Arab Gulf J. Scient. Res., Math. Phys. Sci., **A5** (2), pp. 205-224 (1987)

Mesozoic Trace Fossils from Central Saudi Arabia

Ghalib M.A. El-Asa'ad

Department of Geology, King Saud University, Riyadh, Saudi Arabia

ABSTRACT. Seven trace fossils from three Mesozoic formations in Central Saudi Arabia and their associated palaeoenvironments are described. These trace fossils are: *Rhizocorallium*, recognized from burrowed micrite and shelly biomicrite of the Upper Marrat Formation (Upper Toarcian) at Khashm Qaradan. The micrite and shelly biomicrite were deposited in an intertidal to subtidal environment. *Thalassinoides* sp. 1, recognized from supratidal, heavily dolomitized micrites of the Lower Marrat Formation (Lower Toarcian) at Khashm Al-Dhibi and from an intertidal, heavily burrowed algal biomicrite of the lowermost part of the Aruma Formation (Coniacian) at Khashm Al-Khanasir and Khashm Al-Buwaibiyat. *Chondrites, Thalassinoides ornatus* Kennedy, *Thalassinoides saxonicus* Geintz and *Thalassinoides* sp. 2 were recognized from arenaceous limestone lithofacies (biopelsparite, biorudmicrite, biosparimicrite) of the Middle part of the Hanifa Formation (Oxfordian) in the Ma'ashbah area. The arenaceous limestone lithofacies were deposited on the inner shelf of a shallow, high energy, marine basin above wave base. The trace fossil *Laevicyclus* was recognized from fossilferous, dolomitic biomicrite of the Middle Aruma Formation (Maestrichtian) at Khashm Hajajah. These fossiliferous, dolomitic biomicrites were deposited in a shallow, littoral, warm marine environment.

The sedimentary cover above the Pre-cambrian Basement in Saudi Arabia falls into natural major divisions or groups corresponding to eight cycles of sedimentation; each of which is dominated by a characteristic lithology and is separated from adjacent cycles by significant breaks in the geologic record (Powers *et al.* 1966).

Although the stratigraphy and sedimentation of Mesozoic formations in Central Saudi Arabia has been adequately studied, the trace fossils have not been investigated. In this paper, a study of the Mesozoic trace fossils from the Marrat Formation (Toarcian), Hanifa Formation (Oxfordian-Kimmeridgian) and Aruma Formation (Coniacian-Maestrichtian) is presented. The study area is shown in Fig. 1.

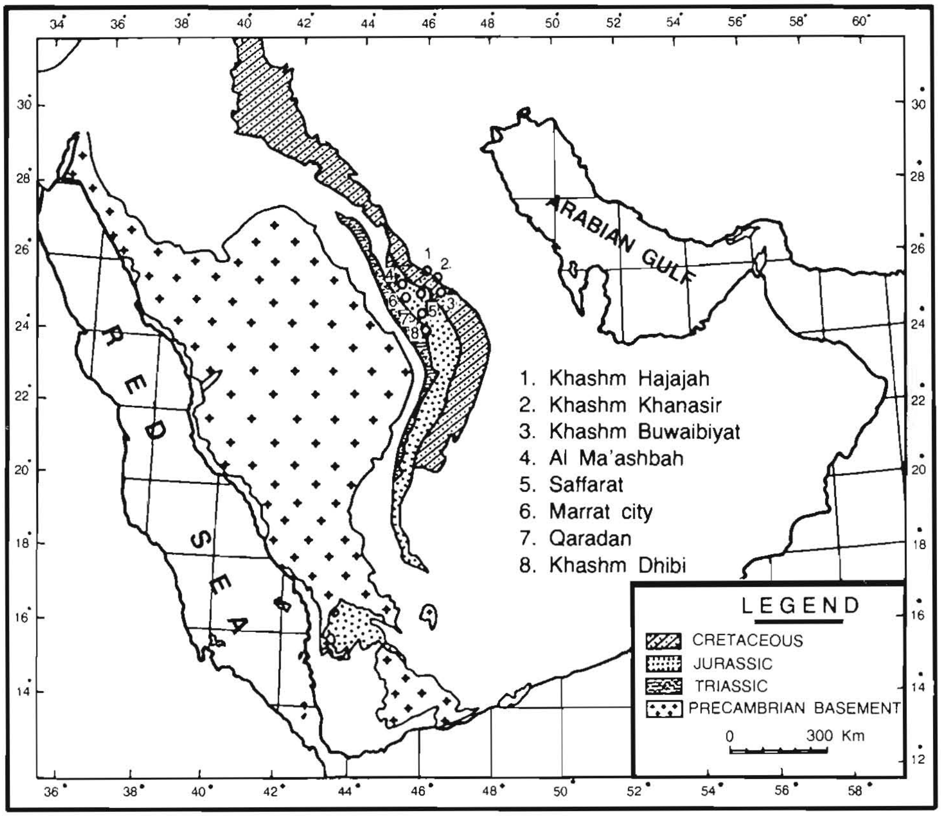


Fig. 1. Location of studied sections on a generalized geological map of the Mesozoic outcrops in Saudi Arabia

Stratigraphy

Marrat Formation

The oldest Jurassic outcrops in Central Saudi Arabia were classified under the Marrat Formation (Powers *et al.* 1966). The Marrat Formation rests unconformably on Upper Triassic continental deposits of the Minjur Sandstone, and it is conformably overlain by the Middle Jurassic shallow marine deposits of the Dhruma Formation. El-Asa'ad (1973) has subdivided the Marrat Formation into three members based on lithology and faunal characteristics. These member are: the Shaqra Member followed upwards by the Qarain Member and the Hadbah Member. A composite section of the Marrat formation at Marrat city and adjacent areas reaches a thickness of about 103.0 m (Fig. 2A). The Shaqra Member (18.3 m thick) is made up of sandstone and calcareous shales at the base, passing up into limestones and dolomites. The Qarain Member (31-60 m thick) is dominantly composed of argillaceous rocks and subordinate siltstone and silty sandstone. The Hadbah Member (53.5 m thick) consists of limestones with few interbeds of shale; it is rich in fossils as compared with the Qarain Member and the Shaqra Member.

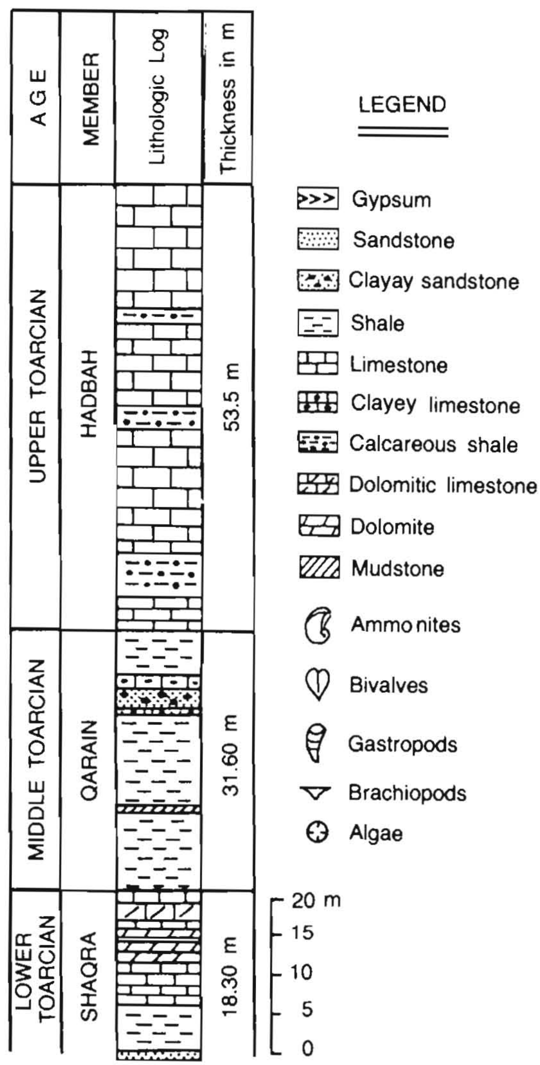


Fig. 2A. Composite section of Marrat Formation at Marrat city and adjacent area showing its lithostratigraphical subdivisions (After El-Asa'ad 1973)

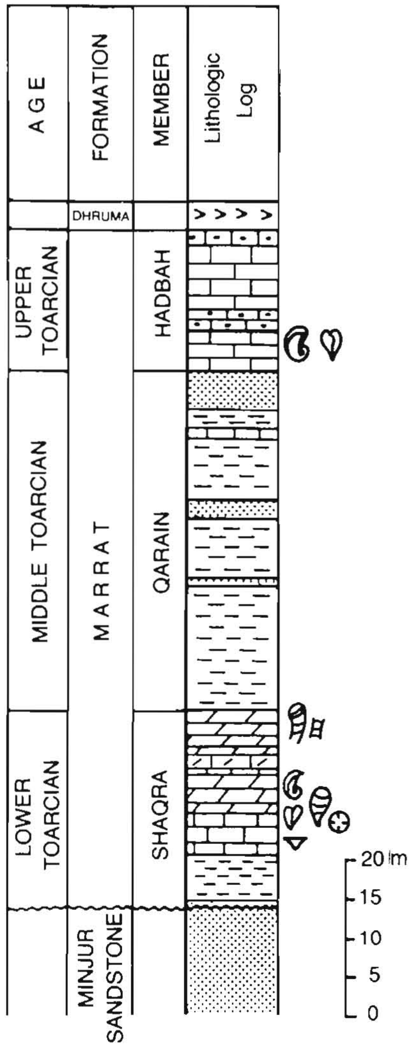


Fig. 2B. Reference section of Marrat Formation at Khashm Al-Dhibi (After El-Asa'ad 1973)

Hanifa Formation

The Hanifa Formation (Oxfordian - Kimmeridgian) outcrops in an irregular narrow arch in Central Arabia. It extends a distance of nearly 1100 km; the outcrop varies from 0.0 to 25 km and averages about 10 km (Powers *et al.* 1966). This formation is generally composed of various carbonate lithofacies intercalated with shale units at several levels. The maximum measured Hanifa section is about 103 m thick (Fig. 3A), and is located in Wadi-al-Saffarat, near Saffarat village (lat. 25° 16′ 16″, long. 46° 04′ 41″). A late Oxfordian to Early Kimmeridgian age is assigned to

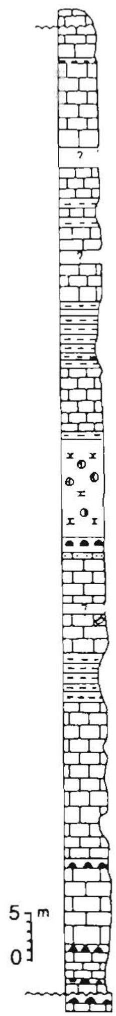


Fig. 3A. Logged section of Hanifa Formation at Saffarat (After Moshrif & El-Asa'ad 1984)

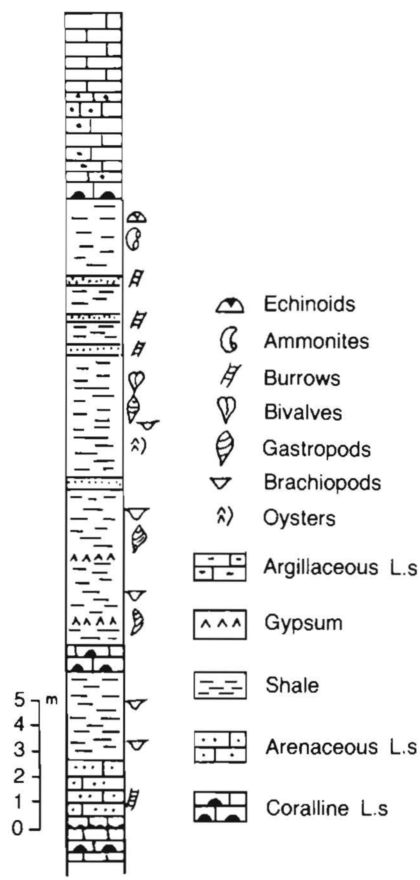


Fig. 3B. Logged section of Hanifa Formation at Ma'ashbah the Hanifa deposits in Central Saudi Arabia based on the presence of large foraminifera (*Kurnubia morrisi* Redmond, *Kurnubia palestiniensis* Henson, *Kurnubia wellingsi* Henson and *Nautiloculina oolithica* Mohler); Moshrif and El-Asa'ad (1984).

Aruma Formation

Steineke and Bramkamp (1952) applied the name Aruma Formation to a Late Cretaceous sequence of rocks outcropping on the Al-Aramah Plateau. These rocks were said to extend from Wadi Al-Dawasir in the south (lat. 20° 30′, long. 46° 30′) to the vicinity of Sakaka (lat. 29° 58′, long. 40° 12′) in the north, continuing northward beyond the Saudi Arabia - Iraqi border. Powers *et al.* (1966) subdivided the Aruma Formation into two members. The Lina Member, composed of shale and impure carbonate, overlying the Atj Member of somewhat cleaner carbonates. The outcropping belt of these Late Cretaceous rocks was subsequently subdivided by El-As'ad (1983) into three members; namely the Khanasir Limestone Member, the Hajajah Limestone Member and the Lina Shale Member (Fig. 4A). He

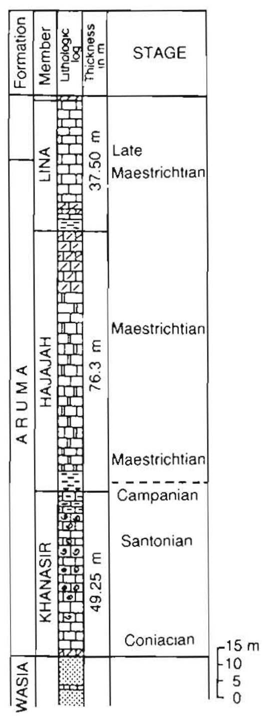


Fig. 4A. Reference section of the Aruma Formation at Wadi Al-Itk showing its lithostratigraphical subdivisions (After El-Asa'ad 1983) recognized nine faunal zones representing the Coniacian to Late Maestrichtian stages in these rocks. The Khanasir Limestone Member is dominantly composed of nodular limestone. This nodular limestone (Fig. 4B) is composed of different lithotypes, these are from bottom to top: Burrowed limestone, intraformational conglomerates, mottled limestones and fractured bedded dolostones (El-Asa'ad 1985).

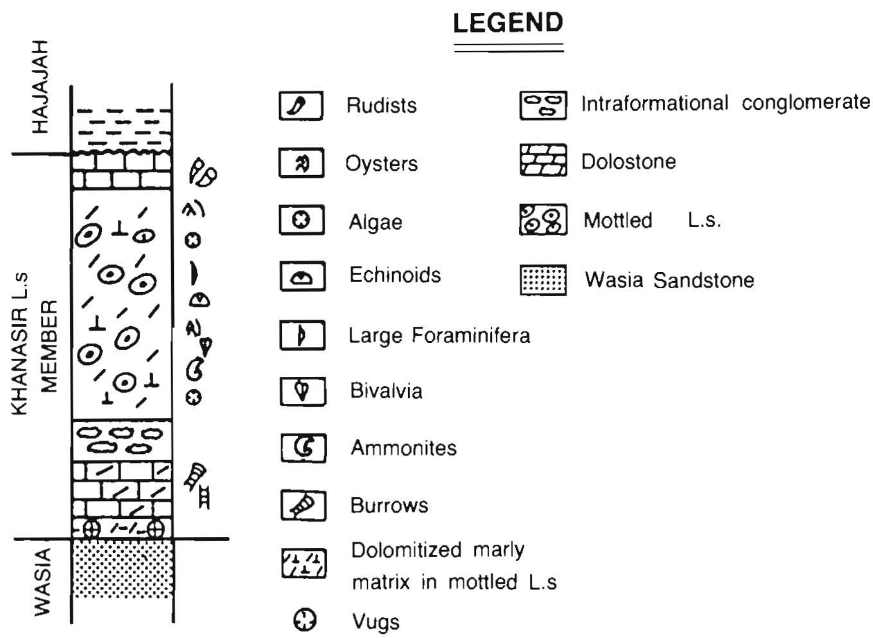


Fig. 4B. Logged section of the Khanasir Limestone Member (Nodular limestone) at Khashm Al-Khanasir (After El-Asa'ad 1985)

Ichnofossils

Thalassinoides sp. 1 (Fig. 5) was recognized from the upper part of the Shaqra Member of the Marrat Formation at Khashm Al-Dhibi (lat. 24° 15′, long. 46° 07′). This is a very irregular horizontal burrow system. A few branches in Y fashion (Fig. 5A). Tunnels are subcylindrical and commonly 3-6 cm in diameter. Burrows tend to be oriented in one direction, so that on a cliff face they appear primarily as transverse sections. The upper part of Shaqra Member at Khashm Al-Dhibi is built up of heavily dolomitized burrowed micrite (7 m thick); mesocrystalline, euhedral dolomite rhombs are abundant in the micrite matrix. Towards the top of this rock unit the mesocrystalline dolomite rhombs are replaced by coarse, iron rich dolomite rhombs. These coarse dolomite rhombs fill in the burrows, fractures and voids. Some crystals of the mesocrystalline dolomite are embedded in the coarser dolomite crystals.

Fig. 5A. Fullrelief, Y shaped, branched burrow of *Thalassinoides* sp. 1 from Shaqra Member at Khashm Al-Dhibi

Fig. 5B. Ovate traces on burrow surface of *Thalassinoides* sp. 1 from Khanasir Limestone Member at Khashm Al-Khanasir

Fig. 5C. Y shaped, epirelief of *Thalassinoides* sp. 1 from Khanasir Limestone Member at Khashm Buwaibiyat

Rhizocorallium sp. was found in the upper part of the Hadbah Member of the Marrat Formation at Khashm Qaradan (lat. 24° 42′ 40″, long. 45° 53′ 56″). This ichnospecies (Fig. 6A) has U shape, subparallel arms between which is a protrusive spreite. Arms are 1 cm in diameter and show scratch marks. The spreite between the arms form series of concentric ridges and grooves up to 1 cm wide. The entire trace ranges from 4.5 to 9 cm in widths and from 9 to 13 cm in length. Complete structures are entirely within the plane of the bed. Some examples were oblique to bedding (Fig. 6B).

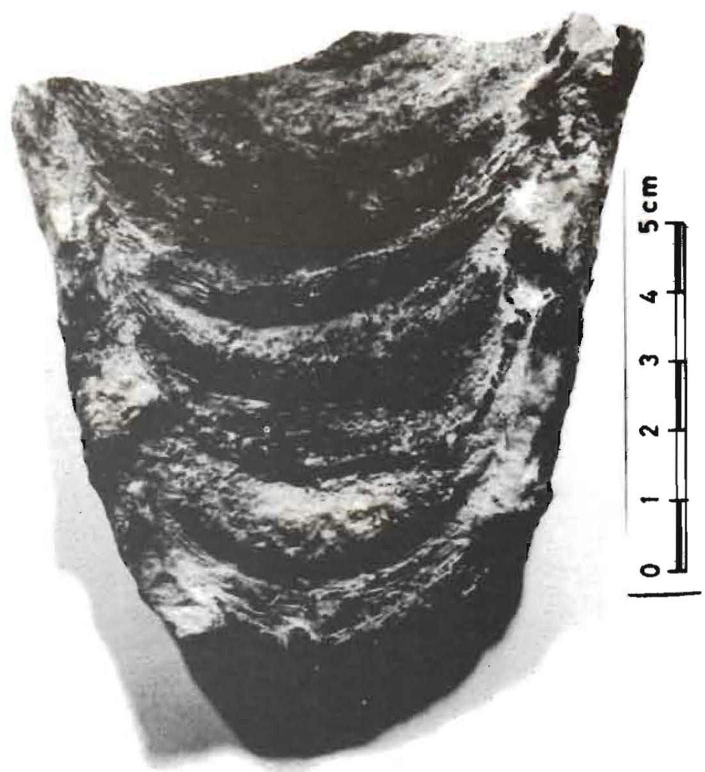
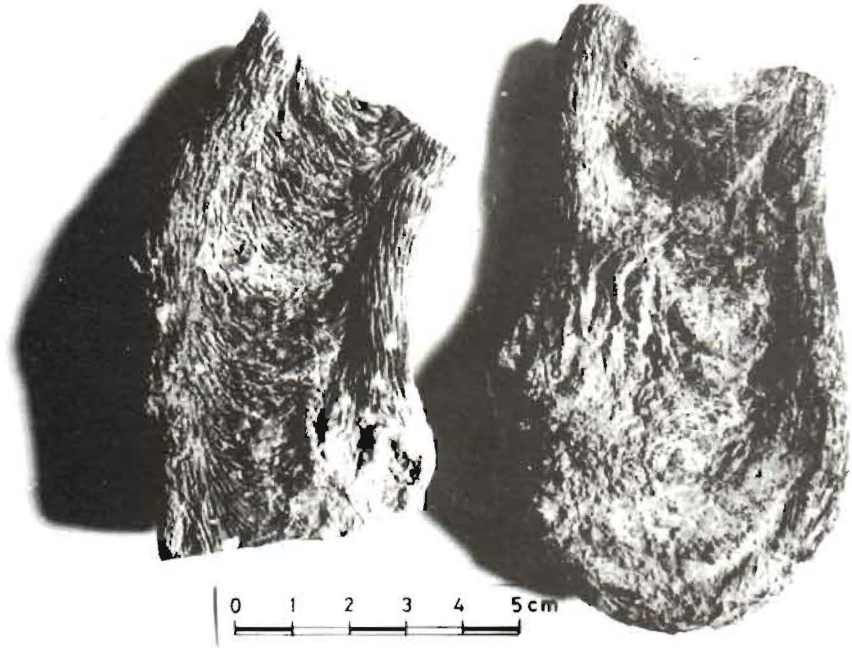


Fig. 6A. U shaped burrows of *Rhizocorallium* from Hadbah Member at Khashm Qaradan



The upper part of Hadbah Member at Khashm Qaradan consists of burrowed micrites (3 m thick). This micrite is overlain by a 7 m thick shelly biomicrite unit; small and large molluscan shell fragments are distributed in the biomicrite. The large shell fragments are stained by iron oxides while the small shell fragments are pure carbonate. The micrite matrix is stained by iron oxides. *Rhizocorallium* are filled with biomicrites rich in iron oxides and large voids. The voids are filled with large sparry calcite crystals.

Ichnospecies of *Chondrites* and *Thalassinoides* were recognized in the middle part of the Hanifa Formation at Al-Ma'ashbah (lat. 25° 33′ 38″, long. 45° 23′ 13″). The *Chondrites* are irregularly branched, plant-like shallow burrows of a deposit feeding animal. Burrows are horizontal, assymmetrically ramifying in plant-like dendritic pattern. Branches are short, concave epireliefs and about 1-2 mm in diameter. The horizontal burrow network was eroded in such a manner that the upper portion is destroyed. Several openly-branched burrow systems weather out from a micrite bed about 20 cm thick in the middle of the Hanifa Formation outcrops at Ma'ashbah (Fig. 7). *Thalassinoides* occur together with, below and

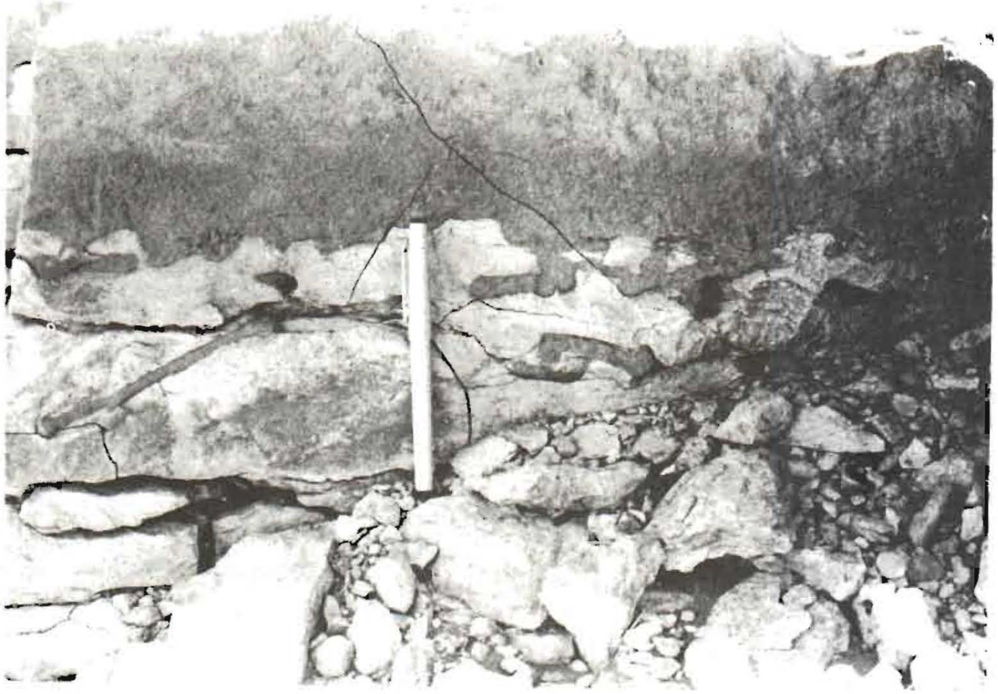


Fig. 6B. Horizontal and oblique burrows of *Rhizocorallium* from Hadbah Member at Khashm Qaradan

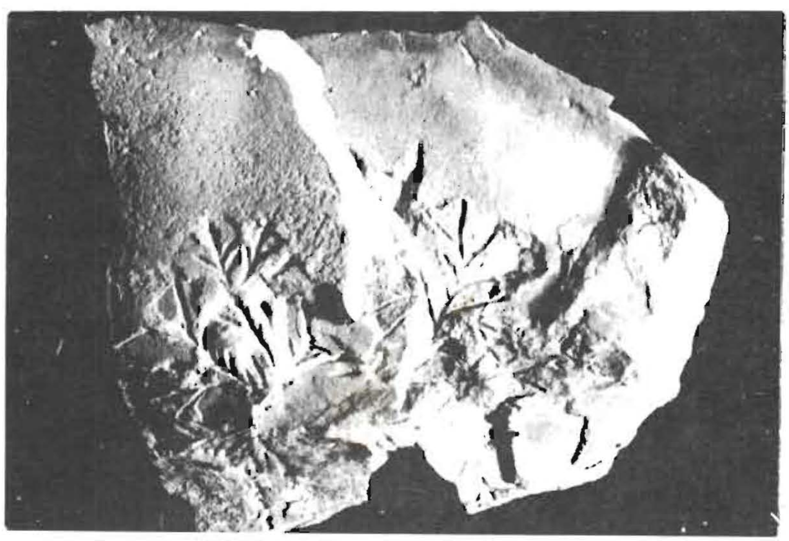


Fig. 7. Open branched burrow system of *Chondrites* from Hanifa Formation at Ma'ashbah

above the *Chondrites* bearing sparry micrites. *Thalassinoides* occurring together with *Chondrites* are horizonal burrows, commonly 1-2 cm in diameter, bifurcating in a Y shape and parallel to bedding plane surfaces. Burrows are eroded and the upper portion is destroyed leaving an empty burrow or mold. Scratch marks are observed on the walls of molds. The complex reticulum of scratch marks (Fig. 8) are comparable to those of *Thalassinoides ornatus* Kennedy 1967. Another ichnospecies of *Thalassinoides* occurs below the *Chondrites.* It closely resembles *Thalassinoides saxonicus* Geintz (Kennedy 1967, p. 134). It is a giant form of horizontal burrow 15-20 cm in diameter, oval in cross section with swellings at the point of branching. A distinctive feature is mammillate ornament; the mounds seem to be pellets pressed into the walls. The pellets are cylindrical in shape and average 1.5 mm in diameter and 10 mm in length (Fig. 9). The giant horizontal burrows of *Thalassinoides saxonicus* Geintz are filled with shelly biomicritic material, molluscan shell fragments may be aligned and have rounded to subrounded edges. This suggests that this burrow producer kept its burrow opened until it was filled directly by currents. The *Thalassinoides* sp. 2 which occurs above the *Chondrites* is an unornamented, very irregular branching horizontal burrow system preserved in fullrelief, individual tunnels being 0.8 - 0.5 cm in diameter. It occurs on the surface of a biopelsparite bed 20 cm thick (Fig. 10). This rock contains 40% foraminiferal tests cemented by sparry calcite crystals and 10% pellets. Foraminiferal tests and pellets are coated by iron oxides.

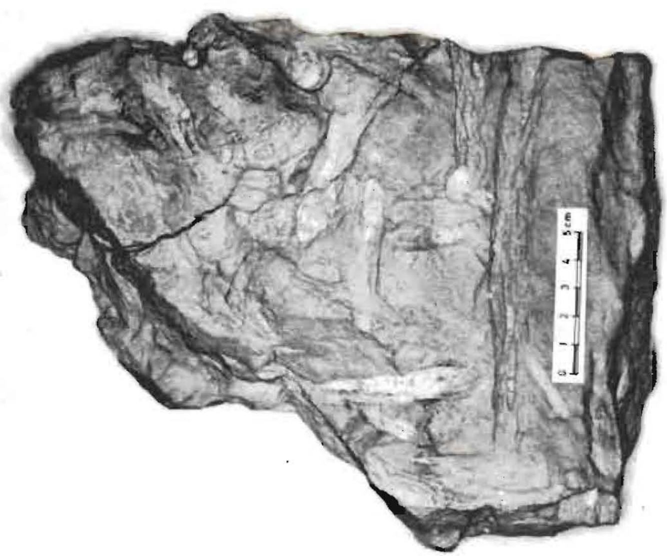


Fig. 8. Scratch marks on walls of *Thalassinoides ornatus* Kennedy from Hanifa Formation at Ma'ashbah

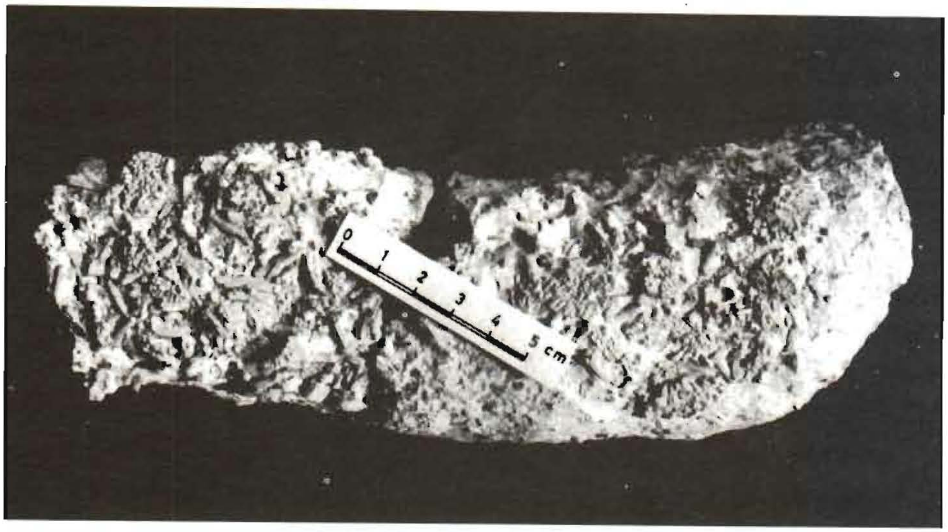


Fig. 9. Filled burrows of *Thalassinoides saxonicus* Genitz from Hanifa Formation at Ma'ashbah

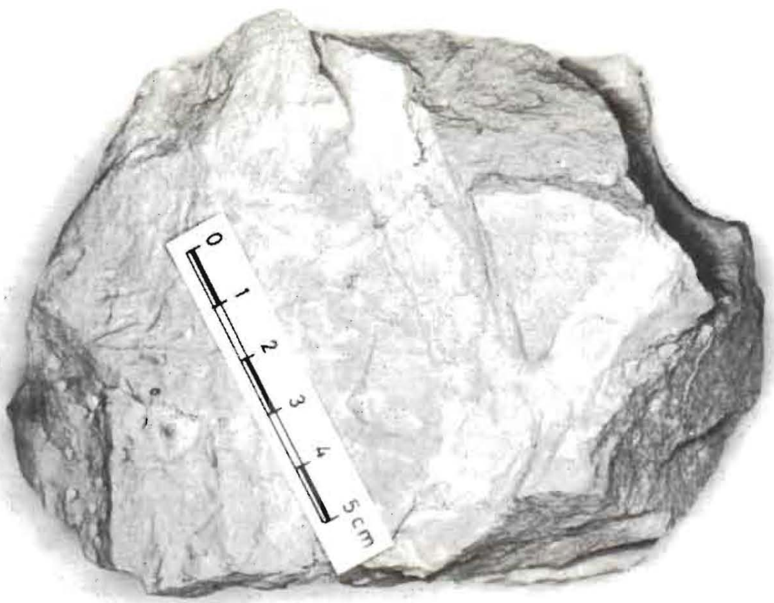


Fig. 10. Horizontal, branching, fullrelief burrows of *Thalassinoides* sp. 2 from Hanifa Formation at Ma'ashbah

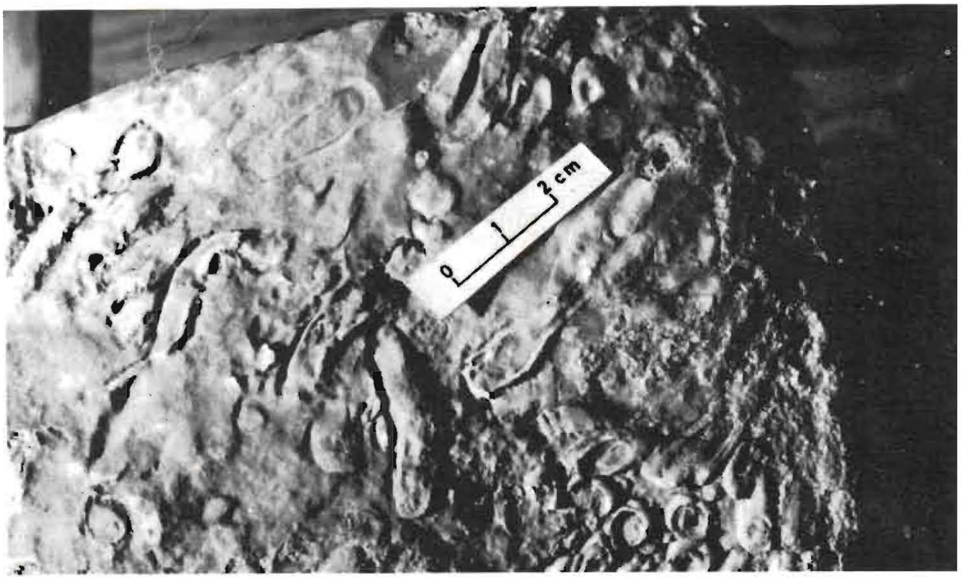


Fig. 11. Vertical, cylindrical, fullrelief shafts of *Laevicyclus* from Hajajah limestone Member at Khashm Hajajah

Thalassinoides sp. 1 was again recognized in the lowermost part of the Al-Khanasir Limestone Member at Khashm Al-Khanasir (lat. 25° 36′ 26″, long. 46° 21′ 25″), see Fig. 4B. The burrowed limestones of the Khashm Khanasir area were heavily churned by irregular, fullrelief, horizontal burrows. Preserved entrance shafts are inclined to the bedding plane, tunnel dimensions are variable (3-6 cm in diameter). Ovate traces on burrow surfaces were recognized (Fig. 5B). These ovate structures could have been resting traces or breeding chambers or for deposition of eggs (Bassan and Scott 1979).

From the same burrowed limestones at Khashm Buwaibiyat (lat. 25° 12′ 12″, long. 46° 49′ 27″) branching Y shaped burrows of *Thalassinoides* sp. 1 were also recognized (Fig. 5C).

Vertical, approximately cylindrical, fullrelief shafts were recognized in dolomitic limestones of the Hajajah Limestone Member of the Khashm Al-Hajajah area (lat. 25° 46′ 14″, long. 46° 12′ 06″). These traces are referred to *Laevicyclus* (Presumably of an annelid origin (Garlock and Isaacson 1977). These vertical, cylindrical bodies are capped at their upper end by a concentric furrow (Fig. 11) and perforated by a central canal, visible on bedding planes as regular concentric circles.

Discussion

Ichnofossils, *Rhizocorallium* and *Thalassinoides* are traces of activity of deposit feeding organisms which exploited the sediment for food through different mining programs. These animals were probably decapod crustaceans (Seilacher 1967) a view supported by the presence of scratch marks on the burrow walls (Fursich 1975). These creatures thus behaved much like the Cretaceous - Recent 'Shrimp' Callianassa (Sheehan and Jessica Schiefelbein 1984).

An intertidal environment is interpreted for the *Rhizocorallium* bearing Hadbah Member at Khashm Qaradan. This interpretation is based on the following criteria: The transgressive micrite and shelly biomicrite of the Hadbah Member overlies continental brownish-red to dark-red mudstone, shale, sandy and silty shale of Al-Qarain Member at Khashm Qaradan (El-Asa'ad 1973, Abed 1979, Al-mohandis 1984). Horizontal *Rhizocorallium* has been interpreted by Bassan and Scott (1979) as a lower to upper shoreface indicator, and by Farrow (1966) as most frequent in intertidal sediments some 1.5 km from the shore. At Khashm Qaradan a few oblique *Rhizocorallium* was associated with horizontal *Rhizocorallium* (Fig. 6B); this prabably indicates a subtidal to intertidal environment (Karaszewski 1973).

Ichnospecies belonging to ichnogenus *Thalassinoides* Ehrenberg, 1944 were recognized from different stratigraphical levels in the Mesozoic section of Central Arabia. *Thalassinoides* sp. 1 was recognized from the upper part of the Shaqra Member at Khashm Al-Dhibi and from the Khanasir Member of the Khanasir and Buwaibiyat areas. A supratidal environment for *Thalassinoides* sp. 1 at Khashm Al-Dhibi is inferred because of the heavily, secondary dolomitization of dolomitic micrites by coarse iron rich dolomite rhombs. These coarse rhombs fill in burrows and sometimes includes smaller dolomite rhombs of the dolomitic micrites. This is supported by the setting of the heavily burrowed, dolomitic micrites below continental deposits of the Qarain Member. Moreover, the extensive bioturbation of the latest beds of the Shaqra Member (the heavily dolomitized, dolomitic micrites) suggests a progressively shallowing environment.

In Khanasir and Buwaibiyat areas, *Thalassinoides* sp. 1 was recognized in heavily burrowed, algal biomicrites located beneath intraformational conglomerates (Fig. 4B). An intertidal to supratidal environment is inferred for these burrowed, algal biomicrites below intraformational conglomerates which were deposited in tidal channels cut in a supratidal area. The intertidal algal biomicrites were subjected to storm waves which removed clasts from the surface and deposited them in the channels (El-Asa'ad 1985).

Ichnospecies *Chondrites, Thalassinoides ornatus* Kennedy, *Thalassinoides saxonicus* Geintz and *Thalassinoides* sp. 2 were recognized in carbonate lithofacies of the Hanifa Formation of the Al-Ma'ashbah area. The Hanifa Formation of Al-Ma'ashbah comprises various carbonate lithofacies intercalated with fossiliferous shale at several horizons (Fig. 3B). These carbonate lithofacies include argillaceous limestones (Biomicrite), arenaceous limestones (Biopelsparites, biorudmicrites, biosparimicrites) and reefal limestones with corals. The trace fossils are limited to the arenaceous limestones lithofacies. *Chondrites* and *Thalassinoides ornatus* Kennedy were recognized on upper surfaces of biomicrite beds, while *Thalassinoides saxonicus* Geintz were found in biorudmicrites and *Thalassinoides* sp. 2 in biopelsparites. The argillaceous limestones probably deposited in deeper (normal marine) waters where fine sediments were laid down below wave base and where both wave and current action were nearly absent (Moshrif and El-Asa'ad 1984). This is supported by the common occurrence of a diverse fauna (ammonites, bivalves, gastropods and echinoids), pellets and microcrystalline ooze. Furthermore, the presence of interbedded, fossiliferous shales also suggests deeper marine conditions. Arenaceous limestones were formed in conditions of high current energy and relatively shallow water. This environment was probably located on the inner shelf, where most of the current activity was concentrated. This conclusion is supported by the diversity of the faunas present (large foraminifera, algae, sponge spicules and abraided mollusc shells). The arenaceous limestones are of a variable type and their bioclasts are reworked and of different shapes and sizes. This suggests deposition on the foreslope of a shallow marine basin margin. The reefal limestones consist of massive limestone built up of corals and much bioclastic debris. Terrigenous clastics are almost absent. This mixture of ill sorted, partially worn and partially angular bioclasts is typical of reef flank deposits. Moreover, the reefal limestones have been found within patches of coral reef developing massive reef framework. The palaeoenvironment of the trace fossil assemblage was thus located on the inner shelf of a shallow marine basin above wave base, and was subjected to the influence of high current energy. The change of the Hanifa lithofacies from coral reef facies into argillaceous limestone and arenaceous limestone then back to coral reef and argillaceous limestone indicates the bathymetric gradient in the basin of deposition.

Laevicyclus was recognized in the upper part of Hajajah Limestone Member of the Aruma Formation. This Member is formed of chalky limestone and dolomitic limestone. fossils include nautiloidea, heavy shelled gastropods and bivalves. This indicates a shallow, littoral, warm marine environment.

Conclusion

Study of trace fossils from some Mesozoic rock units in Central Saudi Arabia leads to the recognition of seven ichnospecies. These are; *Rhizocorallium* sp., *Thalassinoides* sp. 1, *Th.* sp. 2, *Th. ornatus* Kennedy, *Th. saxonicus* Geintz, *Chondrites* sp. and *Laevicyclus* sp.

The palaeoenvironments of deposition of these trace fossils bearing rock units are as follows:

1. Intertidal for the *Rhizocorallium* bearing Hadbah Member at Khashm Qaradan. This is based on its setting above continental deposits of the Qarain Member and on the presence of abundant horizontal and few oblique *Rhizocorallium*.

2. *Supratidal for the Thalassinoides* sp. 1 bearing Shaqra Member at Khashm Al Dhibi. This is based on heavy secondary dolomitization of the member and its setting below continental deposits of the Qarain Member.

3. Intertidal to supratidal for the *Thalassinoides* sp. 1 bearing algal biomicrites of the Khanasir Limestone Member at Khashm Khanasir and Khashm Buwaibiyat areas. This is based on their location beneath intraformational conglomerates which were deposited in tidal channels cut in supratidal deposits.

4. The arenaceous limestone lithofacies of the middle part of the Hanifa Formation of the Al-Ma'ashbah area contain *Chondrites* sp., *Thalassinoides* sp. 2, *Th. Ornatus* Kennedy and *Th. saxonicus* Geintz. These lithofacies were deposited on the inner shelf of a shallow, high energy, marine basin above wave base.

5. *Laevicyclus* sp. was recognized in the upper part of the Hajajah Limestone Member. This member is made up of chalky limestone and dolomitic limestone; fossils include nautiolidea, heavy shelled gastropods and bivalves. This indicates a shallow, littoral, warm marine palaeoenvironment.

References

Abed, A.M. (1979) Lower Jurassic Lateritic beds from Central Arabia, *Sedim. Geol.* **24:** 149-156.

Almohandis, A.A. (1984) Mineralogy of the Qarain clay deposits, Saudi Arabia, *Arab Gulf. J. scient. Res.* **2**(1): 123-133.

Bassan, P.B. and **Scott, R.W.** (1979) Morphology of *Rhizocorallium* and associated traces from the Lower Cretaceous Purgatoire Formation, Colorado, *Palaeogeography. Palaeoclimatology, Palaeocology,* **28:** 5-23.

El-Asa'ad, G.M. (1973) *Biostratigraphical studies on Jurassic rocks at Marrat City and adjacent areas in Saudi Arabia,* M.Sc. Thesis, University of Ain Shams, Egypt, 206 p.

El-Asa'ad, G.M. (1983), Lithostratigraphy of the Aruma Formation in Central Saudi Arabia, *in:* **A.M. Abed** and **H.M. Khaled (eds),** *Proc. 1st Jordanian Geol. Conf.,* Spec. Publ. Jordanian Geologists Association, Amman, **1:** 72-86.

El-Asa'ad, G.M. (1985) Origin and paleoenvironment of Late Cretaceous nodular limestone in Central Saudi arabia, *Jour. Geol. Soc. Iraq,* **18:** 77-100.

Farrow, G.E. (1966) Bathymetric zonation of Jurassic trace fossils from the coast of Yorkshire, England. *Palaeogeography, Palaeoclimatol., Palaeoecol.* Amsterdam, **2:** 103-151.

Fursich, F.T. (1975) Trace fossils as environmental indicators in the Corallian of England and Normandy, *Lethaia,* **8:** 151-172.

Garlock, T.L., and **Isaacson, P.E.** (1977) Trace ichnocoenoses from the Rose Hill Formation (Early Silurian) North Central Pennsylvania, *Geol. Soc. Am. Northern Section, 12th Annual Meeting,* (Abstract), Binghamton, U.S.A.

Karaszewski, W. (1973) *Rhizocorallium, Gyrochorte* and other trace fossils from the Middle Jurassic of the Inowlodz Region, Middle Poland. *Bull. Acad. Polon. Sci. Ser. Sci. de la Terre,* vol. **XXI** Num. 3-4, BPSTBS, 21 (3-4), p. 189-203.

Kennedy, W.J. (1967) Burrows and surface traces from the Lower Chalk of Southern England. *Bull. Br. Mus. nat. Hist. Geol.* **15:** 1-127.

Kennedy, W.J. (1975) Trace fossils in the chalk environment *in:* **R.W. Frey (eds),** *The Study of Trace Fossils,* Springer-Verlag, New York, pp. 263-282.

Moshrif, M.A. and **El-Asa'ad, G.M.** (1984) Sedimentation and environmental interpretation of Hanifa Formation (Upper Jurassic), Central Saudi Arabia, *J. Coll. Sci., King Saud Univ.* **15**(2): 479-505.

Powers, R.W., Ramirez, L.F., Redmond, C.D. and **Elberg, E.L. Jr.** (1966) Geology of the arabian Peninsula, sedimentary geology of Saudi Arabia, *U.S. Geol. Survey Professional Paper* 560-D, p. D1-147.

Seilacher, A. (1967) Bathymetry of trace fossils, *Mar. Geol.* **5:** 413-428.

Sheehan, P.M. and **Jessica Schiefelbein, D.R.** (1984) The trace fossils *Thalassinoides* from the Upper Ordovician of the Eastern Great Basin: Deep burrowing in the Early Paleozoic, *J. Paleont.,* **58**(2): 440-447.

Steineke, M. and **Bramkamp, R.A.** (1952) Stratigraphic introduction, *in:* **W.J. Arkell,** *Jurassic Ammonites from Jebal Tuwaiq, Central Arabia, Phil. Trans. R. Soc.* (London) Ser. B. **236:** 241-313.

(Received on 04/05/85;
in revised form 02/03/86)

دراسة أحافير آثار كائنات حية قديمة من حقب الحياة المتوسطة بوسط المملكة العربية السعودية

غالب محمد عبدالهادي الأسعد

قسم الجيولوجيا ـ جامعة الملك سعود ـ الرياض ـ المملكة العربية السعودية

يشمل البحث وصف سبعة أحافير أثر كائنات حية قديمة درست من ثلاثة متكونات من حقب الحياة المتوسطة. وقد أمكن التعرف على بيئات معيشتها. وأحافير الآثار هذه هي : الريزوكوراليوم وقد وجدت في حجر جير دقيق الحبيبات وحجر جير حيوي صدفي من الجزء العلوي لمتكون مَرات (التوآرسي العلوي) في خشم قاردان. وقد ترسب حجر الجير دقيق الحبيبات وحجر الجير الحيوي الصدفي في بيئة بين مدية إلى تحت مدية. الثاليسينويد نوع (١)، وقد وجدت في حجر جير دقيق التحبب متدلمت بشدة من الجزء السفلي لمتكون مَرات (التوآرسي السفلي) في خشم الذيبي، وكذلك عثر عليها من حجر جير حيوي طحلبي في الجزء الأدني لمتكون العرمة (كونياسي) في خشم الخناصر وخشم البويبيات، وقد عاش هذا النوع في بيئة فوق مدية إلى بيئة تحت مدية. أما الكونودرايتس، الثاليسينويد أورناتس كيندى، ثاليسينويد ساكسونيكس جنيتز وثاليسينويد نوع (٢) فقد وجدت في سحن حجر جير خشن الحبيبات من الجزء المتوسط لمتكون حنيفة (اكسفوردي) في منطقة المعشبة (٢٥ كلم جنوب غرب المجمعة)، وقد ترسبت سحن الجير خشنة الحبيبات الحاوية على هذه الأحافير في بيئة بحرية ذات مياه ضحلة ومتحركة بقوة فوق قاعدة الموج على الرف القاري. وأخيراً اللافيساكلس التي عثر عليها في حجر جير حيوي متدلمت غني بالأحافير في الجزء الأوسط لمتكون العرمة (ماسترختى) في خشم الحجاجة. وقد ترسب حجر الجير المتدلمت الغني بالأحافير والحاوي على اللافيساكلس في بيئة بحرية شاطئية ذات مياه دافئة.