Mineral Res. Expl. Bull., 127, 15-32, 2003

TRACE FOSSILS IN THE WESTERN FAN OF THE CİNGÖZ FORMATION IN THE NORTHERN ADANA BASIN (Southern Turkey)

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ABSTRACT.- In this study, the trace fossils in the Lower-Middle Miocene turbiditic Cingöz formation cropping out around the Karaisalı - Catalan - Eğner regions have been examined for the first time. The trace fossils occur in a sequence, identified as submarine fan deposits. Based on their morphological characteristics, nineteen trace fossils have been identified; eleven of them are ichnospecies and eighteen ichnogenus.

INTRODUCTION

The investigated area is situated on the northern part of the Adana basin, which is bounded by the Ecemiş fault to the west, the Taurus orogenic belt in the north and Amanos Mountain in the east. The basement of the Adana basin is represented by Paleozoic and Mesozoic elastics, carbonates and tectonically transported ophiolitic rocks during and after the Maaestrichtian. Karsanti, Gildırli, Kaplankaya, Karaisalı, Cingöz, Güvenç, Kuzgun formations of Tertiary age rest unconformable on these Paleozoic and Mesozoic rocks. The Cingöz formation was examined by Schmidt (1961) for the first time. Gürbüz (1993) suggested the presence of two submarine fan systems in the west and in the east (Fig. 1). In the western fan, the inner fan sediments at the bottom are composed of large-scale, cross-bedded conglomerate, conglomeratic sandstone and amalgamated coarse sandstone. The middle fan deposits consist of less gravelly sandstone and sandstone-shale alternations. The uppermost of the unit is represented by outer fan sediments, which are composed of thin-bedded sandstone and shale alternations.

ICHNOTAXONOMY

The classification of trace fossils is based on morphological criteria interpreted by Hantzschel (1975), Ksiazkiewicz (1977), Seilacher (1977), Fillon and Pickerill (1990), Crimes and Crossley (1991) and Uchman (1995).

Simple structure

a) Planolites group

This group embraces relatively small, rarely branched, horizontal or oblique burrows.

Planolites beverleyensis Billings 1862

(Plate 1,fig. 1)

1862 *Planolites beverleyensis* (n.sp.)-Billings: p.97, text-fig.8b.

1977 *Sabularia ramosa* n.ichnosp.-Ksiazkiewicz: p.71, text-fig.8, 9a-d.

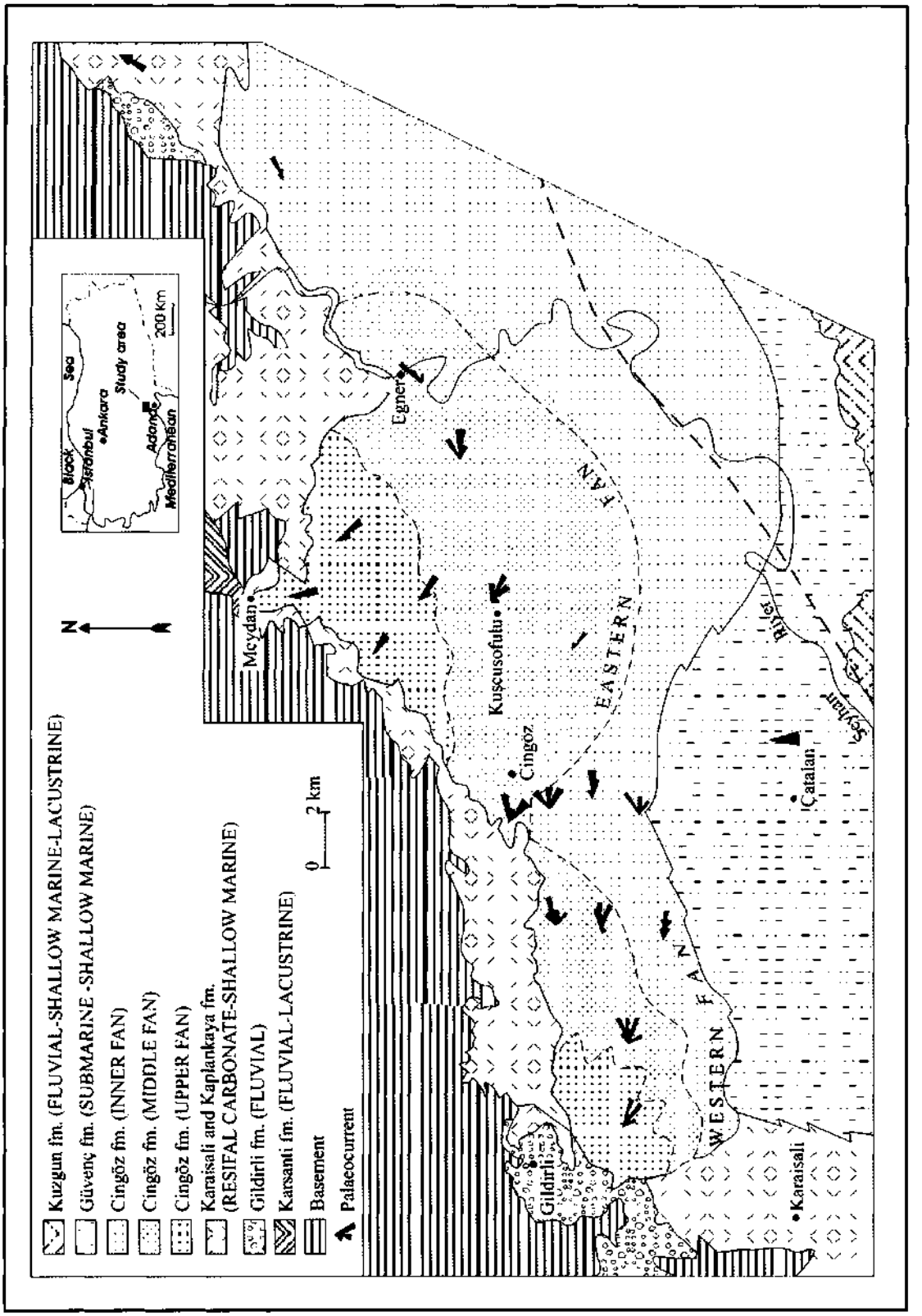

Fig. 1- Geological map showing distribution of Tertiary facies associations in the northern part of the Adana Basin (Gürbüz, 1993)

Description.- Hypichnial, short ridges in fine-grained turbiditic sandstone (Fig. 2a). The burrows are 2.5-4.4 mm in width.

Remarks.- *Planolites* extends from the Precambrian to the recent (Hantzschel, 1975).

Branched structures

a) Chondrites group

Chondrites isp.

(Plate 1, fig. 2b)

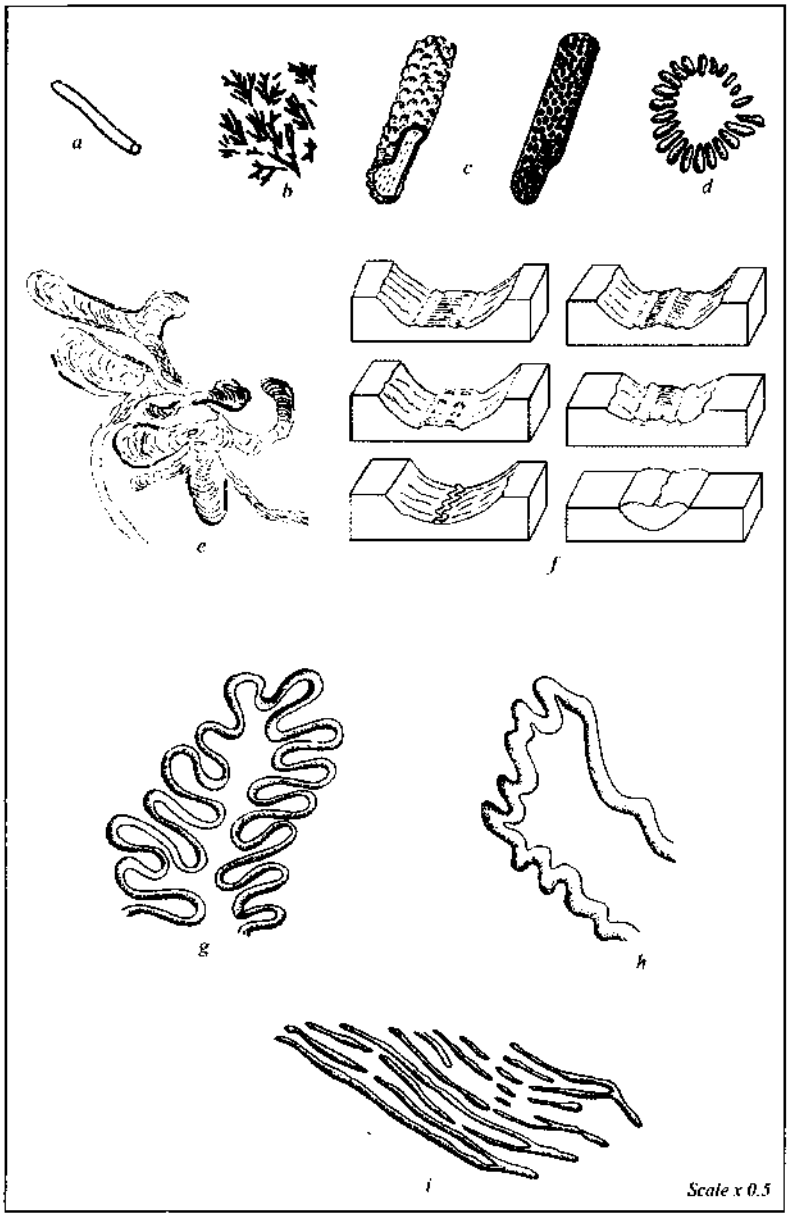

Fig. 2- Schematic view of the trace fossils in the study area *a. Planolites beverleyensis, b. Chondrites* isp, c. *Ophiomorphaisp.,* d. *Capodistria vettersi, e. Zoophycos* isp., f. *Scolicia vertebralis, g. Cosmorhaphe sinuosa, h. Helminthopsis* isp. İ. *Urohelminthopsis* isp.

Description.- It appears in the form of small, circular, elliptical spots (Fig. 2b), 1 mm in diameter.

Remarks.- *Chondrites* is a feeding trace of unknown trace makers. According to Kotake (1991 *a, b),* this ichnotaxon is produced by surface ingestors, packing their faecal pellets inside burrows. According to Seilacher (1990), the trace-maker of *Chondrites* may be able to live under anaerobic conditions as a chemo symbiotic organism.

b) Ophiomorpha group

This group embraces large horizontal and vertical branching burrows. Mostly, they have been interpreted as crustacean burrows.

Ophiomorpha isp.

(Plate 1,fig. 3)

Description.- Hypichnial to endichnial, cylindrical trace fossil covered with sub circular knobs in fine-grained turbiditic sandstone (Fig. 2c). The trace fossils are about 10 mm in width and 49 mm in length. The knobs are 3-5 mm in width and 5-7 mm in length preserved in full relief.

Remarks.- When *Ophiomorpha* isp. is horizontal or vertical resembles *Thalassinoides* (e.g. Kern and Warme, 1974). *Sabularia rudis* (Ksiazkiewicz, 1977) including the holotype, also strongly resembles *Ophiomorpha* (Uchman, 1991 a) and may be regarded as a synonym of the latter. *Ophiomorpha, Thalassinoides, Spongeliomorpha* and *Gyrolithes* have been regarded as differing in their position in a burrow system that is produced by the same trace-maker (Kenedy, 1967; Fursich, 1973; Bromley and Frey, 1974).

In Mesozoic-Cenozoic sediments, *Ophiomorpha* is produced mainly by shrimps as Recent *Callianassa major* (e.g. Weimer and Hayt, 1964; Frey et al., 1978). *Callianassids* are partly suspension, partly deposit feeders,, (e.g. Pryor, 1975; Bromley, 1990).

Ophiomorpha annulata (Ksiazkiewicz 1977)

(Plate 1,fig. 4)

1962 Granularia-Seilacher: p.299, pl.1, fig.4.

1977 *Arthropyhcus annulatus* n.ichnosp.-Ksiazkiewicz: p.56, pl.1, fig.8-10

1977 *Sabularia simplex* n.ichnosp.-Ksiazkiewicz: p.68, pl.2, fig.2; text-fig.9e.

1982 *Ophiomorpha annulata-Frey* and Howard: fig.2B, 4A.

Description.- It embraces mainly horizontal, covered with elongate pellets, cyclindrical burrows. It is observed as exichnial cylindrical lined burrows in the field and 4-7 mm in diameter.

Remarks.- This ichnotaxon has been described as *Granularia.* It was also described by Ksiazkiewicz (1977) as *Sabularia simplex (Tunis* and Uchman, 1996a, *b).*

Ophiomorpha rudis (Ksiazkiewicz 1977)

(Plate 1, fig. 5)

1977 *Sabularia rudis* n.ichnosp.-Ksiazkiewicz: p.70-71, pl. 2, fig. 4; text-fig.7.

Description.- Mainly vertical, near vertical cylindrical lined or unlined, rarely branched, sand filled burrows, which are 8-16 mm in diameter and 28 cm in length.

Remarks.- This ichnotaxon has been described as *Granularia.* It was also described by Ksiazkiewicz (1977) as *Sabularia rudis* (Tunis and Uchman, 1996 a, b).

Thalassinoides Ehrenberg 1944

(Plate 1, fig. 6)

Description.- It has three dimensional burrow systems. Branches are Y or T shaped.

Remarks.- Thalassinoides is *a* facies-crossing form, very typical of shallow-marine environments, and is produced mainly by Crustaceans (e.g. Frey et al., 1984). Origin and palaeoenvironmental meaning of *Thalassinoides were* summarized by Ekdale (1992). According to Follmi and Grimm (1990), Crustaceans producing *Thalassinoides* may survive in turbidity currents and produce burrow under anoxic conditions.

Apart from widespread Mesozoic and Cenozoic occurrences, *Thalassinoides* has also been recorded in the Paleozoic shallow water sediments (Palmer, 1978; Archer and Maples, 1984; Sheehan and Schiefelbein, 1984; Stanistreet, 1989; Kulkov, 1991).

Radialstructures

a) Lorenzinia group

This group presents radial structures as morphological criteria.

Capodistria vettersi Vialov 1968

(Plate 2, fig. 1)

1910 *Hieroglyph aus* - Vetters: 131, fig.a.
1968 *Capodistria vettersi*- Vialov: 337, fig.4
1977 *Capodistria vettersi* - Vialov - Ksiazkiewicz: 99, pl.7, fig.12; text-fig. 13a-b.
1990 *Capodistria moldavica* n.ichnosp. - Brustur and Ionesi: 39, fig.2; pl.1, fig.1.

Description.- It is defined by its central area, which is surrounded by small hypichnial radiating ridges (Fig. 2d). The central area is 2 mm in diameter. Eight short radiating ridges are 0.1-0.5 mm in diameter.

Remarks.- The description of *Capodistria vettersi* is based on figured but unnamed material of Vetters (1910). The specimen illustrated by Vetters (1910) has nine radiating ridges and one central knob. The forms illustrated by Ksiazkiewicz (1977) have one or three central knobs. However, Brustur and Ionesi (1990) distinguished *Capodistria moldavica* ichnospeices by presence of double central simple knobs.

Lorenzinia pustulosa (Ksiazkiewicz 1977)

(Plate 2, fig. 2)

1977 Sublorenzinia pustulosa n.ichnosp. - Ksiazkiewicz: 97. pl.7, fig.9; text-fig.13s.t.

Description.- Hypichnial, short ridges which surround central area in fine-grained turbiditic sandstone. The central is about 17 mm in width. 12 very short radiating ridges are 3-5 mm in width and 3-10 mm length.

Remarks.- Ksiazkiewicz (1977) indicated in his diagnosis that *Lorenzinia pustulosa* was preserved in full relief. The form displays a great morphological variability (Ksiazkiewicz, 1977). It occurs in flysch deposits ranging from the Cenomanian to the Miocene (Ksiazkiewicz, 1977) in age.

Spreitenstructures

a) Zoophycos group

This group embraces three dimensional spreite structures with helicoidal elements (Hantzschel, 1975).

Zoophycos Massalongo 1855

(Plate 2, fig. 3)

Description.- It is observed as endichnial to epichnial spreite structure in fine-grained turbiditic sandstone (Fig. 2e). The spreite lamellae 1-5 mm wide and comprised of numerous small, more or less "U" or "J" - shaped protrusive burrows. The structure is bordered by a marginal tunnel, which is 5 mm wide.

Remarks.- Different ichnogenera and/or species have been described under the name *"Zoophycos"* (Hantzschel, 1975). Recently, the origin of members of the Zoophycos group has been extensively discussed (Bromley, 1991; Wetzel, 1992; Gaillard and Olivero, 1993; Olivero, 1994). This group is to be revised.

Zoophycos is generally assumed to be the trace of unknown deposit feeding organism. Their producers are possibly found sipunculoids (Wetzel and Werner, 1981), polychaete annelids, arthropods (Ekdale and Lewis, 1991 a, *b),* and hemicordates.

According to Kotake (1989, 1991), *Zoophycos* is produced by surface ingestors of organic detritus. But, the origin of this form is still not clear.

Echinospira Girotti 1970

(Plate 2, fig. 4)

1869 *Buthotrepsis radiata* Ludwing - Ludwing: 114, pl.19, fig.1,1.

1877 *Taonurus procerus* Heer - Heer: 123, pl.48, fig.3-5.

1968 *'Zoophycos'* -Stevens: fig.9,11.

1970 *Zoophycos* - Lewis: 295, fig.1 -8.

1984 *Echinospira pauciradiata* Girotti - Belloti and Valeri: fig.4

1991 *Zoophycos* - Ekdale and Lewis: 183, fig.3-8.

Description.- It occurs generally at the top of fine-grained, medium bedded, parallel laminated sandstones, as composite, elongate lobes, which are 30 cm in length. In most cases, the trace fossil displays a narrow proximal part, and a wide, lobate distal part. The proximal part passes into the lobes of the distal part. The proximal part is incised up to 5 cm in the sandstone bed and forms a wide "U" in the vertical plane. They resemble Phycodes at the first look.

Remarks.- *Echinospira* isp. belongs to the Zoophycos group and is commonly described as a synonym of *Zoophycos* (e.g. Seilacher, 1986; Ekdale and Lewis, 1991 a). According to Ekdale (1992), the traces of *Echinospira* present characteristic features which differ from other members of the Zoophycos group.

Plicka (1968) and Girotti (1970) regarded *Echinospira* as an imprint of polychaetes and used a terminology. No diagnosis was given by Girotti (1970), based on morphologic parameters, indicated *Zoophycos.*

Rhizocorallium isp.

(Plate 2, fig. 5)

Description.- *Rhizocorallium* is characterized by lateral to horizontal, oblique "U" shaped burrows with spreite. This structure is about 15 cm in length. Its marginal tunnel is 3-4 mm in width.

Remarks.- This ichnogenus was discussed on morphological and ethological model by Uchman (1992b) and Uchman and Demircan (1999).

Winding and meandering structures

a) Scolicia group

This term "Scolicia group" was used by Hantzschel (1975). This group embraces bilobate and trilobate traces which have been related to Mesozoic and Cenozoic echinoid burrows (Smith and Crimes, 1983). All members of the group are included in the ichnogenus *Scolicia* by Seilacher (1986).

Scolicia vertebralis Ksiazkiewicz 1970

(Plate 2, fig. 6)

Description.- Epichnial, three lobed, winding and meandering in medium-grained turbiditic sandstone (fig. 2f). The furrow is 10 mm in width, and 7 mm in depth. The side lobes are covered with perpendicular ribs which are asymmetric in cross-section. The ribs are 2 mm in width.

Remarks.- *Scolicia vertebralis* is less frequently observed than *Scolicia plana* and *Scolicia prisca* (Ksiazkiewicz, 1970; 1977).

Scolicia prisca De Quatrafages 1849

(Plate 3, fig. 1)

1849 *Scolicia prisca* A. De Qv.- De Quatrafages: 265 (illustration).

1888 *Nemertilites miocenica* Sacco - Sacco: pl.1,fig.15-16.

1888 *Nemertilites pedemontana* Sacco - Sacco: pl.1, fig. 17.

1895 *Fahrte...* -Fuchs: pl.3, fig.3.

1932 *Palaeobullia* - Götzinger and Becker: 379, text-fig.4.1-4.4; pl.7, fig.c,8,ş.b.

1933 *Scolicia prisca* Quatrafages - Azpeita Moros: pl.11, fig.23.

1934 *Paleobullia* - Götzinger and Becker: p1.1, 3a, 4.1-7, 5-6.

1934 *Paleobullia* - Götzinger and Becker: 4.8.9.

1935 *Bullia fahrten* - Abel: ş.202, 203, 206, 208.

1951 *Palaeobullia* - Götzinger: 223, pl.18, 20.

1954 *Scolicia* - Gomez De Larena: pl.34, fig.1;pl.43, fig.1.

1958 Hieroglyph of the *Paleobullia* tip - Ksiazkiewicz: pl.3, fig.1.

1964 *Scolicia prisca* Quatrefages - Farres Mialian: 97, pl.7, fig.1.

1970 *Scolicia* sp. - Frey and Howard: 163, fig.7g.

1970 *Scolicia prisca* De Quatrefages - Ksiazkiewicz: 289, pl. 14.

1971 *Scolicia* sp.-Tanaka: 17, pl.11, fig.2.

1971 *Scolicia* prisca De Quatrefages - Chamberlain: 225, pl.I, fig.13; text-fig.4P-R.

1972 *Paleobullia* - Hanisch: fig.8.

1977 *Scolicia prisca* De Quatrefages - Ksiazkiewicz: 126, pl.I; fig.12; pl.14, fig.8; pi.15, fig.6.

1982 *Scolicia prisca* De Quatrefages - Plicka: pl.57-60.

1983 *Scolicia* sp. - Smith and Crimes: 90, fig.SE, 6A-B.

1988 *Scolicia* De Quatrefages - Plaziat and Mahmoudil: 225, pl.I, fig.A.E.

1992 *Scolicia* - Leszczynski: pl.11, fig.2 (non pl .1, fig.1; pl.5, fig.1, pl., fig.1).

Description.- Epichnial, three lobed, winding trace fossil in medium-grained turbiditic sandstone. The furrow is 10 mm in width and 3-5 mm in depth. The median lobe is the lower ridge on the floor of the furrow. It is 6 mm in width. The side lobes are covered with oblique asymmetric ribs. The ribs are about 2 mm in width.

Remarks.- Ksiazkiewicz (1970, 1977) described *Scolicia plana* which was characterized by a flat bottom divided by a longitudinal median trench or crest. The parallel strings are produced by drainage of spantangoid echinoids. Densely packed ribs at the bottom are probably produced by locomotion organs of the producer. The asymmetric thicker ribs on both sides are remnants of backfill menisci. This ichnotaxon is generally preserved in the middle part of turbidities at the transition from sandstone to mudstone. The lowermost part of the burrow is preserved. The upper part, consisting of backfill structures, remains usually at the top, shale section of the turbidite bed.

Scolicia strozzii (Savi and Meneghini 1850)

(Plate 3, fig. 2)

1850 *Nemertilites strozzii* nob. - Savi and Meneghini: 421.

1877 *Helminthopsis magna* HR. - Heer: 116, pl.47, fig. 1-2.

1887 *Helminthopsis magna* HR. - Maillard: pl.1,fig.1.

1888 *Taphrhelminthopsis auricularis* Sacco - Sacco: 24, pl.2, fig.3.

1888 *Taphrhelminthopsis recta* Sacco-Sacco: 24, pl.1, fig.20.

1888 *Taphrhelminthopsis pedemontana* Sacco - Sacco: 25.

1895 *Eophytonartige Sculptur* - Fuchs: pl.3 fig.1.

1925 *Nemertilites strozzi* - Caterini: 309 pl.1.

1932 *Maanderfahrte* - Götzinger and Becker pl.7, fig.a-b.

1946 *Subphyllochorda (Scolicia)* - Gomez De Larena: 124, pl.2, fig.7.

1946 *Subphyllochorda* - Gomez De Larena: 124, pl.2, fig.5.

1958 Trace of... gastropod from the *Subphylolochorda* Ksiazkiewicz.

1964 *Taphrhelminthopsis? Simplex* noc. isp. - Farres Milian: 95, fig.2.

1964 *Scolicia prisca* Quatrefages-Farres Milian: 97, pl.7, fig.1.

1968 *Taphrhelminthopsis* Sacco, sp. ind. - Ksiazkiewicz: 8, pl.6, fig.3.

1970 *Taphrhelminthopsis subauricularis* sp. nov. - Chiplongar and Badve: 7, pl.2, fig.5.

1970 *Nereites* sp .- Crimes: pl.1 b.

1970 *Taphrhelminthopsis* aff. *recta* Sacco - Ksiazkiewicz: 290-292, pl.2a-d.

1970 *Taphrhelminthopsis auricularis* Sacco - Ksiazkiewicz: 292, pl.2e-g.

1972 *Taphrhelminthopsis convoluta* Heer-Hanisch: fig.3-5,7.

1977 *Taphrhelminthopsis* Sacco and Ksiazkiewicz: 137, pl. 17, fig. 1-3; text-fig.26a-j.

1977 *Taphrhelminthopsis vagans* n. ichnosp.-Ksiazkiewicz: 17, fig.4-5; text-fig.261-s.

1977 *Taphrhelminthopsis recta* Sacco-Ksiazkiewicz:139, I . text-s. 261.

1977 *Taphrhelminthoida convoluta* n.ichnosp. - Ksiazkiewicz: pl.22, fig.1; pl.23, fig.5.

1977 *Taphrhelminthoida plana* (Ksiazkiewicz) - Ksiazkiewicz: pl.22, fig.2-3.

1977 *Taphrhelminthopsis circularis* n. ichnosp. - Crimes: 125, pl.8a-e.

1977 *Taphrhelminthopsis* isp. - Crimes: pl.3, fig.6a-b.

1977 *Taphrhelminthopsis* isp. - Pendon: pl.2, fig.5-6.

1977 *Taphrhelminthopsis auricularis* Sacco - Roniewiz and Pienkowski: pl.3a.

1977 *Taphrhelminthopsis recta* Sacco - Roniewicz and Pienkowski: 287, pl.3c.

1978 *Taphrhelminthopsis* Sacco - Kern: 253, fig.9B.

1980 *Taphrhelminthopsis convoluta* (Heer) - Badve and Ghare: 126, fig.5; text-fig.4.

1980 *Taphrhelminthopsis recta* Sacco - Badve and Ghare: fig.3; text-fig.5.

1983 *Taphrhelminthopsis* Sacco - Singh and Rai: 76, pl.4, fig.28; pl.7, fig.75.

1983 *Taphrhelminthopsis* isp. - Smith and Crimes: fig.7A,D.

1983 *Taphrhelminthopsis* isp.-Raina et al.: 93, pl .2, fig.4.

1983 *Helminthoida crassa* Schafhautl-Tchoumatchenco: pl.2, fig.3.

1984 *Scolicia* isp. Fillion and Pickerill: 38, fig.7c.

1984 *Taphrhelminthopsis auricularis* Sacco-Belloti and Valeri: fig.6.

1985 *Taphrhelminthopsis circularis* Crimes, Legg, Arboleya-Fritz and Crimes: 16, pl.1, fig.4.

1986 *Taphrhelminthoida* Ksiazkiewicz - Pienkowski Westwalewicz-Mogilska: 58, fig.5C.

1986 *Taphrhelminthopsis* Sacco-Pienkowski Westwalewicz-Mogilska: 58,62, fig.5A-B, D-G.

1986 *Taphrhelminthopsis maginensis* ichnosp. n. - Yang: 157, pl.2, fig.7.

1987 *Taphrhelminthoida auricularia* Ksiazkiewicz - Micu et al.: 82, fig.2.

1987 *Taphrhelminthopsis circularis* - Narbonne et al.: fig.6f.

1987 *Taphrhelminthopsis auricularis* Sacco - Plicka: 165, text-fig.23, 43; fig.3-7, pl.44, fig.4; pl.45, fig.6.

1987 *Taphrhelminthopsis meandriformis* n. ichnosp. - Plicka:166, fig.25; pl.44, fig.3.

1988 *Taphrhelminthopsis circularis* Crimes et al. - Li-Ri Hui and Yang: 169, fig.5.

1988 *Taphrhelminthopsis* Sacco - Plaziat and Mahmoudi: 227, pl.2, fig.D.

1988 *Scolicia strozzii* (Savi and Meneghini) - Ragaini: 224, pl.1-2.

1990 *Taphrhelminthopsis* ichnosp. - Mikulas: 337, text-fig.2B; pl.4, fig.2.

1990 *Taphrhelminthopsis* sp. - Pickerill and Peel: 33, fig.13c

1991 *Taphrhelminthopsis* isp. - Crimes and Crossley: 40, fig.6g-h.

1992 *Taphrhelminthopsis* isp. - Crimes et al.: 68, fig.5D.

1992 *Taphrhelminthopsis auricularis* Leszczynski: pl.1, fig.2.

1992 *Taphrhelminthopsis* isp. - Leszczynski pl.8, fig.2; pl.10, fig.1.

1992b Taphrhelminthopsis sp. - Mikulas: 26, pl.8, fig.6 (non pl.15, fig.1).

1993b *Taphrhelminthopsis auricularis* Sacco - Miller: 24, fig.4A.

Description.- Hypichnial, bilobate ridge with median groove in fine-grained turbiditic sandstone. The ridge is 13 mm in width, and 3-5 mm in height. The median groove is narrow and shallow.

Remarks.- This ichnotaxon is a cast of the furrow formed after erosion of the *Scolicia* burrow. Height, depth of the median ridge, and wide of the trace depend on small differences in depth of burrowing, depth and strength of erosion, and properties of substrate. If the burrow is cut by erosion in the middle part, its cast gets higher and wider, the sides of the ridge become gentler, and the median groove seems to be narrower. If erosion cuts the base of the burrow, its cast gets lower, the median groove becomes shallow and wide, and the prominent part of the ridge becomes narrow. Indistinct longitudinal ridges or strige typical of *Taphrhelminthopsis recta* are most probably such tool marks. However, some differences in burrow shapes depend on biological factors. Preservation factors seem to dominate the shape of the ridge. In the past, such criteria were used for distinguishing taxa of *Taphrhelminthopsis.*

Ksiazkiewicz (1977) differentiated there forms; 1) gently winding, usually single *Taphrhelminthopsis vagans,* 2) usually gregariously occurring *Taphrhelminthopsis auricularis,* and 3) tightly meandering *Taphrhelminthoida.* The first form corresponds to locomotion activity (repichnia) and the latter to feeding activity (pascichnia). However, some transitional forms occur among them (e.g. Ksiazkiewicz, 1977; pl. 17, fig.2: Crimes, 1977; pl.6b). *Scolicia prisca* and *Subphyllochorda (Scolicia* isp.) commonly display meanders, which may be preserved as *Taphrhelminthopsis* or *Taphrhelminthoida (=Scolicia strozzii).* The tendency to meandering depends on the nutrient content of the substrate. Thus, differentiating between meandering and non-meandering forms is problematic at the species level.

Scolicia strozzii was produced at shallow tiers as deduced from the co-occurrence of *Paleodictyon strozzii.* Its Mesozoic-Cenozoic producers *(spantangoid echinoids)* can not be excluded. The Paleozoic forms are probably casts of washed out burrows of *Cruziana* and *Curvolithus.* There are no diagnostic features, which allow Paleozoic and past Paleozoic forms.

Scolicia plana Ksiazkiewicz 1970

(Plate 3, fig. 3)

1970 *Scolicia plana* ichnosp. n. - Ksiazkiewicz: 289, pl.1c.

1970 *Subphyllochorda striata* ichnosp. n. - Ksiazkiewicz: 290, pl.1f.

1970 *Subphyllochorda granulata* ichnosp. n. - Ksiazkiewicz: 289, pl.1g.

1977 *Scolicia plana* Ksiazkiewicz - Ksiazkiewicz: 127, pl.14, figs.2,5,7.

1977 *Subphyllochorda granulata* Ksiazkiewicz - Ksiazkiewicz: 131, pl.15, figs.3,5.

1977 *Subphyllochorda striata* Ksiazkiewicz - Ksiazkiewicz: 132, pl.15, fig.1; text-fig.24a.

1977 *Subphyllochorda rudis* n. ichnosp. - Ksiazkiewicz: 133, pl.1, fig.2; text-fig.24d, 25.

Description.- Hypichnial, three lobed, winding and meandering trace fossil. Side lobes are narrow with median groove in fine-grained turbiditic sandstone. The furrow is 9 mm in width, and side lobes are covered with perpendicular ribs which are 1.5 mm in width. The narrow side lobes are 2.6 mm in width.

Remarks.- It is typical for Mesozoic and Cenozoic deposits (Ksiazkiewicz, 1977).

b) Cosmorhaphe group

Cosmorhaphe sinuosa
Azpeitia Moros 1933
(Plate 3, fig. 4)

1933 *Helminthopsis sinuosa* Azpeitia n.sp. - Azpeitia Moros: 45, fig.24B.

1935 *Spirorhaphe* - Abel: fig.263.

1954 *Helminthopsis sinuosa* Azpeitia - Gomez De Llarena: pl.46, fig.1.

1959 *Helminthopsis sinuosa* - Seilacher: tab.1,fig.8.

1964 *Cosmorhaphe sinuosus* Azpeitia - Farres Milian: 86, pl.5, fig.1.

1967 *Cosmorhaphe* - Macsotay: 27, pl.6, fig.22.

1970 *Cosmorhaphe sinuosa* (Azpeitia) - Ksiazkiewicz: 292, text-fig.2a, 3a.

1970 *Cosmorhaphe fuchsi* ichnosp. nov. - Ksiazkiewicz: 294, text-fig.3b.

1977 *Cosmorhaphe sinuosa* (Azpeitia) - Ksiazkiewicz: 153, pl. 19, fig.3-5; text-fig.33g-j.

1977 *Cosmorhaphe fuchsi* Ksiazkiewicz - Ksiazkiewicz: 154, pl.19, fig.7; text-fig.33n-s.

1978 *Cosmorhaphe sinuosa* - Montenat and Seilacher: fig.lc.

1980 *Cosmorhaphe sinuosa* (Azpeitia) - Alexandrescu and Brustur: pl.6, fig.3-4.

1991a *Cosmorhaphe* - Leszczynski: fig.9-10.

1991*b* *Cosmorhaphe* - Leszczynski: fig.5.

1991 *Cosmorhaphe sinuosa* (Azpeitia Moros) - Seilacher: 296, fig.3-6,8.

1992 *Cosmorhaphe sinuosa* - Leszczynskil: pl.3, fig.2.

1992a *Cosmorhaphe ichnosp.* - Uchman: fig.4.4.

1993 *Cosmorhaphe* ef. *sinuosa* - Leszczynski and Uchman: fig.7.

1994 *Cosmorhaphe sinuosa* Azpeitia Moros - Tunis and Uchman: fig.6F, 8D.

1995 *Cosmorhaphe sinuosa* (Azpeitia Moros) - Han and Pickerill: fig.4G.

1995 *Cosmorhaphe sinuosa* (Azpeitia Moros) - Uchman: 40, pl.11, fig.4.

Description.- Hypichnial, convex, meandering string in fine-grained turbiditic sandstone (fig. 2h). It is preserved in semi-relief. The string is 1.3 mm in width. The meanders are 10-11 mm in width.

Remarks.- *Cosmorhaphe* isp. is a graphoglyptid burrow, common in flysch deposits since the Ordovician (Hantzschel, 1975). Fossil forms have been present since the Cambrian (Narbonne et al., 1987).

c) Miscellaneous group

In this group, ichnogenera display unique behaviour.

Helminthopsis Heer 1877

(Plate 3, fig. 5)

Description.- Hypichnial, convex, loosely meandering, smooth, string-like, no branched forms in fine-grained turbiditic sandstone. The string is 4 mm in width.

Remarks.- Examination of the type material of Helminthopsis has revealed that the type species *Helminthopsis magna* is in fact *Taphrhelminthopsis* Sacco, and that *Helminthopsis labyrintica* is identical to *Spirocosmorhaphe* Seilacher. These types of traces are probably produced by polychaetes or pripulid (Ksiazkiewicz, 1977; Fillon and Pickerill, 1990). *Helminthopsis* occurs in the time interval ranging from the Cambrian (Crimes, 1987) to the Recent (Swinbanks and Murray, 1981; Wetzel, 1983a,b).

Branched, winding and meandering structures

a)Urohelminthoida group

Urohelminthoida isp.

Description.- Burrow system is usually preserved in string size, deep, hypichnial meanders. Lateral appendages protrude outwardly from the curved segments of the meanders (fig.2/).

Remarks.- *Urohelminthoida* is a typical graphoglyptid burrow (Seilacher, 1977). Post depositional *Urohelminthoida* (Ksiazkiewicz, 1977) was not confirmed by Kern (1980). Apart from numerous flysch occurrences, it was not found in Mesozoic shallow-water deposits (Fursich and Heinberg, 1983; Gierlowski-Kordesch and Ernst, 1987). Modern traces of *Urohelminthoida* were recorded on the deep-sea floor by Gaillard (1991). Its stratigraphic interval ranges from the Jurassic (Fursich and Heinberg, 1983) to the Miocene (D'Alessandro, 1980).

Urohelminthoida dertonensis

(Plate 3, fig. 6)

1888 *Urohelminthoida dertonensis* Sacco - Sacco: 36, pl.2, fig.8,16.

Description.- Hypichnial meanders in fine-grained turbiditic sandstone. The meanders are 5 mm in width. The string is 2 mm in diameter. The appendages are 32-40 mm in length.

Remarks.- *Urohelminthoida dertonenisis* is a typical graphoglyptid burrow (Seilacher, 1977).

RESULTS

19 trace fossils, morphologically 6 groups are described in Karaisalı-Çatalan-Eğner regions. 11 of these traces are composed of ichnospecies and 8 of them are in ichnogenus level. Most of the traces are observed as horizontal, pascichnial and agrichnia. Groups with simple structures mostly represent the inner fan, spreiten-radial ones belong to middle fan and winding-meandering belong to outer fan. As a result, fans are determined as inner fan: *Skolithos-Curuziana* ichnofacies and displays eutrophic conditions, middle fan: *Skolithos-Curiziana, Nereites* ichnofacies and mixed assemblages where display eutrophic and oligotrophic conditions, outer fan: *Nereites* ichnofacies and display oligotrophic conditions in very high diversity.

Manuscript received January 27, 2003

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PLATES

PLATE-I

Fig. 1 - *Planolites beverleyensis*
Endichnial full-relief in fine grained sandstone.
Cingoz formation, Inner fan - Middle fan.

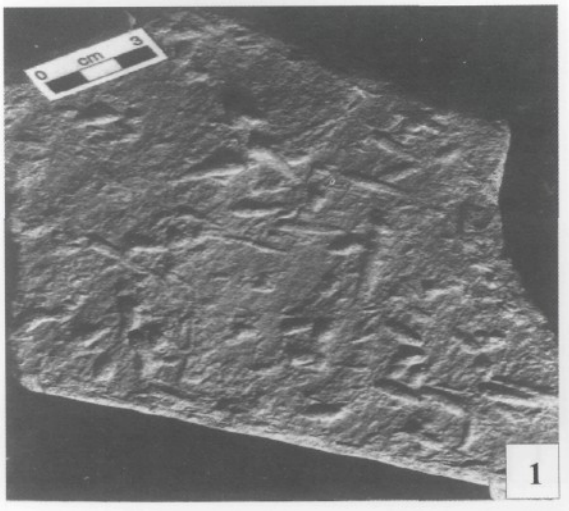
Fig. 2- *Chondrites* isp. and *Scolicia* isp.
Endichnial full-relief in medium-fine grained sandstone.
Cingoz formation, Middle fan.

Fig. 3- *Ophiomorpha* isp.
Endichnial full-relief in coarse-medium grained sandstone.
Cingöz formation, Inner fan.

Fig. 4- *Ophiomorpha* annulata
Endichnial full-relief in medium-fine grained sandstone.
Cingöz formation, Slope - Middle fan.

Fig. 5- *Ophiomorpha* rudis
Endichnial full-relief in medium-fine grained sandstone.
Cingöz formation, Fan fringe.

Fig. 6- *Thallassinoides* isp.
Endichnial full-relief in medium grained sandstone.
Cingöz formation, Middle fan.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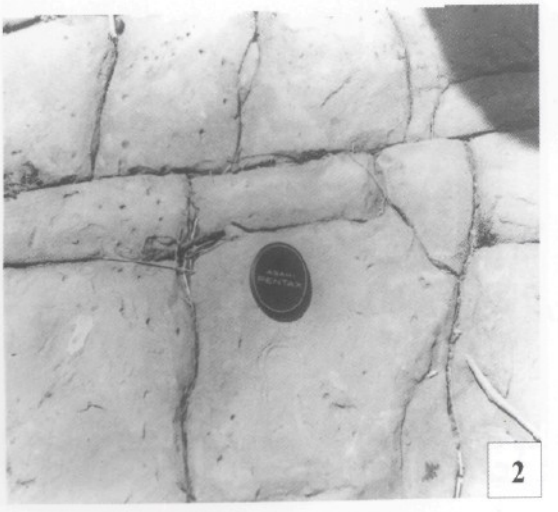
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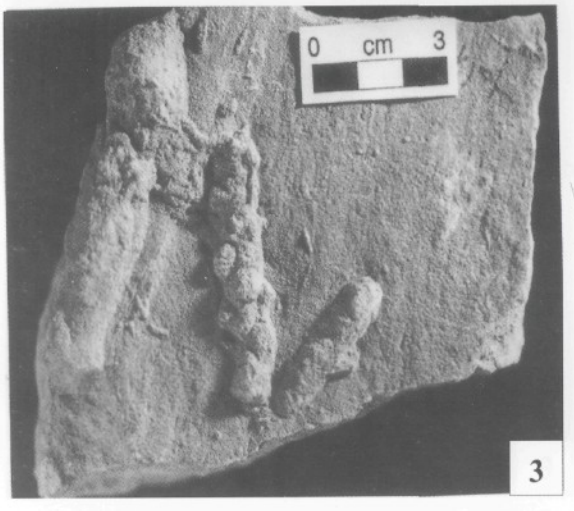
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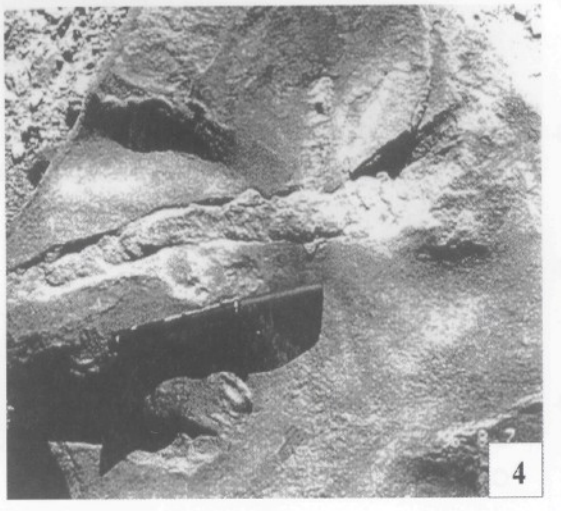
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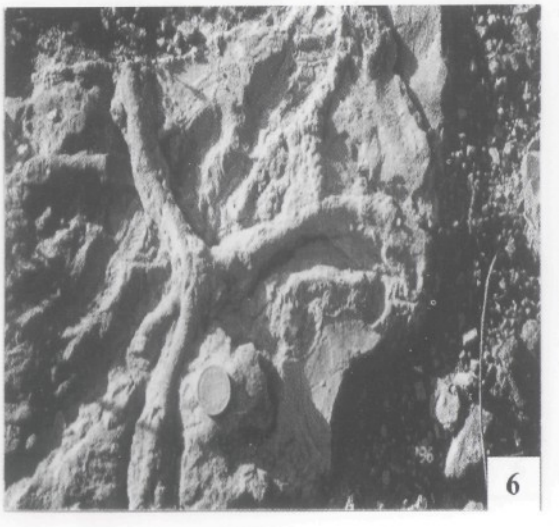
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PLATE-II

Fig.1 *Capodistria vettersi*
Hypichnial semi-relief in fine grained sandstone.
Cingöz formation, Middle fan - Outher fan.

Fig. 2- *Lorenzinia pustulosa*
Hypichnial semi-relief in fine grained sandstone.
Cingöz formation, Middle fan - Outher fan.

Fig. 3- *Zoophycos* isp.
Endichnial semi-relief in medium-fine grained sandstone.
Cingöz formation, Slope - Middle fan.

Fig. 4- *Echinospira* isp.
Endichnial semi-relief in fine grained sandstone.
Cingöz formation, Middle fan.

Fig. 5- *Rhizocorallium* isp.
Endichnial semi-relief in fine grained sandstone.
Cingöz formation, Middle fan.

Fig. 6- *Scolicia vertebralis*
Epichnial full-relief in fine grained sandstone.
Cingöz formation, Middle fan.

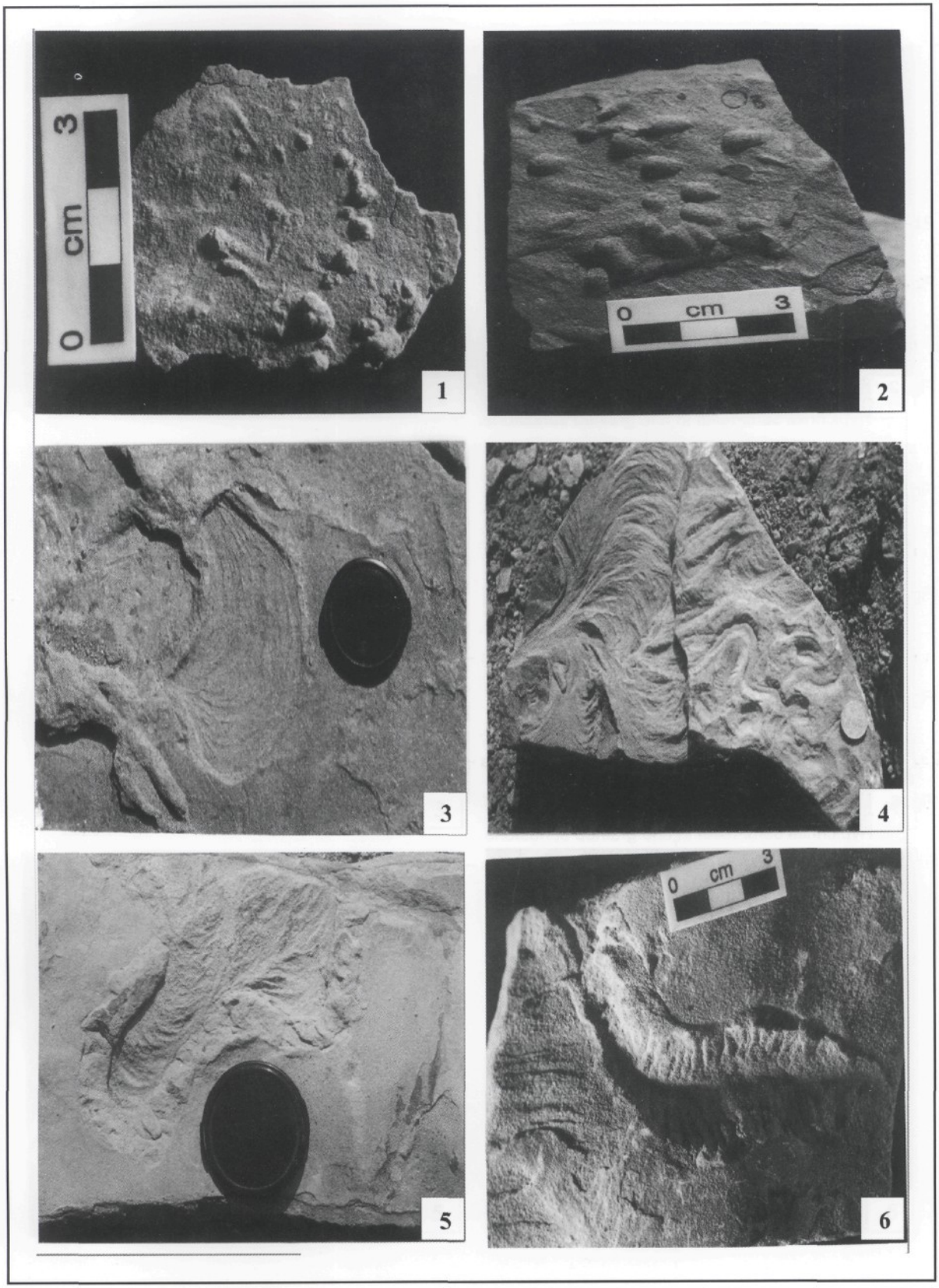
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PLATE-III

Fig. 1- *Scolicia prisca*
Epichnial full-relief in fine grained sandstone.
Cingöz formation, Middle fan - Fan fringe.

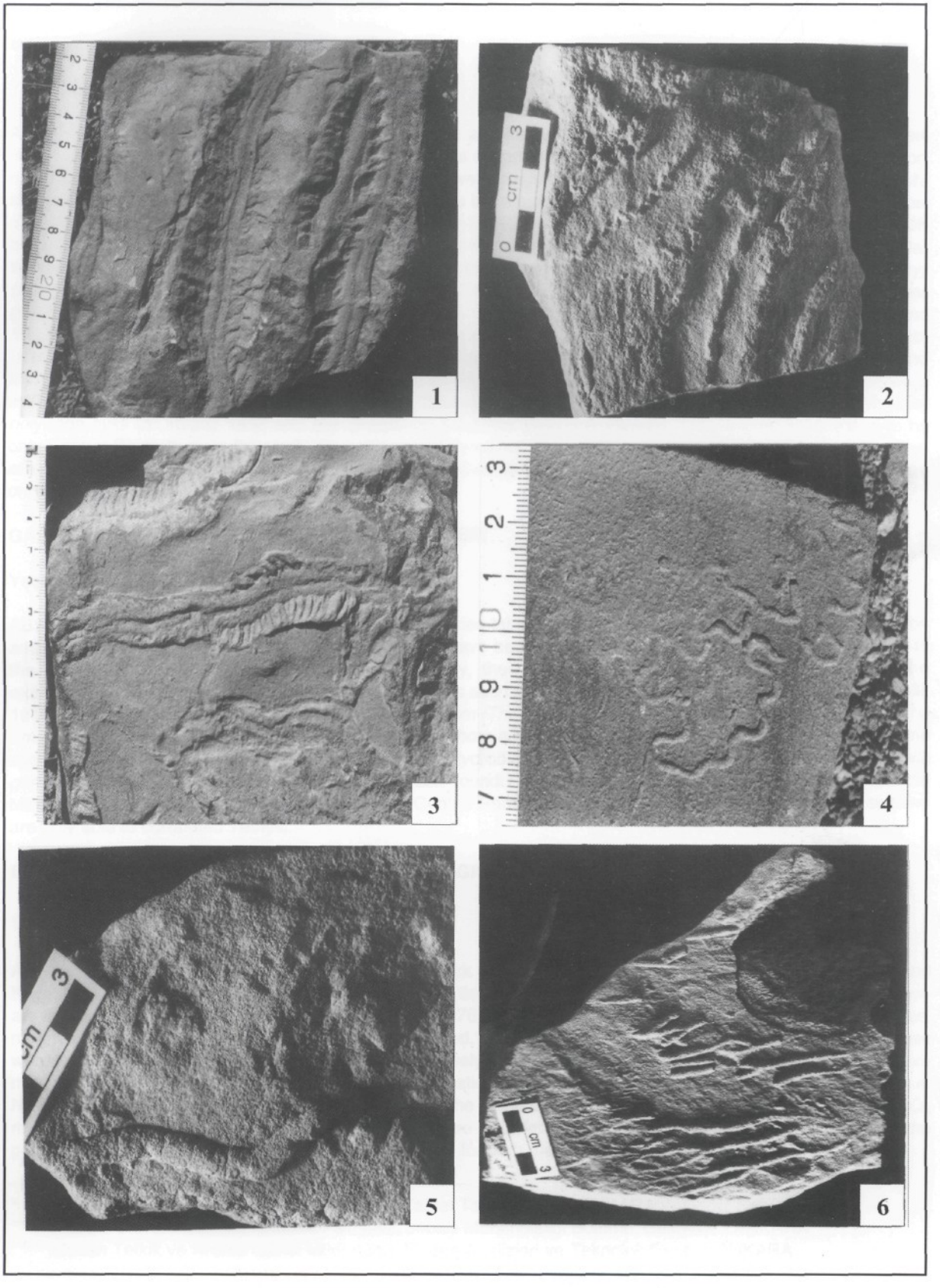
Fig. 2- *Scolicia strozzii*
Hypichnial semi-relief in fine grained sandstone.
Cingöz formation, Middle fan - Outher fan.

Fig. 3- *Scolicia plana*
Epichnial full-relief in fine grained sandstone.
Cingöz formation, Middle fan - Fan fringe.

Fig. 4- *Cosmorhaphe sinuosa*
Hypichnial semi-relief in fine grained sandstone.
Cingöz formation, Outher fan depositional lobes - Fan fringe.

Fig. 5- *Helminthopsis* isp.
Hypichnial semi-relief in fine grained sandstone.
Cingöz formation, Outher fan depositional lobes - Fan fringe.

Fig. 6- *Urohelminthoida dertonensis*
Hypichnial semi-relief in fine grained sandstone.
Cingöz formation, Outher fan depositional lobes - Fan fringe.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