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Measured Sections of the Laki Formation, Ganjo Takkar and Saidpur Outlier, Hyderabad District, Pakistan

by

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Table of Contents

Illustrations

Table

INTRODUCTION

The rock descriptions presented here are from 24 sections measured in a previously unstudied area southeast of the city of Hyderabad and 175 km northeast of Karachi, capital of Sind Province in southern Pakistan (fig. 1). The descriptions are preliminary to more detailed studies, particularly of the fossil fauna and the Paleocene and Eocene stratigraphy in southern Pakistan. The data are the basis of a major elucidation of the lateral relationships of individual rock units that collectively form part of the Laki Formation exposed in the Ganjo Takkar and nearby Saidpur outlier.

The field work was performed as part of the Coal Resource Exploration and Assessment Program (COALREAP) that is Component 2a of the Energy Planning and Development Project. Component 2a is financed by the Government of Pakistan and the U.S. Agency for International Development (USAID) with technical assistance from the U.S. Geological Survey and the Geological Survey of Pakistan (GSP).

Coordinates

The coordinates of the sections in Table 1 are given in latitude and longitude and metric units, including northings and eastings. Northing and easting are metric coordinates used on Pakistan topographic 1:50,000 scale maps. The metric coordinates are divided into 1000 m squares.

Acknowledgments

We are grateful for the expertise and skills of the Geological Survey of Pakistan for assisting in this project. Special thanks are given to the USAID drivers for reaching the off-road sites and to the police who performed guard duty while we measured sections. In addition, the services provided by the team of laborers who uncovered rock contacts in the intense heat and dusty conditions are much appreciated. Finally, the graciousnes of Mohammad Ali Tariq of the Geological survey of Pakistan in permitting Riaz to spend time measuring sections is most appreciated.

STRATIGRAPHY

The Laki Formation of Eocene age is a prominent part of the stratigraphic sequence in Sind Province (fig. 2). The formation is exposed over large areas and crops out in cliffs, ledges, and ridges. The limestone ranges from very soft and chalky to cryptocrystalline and contains a rich fossil micro- and mega-fauna. Because of its fossil fauna, the Laki has attracted researchers beginning with the earliest geologic studies in the western part of the Indian subcontinent. Very

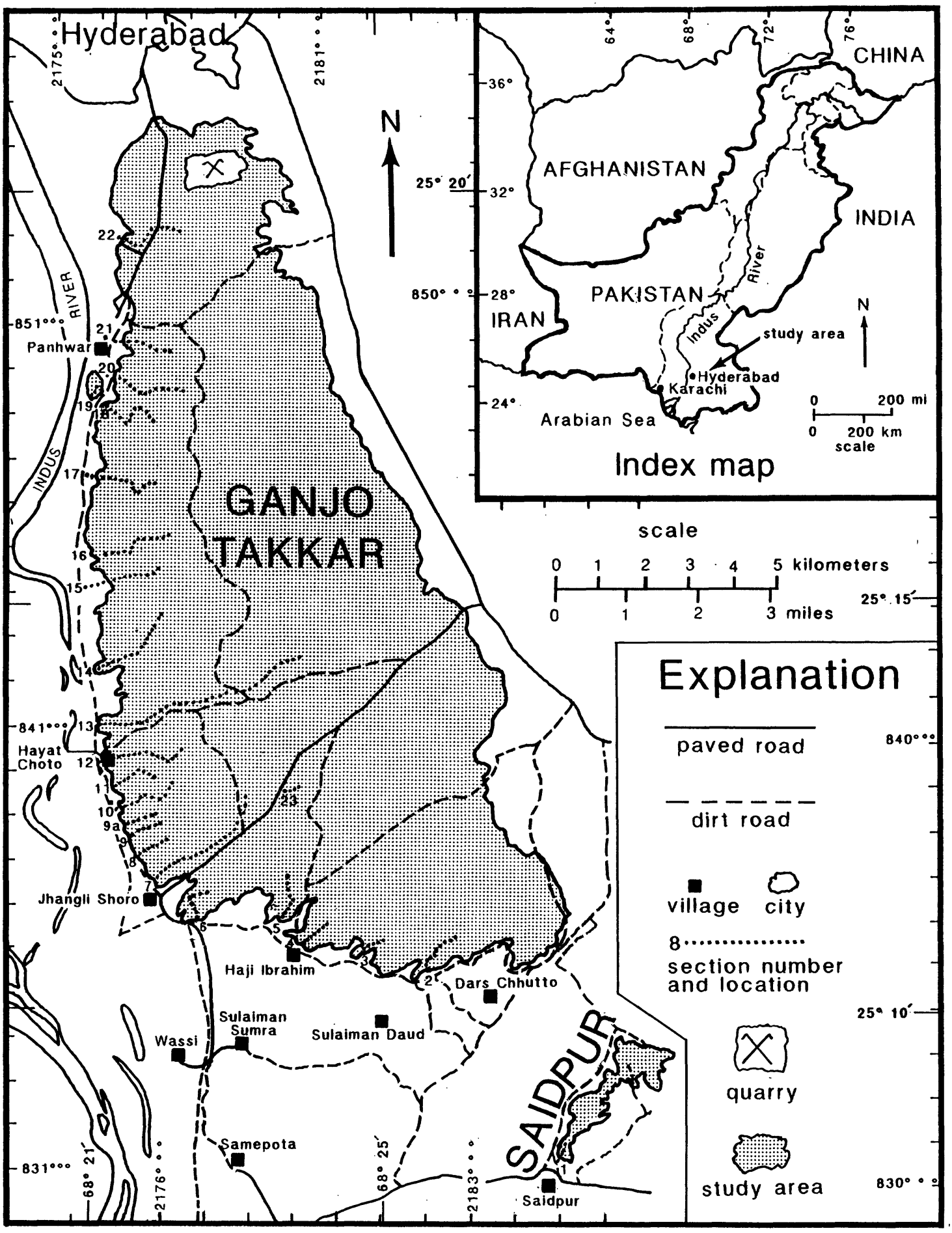

Figure 1.-Location of sections

Table 1. Section locations by coordinates

Section Number	Latitude(N)	Longitude(E)	Northing(m)	Easting(m)
1.	25°08'21''	68°27'25''	830 750	21 85 060
2.	25°10'30''	68°25'38''	835 000	21 82 600
3.	25°10'36''	68°24'50''	835 500	21 80 940
4.	25°10'53''	68°24'07''	835 850	21 79 700
5.	25°11'25''	68°24'00''	836 525	21 79 500
6.	25°11'12''	68°22'29''	836 500	21 77 135
7.	25°11'38''	68°22'00''	837 280	21 76 300
8.	25°11'48''	68°21'53''	837 740	21 76 030
9.	25°12'05''	68°21'46''	838 075	21 76 840
9a.	25°12'09''	68°21'37''	838 400	21 75 600
10.	25°12'31''	68°21'30''	838 995	21 75 450
11.	25°12'42''	68°21'30''	839 500	21 75 460
12.	25°13'09''	68°21'22''	840 150	21 75 300
13.	25°13'30''	68°21'14''	840 890	21 75 150
14.	25°14'12''	68°21'08''	842 300	21 75 100
15.	25°15'22''	68°21'02''	844 340	21 74 900
16.	25°15'32''	68°21'29''	844 810	21 75 640
17.	25°16'30''	68°21'13''	846 500	21 75 280
18.	25°17'23''	68°21'24''	848 080	21 75 725
19.	25°17'31''	68°21'14''	848 400	21 75 510
20.	25°17'42''	68°21'23''	848 675	21 75 750
21.	25°18'15''	68°21'30''	849 685	21 75 900
22.	25°19'27''	68°21'38''	851 860	21 76 240
23.	25°12'45''	68°23'46''	839 300	21 79 250

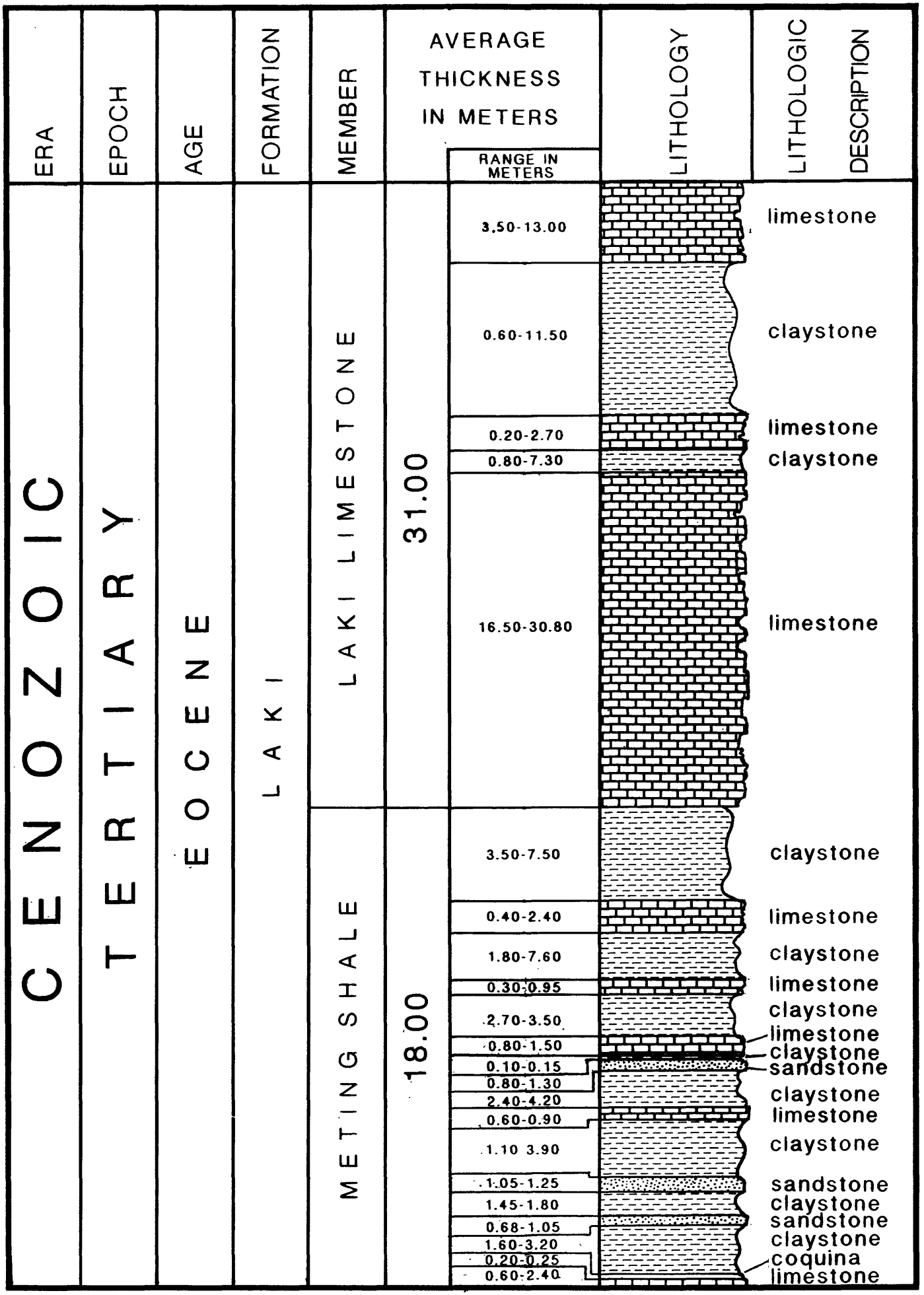

Figure 2.-Generalized section of the Ganjo Takkar and Saidpur outlier.

little small-scale mapping of the formation has been performed and there are almost no data available on its physical characterisitcs. Faunas from a few widely scattered exposures have been studied to determine the biostratigraphy but minimal attention was paid to the lithology. All stratigraphic sections of this report have been measured from the Indus River base level (Meting Shale Member) to the top of the Ganjo Takkar hills (Laki Limestone Member).

LAKI FORMATION

The Laki Formation of Early Eocene (Ypresian) age was divided by Nuttall (1925) into four subdivisions from top to bottom: (1) Laki Limestone Member, (2) Meting Shale Member, (3) Meting Limestone Member, and (4) Sohnari Member (basal Laki laterite). This report concentrates on the upper units, the Laki Limestone Member and the Meting Shale Member (fig. 3). These units are well exposed along the Ganjo Takkar bluffs and form steep slopes, especially in the Laki Limestone Member. Rocks in the Laki Formation are predominantly marly limestone and claystone with thin beds of sandstone and lateritic claystone. Both the claystone and the limestone have abundant mega- and micro-fossils with the foraminifera, Alveolina sp. being common.

The Laki Limestone Member forms plateaus and weathers to a vuggy and undulatory surface (fig. 4). The contact between the Laki Limestone Member and the underlying Meting Shale Member is sharp and undulatory, indicating a local unconformity. The contact of the Meting Shale Member with the underlying Meting Limestone Member is concealed in this area by Holocene colluvium and the Indus River alluvial silt and sand. The Sohnari Member lies on the Ranikot Group or Lakhra Formation and is unconformably overlain by the Meting Limestone Member of the Laki Formation.

Laki Limestone Member

The Laki Limestone Member of the Laki Formation crops out in cliffs and ledges with steeply dipping slopes. It conformably overlies the Meting Shale Member and they typically have a sharp undulatory contact. The limestone is usually thick-bedded to massive with numerous cavernous to drape-like features. The surface has undergone intensive weathering, producing many vug and solution cavities. Where it forms ledges, the limestone typically is cryptocrystalline (fig. 5) and gives a sharp ring when struck by a hammer. The thick-bedded limestone is generally chalky and crumble easily. Fossil burrows and pelecypods are common throughout the member. In the sandy and argillaceous parts of the member, fossil invertebrates such as pelecypods, gastropods, and brachiopods are abundant. Cephalopods are found scattered on the surface along with sea urchins and spines. Foraminifera are so abundant in places that entire beds can be recognized from section to section. Scattered dark mineral grains commonly occur where the texture becomes saccharoidal and chalky. Color varies from very pale orange (10 YR 8/2) to dark-yellowish-orange (10YR 6/6) to pale-yellowish-orange (10YR 8/6), (Geological Society of American Rock-Color Chart).

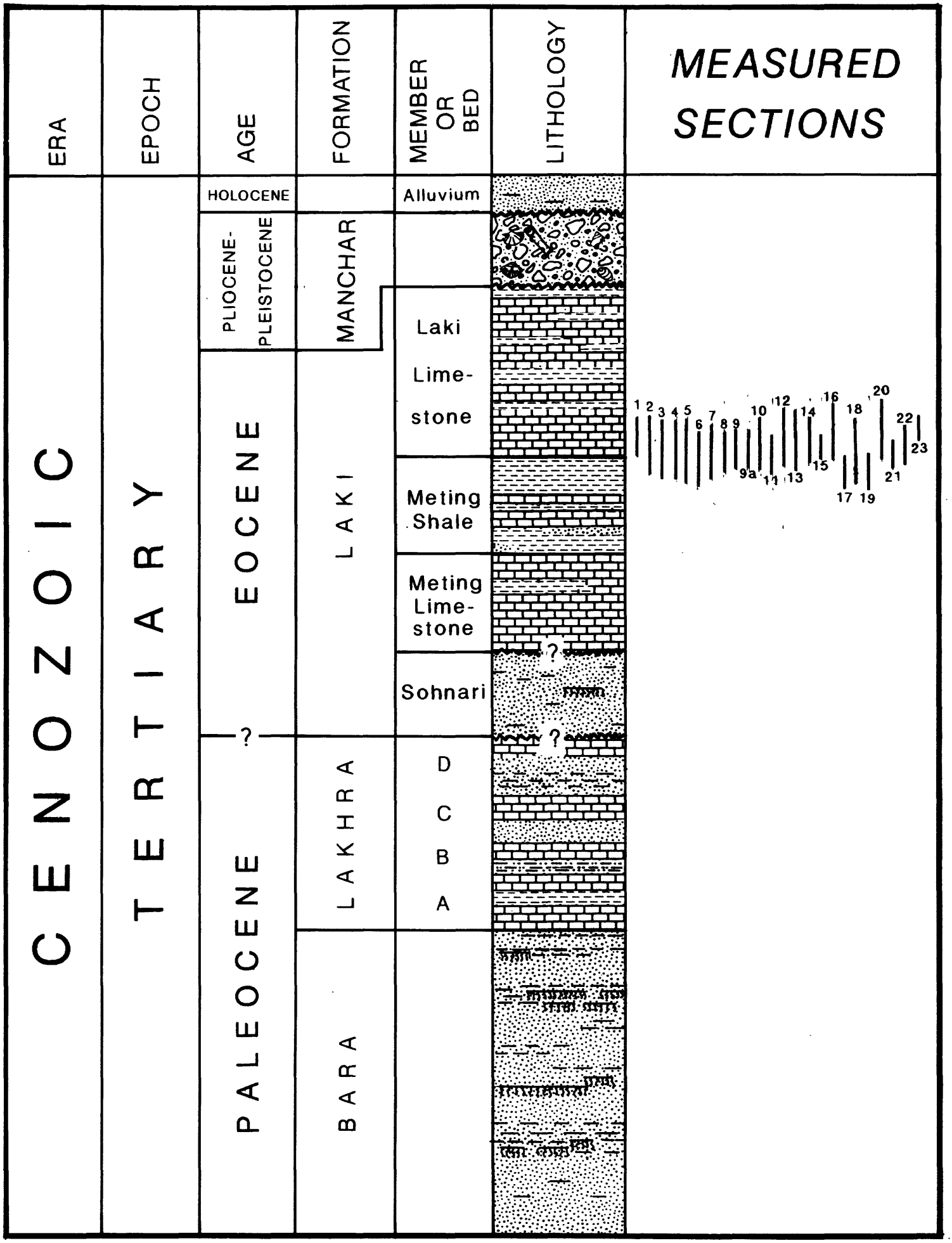

Figure 3.-Generalized stratigraphic column and measured section distribution.

Figure 4. Ganjo Takkar area near section no. 7. View looking northwest of the broad, flat plateaus in the Laki Limestone Member.

Figure 5. Ganjo Takkar area looking northeast near section no. 7. Contact between the Meting Shale Member (bottom) and the massive, vuggy, cryptocrystalline Laki Limestone Member.

Claystone in the Laki Limestone Member is soft and very friable. Most contacts are sharp and well defined but some are gradational with thick-bedded, slope-forming limestone. In addition to scattered gypsum crystals and lenses, dark mineral grains are common. Some beds are very fossiliferous with numerous pelecypods, gastropods and echinoderms, whereas similar beds show no fossil fauna. Due to intense weathering, color varies from moderate-brown (5YR 4/4) to moderate-yellowish-brown (10YR 5/4) to light-brown (5YR 5/6) with moderate-red (5YR 4/6) oxidized zones.

Meting Shale Member

The Meting Shale Member of the Laki Formation is conformably overlain by the Laki Limestone Member (fig. 6). The Meting Shale Member is predominantly claystone with a few massive to thick-bedded limestone and sandstone beds. Fossil coquina approximately 30 m below the Laki Limestone-Meting Shale contact serves as a marker bed in several sections.

Claystone in the member is soft and loose and forms gentle slopes. Abundant gypsum crystals and lenses are common and sparce glauconite weathers to moderate-olive-brown (5Y 4/4) colored units. In various sections, the claystone is sandy and ferruginous and grades into limestone or sandstone. Abundant pelecypods, gastropods, and echinoderms comprise the fossil fauna in particular sections and cephalopods weather out near the limestone contacts. Color varies, depending upon the duration of weathering, but is generally moderate-brown (5YR 4/4) to moderate-yellowish-brown (10YR 5/4).

Sandstone is thick-bedded, fine-grained and contains less than 50 percent quartz. It commonly has a sharp contact with claystone and may represent channel deposits. The color is dark-yellowish-orange (10YR 8/6) weathering to grayish-orange (10YR 7/4). The fossils include pelecypod and gastropod fragments, scattered foraminifera, and echinoderms. The sandstone is calcareous and clayey in a few sections.

The fossil coquina bed is comprised of broken pelecypods, gastropods, brachiopods, and echinoderms with few cephalopods. It ranges in thickness from 0.16 to 0.25 m and extends northward 4 km from section 5 to section 9 (fig. 1), where it has been eroded by the Indus River. The coquina makes a sharp contact with a pale-yellowish-orange (10YR 8/6) limestone and together can be traced through the five sections (fig. 7). The coquina bed typically forms a plateau and ledges out intermittently. Due to the number of broken shells and their disorientation, the coquina may represent a storm or marginal marine deposit.

The limestone in the Meting Shale Member is chalky, thick-bedded to massive, and forms gentle slopes. Individual units can be traced from section to section but others abruptly disappear under thick colluvium. Ironstone concretions are found frequently on the slopes. Exposed contacts are sharp and undulatory. Scattered fossil pelecypods, gastropods, and numerous fossil burrows are present. The limestone color ranges from dark-yellowish-orange (10YR 6/6) to very pale orange (10YR 8/2).

Figure 6. Ganjo Takkar area looking northeast near section no. 4. Contact between Meting Shale Member (left) with the Laki Limestone Member.

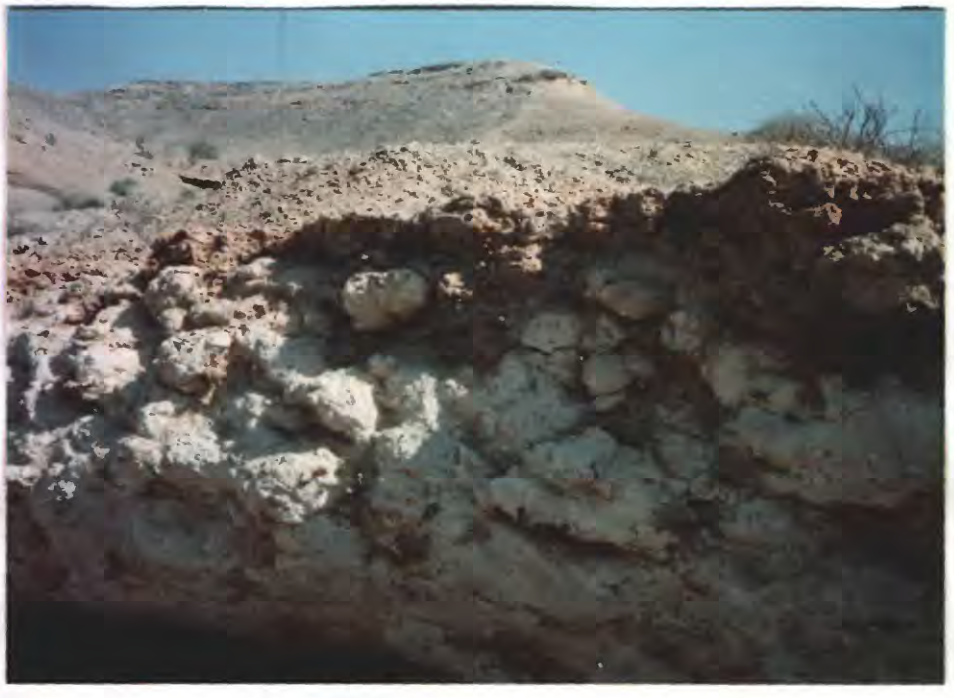

Figure 7. Ganjo Takkar area looking east between section nos. 6 and 7. Sharp contact between the dark-yellowish-orange coquina (0.16m) and the underlying nodular, very pale orange to white limestone (1.45m), Meting Shale Member.

Colluvium

Colluvium is extremely thick on the lower slopes and gradually thins towards the top of each section. The steep upper slopes characteristically are covered with large scree and boulders from the massive ledge-forming limestone above. In addition, the weathering of the soft, chalky upper limestone creates thick powdery, clayey material with large angular cobbles. The contacts between different rock types is usually located by digging through the cobbles and into the underlying unit. The contacts in the lower slopes are found by digging as much as 2 m. Indus River alluvial silt and sand are extremely thick and are used as a point to begin the description of a section.

Section 1

Location: Approximately 1,850 m southeast off the Gaja Branch Canal, 3,930 m southeast from the village of Dars Chhutto and 3,500 m southwest from the village of Nuru Mohan.

Topographic Sheet Number: 40 C/8

Coordinates: Longitude 68°27'25''E
Latitude 25°08'21''N
Northing 830 750 m
Easting 21 85 060 m

Date: September 27, 1987

Unit Number	Description	METERS (Total)
	BASE OF SECTION	
1.	Alluvium	(3.10)
	Laki Limestone Member	
2.	Limestone, pale-yellowish-orange (10YR 8/6), weathers yellowish-gray (5Y 8/1), scattered gypsum veins, ferruginous zones, sandy towards top, marly, foraminifera, poorly bedded to massive, hard and compact	3.55 (6.65)
3.	Limestone, pale-yellowish-orange (10 YR 8/6) to very pale orange (10YR 8/2), sandy, clayey, slightly ferruginous, scattered gypsum veins, hard and compact	1.57 (8.22)
4.	Limestone, dark-yellowish-brown (10YR 6/6) to moderate-yellowish-brown (10YR 5/4), contains fine-grained sand, calcareous, clayey, ferruginous, fossiliferous, burrowed, massive, compact	0.32 (8.54)
5.	Limestone, very pale orange (10YR 8/2) to dark-yellowish-orange (10YR 6/6), iron stains on surfaces, scattered fossil pelecypods, massive, soft, compact	5.77 (14.31)
6.	Limestone, very pale orange (10YR 8/2) to grayish-white, silty, sandy, ferruginous, scattered fossils, nodular, massive, hard and compact	2.90 (17.21)
7.	Limestone, very pale orange (10YR 8/2) to dark-yellowish-orange (10YR 6/6), silty, sandy, ferruginous, marly, scattered fossils, nodular, massive, hard and compact	0.86 (18.07)
8.	Limestone, mostly covered	1.42 (19.49)

Unit Number	Description	METERS (Total)
9.	Limestone, very pale orange (10YR 8/2) to dark-yellowish-orange (10YR 6/6), ferruginous, fossiliferous, nodular, massive, hard and compact.....	2.29 (21.78)
10.	Claystone, moderate-brown (5Y 3/4), weathers dark-yellowish-brown (10YR 4/2), sandy, massive, loose, soft.....	7.40 (29.18)
11.	Limestone, very pale orange (10YR 8/2), fossiliferous, hard and compact.....	0.80 (29.98)
12.	Claystone, dark-yellowish-orange (10YR 6/6) to moderate-brown (5Y 3/4), sandy, massive, loose, soft.....	0.60 (30.58)
13.	Limestone, very pale orange (10YR 8/2), weatheres yellowish-gray (5Y 8/1), iron stains on surfaces, fossiliferous, nodular, vuggy, massive, hard and compact.....	13.03 (43.58)

TOP OF SECTION

Section 2

Location: Approximately 1,200 m northwest from the village of Dars Chutto and 1,600 m northwest from the village of Sulaiman Daud.

Topographic Sheet Number: 40 C/8

Coordinates: Longitude 68°25'38''E
Latitude 25°10'30''N
Northing 835 000 m
Easting 21 82 600 m

Date: September 30, 1987

Unit Number	Description	METERS (Total)
	BASE OF SECTION	
	Meting Shale Member	
1.	Claystone, dark-yellowish-orange (10YR 6/6), calcareous, slightly sandy, ferruginous, gypsum, scattered limestone beds and laminae, friable and loose, top sharp, heavy colluvium.....	13.58 (13.58)
	Laki Limestone Member	
2.	Limestone, very pale orange (10YR 8/2) to white (N9), sandy, marly, scattered gypsum crystals, nodular, massive, vuggy, soft, friable, weathered, base sharp.....	9.29 (22.87)
3.	Claystone, dark-yellowish-orange (10YR 6/6), calcareous, soft, friable, weathered, base sharp.....	0.30 (23.17)
4.	Limestone, very pale orange (10YR 8/2) to white (N9), marly sandy in parts, nodular, massive, weathered.....	2.07 (25.24)
5.	Claystone, dark-yellowish-orange (10YR 6/6), scattered gypsum flakes and crystals, ferruginous black grains, foraminifera, fossil bivalves, friable, weathered, top sharp.....	0.73 (25.97)
6.	Limestone, very pale orange (10YR 8/2) to white (N9), sandy, ferruginous concretions, scattered gypsum crystals near base, contains a 1.30 m thick chalky weathered limestone bed at base, contains .10 to 1.00 m thick, pale-yellowish-orange (10YR 8/6) limestone bed 1.30 m from base, contains a 0.05 to 0.10 m thick layer of medium-light-gray weathered claystone 1.20 m from base, scattered pelecypods and fossiliferous zones, burrowed(?), nodular.....	8.84 (34.81)
7.	Claystone, pale-yellowish-orange (10YR 8/6) to dark-yellowish-orange (10YR 6/6), scattered gypsum flakes and crystals, soft, friable, weathered, base and top sharp.....	1.12 (35.93)

Unit Number	Description	METERS (Total)
8.	Limestone, very light gray (N8) to white (N9), sandy, gypsum flakes and crystals, some dark mineral grains, scattered fossil pelecypods and shell fragments, nodular, massive, weathered, base sharp	2.63 (38.56)
9.	Claystone, pale-yellowish-orange (10YR 8/6), faintly bedded, contains two beds of white (N9) sandy nodular limestone 0.20 to 0.30 m thick 6.58 m from base, weathered, soft, friable, heavy colluvium	10.69 (49.25)
10.	Limestone, white (N9), fossil shell fragments, fossil gastropods, massive, weathered, top sharp	2.26 (51.51)
11.	Claystone, pale-yellowish-orange (10YR 8/6), soft, friable, weathered	1.18 (52.69)
12.	Limestone, white (N9), nodular, massive	3.24 (55.93)
13.	Limestone, very light gray (N8) to white (N9), cryptocrystalline, contains black mineral grains, fossil corals, saccharoidal, vuggy, blocky and massive, differential weathering	1.65 (57.58)

TOP OF SECTION

Section 3

Location: Approximately 2,930 m northwest from the village of Dara Chhutto and 1,550 m north by northwest from the village of Sulaiman Daud.

Topographic Sheet Number: 40 C/8

Coordinates: Longitude 68°24'50''E
Latitude 25°10'36''N
Northing 835 500 m
Easting 21 80 940 m

Date: October 2, 1987

Unit Number	Description	METERS (Total)
		4.25
1.	Alluvium	(4.25)
	BASE OF SECTION	
	Meting Shale Member	
2.	Claystone, dark-yellowish-orange (10YR 8/6), to grayish-orange (10YR 7/4), calcareous, sandy, ferruginous, scattered gypsum lenses and crystals, numerous fossil pelecypods and gastropods (sample number S-3-1), faintly bedded, very weathered, top gradational	7.49 (11.74)
3.	Limestone, pale-yellowish-orange (10YR 8/6), weathers to dark-yellowish-orange (10YR 6/6), slightly ferruginous, contains fossil pelecypods (sample number S-3-2), burrowed(?), nodular, massive	3.08 (14.82)
4.	Claystone, pale-yellowish-orange (10YR 8/6) to very pale orange (10YR 8/2), contains gypsum crystals and flakes, calcareous, contains a 0.30 m thick white (N9) limestone bed 0.30 m above base and a 0.35 m thick white (N9) limestone bed 0.88 m above base, few scattered fossils, faintly bedded, weathered, base gradational, top sharp	2.12 (16.94)
5.	Limestone, pale-yellowish-orange (10YR 8/6) to very pale orange (10YR 8/2), scattered gypsum lenses and flakes, contains large fossil gastropods (sample number S-3-3), nodular, massive, weathered	0.62 (17.56)
6.	Claystone, pale-yellowish-orange (10YR 8/6), weathers to very pale orange (10YR 8/2), calcareous, scattered fossil pelecypods, weathered	0.43 (17.99)

Unit Number	Description	METERS (Total)
7.	Limestone, very pale orange (10YR 8/2), weathers to grayish-yellow (5Y 8/4), marly, chalky, scattered fossils (sample number S-3-4), massive, soft, weathered	2.61 (20.60)
8.	Claystone, dark-yellowish-orange (10YR 6/6), calcareous, scattered gypsum flakes and crystals, soft	0.31 (20.91)
	Laki Limestone Member	
9.	Limestone, very pale orange (10YR 8/2), sandy, chalky, soft, weathered	2.90 (23.81)
10.	Limestone, dark-yellowish-orange (10YR 6/6), sandy, fossiliferous, hard	0.36 (24.17)
11.	Limestone, very pale orange (10YR 8/2, slightly sandy, slightly ferruginous, marly, chalky, fossiliferous, nodular, massive, weathered, top gradational	3.44 (27.61)
12.	Claystone, moderate-yellowish-brown (10YR 5/4) to dark-yellowish-orange (10YR 6/6), friable, soft and loose, weathered, top undulatory	0.35 (27.96)
13.	Limestone, very pale orange (10YR 8/2), chalky, vuggy, massive, weathered, top undulatory	3.29 (31.25)
14.	Claystone, moderate-yellowish-brown (10YR 5/4), gypsum crystals, soft and friable, weathered	1.59 (32.84)
15.	Limestone, very pale orange (10YR 8/2) to pale-yellowish-orange (10YR 8/6), nodular, massive, weathered	0.94 (33.78)
16.	Claystone, pale-yellowish-orange (10YR 8/6) to very pale orange (10YR 8/2), friable, soft, weathered	0.29 (34.07)
17.	Limestone, very pale orange (10YR 8/2), nodular, massive, weathered	3.35 (37.42)
18.	Claystone, pale-yellowish-orange (10YR 8/6) to very pale orange (10YR 8/2), gypsum, friable, weathered	0.49 (37.91)
19.	Claystone, dark-yellowish-orange (10YR 6/6) to pale-yellowish brown (10YR 8/6), slightly calcareous, friable and soft, weathered	0.18 (38.09)
20.	Limestone, pale-yellowish-orange (10YR 8/6) to white (N9), sandy, scattered gypsum crystals and flakes, massive	8.01 (46.10)

Unit Number	Description	METERS (Total)
21.	Claystone, moderate-yellowish-brown (10YR 5/4) to dark-yellowish-orange (10YR 6/6), slightly bedded, loose, friable..	11.58 (57.64)
22.	Limestone, very light gray (N8) to white (N9), chalky, nodular, massive, weathered, top gradational.....	0.68 (58.32)
23.	Limestone, very light gray (N8) to white (N9), sandy, crypto-crystalline, vuggy, nodular, massive and blocky.....	3.00 (61.32)

TOP OF SECTION

Section 4

Location: Approximately 2,700 m northeast from the village of Sulaiman Sumra and from the west facing section at the village of Haji Ibrahim.

Topographic Sheet Number: 40 C/8

Coordinates: Longitude 68°24'07''E
Latitude 25°10'53''N
Northing 835 850 m
Easting 21 79 700 m

Date: October 4, 1987

Unit Number	Description	METERS (Total)
	BASE OF SECTION	
	Meting Shale Member	
1.	Claystone, moderate-yellowish-brown (10YR 5/4) to dark-yellowish-orange (10YR 6/6/), weathers pale-yellowish-brown (10 YR 6/2), slightly calcareous, sandy, manganese surface coatings, gypsum crystals, soft and loose, top sharp.....	4.86 (4.86)
2.	Limestone, dark-yellowish-orange (10YR 6/6), weathers grayish-orange-pink (5YR 7/2), sandy, dark mineral grains, iron stained surfaces, fossiliferous, massive, weathered.....	0.57 (5.43)
3.	Claystone, variegated, weathers dark-yellowish-orange (10YR 6/6) to moderate-brown (5YR 3/4), sandy, scattered gypsum crystals and flakes, top 0.25 m weathers moderate-red (5R 4/6), oxidized zones, soft, friable, weathered, top sharp.....	3.36 (8.79)
4.	Sandstone, grayish-orange (10YR 7/4), fine-grained, contains less than 50 percent quartz, slightly calcareous, scattered dark mineral grains, massive, hard.....	0.42 (9.21)
5.	Claystone, dark-yellowish-brown (10YR 4/2) to dark-yellowish-orange (10YR 6/6), slightly sandy, gypsum crystals, oxidized near top, weathered, top undulatory.....	13.59 (22.80)
	Laki Limestone Member	
6.	Limestone, pale-yellowish-orange (10YR 8/6), weathers to grayish-orange (10YR 7/4), slightly sandy, scattered gypsum crystals and flakes, pelecypods, (sample number S-4-1), top undulatory.....	2.47 (25.27)
7.	Claystone, pale-yellowish-orange (10YR 8/6), weathers very pale orange (10YR 8/2), calcareous, weathered.....	0.97 (26.24)

Unit Number	Description	METERS (Total)
8.	Limestone, very pale orange (10YR 8/2) to pale-yellowish-orange (10YR 8/6), contains a 0.70 m thick bed of chalky very light gray (N8) limestone 3.24 m from top, contains a 0.05 to 0.10 m thick dark-yellowish-orange (10YR 6/6) 2.44 m from top, massive, weathered	6.48 (32.72)
9.	Limestone, dark-yellowish-orange (10YR 6/6), fossiliferous, massive, weathered	0.31 (33.03)
10.	Claystone, very pale orange (10YR 8/2) to grayish-orange (10YR 7/4), weathered	0.43 (33.46)
11.	Limestone, very pale orange (10YR 8/2), nodular, massive, weathered	1.13 (34.59)
12.	Claystone, dark-yellowish-orange (10YR 6/6) to light-brown (5YR 5/6), slightly calcareous, soft, friable	5.89 (40.48)
13.	Limestone, very pale orange (10YR 8/2) to pale-yellowish-orange (10YR 8/6), weathers to medium-dark-gray (N4), very weathered, honeycomb texture, hard	1.62 (42.10)
14.	Claystone, very pale orange (10YR 8/2)	0.78 (42.88)
15.	Claystone, dark-yellowish-orange (10YR 6/6), weathered	0.30 (43.18)
16.	Claystone, pale-yellowish-orange (10YR 8/6) to grayish-orange (10YR 7/4), mostly covered	2.56 (45.74)
17.	Limestone, very pale orange (10YR 8/2) to pale-yellowish-orange (10YR 8/6), large fossil gastropods (sample number S-4-2), very weathered, hard	1.97 (47.71)
18.	Claystone, mostly covered, top undulatory	11.56 (59.27)
19.	Limestone, very pale orange (10YR 8/2) to grayish-orange (10YR 7/4), chalky, ferruginous, dark mineral grains, fossiliferous, nodular, massive, very weathered, hard	1.62 (60.89)
20.	Claystone, very pale orange (10YR 8/2) to dark-yellowish-orange (10YR 6/6), calcareous, soft, friable, weathered	0.74 (61.63)
21.	Limestone, grayish-orange-pink (5YR 7/2) to very pale orange (10YR 8/2), weathers light-gray (N7) to medium-light-gray (N6), micritic, cryptocrystalline, vuggy, solution cavities, massive, top 0.51 m forms ridge top, hard, weathered	1.06 (62.69)

TOP OF SECTION

Section 5

Location: Approximately 650 m north from the village of Haji Ibrahim and 3,200 m northeast from the village of Sulaiman Sumra.

Topographic Sheet Number: 40 C/8

Coordinates: Longitude 68°24'00''E
Latitude 25°11'25''N
Northing 836 525 m
Easting 21 79 500 m

Date: October 7, 1987

Unit Number	Description	METERS (Total)
	BASE OF SECTION	
	Meting Shale Member	
1.	Limestone, dark-yellowish-orange (10YR 8/6) to grayish-orange (10YR 7/4), sandy, scattered dark mineral grains, fossiliferous, hard in places, weathered, top sharp	0.60 (0.60)
2.	Limestone, fossil coquina bed, light-brown (5YR 5/6) to moderate-brown (5YR 4/4), abundant fossils, burrowed, very sandy, weathered, base sharp	0.20 (0.80)
3.	Limestone, pale-yellowish-orange (10YR 8/6), slightly sandy, scattered dark mineral grains, fossiliferous, foraminifera, chalky, soft, weathered, mostly covered	0.10 (0.90)
4.	Claystone, dark-yellowish-orange (10YR 6/6) to moderate-yellowish-brown (10YR 5/4), sandy, gypsiferous, scattered dark mineral grains, soft, friable, weathered, top sharp	3.27 (4.17)
5.	Sandstone, dark-yellowish-orange (10YR 6/6), weathers grayish-orange (10YR 7/4), fine-grained, contains less than 50 percent quartz, calcareous, scattered dark mineral grains, fossiliferous, foraminifera (sample number 29F), poorly bedded, compact, base sharp	0.68 (4.85)
6.	Claystone, moderate-brown (5YR 4/4), slightly sandy, ferruginous in places, contains thin gypsum veins, glauconitic and foraminiferal in basal 0.20 m, weathered	0.85 (5.70)
7.	Claystone, moderate-olive-brown (5Y 4/4) to light-olive-brown (5Y 5/6), sandy, glauconite, abundant foraminifera, claystone (sample number S-5-1)	0.60 (6.30)

Unit Number	Description	METERS (Total)
8.	Sandstone, dark-yellowish-orange (10YR 6/6), weathers grayish-orange (10YR 7/4), fine-grained, contains less than 50 percent quartz, calcareous, clayey, scattered dark mineral grains, fossiliferous, foraminifera (sample number 30F).....	1.05 (7.35)
9.	Claystone, dark-yellowish-orange (10YR 6/6), contains 45 percent light-olive-gray (5Y 5/2) very fine to fine-grained sand, glauconite, gypsiferous, soft, friable, (sample number S-5-3).....	3.85 (11.20)
10.	Limestone, very pale orange (10YR 8/2), weathers grayish-orange (10YR 7/4), slightly sandy, scattered ironstone concretions on surface, some dark mineral grains, fossiliferous, large foraminifera (sample number 31F), burrowed, saccharoidal.....	0.85 (12.05)
11.	Claystone, moderate-yellowish-brown (10YR 5/4), slightly calcareous and sandy, gypsiferous, silty at places, scattered manganese surface coatings and mineral grains, faintly bedded, soft, loose, friable, weathered.....	2.30 (14.35)
12.	Gypsum, weathers moderate-reddish-brown (10YR 4/6), oxidized zones, weathered, base and top sharp.....	0.10 (14.45)
13.	Sandstone, moderate-yellowish-brown (10YR 5/4) to dark-yellowish-orange (10YR 6/6), fine- to medium-grained, contains 65 percent quartz, scattered dark mineral grains, some ferruginous material, thin gypsum lenses, scattered oxidized zones, fossiliferous, thick-bedded, soft, friable, weathered, top sharp.....	0.80 (15.25)
14.	Claystone, moderate-yellowish-brown (10YR 5/4) to dark-yellowish-orange (10YR 6/6), slightly calcareous, faintly bedded, soft, weathered, top and base sharp.....	0.10 (15.35)
15.	Sandstone, dark-yellowish-orange (10YR 6/6) to grayish-orange (10YR 4/4) to pale-yellowish-orange (10YR 8/6), fine- to medium-grained, contains 65 percent quartz, subrounded to subangular quartz grains, scattered dark mineral grains, some glauconite grains, foraminifera (sample number 32F), crossbedding inclined approximately 30 degrees, few oxidized zones, thick bedded, contains a thin ferruginous laminae at top, soft,friable, weathered, top and base sharp.....	0.45 (15.80)
16.	Claystone, moderate-yellowish-brown (10YR 5/4), weathers pale-yellowish-brown (10YR 6/2), sandy, silty, soft, friable, loose, faintly bedded, weathered, base sharp, top undulatory.....	0.45 (15.95)

Unit Number	Description	METERS (Total)
17.	Limestone, dark-yellowish-orange (10YR 6/6), weathers pale-orange (10YR 8/2), sandy, fossiliferous, nodular, weathered, base and top undulatory	0.12 (16.07)
18.	Claystone, pale-yellowish-brown (10YR 6/2), weathers very pale orange (10YR 8/2), sandy, calcareous and glauconitic in parts, abundant gypsum lenses with oxidized zones in basal 0.20 m, fossiliferous, weathered, top sharp	0.37 (16.44)
19.	Limestone, grayish-orange (10YR 7/4), few quartz grains and dark mineral grains, basal 0.18 m is soft and sandy, top 0.22 m is hard and cryptocrystalline forming ledges, fossiliferous, foraminifera, thick-bedded, weathered	0.40 (16.84)
20.	Claystone, moderate-brown (5YR 4/4), calcareous, gypsiferous, scattered ferruginous zones, some glauconite grains, foraminifera, vertical gypsum lenses in top 0.20 m, loose, friable, soft, weathered	2.70 (19.54)
21.	Sandstone, grayish-orange (10YR 7/4), very fine to fine-grained, contains less than 50 percent quartz, calcareous, scattered dark mineral grains, gypsum lenses, fossiliferous, foraminifera, poorly sorted, thick-bedded to massive, base undulatory	0.95 (20.49)
22.	Claystone, pale-yellowish-orange (10YR 8/6) to grayish-orange (10YR 7/4), calcareous, sandy, containss a 0.02 m thick gypsum band at top, fossiliferous, foraminifera, massive	0.60 (21.09)
23.	Claystone, dark-yellowish-orange (10YR 6/6) to pale-brown (5YR 5/2), calcareous at top, slightly sandy, some gypsum lenses, scattered red and yellow oxidized zones, hard, base sharp	2.50 (23.59)
24.	Limestone, very pale orange (10YR 8/2) to grayish-orange (10YR 7/4), sandy, scattered ironstone concretions on surface, fossiliferous (sample number S-5-4), foraminifera, thin-bedded to poorly bedded, weathered	2.10 (25.69)
25.	Claystone, dark-yellowish-orange (10YR 6/6), weathers grayish-orange (10YR 7/4) to dusky-yellow (5Y 6/4), sandy, gypsiferous, fossiliferous (sample number S-5-5), scattered concretions on surface, soft, loose, weathered	6.35 (32.04)

Unit Number	Description	METERS (Total)
	Laki Limestone Member	
26.	Limestone, very pale orange (10YR 8/2) to grayish-orange (10YR 7/4), scattered dark mineral grains, sandy, nodular, fossiliferous (sample number S-5-6), foraminifera, burrowed, hard, compact, weathered, ledge forming.....	4.05 (36.09)
27.	Limestone, very pale orange (10YR 8/2), weathers dark-gray (N3), slightly sandy, chalky, scattered dark mineral grains, very weathered, sandy and clayey in basal 0.50 m, fossiliferous (sample number S-5-7), burrowed, massive, slope forming, mostly covered.....	2.65 (38.74)
28.	Limestone, very pale orange (10YR 8/2) to grayish-orange (10YR 7/4), chalky, scattered dark mineral grains, fossiliferous, foraminifera, nodular, massive, ledge forming.....	3.60 (42.34)
		7.80
29.	Limestone, soft, weathered, slope forming, mostly covered....	(50.14)
30.	Limestone, very pale orange (10YR 8/2) to pale-yellowish-orange (10YR 8/6), weathers medium-dark-gray (N4), scattered dark mineral grains, fossiliferous, foraminifera, nodular, massive, vuggy, ledge forming at base.....	4.20 (54.34)
31.	Claystone, dark-yellowish-orange (10YR 6/6) to moderate-yellowish-brown (10YR 5/4), slightly calcareous and sandy, few gypsum flakes, soft, friable, loose, weathered.....	1.65 (55.99)
32.	Limestone, very pale orange (10YR 8/2) to grayish-orange (10YR 7/4), scattered dark mineral grains, foraminifera, nodular, massive, hard, compact, ledge forming.....	2.30 (58.29)
33.	Claystone, moderate-yellowish-brown (10YR 5/4) to dark-yellowish-orange (10YR 6/6), sandy, scattered dark mineral grains, contains a dark-yellowish-orange (10YR 6/6) to grayish-orange (10YR 7/4) 0.20 m thick limestone bed 4.20 m from base, fossil cephalopods and corals on surface (sample number S-5-9), foraminifera, soft, friable.....	10.20 (68.49)
34.	Limestone, very pale orange (10YR 8/2) to white (N9), chalky, scattered dark mineral grains, fossiliferous, foraminifera, burrowed, thick-bedded to massive, base sharp, ledge forming.....	5.15 (73.64)

TOP OF SECTION

Section 6

Location: Approximately 3,050 m northwest from the village of Sulaiman Sumra and 840 m southeast from the village of Jhangli Shoro, and at the village of Ziarat Pir Haji.

Topographic Sheet Number: 40 C/8

Coordinates: Longitude 68°22'29''E
Latitude 25°11'12''N
Northing 836 500 m
Easting 21 77 135 m

Date: October 7, 1987

Unit Number	Description	METERS (Total)
	BASE OF SECTION	
	Meting Shale Member	
1.	Claystone, moderate-yellowish-brown (10YR 5/4) to dark-yellowish-orange (10YR 6/6), very sandy at top, soft, weathered, top gradational	0.15 (0.15)
2.	Sandstone, light-olive-gray (10YR 5/2) to light-olive-brown (5Y 5/6), fine-grained, contains less than 50 percent quartz, clayey, calcareous, scattered dark mineral grains, slightly gypsiferous, slightly fossiliferous, sorted, soft, weathered	0.55 (0.70)
3.	Claystone, light-olive-brown (5Y 5/6), calcareous, sandy, silty, gypsiferous, few ferruginous bands, contains fossiliferous and glauconitic sandstone laminae, faintly laminated	1.95 (2.65)
4.	Limestone, grayish-orange-pink (5YR 7/2) to light-brown (5YR 6/4), very sandy, scattered dark mineral grains, fossiliferous, foraminifera, hard	0.10 (2.75)
5.	Claystone, grayish-orange (10YR 7/4) to dusky-yellow (5Y 6/4), slightly calcareous, sandy, scattered dark mineral grains, gypsiferous, soft, loose, top sharp	0.90 (3.65)
6.	Sandstone, yellowish-gray (5Y 7/2), very fine to fine-grained, subrounded quartz grains, silty, clayey, scattered dark mineral grains, sorted, thick-bedded, top sharp	0.50 (4.15)
7.	Claystone, dark-yellowish-orange (10YR 6/6) to dusky-yellow (5Y 6/4), sandy, gypsiferous, fossil cephalopods on surface (sample number S-6-1), soft, loose, friable, weathered, top sharp	1.55 (5.70)

Unit Number	Description	METERS (Total)
8.	Limestone, very pale orange (10YR 8/2), chalky, slightly sandy, scattered ferruginous zones, fossiliferous (sample number S-6-3), foraminifera, soft, top sharp.....	1.45 (7.15)
9.	Limestone, fossil coquina, dark-yellowish-orange (10YR 6/6), contains fossil pelecypods, gastropods, shell fragments, burrowed, oxidized zones at surface, (sample number S-6-2).....	0.20 (7.35)
10.	Limestone, very pale orange (10YR 8/2), chalky, sandy, slightly gypsiferous, fossiliferous (sample number S-6-4), foraminifera, thick-bedded, weathered.....	1.45 (8.80)
11.	Claystone, pale-yellowish-brown (10YR 6/2), calcareous, sandy, slity, abundant gypsum lenses, some oxidized zones, scattered fossil hash zones, friable, weathered.....	6.85 (15.65)
12.	Limestone, dark-yellowish-orange (10YR 6/6), very sandy, scattered gypsum lenses and veins, abundant fossils, burrowed, thick-bedded, base sharp and undulatory, ledge forming.....	0.45 (16.10)
13.	Claystone, moderate-yellowish-brown (10YR 5/4) to grayish-orange (10YR 7/4), slightly sandy, gypsiferous, scattered ferruginous zones, some dark mineral grains, soft, weathered.....	1.05 (17.15)
14.	Sandstone, light-olive-brown (5Y 5/6) to dusky-yellow (5Y 6/4), some fossil hash, abundant glauconite.....	0.30 (17.45)
15.	Limestone, dark-yellowish-orange (10YR 6/6), very sandy, gypsiferous, scattered dark mineral grains, fossiliferous, foraminifera.....	0.55 (18.00)
16.	Claystone, dark-yellowish-orange (10YR 6/6) to light-brown (5YR 5/6) to light-olive-gray (5Y 5/2), abundant gypsum, sandy, glauconitic, soft, loose.....	3.35 (21.35)
17.	Limestone, dark-yellowish-orange (10YR 6/6) to pale-yellowish-orange (10YR 8/6), very sandy, gypsiferous, scattered dark mineral grains, thick-bedded, weathered.....	1.15 (22.50)
18.	Claystone, moderate-brown (5YR 4/4) to dark-yellowish-orange (10YR 6/6), slightly sandy, gypsiferous, soft, loose, friable.....	3.50 (26.00)
19.	Limestone, moderate-orange-pink (5YR 8/4) to light-brwon (5YR 6/4), abundant ironstone concretions, fossiliferous, foraminifera, saccharoidal, thick-bedded, hard, base sharp.....	0.65 (26.65)

Unit Number	Description	METERS (Total)
20.	Claystone, dark-yellowish-orange (10YR 6/6) to moderate-yellowish-brown (10YR 5/4), calcareous, gypsiferous, slightly sandy and silty, scattered oxidized zones, fossiliferous, foraminifera (sample number 34F), soft, loose, friable, weathered, top sharp	2.55 (29.20)
21.	Limestone, pale-yellowish-orange (10YR 8/6) to dark-yellowish-orange (10YR 6/6), sandy, few scattered dark mineral grains, fossiliferous (sample number S-6-5), foraminifera, poorly bedded, loose, friable, weathered, base sharp	1.05 (30.25)
22.	Claystone, moderate-yellowish-brown (10YR 5/4) to moderate-brown (5Y 4/4), slightly sandy, few dark mineral grains, calcareous at top, gypsiferous, loose, weathered, top sharp and undulatory	7.50 (37.75)
	Laki Limestone Member	
23.	Limestone, very pale orange (10YR 8/2) to pale-yellowish-orange (10YR 8/6) to white (N9), chalky, few scattered dark mineral grains, fossiliferous, foraminifera (sample number 35F), burrowed, saccharoidal, massive, vuggy, soft, weathered, base sharp and undulatory	19.35 (57.10)
	TOP OF SECTION	

Section 7

Location: Approximately 400 m northwest from the village of Jhangli Shoro and 3,200 m southeast from the village of Hayat Choto.

Topographic Sheet Number: 40 C/8

Coordinates: Longitude 68°22'00''E
Latitude 25°11'38''N
Northing 837 280 m
Easting 21 76 300 m

Date: October 10-13, 1987

Unit Number	Description	METERS (Total)
	BASE OF SECTION	
	Meting Shale Member	
1.	Claystone, dark-yellowish-orange (10YR 8/6) to moderate-yellowish-brown (10YR 5/4), calcareous, sandy, gypsiferous, scattered dark mineral grains, soft, friable, (sample number S-7-1)	0.35 (0.35)
2.	Sandstone, dark-yellowish-orange (10YR 6/6) to grayish-orange (10YR 7/4), fine-grained, contains less than 65 percent quartz, subrounded grains, calcareous, scattered dark mineral grains, clayey in parts, sorted, thin-bedded, loose, friable, weathered, top sharp	0.20 (0.55)
3.	Claystone, dark-yellowish-orange (10YR 6/6) to light-brown (5YR 5/6), calcareous, sandy, scattered gypsum flakes, faintly bedded, soft, loose and friable, weathered	0.18 (0.73)
4.	Sandstone, grayish-orange (10YR 7/4), very fine to fine-grained, contains 80 percent quartz, calcareous, clayey, scattered dark mineral grains, few fossils, thin-bedded to massive, loose, friable, weathered	0.70 (1.43)
5.	Claystone, dark-yellowish-orange (10YR 6/6), calcareous, sandy, gypsum flakes, scattered fossil fragments, manganese surface coatings, soft, friable, weathered, top sharp	0.68 (2.11)
6.	Limestone, dark-yellowish-orange (10YR 6/6) to pale-yellowish-orange (10YR 8/6), clayey, very sandy, scattered gypsum veins, dark mineral grains, fossiliferous, soft, loose and friable	0.22 (2.33)

Unit Number	Description	METERS (Total)
		1.00
7.	Claystone, mostly covered, thins and thickens laterally	(3.33)
8.	Limestone, dark-yellowish-orange (10YR 8/6) to grayish-orange (10YR 7/4), sandy, clayey, scattered gypsum lenses, fossil bivalve fragments, abundant foraminifera, massive, soft to hard, base sharp	1.30 (4.63)
9.	Limestone, very pale orange (10YR 8/2), gypsum lenses along solution fractures, dark mineral grains, scattered oxidized zones, nodular and massive, hard, top gradational	1.20 (5.83)
10.	Limestone, fossil coquina, dark-yellowish-orange (10YR 6/6), (sample number S-7-3), ironstone concretions, dark mineral grains, hard, compact	0.16 (5.99)
		0.05
11.	Claystone, calcareous, soft, base undulatory	(6.04)
12.	Limestone, very pale orange (10YR 8/2), weathers grayish-orange (10YR 7/4), sandy, scattered dark mineral grains, gypsiferous, slightly fossiliferous, hard, compact, top sharp	0.15 (6.19)
13.	Claystone, dark-yellowish-orange (10YR 6/6), sandy, gypsum, soft, friable, weathered, mostly covered	1.70 (7.89)
14.	Limestone, dark-yellowish-orange (10YR 6/6) to pale yellowish-orange (10YR 8/6), sandy, gypsiferous, clayey in parts, weathered, base undulatory	0.23 (8.12)
15.	Sandstone, grayish-orange (10YR 7/4), fine- to medium-grained, contains 60 percent quartz, calcareous, subrounded to subangular grains, glauconite, ferruginous grains, poorly sorted, base undulatory	0.10 (8.22)
16.	Limestone, very pale orange (10YR 8/2) to pale-yellowish-orange (10YR 8/6), sandy, gypsum, includes a 0.34 m thick wavy-bed 0.22 m from base, few fossils, hard and compact	0.56 (8.78)
17.	Claystone, dark-yellowish-brown (10YR 4/2) to dark-yellowish-orange (10YR 6/6), calcareous, sandy, abundant glquconite, numerous foraminifera (sample number S-7-4), fossiliferous, top 0.13 m very sandy, gypsiferous, loose, friable, soft, weathered, top gradational, partly covered	5.01 (13.79)
18.	Limestone, grayish-orange (10YR 7/4), weathers dark-yellowish-orange (10YR 6/6), sandy, clayey in parts, scattered dark mineral grains, fossil pelecypods, thin-bedded to massive, compact, top sharp	0.36 (14.15)

Unit Number	Description	METERS (Total)
19.	Claystone, dark-yellowish-orange (10YR 6/6) to dark-yellowish-brown (10YR 4/2), sandy, scattered gypsum partings, fossiliferous, friable, weathered, top gradational	0.35 (14.50)
20.	Claystone, pale-brown, (5YR 5/2), sandy, glauconite, scattered ferruginous grains, abundant foraminitera, soft	0.20 (14.70)
21.	Claystone, dark-yellowish-orange (10YR 6/6) to dark-yellowish-brown (10YR 4/2), slightly sandy, manganese surface coatings, ferruginous grains, faintly bedded, soft and friable to compact	0.42 (15.12)
22.	Claystone, moderate-brown (5YR 4/4), sandy, calcareous, abundant glauconite, few gypsum crystals, few fossils, numerous foraminifera, faintly bedded, soft, friable, top sharp	0.14 (15.26)
23.	Claystone, dark-yellowish-orange (10YR 6/6) to light-olive-gray (5Y 5/2), sandy, calcareous, gypsiferous, few fossils	0.18 (15.44)
24.	Limestone, dark-yellowish-orange (10YR 6/6) to grayish-orange (10YR 7/4) to yellowish-gray (5Y 7/2), sandy, scattered gypsum lenses, glauconitic, fossiliferous, basal 0.15 m less fossiliferous, grades less forminiferal towards top, top sharp	1.00 (16.44)
25.	Claystone, dark-yellowish-orange (10YR 6/6) to light-olive-gray (5Y 5/2), sandy, scattered gypsum flakes, soft, friable and loose, top sharp	3.47 (19.91)
26.	Limestone, grayish-orange (10YR 7/4) to very pale orange (10YR 8/2), cryptocrystalline, ferruginous grains, basal 0.30 m is very gypsiferous, fossiliferous, thick-bedded, weathered, top sharp	0.80 (20.71)
27.	Claystone, dark-yellowish-orange (10YR 6/6) to dark-yellowish-brown (10YR 4/2), slightly sandy, few gypsum flakes, ferruginous grains, iron staining on surfaces, soft, friable, weathered, top sharp and undulatory	2.97 (23.68)
28.	Limestone, grayish-orange (10YR 7/4), slightly sandy, scattered dark mineral grains, fossiliferous, thick-bedded to massive, weathered, hard and compact	0.73 (24.41)
29.	Claystone, light-brown (5Y 5/6) to moderate-brown (5Y 4/4), calcareous, contains 40 percent sand grains, less sandy towards top, scattered oxidized zones, iron staining on surfaces, soft, friable, weathered, top sharp and undulatory	1.79 (26.20)

Unit Number	Description	METERS (Total)
30.	Limestone, pale-yellowish-orange (10YR 8/6) to grayish-orange (10YR 7/4), dark mineral grains, cryptocrystalline, fossiliferous, saccharoidal, thick-bedded to massive, hard.....	2.44 (28.64)
31.	Claystone, moderate-brown (5YR 4/4) to dark-yellowish-orange (10YR 6/6), sandy, scattered gypsum flakes, dark mineral grains, iron staining on surfaces, contains thin beds of red and yellow oxidized zones, faintly bedded, soft, friable, compact, weathered, base sharp and undulatory.....	5.99 (34.63)
	Laki Limestone Member	
32.	Limestone, dark-yellowish-orange (10YR 6/6), weathers grayish-orange (10YR 7/4), sandy in parts(?), burrowed, massive, highly brecciated with angular fragments, base undulatory and sharp, top sharp.....	2.60 (37.23)
33.	Limestone, pale-yellowish-orange (10YR 8/6), weathers grayish-orange (10YR 7/4), sandy, marly, fossiliferous, foraminifera, massive, soft.....	1.80 (39.03)
34.	Limestone, dark-yellowish-orange (10YR 6/6) to pale-yellowish-orange (10YR 8/6), sandy, manganese surface coatings, massive, forms ledges, weathered.....	1.70 (40.73)
35.	Limestone, pale-yellowish-orange (10YR 8/6), sandy, marly, clayey, scattered dark mineral grains, massive, thickness varies laterally.....	0.40 (41.13)
36.	Limestone, pale-yellowish-orange (10YR 8/6) to light-brown (5YR 6/4), sandy, contains a 2.28 m thick grayish-orange (10YR 7/4) bed 2.80 m from base, scattered dark mineral grains, burrowed, nodular, massive, (sample number S-7-7).....	5.08 (46.21)
37.	Claystone, dark-yellowish-brown (10YR 4/2), calcareous in parts, chalky zones, gypsiferous, weathered, top gradational..	0.28 (46.49)
38.	Limestone, light-brown (5YR 6/4) to grayish-orange (10YR 7/4), sandy, scattered dark mineral grains, nodular, loose, weathered.....	2.03 (48.52)
39.	Claystone, light-brown (5YR 6/4), calcareous, sandy, soft.....	0.22 (48.74)
40.	Limestone, grayish-orange-pink (5YR 7/2), sandy, scattered dark mineral grains, fossiliferous (sample number S-7-8), nodular, massive, hard, weathered.....	2.36 (51.10)

Unit Number	Description	METERS (Total)
41.	Claystone, dark-yellowish-brown (10YR 6/2) to dark-yellowish-orange (10YR 6/6), calcareous, few oxidized zones on surfaces, few fossil cephalopods (sample number S-7-9) at top, top sharp and undulatory	2.30 (53.40)
42.	Limestone, pale-yellowish-orange (10YR 8/6) to dark-yellowish-orange (10YR 6/6), sandy, chalky in places, contains a 0.05 m thick sandy layer at top, weathered, top sharp	7.48 (60.88)
43.	Limestone, moderate-orange-pink (5YR 8/4) to light-brown (5YR 6/4), scattered dark mineral grains, cryptocrystalline, saccharoidal, massive, highly fractured, weathered, (sample number S-7-10)	2.02 (62.90)

TOP OF SECTION

Section 8

Location: Approximately 2,850 m south by southeast from the village of Hayat Choto and 690 m north by northwest from the village of Jhangli Shoro.

Topographic Sheet Number: 40 C/8

Coordinates: Longitude 68°21'53''E
Latitude 25°11'48''N
Northing 837 740 m
Easting 21 76 030 m

Date: November 21, 1987

Unit Number	Description	METERS (Total)
	BASE OF SECTION	
	Meting Shale Member	
1.	Claystone, dark-yellowish-orange (10YR 6/6) to light-olive-brown (5Y 5/6), sandy, glauconite, scattered gypsum flakes and oxidized zones, soft, friable, loose, weathered, top sharp	0.87 (0.87)
2.	Limestone, very pale orange (10YR 8/2) to white (N9) to grayish-orange (10YR 7/4), few dark mineral grains, some gypsum lenses, chalky, clayey near base, burrowed, foraminifera, nodular in parts, massive, weathered, base and top sharp	1.85 (2.72)
3.	Limestone, fossil coquina, dark-yellowish-orange (10YR 6/6) to light-brown (5YR 5/6), scattered dark mineral grains, fossil fauna includes gastropods, pelecypods, cephalopods and shell fragments, hard, compact, weathered, less fossiliferous compared to section 6 and 7, base sharp and undulatory	0.23 (2.95)
4.	Claystone, moderate-yellowish-brown (10YR 5/4), sandy, scattered dark mineral grains, gypsum flakes, abundant fossil hash, fossiliferous, few foraminifera, soft, loose, friable, weathered	6.08 (9.03)
5.	Limestone, dark-yellowish-orange (10YR 6/6), weathers grayish-orange (10YR 7/4), sandy, scattered dark mineral grains, fossiliferous, burrowed, foraminifera, thin-bedded, hard, weathered, top sharp, base sharp and undulatory	1.00 (10.03)

Unit Number	Description	METERS (Total)
6.	Claystone, moderate-brown (5Y 4/4), sandy, abundant glauconite in top 0.40 m, gypsiferous, scattered dark mineral grains, abundant fossil hash, soft, loose, friable, weathered, top and base sharp.....	0.88 (10.91)
7.	Limestone, foraminiferal, grayish-orange (10YR 7/4) to dark-yellowish-orange (10YR 6/6), few dark mineral grains, gypsum crystals, thin- to poorly bedded, soft, weathered, base sharp.....	0.68 (11.59)
8.	Claystone, dusky-yellow (5YR 6/4) to light-olive-brown (5Y 5/6), abundant glauconite, sandy, gypsiferous, soft, loose, friable, top sharp.....	4.13 (15.72)
9.	Limestone, grayish-orange (10YR 7/4) to dark-yellowish-orange (10YR 8/6), slightly sandy, scattered dark mineral grains, fossiliferous, burrowed, hard, compact, base sharp...	1.00 (16.72)
10.	Claystone, light-brown (5YR 5/6) to moderate-yellowish-brown (10YR 5/4), sandy, gypsiferous, loose, friable, weathered, mostly covered.....	3.49 (20.21)
11.	Limestone, grayish-orange (10YR 7/4) to pale-yellowish-brown (10YR 6/2), scattered dark mineral grains, some manganese surface coatings, saccharoidal, thick-bedded to massive, hard, compact, weathered.....	0.35 (20.56)
12.	Claystone, light-brown (5YR 5/6) to moderate-brown (5YR 4/4), calcareous, sandy, gypsiferous, scattered dark mineral grains, few glauconite grains, oxidized zones on surfaces, soft, loose, friable, weathered, top sharp.....	10.27 (30.83)
	Laki Limestone Member	
13.	Limestone, very pale orange (10YR 8/2), clayey, scattered dark mineral grains, slightly sandy, fossiliferous, foraminifera, saccharoidal, massive, hard, compact, weathered, forms ledges.....	12.96 (43.79)
	TOP OF SECTION	

Section 9

Location: Approximately 2,500 m south by southeast from the village of Hayat Choto and 1,150 m north by northwest from the village of Jhangli Shoro.

Topographic Sheet Number: 40 C/8

Coordinates: Longitude 68°21'46''E
Latitude 25°12'05''N
Northing 838 075 m
Easting 21 75 840 m

Date: November 22, 1987

Unit Number	Description	METERS (Total)

BASE OF SECTION

Meting Shale Member

1. Claystone, grayish-orange (10YR 7/4) to dark-yellowish-orange (10YR 8/6), calcareous, sandy, scattered dark mineral grains, gypsiferous, soft, loose, friable, weathered, top gradational..... 0.63 (0.63)

2. Limestone, very pale orange (10YR 8/2), weathers dark-gray (N3), slightly sandy, dark mineral grains, some manganese coatings, clayey in part, chalky, fossiliferous, foraminifera, burrowed, poorly bedded, weathered, top sharp and undulatory, base sharp..... 1.59 (2.22)

3. Limestone, fossil coquina, dark-yellowish-orange (10YR 6/6) to pale-yellowish-orange (10YR 8/6), scattered dark mineral grains, very sandy, few glauconite grains, fossil fauna includes gastropods, pelecypods, cephalopods and shell fragments, thin-bedded, hard, base sharp and undulatory..... 0.25 (2.47)

4. Limestone, pale-yellowish-orange (10YR 8/6) to very pale orange (10YR 8/2), sandy, clayey, scattered dark mineral grains, fossiliferous, slightly burrowed, thin-bedded, soft, weathered, base sharp and undulatory..... 0.30 (2.77)

5. Claystone, moderate-yellowish-brown (10YR 5/4) to moderate-brown (5YR 4/4), slightly sandy, scattered dark mineral grains, abundant gypsum flakes, soft, loose, weathered..... 3.24 (6.01)

6. Limestone, very pale orange (10YR 8/2) to moderate-yellowish-brown (10YR 5/4), abundant nodules, scattered dark mineral grains, soft, loose, friable, weathered, top sharp and undulatory..... 0.20 (6.21)

Unit Number	Description	METERS (Total)
7.	Claystone, moderate-yellowish-brown (10YR 5/4) to moderate-brown (5YR 4/4), slightly sandy, abundant gypsum, scattered dark mineral grains, soft, loose, friable, weathered, top sharp and undulatory	2.06 (8.27)
8.	Limestone, dark-yellowish-orange (10YR 6/6), weathers grayish-orange (10YR 7/4), sandy, scattered dark mineral grains, fossiliferous, foraminifera, burrowed, thin-bedded, hard, weathered, base sharp and undulatory	0.55 (8.82)
9.	Limestone, foraminiferal, grayish-orange (10YR 7/4) to dark-yellowish-orange (10YR 6/6), slightly sandy, scattered dark mineral grains, hard, compact, weathered, base sharp and undulatory	1.00 (9.82)
10.	Claystone, dark-yellowish-orange (10YR 6/6) to light-olive-brown (5Y 5/6), abundant glauconite, sandy, gypsum flakes, soft, loose, friable, weathered, top sharp and undulatory	3.36 (13.46)
11.	Limestone, pale-yellowish-orange (10YR 8/6) to grayish-orange (10YR 7/4), slightly sandy, scattered dark mineral grains, clayey in parts, saccharoidal, fossiliferous, burrowed, hard, compact, massive, weathered, base sharp and undulatory	1.45 (14.91)
12.	Claystone, dark-yellowish-orange (10YR 6/6) to moderate-yellowish-brown (10YR 5/4) to moderate-brown (5YR 4/4), sandy, gypsiferous, soft, loose, friable, weathered, base sharp, top sharp and undulatory	3.66 (18.57)
13.	Limestone, grayish-orange-pink (5YR 7/2) to grayish-orange (10YR 7/4), slightly sandy, scattered dark mineral grains, gyupsiferous, fossiliferous, thick-bedded, hard, weathered, base sharp and undulatory	0.40 (18.97)
14.	Claystone, dark-yellowish-orange (10YR 6/6) to dusky-yellow (5Y 6/4), sandy, gypsiferous, fossiliferous, some oxidized zones on surfaces, soft, loose, friable, weathered, top gradational, base sharp and undulatory	4.46 (23.43)
	Laki Limestone Member	
15.	Limestone, very pale orange (10YR 8/6) to white (N9), chalky, scattered dark mineral grains, saccharoidal, vuggy, fossiliferous, foraminifera, massive, weathered, ledge forming, numerous cave openings	10.32 (33.75)
	TOP OF SECTION	

Section 9a

Location: Approximately 1,940 m south by southeast of the village of Hayat Choto and 1,500 m northwest of the village of Jhnngli Shoro.

Topographic Sheet Number: 40 C/8

Coordinates: Longitude 68°21'37''E
Latitude 25°12'09''N
Northing 838 400 m
Easting 21 75 600 m

Date: October 14, 1987

Unit Number	Description	METERS (Total)
	BASE OF SECTION	
	Meting Shale Member	
1.	Limestone, very pale orange (10YR 8/2) to pale-yellowish-orange (10YR 8/6), sandy, scattered dark mineral grains, and gypsum lenses, some claystone laminae, contains a 0.10 m thick dark-yellowish-orange (10YR 6/6) very sandy fossiliferous bed 1.50 m from base (coquina bed), fossiliferous, foraminifera, chalky, massive, soft, weathered.....	1.60 (1.60)
2.	Claystone, dark-yellowish-orange (10YR 6/6) to light-olive-gray (5Y 5/2) to moderate-brown (5YR 4/4), slightly sandy, gypsiferous, few manganese surface coatings, soft, loose, friable, weathered, base sharp, top undulatory.....	3.34 (4.94)
3.	Limestone, grayish-orange (10YR 7/4) to light-brown (10YR 5/6), sandy, glauconite, scattered gypsum lenses, manganese surface coatings, fossiliferous, few cephalopods, foraminifera, hard, abundant nodules on surface, weathered, top sharp.....	0.20 (5.14)
4.	Claystone, dark-yellowish-orange (10YR 6/6) to moderate-yellowish-brown (10YR 4/4), calcareous, sandy, silty, gypsiferous, loose, friable, weathered, top sharp and undulatory.....	2.05 (7.19)
5.	Limestone, dark-yellowish-orange (10YR 6/6), sandy, scattered gypsum flakes and dark mineral grains, fossiliferous, abundant burrows, poorly bedded to massive, hard, compact, weathered, base sharp.....	1.40 (8.59)

Unit Number	Description	METERS (Total)
6.	Claystone, dark-yellowish-orange (10YR 6/6) to grayish-orange (10YR 8/6), sandy, abundant gypsum, few dark mineral grains, loose, soft, friable, weathered, top sharp.....	1.42 (10.01)
7.	Limestone, dark-yellowish-orange (10YR 6/6) to light-brown (5YR 5/6) to grayish-orange-pink (5YR 7/2), very sandy, scattered gypsum grains and crystals, some dark mineral grains, fossiliferous, burrowed, thin-bedded to massive, base sharp and undulatory.....	0.92 (10.93)
8.	Claystone, moderate-brown (5YR 4/4) to dark-yellowish-orange (10YR 6/6), calcareous, fossiliferous, loose, weathered, top undulatory.....	1.00 (11.93)
9.	Limestone, pale-yellowish-orange (10YR 8/6) to grayish-orange (10YR 7/4), sandy, scattered dark mineral grains, foraminifera, poorly bedded, soft, weathered, top sharp and undulatory.....	1.97 (13.90)
10.	Claystone, dark-yellwoish-orange (10YR 6/6) to moderate-brown (5YR 4/4), sandy, gypsiferous, scattered dark mineral grains, abundant fossils (sample number S-9a-1), very glauconitic in parts, soft, loose, friable, weathered, top sharp and undualtory.....	2.82 (16.72)
11.	Limestone, pale-yellowish-orange (10YR 8/6) to grayish-orange (10YR 7/4), sandy, dark mineral grains, scattered gypsum crystals, fossiliferous, soft, weathered, top sharp and undulatory.....	0.62 (17.34)
12.	Claystone, moderate-brown (5YR 4/4), calcareous, sandy, silty, abundant glauconite at places, fossiliferous, soft, loose, friable, weathered, base sharp and undulatory.....	3.64 (20.98)
	Laki Limestone Member	
13.	Limestone, pale-yellowish-orange (10YR 8/6) to dark-yellowish-orange (10YR 6/6), sandy, scattered dark mineral grains, gypsum crystals, fossiliferous, foraminifera 8.10 m from base, abundant burrows near base, nodular, massive, hard, compact, weathered.....	13.93 (34.91)
	TOP OF SECTION	

Section 10

Location: Approximately 1,500 m south by southeast from the village of Hayat Choto and 2,140 m northwest from the village of Jhangli Shoro.

Topographic Sheet Number: 40 C/8

Coordinates: Longitude 68°21'30''E
Latitude 25°12'31''N
Northing 838 995 m
Easting 21 75 450 m

Date: November 17, 1987

Unit Number	Description	METERS (Total)
	BASE OF SECTION	
	Meting Shale Member	
1.	Claystone, moderate-brown (5YR 4/4) to dark-yellowish-orange (10YR 6/6), calcareous, sandy, gypsiferous, scattered manganese surface coatings, loose, friable, weathered....	3.42 (3.42)
2.	Limestone, dark-yellowish-orange (10YR 6/6), weathers dark-gray (N3), sandy, scattered dark mineral granins, fossiliferous, foraminifera, thick-bedded, soft, weathered.....	0.65 (4.07)
3.	Claystone, dark-yellowish-brown (10YR 4/2) to dark-yellowish-orange (10YR 6/6), slightly sandy, scattered manganese surface coatings, dark mineral grains, gypsum, soft, friable, loose, top sharp.....	1.25 (5.32)
4.	Limestone, grayish-orange (10YR 7/4), abundant foraminifera, sandy, glauconite grains, scattered gypsum crystals, poorly bedded, soft, weathered, base sharp.....	1.62 (6.94)
5.	Claystone, dark-yellowish-brown (10YR 4/2), calcareous, scattered dark mineral grains, manganese surface coatings, gypsiferous, soft, loose, friable, weathered, top and base sharp.....	2.92 (9.86)
6.	Limestone, very pale orange (10YR 8/2) to grayish-orange (10YR 7/4), dark mineral grains, scattered manganese suface coatings, fossiliferous, abundant foraminifera, burrowed, saccharoidal, nodular, massive, hard, compact, weathered.....	1.30 (11.16)
7.	Limestone, dark-yellowish-orange (10YR 6/6), very sandy, scattered dark mineral grains, gypsiferous, clayey, abundant nodules on surfaces, very loose, soft, weathered, top grades.....	1.37 (12.53)

Unit Number	Description	METERS (Total)
8.	Claystone, moderate-yellowish-brown (10YR 5/4) to dark-yellowish-orange (10YR 4/2), calcareous, sandy, gypsiferous, scattered dark mineral grains, few oxidized zones on surfaces, soft, loose, weathered, top sharp and undualtory.....	1.60 (14.13)
9.	Limestone, grayish-orange (10YR 7/4) to moderate-yellowish-brown (10YR 5/4), scattered dark mineral grains, fossiliferous, foraminifera, burrowed, saccharoidal, massive, compact, weathered, base sharp and undualtory.....	1.62 (15.75)
10.	Claystone, dark-yellowish-orange (10YR 6/6) to grayish-orange (10YR 7/4), calcareous, scattered glauconite grains, slightly sandy, some manganese surface coatings, gypsiferous, soft, loose, friable, weathered, top sharp and undulatory.....	5.93 (21.68)
11.	Limestone, dark-yellowish-orange (10YR 8/6) to grayish-orange (10YR 7/4), slightly sandy, scattered dark mineral grains, some manganese surface coatings, gypsum crystals, fossiliferous, burrowed, poorly bedded, soft, weathered, base sharp and undualtory.....	0.89 (22.57)
12.	Claystone, moderate-yellowish-brown (10YR 5/4) to moderate-brown (5YR 4/4), calcareous, sandy, scattered dark mineral grains, gypsiferous, slightly fossiliferous, loose, soft, friable, weathered, base sharp.....	5.16 (27.73)
	Laki Limestone Member	
13.	Limestone, very pale orange (10YR 8/2) to pinkish-gray (5YR 8/1), scattered dark mineral grains, few fossils, abundant burrows 9.87 m from base, foraminifera, saccharoidal, chalky at places, nodular, massive, vuggy, ledge forming, hard, compact, cave-like in parts, weathered, base sharp and undulatory.....	24.36 (52.09)
14.	Claystone, dark-yellowish-orange (10YR 6/6) to moderate-brown (5YR 4/4), calcareous, sandy, gypsiferous, fossil hash, scattered oxidized zones on surfaces, soft, loose, weathered.....	3.64 (55.73)
15.	Limestone, pale-yellowish-orange (10YR 8/6) to dark-yellowish-orange (10YR 6/6), slightly sandy, dark mineral grains, fossilifierous, foraminifera, thick-bedded to massive, hard, weathered, top sharp	0.80 (56.53)
16.	Claystone, dark-yellowish-orange (10YR 6/6) to moderate-yellowish-brown (10YR 5/4), calcareous, loose, soft, friable, weathered, base and top sharp and undulatory.....	0.97 (57.50)

Unit Number	Description	METERS (Total)
17.	Limestone, very pale orange (10YR 8/2) to grayish-orange (10YR 7/4), fossiliferous, saccharoidal, thick-bedded to massive, hard, weathered, base and top sharp and undulatory.....	3.86 (61.36)
18.	Claystone, dark-yellowish-orange (10YR 6/6) to moderate-yellowish-brown (10YR 5/4), calcareous, loose, soft, weathered, top sharp.....	0.25 (61.61)
19.	Limestone, very pale orange (10YR 8/2) to grayish-orange-pink (5YR 7/2), scattered dark mineral grains, some manganese surface coatings, slightly burrowed, cryptocrystalline, vuggy, hard, compact, weathered, ledge forming, base sharp and undulatory.....	4.86 (66.47)

TOP OF SECTION

Section 11

Location: Approximately 900 m south by southeast from the village of Hayat Choto and 2,550 m northwest from the village of Jhangli Shoro.

Topographic Sheet Number: 40 C/8

Coordinates: Longitude 68°21'30''E
Latitude 25°12'42''N
Northing 839 500 m
Easting 21 75 460 m

Date: October 18-19, 1987

Unit Number	Description	METERS (Total)

BASE OF SECTION

Meting Shale Member

1. Claystone, pale-yellowish-orange (10YR 8/6) to dark-yellowish-brown (10YR 4/2), very sandy, scattered dark mineral grains, gypsiferous, few fossils, soft, friable, weathered, top sharp..... 1.00 (1.00)

2. Limestone, very pale orange (10YR 8/2) to grayish-orange (10YR 7/4), sandy, manganese surface coatings, scattered gypsum veins, thin-bedded, hard, compact, weathered, top and base sharp..... 0.20 (1.20)

3. Claystone, moderate-brown (5YR 3/4) to dark-yellowish-orange (10YR 6/6), sandy, gypsiferous, scattered dark mineral grains, maroon-yellow iron oxide patches on surfaces, soft, weathered, top sharp and undulatory..... 3.16 (4.36)

4. Limestone, dark-yellowish-orange (10YR 6/6), weathers olive-gray (5Y 4/1), sandy, clayey, scattered dark mineral grains, fossiliferous, weathered..... 1.08 (5.44)

5. Claystone, dark-yellowish-brown (10YR 4/2) to pale-yellowish-brown (10YR 6/2), sandy, gypsiferous, scattered dark mineral grains, contains fossil pelecypods, loose, friable, top sharp and undulatory..... 1.06 (6.50)

6. Limestone, very pale orange (10YR 8/2), abundant fossils and foraminifera (sample number S-11-1)..... 1.10 (7.60)

7. Claystone, moderate-brown (5YR 3/4), gypsiferous, contains a 0.01 to 0.03 m thick gypsum layer at base, very loose, friable, very weathered, top sharp and undulatory..... 2.92 (10.52)

Unit Number	Description	METERS (Total)
8.	Limestone, very pale orange (10YR 8/2) to pale-yellowish-orange (10YR 8/6), sandy, few green mineral grains, scattered dark mineral grains, fossiliferous, some oxidized zones on surfaces, saccharoidal, manganese surface coatings on weathered surfaces, weathered	0.85 (11.37)
9.	Claystone, dark-yellowish-orange (10YR 6/6), sandy, top 0.40 m calcareous, scattered 0.02 m thick gypsum veins, dark mineral grains, scattered nodules and concretions, loose, friable, weathered	5.26 (16.63)
10.	Limestone, very pale orange (10YR 8/2) to dark-yellowish-orange (10YR 6/6), ferruginous grains, scattered dark mineral grains, chalky in basal 0.30 m, cryptocrystalline, thin-bedded to massive	0.88 (17.51)
11.	Claystone, moderate-brown (5YR 4/4) to light-olive-gray (5Y 6/1) to dark-yellowish-orange (10YR 6/6), sandy, gypsiferous, soft, friable, mostly covered	7.56 (25.07)
12.	Limestone, dark-yellowish-orange (10YR 6/6), weathers to grayish-orange (10YR 7/4), sandy, few dark mineral grains, contains up to 0.02 m thick gypsum veins, few fossils, hard and compact	0.48 (25.55)
13.	Claystone, moderate-yellowish-orange (10YR 5/4) to dark-yellowish-orange (10YR 6/6), calcareous, sandy, gypsiferous, loose, friable, weathered, top 2.30 m covered	5.72 (31.27)
	Laki Limestone Member	
14.	Limestone, very pale orange (10YR 8/2), sandy, chalky in parts, scattered concretions, some dark mineral grains, thin-bedded to massive, vuggy, nodular, hard and compact	18.22 (49.49)
	TOP OF SECTION	

Section 12

Location: Approximately 200 m south from the village of Hayat Choto and 3,200 m northwest from the village of Jhnngli Shoro.

Topographic Sheet Number: 40 C/8

Coordinates: Longitude 68°21'22''E
Latitude 25°13'09''N
Northing 840 150 m
Easting 21 75 300 m

Date: October 20, 1987

Unit Number	Description	METERS (Total)
	BASE OF SECTION	
	Meting Shale Member	
1.	Claystone, light-brown (5YR 5/6) to moderate-brown (5YR 4/4), sandy, gypsiferous, scattered black mineral grains, soft, loose, friable, weathered, top sharp and undulatory.....	2.22 (2.22)
2.	Limestone, pale-yellowish-orange (10YR 8/6), sandy, scattered black mineral grains, some gypsum lenses, few fossil fragments, weathered.....	1.02 (3.24)
3.	Claystone, moderate-brown (5YR 4/4) to moderate-yellowish-brown (10YR 5/4), calcareous, slightly sandy, loose, friable, top sharp and undulatory.....	4.81 (8.05)
4.	Limestone, grayish-orange (10YR 7/4) to pale-yellowish-orange (10YR 8/6), slightly sandy, some gypsum veins, cryptocrystalline, fossil cephalopods at top (sample number S-12-1), thick-bedded to massive, weathered, hard and compact...	1.24 (9.29)
5.	Claystone, dark-yellowish-orange (10YR 6/6), sandy, abundant fossils on surface, soft, friable, top undefined, mostly covered.....	2.27 (11.56)
6.	Limestone, dark-yellowish-orange (10YR 6/6), clayey, abundant dark mineral grains, numerous nodules on surface, fossiliferous, abundant foraminifera, very weathered.....	0.37 (11.93)
7.	Claystone, abundant ironstone concretions, some oxidized zones, soft, friable, loose, weathered, top sharp and undulatory.....	4.57 (16.50)

Unit Number	Description	METERS (Total)
	Laki Limestone Member	
8.	Limestone, very pale orange (10YR 8/2) to grayish-orange (10YR 7/4), scattered dark mineral grains, cryptocrystalline, chalky in middle to lower part, top 2.0 m forms ledge, middle part soft and forms steep slopes, basal 1.0 m hard and forms ledge, nodular, fossiliferous, scattered foraminifera, weathered	13.16 (29.66)
9.	Limestone, very pale orange (10YR 8/2) to very light gray (N8), weathers medium-dark-gray (N5), scattered dark mineral grains, chalky, some nodules, saccharoidal, fossiliferous, top 1.0 m forms ledge, nodular	9.72 (39.38)
10.	Claystone, grayish-orange (10YR 7/4) to dusky-yellow (5Y 6/4), slightly calcareous, sandy, soft, friable, few thin limestone beds, mostly covered, weathered	3.88 (43.26)
11.	Limestone, very pale orange (10YR 8/2) to pinkish-gray (5YR 8/1), scattered dark mineral grains, cryptocrystalline, fossiliferous, foraminifera, top includes angular limestone beds, hard	1.50 (44.76)
12.	Claystone, moderate-yellowish-brown (10YR 5/4) to dark-yellowish-orange (10YR 6/6), sandy, slightly gypsiferous, soft, friable, weathered	3.60 (48.36)
13.	Limestone, dark-yellowish-orange (10YR 6/6) to pale-yellowish-orange (10YR 8/6) to grayish-orange-pink (5YR 7/2), sandy, clayey at places, scattered dark mineral grains, fossiliferous, hard	1.40 (49.76)
14.	Claystone, dark-yellowish-orange (10YR 6/6) to light-olive-gray (5Y 6/1), sandy, gypsiferous, some oxidized zones on surfaces, soft, friable, weathered, top undulatory	1.62 (51.38)
15.	Limestone, very pale orange (10YR 8/2) to very light gray (N8), scattered dark mineral grains, chalky, some nodules, fossiliferous, nodular	0.75 (52.13)
16.	Claystone, dark-yellowish-orange ((10YR 6/6) to light-olive-gray (5Y 6/1), sandy, gypsiferous, some oxidized zones, soft, friable, weathered, top undulatory	3.34 (55.47)
17.	Limestone, very pale orange (10YR 8/2) to very light gray (N8), chalky, scattered dark mineral grains, crypto-crystalline, fossiliferous, nodular, massive, hard, compact	1.80 (57.27)

Unit Number	Description	METERS (Total)
18.	Limestone, dark-yellowish-orange (10YR 6/6) to pale-yellowish-orange (10YR 8/6), sandy, clayey, few mega-fossils, soft, weathered.....	1.20 (58.47)
19.	Limestone, very pale orange (10YRT 8/2) to yellowish-gray (5Y 7/2), scattered dark mineral grains, cryptocrystalline, fossiliferous, poorly bedded, weathered, hard and compact.....	1.62 (60.09)

TOP OF SECTION

Section 13

Location: Approximately 600 m northwest from the village of Hayat Choto.

Topographic Sheet Number: 40 C/8

Coordinates: Longitude 68°21'14''E
Latitude 25°13'30''N
Northing 840 890 m
Easting 21 75 150 m

Date: October 23-24, 1987

Unit Number	Description	METERS (Total)
	BASE OF SECTION	
	Meting Shale Member	
1.	Claystone, dark-yellowish-orange (10YR 6/6) to dark-yellowish-brown (10YR 4/2), slightly calcareous, very sandy at base, gypsiferous, becomes glauconitic towards top, contains fine- to coarse grained quartz, few dark mineral grains, foraminifera (sample number 1F), few oxidized zones, weathered, top sharp and undulatory	2.68 (2.68)
2.	Limestone, very pale orange (10YR 8/2), weathers grayish-orange (10YR 7/4), slightly sandy, few dark mineral grains, fossiliferous (sample number S-13-1), foraminifera (sample number 2F), thick-bedded to massive, hard, top undefined	2.03 (4.71)
3.	Claystone, moderate-brown (5YR 4/4) to moderate-yellowish-brown (10YR 5/4), slightly sandy and gypsiferous, scattered dark mineral grains, few concretions with iron oxide coatings, soft, weathered, top sharp and undulatory	4.41 (9.12)
4.	Limestone, pale-yellowish-orange (10YR 8/6), slightly sandy, chalky, scattered dark mineral grains, fossil pelecypods and gastropods, foraminifera (sample number 3F), burrowed, poorly bedded, soft, friable, weathered	1.47 (10.59)
5.	Claystone, pale-yellowish-orange (10YR 8/6) to dark-yellowish-brown (10YR 4/2), calcareous, silty, gypsiferous, soft, weathered	0.60 (11.19)
6.	Claystone, very pale orange (10YR 8/6), very calcareous, slightly sandy, scattered dark mineral grains, slightly gypsiferous, fossil pelecypods and gastropods (sample number S-13-2), soft	0.45 (11.64)

Unit Number	Description	METERS (Total)
7.	Limestone, pale-yellowish-orange (10YR 8/6) to grayish-orange (10YR 7/4), scattered dark mineral grains, few gypsum crystals, some ferruginous grains, fossiliferous (sample number (S-13-3), foraminifera (sample number 4F), abundant burrows, cryptocrystalline, hard, compact.....	0.50 (12.14)
8.	Limestone, dark-yellowish-orange (10YR 6/6), slightly sandy, scattered dark mineral grains, fossiliferous, burrowed, foraminifera (sample number 5F), poorly bedded to massive, weathered, mostly covered.....	2.56 (14.70)
9.	Claystone, pale-yellowish-brown (10YR 6/2) to moderate-yellowish-brown (10YR 5/4), calcareous, sandy, gypsiferous, few dark mineral grains, abundant nodules up to 0.10 m long, foraminifera (sample number 6F), loose, friable, soft, weathered, mostly covered.....	8.10 (22.80)
	Laki Limestone Member	
10.	Limestone, very pale orange (10YR 8/2) to grayish-orange (10YR 7/4), cryptocrystalline, fossiliferous (sample number S-13-4), foraminifera (sample number at base 7F, in middle 8F, at top 9F), massive, nodular, solution cavities, hard, compact.....	22.70 (45.50)
11.	Claystone, moderate-brown (5YR 4/4), calcareous, gypsiferous, sandy at top, scattered ironstones and ferruginous zones, few pyrite grains, abundant fossils, fossil cephalopods on surface (sample number S-13-5), foraminifera (sample number 11F), few fossil plants(?), some manganese surface coatings, soft, weathered, loose, top undulatory.....	2.97 (48.47)
12.	Limestone, pale-yellowish-orange (10YR 8/6) to very pale orange (10YR 8/2), clayey, scattered nodules, fossiliferous (sample number S-13-6), foraminifera (sample number 12F), nodular, hard, compact.....	0.82 (49.29)
13.	Claystone, moderate-brown (5YR 4/4), slightly sandy and calcareous, gypsiferous, foraminifera (sample number 13F) 1.00 m above base, soft, weathered, top undulatory.....	2.45 (51.74)
14.	Limestone, very pale orange (10YR 8/2) to pale-yellowish-orange (10YR 8/6), chalky, scattered dark mineral grains, fossiliferous (sample number S-13-7), foraminifera (sample number 14F at base), poorly bedded, weathered.....	1.35 (53.09)
15.	Claystone, grayish-ornge (10YR 7/4) to yellowish-orange (10YR 6/6), sandy, gypsiferous, foraminifera (sample number 15F) 2.0 m from base, weathered.....	3.04 (56.13)

Unit Number	Description	METERS (Total)
16.	Limestone, very pale orange (10YR 8/2), scattered dark mineral grains, contains 0.45 m thick grayish-yellow (5Y 8/4) marly bed 1.0 m below top, fossiliferous, foraminifera (sample number 16F 1.0 m from base, 17F from top), cryptocrystalline, vuggy, poorly bedded to massive, (sample number S-13-8), hard, weathered, base sharp and undulatory, forms cap rock.....	3.87 (60.00)
17.	Limestone, very pale orange (10YR 8/2), scattered dark mineral grains, cryptocrystalline, vuggy, poorly bedded to massive, hard, weathered.....	1.62 (61.62)
18.	Limestone, very pale orange (10YR 8/2) to yellowish-gray (5Y 7/2), slightly sandy, marly, fossiliferous, foraminifera (sample number 18F), soft, very weathered.....	0.55 (62.17)
19.	Limestone, very pale orange (10YR 8/2) to very light gray (N8), clayey, chalky, scattered dark mineral grains, fossiliferous, foraminifera (sample number 19F), nodules, nodular, hard, compact, weathered.....	3.17 (65.34)

TOP OF SECTION

Section 14

Location: Approximately 2,000 m north by northwest from the village of Hayat Choto and 8,000 m south from the village of Panhwar.

Topographic Sheet Number: 40 C/8

Coordinates: Longitude 68°21'08''E
Latitude 25°14'12''N
Northing 842 300 m
Easting 21 75 100 m

Date: October 25-27, 1987

Unit Number	Description	METERS (Total)
	BASE OF SECTION	
	Meting Shale Member	
1.	Claystone, moderate-yellowish-brown (10YR 5/4) to dark-yellowish-orange (10YR 6/6), calcareous in parts, very sandy, silty, few dark mineral grains, few scattered quartz pebbles, foraminifera, soft, friable, weathered, top sharp and undulatory	0.70 (0.70)
2.	Limestone, pale-yellowish-orange (10YR 8/6) to grayish-orange (10YR 7/4), sandy, glauconitic, gypsiferous, scattered dark mineral grains, fossil shell fragments, foraminifera (sample number 20F), weathered	0.20 (0.90)
3.	Claystone, dark-yellowish-orange (10YR 6/6) to grayish-orange (10YR 7/4), calcareous, sandy, scattered dark mineral grains, gypsiferous, soft, friable, loose	1.50 (2.40)
4.	Limestone, pale-yellowish-orange (10YR 8/6) to grayish-orange (10YR 7/4) to pale-yellowish-brown (10YR 6/2), sandy at places, few dark mineral grains, scattered ironstone concretions, fossiliferous, foraminifera, burrowed, fossil cephalopods and sea urchins on surface, cyrptocrystalline, weathered	1.00 (3.40)
5.	Limestone, pale-yellowish-orange (10YR 8/6) to pale-yellowish-brown (10YR 6/2) to grayish-orange (10YR 7/4), creyptocrystalline, scattered ferruginous zones, fossiliferous, foraminifera (sample number 21F), hard, compact, base sharp undulatory	0.58 (3.98)
6.	Claystone, moderate-brown (5YR 4/4), sandy, gypsiferous, scattered manganese surface coatings, ferruginous zones, abundant fossils, weathered	1.32 (5.30)

Unit Number	Description	METERS (Total)
7.	Limestone, pale-yellowish-orange (10YR 8/6) to grayish-orange (10YR 7/4), clayey, marly, few scattered ironstone concretions on surface, very fossiliferous (sample number S-14-1), few burrows, foraminifera, weathered, top not defined.....	0.30 (5.60)
8.	Claystone, moderate-brown (5YR 4/4), slightly calcareous, glauconitic, sandy, gypsiferous, weathered.....	4.96 (10.56)
9.	Limestone, pale-yellowish-orange (10YR 8/6) to dark-yellowish-orange (10YR 6/6), scattered dark mineral grains, few gypsum flakes, sandy, fossiliferous, foraminifera (sample number 22F), weathered.....	0.85 (11.41)
10.	Claystone, pale-yellowish-brown (10YR 6/2) to moderate-yellowish-brown (10YR 5/4), sandy, silty, loose, weathered, top sharp, mostly covered.....	3.51 (14.92)
	Laki Limestone Member	
11.	Limestone, very pale orange (10YR 8/2) to pale-yellowish-orange (10YR 8/6) basal 1.10 m chalky with few dark mineral grains and very weathered, from 1.10 to 3.00 m slightly nodular with few dark mineral grains and harder, from 3.00 to 4.60 m is weathered medium-dark-gray and forms ledge, fossiliferous, foraminifera (sample number 23F), burrowed, vuggy, massive, weathered.....	4.60 (19.52)
12.	Limestone, very pale orange (10YR 8/2) to pale-yellowish-orange (10YR 8/6), fossiliferous, foraminifera (sample number 24F), vuggy, massive, weathered.....	8.10 (27.62)
13.	Limestone, very pale orange (10YR 8/2) to pinkish-gray (5YR 8/1), chalky, scattered dark mineral grains, cryptocrystalline, fossiliferous, foraminifera (from base sample number 25F, from top sample number 26F), compact, weathered.....	7.83 (35.45)
14.	Claystone, moderate-yellowish-brown (10YR 5/4) to moderate-brown (5YR 4/4), sandy, gypsiferous, scattered ferruginous grains, foraminifera, weathered, basal 1.62 m covered.....	2.93 (38.38)
15.	Limestone, pale-red (10YR 6/2), sandy, scattered dark mineral grains, fossiliferous, foraminifera (sample number 27F), hard, compact, weathered, top undulatory.....	0.40 (38.78)
16.	Claystone, moderate-yellowish-brown (10YR 5/4), slightly calcareous, sandy, gypsiferous, scattered oxidized zones, loose, friable, weathered, top gradational.....	3.17 (41.95)

Unit Number	Description	METERS (Total)
17.	Limestone, very pale orange (10YR 8/2), chalky, scattered dark mineral grains, fossiliferous, foraminifera, soft, compact, weathered, mostly covered.....	1.25 (43.20)
18.	Claystone, grayish-orange (10YR 7/4) to yellowish-orange (10YR 6/6), sandy, gypsiferous, weathered, mostly covered.....	3.00 (46.20)
19.	Limestone, very pale orange (10YR 8/2), scattered dark mineral grains, fossiliferous, foraminifera (sample number 28F), cryptocrystalline, vuggy, poorly bedded to massive, hard, weathered.....	9.00 (55.20)

TOP OF SECTION

Section 15

Location: Approximately 3,920 m north by northwest from the village of Hayat Choto and 5,150 m south from the village of Panhwar.

Topographic Sheet Number: 40 C/7

Coordinates: Longitude 68°21'02''E
Latitude 25°15'22''N
Northing 844 340 m
Easting 21 74 900 m

Date: November 5-6, 1987

Unit Number	Description	METERS (Total)
	BASE OF SECTION	
	Meting Shale Member	
1.	Claystone, moderate-olive-brown (5Y 4/4) to grayish-orange (10Y 4/2), slightly calcareous and sandy, abundant glauconite, soft, loose, weathered, top sharp and undulatory	0.25 (0.25)
2.	Limestone, pale-yellowish-orange (10YR 8/6) to grayish-orange (10YR 7/4), scattered dark mineral grains, fossiliferous, foraminifera (sample number 36F), poorly bedded, hard, weathered	0.55 (0.80)
3.	Claystone, dusky-yellow (5Y 6/4) to pale-yellowish-orange (10YR 8/6), calcareous, sandy, gypsiferous, scattered dark mineral grains, gypsum veins, loose, top sharp, mostly covered	1.30 (2.10)
4.	Limestone, very pale orange (10YR 8/2) to white (N9), clayey, slightly chalky, few dark mineral grains, fossiliferous (sample number S-15-1), foraminifera (sample number 37F), burrowed, saccharoidal, poorly bedded, some oxidized zones, weathered	1.30 (3.40)
5.	Claystone, moderate-yellowish-brown (10YR 5/4) to moderate-brown (5YR 4/4), sandy, slightly gypsiferous, loose, friable, scattered manganese surface coatings, weathered	4.35 (7.75)
6.	Limestone, pale-yellowish-orange (10YR 8/6) to dark-yellowish-orange (10YR 6/6), sandy, fossiliferous, foraminifera (sample number 38F), thick-bedded to massive	1.30 (9.05)

Unit Number	Description	METERS (Total)
7.	Claystone, moderate-brown (5YR 4/4) to moderate-brown (5YR 3/4), slightly sandy, gypsiferous, contains a 0.05 m thick ferruginous band near base, loose, friable, weathered, base sharp	3.75 (12.80)
	Laki Limestone Member	
8.	Limestone, very pale orange (10YR 8/2) to white (N9), chalky, fossiliferous, foraminifera (sample number 39F), massive, soft, weathered	1.50 (14.30)
9.	Limestone, very pale orange (10YR 8/2), weathers dark-gray (N3), scattered dark mineral grains, saccharoidal, fossiliferous, foraminifera (sample number 40F), burrowed, nodular, massive, vuggy, very hard, forms ledge	12.00 (26.30)
10.	Limestone, pale-yellowish-orange (10YR 8/2) to white (N9), scattered black mineral grains, marly near base, top hard and burrowed, fossiliferous, foraminifera (sample number 41F), thin-bedded, nodular at top, forms slope, weathered, soft in places	10.00 (36.90)
	TOP OF SECTION	

Section 16

Location: Approximately 4,600 m south from the village of Panhwar and 4,250 m north from the village of Hayat Choto.

Topographic Sheet Number: 40 C/7

Coordinates: Longitude 68°21'29''E
Latitude 25°15'32''N
Northing 844 810 m
Easting 21 75 640 m

Date: November 6-8, 1987

Unit Number	Description	METERS (Total)
	BASE OF SECTION	
	Meting Shale Member	
1.	Claystone, dark-yellowish-orange (10YR 6/6) to dark-yellowish-brown (10YR 4/2), sandy near top, glauconitic, gypsiferous, fossiliferous near top, loose, friable, weathered, top sharp and undulatory	3.10 (3.10)
	Laki Limestone Member	
2.	Limestone, pale-yellowish-orange (10YR 8/6) to grayish-orange (10YR 7/4), sandy, scattered dark mineral grains, gypsum lenses, top 0.30 m vuggy, hard, nodular, burrowed and ledge forming, fossiliferous, massive, soft and friable at places, weathered	20.95 (24.05)
3.	Limestone, marly, weathered, mostly covered	1.90 (25.95)
4.	Claystone, dark-yellowish-orange (10YR 6/6), calcareous, silty, sandy, slightly gypsiferous, few scattered dark mineral grains, loose, friable, soft	0.20 (26.15)
5.	Claystone, dusky-yellow (5Y 6/4) to grayish-orange (10YR 7/4), sandy, gypsiferous, soft, loose	0.42 (26.57)
6.	Limestone, very pale orange (10YR 8/2) to very light gray (N8), chalky, scattered dark mineral grains, slightly sandy, gypsiferous at top, some claystone fragments(?), fossiliferous, foraminifera, nodular, massive	1.80 (28.37)
7.	Claystone, moderate-brown (5YR 4/4) to moderate-yellowish-brown (10YR 5/6), calcareous, sandy, gypsiferous, few foraminifera, weathered, soft, loose	0.80 (29.17)

Unit Number	Description	METERS (Total)
8.	Limestone, grayish-orange (10YR 7/6) to very pale orange (10YR 8/2), scattered dark mineral grains, fossiliferous, saccharoidal, nodular, massive, hard and compact.....	1.30 (30.47)
9.	Claystone, dark-yellowish-orange (10YR 6/6) to moderate-brown (5YR 4/4), sandy, abundant pelecypods and echinoderms on surface (sample number S-16-1), weathered, soft and loose, friable.....	3.05 (33.52)
10.	Limestone, very pale orange (10YR 8/2) to grayish-orange (10YR 7/4), scattered dark mineral grains, marly at places, fossiliferous, foraminifera, saccharoidal, nodular, massive...	2.05 (35.57)
11.	Claystone, moderate-yellowish-brown (10YR 5/4) to moderate-brown (5YR 4/4), calcareous, sandy, gypsiferous, abundant fossil pelecypods and cephalopods on surface, soft and loose, weathered.....	2.25 (37.82)
12.	Limestone, grayish-orange (10YR 7/4) to very light gray (N8), scattered ironstone concretions on surface, fossiliferous, foraminifera (sample number 42F), burrowed, saccharoidal, very weathered, mostly covered.....	6.50 (44.32)
13.	Limestone, moderate-orange-pink (5YR 8/4) to grayish-orange (10YR 7/4), weathers medium-dark-gray (N4), few dark mineral grains, foraminifera (sample number 43F), saccharoidal, thin-bedded to massive, top sharp.....	1.60 (45.92)
14.	Limestone, dark-yellowish-orange (10YR 6/6), sandy, scattered dark mineral grains, thin-bedded, weathered, top and base gradational.....	0.85 (46.77)
15.	Limestone, very pale orange (10YR 8/2) to white(N9), chalky, scattered dark mineral grains, saccharoidal, thin-bedded to massive, top sharp.....	0.80 (47.57)
16.	Limestone, very pale orange (10YR 8/2), weathers medium-dark-gray (N4), foraminifera (sample number 44F), saccharoidal, thick-bedded, vuggy, forms ledge with caves, weathered, base sharp.....	3.25 (50.82)

TOP OF SECTION

Section 17

Location: Approximately 2,950 m south by southwest from the village of Panhwar and 6,030 m north from the village of Hayat Choto.

Topographic Sheet Number: 40 C/7

Coordinates: Longitude 68°21'13''E
Latitude 25°16'30''N
Northing 846 500 m
Easting 21 75 280 m

Date: November 9, 1987

Unit Number	Description	METERS (Total)
	BASE OF SECTION	
	Meting Shale Member	
1.	Limestone, very pale orange (10YR 8/20), chalky, slightly sandy, fossiliferous, foraminifera, saccharoidal, thick-bedded to massive, weathered	0.85 (0.85)
2.	Claystone, grayish-orange (10YR 7/4) to dark-yellowish-orange (10YR 6/6), gypsiferous, loose, friable, weathered, partly covered	6.05 (6.90)
3.	Limestone, dark-yellowish-orange (10YR 6/6), sandy, few manganese surface coatings, foraminifera, massive, soft, friable, weathered, base sharp and undulatory	0.60 (7.50)
4.	Claystone, moderate-brown (5YR 4/4), sandy, gypsiferous, scattered gypsum lenses 0.02 to 0.03 m thick, soft, loose, weathered	5.58 (13.08)
	Laki Limestone Member	
5.	Limestone, very pale orange (10YR 8/2) to grayish-orange (10YR 7/4), scattered dark mineral grains, slightly sandy, foraminifera, abundant burrows, saccharoidal, vuggy, massive, top 2.0 m ledge forming, weathered	20.80 (33.88)
	TOP OF SECTION	

Section 18

Location: Approximately 1,325 m south from the village of Panhwar and 7,600 m north from the village of Hayat Choto.

Topographic Sheet Number: 40 C/7

Coordinates: Longitude 68°21'24''E
Latitude 25°17'23''N
Northing 848 080 m
Easting 21 75 725 m

Date: November 11, 1987

Unit Number	Description	METERS (Total)
	BASE OF SECTION	
	Meting Shale Member	
1.	Limestone, pale-yellowish-orange (10YR 8/6), sandy, scattered dark mineral grains, fossiliferous, foraminifera (sample number 45F), burrowed, hard, compact, weathered, top sharp	0.10 (0.10)
2.	Claystone, pale-olive (10Y 6/2) to dark-yellowish-orange (10YR 6/6), calcareous, sandy, gypsiferous, scattered dark mineral grains, loose, friable, soft, weathered, top sharp and undulatory	1.37 (1.47)
3.	Sandstone, pale-yellowish-orange (10YR 8/6) to dusky-yellow (5Y 6/4), very fine to fine-grained, contains 60 percent quartz, subrounded quartz grains, calcareous, scattered dark mineral grains, fossiliferous, foraminifera, massive, loose, soft, weathered	1.72 (3.19)
4.	Claystone, dark-yellowish-orange (10YR 6/6) to moderate-brown (5YR 3/4), sandy, few glauconite grains, gypsiferous, soft, loose, weathered, base sharp	5.16 (8.35)
	Laki Limestone Member	
5.	Limestone, very pale orange (10YR 8/2) to very light gray (N8), scattered dark mineral grains, saccharoidal, few fossils, hard, massive, top gradational	11.34 (19.69)
6.	Limestone, very pale orange (10YR 8/2) to pale-yellowish-orange (10YR 8/6), fossiliferous, foraminifera (sample number 46F), abundant burrows, massive, vuggy, hard and compact, forms ledges and cavernous openings, weathered	3.12 (22.81)

Unit Number	Description	METERS (Total)
7.	Limestone, very pale orange (10YR 8/2) to pale-yellowish-orange (10YR 8/6), scattered dark mineral grains, fossiliferous, saccharoidal, thick-bedded to massive, hard, weathered, top sharp.....	3.59 (26.40)
8.	Claystone, moderate-brown (5YR 4/4), calcareous, sandy, glauconite, gypsum flakes, loose and soft, weathered, base sharp.....	5.93 (32.33)
9.	Limestone, very pale orange (10YR 8/2) to grayish-orange-pink (5YR 7/2), scattered black mineral grains, foraminifera (sample number 47F), cryptocrystalline, massive, vuggy, hard, forms ledges, base sharp and undulatory.....	10.42 (42.75)

TOP OF SECTION

Section 19

Location: Approximately 1,000 m south by southwest from the village of Panhwar and 2,180 m southeast from the village of Karokho across the Indus River.

Topographic Sheet Number: 40 C/7

Coordinates: Longitude 68°21'14''E
Latitude 25°17'31''N
Northing 848 400 m
Easting 21 75 510 m

Date: November 12, 1987

Unit Number	Description	METERS (Total)

BASE OF SECTION

Meting Shale Member

1. Claystone, dusky-yellow (5Y 6/4) to light-olive-brown (5Y 5/6) moderate-brown (5YR 4/4), calcareous, sandy, gypsiferous, scattered gypsum bands, dark mineral grains, silty at top, abundant glauconite, fossiliferous (sample number S-19-1), soft, loose, friable, weathered, top sharp.... 1.00 (1.00)

2. Limestone, very pale orange (10YR 8/2) to white (N9), sandy, scattered dark mineral grains, few oxidized zones on surfaces, fossiliferous, foraminifera, hard, weathered, base sharp..... 1.74 (2.74)

3. Claystone, dark-yellowish-orange (10YR 6/6) to grayish-orange (10YR 7/4), slightly calcareous, sandy, gypsiferous, few glauconite grains, scattered gypsum lenses up to 0.03 m thick, fossiliferous, soft, loose, friable, weathered..... 3.14 (5.88)

4. Claystone, very pale orange (10YR 8/2) to pale-yellowish-orange (10YR 8/6), very sandy, fossiliferous, few foraminifera (sample number 48F), faintly bedded, hard, weathered, base sharp and undulatory..... 0.43 (6.31)

5. Sandstone, dark-yellowish-orange (10YR 6/6), weathers grayish-orange (10YR 7/4), very fine grained, contains 65 percent quartz, subrangular to subrounded quartz grains, calcareous, scattered dark mineral grains, fossiliferous (sample number S-19-2), burrowed, gypsum veins, thick-bedded, weathered, base sharp and undulatory..... 3.02 (9.33)

Unit Number	Description	METERS (Total)
6.	Claystone, dark-yellowish-orange (10YR 6/6) to light-gray (N7), slightly sandy at places, scattered dark mineral grains, gypsum flakes and bands, fossiliferous, soft, loose, friable, weathered, top sharp and undulatory	1.82 (11.15)
7.	Sandstone, dark-yellowish-orange (10YR 6/6), very fine to fine-grained, contains 70 percent quartz, subangular to subangular to subrounded quartz grains, calcareous, dark mineral grains, scattered gypsum crystals, hard, compact, weathered	2.20 (13.35)
8.	Claystone, moderate-brown (5YR 4/4) to moderate-yellowish-brown (10YR 5/4), calcareous, sandy, gypsiferous, scattered manganese surface coatings, soft, loose, friable, weathered, base sharp	3.34 (16.69)
	Laki Limestone Member	
9.	Limestone, pale-yellowish-orange (10YR 8/6) to grayish-orange (10YR 7/4), some manganese surface coatings, fossiliferous, few foraminifera (sample number 49F), cryptocrystalline, nodular, massive, compact and hard, weathered, slope forming	5.98 (22.67)
	TOP OF SECTION	

Section 20

Location: Approximately 700 m southwest from the village of Panhwar and 2,150 m southeast from the village of Karokho across the Indus River.

Topographic Sheet Number: 40 C/7

Coordinates: Longitude 68°21'23E
Latitude 25°17'42''N
Northing 848 675 m
Easting 21 75 750 m

Date: November 13, 1987

Unit Number	Description	METERS (Total)
	BASE OF SECTION	
	Meting Shale Member	
1.	Sandstone, dark-yellowish-orange (10YR 6/6) to grayish-orange (10YR 7/4), very fine to fine-grained, contains 50 percent quartz, subrounded quartz grains, calcareous, scattered dark mineral grains, gypsiferous, weathered, hard, top sharp	0.40 (0.40)
2.	Claystone, dark-yellowish-orange (10YR 6/6) to dark-yellowish-brown (10YR 4/2), slightly calcareous, sandy, gypsiferous, scattered gypsum veins up to 0.03 m thick, fossiliferous, weathered, friable, soft, base sharp	1.70 (2.10)
3.	Sandstone, very pale orange (10YR 8/2) to yellowish-gray (5Y 7/2), very fine to fine-grained, contains 50 percent quartz, subangular to subrounded quartz grains, scattered dark mineral grains, calcareous, clayey in parts, fossiliferous, foraminifera, sorted, thick-bedded to massive, weathered, top undulatory	0.70 (2.80)
4.	Claystone, moderate-yellowish-brown (10YR 5/4) to moderate-brown (5Y 4/4), calcareous, sandy, gypsiferous, scattered manganese surface coatings, glauconite, soft, loose, weathered, mostly covered	3.54 (6.34)
	Laki Limestone Member	
5.	Limestone, moderate-orange-pink (5YR 8/4) to grayish-orange (10YR 7/4), slightly sandy, scattered manganese surface coatings, fossiliferous, foraminifera (sample number 50F), abundant burrows, nodular, thick-bedded to massive, hard, compact, weathered, base sharp, ledge forming at places	30.78 (37.12)

Unit Number	Description	METERS (Total)
6.	Claystone, pale-yellowish-orange (10YR 8/6) to dusky-yellow (5Y 6/4), calcareous, scattered manganese surface coatings, very fossiliferous, soft, loose, weathered.....	2.04 (39.16)
7.	Limestone, very pale orange (10YR 8/2) to grayish-orange (10YR 7/4), abundant foraminifera (sample number 51F), very fossiliferous (sample number S-20-1), clayey, poorly bedded, base sharp and undulatory.....	1.20 (40.36)
8.	Claystone, moderate-brown (5Y 4/4) to moderate-yellowish-brown (10YR 5/4), calcareous, few glauconite grains, slightly gypsiferous, loose, soft, friable, weathered, top sharp and undulatory.....	2.96 (43.32)
9.	Limestone, very pale orange (10YR 8/2) to white (N9), scattered manganese coatings, fossiliferous (sample number S-20-2), foraminifera (sample number 52F), burrowed, saccharoidal, nodular, thin-bedded to massive, hard, compact, weathered, ledge forming in parts.....	6.73 (50.05)
10.	Claystone, moderate-yellowish-brown (10YR 5/4) to grayish-orange (10YR 7/4), slightly calcareous, sandy, soft, loose, friable.....	0.25 (50.30)
11.	Limestone, very pale orange (10YR 8/2) to white (N9), scattered dark mineral grains, cryptocrystalline in parts, slightly fossiliferous, saccharoidal, vuggy, poorly bedded to massive, hard, compact, weathered, ledge forming.....	5.31 (55.61)

TOP OF SECTION

Section 21

Location: Approximately 300 m northeast from the village of Panhwar and 1,900 m east from the village of Karokho across the Indus River.

Topographic Sheet Number: 40 C/7

Coordinates: Longitude 68°21'30''E
Latitude 25°18'15''N
Northing 849 685 m
Easting 21 75 900 m

Date: November 14, 1987

Unit Number	Description	METERS (Total)
	BASE OF SECTION	
	Meting Shale Member	
1.	Claystone, moderate-brown (5YR 4/4) to moderate-yellowish-brown (10YR 5/4), sandy and slity in parts, gypsiferous, scattered manganese surface coatings, contains pale-yellowish-orange (10YR 8/6) very fine to fine-grained sandstone boulders 2.0 m from base, loose, friable, soft, weathered	7.36 (7.36)
	Laki Limestone Member	
2.	Limestone, pale-yellowish-orange (10YR 8/6), weathers grayish-orange (10YR 7/4), sandy, scattered clayey zones, dark mineral grains, lower 2.0 m is soft and chalky, fossiliferous, (sample number S-21-1), foraminifera (sample number 53F), burrowed 2.0 m from base, vuggy, thin-bedded to massive, weathered, forms caves near top	18.74 (26.10)
3.	Claystone, moderate-yellowish-brown (10YR 5/4), weathers light-brown (5YR 5/6), calcareous, sandy, scattered dark mineral grains, slightly gypsiferous, some manganese surface coatings, loose, soft, friable, top undulatory, weathered	0.90 (27.00)
4.	Limestone, loose, forms plateau surface	0.20 (27.20)
5.	Claystone, moderate-yellowish-brown (10YR 5/4) to moderate-brown (5YR 4/4), calcareous, slightly sandy, gypsiferous, scattered manganese surface coatings, loose, friable, weathered, top sharp and undulatory	2.22 (29.42)

Unit Number	Description	METERS (Total)
6.	Limestone, very pale orange (10YR 8/2), weathers grayish-orange (10YR 7/4), scattered dark mineral grains, chalky, abundant fossils, numerous foraminifera (sample number 54F), burrowed, poorly bedded, weathered.....	5.01 (34.43)
7.	Claystone, dark-yellowish-orange (10YR 6/6) to moderate-brown (5YR 4/4), slightly sandy, calcareous, gypsiferous, loose, soft, friable, weathered.....	0.25 (34.68)
8.	Limestone, very pale orange (10YR 8/2), scattered dark mineral grains, saccharoidal, fossiliferous, foraminifera (sample number 55F), burrowed, nodular in parts, poorly bedded to massive, hard, compact, weathered, base sharp.....	1.50 (36.18)

TOP OF SECTION

Section 22

Location: Approximately 2,500 m north by northeast from the village of Panhwar and 1,750 m southeast from the village of Nahejani Mian.

Topographic Sheet Number: 40 C/7

Coordinates: Longitude 68°21'38''E
Latitude 25°19'27''N
Northing 851 860 m
Easting 21 76 240 m

Date: November 20-21, 1987

Unit Number	Description	METERS (Total)
	BASE OF SECTION	
	Laki Limestone Member	
1.	Limestone, very pale orange (10YR 8/2) to white (N9), chalky, nodular, fossiliferous, few foraminifera, abundant burrows, saccharoidal, vuggy, massive, hard, compact, weathered, forms ledges in parts, 1.62 m covered at base	22.33 (22.33)
2.	Claystone, pale-yellowish-orange (10YR 8/6) to dark-yellowish-orange (10YR 6/6) to moderate-brown (5YR 4/4), sandy, gypsiferous, scattered manganese coatings, few fossils, foraminifera, soft, loose, friable, weathered, base sharp, top sharp and undulatory	1.84 (24.17)
3.	Limestone, pale-yellowish-orange (10YR 8/6) to grayish-orange (10YR 7/4), scattered dark mineral grains, fossiliferous, foraminifera, top 0.10 m is dark-yellowish-orange, cryptocrystalline, thick-bedded, hard, compact, weathered, base sharp	0.32 (24.49)
4.	Claystone, dark-yellowish-orange (10YR 6/6) to moderate-yellowish-brown (10YR 5/4), slightly sandy, manganese surface coatings, scattered gypsum flakes, soft, loose, friable, weathered, base sharp, top sharp and undulatory	1.22 (25.71)
5.	Limestone, pale-yellowish-orange (10YR 8/6), weathered, mostly covered	1.90 (25.61)
6.	Claystone, dark-yellowish-orange (10YR 8/6) to pale-yellowish-orange (10YR 6/6), slightly calcareous, sandy, abundant gypsum flakes, few dark mineral grains, loose, friable, weathered, mostly covered	0.30 (27.91)

Unit Number	Description	METERS (Total)
7.	Limestone, very light gray (N8) to white (N9), clayey in parts, fossiliferous, mostly covered.....	6.48 (34.39)

TOP OF SECTION

Section 23

Location: Approximately 6,500 m southwest along a paved road from the intersection near the village of Khathar and 3,500 m northeast from the village of Jhangli Shoro.

Topographic Sheet Number: 40 C/8

Coordinates: Longitude 68°23'46''E
Latitude 25°12'45''N
Northing 839 300 m
Easting 21 79 250 m

Date: November 25, 1987

Unit Number	Description	METERS (Total)
	BASE OF SECTION	
	Laki Limestone Member	
1.	Claystone, grayish-orange (10YR 7/4), gypsiferous, fossiliferous, soft, friable, loose, weathered, top sharp.....	2.20 (2.20)
2.	Sandstone, grayish-orange (10YR 7/4) to pale-yellowish-orange (10YR 8/6), fine- to medium-grained, contains less than 50 percent quartz, calcareous, clayey, fossiliferous, thick-bedded, weathered, base sharp.....	0.35 (2.55)
3.	Claystone, moderate-brown (5YR 4/4), sandy, few dark mineral grains, scattered gypsum grains, ironstone concretions on surface, loose, friable, weathered, base sharp.....	2.30 (4.85)
4.	Limestone, pale-yellowish-brown (10YR 6/2) to dark-yellowish-orange (10YR 6/6), fossiliferous, foraminifera, saccharoidal, thin-bedded, hard, compact, weathered.....	0.22 (5.07)
5.	Claystone, grayish-orange (10YR 7/4) to moderate-brown (5YR 4/4), sandy, scattered dark mineral grains, gypsiferous, loose, soft, friable, weathered.....	0.75 (5.82)
6.	Limestone, very pale orange (10YR 8/2) to pale-yellowish-orange (10YR 8/6), chalky, slightly sandy, scattered dark mineral grains, fossiliferous, foraminifera, nodular.....	2.30 (8.12)
7.	Claystone, dark-yellowish-orange (10YR 6/6) to moderate-yellowish-brown (10YR 5/4), sandy, gypsiferous, scattered dark mineral grains, soft, loose, friable.....	0.30 (8.42)

Unit Number	Description	METERS (Total)
8.	Limestone, very pale orange (10YR 8/2) to pale-yellowish-orange (10YR 8/6), chalky, nodular, weathered, top and base sharp	0.75 (9.17)
9.	Claystone, dark-yellowish-orange (10YR 6/6) to moderate-yellowish-brown (10YR 5/4), sandy, soft, loose, friable, weathered	0.80 (9.97)
10.	Limestone, very pale orange (10YR 8/2) to white (N9), chalky, fossiliferous, burrowed, vuggy, saccharoidal, massive, soft, cave forming, scattered ledges, weathered	8.40 (18.37)

TOP OF SECTION

REFERENCES

Goddard, E.N., and others, 1948, Rock-Color Chart; Washington, D.C., National Research Council: Reprinted by Geological Society of America 1951, 1963, 1970, 1970, 6p.

Hunting Survey Corporation, Limited, Reconnaissance Geology of Part of West Pakistan, Toronto, Canada, 1960, p. 184-189, 253-256.

Khan, M. Siddique, M.A. Tariq and Rafiq Ahmed Khan, 1983, Geology and Subsurface Details of Sonda-Thatta Coal Field, Sind Pakistan, Geological map series no. 12, part of sheets nos. 40 c/4 and D/1, 1:50,000 map.

Shah, S.M. Ibrahim, ed., Stratigraphy of Pakistan, Memoirs of the Geological Survey of Pakistan: The Manager Printing Corporation of Pakistan Press, Islamabad, Pakistan, v. 12, p. 60-62, 71-72.