sampled two stratigraphic sections in Tang-e-Zakin of Kuh-e-Faraghan and in Tang-e-Abzagh of Kuh-e-Gahkum in 1984. The location of this formation is in the critical area of the overthrust of the Iranian Plate on the Arabian Shield.

Totally 137 samples were collected from the areas, seven samples are of Chal-i-Sheh (Fig. 4) and the remaining 130 are from the Faraghan formation in Kuh-e-Faraghan. The investigations indicate that the 200 out of 300 meters outcrop sections of Faraghan formation in Kuh-e-Faraghan and Kuh-e-Gahkum were deposited during the Devonian period and the remaining parts accumulated in the Lower Permian time (Figs. 5-6). Supports for this idea, and details in finer stratigraphic subdivisions are discussed under the bizonations of the Faraghan formation. It should also be added that the Faraghan palynology has been a part of doctoral fullfilments of the present author. For this investigation no additional field works achieved for this rock unit but all the needed samples and materials were picked from the field and laboratory stocks of N.I.O.C.

Biostratigraphic Zonation :

In geology, the palynology includes some palynomorph entities which are useful in the relative age determination, interpreting different sedimentary environments and correlation of the surface sections. Palynomorph entities can be obtained in abundance from acid-insoluble residues of shales, siltstone, peats, salts, lingnites and some limestones, but they are typically rare or absent in coarse-grained sandstones and conglomerates. The factors that make palynology as an important field of paleontology are the small size and good preservation of the fossil dinoflagellates, chitinozoa, acritarchs, spores, pollen grains and algal cells or the cysts that are available in many and various sedimentary environments. Almost, always, a very small piece of a suitable sedimentary sample contains some types of palynomorphs which are useful for determining the age or the environmental conditions. Chemical maceration of the sedimentary samples releases plant microfossils even when no macrofossils or other microfossils are present.

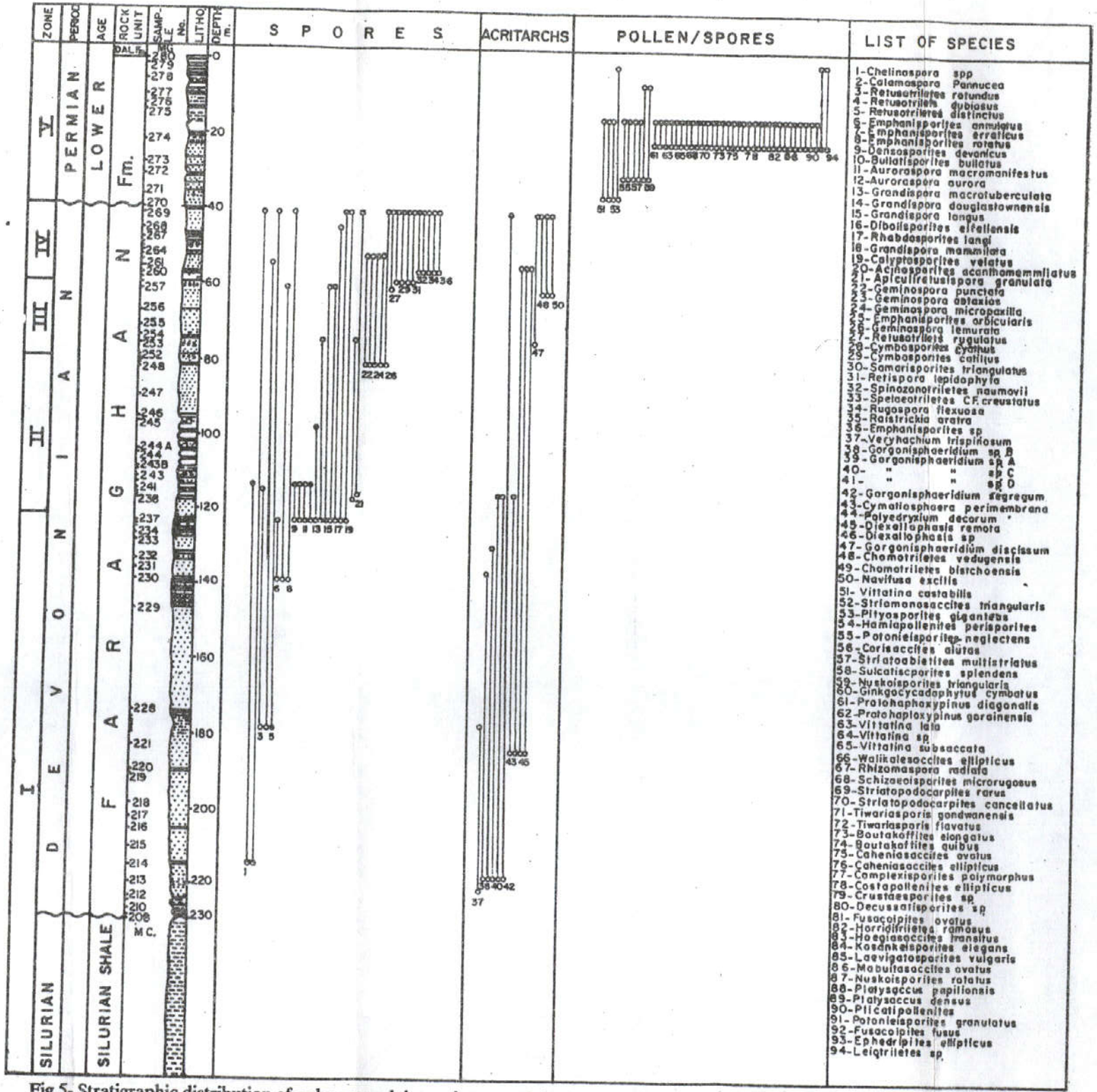

Fig.5- Stratigraphic distribution of palynomorph in section one of the Faraghan formation at Tang-e-Zakeen, Kuh-e-Faraghan.

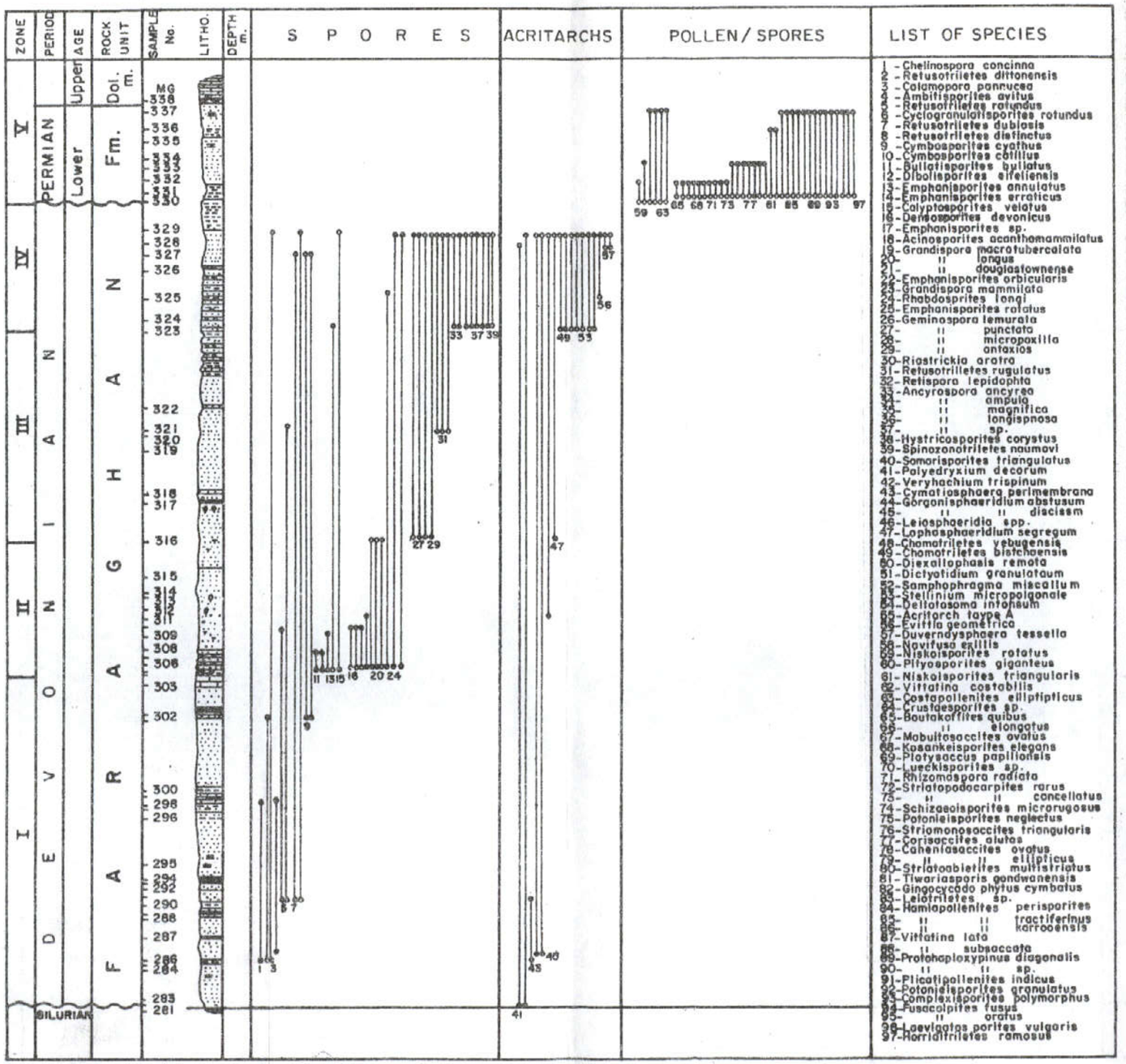

Fig.6- Stratigraphic distribution of pollen/spore and acritarchs in section two of the Faraghan formation at Tang-e-Zakeen, Kuh-e-Faraghan.

Acritarchs are cysts of marine algae which range from Protrozoic to present time, but their greatest significance and high point of abundance is in early paleozoic time. Chitinozoans have the possible affinity of graptolites. They first appeared in Cambrian rocks, but are most abundant in Ordovician. The Chitinozoa highly diminishing in Devonian and they are entirely disappeared by the end of Permian. Pollen and spores are from plant remains. Although very few spore and pollen genera have been found within the sporangia or pollen bearing-structures, but it is very safe to assume that these types are derived from the plant macrofossils. The plants of Paleozoic age have few, if any, modern equivalents. But knowledge of spores and pollen in fertile fossil organs has made it possible to relate some fossil spores and pollen to specific source plants of the paleozoic time.

With some knowledge of source plants and sufficiently characteristic microscopic fossils, one can often make actual microfloristic zonation. Similar studies on the sediments of other geological systems, in other countries have resulted to reconstruct the basic history of earth's vegetation and finally concluded the habitat and specific environments during the deposition.

Palynological reports in Iran, in comparison to those of other countries, are very limited and not more than a few. Which these papers are mainly on general palynological aspects of Devonian-Carboniferous times. But this type of palynological investigation that affects the Paleozoic of various parts of Iran is done for the first time and the author hopes that the results can be a sound foundation for the future palynological information, in the country.

Biostratigraphy of Paleozoic sequence in the Hassanakdar area

From the Hassanakdar area, only samples of Lashkarak, Geirud and the Dorud Formations were palynologically treated for more precise geological age determination. The examined samples yielded a total of 90 palynomorph taxa. Lashkarak foramtion containing acritarchs, Geirud formation yeilded some acritarch and spore associations, while Dorud formation yeilding only spores and some pollen

grains. Based on the encountered of the diagnostic palynomorphs, and comparing the obtained data with the zonal assemblages which have been suggested by others from different conutries, six local assemblage zones can be recognized in Hassanakdar area. These zones from bottom to top are as follows:

Acritarch assemblage zone I.

this zone begins at the base of Lashkarak formation and includes 18.4 m thickness of this unit. It is characterized by the presence of acritarch taxa such as *Acanthodiacrodium bicoronata, Acanthodiacrodium spinum, Cymatiogalea cylindrata, Cymatiogalea diversita, Goniosphaeridium dentatum, Leiosphaeridia* sp., *Vulcanisphaera africana,* and *Vulcanisphaera nebulosa.* This assemblage zone is considered to be the lowermost part of Ordovician (Tremadocian) (Fig.3).

Acritarch assemblage zone II.

This zone with 6 meters thickness is marked by the appearence of more *acritarch* species than zone I. The acritarch species of this zone are: *Acanthodiacrodium complanatum, A.seratimum, A.zonoconstrictum,Arbusculidium filamentosum , A. rommelaerei , Cymatiogalea bellicosa , Cymatiogalea cristata , Cymatiogalea membranispina , Dasydiacrodium polarum , Goniosphaeridium sufflatum , Goniosphaeridium tener , Lophosphaeridium* sp., *Priscotheca raia , Priscotheca tumida and Saharidia downiei.* The encountered acritarchs of this zone represent lower Ordovician (Late Tremadocian to Early Arenigian). So far, the above- mentioned acritarch species of this zone have been recorded from Tremadocian strata of Algerian Sahara, England, Norway, Bohemia, China and Russia. The sedimentary strata of this zone are associated with basaltic igneous rocks. It has been a question to know whether these igneous rocks are post- or syn-sedimentary. Based on the overall palynological data, the basaltic igneous rock materials are post-sedimentary because the natural color of acritarch species have converted from orange into gray color (see Fig. 3).

Acritarch assemblage zone III.

This zone only covers 10.6 meters of upper parts of Lashkarak formation. It is characterized by presence of *Acanthodiacrodium tadlense* , *Acanthodiacrodium vavrdovae* , *Athabascaella penika* , *Athabascaella playfordi* , *Coryphidium elegans* , and *Dactylofusa squama* . Although some species of Zones I and II are exist in this zone but a reduction in number of acritarch species is obvious(fig.3). Based on the above-mentioned acritarch taxa, this zone is considered to be the uppermost part of lower Ordovovican (Arenigian). Since the acritarch species of this zone have been recorded from Arenigian strata of Morocco and China. Moreover the comparison of acritarch taxa of Lashkarak formation including *Acanthodiacrodium* spp., *Arbusculidium filamentosum, Coryphidium elegans* , *Dasydiacrodium polarum, Priscotheca* spp., *Vulcanisphaera africana* , and *Vulcanisphaera nebulosa.* with those that have been recorded from Zagros of Iran, Belgium, England, France, Bulgaria, Czechoslavakia, China, Algeria, Morocco, Tunisia and Saudi Arabia are quite similar. The presence of the above mentioned species of acritarch in the Lashkarak formation represent that the Alborz Mountain Ranges have been a part of Mediterranian acritarch provinces which in turn it has been a part of Gondowanian Landmass.

Acritarch and spore assemblage zone IV :

This zone begins at the base of Geirud formation and covers 123 meters of this rock unit. This zone is characterized by appearance of Late Devonian index acritarch species such as *Chomotriletes bistchoense* , *Chomotriletes vedugensis* , *Deltotosoma intonsum, Gorgonisphaeridium carnarvonense* , *Gorgonisphaeridium discissum* , *Melikeriopalla venulosa* , *Navifusa exilis* , *Papulogabata annulata, Saharidia lusca* , *Stellinium octoaster,* and *Tunisphaeridium flaccidium.* In addition to the above-mentioned index acritarch species, there are also many index spore species in this zone, such as *Calyptosporites proximocavatus* , *Cyclogranisporites isosticus* ,

Dibolisporites turriculatus , *Dictyotrileles sphaericus* , *Grandispora megista* , *Geminospora lemurata* , *Hystricosporites furcatus* , *Lagenicula minutus* , *Retusotriletes pychovii* , *Samarisporites triangulatus*, and *Vallatisporites* devoncus. Several longer-ranging spore and acritarch taxa are also present in this zone(fig.3). This assemblage spore and acritarch species of this zone is considered to be of Early Frasnian in age. Apparently the palynomorph taxa such as *Chomotriletes bistchoense, Chomotriletes vedugensis, Geminospora lemurata* , and *Samarisporites triangulatus* have not yet been recorded from the deposits older than the Frasnian stage.

Acritarch and spore assemblage zone V

This zone is characterized by occurrence of *Diducites mucronatus* which is associated with most of the acritarch and spore species of zone IV. Thickness of this zone, of Geirud formation, is about 237 meters at the site of this study. This zone is considered to be the Late Frasnian in age. In addition to *Diducites mucronatus*, other *species* of uppermost Devonian such as *Cyclogranisporites isostictus* , *Dictyotriletes sphaericus* , *Samarisporites triangulatus* , and *Spinozonotriletes* sp. are also present in this assemblage zone. Among of 53 encountered palynomorph taxa of Geirud formation, most of the species are index forms for Frasnian and a few of them are long-ranging species whithin the whole Devonian period. Therefore based on palynological data of zones IV and V, the Geirud formation has been deposited during the early Upper Devonian (Frasnian) time. One of the most marked aspects of zones IV and V is the occurrence of bifurcating spinous spore species such as *Ancyrospora longispinosa* , and *Hystricosporites furcatus.* These two species have been recorded elsewhere from the Middle Devonian strata. This view may suggest possibility of a Middle Devonian age assignment for this zone. But the numerous Upper Devonian index spore and acritarch taxa , especially , *Chomotriletes bistchoense* , *Chomotriletes vedugensis* , *Geminospora lemurata* , *Lagenicula minuta* ,

and *Samarisporites triangulatus* strongly confine the Geirud formation to the Frasnian age. Hence, it must be assumed that bifurcate spinous spores extend from the Middle to the Upper Devonian in the Alborz Mountain Ranges. A similar pattern has been recorded by Hemer and Nygreen (1967) from the Frasnian deposits of Saudi Arabia, Zagros Basin of Iran (Ghavidel-Syooki,1988) and Frasnian of western Australia (Balme, 1962,1988). It should also mention that there is very much similarity between spore taxa of Geirud formation with southeastern Iran and those of the western Australia. Some of the acritarch species of Geirud formation have also been known from Europe and North America including *Chomotriletes bistchoene* , *Chomotriletes vedugensis* , *Cymatiosphaera perimembrana* , *Stellinium conptum, Stellinium octoaster* , *Tyligmasoma* sp. and *Veryhachium* spp. Many other acritarch species which are listed below, are not only found in the Frasnian of Geirud formation but they have also been recognized in the Frasnian of Zagros basin of Iran as well as in the Frasnian strata of western Australia: *Deltotosoma intonsum, Dictyotidium granulatum, Gorgonisphaeridium carnarvonense, G. condensum, Melikeriopalla venulosa Navifusa exilis* , *Saharidia lusca* , and *Tunisphaeridium flaccidum.* Based on these similarities it would be possible to consider that Alborz Mountain Ranges , Zagros basin , Arabian Penninsula , and the western Australia were at similar palaeolatitude along the southern shore of the Tethys Sea during the late Devonian (Frasnian) time (Fig. 3).

Pollen assemblage zone VI

This zone includes 40 meters and is marked by disappearance of Devonian taxa and appearance of the Lower Permian index pollen species. Consisting of *Complexisporites polymorphus* , *Hamiapollenites perisporites* , *Nuskoisporites rotatus* , *plicatipollenites indicus* , *Potonieisporites granulatus* , *Striatopodocarpites cancellatus* , *Vesicaspora* sp., and *Vittatina contabillis.* These pollen grains appear in the Dorud formation (Fig. 3). Based on, these species, the Dorud formation has

deposited in the Lower Permian (Sakmarian). The Early Permian pollen species encountered from the Dorud formation are similar to those recorded from Lower Permian of the Faraghan formation in Zagros Ranges, Lower Permian of Saudi Arabia , Turkey, Africa and the U.S.A.

Analysis of palynological data in the Khoshyeilagh area

In eastern part of the Alborz Mountains, from Padeha and Khoshyeilagh formations in the Khoshyeilagh area, 55 palynomorph taxa were encountered and identified. From these taxa, 24 are spore species and 31 acritarch species. Comparison of the palynomorph assemblages between this area and those have been recorded from other parts of the world show a close similarity. The identified forms are subdivided into 5 biostratigraphic assemblage zones. Zones one and two occur in the Padeha formation with the age of Early Frasnian (Fig. 2). Zones three and four suggested Middle-Upper Frasnian and zone V reveals the Famennian age. By this study, it is concluded that the Padeha and Khoshyeilagh formations, in the Alborz Ranges have been deposited during the Upper Devonian and not Lower or the Middle parts of this system. Identified zones are arranged in ascending order in five local stratigraphic zones as follows :

Acritarch and spore assemblage zone I

This zone begins a few meters above the conglomerate and white quartzitic sandstones of basal part of the Padeha formation and characterized by presence of *Cymatiosphaera nebulosa, Cymatiosphaera perimembrana, Saharidia lusca,* and *Gorgonisphaeridium discissum.* There are also some organic residues such as black spores and pro-gymnosperm tracheids, associating with the above-mentioned acritarch taxa which are mostly oxidized, perhaps during deposition of the Padeha formation.

Based on the above mentioned diagnostic palynomorph taxa and the pro-gymmosperm tracheids, the lowermost Frasnian age is suggested for this part of

the Padeha formation, since this association has only been recorded elsewhere from the Early Frasnian strata.

Also, the comparison of igneous rocks of Soltan-Maidan formation of Khosyeilagh area with those of within the Ghelli formation of eastern Alborz Range and the Lashkarak formation of Hassanakdar in Central Alborz Range, suggests possibly Lower Ordovician for Soltan Maidan formation. Since the sedimentary strata which surrounding the basalt of both Ordovician formation of Central and Eastern Alborz Ranges contain well-preserved and abundant lower Ordovician acritarch taxa(fig.2).

Acritarch and spore assemblage zone II

This assemblage zone also occurs in the Padeha formation and includes 150 meters from this rock unit. This zone is characterized by appearance of *Papulogabata annulata, Ancyrospora langii, Emphanisporites rotatus , Retusotriletes rotundus Samarisporite triangulatus* which are associated with *Cymatiosphaera nebulosa , Cymatiosphaera perimembrana , Gorgonisphaeridium discissum* and *Saharidia lusca.* Among the above- mentioned palynomorph taxa, several spore and actitarch species are diagnostic forms in the Frasnian age and a few of them are longing-range taxa in the whole Devonian period. Based on some diagnostic Frasnian taxa Including *Ancyrospora langii, Cymatiosphaera nebulosa, Gorgonisphaoridium discissum Papulogabata annulata, Saharidia lusca* and *Samarisporites triangulatus,* This part of Padeha formation in Khoshyeilagh area is considered to be Early Frasnian age. As most of the palynomorph species in this assemblage zone are also comparable with those that have been recorded from the Frasnian strata of France, Canadian Arctic Islands, Belgium, Saudi-Arabia, Early Frasnian of western Australia, United states and the Central Poland.

Acritarch and spore assemblage zone III

This zone begins few meters in the uppermost of the Padeha formation (few

meters below the basal conglomerate of the overlying Khoshyeilagh formation) and continues to 550 meters in the Khoshyeilagh formation(fig.2).

This zone is marked by appearence of *Chomotriletes bistchoense* , *Chomotriletes vedugensis* , *Diexallophasis simplex* , *Duvernaysphaera tenuicingulata*, *D. tessella*, *Helosphaeridium guttatum*, *Navifusa exilis* , *Polyedryxium embudum* , *Calamospora pannuceae* , *Cyclogranisporites isostictus* , *Dibolisporites turriculata* , *Geminospora lemurata* , *G. punctata* , *Grandispora mammillata* and *Samarisporites triangulatus*. Some of the species of this assemblage , such as *Calamospora pannuceae* , *Duvernaysphaera tenuicingulata* , *D. tessella* , and *Polyedryxium embudum* are longing-range and their extensions have been recorded through the whole Devonian period, But the other forms with more restricted age have only been recorded from the Frasnian of elsewhere.

In this study and based on all the above-mentioned diagnostic taxa a Middle Frasnian age is suggested for this interval of Padeha and Khoshyeilagh formations. Therefore there is a "hiatus" at the base of Padeha formation in the Khoshyeilagh area that includes Silurian and Lower-Middle Devonian. This Conclusion is derived form the presence of *Chomotriletes bistchoense* , *Chomotriletes vedugensis* , *Cyclogranisparites isostictus* , *Geminospora lemurata* , *Grandisporites mammillata* , and *Samarisporites triangulatus*. These species have been reported from Frasnian strata of North America, western Australia, Saudi Arabia, Russia and Iran.

Acritarch and spore assemblage zone IV

This zone immediately follows zone III and includes 875 meters thickness of the Khoshyeilagh formation. This zone is characterized by occurrence of *Crameria pharaonsis*, *Cymatiosphaera fistulosa* , *Cymatiosphaera parvicarina*, *Cymatiosphaera platoloma* , *Deltotosoma intonsum* , *Estiastra rugosa*, *Stellinium comptum*, *Stellinium octoaster* , *Tylotopalla pyramindale* , *Veryhachium arcarium* , *Archaeoperisaccus opiparus* , *Calyptosporites proximocavatus* , *Dictyotriletes subgranifer* , *Grandispora fibrilabrata* , *Lagenicula minutus* , *Rhabdosporites langii* , *Samarisporites galeatus* ,

and *Samarisporites praeterrisus.* Among the above mentioned palynomorphs , certain species such as *Rhabdosporites langii, Stellinium comptum* and *Stellinium octoaster* are longing-range through Middle-Upper Devonian but the rest of them appear in the Frasnian-Famennian strata.

In addition to the above-mentioned palynomorph assemblag, some acritarch and spore species of zone III also persist into the zone IV. These forms are *Chomotriletes bistchoense* , *Chomotriletes vedugensis Papulogabata annulata* , *Geminospora lemurata* , and *Samarisporites triangulatus(fig.2).* Based on the first occurrence of some palynomorph taxa in zone IV and presence of morphotype species of zone III, this assemblage zone is considered to be Upper Frasnian or possibly Upper Frasnian to Lower Famennian age. The mentioned assemblage palynomorph taxa of zone IV are similar to those have been recorded from Upper Devonian of North America, Western Australia, Frasnian of England , Upper Devonian of Russia, France, and also Upper Devonian of Southeastern Iran.

Acritarch and spore assemblage zone V

This assemblage zone includes 320 meters of the upper part of Khoshyeilagh formation. Zone V is distinguished by presence of the following diagnostic palynomorph taxa such as *Auroraspora hyalina* , *Crassiangulina tessellita* , *Diducites mucronatus* , and *Retispora lepidophyta(fig.2).* All species which occur in this zone are diagnostic for the Famennian stage. Most of the palynomorph taxa of zone IV disappear in the basal part of this zone but some of them persist into the assemblage zone V, consisting of *Ancyrospora langii* , *Crameria pharaonsis* , *Deltotosoma intonsum* , *Estiastra rugosa* , *Papulogabata annulata* , and *Retusotriletes distinctus.* The interval of zone V of Khoshyeilagh formation is considered to be Famennian in age. The encountered assemblage of this zone is comparable with those have been recorded from Famennian strata of southern Irish Republic, North America, and England.

Biostratigraphy of Padeha and Khoshyeilagh formations in Kuh-e-Ozom, Kopeh-Dagh region

In this chapter, the palynomorph taxa of Padeha and Khoshyeilagh formations of Kuh-e-Ozomin in the Kopeh-Dagh Region are discussed. The encountered palynomorphs consist of acritarchs spores, chitinozoa and scolecodents. In here, the last two groups are neglected as they are very limited in numbers , and the specimens are not more than a couple of varieties. On the other hand, the acritarchs and spores are numerous and can be used for all phases of palynology. The preparations of 100 surface samples were contained 74 palynomorph taxa, including 22 spore genera with 33 species and 24 acritarch genera with 41 species. This association are arranged in four local ascending stratigraphic assemblage zones (Fig. 1). The treated zonal assemblages are classified alphabetically by genera and species. Zones I through III occur in the Padeha formation and represent Early Frasnian age. Zone IV appears in Khoshyeilagh formation and suggests the Late Frasnian to Famennian. Before this palynological investigation the Padeha formation was assumed to be Lower Devonian and Khoshyeilagh formation assigned as the Middle and Upper Devonian ages.

Acritarch and spore assemblage zone I

This assemblage zone begins at the base of Padeha formation and includes 53 out of 340 meters of the total thickness of this rock unit. This assemblage zone is characterized by acritarch and spore species such as *Chomotriletes bistchoense* , *Chomotriletes vedugensis* , *Cymatiosphaera adaiochorata* , *Cymatiosphaera perimembrana* , *Cymatiosphaera spicigera* , *Diexallophsis remota* , *Duvernaysphaera tenuicingulata* , *Gorgonisphaeridium condensum* , *Gorgonisphaeridium discissum* , *Helosphaeridium psilata* , *Lophosphaeridium deminutum* , *Polyedryxium decorum* , *Veryhachium europeum* , *Visbysphaera conica* , *Calyptosporites stolidotus* , *Cyclogranisporites rotundus* , *Dictyotriletes sphaericus* , *Emphanisporites annulatus* , *Emphanisporites rotatus* , *Geminospora lemurata* , *Grandispora fibrilabrata* ,

Raistrickia aratra , *Retusotriletes distinctus* , *Retusotriletes pychovii* , *Retusotriletes rotundus* , *Retusotrilete rugulatus* and *Rugulatisporites iranica.* Among this assemblage of palynomorphs, several species have only been recorded elsewhere form the Early Frasnian sediments. These species are *Chomotritetes bistchoense* , *Chomotriletes vedugensis, Cymatiosphaera adaiochorata, Cymatiosphaera spicigera, Lophosphaeridium deminutum, Calyptosporites stolidotus, Dictyotriletes sphaericus, Geminospora lemurata* , *Grandispora fibrilabrata* , and *Retustriletes pychovii* (fig.1). Except for these index taxa, the rest of palynomorphs are long-ranging species in the whole Devonian period (Figs. 7-8). Based on these index taxa, this assemblage zone of Padeha formation is considered to be Late Devonian, indeed Early Frasnian. This assemblage zone of Padeha formation is comparable with those that have been recorded from Frasnian of Canadian Arctic Islands, U.S.A., Belgium, Poland, Saudi Arabia and western Australia.

Acritarch and spore assemblage zone II

This assemblage zone is characterized by occurrence of *Ancyrospora langii* , *Apiculatisporites adavalensis* , *Apiculatisporites* sp., *Calyptosporites proximocavatus, Cymatiosphaera craticula* , *Cymatiosphaera subtrita* , *Dibolisporites turriculatus* , *Duvernaysphaera tessella* , *Grandispora megista* , *Michrystridium coronatum* , *Multiplicisphaeridium ramosculosum* , *Navifusa exilis* , *Papulogabata annulata* , *Saharidia lusca* , *Stellinium octoaster* , *Synsphaeridium catenarium* , *Veryhachium downiei and Veryhachium lairdi* (fig.1).

This zone includes 127 meters of member "b" of the Padeha formation that consists of mainly gypsum layers, alternation with subordinate shales and dolomites. Among the palynomorph taxa of zone II, there are certain Frasnian diagnostic taxa, consisting of *Ancyrospora langii* , *Calyptosporites proximocavatus* , *Dibolisporites turriculatus* , *Cymatiosphaera craticula* , *Cymatiosphaera subtrita* , *Grandispora megista* , *Michrystridium coronatum* , *Navifusa exilis* , *Papulogabata annulata* ,

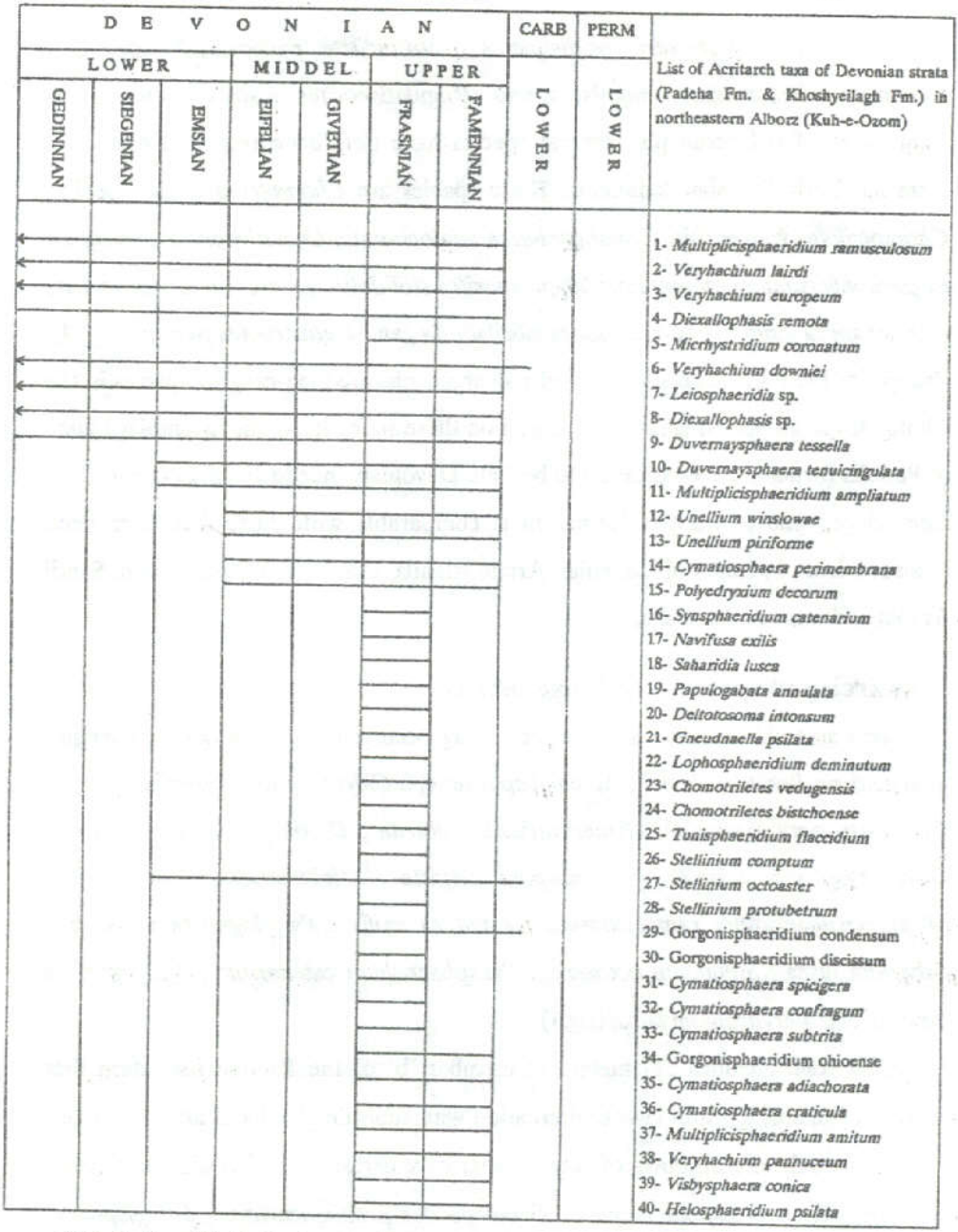

Fig.7- Stratigraphic distribution of Devonian acritarch taxa in Padeha Fm. & Khoshyeilagh Fm. in Kuh-e-Ozom, at Kopeh-Dagh region.

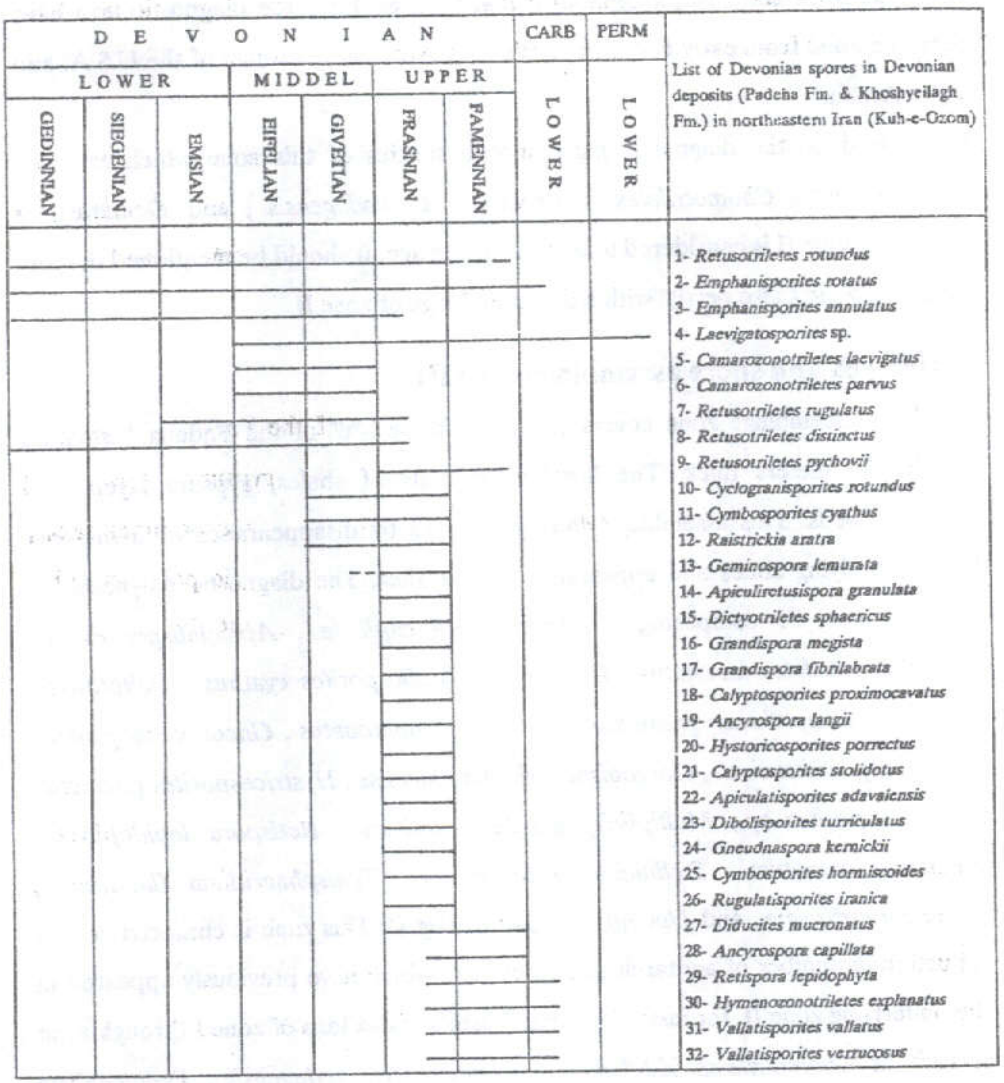

Fig.8- Stratigraphic distribution of spore taxa in Devonian strata (Padeha Fm. & Khoshyeilagh Fm.) in Kuh-e-Ozom at Kopeh-Dagh region.

Saharidia lusca and *Synsphaeridium catenarium*. So far these diagnostic taxa have been recorded from early Frasnian of Western Australia, Frasnian of the U.S.A. and Saudi Arabia.

Based on the diagnostic palynomorph species of this zone which are also associated with *Chomotriletes bistchoense* , *C. vedugensis* , and *Geminospora lemurata* , zone II is considered to be Frasnian in age. It should be mentioned that the species of zone I also persist within the assemblage of zone II.

Acrictarch and spore assemblage zone III.

This assemblage zone covers members "c" and "d" of the Padeha formation and is 239 meters thick. The lithology consists of shales, gypsum layers and limestone beds. This assemblage zone is marked by disappearance of many taxa from underlying zones and appearance of new taxa. The diagnostic palynomorph taxa of zone III composing of *Ancyrospora capillata* , *Apiculatisporites* sp., *Camarozonotriletes laevigatus* , *C. parvus* , *Cymbosporites cyathus* , *Deltotosoma intonsum* , *Dictyotidium granulatum* , *Diducites mucronatus* , *Gneudnaella psilata* , *Gneudnaspora kernickii* , *Gorgonisphaeridium ohioense* , *Hystricosporites porrectus*, *Laevigatosporites* sp., *Multiplicisphaeridium amitum* , *Retispora lepidophyta* , *Stellinium comptum* , *Stellinium protubertrum* , *Tunisphaeridium flaccidum* , *Unellium piriforme* , and *Unellium winslowae* (fig.1). This zone is characterized by reduction in number of acritarch and spore taxa which have previously appeared in the underlying zone II, for instance, some Frasnian index taxa of zone I through zone II such as *Chomotriletes bistchoense* , *Chomotriletes vedugensis* , *Papulogabata annulata* , *Stellinium octoaster* and *Synsphaeridium catenarium* still persist in the base of this zone. Moreover, many species which appear in the underlaying zones completely disappear in the top of this zone. The best age proposal for this zone is Late Frasnian as the following forms have been recorded elsewhere from the Upper Frasnian strata: *Deltotosoma intonsum* , *Dictyotidium granulatum* , *Diducites*

Palynomorphs known from Devonian sediments of northeastern Alborz (Kuh-e-Ozom)	S. & N. IRAN	Australia	Africa (Algeria)	North America (U.S.A & Canada)
	Ghavidel-syooki,1988 Ghavidel-syooki,1992 Coquel et al.,1977 Mohammad-Beiggi,1991 Saburi,1991	Playford & Dring,1981 Playford,1981 Blame,1962	Jardin et al.,1977 Coquel et Moreau-Benoit, 1986	Staplin,1961 Wicander,1974,1977 Wicander & Loeblich,1977 Wicander & Playford,1985
Synsphaeridium catenarium	+	+	–	–
Lophosphaeridium deminutum	+	+	–	–
Duvernaysphaera tenuicingulata	+	+	–	+
Cymatiosphaera spicigera	+	+	–	–
Cymatiosphaera confragum	+	+	–	–
Helosphaeridium psilata	+	+	–	+
Unellium winslowae	+	+	–	+
Unellium piriforme	+	+	–	+
Veryhachium downiei	+	+	–	+
Veryhachium lairdi	+	–	+	+
Cymatiosphaera craticula	+	–	–	+
Multiplicisphaeridium ampliatum	+	–	–	+
Diexallophasis remota	+	–	–	+
Veryhachium pannuceum	+	–	–	+
Micrhystridium coronatum	+	–	–	+
Tunisphaeridium flaccidum	+	+	–	–
Saharidia lusca	+	+	–	–
Cymatiosphaera subtrita	+	+	–	–
Multiplicisphaeridium ramusculosum	+	+	+	+
Melikeriopalla venulosa	+	+	–	–
Stellinium octoaster	+	–	+	+
Stellinium comptum	+	+	+	+
Stellinium protubetrum	+	–	+	+
Gneudnaella psilata	+	+	–	–
Gorgonisphaeridium ohioense	+	–	–	+
Cymatiosphaera adaiochorata	+	–	–	+
Duvernaysphaera tessella	+	+	+	+
Cymatiosphaera perimembrana	+	–	+	+
Polyedryxium decorum	+	–	+	+
Visbysphaera conica	+	–	–	+
Gorgonisphaeridium condensum	+	+	–	–
Gorgonisphaeridium discissum	+	+	–	–
Navifusa exilis	+	+	–	–
Chomotriletes vedugensis	+	+	–	+
Chomotriletes bistchoense	+	–	–	+
Deltotosoma intonsum	+	+	+	–
Papulogabata annulata	+	+	–	–
Apiculiretusispora granulata	+	–	–	+
Dibolisporites turriculata	+	+	–	–
Retusotriletes distinctus	+	+	–	+
Retusotriletes rugulatus	+	–	–	+
Ancyrospora capillata	+	–	–	+
Retusotriletes rotundus	+	+	–	+
Retusotriletes pychovii	+	+	–	+
Gneudnaspora kernickii	+	+	–	–
Cymbosporites cyathus	+	+	–	+
Ancyrospora langii	+	+	–	+
Hystricosporites porrectus	+	–	–	+
Geminospora lemurata	+	+	–	+
Samarisporites triangulatus	+	+	–	+
Laevigatosporites sp.	+	–	–	+
Emphanisporites annulatus	+	+	–	+
Emphanisporites rotatus	+	+	+	+
Cyclogranisporites rotundus	+	+	–	–
Dictyotriletes sphaericus	+	–	–	–
Grandispora megista	+	+	–	–
Vallatisporites verrucosus	+	–	–	+
Calyptosporites stolidotus	+	+	–	–
Calyptosporites proximocavatus	+	+	–	–
Cymbosporites hormiscoides	+	–	–	+
Raistrickia aratra	+	+	–	+
Grandispora fibrilabrata	+	+	–	–
Diducites mucronatus	+	–	–	+
Camarozonotriletes parvus	+	–	–	+
Camarozonotriletes laevigatus	+	–	–	+
Retispora lepidophyta	+	–	–	+
Apiculatisporites adavalensis	+	+	–	–
Hymenozonotriletes explanatus	+	+	–	+
Vallatisporites vallatus	+	+	–	+

Fig.9- Comparison of Devonian palynomorph taxa of Kuh-e-Ozom (Kopeh-Dagh region) with other parts of the world.

mucronatus , *Gorgonisphaeridium ohioense* , *Gneudnaspora kernickii* , *Retispora lepidophyta* , *Tunisphaeridium flaccidum and Veryhachivm pannuceum.*

Acritarch and spore assemblage zone IV

This assemblage zone occurs in the Khoshyeilagh formation, including 102 out of 209 meters thickness of this rock unit. The Khoshyeilagh formation is differentiated from the Padeha formation by a white quartzitic sandstone and follows upward with fossiliferous limestones, shales, and finally basaltic igneous rock. The upper part of Khoshyeilagh formation lacks of palynomorph taxa but the lower part contains well-preserved palynomorph species, consisting of *Diducites mucronatus* , *Hymenozonotriletes explanatus* , *Vallatisporites vallatus* , and *Vallatisporites verrucosus.* Likewise, some acritarch and spore taxa from underlying zones persist in this zone which consist of *Ancyrospora capillata* , *Calyptosporites proximocavatus* , *Cymatiosphaera perimembrana* , *Cymatiosphaera subtrita* , *Deltotosoma intonsum* , *Gorgonisphaeridium ohioense* , *Grandispora fibrilabrata* , *Gandispora megista* , *Hystricosporites porrectus* , *Leiosphaeridium* sp., *Multiplicisphaeridium ramusculosum* , *Raistrickia aratra* , *Retispora lepidophyta* , *Stellinium comptum* , *S.octoaster* , *Unellium piriforme, Unellium winslowae* , *Veryhachium downiei* , *Veryhachium lairdi* , *and Veryhachium pannuceum* (fig.1). This zone is considered to be Late Devonian, probably Latest Frasnian-Early Famennian. Since certain diagnostic palynomorph taxa represent in this zone including *Ancyrospora capillata* , *Ancyrospora langii* , *Calyptosporites proximocavatus* , *Deltotosoma intonsum* , *Diducites mucronatus* , *Grandispora megista* , *Hystricosporites porrectus* , *Hymenozonotriletes explanatus* , *Vallatisporites vallatus, Vallatisporites verrucosus* , and *Stellinium octoaster* have been recorded from Famennian of western Australia, southern Irish Republic and Late Devonian of U.S.A (Fig. 9).