

THE TRIASSIC OF AGHDARBAND

By: Dr. A. W. Ruttner

تریاس در آق دربند

مقاله انگلیسی زیر که از نظر خوانندگان گرامی می‌گذرد نوشته آقای دکتر روتنر و همکاران است که گویای کار با ارزش نامبرده روی تریاس آق‌دربند می‌باشد. ایشان پس از اتمام مطالعات برای اولین بار چهار سازند:

«سازند آهکی سفید کوه، سازند آهکی نظر کرده، سازند ولکانیکی سپنا و سازند شیلی میانکوهی» را به کمیته ملی چینه‌شناسی ایران معرفی نمودند که کمیته مذکور پس از بررسی‌های لازم و انجام اصلاحاتی سازندهای فوق‌الذکر را به‌عنوان سازندهای رسمی در فرهنگ چینه‌شناسی ایران پذیرفته‌اند. نظر به این که نوشتار حاوی یافته‌های بسیار با ارزشی در مورد «تریاس آق‌دربند» می‌باشد، پس از بازنگری‌های لازم و تنظیم برای فصلنامه، اقدام به چاپ آن شده است. با این امید که مورد قبول و استفاده همکاران گرامی و اساتید فن واقع گردد.

فصلنامه علوم زمین

چکیده

توالی ویژه‌ای از سنگهای تریاس در پنجره فرسایشی آق‌دربند در منتهی‌الیه خاوری کوههای کپه‌داغ که حدود ۱۰۰ کیلومتری خاور- جنوب خاوری مشهد واقع شده است برون‌زد دارند. این توالی دارای شباهت‌های نزدیک و واضحی با سنگهای گروه نخلک در ایران مرکزی می‌باشد و افزون بر آن شباهتهایی نیز با بخش‌های پائینی تریاس در شمال ایران (کوههای البرز) دارد، ولی بطور کلی توالی سنگی تریاس مورد بحث دارای ویژگی‌های خاص خود بوده که نشانگر رسوبگذاری متناوب دریای آق‌دربند می‌باشد.

در این توالی سنگ چهار سازند قابل تشخیص هستند که از پائین به بالا شامل

- سازند آهکی سفید کوه

- سازند آهکی نظر کرده

- سازند آتشفشانی سپنا

- سازند شیلی میانکوهی

این چهار سازند ابتداء به‌عنوان گروه تریاس آق در بند (Ruttner 1991, 1993) معرفی شده بودند، ولی بنابه پیشنهاد کمیته ملی چینه‌شناسی ایران، سازند میانکوهی بدلیل ویژگی‌های آن و احتمال وجود نمونه‌های رسوبگذاری قابل ملاحظه‌ای بین این سازند و سازند سپنا که روی آن قرار دارد و همچنین نمونه‌هایی که در قاعده سازند سپنا به‌چشم می‌خورد، عقلانی به‌نظر رسید که واژه «گروه آق‌دربند» حذف و به‌جای آن به معرفی هر کدام از سازندهای به‌طور جداگانه پرداخته شود. سازند قره‌قیطان که زیر سازند آهکی سفیدکوه قرار گرفته در محل رخنمون کامل است ولی خارج از محدوده این بررسی‌ها است و شیل‌های قلعه‌گیری که در خاور آق‌دربند برون‌زد دارند هنوز در دست مطالعه می‌باشند.



Abstract

A particular sequence of Triassic rocks is exposed in the erosional window of Aghdarband in the easternmost part of the Kopet Dagh (Koppeh Dagh) mountains, 100 kilometers east-southeast of the town Mashhad. It bears obvious relations to special sections of the Naxhlak Group (Central Iran), and it shows also some similarities to lowest parts of Triassic sequences in North-Iran (Alborz Mountains). But on the whole, the Triassic rock sequence in question has an individuality of its own; it is the result of an intermittent sedimentation in a Triassic "Aghdarband Sea".

In this Triassic rock sequence four formations are distinguishable; these are, from base to top:

- the Sefid Kuh Limestone Formation
- the Nazarkadeh Limestone Formation
- the Sina Volcanic Formation
- the Miankuhi Shale Formation.

Originally, these four formations were comprised to a Triassic Aghdarband Group (A. RUTTNER, 1991, 1993). According to the suggestion of the National Iranian Stratigraphy Committee, however, the Miankuhi Formation should better not be included in that Group, because of the probable existence of a considerable gap of sedimentation between this Formation and the top of the underlying Sina Formation. But, since such a gap in sedimentation exists very probably also at the base of the Sina Formation, it seems advisable to abandon the term "Aghdarband Group" altogether and to deal with each of the four formations individually.

The Qara Gheitan Formation below the Sefid Kuh Limestone Formation is more completely exposed at sites outside the Aghdarband area proper. The Ghalch Qabri Shales - exposed far to the east of Aghdarband - await still a closer examination.

Sefid Kuh limestone Formation

References:

A. BAUD, R. BRANDNER and D. DONOFRIO: The Sefid Kuh limestone
— a Late Lower Triassic carbonate ramp (Aghdarband, NE-Iran.)
Abh. Geol. B.-A., vol. 38, p. 125-137, Vienna 1991.

A. RUTTNER, Geology of the Aghdarband Area (Kopet Dagh.)
NE-Iran. - Abh. Geol. B.-A., B.-A., vol. 38, p. 26f, p. 26f, Vienna 1991.

Name: from the mountain Sefid Kuh, 6,6 kilometers WNW of the
mining settlement Aghdarband.

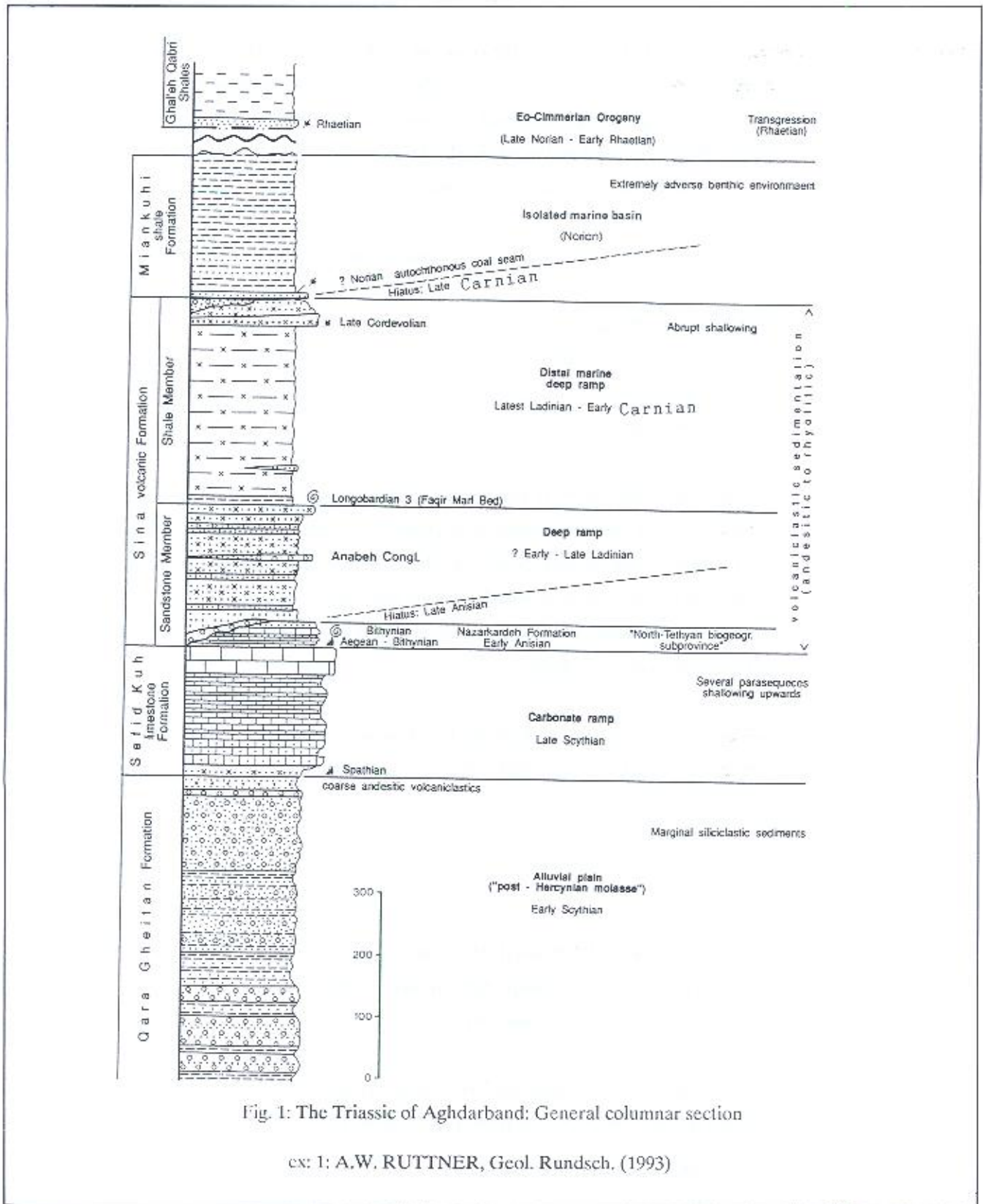


Fig. 1: The Triassic of Aghdarband: General columnar section

ex: 1: A.W. RUTTNER, Geol. Rundsch. (1993)



Thickness: about 200 meters.

Base: with a slight unconformity on a thick sequence of conglomerates, sandstones and shales, brown-red in colour, Late Permian to Early Triassic in age (informal name: Qara Gheitan Formation).

Top: overlain by the base of the Nazarkardeh Formation and the Sina Volcanic Formation respectively.

Type section: Lat.: $36^{\circ}, 00'$; long.: $60^{\circ}, 45'$; Alt.: ca 800m (base of the section); measured at the NW-face of Sefid Kuh by A. BAUD and R. BRANDNER, from base to top:

A about 55 m:

1. dark green to black coarse-grained volcanic litharenite, andesitic in composition, and black conglomerate. 15 m; transition to
2. oolitic limestone (cross-bedded oolitic grainstone), mainly thick-bedded, cliff-forming, light yellow in colour; microgastropods, crinoids, bivalves, ? algal spores, echinoid spines, conodonts.

B about 25 m:

3. platy peloidal and crinoidal packstone, overlain by
4. nodular, highly biotubated calcilitite, i.e. ostracods and brachiopods-bearing crinoidal mudstone to wackestone, interrupted by thin rhythmites of graded crinoidal packstone.

C about 70 m:

5. thinbedded limestone and yellow marl with brachiopods, intercalated between two layers of peloidal-oncoidl thick-bedded packstone to grainstone; foraminifers (*Earlandia* sp., *Nodosaria* sp.), sponge spicules, annelids (*Spirorbis* sp.), overlain by
6. vermicular limestone, interbedded with proximal coarse grained rhythmites, i.e. mainly crinoidal and peloidal packstone with ostracods, Formainifera (*Meandrospira pusilla* (OH), *Cyclogyra mohajeri*



BRONNIMANN, ZANINETTI & BOZORGNIA, *Glomospira* sp.), Annelids (*Spirorbis* *phlyctacna*
DAUDIN, conodonts, and glauconite;
7., 8., 9.: a thinning and deepening upward sequence;
9. highly bioturbated nodular calcilutite.

D about 40 m:

10. very thickbedded to massive, cliff- forming, light colored limestone (algal boundstone, oncoidal, grainstone), in its upper part with large solution cavities (paleokarst) and partial dolomitization; calcareous algae
(*Acicularia* sp.)

Fossils: Generally badly preserved; for biostratigraphic purposes and useful the conodonts:

Neospathodus triangularis (BENDER) 1967

Ellisonia torta SWEET 1970

Ellisonia triassica SWEET 1970

Age: Late Scythian (Spathian).

This sequence of rocks suggests partially a certain similarity to the lower calcareous part of the Elikah Formation as exposed in the Alborz Mountains.

Nazarkardeh Formation (= "fossil horizon 1" at the geological map)

References:

- L.KRYSTYN and F.TATZREITER: Middle Triassic ammonoids from Aghdarband (NE-Iran) and their paleobiogeographical significance.- Abh.Geol.B.-A., vol. 38, p. 139-163, Vienna 1991.
- A. BAUS, G. STAMPFLI and D. STEEN: The Triassic Aghdarband Group: volcanism and geological evolution.- Abh. Geol.B.-A., vol. 38 p. 125-137, Vienna 1991.
- M. SIBLIK: Triassic Brachiopods from Aghdarband.- Abh. Geol.B.-A., vol. 38, p. 165-174, Vienna 1991.
- A. RUTTNER: Geology of the Aghdarband Area (Kopet Dagh, NE-Iran). - Abh. Geol. B. A., vol 38, p. 29-30., Vienna 1991.
- M. DAVOUDZADEH & K. SEYED-EMAMI, Stratigraphy of the Triassic Nakhlak Group, Anarak Region, Central Iran.- Geological Survey of Iran, Report No. 28, p.5-28, Tehran 1972.

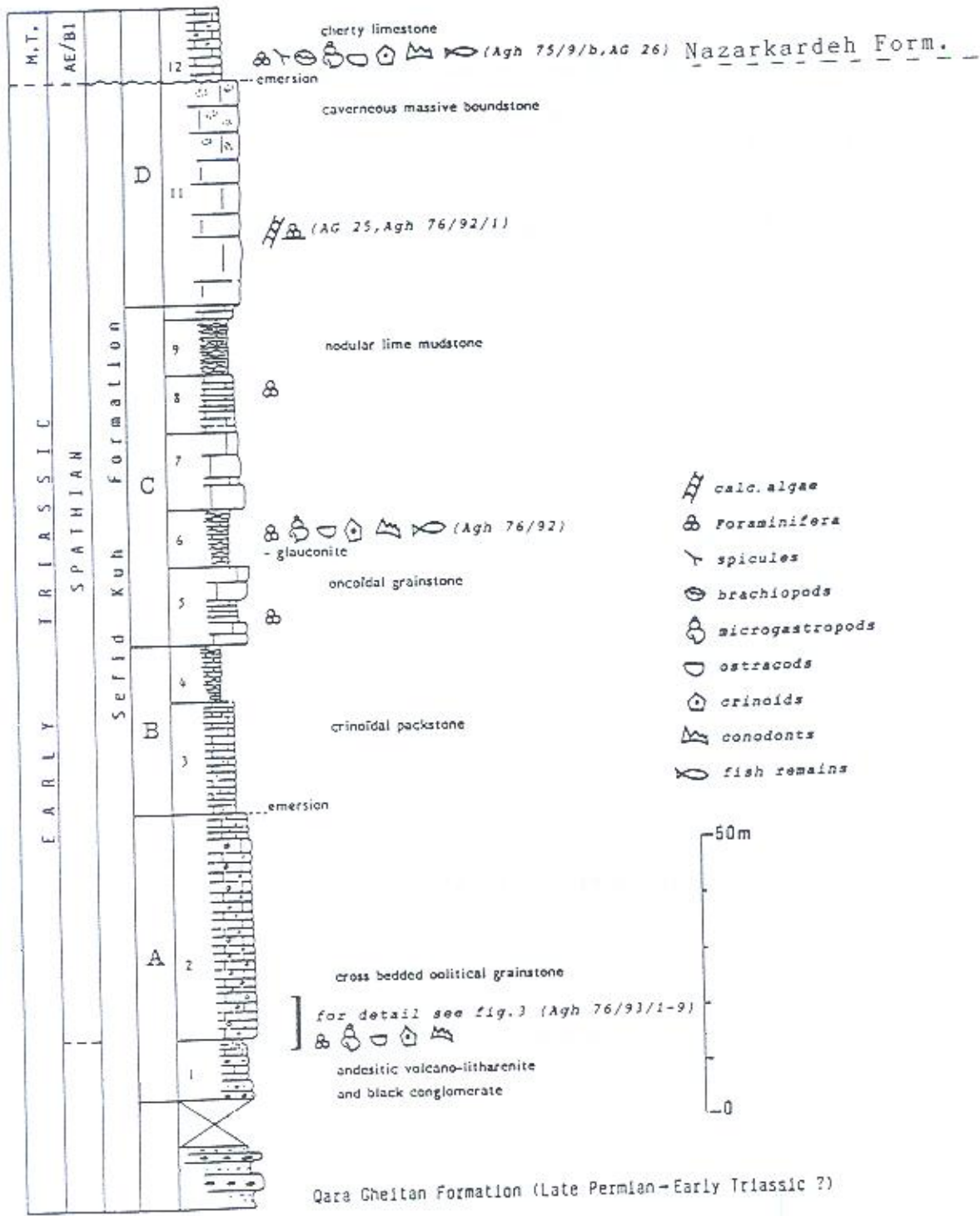


Fig. 2: Type section of the Sefid Kuh Formation
 ex: A. BAUD, R. BRANDNER & D.A. DONEFRIO, (1991)



E.T, TOZER. Trassic Ammonoids and Daonella from the Nakhlak Group, Anarak Region, Central Iran.- Geological Survey of Iran, Report No. 28, p.29-69, Tehran 1972.

Name: from Kuh-e-Nazarkardeh (P. 1328), 1.5 kilometer northwest of the mining settlement Aghdarband; the Formation is well exposed at the southeastern of this dominating summit (see cross - section 3, p1.2 and cross-section C-C', p1.4 respectively, in RUTTNER 1991).

Lat. 35° 59' N; long. 60° 48' E; alt. 1200m (base of formation).

Thickness : 0-50 meters.

Base : overlying the Sefid Kuh Formation.

Top : overlain unconformably by the Sina Volcanic Formation.

Lithology : an alternating sequence of greenish- grey nodular thin-bedded limestone and tuffaceous shale; at the base thin-bedded cherty limestone (see figs. 2 and 3).

Fossils :

1. Basal cherty limestone:

Conodont:

Gondolella bulgarica (BUDUROV & STEFANOV), 1975

2. Nodular limestone:

Cephalopods: "*Nicomedites* fauna", distinctive of the North Tethyan biogeographical subprovince (L.KRYSTYN & F.TATZREITER, p. 143 f.):

Nicomedites osmani TOULA, 1896

Aghdarbandites ismidicus ARTHABER, 1915

Pseudohollandites eurasicus KRYSTYN & TATZREITER, 1991

Procladiscites proponticus TOULA, 1896

Gymnites asseretoi TOZER, 1972



besides of

Gymnites *aghdarbandensis* KRYSSTYN & TATZERITER, 1991

Costigmmites *asiaticus* KRYSSTYN & TATZERITER, 1991

Leiophyllites *suessi* MOJSISOVICS, 1882

Sturia *sansovinii* MOJSISOVICS, 1869

Brachiopods:

Tetractinella *trigonella* SCHLOTHEIM, 1820

Punctospirella aff. *fragilis* SCHLOTHEIM, 1914

Darcithyris *vulgaris* SIBLIK, 1991

Costrhynopsis *rutneri* SIBLIK, 1991

Age: Early Anisian: Aegian: Aegcan/Bithynian with regard to the basal cherty limestone, Bithynian for the main body of the Formation.

Both the lithology and the faunal assemblage of the formation correspond with that of Members 3 and 4 of the Alam Formation, Naxhlak Group (M. DAVOUDZADEH & K. SEYED-EMAMI; E.T. TOZER; 1972).

Sina volcanic Formation

References :

A. RUTTNER, Geology of the Aghdarband Area (Kopet Dagh), NE-Iran. - Abh. Geol. B.-A., vol. 38, p. 30-44), Vienna 1991.

A. BAUD. G.STAMPFLI & D. STEEN: The Triassic Aghdarband Group: volcanism and geological evolution.- Abh. Geol. B.-A., vol. 38, p. 125-137, Vienna 1991.

L.KRYSSTYN & F. TATZREITER: Middle Triassic Ammonoids from Aghdarband (NE-Iran) and their paleobiogeographical significance.- Abh. Geol. B.-A, vol. 38, p.139-163, Vienna, 1991.

M. SIBLIK: Triassic Brachiopods from Aghdarband (NE-Iran).

— Abh. Geol. B.-A., vol. 38, p.165-174.

E. KRISTAN- TOLLMANN: Echinoderms from the Middle Triassic Sina Formation (Aghdarband Group) in NE-Iran. - Abh-Geol B.-A., vol. 38, p.175-194, Vienna 1991.



E. KRTSTAN-TOLLMANN: Ostracods from the Middle Triassic Sina Formation (Aghdarband Group) in NE-Iran. -Abh. Geol. B.- A., vol. 38, p. 195-200, Vienna 1991.

R. OBERHAUSER: Triassic Foraminifera from the Faqir Marl Bed of the Sina Formation (Aghdarband Group, NE-Iran). Abh. Geol. B.-A., vol. 38, p. 201-204, Vienna 1991.

D.A. DONOFRIO: Radiolaria and Porifera (Spica) from the Upper Triassic of Aghdarband (NE-Iran). -Abh. Geol. B. -A., vol. 38, p. 205-222, Vienna 1991.

M. DAVOUDZADEH & K. SEYED- EMAMI, Stratigraphy of the Triassic Nakhlak Group, Anarak Region, Central Iran. - Geological Survey of Iran, Report No. 28, 5- 28, Tehran 1972.

Name : from the main tunnel in the eastern Aghdarband coalfield

Thickness : about 500 - ? 750 meters.

Base : unconformably on the Nazarkardch Formation or on the Sefid Kuh Limestone Formation respectively.

Top : disconformably overlain by the Miankuhi Formation.

Rock : sequence :

Mainly tuffaceous sandstone and shale of andesitic (or trachyandesitic) to trachy-dacitic (even rhyolitic) origin, with intercalations of tuffaceous limestone, marlstone and marl; frequently graded bedding and sole markings on bedding planes. The volcanic influence comes to an end at the top of the formation. An establishment of a representative section through the formation was not possible because of its imbricate structure and its lithological diversity.

The Formation can be divided into two members:

1. Tuffaceous Sandstone Member:

Mainly coarse- to finegrained, well -(cm-dm-) bedded tuffaceous sandstone, mostly grey to bright green in colour, interbedded by varying amounts of shale, calcareous shale and even limestone; at the base of the Member locally a monomictic limestone conglomerate; at the top a dark green coloured hard and massive sandstone ("litharenite", 5-20 meters thick).

Total thickness of the Sandstone Member: 200-300 meters.

Anabeh Conglomerate : an interlayer exposed in the southeastern part of the Aghdarband region ("Slice III"), a few



meters thick, the composition of which (felsic metamorphic fragments, chert, granophyre, abundant quartz and bioclastic limestone, acid volcanic rocks and white quartzarenite) is suggestive of the conglomerates of the Baqoroq Formation (Nakhlak Group, Central Iran). Name: from the Kal-e-Anabeh valley in the eastern part of the Aghdarband region.

2. Tuffaceous Shale Member:

Tuffaceous shale, dark green to greenish-grey, interbedded with layers of thinly bedded, fine-grained sandstone and fossiliferous calcareous beds.

At the base: the Faqir Marl Bed,

20-25 meters thick, pink and light green in colour, consisting of highly fossiliferous marl, calcareous shale, tuffaceous marly limestone and tuffaceous calcareous sandstone.

Name: from the Kal-e- Faqir valley in the western part of the Aghdarband region.

At the top: a layer of a hard, dark green coloured litharenite, similar to that on top of the Sandstone Member; locally a conglomerate, being 2-3 meters thick, the well- rounded pebbles consisting mainly of volcanic matter, combined with a coarse, crossbedded sandstone on top of this "top-litharenite"

Total thickness of the Shale Member: 200 (?-500) meters.

Four partial rock sequences from the Sina Formation were measured by R. BRANDNER and A. BAUD (figs. 3, 4, 5 and 6).

Fossils:

1. Sandstone Member:

Close to its base, the Condonts

Gondolella mombergensis TATGE, 1956 and

Gondolella constricta MOSHER & CLARK; 1965

Close to its top, the pelecipods

Daonella tyrolensis MOJSISOVICS < 1874

and the ammonite

Gevaites cf. zaheri FOURON & RAOUGET, 1951

2. Shale Member:

A. The fossiliferous Faqir Marl Bed at its base (= "fossilhorizon 2" at the geological map):

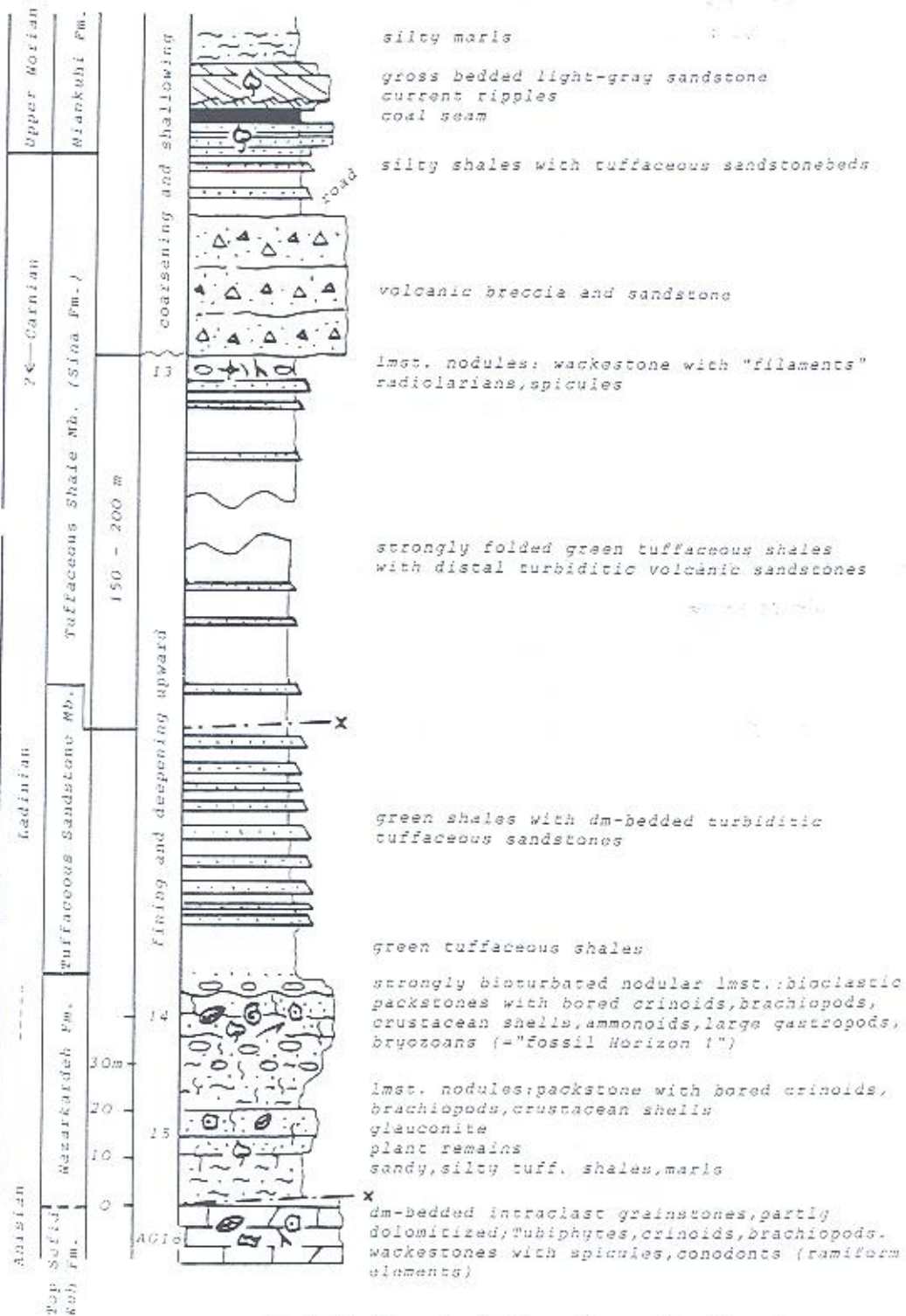


Fig. 3: The Nazar kerdh Formation and Sina Formation
ex: A. RUTTNER, (1991)

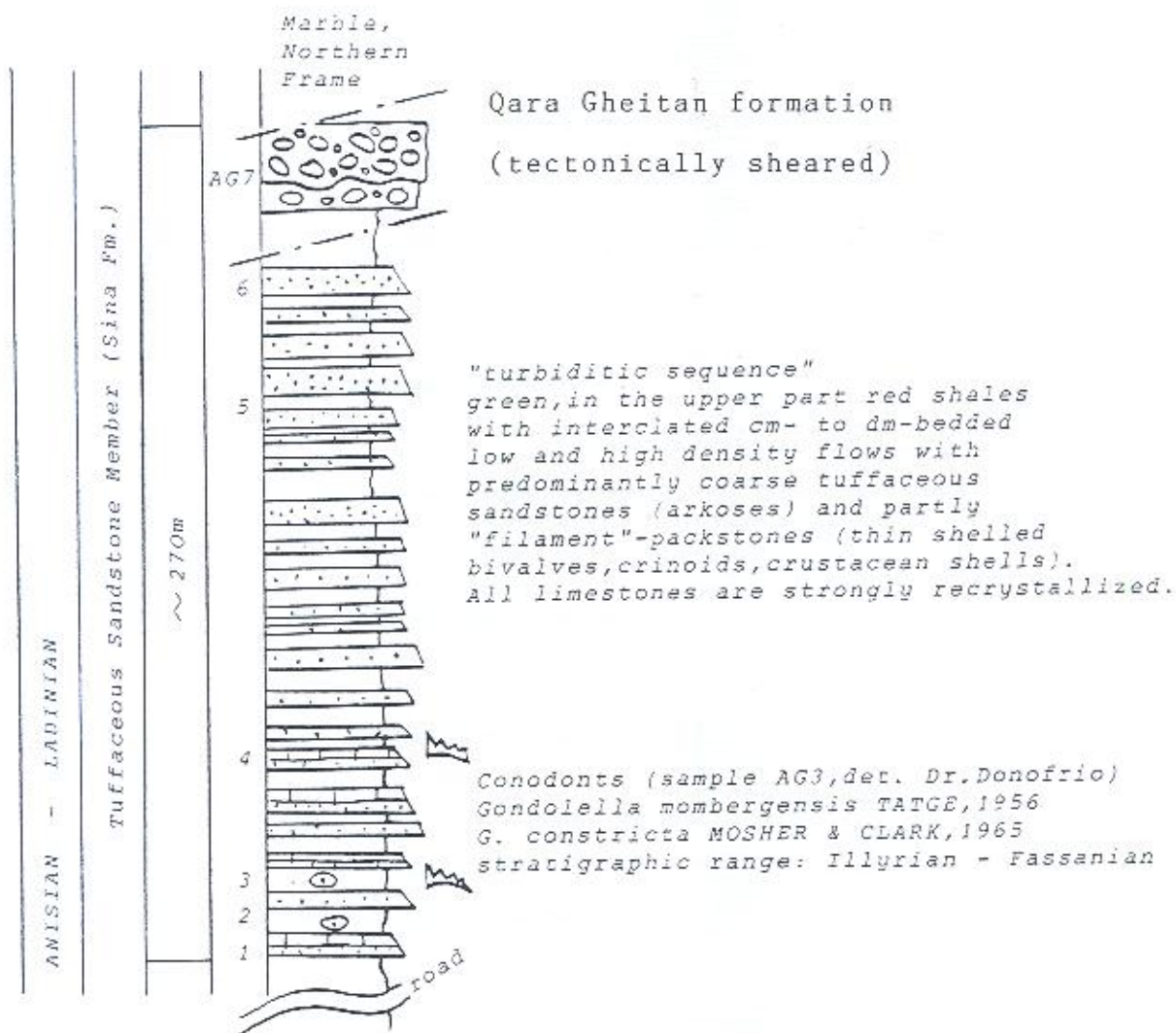


Fig. 4: Part of the Sandstone Member, Sina Formation

ex: A. RUTTNER, (1991)

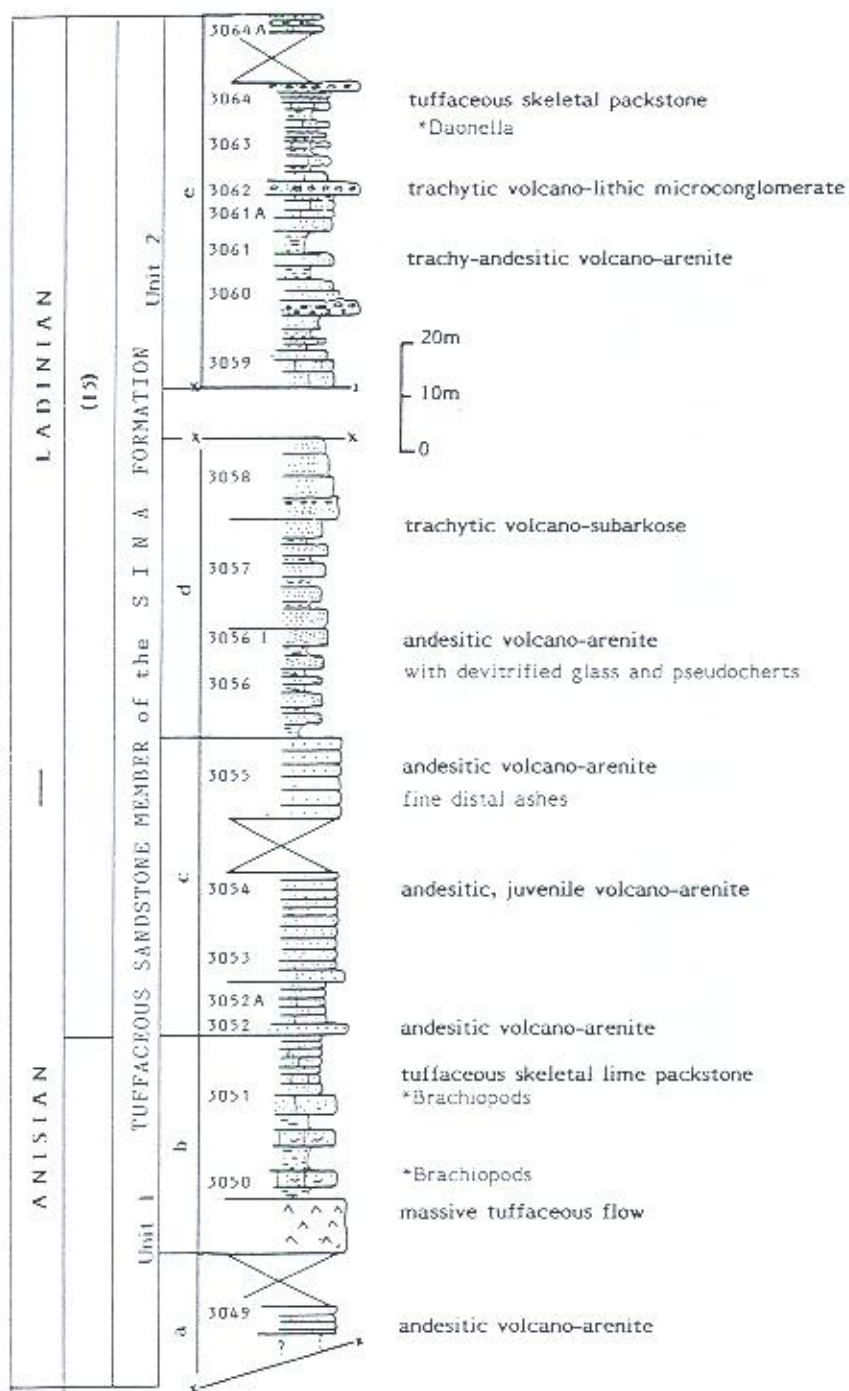


Fig. 5: Part of the Sandston Member, Sina Formation

ex: A. BAUD, G. STAMPFLI & D. STEEN (1991)

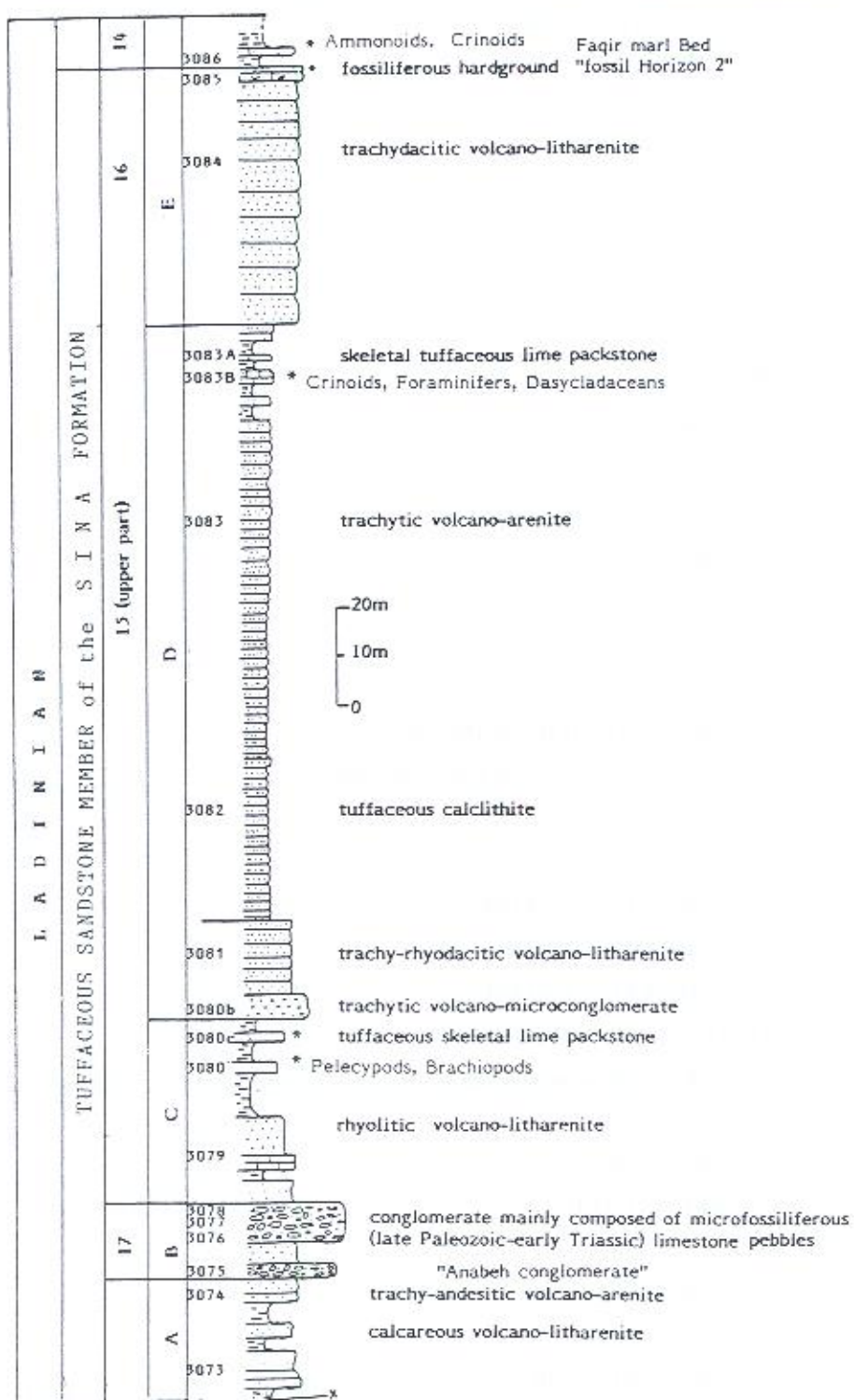


Fig. 6: Part of the Sandston Member, Sina Formation
ex: A. BAUD, G. STAMPFLI & D. STEEN (1991)



Cephalopods L. KRYSZYN & F. TATZREITER

Romanites simionescui KITTL, 1908

Lobites ellipticus HAUER, 1890

Sphingites n. sp.

Proarcestes sp.

big coiled nautiloids

small othoceratides.

Brachiopods (M.SIBLIK):

Tethyspira persis SIBLIK, 1991.

Echinoderms E.KRISTAN- TOLLMANN:

Stem-crinoids:

Traumatocrinus caudex DITTMAR, 1866

Holocrinus? *quinqueradiatus* BATHER, 1911

Balanocrinus sp.

Entrochus sp.

Stemless pelagic crinoids:

Osteocrinus saklibclensis KRISTAN- TOLLMANN, 1975

Osteocrinus aghdarbandensis KRISTAN- TOLLMANN, 1991

Osteocrinus rectus ?

Holothuroidea:

Eocaudina cassianensis FRIZZELL & EXLINE

Achistrum triassicum FRIZZELL & EXLINE

Acanthocheelia spinosa FRIZZELL & EXLINE

Kaliobullites umbo KRISTAN- TOLLMANN

Foraminifers R.OBERHAUSER, mostly removed out of a caly of *Traumatocrinus caudex*:

Ammodicidae:

Ammodiscus cf. *intimus* (STRICKLAND)

Ammovertella persica OBERHAUSER

Spirillinidae:

Permodiscus ex gr. *eomesozoicus* OBERHAUSER

Nodosinellidae:

Lunucamina aghdarbandi OBERHAUSER

Nodosariidae:

Lenticulina munsteri ROEMER

Lenticulina polygonata FRANKE



Lenticulina aff. *varians* BORNEMANN

Darbyekka *Kollmanni* OBERHAUSER

Margulina aff. *vetusta* ORB.

Dentalina ex gr. *subsiliqua*

Dentalina div. sp. (smooth)

Lingulina *iranica* OBERHAUSER

Lingulina *iranica* *sieberi* OBERHAUSER

Lingulina aff. *major* OBERHAUSER

Lingulina aff. *klebelsbergi* OBERHAUSER

Fronicularia *ruttneri* OBERHAUSER

Fronicularia ex gr. *tencra* BORNEMANN

Rotaliidae:

Duostomina ex gr. *rotundata* KRISTAN (very flat)

Ostracods E. KRISTAN- TOLLMANN), mostly larvae;

Bairdia sp.

Acratia sp.

Bairdiacypris sp.

Bythocypris sp.

Saria *vetusa* PESSAGIO, 1979

Plafkerium ? *contortum* DUMITRICA, KOZUR & MOSTLER, 1980

Porifera (Spicula):

Mostly megascleres, a few microscleres.

Age of the Formation :

1. Sandstone Member:

Close to its base: ?Late Anisian-Early Ladinian; Upper part of the Member: Late Ladinian

2. S h a l e M e m b e r :

A. Faqir Marl Bed: Latest Ladinian (Langobardian 3)

B. Bulk of the Shale Member: Still Latest Ladinian

C. Top of the Shale Member: Early Carnian (Cordevolian)

A gap of sedimentation seems to exist between the Nazarkardeh Formation and the Sina Volcanic Formation comprising at least the Middle Anisian.

Miankuhi Formation

Fabalicypsis sp.

Ptychobairdia *ruttneri* KRISTAN- TOLLMANN, 1991

Judahella (*Costahella*) *hungarica* KOZUR, 1971

Hungarella sp.

Ancisohealdia aff. *labiata* KRISTAN- TOLLMANN, 1971

Triadohealdia n.sp. KRISTAN-TOLLMANN, 1991

B. In calcareous intercalations of the Shale Member:

L. KRISTYN & F. TATZREITER:

Daonella *Iommeli* WISSMANN, 1841

Protraxhycceras ? sp. ind.

Gervatites ? sp. ind.

E. KRISTAN-TOLLMANN:

Isocrinus aff. *rolleri* LORIOL, 1886

C. At the very top of the Shale Member in a layer of Siliceous limestone D. DONOFRIO:

Radiolaria:

Spicularina *ericae* DONOFRIO, 1991

Vinassospongia *ruttneri* DONOFRIO, 1991

References :

A. RUTTNER, Geology of the Aghdarband Area (Kopet Dagh), NE-Iran. - Abh. Geol. B.-A., vol. 38, p. 44-47, Vienna 1991.

M. BOERSMMA & J.H.A. VAN KONIJNENBURG-VAN CITTERT: Late Triassic Plant Megafossils from Aghdarband (NE-Iran)- Abh. Geol.B.-A.,vol. 38, p. 223-225.

K.SEYED-EMAMI, G.SCHRAIER & a.A.BEHROOZI: Einige ammoniten aus der Kashafrud - Formation (Mittlerer Jura) E Mashhad(NE-Iran) - Mitt. Bayer. Staatslg., Palaont. hist. Geol., vol. 34, p. 145-158, Munchen, 1994.

Name : From a region called "Miankuhi" in the western part of the Aghdarband area.

Thickness : more than 200 meters.

Base : disconformably on the Sina volcanic Formation.

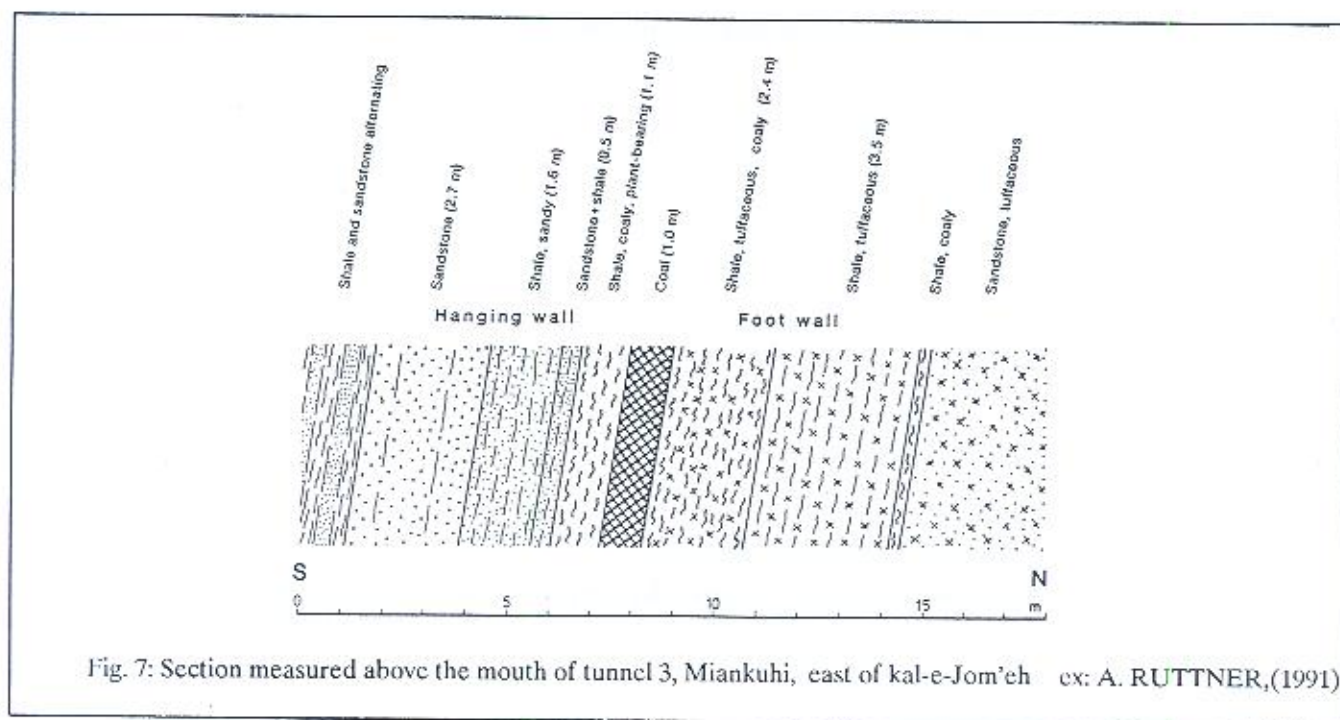
Top : there is no direct contact with overlying beds exposed in the Aghdarband area.

Rock sequence :

1. The Coal Bed at the base of the Formation:

The volcanic influence on sandstones and shales ends just below that coal bed.

2. The Miankuhi Shales : a rather monotonous sequence of brown-coloured shale with some interbedded siltstone and/or



fine- grained sandstone.

Fossils:

1. Coal Bed :

Plant megafossils (M.BOERSMA & J.A.H.VAN KONIJENBURG VAN CITTERT):

Equisetophyta:

Neocalamites sp.A

"Pteridophylla" (sensu NATHORST):

Tacniopteris sp.A

Ginkophyta:

Spenobaiera sp.A

Coniferae:

Podozamites paucinervis BOERSMA & VAN KONIJENBURG VAN CITTERT, 1991

Podozamites sp.

Incertae sedis:

Carpolithes cf. cinctus NATHORST

Seed scale

2. Miankuhi Shales:

Foraminifers, agglutinated tests (det. R.OBERHAUSER and S.PREY):

Ammodiscus sp. (small sized)

Rheophax sp.

Nodellum sp.

Saccaminidae (pinched)

Textulariidae

Dendrophyrae (fragments)

Hyperammina sp.

Ammobaculites sp.

cf. Endothyra sp.

cf. Heterohelix sp

It is a benthonic microfauna pointing to an extremely adverse living environment.

Age : A precise dating is not possible yet. According to BOERSMA and VAN KONIJENBURG-VAN CITTERT " a Norian age seems more probable than a Karnian or Rhaetian one". The assemblage of benthonic foraminifers listed above is not indicative of its age.

The existence of a middle and late Carnian gap of sedimentation is very probable, but no angular unconformity is recognizable below the coal bed in the Aghdarband area. Therefore the Miankuhi Formation was thought to mark the last stage of the Triassic "Sea of Aghdarband". SEYED-EMAMI et al. (1994, p.154), on the other hand, consider the Miankuhi Formation to be equivalent to lowermost parts of the Shemshak Formation.