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# Carboniferous Ammonoids from Anarak (Central Iran)

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2 Text-Figures and 1 Plate

*Iran*
*Carboniferous*
*Ammonoids*
*Goniatites*
*Biostratigraphy*
*Biogeography*

## Contents



## Karbon-Ammoniten aus Anarak (Zentraliran)

### Zusammenfassung

Goniatiten aus roten Knollenkalksteinen des Gebietes von Anarak, Zentral-Iran, können bestimmt werden als *Beyrichoceras* sp. (Unter- oder Ober-Visé), *Neogoniatites* sp. und *Dombarites liratus* RUZHENCEV & BOGOSLOVSKAYA 1971 (beide von der Visé/Namur-Grenze) sowie *Proshumarditesdelepinei* SCHINDEWOLF 1939, *Glaphyrites anarakensis* n. sp. und *Schartymites* cf. *aravanensis* RUZHENCEV & BOGOSLOVSKAYA 1978 (Mittel- bis Ober-Namur). Die Namur-Faunen zeigen enge Beziehungen zu Faunen aus dem Südural und Zentral-Asien.

### Abstract

Goniatites from red nodular limestones of the Anarak area, central Iran are identified as *Beyrichoceras* sp. (Early or Late Viséan), *Neogoniatites* sp. and *Dombarites liratus* RUZHENCEV & BOGOSLOVSKAYA 1971 (both from the Viséan-Namurian Boundary), and *Proshumardites delepinei* SCHINDEWOLF 1939, *Glaphyrites anarakensis* sp. nov., and *Schartymites* cf. *aravanensis* RUZHENCEV & BOGOSLOVSKAYA 1978 (middle to late Namurian). The Namurian faunas show close relations to those known from the South Urals and Central Asia.

## 1. Introduction

Reports of Palaeozoic ammonoids from Iran and adjacent countries are very rare. An intensively studied section, the Kuh-e-Ali Bashi locality, lies in the vicinity of the famous Permian/Triassic Boundary localities at Dzulfa, Araxes River Gorge, near the frontier between Iran and Azerbaidzhan (STEPANOV, GOLSHANI & STÖCKLIN, 1969; TOZER, 1979). Faunal lists, based on determinations provided by V.E. RUZHENCEV for the report of STEPANOV et al. (1969) included latest Permian genera: *Pseudogastrioceras, Cyclolobus, Xenodiscus, Paratirolites, Araxoceras, Vescotoceras, Avushoceras*, and *Vedioceras*. STEPANOV et al. (1969) also described sections near Nesen and Amol in the Alborz Mountains; from the latter locality FREST, GLENISTER & FURNISH (1981) described the Dzulfian (Late Permian) prionoceratid *Neoaganides nesenensis*.

Early Late Permian ammonoids are known from Beyerah, Kurdistan, NE Iraq (VASICEK & KULLMANN, 1988; VASICEK, 1988); this fauna consists of the genera *Agathiceras, Altudoceras, Kurdiceras, Stacheoceras, Tauroceras, Sosiocrimites, Palermites, Sizilites, Aricoceras, Daraelites, Sicanites, Propinacoceras*,

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and *Neogeoceras*. From the Bamyan Mountains, Hindu Kush, Afghanistan, TERMIER & TERMIER (1970) described an Artinskian (Early Permian) fauna consisting of the genera *Agathiceras, Perrinites, Prostacheoceras*, and *Bamyaniceras*.

Devonian and Carboniferous ammonoids from South Asia are less well known. WALLISER (1966) documented Devonian and Late Carboniferous ammonoids from the Shotori Range and Early Carboniferous goniatites from Ozbak-kuh, Tabas area, east Iran (see STÖCKLIN, EFTEKHAR-NETHAD & HUSHMAND-ZADEH, 1965 for locality details). The well preserved faunas were collected from Frasnian (*Manticoceras*), mid-Famennian (*Platyclymenia, Prionoceras, Maeneceras, Iranoceras*, and possibly *Praeglyphioceras*), late Tournaisian or earliest Viséan (*Muensteroceras, Eurites*, and *Merocanites*), and basal Westphalian (*Brannerоceras*) rocks. Unfortunately, isolated occurrences of Early Carboniferous goniatites (WALLISER, 1966) cannot be attributed to measured sections, thus reducing their biostratigraphical value.

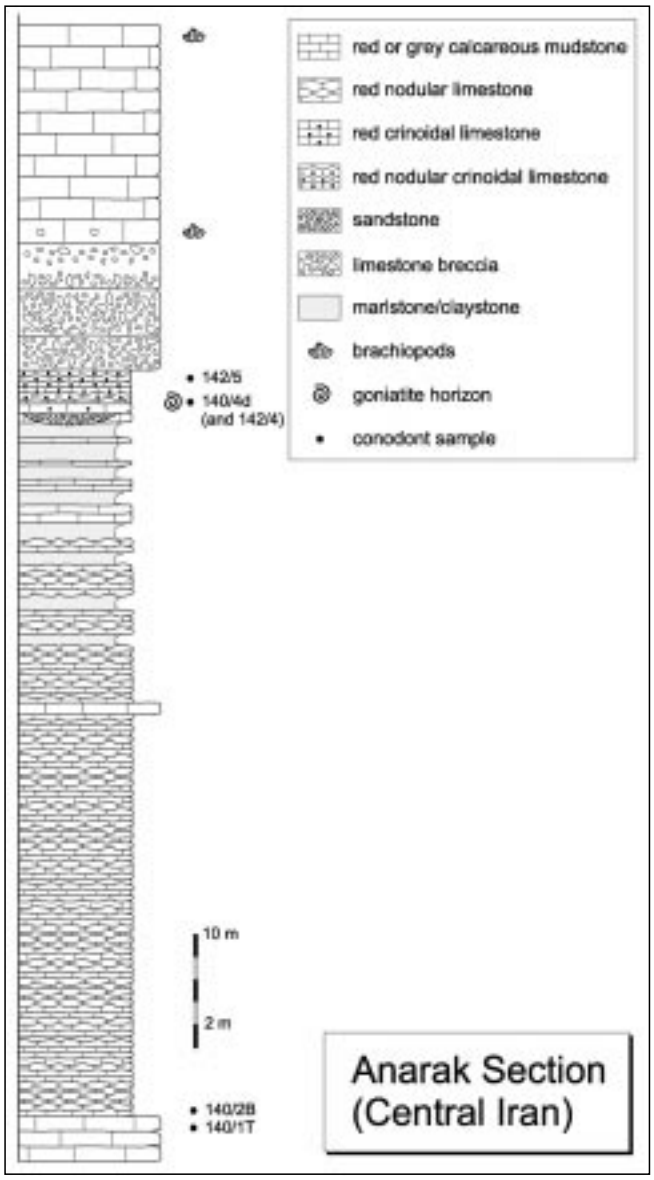
Marine Carboniferous deposits are widely distributed in Iran and appear to have developed without obvious lithological breaks above late Devonian neritic carbonates and shales (HUCKRIEDE et al., 1962; DAVOUDZHADEH & WEBER-DIEFENBACH, 1987; WENDT et al., 1997). Lithostratigraphically these strata are included in the upper Shishtu (Shishtu 2) and lower Sardar (Sardar 1) formations (STÖCKLIN, 1972; WEDDIGE, 1984) within which, however, precise zonal division has not been achieved. Conodont recovery from these deposits is poor, and macrofossils, including brachiopods, give only approximate age attributions. YAZDI (1995 and in press), however, has reported goniatites from a horizon in the Sadar Formation at Howz-e-Dorah, dated by conodonts as *sinuatus-corrugatus-sulcatus* Zone.

SAHARKOVSKI, SUSOV & KRIVYAKIN (1984), in their description of the geology of the Anarak Area, central Iran, mentioned *Glaphyrites* sp. from the Carboniferous Shishtu Formation (brownish-red argillaceous limestone with marl intercalations). The small Carboniferous ammonoid fauna described below was collected from this locality by AKB, BK and JW. As it is the first Namurian ammonoid fauna from Iran documented from the eastern realm of North Gondwana, it is important for palaeobiogeographical interpretations. Faunas with *Neogoniatites*, *Dombarites*, *Proshumardites*, *Glaphyrites*, and *Schartymites* are known from many places, e.g. the American Midcontinent, the Cantabrian Mountains, North Africa, South Urals, Central Asia and Southwest China, but the genera are completely missing in faunas of the northern Variscan Realm.

## 2. Locality Details and Geological Setting

The tectonically highly complicated Anarak area in central Iran has attracted geologists and geophysicists since the 1960's because of the juxtaposition of "geosynclinal" metamorphosed rocks of presumed Devonian–Carboniferous age (DAVOUDZHADEH et al., 1981; DAVOUDZHADEH & WEBER-DIEFENBACH, 1987) and coeval unmetamorphosed neritic deposits. This contrast has been explained by major crustal movements associated with basaltic and ultrabasic volcanism defining the boundary of the East-Central-Iranian Microplate (DAVOUDZHADEH et al., 1981; SOFFEL et al., 1996), an entity subjected to a 135° anticlockwise rotation since the Triassic. According to this interpretation, the study area is situated at the present north-western margin of this microplate.

The section described below is located close to the northern end of an unnamed N–S tending mountain range




Text-Fig. 1.
The Anarak section and the position of the goniatite-bearing horizons.

southwest of Kuh-e-Lakh about 22 km southwest of Anarak township (sheet 6756 Anarak, 1 : 100.000; co-ordinates: N 33° 10,587', E 53° 52,452'). A several hundred metre sequence of unmetamorphosed Ordovician to Carboniferous rocks is exposed northwest of a 1625 m high peak; it has been described in detail by SAHARKOVSKI et al. (1984).

Most of the sequence is Devonian in age with the upper horizons dated partly as late Frasnian on the basis of tentaculites and conodonts. The sequence consists principally three units: red siliciclastic Padeha Formation with intercalated basic volcanics at the base giving way to the dolomitic Sibzar Formation capped by the calcareous Bahram Formation. The presence of Famennian equivalents of the upper Bahram/lower Shishtu Formation mentioned by SHARKOVSKI et al. (1984) has not been confirmed by us. The topmost portion of this section (Fig. x) is locally affected by several minor faults which cut out the top of the Bahram Formation, but in some places the boundary between the latter and the overlying red limestones of what is thought to be the Shishtu Formation is undisturbed, showing a sharp depositional contact. The sequence consists of about 60 m of red marly nodular lime-

stones with the topmost portion consisting of more marly, nodular limestones with some solitary rugose corals, *Pleurodictyum* and crinoid fragments. A few metres below the top of this sequence is a channel (up to 1 m thick and 3 m wide) filled with coarse quartz-sandstone. The 0.2 m thick goniatite-bearing level occurs 2.0 to 2.5 m below the top of the red nodular limestones and can be followed along strike for about 500 m. Goniatites are rather rare and were found by us in only one level of three easily correlatable sections. Because of the different ages of the goniatites (see systematic section), this level appears to be condensed or allochthonous. It is possible, however, that the goniatites come from two or more different layers which, because of the scarcity of index fossils, cannot be discriminated in the field.

Red nodular limestones are conformably overlain by a cliff-forming, coarse and poorly sorted limestone breccia which in turn passes into grey thick-bedded calcareous mudstones with brachiopods, bryozoans and indeterminate shell remains forming the top of the peak. According to the brachiopod data from SHARKOVSKI et al. (1984) they are of Early Carboniferous (Viséan–Namurian) age. A conodont sample from the base of the breccia has yielded a fauna of Viséan age (det. M. YAZDI, Isfahan).

## 3. Material, Description, Biostratigraphical Interpretation

### *Beyrichoceras* sp.

(Pl. 1, Fig. 1; Text-Fig. 2A)

Material: One slightly distorted phragmocone of 80 mm diameter (GPIT 1852-1) and one fragment of a smaller specimen (GPIT 1852-2). Both are from red marly limestone (sample 141, surface collected); no shell material is preserved. The larger specimen is discoidal in shape and has an almost closed umbilicus. The suture line is typical for *Beyrichoceras*, with a very narrow and slightly pouched external lobe with subparallel flanks. The median saddle is relatively low, only 0.37 of the ventrolateral saddle, and the adventive lobe is V-shaped and asymmetric.

Stratigraphical occurrence: *Beyrichoceras* is known from the late Early Viséan and early Late Viséan of various regions, but is most frequent in the British Isles and the Rhenish Massif.

### *Neogoniatites* sp.

(Pl. 1, Fig. 7)

Material: One slightly distorted fragment of a conch, originally 60 mm diameter (GPIT 1852-3), from sample 125/28. The ornament is not preserved, and the conch shape cannot be reconstructed. The suture line is typical for *Neogoniatites*, with a rather wide external lobe, a high median saddle, and a narrowly rounded ventrolateral saddle.

Stratigraphical occurrence: *Neogoniatites* occurs in the Nm1a1 Nm1b1 Zones (latest Viséan and earliest Namurian) of the South Urals and its time equivalents in the American Midcontinent.

### *Dombarites liratus* RUZHENCEV & BOGOSLOVSKAYA 1971

(Pl. 1, Fig. 2, 3; Text-Fig. 2B)

Material: Two fragmentary specimens from red marly nodular limestone of sample 125/28 are available for study. They range in the size from 45 to 70 mm in diameter, but it cannot be stated with certainty if they are conspecific. Both show involute conchs (uw/dm = 0.10) as well as remains of the suture line; the larger one (GPIT 1852-5) displays ornament on the venter consisting of coarse, spiral lines, spaced at distances of 0.5 to 1.0 mm, and much finer growth lines which cause a granulation when running over the spirals.

The smaller specimen (GPIT 1852-4) allows study of the suture line, which has the typical outline of the genus *Dombarites*. The external lobe is moderately wide (width measured at half of its depth is 0.70), and the median saddle moderately high (0.62 of ventrolateral saddle). The ventrolateral saddle is subacute, and the flanks of the adventive lobe possess angular incisions. In outline and measurable parameters, the suture line of this specimen closely resembles that of *Dombarites falcatoides* RUZHENCEV & BOGOSLOVSKAYA 1970 and *Dombarites liratus* RUZHENCEV & BOGOSLOVSKAYA 1971. The other species of *Dombarites* described by RUZHENCEV & BOGOSLOVSKAYA (1971) have either a lower median saddle (*D. parafalcatoides*), or a higher median saddle. *D. falcatoides* has a wider umbilicus and wider conch than the Iranian specimens, but *D. liratus* closely resembles them.

Two other specimens of 25 mm and 75 mm diameter respectively (GPIT 1852-6 and 1852-7) are available from sample 142/4, but their poor preservation does not allow exact specific interpretation.

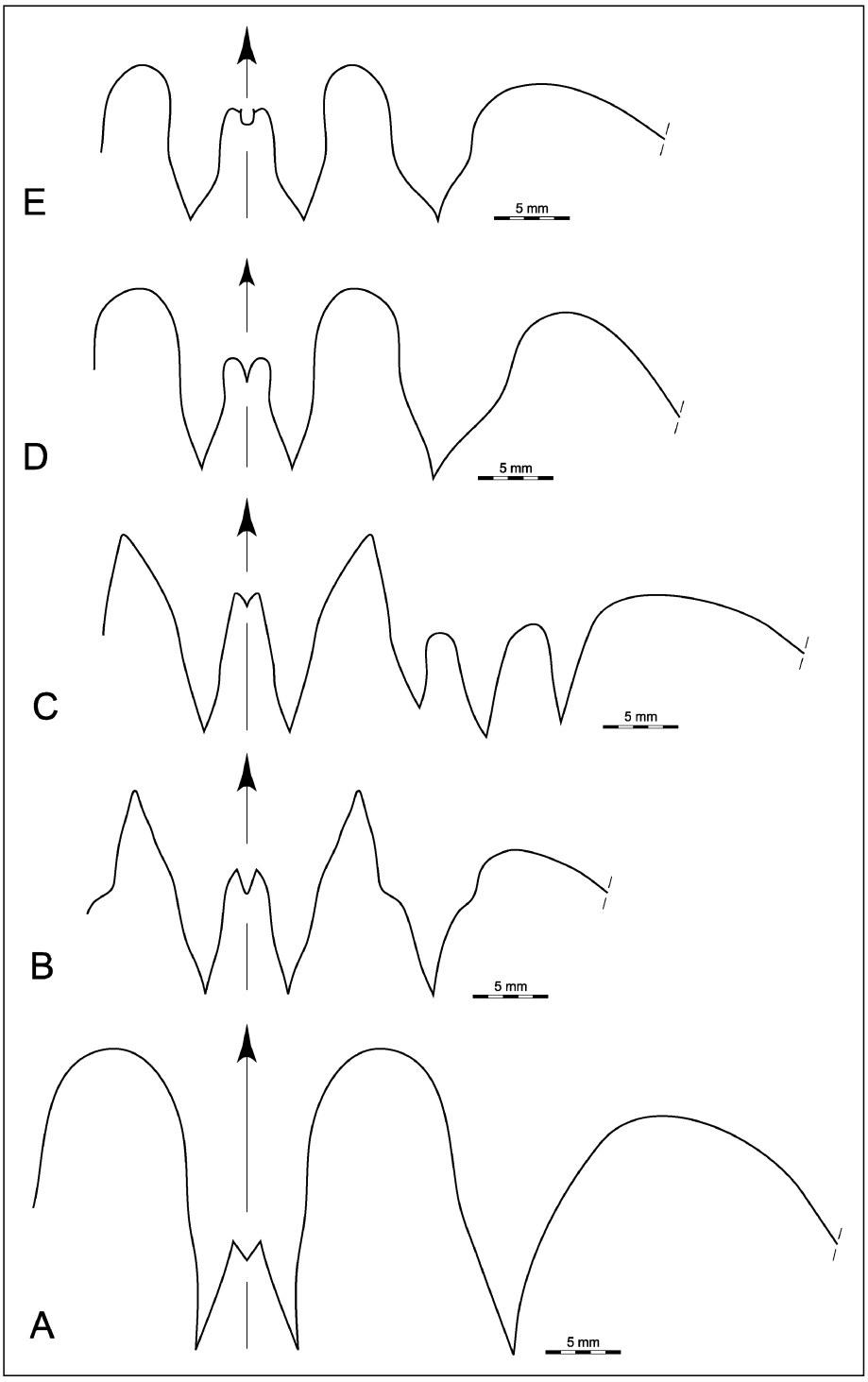
Stratigraphical and geographical distribution: *Dombarites liratus* is the most frequently occurring goniatite species in the Nm1b1 Zone of the South Urals (districts Orenburg of Russia, and Aktyubinsk of Kazakhstan, RUZHENCEV & BOGOSLOVSKAYA 1971: 60); this zone can be correlated with the base of the Central European Namurian Stage (KORN 1996).

### *Proshumardites delepinei* SCHINDEWOLF 1939

(Pl. 1, Fig. 4, 5; Text-Fig. 2C)

Material: Four specimens between 45 and 70 mm in diameter from sample 142/4 (GPIT 1852-8-11), and three specimens between 24 and 60 mm in diameter from sample 140/4d (GPIT 1852-12-14). All individuals are somewhat distorted and preserved only as fragment; they are septate conchs without body chambers, and the phragmocones are eroded. The smallest specimen (GPIT 1852-12) has, at 24 mm diameter, an almost closed umbilicus and a thickness of 16.5 mm; it is strongly weathered but displays a steinkern constriction that runs almost linearly over flanks and venter. The larger specimens suggest that the conch parameters and ratios have not been changed until 70 mm conch diameter. The suture line of specimen GPIT 1852-8 belongs to a corroded specimen and thus has lost finer details; in general outline, however, it resembles the suture line of Uralian specimens figured by RUZHENCEV & BOGOSLOVSKAYA (1971: 241) with its high median saddle and trident adventive lobe.

Stratigraphical and geographical distribution: In localities of the South Urals, this species occurs rather frequently in the Nm1c2 Zone and Nm2a2 Zone. Co-occurrence with species of the genus *Dombarites* is not known. *Proshumardites delepinei* has a wide geographical distribution. It is known from North Africa (Algeria), Spain (Cantabrian Mountains), the South Urals (districts Orenburg and Baschkir of Russia and Aktyubinsk of Kazakhstan), Novaya Zemlya, and Central




Text-Fig. 2.
Suture lines of ammonoids from 22 km southwest of Anarak (central Iran).
A) *Beyrichoceras* sp.; specimen GPIT 1852-1; sample 141; × 2 (at dm 68 mm, wh 33.5 mm).
B) *Dombarites liratus* RUZHENCEV & BOGOSLOVSKAYA 1971; specimen GPIT 1852-4, sample 125/28; × 2 (at ww ca. 26 mm, wh ca. 21 mm).
C) *Proshumardites delepinei* SCHINDEWOLF 1939; specimen GPIT 1852-8, sample 142-4; × 2 (at wh ca. 32 mm).
D) *Glaphyrites anarakensis* KORN sp. nov.; holotype GPIT 1852-15, sample 140/4d; × 2 (at dm 54 mm, ww 40 mm, wh ca. 25.5 mm).
E) *Schartymites* cf. *aravanensis* RUZHENCEV & BOGOSLOVSKAYA 1978; specimen GPIT 1852-21, sample 125/28; × 2 (at ww ca. 18 mm, wh 21 mm).

Asia (Gissar Mountain Chain and Surkandarinsk region of Uzbekistan).

### *Glaphyrites anarakensis* KORN sp. nov.

(Pl. 1, Fig. 6; Text-Fig. 2D)

Derivation of name: After the Anarak region, from which the material was collected.

Holotype: Specimen GPIT 1852-15, figured in Pl. 1, Fig. 6.

Type locality and horizon: 22 km southwest of Anarak (central Iran), sample 140/4d; probably middle Namurian age (Nm1c2 Zone or Nm2a2 Zone of RUZHENCEV & BOGOSLOVSKAYA [1971]).

Type Material: Six specimens (GPIT 1852-15 to 1852-20) from the type locality, of which only two are almost complete. All are similar in size, and are slightly distorted phragmocones of specimens with approximately 55 mm conch diameter. None of the specimens displays shell ornament, but the conch form as well as the suture line can be studied.

Species diagnosis: A species of *Glaphyrites* with large, pachyconic conch (ww/dm = 0.70 to 0.75). Umbilicus narrow in early growth stages (uw/dm = 0.25), umbilical margin rounded. Whorl expansion rate low (1.70). Suture line with high median saddle (MS/h = 0.60), broadly rounded ventrolateral saddle, and narrow external lobe (EL/h = 0.75) with parallel flanks and lanceolate prongs. adventive lobe symmetric, mammiform with slightly sinuous flanks.

Conch form: The holotype is slightly distorted but allows description of the conch form. At 55 mm diameter, it is pachyconic with an umbilicus that has one fourth of the diameter. It is thickest at the rounded umbilical margin, and the umbilical wall is steep. The aperture is low, and hence the whorl expansion rate has only a value of 1.68.

Dimensions in mm and ratios:

| | dm | ww | wh | uw | ah | WER | ww/dm | ww/wh | u/d |
|---|---|---|---|---|---|---|---|---|---|
| holotype GPIT 1852-15 | 54.5 | 40.0 | 25.5 | 13.6 | 12.6 | 1.68 | 0.72 | 1.57 | 0.25 |

Ornamentation: None of the specimens has shell ornament preserved, and the internal moulds seem to bear no constrictions.

Suture line: The suture line of the holotype is characteristic for stratigraphically older species of the genus *Glaphyrites*. Its external lobe has parallel flanks, and also its prongs are symmetric and lanceolate. The broadly

rounded ventrolateral saddle and the mammiform adventive lobe are symmetric.

Comparisons: *Glaphyrites anarakensis* sp. nov. belongs to the narrowly umbilicate species of the genus, and hence can be separated from most of the other species. A similar species, *Gl. consuetus* POPOV & KUSINA 1993, is known from a single specimen from Novaya Zemlya, but this has a higher aperture and thus more prominent whorl expansion rate, 2.00, in contrast to 1.68 in *Gl. anarakensis*. Other species with similar conch form are *Gl. uralensis* RUZHENCEV & BOGOSLOVSKAYA 1971, *Gl. solidus* RUZHENCEV & BOGOSLOVSKAYA 1971, *Gl. postsolidus* RUZHENCEV & BOGOSLOVSKAYA 1978, and *Gl. librovitchi* POPOV & KUSINA 1993, but all have an umbilicus wider than one third of the conch diameter.

Stratigraphical and geographical distribution: The new species was found together with *Proshumardites delepinei*, and hence a middle Namurian age (Nm1c2 Zone or Nm2a2 Zone of RUZHENCEV & BOGOSLOVSKAYA [1971]) can be proposed.

### *Schartymites* cf. *aravanensis* RUZHENCEV & BOGOSLOVSKAYA 1978

(Pl. 1, Fig. 8; Text-Fig. 2E)

Material: One specimen of 62 mm (GPIT 1852-21) in diameter from a light-red nodular limestone of sample 125/28. The conch is involute (uw/dm = 0.06), and thickly lenticular (ww/dm = ca. 0.4). Characteristic of the conch is the very low aperture, indicating a whorl expansion rate of 1.55.

The suture line displays a wide external lobe (1.05 of its depth), and a high median saddle (0.72 of the ventrolateral saddle). The prongs of the external lobe are almost symmetric and lanceolate, the ventrolateral saddle is broadly rounded, and the adventive lobe is slightly asymmetric and lanceolate. In conch shape, the Iranian specimen closely resembles *Sch. aravanensis* RUZHENCEV & BOGOSLOVSKAYA 1978, but the suture line shows some differences, e.g. the asymmetric prongs of the external lobe, and the rather V-shaped adventive lobe.

Stratigraphical and geographical distribution: *Schartymites* occurs in the late Namurian Nm2b2 to Nm2c2 Zones of the South Urals (Sakmara River, district Orenburg, Russia) and Central Asia (Aravan River, Fergana, Uzbekistan; see RUZHENCEV & BOGOSLOVSKAYA [1978]).

### *Pronoritidae* indet.

(Pl. 1, Fig. 9)

Material: One poorly preserved phragmocone (GPIT 1852-22), 70 mm in conch diameter from sample 140/4d, does not allow specific determination.

## 4. Biostratigraphical and Biogeographical Implications

The ammonoid species described above are, at least, of three different ages:

- Middle to late Namurian (samples 140/4d and 142/4): *Proshumardites delepinei* SCHINDEWOLF 1939, *Glaphyrites anarakensis* sp. nov., *Schartymites* cf. *aravanensis* RUZHENCEV & BOGOSLOVSKAYA 1978, and Pronoritidae indet.
- Viséan-Namurian boundary (sample 125/28): *Neogoniatites* sp. and *Dombarites liratus* RUZHENCEV & BOGOSLOVSKAYA 1971.
- Early or Late Viséan (sample 141): *Beyrichoceras* sp.

All the Namurian taxa show close relations to faunas described from the South Urals (RUZHENCEV & BOGOSLOVSKAYA, 1971, 1978), Novaya Zemlya (LIBROVICH, POPOV & KUSINA, 1993), Central Asia (NIKOLAEVA, 1994, 1995), and North Africa (PAREYN, 1961), suggesting a close approximation of these pelagic sedimentary basins during this timespan. The assembled faunas, however, are still too small for a detailed biogeographical analysis.

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# Plate 1

Ammonoids from 22 km southwest of Anarak (central Iran).

Fig. 1: *Beyrichoceras* sp.
Specimen GPIT 1852-1.
loc. 141; × 1.

Fig. 2: *Dombarites liratus* RUZHENCEV & BOGOSLOVSKAYA 1971.
Specimen GPIT 1852-5, sample 125/28.
× 1.

Fig. 3: *Dombarites liratus* RUZHENCEV & BOGOSLOVSKAYA 1971.
Specimen GPIT 1852-4, sample 125/28.
× 1.

Fig. 4: *Proshumardites delepinei* SCHINDEWOLF 1939.
Specimen GPIT 1852-8, sample 142-4.
× 1.

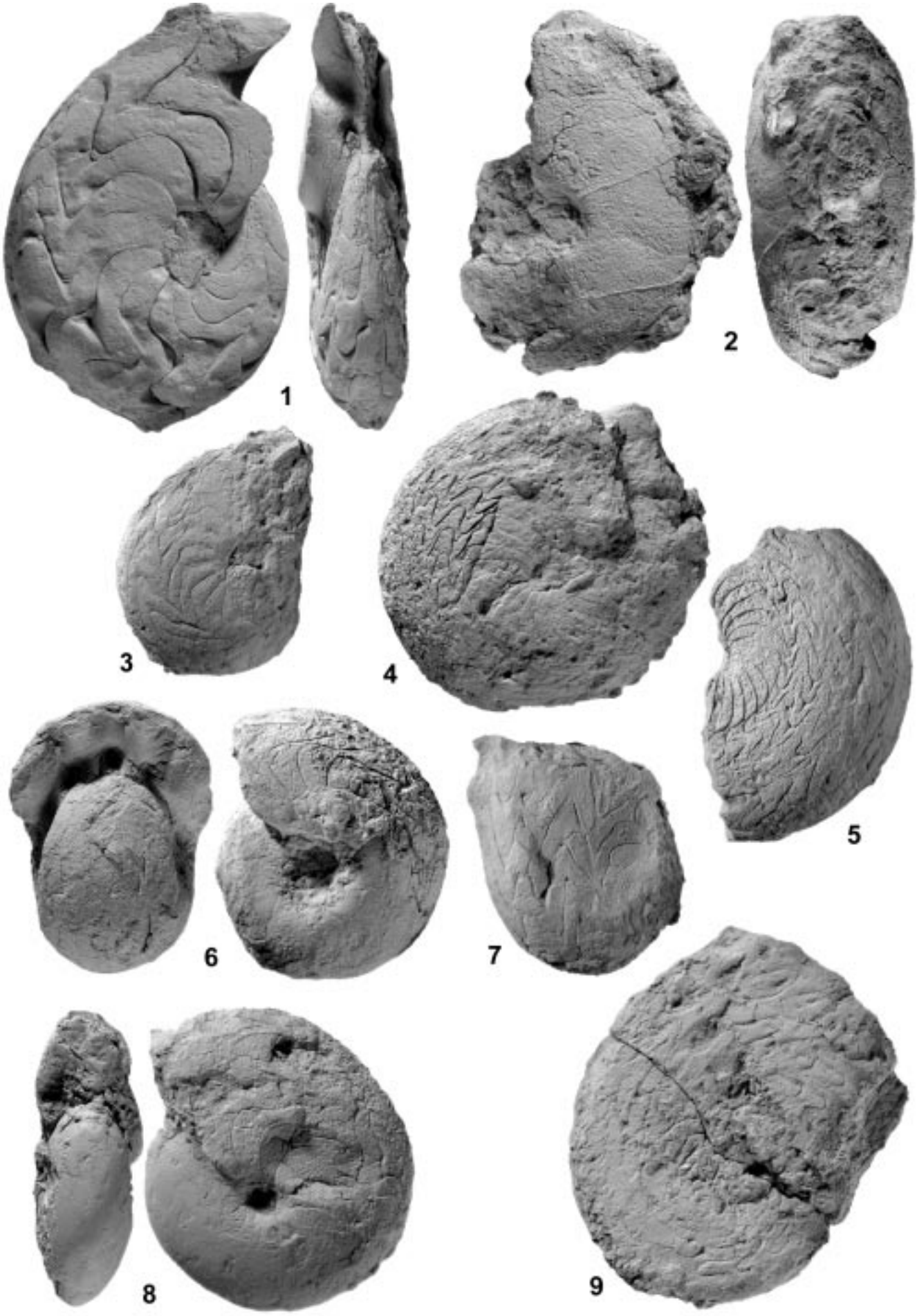
Fig. 5: *Proshumardites delepinei* SCHINDEWOLF 1939.
Specimen GPIT 1852-9, sample 142-4.
× 1.

Fig. 6: *Glaphyrites anarakensis* KORN sp. nov..
holotype GPIT 1852-15, sample 140/4d.
× 1.

Fig. 7: *Neogoniatites* sp..
Specimen GPIT 1852-3, sample 125/28.
× 1.

Fig. 8: *Schartymites* cf. *aravanensis* RUZHENCEV & BOGOSLOVSKAYA 1978.
Specimen GPIT 1852-21, sample 125/28.
× 1.

Fig. 9: Pronoritidae indet.
Specimen GPIT 1852-22, sample 140/4a.
× 1.



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