New Finding of Tertiary Bisaccate Pollen of Gorgan's Shcists (Precambrian –Upper Paleozoic) Northeast of Iran, the First Report

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Abstract: Some Bisaccate Pollens are found during palynologycal investigation on Gorgan's low grade metamorphic rocks which were called Gorgan's Schists by Gansser, 1951 for the first time. All of them resemble to Bisaccate pollens that are reported from the rest of the world. A few of them couldn't be identified due to the lack of references so they are described and presented as SP. ones. 250 samples collected from Slate, Pyrite, Calaphylite and Calcschists in three geological cross sections on Gorgan's low grade metamorphic rocks. Angiosperm pollens, Pteridophyte spores, Fungal spores and fruit body finally Hypoxylonites are paper many Bisaccate pollen are presented. It must be mentioned that by tectonic mixing and metamorphism it is not possible to introduce a scheme of palynological biozone and correlation. The well preserved palynomorphs that could endure low temperature not quite in accordance with Travere's A. 1988 (page 34) point of view are useful for determination of this metamorphic rock unit.
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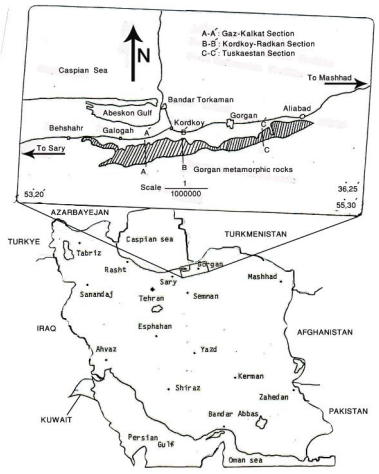
Keywords: Gorgan's Schists, Metamorphic, Bisaccate, Olistostrome, Angiosperm, Gymenosperm, Pteridophyte, Olistolite.

INTRUDACTION

Recovered along with Bisaccate pollens, a few Acritarchs, scelocodonts and chitinozoa have been obtained too which ascribed as rework palynomorfs.

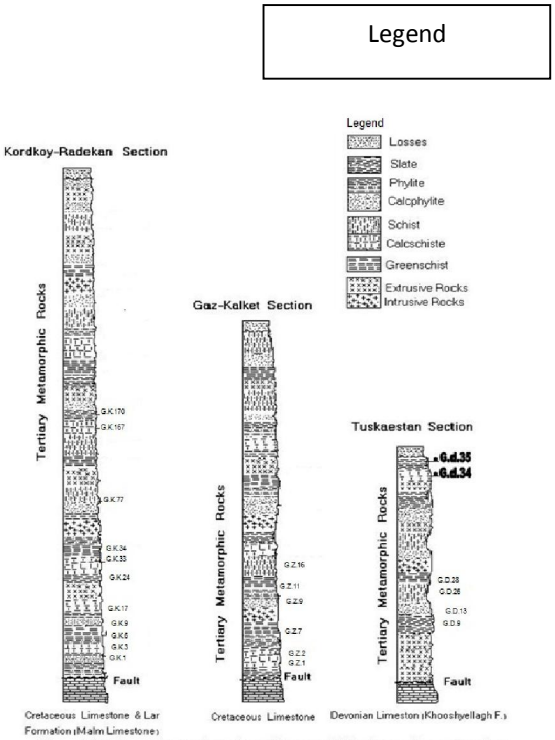
The Gorgan's Schists is a low grade metamorphic complex or rock unit that is located in northnorth east of Iran between 53˚, 38' and 54˚,45' longitude and 36˚,36',08" and36˚, 53', 02" latitude (fig.1) from Galoogah city to Aliabad city in Golestan province. Palynological investigation on this rock unit have been carrie out during 1999-2006 as an author's Ph.D. thesis. Previous studies on the basis of non palynofossil evidence have been done by Gansser, 1951 for the first time, who called this low grade metamorphic rocks as "Gorgan's Schists", others were cuntinued up to 1994.They have assigned this complex or metamorphic rocks to Precambrian, Ordovician, Upper Devonian, and Preliassic geological times. On the basis of few fossil evidence with attention to lithosteratigraphy, radiometric and tectonic origin, previous study ascribed "Gorgan's Schists " to Precambrian (Jenny, 1977) (Salehirad, 1979) and (Delaloye et al, 1981). moreover, Ordovician (Ghavidel syooki, M. 1994) upper Devomian (Gansser, 1951), (Hubber, 1957), (Berberian et al, 1973) and (Ghavidel syooki M., 1994) and Preliassic (Stocklin,1955), (Berberian et al, 1973) and (Ghasemi,1990). Hushmandzadeh et al, 1997 on their investigation of this complex couldn't accept the previous radiometric age determination.



(figure 1) Geographic location of studied area

Low grade metamorphic rocks as "Gorgan's Schists", others were cuntinued up to 1994.They have assigned this complex or metamorphic rocks to Precambrian, Ordovician, Upper Devonian, and Preliassic geological times. On the basis of few fossil evidence with attention to lithosteratigraphy, radiometric and tectonic origin, previous study ascribed "Gorgan's Schists " to Precambrian (Jenny,

1977) (Salehirad, 1979) and (Delaloye et al, 1981). moreover, Ordovician (Ghavidel syooki, M.1994) upper Devomian (Gansser, 1951), (Hubber, 1957), (Berberian et al, 1973) and (Ghavidel syooki M., 1994) and Preliassic (Stocklin, 1955), (Berberian et al, 1973) and (Ghasemi,1990). Hushmandzadeh et al, 1997 on their investigation of this complex couldn't accept the previous radiometric age determination. In Gorgan's geological sheets 1/250000, 1/100000 this rock unit have determined Precambrian and upper Paleozoic in 1991and 1999 respectively. Fabrizo, B. et al, 2007 studied this area and recognized a late Cretaceous transgression with glauconite sands in the base of this transgression. In figure I, they have elucidated a transgression contact between Certaceous and Gorgan's Schist in the Stratigraphy section I. But in this location Ghezelghaleh metamorphic rock unit (upper Carboniferous) is underlie the Cretaceous transgression with limestone rocks in general (geological map 1/250000,1/100000). In figure 2 this is elucidated in the (b,c) two part of pictures. In this area it is not possible to identify a correct differential between Ghezelghaleh and Gorgan's metamorphic rock units. In figure 2 part (a) they have assigned a contact between Shemshak formation and Gorgan's Schist with a conglomeratic base. It is not possible to identify whether this metamorphic rock unit is Gorgan's Schist or Ghezelghaleh metamorphic rock unit. Well preserved palynomorphs could be studied clearly, not much according to the Traverse's A., 1988 opinion (page 34). A large group of palynomorphs could endure low degree metamorphism tha effected on this complex and are obtainable from Slate Phylite, Calcphylite and sometimes Schists. All recovered palynomorphs are the same as Tertiary palynomorphs that are reported all over the world. 250 samples were collected from three roadcut Sections that are the best outcrop of low grade metamorphic rock unit for sampling. These geological section are Kordkuy –Radekan Tuskaestan and GazKalkat (fig,2). The present palynological study is the first systematic record of palynological investigation on these rocks unit which delineate the Tertiary geological age for most part of them. Gavidel syooki, M., 1994 on the basis of three spot samples from low grade metamorphic rocks reported Diexallphasis simplex Wicander & Wood, 1981, Navifusa exilis Playford, 1981, Retusotriletes sp. Geminospora sp. Triquitrites sp. and has ascribed upper Devonian, Carboniferous epoch of this rock unit.



(figure 2) Schematic stratigraphy column and lithology of cross Section with location of productive samples Scale: 1/10000

MATERIALS AND METHODS

All 250 samples were collected from Slate, Phylite, Calcphylite and Calcschists are put in polythene bags, labeled and sealed. To avoid the contamination all samples locality were dug 40-50 cm and non weathered samples were collected. The samples were washed and crashed carefully and treated with HNO3 for 5-15 hours, HF %70 for 24 hours and HCL %17 for 24 hours. After each step the remained materials were washed and decantated for many times, until no acidic affection remain.The residue after sieving with sieve 200 µ were boiled by HCL for half an hour. Eventually the residue centrifuged with ZnCl2. The materials which remained between the surface of clear water and ZnCl2 passed through sieve 20 µ. Finally, the residue mixed with poly vanilla Alcohol (P.V.A) and after drying by low temperature heater mounted with liquid Canada Balsam, then lameled.

GEOLOGY AND STRATIGRAPHY

The Gorgan's low degree metamorphic rocks comprise mainly sedimentary metamorphic rocks and somewhere igneous metamorphic rocks. This complex named "Gorgan's Schists" by gansser, 1951. It contains of sedimentary metamorphic rocks such as Slate,Phylite, Calcphylite, Calcschist and Schists and also meta intrusive rocks visa metagabbro and metadiorite.The metaextrusive

rocks comprise metatrachyte, metatrachyandesite and metatuff. All meta igneous rocks are surrounded by metasedimentary rocks and are similar to not extended mass. This complex lies in west-southwest to east-southeast of Gorgan city in north north-east of Iran, with 110 kilometers length and 15 kilometers maximum in width (fig.1). This complex is extended from Galogah city to Aliabad city with an almost east-west trend. All other formation such as Devonian sandstone Shale and limestone (Khoshyelagh F.), Jurassic siltstone, marl and sandstone (Shemshak F.), Malm limestone (Lar F.) and Cretaceous marlmarly limestone have a fault contact with Gorgan's metamorphic complex. Previous authors have identified that the degree of metamorphism is too low, close to "Green Schitsts faces". This low degree metamorphic complex is also underlain by Quaternary losses with disconformities contact along with 110 kilometers.

This complex is exposed as anticline both earlier formation and Quaternary losses are located on both sides, in this way no leaching and contamination could be happen. Maximum thickness of the low grade metamorphic rocks in Kordkuy – Radekan geological section is 200 meters. Low degree metamorphism has effected this rocks, so palynomorphs could remain and are preserved very well. This metamorphism is known as a shear zone (tectonic metamorphism) mechanism, and not a contact or a regional one. There are some reworked pebbles from earlier formations in sedimentary metamorphic rocks that are exotic grains or blocks. For tectonic metamorphism in this low grade sedimentary metamorphic a few reworked fossils are involved in Pebbles with faint deformation, this fossil could help previous authors for age determination that is why different identifications, are presented by previous authors. After this research Iranian field geologists and tectonician called this complex as an Olistostrome. According to this theory all reworked Pebbles and Blocks that have some reworked fossils in them, must be considerd as Olistolite. In this way the main matrix formed in Tertiary epoch. (figs.3,4)

PALYNOLOGY

Quantitative and Qualitative analysis of the palynological assemblages recorded from the Gorgan's low grade metamorphic complex are comprised of 145 species belonging to 112 genera. Out of these 43 species belonging to 36 genera are Fungi, 64 species under 51 genera belong to Angiosperms, while 6 genera with 9 species have an affinity with Gymnosperms, Pteridophytes are represented by 29 species of 19 genera. Hypoxylonites are considered as Fungal spores. Laboratory investigations have revealed that the palynological assemblage of Gorgan's Schists are dominated by Fungi, followed by Angiosperms Pollen, while Gymnosperms and Pteridophytes are the next as quantity,and the last one is Hypoxylonites. Scheme of Palynozone could not be drown because of tectonic effect and mixing. Most recovered Palyno assemblage contains Tertiary Palynomorphs which are comparable with the Tertiary Palyno fossils from all over the world. There are some Bissacate pollens in slides, but the author could not identify them because there aren't useful references in Iran, so most of them reported as a Sp. or type one.

A few Acritarch, Scelocodont and Chitinozoa are obtained during processing that are identified as reworked Palynomorphs

SYSTEMATIC

Anteturma *pollenites* Potonie, 1931
Turma *saccites* Erdtman, 1947
Subturma *Disaccites* Cookson, 1947
Infraturma *pinosacciti* Erdtman, 1975 emend Potonie, 1958
Genus: *pinuspollenites* Raatz, 1937
Type species: *pinuspollenites labdacus* (R. pontonie 1931) Raatz 1937 ex Potonie 1985.

***Pinuspollenites* cognatus kar r.k.1990**

Plate:1 figs:1,2

Pollen grains, bisaccate, sacci hemispherical and equal in size, smaller than central body, saccs attachment together on central body, sacci reticulate and at the end it seems regulate. The size of saccs is 30×30µ. Central body hemispherical to oval shape, exine granulate and there is a thin cap at proximal side. At the distal side there is a narrow furrow. Size of central body 41×38 micron.

Stratigraphy: Miocene and Mio- Pliocene northeast of India (Kar R.K.1990). northeast of Iran

Occurrence: Gorgan's schist Tuscaestan s., no 26

Picea Friedrich Gottlieb Dietrich

Plate 1 Figs 4,5

Pollen grain, bisaccate, sacci's length is smaller than body, kidney form, reticulate, completely attached to central body at distal area, size of saccs 35×20µ. Body squarish to subsquarish form, exine with infra reticulation, prominent cap with 3µ thick at distal area, size of body 47×46µ.

Stratigraphy: Late Miocene southwestern of China (Xu. Jx. et al 2008). Gorgan's schist northeast of Iran.

Occurrence: Gorgan's schist Kordkuy Radekan s., no 34

Abiespollenites sp.

Plate1 fig 6

Pollen grain, bisacate, sacci kidney form, reticulate, attachment area is too less than

nonattachment area, size of sacci is near to central body 43×30µ, distal attachment equatorial. Body circular, exine of central body laevigate – weakly intra micro reticulate, prominent cap at distal area with 3µ thick, size of central body 45µ.
Stratigraphy: Gorgan's schist northeast of Iran
Occurrence: Gorgan's schist Kordkuy Radekan s., no 3
Genus: ***pinuspollenites*** Raatz, 1937
Type species: ***pinuspollenites labdacus*** (R. pontonie 1931) Raatz 1937 ex Potonie 1985.
Pinuspollenites salmanicos sp. Nov.
Plate 1 figs 7,8
Holo type: slide G.K.167 a – 4
Locus typicus: Kordkuy – Radekan s.
Stratum typicum: Gorgan's schist

Pollen grain, bisaccate. sacci rein form, reticulate, a thick bound of reticulation at the margin of saccs, nonequatorial attachment area are less than nonattachment area. Size of saccs 40×25µ. Central body oval shape with a cap 3µ thick, exine psilet to micro infra reticulate, size of central body 60×30µ.
Comparison: this new species is different with all other spices from reset of the world by having an ellipsoid conic body and special sacci attachment on the body. There is an equatorial furrow on the body.
Stratigraphy: northeast of Iran
Occurrence: Gorgan's schist Kordkuy-Radekan s.G.K.167a,G.K.3,G.K.34,G.K.33
Parcisporites parvisaccus *Song & Zheng 1981*
Plate 2 fig 1

Pollen grain, bisaccate, sacci kidney form, reticulation of sacci by black color is not obvious, sacci smaller than central body size 30x15, equatorial completely attached to central body. Body circular to sub circular, exine 2µ with micro reticulation, cap thick near to 5µ, size of central body 40×35µ.
Stratigraphy: late Eocene of southern China (Gengwu L. & Rongyu Y.1999). northeast of Iran
Occurrence: Gorgan's schist Gaz-Kalkat s. no 2
Abiespollenites cf. microsaccoides Krutzsch, 1966
Plate 2 figs 2,3

Pollen grain, bisaccate, sacci spherical, with fine reticulation, subequatorial attachment less than nonattachment area, size 27µ height 26µ width. Central body oval shape, bigger than sacci, exine with fine reticulation and a 3µ prominent cap, size of central body 42×30µ.
Stratigraphy: Miocene of Yeoungill Korea(Takahashi K.&Kim B.K.,1979). northeast of Iran
Occurrence: Gorgan's schist, Tuskestan S., no 9. Kordkuy – Radekan S., no 77.1.b
Pinuspollenites elongates Norton & Hall 1969
Plate:2 fig:4

Pollen grains, bisaccate, sacci equal, subcircular to elliptical, reticulate, proximal attachment of sacci equatorial, distal attachment subequatorial. Centeral body cup form, granulate, a cap at proximal side with 2 micron thickness. Size of body 42 (width) × 32 (height) micron, sacci 28 (width) × 33 (height) micron.
Distribution: East of China & Korea (Takahashi, 1981) Late Paleocene north Dakota of America (Zetter R. et al, 2011). northeast of Iran
Stratigraphy: East of China & Korea
Late Paleocene north Dakota of America.
northeast of Iran
Occurrence: Gorgan's schist Kordkuy-Radekan S., no 77. a

Pinuspollenites crestus Kar 1985
Plate: 2 figs 5,6

Pollen grain, bisaccate, bilaterally symmetrical, body subcircular to hemispherical and oval shape, there is a prominent cap at proximal side, intrabaculate, size of body 37µ height and 35µ width. Saccs subthemespheric and equal together, intra reticulate, proximal attachment of sacci to central body equatorial, distal attachment sunequatorial, size of sacci, 45µ high and 35µ width. General size of pollen 92×37µ.

Distribution: North west of India (Saxena, 1979) and Gojarat (Kar, 1985), Bengal fan of Indian ocean (Chandra & Kumar, 1997), Bangladesh (Saha, 1999), Miocene and Mio-Pliocene northeast of India (Kar 1990). Northeast of Iran **Stratigraphy:** Eocene north west of India, Miocene Gujarat, Miocene north east of India, Tertiary of Bengal fan, Tertiary of Bangladesh, Tertiary of northeast Iran.
Occurrence: Gorgan's schist, Tuskaestan S., no 13.a. Kordkuy – Radekan S., no 17.b. Gaz-Kallkat, section no 16 d.

Rugubivesiculites reductus Pierce 1961
Plate: 3 fig: 1

Pollen grain, bisaccate, body subcircular to elliptical in lateral view. Body with 40µ height and 50µ width, there is a cap with 2µ thickness at proximal side, body granular. Sacci equal and hemispherical, attachment area on the body is less than non attachment, proximal attachment of sacci to central body equatorial, sacci with 25µ width and 35µ high, reticulate distal side is 1/4 proximal side.
Stratigraphy: Late Cretaceous – Paleocene of west of Canada (Braman D.R. & Sweet A.R., 2012). Northeast of Iran.
Occurrense: Gorgan's schist, Kordkuy-Radekan S.,no 34, Gazkalkat s., no7.b
Pinuspollenites pseudolarix

Plate:3 fig:2

Pollen grains, bisaccate, sacci equal, bean form,thick and prominent reticulation, attachment area on the body is less than non attachment. Equatorial, sacci 35µ height and 20µ width. Body circular to elliptical in polar view and show three cross circle, body has a prominent 3µ thickness cap, granular, 38µ height and 30µ width, General size 50µ.

Stratigraphy: Neogene of Himi central Japen (Wang W.M. & Saito T. & Nakagawa T., 2001). Northeast of Iran.

Occurrence: Gorgan's schist, Kordkuy-Radekan S., no 170 a, 1b. Gaz-Kalkat S., no 1.a

Genus: ***Podocarpidites;***(Cookson)Potonie 1985

Type species: ***Podocarpidites ellipticus*** Cookson, 1947.

Podocarpidites couperi Sarkar & Singh (1988).

Plate 1 fig 3

Pollen grain, bisaccate, sacci large and length of them equal to the body, elliptical form, reticulate, attached at distal, attachment area to central body is equal with non attachment area. Sacci 50µ in length 35µ in width, distal attachment equatorial. Body circular to sub circular form, exine of central body psilet, a prominent 3µ thick cap at proximal area. Size of body 54×50µ

Stratigraphy: Eocene of Himachal Pradesh of India (Sarkar S. & Singh H.P.,1988). Gorgan's schist northeast of Iran

Occurrence: Gorgan's schist Tuskaestans., no 28

Pdocarpidites densicorpus Kar, 1985

Plate: 3 figs 3,4

Pollen grains, bisaccate, bilaterally symetical, general size 57×37µ. Sacci subhemispherical, the line of sacci attachment on body is smaller than height and width, intrareticulate, height of sacci 42µ and width 30µ. Body prominent, dense and brown, oval to quadrangle, cap clear, clearance is more in proximal side, intrapeculate, 37µ height and 53µ width. Proximal attachment of sacci on central body equatorial, distal attachment non equatorial, sacci attachment area on body is less than non attachment.

Distribution: East of China & Japan (Takahashi, 1981), north of India (Kar, 1985), Bengal fan of Indian ocean (Chandra & Kumar, 1997), northeast of Iran.

Stratigraphy: Tertiary of China & Japan, Oligocene-Miocene of north east of India, Tertiary of Bengal sedimentary fan, Tertiary northeast of Iran.

Occurrence: Gorgan's schist Kordkuy – Radekan S., no 33.

Pdocarpidites decorous Sarkar & Sing, 1988

Plat:3 figs 5,6

Pollen grains, bisaccate, body spherical to oval shape, exine granulose, there is a non prominent furrow on distal side and a cap, size of body 42µ (height) and 45µ (width). Sacci reniform, reticulate and in equaterial area, (height) of sacci 47µ, width of sacci 30µ.

Distribution: Eocene North of India (Singh & Sarkar, 1986) Eocene north of India (Sarkar & Singh, 1988) northeast of Iran.

Stratigraphy: Eocene of north India, Tertiary of north Iran.

Occurrence: Gorgan's schis Gaz Kalkat S., no 7.a. Kurdkuy – Radekan S., no 9.b.

Genus: ***Abiespollenites*** Thiergart, 1937

Type species: ***Abiespollenites absolutes*** Thiergart, 1937

Abiespollenites absolutes Thiergart, 1937

Plate: 3 figs 7-9

Pollen grains, bisaccate, bilaterally, general size 83×40µ. Body clear, oval shape, a thick and prominent cap in lateral side, a distinct furrow at distal side. Pollen is very black so reticulation is not lear. Proximal attachment of sacci on central body equatorial and distal attachment nonequatrial. Size of body (width) 58µ (height) 40µ sacci 33µ (height) 30µ (width).

Distribution: Miocene of England and north west of India(Kar, 1985), northeast of Iran.

Stratigraphy: Miocene of England and India, Tertiary northeast of Iran.

Occurrence: Gorgan's schis Kordkuy-Radekan S., no 6. Gaz-Kalkat S., nod.2,16.

Abiespollenites **sp.**

Plate:3 fig 10, Plate 4 figs 1-3

Pollen grains, bisaccate, sacci kidney form reticulate, attachment area is too less than nonattachment area, size of sacci is near to body 43×30µ, distal attachment equatorial, body circular, exine of central body laevigatweakly intramicro reticulate prominent cap at distal area with 3µ thick size of body 45µ.

Occurrence: Gorgan's schist Kordkuy – Radekan S., no 1.c Tuskaestan S., no 13.b.Gaz-Kalkat S., no 11.a

Genus: ***Alisporites*** Daugherty. 1941

Type species: ***Alisporites bilateralis*** Rouse,1959

Alisporites **gorganicus sp.Nov.**

Holo type: slide G.D.26

Locus typicus: Tuscaestan section.

Stratum typicum: Gorgan's schist

Plaie:4 figs 4,5

Pollen grains, bisaccate, sacci equal, bean form, reticulation reniform, attachment of sacii on central body no equatorial, sacci high 32µ and width 15µ. Body big, subcircular to quadrat with an

expand exine, reticulate, the thickness of reticulation is 3µ, size of body 41µ (height) 46µ (width).
Comparison: This species is different with all other Alisporites which are reported from rest of the world by completely attachment of sacci on body and oblique attachment.
Stratigraphy: northeast of Iran
Occurrence: Gorgan's schist Tuskaestan S., no 26.Gaz-Kalkat.,no9

Genus: *Dacrydium* Erdtman,1943
Dacrydium franklinii Erdtman, 1943
Plate:4 figs 6,7

Pollen grains, bisaccate, oval shape, to quadrate, in polar view, Body oval shape to lent form with a thick cap (8µ), exine granulate especially on cap, size of body 38µ (height) 50µ (width). Sacci smaller than body, cartridge form in lateral view, high of sacci 25µ and width 33µ. Proximal attachment of sacci on central body equatrial, fine reticulate, there is a clear furrow on distal side.
Distribution: South of Australia (Cookson, 1953), northeast of Iran
Stratigraphy: Tertiary of Australia, Tertiary northeast of Iran
Occurrence: Gorgan's schist Kordkuy Radekan S., no 33

Dacrydiumites mawsonii Cookson, 1953
Plate:4 figs 8,9

Pollen grains, bisaccate. Body quadrate in polar view, general size of pollen 50×30µ. Body with a distinct cap, there is a furrow on distal side. Sacci equal hemispherical to spherical, reticulate, high of sacci 25µ and width 23µ. Body 33µ (height) 30µ (width). There are tow verrucate shape of appendage on attachment area of sacci on central body in proximal side.
Distribution: South of Australia, (Cookson,1953) northeast of Iran
Stratigraphy: Tertiary of Australia, Tertiary northeast of Iran.
Occurrence: Gorgan's schist Kodkuy-Radekan S., no 24.

DISCUSSION

After getting this result which show that there are much Tertiary palynomorphs in Gorgan's lowgrade metamorphic complex many famous Iranian Tectonicians and field geologists visited this complex, and on the basis of their opinion it is an Olistostrome geology phenomena. So that much exotic blocks or pebbles reworked as an Olistolit from earlier formations in to the Tertiary matrix. Finally, all matrix and blocks by tectonic affect endured a low grade metamorphism. According to this new concept it delineates that previous authors for the lake of information about systematic palynofossils data had to make their judegment on a few reworked fossils. In this way there were different age determinations that were carried out during 1951-1994. Previous authors proposed different geological age for the Gorgan's low grade metamorphic complex. These differences of opinion are due to mixing of much exotic block and grains from earlier formations in the Tertiary matrix they were reworked in to Tertiary sedimentary environment During upper Paleocene to upper most Miocene. In this investigateion the author encountered with a few Acritarch Scelocodont and chitinozoa. But much Tertiary palynomorphs are identified in the slides. According to the new palynomorphs which are found in Gorgon's metamorphic unit many Iranian filed geologists and tectonician proposed an Olistostorome event for Gorgan's low degree metamorphised rocks. According this theory, the main part of this complex and matrix of sedimentary rocks were formed during Tertiary epoch. Much exotic blocks and grains were reworked from earlier formations and were finally metamorphed by tectonic affect in upper most Miocene.

CONCLUSION

In this palynological study on Gorgan's low grade metamorphic complex much palynomorphs were obtained from 250 samples. Tertiary palynomorphs recovered from Slate, Phylite, Calcphylite and some times Calcschist, that are sedimentary metamorphic rocks which may be as a matrix of this complex. As palynological evidence in this complex that are comparable with other Tertiary palynomorphs reported from all over the world. According to this investigation Tertiary geological time supposed by author for most part of Gorgan's low grade metamorphic complex so the other proposed age such as Precambrian, Ordovician upper Devonian Carboniferous and Preliasic probably goes back to reworked pebbles on a few fossils evidence. It is possible that some parts of this complex have an earlier geological age but are mostly identified as Tertiary geological time. Palynomorph assemblage consists of 64 species of 51 genera Angiosperm. 9 species of 6 genera Gymnosperm, Pteridophyte are represented by 29 species of 19 genera and finally 43 species of 36 genera Fungal spore.

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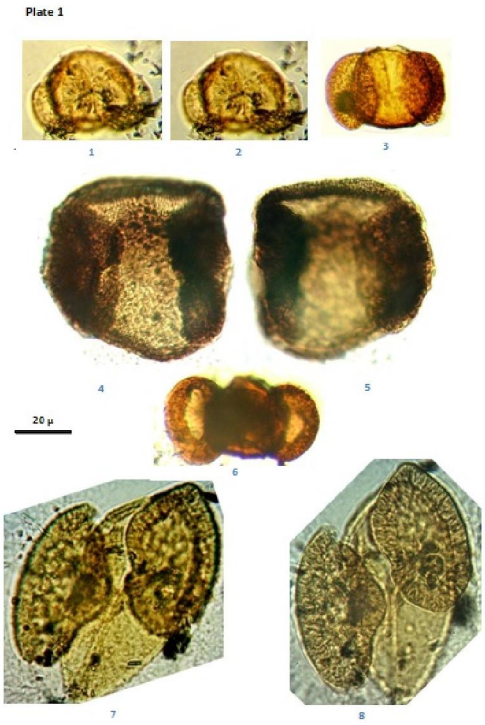

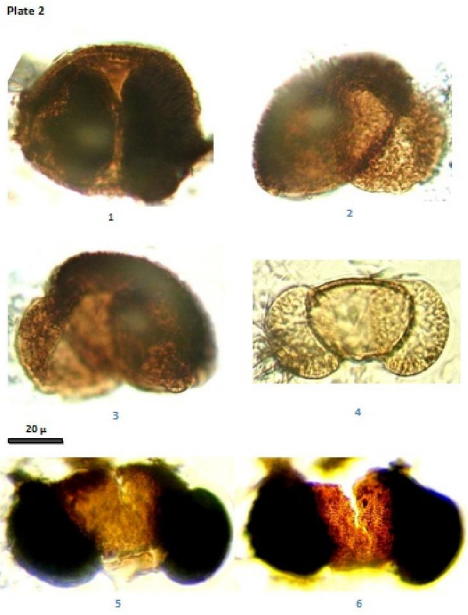

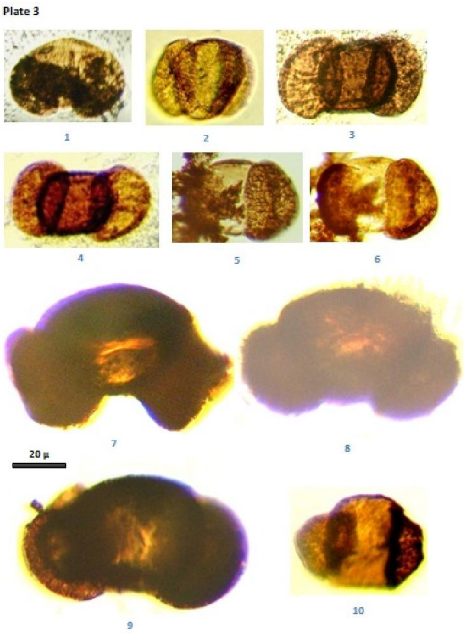

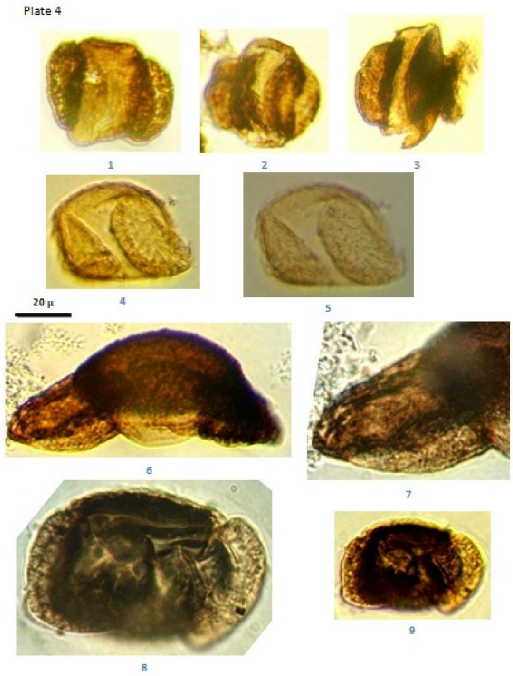

REFERENCES

1. Barnett. J. (1989). Palynology and paleoecology of the Tertiary Weaverville formation northwestern California, U.S.A., Palynology (a.a.s.p). Vol. 13, pp. 195 – 246.
2. Berman D. R. & Sweet A. R. (2012). Biostratigraphically useful late Cretaceous - Paleoccene terrestrial palynomorphs from the Canadian Western Interior sedimentary Basin; Palynology vol 36(1) pp.8 - 35
3. Berberian, M. & Hushmandzadeh, A. & Lotfi, M., (1973). Deformational phases and related metamorphism in the Gorgan area, Geological Survey of Iran, internal report, 16p.
4. Chandra, A. & Kumar, M. (1997). Palynology of the Tertiary sediments in the Bengal Fan, Indian Ocean: The identification of the sporomorph phyllocladidites with Dacrydium and its distribution in southern Tertiary deposits, Australian Journal of Botany, Vol. 1, pp.64 - 70.
6. Cookson, I. C. (1953). The identification of the sporomorph Phyllocladites with Dacrydium and its distribution in southern Tertiary deposits, Australian Journal of Botany, pp. 64 - 70
7. Delaloye, M., Jenny, J., and Stampfi, G., (1981). K-Ar dating in the eastern Elburz (Iran): Tectonophysics, Vol. 79, pp. 27 - 36
8. Fabrizo et al (2007). Late Cretaceous transgression on a Cimmerian high (Neka vall, Eastern Alborz, Iran): A geodynamic event record by glaugonitic sands; Elsevier, sedimentary geology, vol 199, pp. 189 - 204
9. Gansser, A. (1951a). Geological reconnaissance's in the Gorgan and surrounding area; National Iranian Oil Company, unpublished internal Geological Report No. 10, 37p.
10. Gengwu L. & Rongyu Y. (1999). Pollen assemblages of the late Eocene Nadu formation from the Bose basin of Guangxi southern China; Palynology (a.a.s.p) vol 23 pp. 97 - 114
11. Ghasemi, M., (1990). Geological, stratigraphical and structural geology investigation of Chahardeh region (Eastern Alborz) M.SC. thesis faculty of science university of Tehran.
12. Ghavidel souyouki, M. (1994). Palynological investigation reconnoiter of geological time of low grade metamorphic rocks (Gorgan schists), National Iranian oil company (NIOC). No. II
13. Hubber, H. (1957). Geological report on the south Geogan mountain front between Nike and Shah-Passand, National Iranian Oil company, unpublished internal Geological repot No. 164, 39p.
14. Hushmandzadeh, A. Hamdi, B. &Nabavi M.H. (1997): Precambrianlower Precambrian rocks in Iran. Mining reservoir and capable mine in yazd province (last paper), Ministry of Mining and Metals, mining and metals office of yazd. 97p.
15. Jing – Xian Xu. et al (2008). Late Miocene vegetation and climate of the Luhe region in Yunnan, southwestern of China; Elsevier (Review of Paleobotany and Palynology) vol 148, pp.36 – 59.
16. Kar. P. K. (1990). Palynology of Miocene and Mio-Pliocene sediments of north-east India; Silver Jubilee commenmoraction volume of the Journal of palynology, pp.171 - 172.
17. Sah. S. K. (1999). Micropalaeontological investigations of Tertiary sediments of Bangladesh in relation to hydrocarbon potential, Unpublished Ph.D thesis, Panjab University, India, 250 P.
18. Salehi-Rad, M.R, (1979). Etude Geologique de la region de Gorgan (Alborz oriental, Iran); Unpublished Ph.D. Thesis, University de Parissud, 162P.
19. Sarkar. S. & Singh. H. P. (1988). Palynological investigation of the Subathu formation (Eocene) in the Banethi-Bagtan area Himachal Pradesh, India: Palaeontographica Vol 209, pp. 29 - 109.
20. Saxena. R. K.(1976). Palynology of the Matanomadh Formation in Type area, north – western Kutch. India (Part. 1); the palaeobotanist, Vol. 25, pp. 448 - 479.
21. Singh, H. P. & Sarkar. S. (1986). Significant palynozones of Subathu formation (Himachal Praesh) and their bearin, on Stratigraphy: the Palaeobotanist, Vol 35 (3), pp. 249 - 257.
22. Stocklin, J., (1955). Stratigraphical studies in East-Mazndran and Elburz between Nika and Dameghan; National Iranian Oil Company, unpublished Geological Report No. 141. 36P.
23. Takahashi, k. (1981). Palynoflora from the Chojabaru Diatomite Formation of the Lki Group; Bulletin of the Faculty of Liberal Arts, Natural Science, Vol. 22 (1), pp. 21- 48.
24. Takahashi & Kim, B. K. (1979). Palynology of the Miocene Formation in the Yeungili by district, Korea, Palaentographica, Vol 170,pp. 10 - 80.
25. Traverse. A. (1988). Paleopalynology. Allen & Unwin Inc Winchester, Masso, 1890. U.S.A. 565.P.
26. Wang W. M. & Saito T. & Nakagawa T. (2001). Palynostratigraphy and climatic implication of Neogene deposits in the Himi area of Toyama prefecture, Central Japan; Elsevier (Review of Paeobotany and Palynology) vol 117, pp.281 – 295
27. Zetter R. et al (2011). Palynoflora of the Late Paleocene silicified shale at Almont north

Dakota, U.S.A., Palynology (a.a.s.p) vol 35 (2) pp.179 – 211.

Plate 1

1,2**-** *Pinuspollenites* cognatus x 400 kar r.k.1990 slide no G.D.26
3- Podocarpidites couperi x 400 Sarkar & Singh 1988 slide no G.D.28
4,5- Picea Friedrich Gottlieb Dietrich x 1000 slide no G.K.34
6**-** *Abiespollenites* sp x 400 slide no G.K.3
7,8- *Pinuspollenites salmanicos sp. Nov.* x 1000 slide no G.K.167.

Plate 2

1-*Parcisporites parvisaccus* x 1000 Song & Zheng 1981 slide no G.Z.2
2,3- Abiespollenites cf. microsaccoides**.** x 1000 Krutzsch, 1966 slide no G.K.33
4- *Pinuspollenites elongates* x 400 Norton & Hall 1969 slide no G.K.77
5,6- *Pinuspollenites crestus* x 400 Kar 1985 slide no G.Z.16.

Plate 3

1-*Rugubivesiculites reductus* x **400** Pierce 1961 slid no G.K.34
2- *Pinuspollenites pseudolarix* x 400 slid no G.K.170
3,4- *Pdocarpidites densicorpus* x 400 Kar, 1985 slide no G.K.33
5,6- *Pdocarpidites decorous x400* Sarkar & Sing, 1988 slide no G.Z.7
7-9- *Abiespollenites absolutes* x *400* Thiergart, 1937 slide no G.K.6, G.Z.16
10- *Abiespollenites* sp. x 400 slide *no* G.D.34, G.D.35.

Plate 4

1-3-*Abiespollenites* sp. x 400 slide *no* G.D.34, G.D.35
4,5**-** *Alisporites* gorganicus sp.Nov. x 400 slide no G.D.26
6,7- *Dacrydium franklinii* x 400, 1000 Erdtman, 1943. Slide no G.K.33
8,9- *Dacrydiumites mawsonii* x 400, 1000 Cookson, 1953-G K24.

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