سفالوپودها و موقعیت چینه شناسی لایه سفالوپوددار سازند شیشتو، ایران

نوشته: دکتر علیرضا عاشوری* و احمد یمینی *

Cephalopods and Stratigraphical Position of Cephalopod Bed of Shishtu Formation, Iran

By: Dr. A.R. Ashouri* & A. Yamini*

چکیده

مقاله حاضر به معرفی زیای سفالوپودهای لایه سفالوپوددار در رشته کوه شتری در مرکز ایران پرداخته است. این زیای سفالوپودی شامل ۵ جنس نوتیلوییدی و ۱۲ جنس آمونوییدی است. از این میان ۷ جنس آمونوییدی *(Tornoceras, Cheiloceras, Maeneceras, Gonioclymenia, Cyrtoclymenia, Staffites)* و *Falcitornoceras* و ۵ جنس نوتیلوییدی *(Ormoceras ,Mooreoceras, Sycoceras, Michelinoceras, Macroloxoceras)* برای اولین بار از ایران گزارش می‌شوند.

زیای آمونوییدی نشانگر سن فرازنین میانی (؟)/ پسین تا فامنین پسین برای لایه سفالوپوددار است که با نتایج حاصل از مطالعه کنودونتها (Ashouri, 1990 و عاشوری، ۱۳۷۴ و۱۳۷۶) و براکیوپودها (راستکار،۱۳۷۵) همخوانی دارد.

مطالعه ریزرخساره برش مورد مطالعه گویای محیط رسوبی عمدتا کم عمق و پر انرژی است.

پراکندگی زیای گونیاتیتی در خاور وشمال خاور ایران نشانگر تشابه زیست شناسی دیرین و ارتباط دریایی دو ناحیه در زمان فامنین است. مقایسه نقشه جغرافیایی دیرینه دونین پسین و زیای گونیاتیتی منطقه مورد مطالعه با مناطق البرز، قزاقستان، چین، شمال افریقا، و اروپا بیانگر قرار داشتن این مناطق در عرضهای جغرافیایی پایین است.

کلید واژه‌ها: لایه سفالوپوددار، سفالوپود، سازند شیشتو، رشته کوههای شتری، ایران

Abstract

This paper attempts to describe a cephalopod fauna from the "Cephalopod Beds" in the Shotori Range, Central Iran. The fauna contains 5 genera of nautiloid cephalopods and 12 genera of ammonoids. Among these, 7 ammonoid genera (*Tornoceras, Cheiloceras, Maeneceras, Gonioclymenia, Cyrtoclymenia, Staffites,* and *Falcitornoceras*) and 5 nautiloid genera (*Ormoceras, Mooreoceras, Sycoceras, Michelinoceras,* and *Macroloxoceras*) are reported for the first time from Iran.

Ammonoid faunas indicate a Middle(?)/Late Frasnian to Late Famennian age for the "Cephalopod Beds", confirmed by conodont (Ashouri, 1990, 1995 & 1997) and brachiopod (Rastkar, 1996) studies.

Microfacies analysis of the sections indicates that sedimentation occurred in a mostly shallow and high energy sedimentary environment.

The distribution of goniatite fauna in eastern as well as northern Iran suggests similar paleobiological condition and a marine connection of the two regions during the Famennian stage. A paleogeographical map of the Late Devonian and comparison of the goniatite fauna of the study area with Alborz, Kazakhstan, China, North Africa and Europe indicate that these areas were in low latitudes during this time.

Key words: Cephalopod Beds, Cephalopod, Shishtu Formation, Shotori Range, Iran.

Introduction

The "Cephalopod Beds" (Stöcklin *et al*. 1966) conform to the upper part of the Shishtu 1 subformation. The Shishtu Formation was named and described by Ruttner *et al.* (not published) in the Ozbak-Kuh Mountains. It is divided into two subformations: Shishtu 1 and Shishtu 2. The limit of the two subformation is marked by a characteristic black shale unit called "Mush Horizon " at the top of Shishtu 1.

Later, Ruttner and Stöcklin (1966) recognized a goniatite horizon in each subformation.

Stöcklin *et al.* (1965) described a reference section about 150 km towards the south from the type area (Howz-e-Dorah) in the south of the Shotori Range, about 40 km south of the Niaz area (Fig. 1). The reference section with a thickness of 543 m represents 2 subdivisions; which are similar to the type area. The equivalent of Shishtu 1 is 326m thick and consists of dark green shales interbedded with quartzitic sandstone and intercalations of fossiliferous limestone. The uppermost 26.5m (Fig. 2) are formed by highly fossiliferous shale, sandstone, oolitic limestone and iron-oolites which are equivalent of Goniatite Horizon 1 and of the so called "Cephalopod Beds" (Stöcklin *et al.* 1965). The lithology of Shishtu 2, which reaches 217m thickness, is mainly dark gray well-bedded limestone with some inter-bedded black-gray shale at the base and the top. Shishtu 1 ranges from the Frasnian to the topmost Famennian possibly with the Early Tournaisian in barren top beds (Stepanov 1967).

The "Cephalopod Beds" can be traced as disconnected outcrops along the thrust zone in the western foot of the Shotori Range towards north around the Niaz area , the last exposure is visible around the Posha Village.

Despite the fragmentation and remarkable lithological changes in a short distance, the general lithology remains similar. Main characteristics are rust-red iron oolites, highly oolitic and sandy limestone and associated greenish and ash-gray shale (Stöcklin *et al.* 1965).

Stratigraphy

The highly fossiliferous “Cephalopod Beds” is a remarkable horizon in the Shotori Range and have been the most interesting part of the Shishtu Formation for many authors. Stöcklin *et al.* (1965) gave a Frasnian-Famennian age to the unit. Walliser (1966) added precision and described Upper Devonian I (Frasnian) and Upper Devonian IV faunas. Stepanov (1967) illustrated a Famennian age but later (1971) he conformed to the age assigned by Stöcklin *et al.* (1965).

Based on a palynomorph study, Moussavi (1995) and Ghavidel-Syooki and Moussavi (1996) proposed a Late Frasnian-Late Famennian age. Conodont studies (Ashouri,1990,1995,1997,2002&2004;Yazdi, 1996 & 1999; Gholamalian,2002) also indicated a Late Frasnian-Late Famennian age. Cephalopod faunas considered by Yamini (1996) and Becker *et. al(*2004) represent Late Frasnian-Late Famennian time. A brachiopod study (Rastkar, 1996) indicates a Middle Frasnian-Late Famennian age. In this study, the following three areas have been investigated:

1-Howz-e-Dorah area

Cephalopods of this area (Fig. 3) mainly include nautiloids. Only one goniatite specimen has been obtained. The following fossils were collected from the area: *Mooreoceras* sp., *Ormoceras* sp., Polyelasmoceratidae indet., Brevicoceratidae indet. and *Falcitornoceras* sp.

2-Niaz area

Lithologically, the unit comprises iron oolitic limestones and alternations of shales and sandy limestones with minor sandstone beds. These are exposed as disconnected outcrops at the western foot of the Shotori Range (Fig. 4).

The succession yielded abundant cephalopods comprising ammonoids and nautiloids. The marly limestone has a thickness of about 10-cm and consists of abundant juveniles of ammonoids. The following species have been found:

Manticoceras cf. *intumescens*, *Manticoceras* cf. *cordatum*, *Manticoceras* sp. 2, *Prionocras sulcatum, Pr. divisum*, *Platyclymenia* (*P.*) *intracostata*, *P.* (*P.*) *ruedemani*, *P.*(*P.*)cf. *intracostata*, *P.* (*P.*) spp., *Maeneceras descendens*, *M.* aff. *descendens*, *M.* aff. *biferum*, *Iranoceras pingue*, *Sporadoceras angustisellatum*, *S.* sp., *I. pachydiscus*, *I. sphaericum*, *I.* cf. *pachydiscus*, *I.* cf. *sphaericum*, *I.* sp., *Gonioclymenia* sp., *Cyrtoclymenia* sp., *Cheiloceras* sp., *Tornoceras* cf. *contractum*, *Michelinoceras* sp., *Sycoceras* sp.,*Macroloxoceras* sp. and Polyelasmoceratidae indet.

3- Hurmuk and Pusha area

In this area, the "Cephalopod Beds" is widely distributed. Because of being part of a thrust zone, the stratigraphy is highly complicated. The succession formed herein as disconnected outcrops in a thrust zone across the western foot of the Shotori Range.

The unit is highly fossiliferous and is dominated by cephalopods. The following specimens have been identified:

Manticoceras cf. *sinuosum*, *Prionoceras sulcatum*, *Tornoceras* sp., *Platyclymenia,* (*P.*) cf. *ruedemanni, P* . (*P.*) cf. *intracostata, P.* (*P.*) spp., *M.* cf. *biferum, Maeneceras* aff.*sedgwicki*,*M.*aff. *biferum*,*M.*cf. *latilobatum*, *Iranoceras pingue*, *I. pachydisucus*, *I. sphaericum, I.* cf. *pachydiscus*, *Cheiloceras* (*Staffites*) *curvispina*, *Michelinoceras* sp., Brevicoceratidae indet. and Actinoceratidae indet.

The faunal composition points to a Frasnian to Late Famennian age of the"Cephalopod Beds". All of the classical German ammonoid Stufen (do I -VI) seem to be present in the condensed interval, although there is not yet clear evidence for typical do VI species.

Microfacies

The "Cephalopod Beds" has 26.5 m thickness in the Howz-e-Dorah area. The whole section contains Fe as Hematite, limonite and to a minor extent as Siderite which is recognized by its brown-red color.

Based on Tucker´s (1991) classification for the ironic rocks, the studied rocks can be referred "ironstone". They were deposited under special tectonic condition usually characterized by a low rate of sedimentation (Young, 1989). Such rocks usually are fossiliferous and they are known as good index for stratigraphy and correlation.

A microfacies study briefly yielded the following results: The lower part of the studied section consists of grainstone with bioclasts of echinoid red algae (coralinacea), echinoid

spines and ostracods. 7.5 m above the base of the sectin, the beds include oolites, anchoid and red algae. Some oolites are completely hematitized and their cores are formed by gastropods and by brachiopod shells and other rock particles. Echinoid plates, trilobites and tentaculite particles are also present. There is no matrix between the particles. Based on Dunham classification (1962) the sediments can be named as grainstone (Fig. 7).

Five meters higher in the succession, beds includes crinoids, ostracods, red algae and concentric oolites. Quartz grains occur as subordinate particles in the upper part and the microfauna is similar as in the lower part; however, limestones have changed from grainstone to packstones (Fig. 8) which may indicate low energy deposition.

Based on the above description, it is concluded that the studied section was deposited in a near-shore, shallow and highly energetic environment. The succession changes towards the upper part to greater depth and to a low energy environment.

Conclusion

The cephalopod fauna of the "Cephalopod Beds" in the Shotori Range, east Iran, indicates a Middle (?) / Upper Frasnian to Upper Famennian age. This is confirmed by conodont (Ashouri, 1990, 1995, 1997, 2002 & 2004; Yazdi, 1996 &1999; Gholamalian 2002), brachiopod (Rastkar, 1996; Becker *et. al* 2004) and cephalopod studies (Yamini, 1996).

The correlation of cephalopod fauna of the studied area with Member A of the Geirood Formation of Central Alborz, North Africa, Europe, Kazakhstan and China indicates similar marine condition at low latitudes.

The microfacies and general sedimentary studies indicates that the unit was deposited in a near – shore, shallow and highly energetic environment.

Acknowledgment

The authors thank the Ferdowsi University of Mashhad, Iran for fieldwork and other logistic support. Also we like to thank late Prof. Michael House (University of Southampton, England) and Prof. Thomas Becker (Wetfälische wilhelws-Universität Münster) for their valuable recommendations.

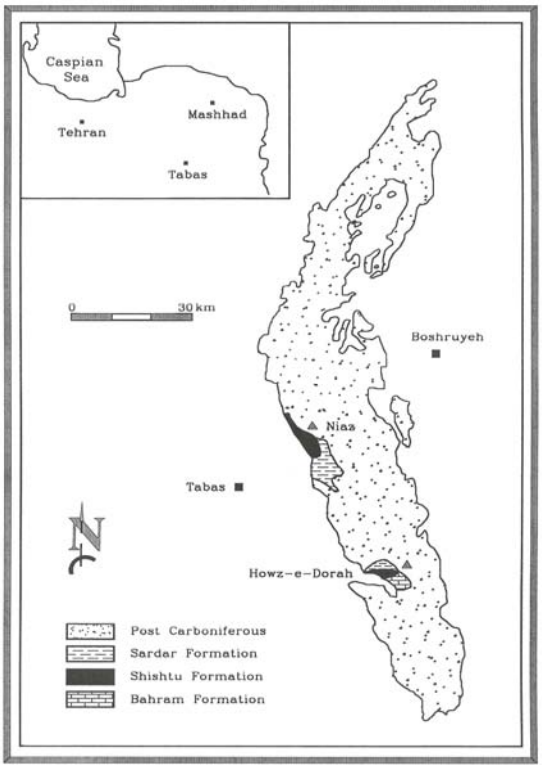


Fig 1-Geological map of the Shotori Range and illustrated area.

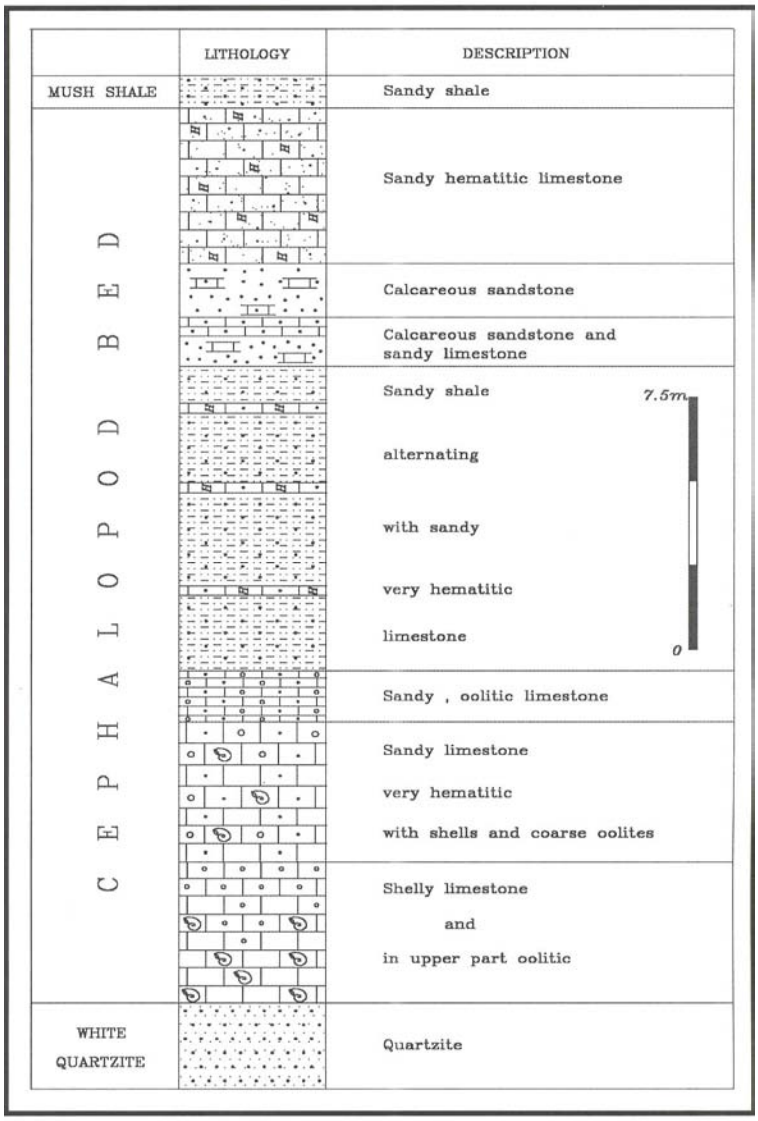


Fig 2- Stratigraphic Section of the Cephalopod Bed in the Howz-e-Dorah

Fig 3- Photograph of the Cephalopod Bed outcrops in the Howz-e-Dorah area

Fig 4- Photograph of the "Cephalopod Beds" outcrops in the Niaz area.

GENUS (SUBGENUS)	STAGE										
	FRASNIAN			FAMENNIAN							
	Early	Middle	Late	doIIα	doIIβ	doIIIα	doIIIβ	doIV	doV	doVI
Manticoceras										
Tornoceras										
Falciornoceras										
Cheiloceras (*Cheiloceras*)										
Cheiloceras (*Staffites*)										
Maeneceras										
Sporadoceras										
Iranoceras							?			
Platyclymenia (*P.*)										
Cyrtoclymenia										
Gonioclymenia										
Prionoceras										

Fig 5- Chart range of the studied genera and subgenera

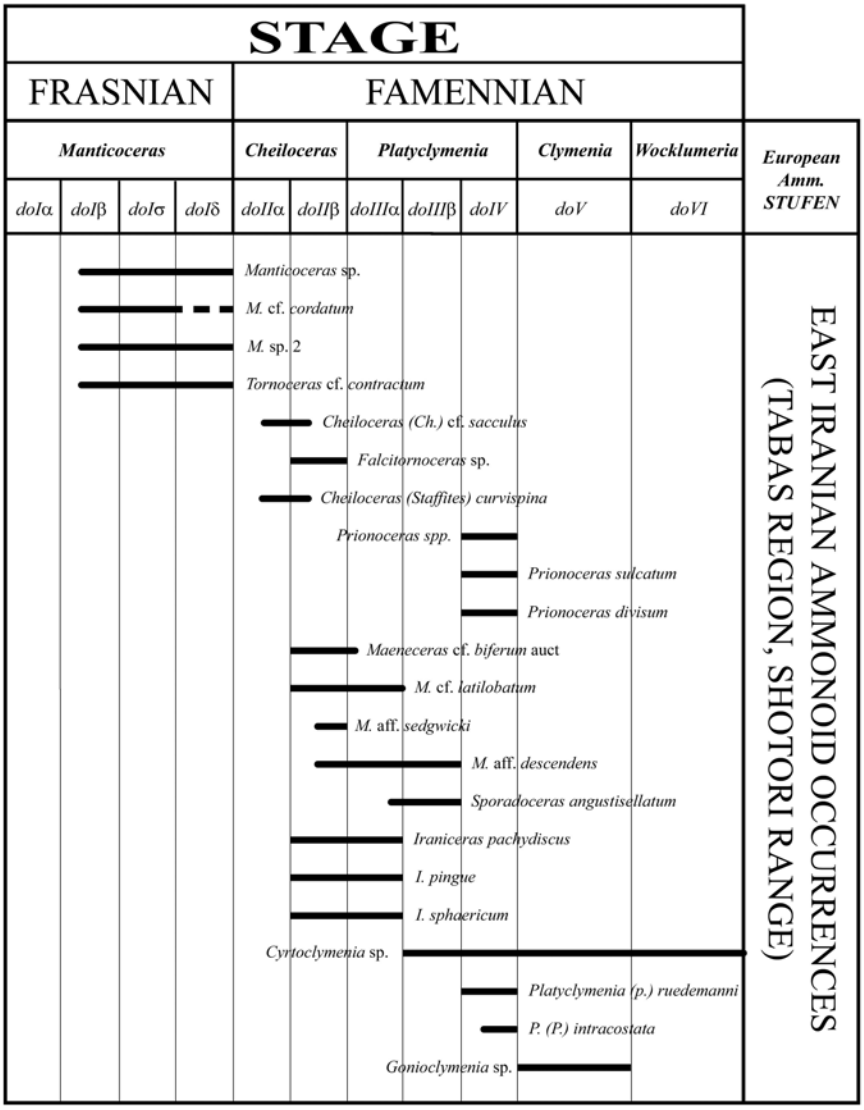


Fig 6- Chart range of the studied species.

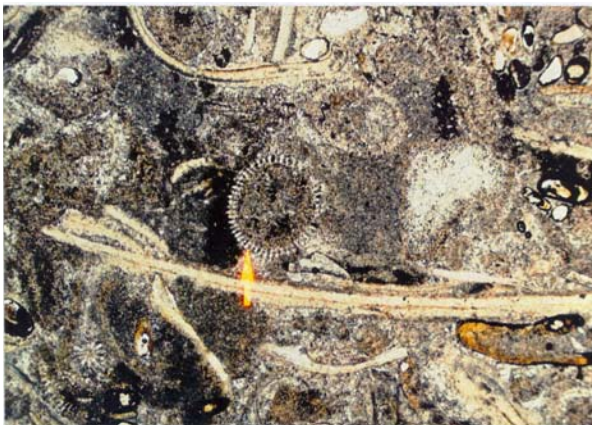


Fig 7- Bioclast grainstaone, with abundant brachiopod shell trilobite remains, bryozoan corallinacean red algae , some ostracod shell, echinoid spine, fragments.

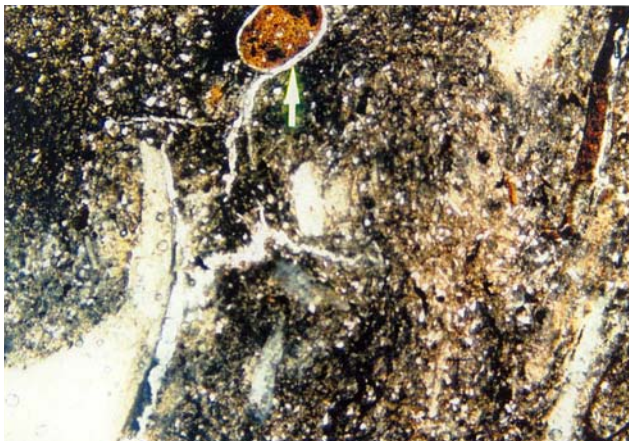
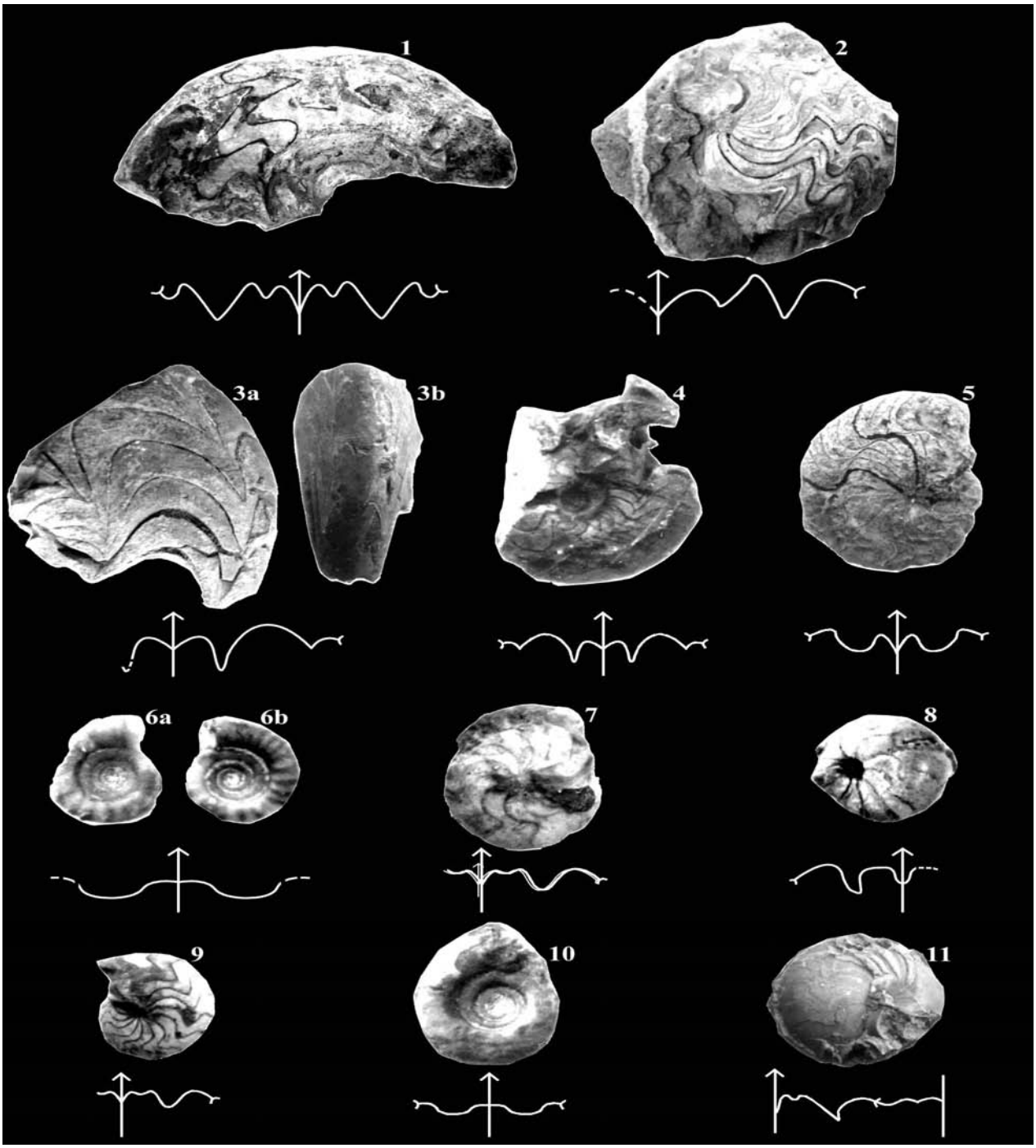


Fig 8- Sandy (brachiopod) bioclast packstone with brachiopod shell and echinoderm fragments. Well sorted and fine grained quartz is dispersed in the micritic matrix.

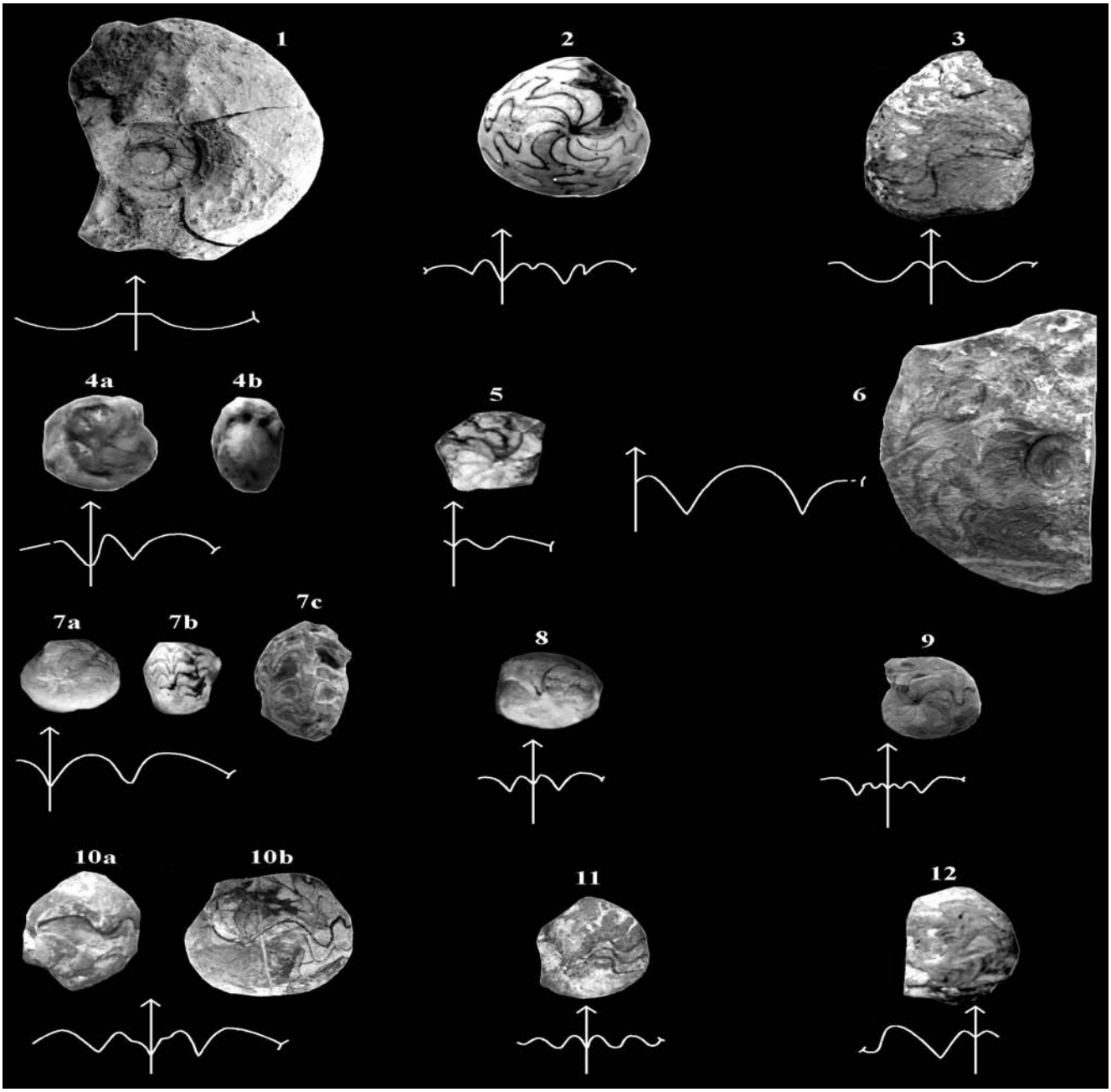
Plate 1



Explanation of Plate 1

Fig 1- Gonioclymenia sp., Lateral view. Niaz area. X1
Fig 2- Maeneceras cf. latilobatum (Schindewolfd), Lateral view. Hormuk area. X0.7
Fig 3- Manticoceras cf. cordatum (Sandberger & Sandberger), Lateral & ventral views. Niaz area. X1
Fig 4- Manticoceras sinuosum (Hall), Lateral view. Hormuk area. X0.8
Fig 5- Tornoceras cf. contractum (Glenister), Lateral view. Niaz area. X0.8
Fig 6-Platyclymenia (P.) spp., Lateral view. Hormuk area. X2.1
Fig 7-Iranoceras sp., Lateral view. Niaz area. X1.7
Fig 8- Cheiloceras (Staffites) curvispina (Sandberger & Sandberger), Lateral view. Hormuk area.X1.6
Fig 9- Iranoceras sphaericum (Walliser), Lateral view. Niaz area. X0.7
Fig10- Platyclymenia (P.) ruedemanni (Wedekind), Lateral view. Hormuk area.X2.1
Fig. 11- Iranoceras pingue (Walliser), Lateral view. Niaz area Xo.7

Plate 2



Explanation of Plate 2

Fig 1- Cyrtoclymenia sp., Lateral view. Niaz area. Xo.8
Fig 2- Sporadoceras angustisellatum (Wedekind), Lateral view. Niaz area. X1.4
Fig 3- Tornoceras cf. contractum (Glenister), Lateral view. Hormuk area. X1.3
Figs. 4. Prionoceras sulcatum (Münster), Lateral view. Niaz area. X2.
Fig 5- Cheiloceras (Ch.) cf. sacculus (Sandberger & Sandberger), Lateral Niaz area. X1.2
Fig. 6- Manticoceras sp., Lateral view. Niaz area. X0.7
Fig 7- Prionoceras cf. sulcatum (Munster), Later and ventral views. Niaz area. X1.1, X1.1 & X0.7
Fig 8-Mimimitoceras cf. liratum (Schmidt), Lateral view. Niaz area. X1.1
Fig 9- Maeneceras sp., Lateral view. Niaz area, X1.1
Fig 10- Maeneceras descendens (Schmidt), Lateral view. Niaz area. X1.3
Fig11- Falcitornoceras sp., Lateral view. Howz-e-Dorah area. X1.2
Fig.12- Manticoceras sp.2, Lateral view. Niaz area. X1.3

References

Alavi-Naini, M, 1993- Paleozoic Stratigraphy of Iran. *Treatise on the Geology of Iran. 5:* (in Persian). 492 p.

Ashouri, A.R, 1990- Devonian and Carboniferous conodont faunas from Iran.*University of Hull*. (unpublished Ph.D.thesis). 351 p.

Ashouri, A.R, 1995 - Conodonts and Cephalopod Bed and Devonian/Carboniferous boundary in Howz-e-Dorah. *14th Symposium of Geosciences.* Tehran. (in Persian). 68-71 pp.

Ashouri, A.R, 1997- Revision in stratigraphical position of the "Cephalopod Beds" and Devonian Carboniferous boundary and introducing 5 conodont zones in Howz-e-Dorah (East Iran). *Geosciences 6: Geol. Surv. Iran.* (in Persian). 10-17 pp.

Ashouri, A.R, 2002- *Palmatolepis* (conodonta; Late Devonian) from the Tabas region, east Iran. *J. Sciences, 27:* Tehran University.

Ashouri, A.R, 2004 - Late Devonian and Middle-Late Devonian conodonts from eastern and northern Iran. *Revista Espaňola Micropaleontologia, 3:* 355-365.

Becker, R.T., Ashouri, A.R. & Yazdi, M, 2004 - The Upper Devonian annulate event in the Shotori Range of eastern Iran. *N. Jb. Geol. Paläont. Abh. 231(1).*

Dunham, R. J, 1962- Classification of carbonate rocks according to depositional texture. In: *Classification of carbonate rocks*. (Ham, W. E., ed.), AAPG. Mem. 108-121 pp.

Ghavidel-Syooki, M.& Moussavi, M.J,1996- Palynostratigraphy and paleogeography study of Padeha, Bahram, Shishtu (1&2) and Sardar Formations in the Howz-e-Dorah (east of Tabas). *First Geological Congress of Iranian Universities, Kerman*. (in Persian). 45-46 pp.

Gholamalian, H, 2002- Biostratigraphy of Frasnian/Famennian Boundary in Esfahan & Tabas Areas. *Ph.D thesis. Esfahan University.*

Moussavi, M. J, 1995- Palynostratigraphy and paleobiogeography of Padeha, Shishtu and Sardar Formations in Howz-e-Dorah (East of Tabas). *M. Sc. thesis. Tarbiat Moallem University*. (in Persian). 244p.

Rastkar, G, 1996- Brachiopods and stratigraphical position of Cephalopod Bed of Shishtu Formation, Shotori Range. *M.Sc. Thesis, Mashhad University*. (in Persian). 124 p.

Ruttner, A. & Stöcklin, J.,1966- Foreword. In: Contribution to the paleontology. *Geol. Surv. Iran, 6:* 2-5 pp. of East Iran. Geol.

Stepanov, D. L, 1967- Carboniferous stratigraphy of Iran. *Geol. Surv. Iran, Library report.* (unpublished).

Stepanov, D. L, 1971- Carboniferous stratigraphy of Iran. *C. F. Ceme Congr. Strat. Carbon., 4:* Maestricht. 1505-1518 pp.

Stöcklin, J., Eftekharnejad, J. & Hushmand- Zadeh, A, 1965 - Geology of the Shotori Range (Tabas area, East Iran). *Geol. Surv. Iran, 3:* 69 p.

Walliser, O. H, 1966 - Preliminary notes on Devonian-Lower and Upper Carboniferous goniatites in Iran. In: *Contributions to the paleontology of East Iran. Geol. Surv. Iran. 6:* 7-24 p.

Tucker, M. E, 1991- Sedimentary petrology. An introduction to the origin of sedimentary rocks. *Blackwell Scientific Publication*. London. 260 p.

Yamini, A, 1996 - Cephalopod and stratigraphical position of Cephalopod Bed of Shishtu Formation, Shotori Range *M.Sc. thesis, Ferdowsi University of Mashhad*. (in Persian). 113 pp.

Yazdi, M., 1996 -Late Devonian-Carboniferous Conodont biostratigraphy of theTabas area, Eastern Iran. *Ph. D. thesis, Macquarie University*. Sydney.

Yazdi M, 1999 - Late-Devonian-Carboniferous conodonts from Eastern Iran. *Rivista Italiana di Paleontologica e Stratigrafia. 103:* 167-200.

Young, T. P, 1989 -Phanerozoic ironstones: an introduction and review. In*: Phanerozoic ironstones* (Young, T. P. & Taylor, W. E. G.. eds.). *Geol. Soc. London Special Publication 46:* IX-XXV pp.

*دانشگاه فردوسی مشهد، مشهد، ایران

* Ferdowsi University of Mashhad, Mashhad, Iran