was reversed, and the uppermost site from the Env was reversed. No sites were collected from the Ep.

MS-9. Sunnencourt
An 84 m-thick composite section was measured in the undifferentiated Frairs Formation, the Eet-a, Eet-b, and Env, during grading for two different phases of the Sunnencourt development on the west side of the Murphy Canyon Road. The upper 32 m of the measured section have been largely eroded away, but the lower 52 m of this section (EF and Eet-a) are currently exposed in artificial cuts behind commercial buildings at the NW corner of the intersection of Murphy Canyon Road and Ruffin Road, and in a landscaped railroad to the west side of West Canyon Avenue. If the EF is present below the surface of Murphy Canyon at Sunnencourt, then the sampled Frairs section would exceed entirely the upper horizon, however, it is equally likely that the EF exhausts a maximum 9 m-thick section on Murphy Canyon Road. Thus, the site was located about 500 m east of and at least 9 m stratigraphically below the base of the main section, and was of indeterminate polarity. The main horizon is located on the upper west-facing cut on the west side of Murphy Canyon, about 500 m south of the Murphy Canyon Road. All sites from the EF were reversed polarity, as were all sites from the overlying Eet-a.

MS-10. Type Section of Stadium Conglomerate
A composite 73 m-thick section consisting of two subunits was measured in the debris gravel quarry of the G. Fonten Materials Co., on the north side of Mission Valley, north of Friars Road and east of Interstate 805. This section is essentially the same as kettle and moker's (1971) type section of the Stadium Conglomerate. The lower subunit was located in a sandpit on the north side of Friars Road, about 200 m east of Northside Drive directly opposite Friars Road from the northwestern entrance to the parking lot for San Diego Jack Murphy Stadium. Two sites were collected from light yellowish-brown, fine- to medium-grained sandstone lenses within the Eet-a, from 5 m to 11 m above the Eet-a/EF contact. The base of the upper subunit is located about 400 m northeast of the first section, on the surface of the gravel pit immediately below the large southwestern-facing face in the NE part of the Fonten property. The two subunits are correlated on the basis of elevation, samples from the upper subunit consisted of light gray and pale greenish-gray medium-grained sandstones from lenses in the Eet-a light grey brown medium-grained sandstones from lenses in the Eet-b, and very light gray, very-fine-grained sandstones of the Env.

All six sites from the Eet-a were of reversed polarity. Five sites were collected from the Eet-b of which the lower two were indeterminate, the next-highest was reversed, and the uppermost two were normal. All four sites from the Env were of normal polarity.

MS-11. Type Section of Mission Valley Formation
A continuous, but subordinately covered section spanning the maximum preserved thickness of the Env (approx. 75 m) was measured from roadcuts on the west side of State Route 512 between Interstate 5 and the Sixth Avenue exit. This section is located immediately east and southeast of the type section of the Env (Kennedy and Moore, 1971), which is currently obscured by vegetation.

Most sites were collected from light gray, fine-to-medium-grained, often concretionary sandstone, while some of the uppermost sites consisted of light gray, medium-grained, poorly sorted sandstones. Of the 10 sites collected, the lower 9 were of normal polarity, and the upper 5 were reversed.