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Occurrences of Perlite Deposits in Yemen

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ABSTRACT

Yemen, which is lies in South West Asia country, in recent years has been known to occasionally produce small quantities of industrial rocks and minerals. Perlite is deposit of comparatively recent interest, it was first described as; a glassy rhyolite, the perlite occurrences are almost always associated with Cenozoic (Tertiary) volcanic rocks of Yemen as; rhyolitic, agglomerate and volcanic tuff, it widespread in various districts in Yemen, among Taiz and Ibb, Thamar districts..etc.

Yemeni perlite deposits ranges in colour from greyish black, greenish black to almost black and has vitrophyric structures, waxy to pearly luster and resemble obsidian rock futures. The perlitic deposits vary in thickness from a few to tens meters, appears as thick to discontinuous layer-shaped, masses that cover several tenth meters and domes.

Petrographic study shows that the Yemeni perlite rocks/ deposits are composed mainly of more than 65% silica groundmass with embedded phenocrysts of quartz, chalcedony, K-feldspars, plagioclase pyroxene, chlorite and iron oxides, showing the similarity with silica groundmass more than 65% Toloshi-Georgian perlite with phenocrysts of chalcedony, orthoclase, sandine, plagioclase, pyroxene, biotite, chlorite and iron oxides.

Chemical analysis shows that the majority of studied Yemeni perlite rocks/ deposits have silica content ranging from 69.99 – 73.22 wt.% with an average 71.07 wt.% and water content from 2.04 – 3.30 wt.% with an average 2.96 wt.%, compared with chemical analysis of the Georgian perlite; silica and water content with an average 71.20 wt.% and 3.46 wt.% respectively, while commercial perlite content silica > 65 wt.% and water content range from 2 – 5 wt.%.

The uses of expanded perlite are many /varied and based primarily upon its chemical and physical properties where perlite has the unusual characteristic of expanding to about 20 times its original volume when heating up to above 871 °C (1600 °F). Perlite deposits in the Yemen volcanic districts were estimated to have resources of at least 65 – 335 million cubic meters.

Key words: Yemeni perlite, perlite.

INTRODUCTION

Perlite is not a trade name but a generic term for a naturally according siliceous rock. Perlite is deposit/rock has comparatively recent interest; it was first described as a glassy rhyolite. Yemen, which is lies in South West Asia country, its embraces the southern corner of the Arabian Peninsula bordering the Red Sea and the Gulf of Aden (Fig. 1), in recent years has been known to occasionally produce small quantities as; clays, granite, limestone, marble, salt, gypsum, magnesite, perlite, pumice, sand and other mineral of potential economic interest included; zinc- lead, gold, copper, nickel and iron. Some other minerals are also available and are exploited in limited extent.

The perlite occurrences are almost always associated with Cenozoic volcanic rocks belong to upper Tertiary "Yemen Volcanic Group" (e.g; rhyolitic, dacite, ignimbrites and volcanic rhyolitic tuff). It widespread in various districts in Yemen as: Thamar , Ibb, Sana'a, Aden, Al-Baydha and Taiz districts (Fig. 1). Perlite crop out as a kind of layers and dome shaped extrusive bodies, the jointing of the rock is mostly prismatic (columnar), thinner layers (beds/sills) of the rock are disintegrated to small fragments. Also, the perlite deposits occur as; lenses of irregular shape associated with rhyolitic lavas as flows with thicknesses ranging from a few to tens of meters.

perlite is characterized by black or deep green grey in colour, compact, hard or weathered and as a rule contain feldspar, pyroxene phenocrysts and glassy ground mass with vitrophyric structures and perlitic textures. Its petrochemical composition corresponds to rhyolite, layered deposits of volcanic glass (perlite) formed during rapid cooling of acid lavas at the surface. The volume of perlite rock increases from 4 to 20 times at temperature of about 860 to 1200°C and produces expanded perlite [1]. The testing physical properties that were done roughly on perlite indicate the perlite deposit in Yemen is suitable for use and trading at least in local markets. The apparent reserves of perlite in some areas were estimated to be about 65–335 million m^3 [2, 3].

The objective of this study is to investigate the occurrences and origin of perlite deposits in Yemen. In addition, spotlight on the general appropriate usability of perlite's in different fields.

METHODOLOGY

Field work involved collecting suitable representative samples of perlite including associated volcanic rocks in studied districts; Taiz and Ibb, Thamar. Field description, measurements and photographs were done, then followed by lab work as: preparation and study (15) thin sections were prepared carried out at the laboratories of the Geological Survey and Mineral Resources Board (GMRB), Sana'a, Yemen and those thin-sections slides were studied under professional petrographic microscope. Chemical analysis of (9) samples to determine the major oxide contents and the water percentage of the perlites were done. Chemical analyses of nine collected samples were carried out by unit Model ARL 9800 XP SIM-SEQ XRF - Technique in Amran Cement Plant (ACP) - Yemen.

GEOLOGICAL SETTING

The unique geological setting of Yemen has provided suitable for the deposition of abundant natural resources, it is characterized by a wide diversity of main rock units, which

range in age from Precambrian to Holocene [4,5,6,7,8], related to the Tertiary Period,. Perlite deposit is associated with rhyolite and acidic volcanic tuff. It is found as lava flows, massive, columnar beds, as domes, lenses, irregular shape and layers or sills (Figs. 2a-f) associated with "Yemen Volcanic Group" (Cenozoic volcanic rocks) of Yemen (Fig. 1). Generally perlites are found as flows with thicknesses ranging from a few to tens meters and commonly characterized by vitrophyric structures and perlitic textures.

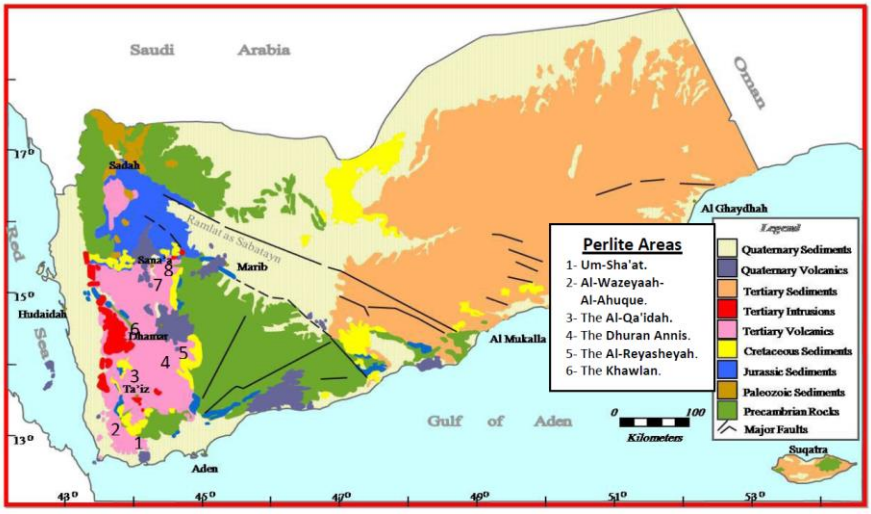

Fig. 1: Geologic Map of Yemen shows Perlite Deposits Occurrences, modified after [9].

PERLITE OCCURRENCES IN YEMEN

Several occurrences with economic potential occur in Yemen:, the major perlite deposits not restricted to the major following districts as; Aden -Um-Sha'at, Thamar -Dhuran Annis, Taiz -Wazeyaah, Ibb -Al-Qa'idah, Al-Baydha -Al-Reyasheyah and Sana'a -Khawlan (Fig. 1), but there are many known minor occurrences are exposed withen and the vicinity of those districts. Perlite is found associated with porphyritic – rhyolitic lavas/tuffs, obsidian, pitchstones, and agglomerate of Tertiary volcanic rocks that covered most northwest mountainous areas (Fig. 1), the construction development of new roads may lead to discovery of new exposures of perlite deposits in Yemen. The main occurrences will discuss in the next paragraphs as:

1- Aden District (The Um-Sha'at Area)

The perlite deposit is situating 44° 03' 30" E and 14° 54' 11" N about 297 Km north – west of Aden City in between Wadi Showrega and Wadi Battan (see Fig. 1). It appears as massive perlite, domes with greenish black to black in colour and associated with acidic volcanic glasses of the Ad Dali. They were tentatively sampled and analyzed as potential resources of expanded perlit [2, 3, 10].

2- Taiz District (The Al-Wazeyaah-Al-Ahuque Area)

The Al-Wazeyaah-Al-Ahuque perlite deposit is located approximately 60 Km southwest of Taiz City 43° 44' 37" E and 13° 17' 42" N, it is found in large deposits associated with a naturally occurring rhyolitic, volcanic glass rock and zeolite deposits (see Fig. 1). The deposit with other acidic rocks occurs as medium plateaus and hills with gentle topography and easy to access through asphaltic road, covers more than 400 m^2 and is found at the surface associated with zeolite deposits, rarely without covered by any rock types. The perlite occurs as grey to blackish grey-black, flow layers (Fig. 2d,f) and sometimes columnar, with thicknesses ranging from 5 – 12 m. The apparent reserves of perlite are estimated to be in Al-Wazeyaah about 13 million m^3 [2, 3].

There are many small exposures of perlite layers - domes in west-southwest Taiz City, namely (e.g.: Al-Ruby'ay, Ramada, Hagdah and Al-Barh) areas and east-southeast Taiz City (e.g.: Al-Addanah area is situated 44◦ 05' 00" E and 13◦ 34' 12" N about 5 Km east Taiz City. At all sits associated with zeolite deposits within acidic-rhyolite rocks/tuffs.

3- Ibb District (The Al-Qa'idah Area)

Perlite deposit in Al- Qa'idah is situated 44° 06' 59" E and 13° 45' 30" N about 60 Km southwest of Ibb City (see Fig. 1), perlite exposed on the distances range from 3-12 Km west to southwest of Al- Qa'idah City center. perlites were discovered as one of the products of layered acidic Tertiary volcanism in many places around the area associated with rhyolitic tuff and zeolite (see Fig. 2e), but this area is has a low potential resource because it is nearby of villages buildings. More locations of perlite associated with zeolite within Al-Qa'idah area such as; Jabal Al-Hard area is situated 44° 03' 15" E and 13° 46' 00" N about 16 Km west of Al-Qa'idah City, Al-Qubbah area is situated 44° 04' 45" E and 13° 46' 15" N about 8 Km southwest of Al-Qa'idah, Al-Kharf area is situated 44° 10' 00" E and 13° 55' 00" N about 8 Km south of Al- Qa'idah City.

Furthermore, there are some minor perlite occurrences within Ibb district as; Aryan area is situated 44° 13' 00" E and 14° 15' 15" N about 38 Km northwest, Wadi Zarah area deposit is situated 44° 14' 50" E and 14° 17' 30" N about 20 Km west of Yarrim nearby Aryan area, Wadi Bana Area, exposed at 44° 50' 19" E and 14◦ 16' 30" N, Jabal Sumarah lies between the latitudes 14º 8' 00" and 14º 13' 00" E and longitudes 44º 11' 01" and 44º 18' 00" N at different elevations.

4- Thamar District (The Dhuran Annis Area)

The perlite deposit in the Dhuran Annis is situated 44° 15' 13" E and 14° 43' 42" N about 48 Km northwest of Thamar City (see Fig. 1), Dhuran-Annis area represent the main occurrence of perlite in Thamar District, lies Between Dhuran and Bayt Al-Umaisy, there is a high plateau with gentle to medium topography and formed of massive perlite, varies in thickness from 10 – 80 m. The deposit is approximately 5 Km^2 and its mostly will exposed at the surface, without covered by any rock types (see Fig. 2a,b). The area is also a suitable for potential resource due to easy to open quarry and access through paved or unpaved roads. The apparent reserves of perlite are estimated to be about 36 million m^3 in Annis [2, 3, 11].

There are some minor perlite occurrences are recorded/exposed in several areas lies surrounding the main area, they lies at west- northwest of Thamar district as: Dhi-Mansa, Naqil-Annis, Bani-Assad, Bani-Samhi, Wadi Al-Qathb, Najd Al-Sa'ad, Naqil-Bani Salama are associated with obsidian-ryholite - ryholitic tuff. In addition, Marya'a area is situated 44° 16' 00" E and 14° 29' 25" N about 16 Km southwest of Thamar City, Jabal haddad area

is situated 44° 08' 00" E and 14° 32' 00" N about 50 Km northwest of Thamar City, Sawad Al-Hada'a area is situated 44° 24' 00" E and 14° 44' 00" N about 27 Km northeast of Thamar City, Al-Qulah area is situated 44° 34' 55" E and 14° 27' 00" N about 18 Km northeast of Thamar City, and Al-Gubah area is situated 44° 15' 30" E and 14° 32' 00" N about 14 Km northwest of Thamar City.

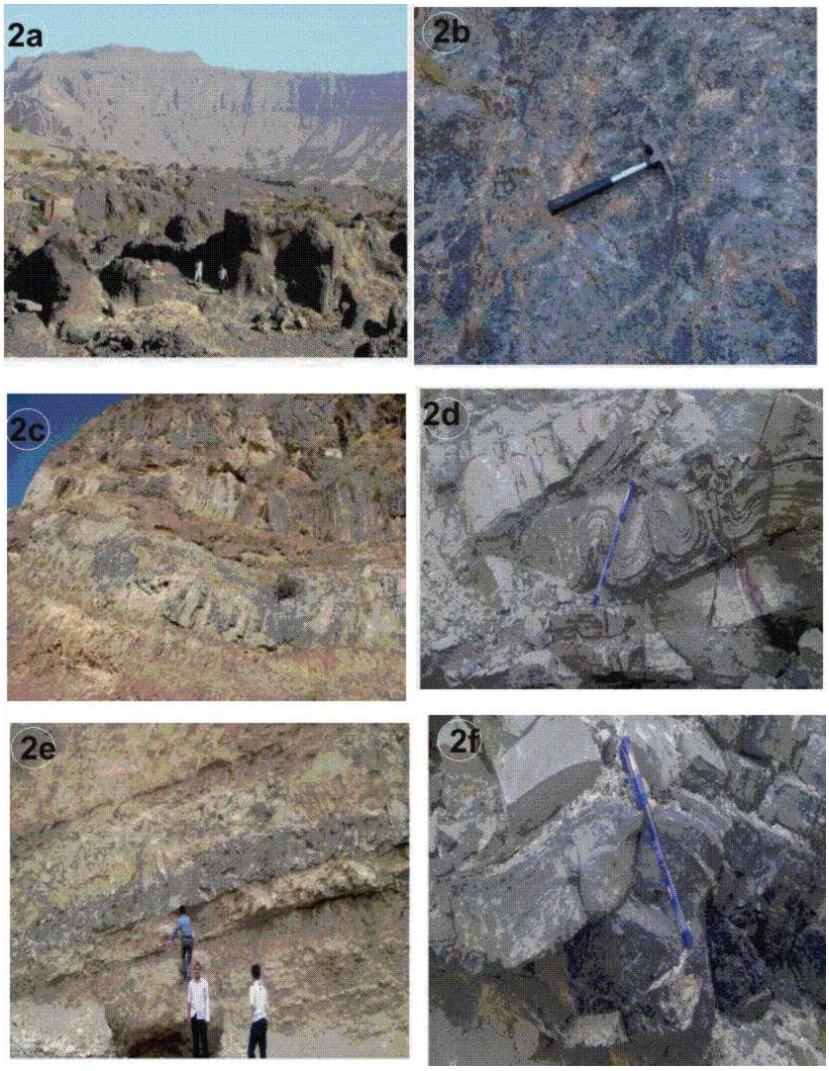

Fig. 2: Photographs Showing; (a) Well exposed perlite from Bayt Al-Umaisy - Annis, (**b**) Massive perlite from Dhuran -Annis, (**c**) Columnar perlite from Al-Qa'idah - Ibb, (**d**) Flow perlite from Al-Wazeyaah -Taiz, (**e**) Layer of perlite from Al-Qa'idah -Ibb and (**f**) Lens of perlite from Al-Wazeyaah - Taiz.

5- Al-Baydha District (The Al-Reyasheyah Area)
Perlite deposit is situated 44° 35' 11" E and 14° 14' 03" N about 120 Km south - west Thamar City (see Fig. 1). There is medium plateau with gentle to medium topography, its formed of massive perlite, varies in thickness and black colour. Also a suitable for potential resource due to easy to open quarry and access [2, 3].

6- Sana'a District (The Khawlan Area)
Perlite rocks are crop out at Bait Al-Qeyarie locality 44° 20' 39" E and 14° 48' 11" N, Khawlan area, which lies about 60 Km (see Fig. 1). southeast of Sana'a City, perlite deposits are considered to be of good quality for industrial uses [12]. Several occurrences with low economic potential occur nearby Sana'a district as; Blad Al-Rouse which lies about 30 south Sana'a, some perlite lens and beds are exposed nearby asphaltic Sana'a-Taiz road within acidic rhyolite tuff.

PETROCHEMISTRY AND ORIGIN

Petrographically, the perlite deposit is defined as a natural hydrated volcanic glass that exhibits a pearl like luster with perlitic textures [13], its characterized by black or deep green-grey in colour contain vitrophyric structures and compact (Fig. 3). Perlite display concentric onion-skin like fractures in hand sample or in thin section with perlitic separations within the rock mass, some flow lines can be noticed (Fig. 4), sometimes interrupted by small spherulites; the perlite formed of crystals of feldspar phenocrysts ranging in size from 2 - 5 mm and very rarely pyroxene minerals embedded in the amorphous silica groundmass associated with chalcedony, quartz, chlorite, sometimes sanidine, carbonate, epidote, sericite, zeolit iron oxides (Figs 5-10) and they are characterized by onion perlitic texture, spheriolite structure, vitrophyric structure and glomerophyric texture (Figs 11-16).

Fig. 3: Photographs Showing; colours of perlite and vitreous structure from Dhuran Annis.

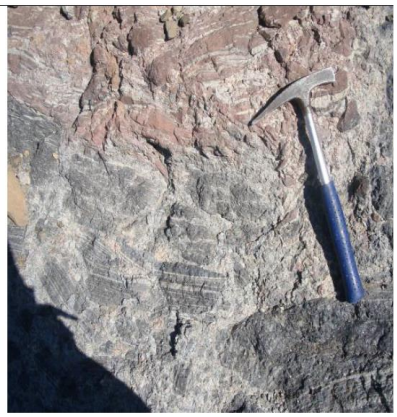

Fig. 4: Photographs Showing; the perlite mass and flow lines from Bayt Al-Umaisy Annis.

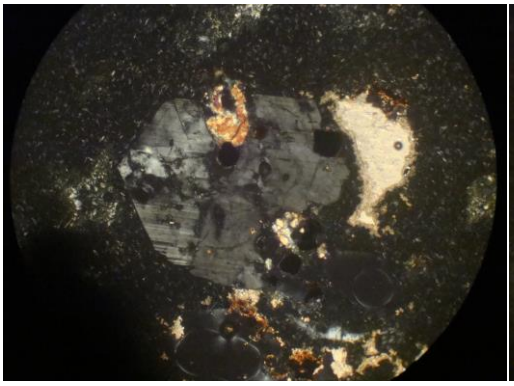

Fig. 5: Photomicrograph showing feldspar and pyroxene with carbonate, C.N. 10X.

Fig. 6: Photomicrograph showing plagioclase embedded in glassy ground mass, C.N. 10X.

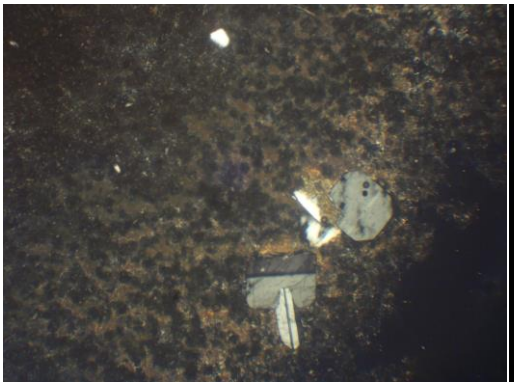

Fig. 7: Photomicrograph showing twinning, deformation and intersect plagioclase crystals, C.N. 10X.

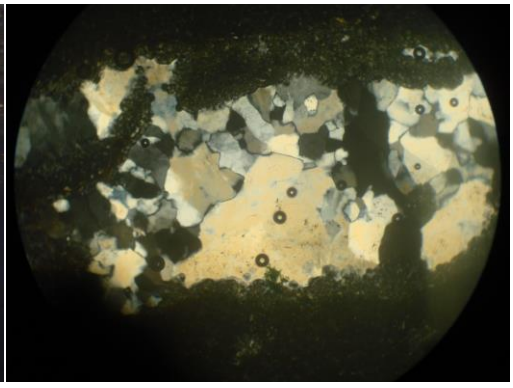

Fig. 8: Photomicrograph showing pocket of quartz in perlite rock thin section, C.N. 20X.

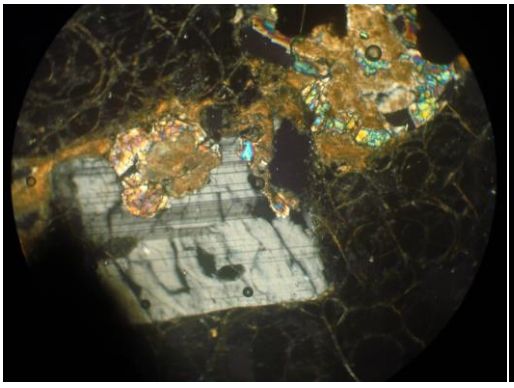

Fig. 9: Photomicrograph showing altered plagioclase to sercite and chlorite after pyroxene, C.N. 20X..

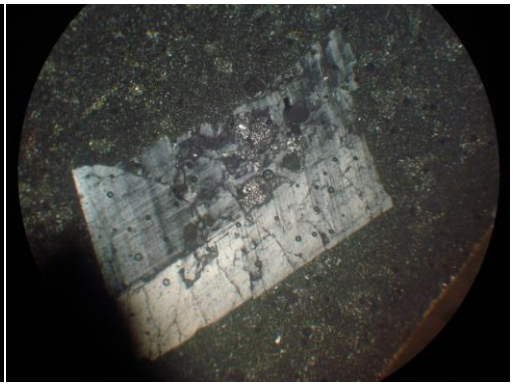

Fig. 10: Photomicrograph showing altered plagioclase, C.N. 20X.

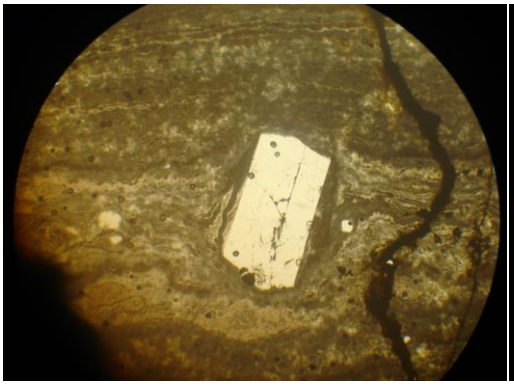

Fig. 11: Photomicrograph showing rhyolitic flow texture and veinlet of iron oxide, C.N. 10X.

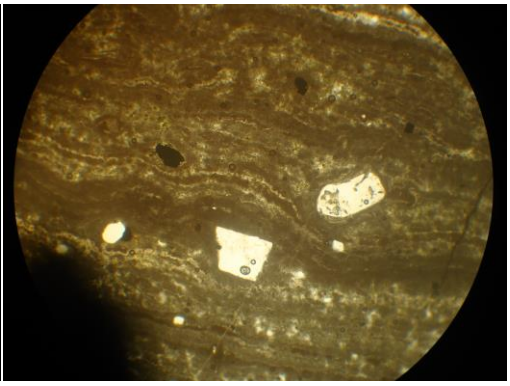

Fig. 12: Photomicrograph showing a flow texture, C.N. 10X.

Fig. 13: Photomicrograph showing typical onion perlitic texture, C.N. 10X.

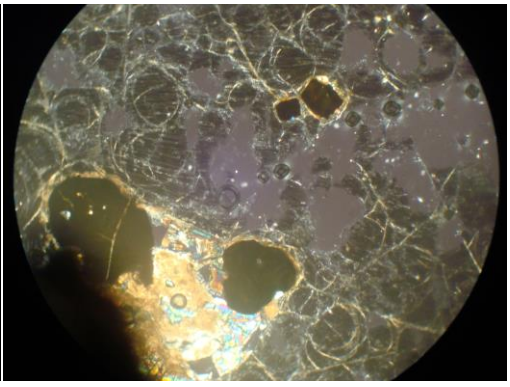

Fig. 14: Photomicrograph showing typical spheriolite structure, C.N. 10X.

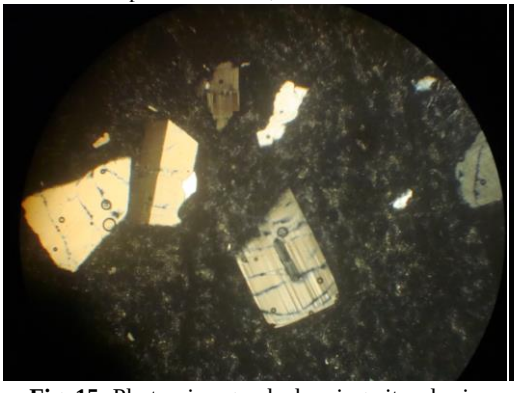

Fig. 15: Photomicrograph showing vitrophyric structure, C.N. 10X.

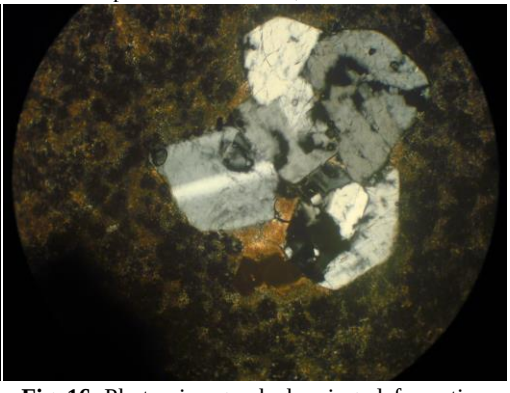

Fig. 16: Photomicrograph showing, deformation and glomerophyritic texture, C.N. 10X.

There are two main processes that cause hydration of perlite. Primary hydration occurs during formation of a volcanic rock or glass before it has cooled; secondary hydration occurs after emplacement and late in the cooling history, probably of the glass under zeolite facies conditions, or after complete cooling to surface temperatures [14] and is the more important of the two processes, Zeolite facies metamorphism and rock weathering typically occur below 2.5kb (Kilobars) and 300ºC [15]. The water content of perlite ranges up to about 5% which is attributed to the addition secondary of water from external sources such as ground water or surface water [16].

Chemically, based on the results of geochemical data of nine samples of Yemeni perlite are represented the major occurrences; Taiz, Ibb and Thamar. Table (1), shows that the majority of the studied perlite rocks have silica content average as flows; SiO_2, 69.99 - 73.22%; $Al2O_3$, 9.56 - 12.17%; Fe_2O_3, 2.00 - 4.21%; Na_2O, 3.05 - 3.63%; K_2O, 2.18 - 3.63%; H_2O^+, 2.04 - 3.30% and LOI (Loss of Ignition), 3.03 - 4.27 %.

TABLE 1: Chemical Results Analysis of Perlite –Yemen.

Oxide	*Sample No.*									*Min.* Wt.%	*Max.* Wt.%	*av.* Wt.%	*av.* Wt.% *Anes*	*av.* Wt.% *khawlan*	*av.* * Wt.% *Toloshi-Georgian Perlite*	*av.* ** Wt.% *Rhyolite*
	Taiz District (The Al-Wazeyaah Wt.%)			Ibb District (The Al-Qa'idah) Wt.%			Thamar District (The Dhuran Annis) Wt.%									
	Ta 1	Ta 2	Ta 3	Ib 4	Ib 5	Ib 6	Th 7	Th 8	Th 9							
SiO_2	72.00	70.12	70.67	69.99	70.16	71.10	73.22	71.34	71.02	69.99	73.22	71.07	**69**.60	67.20	71.20	72.28
TiO_2	0.67	1.02	0.59	0.34	1.04	0.24	0.30	0.24	0.59	0.24	1.04	0.49	-	-	0.18	0.28
Al_2O_3	11.06	11.26	10.90	10.76	12.17	11.08	10.12	9.56	11.02	9.56	12.17	10.81	11.15	11.80	14.20	13.27
Fe_2O_3	2.06	3.06	4.21	2.00	2.58	2.04	2.14	3.13	2.27	2.00	4.21	2.62	3.07	2.30	1.08	2.58
MnO	0.14	0.11	0.18	0.15	0.11	0.33	0.15	0.15	0.13	0.11	0.33	0.17	-	-	-	0.07
MgO	0.49	0.70	0.66	0.43	0.62	0.50	0.33	0.30	0.54	0.30	0.70	0.49	0.64	0.19	0.47	0.39
CaO	0.39	0.63	0.60	0.65	1.15	0.89	0.25	0.40	0.36	0.25	1.15	0.61	1.40	0.96	1.30	1.57
Na_2O	3.05	3.57	3.60	3.39	3.18	3.37	3.41	3.63	3.12	3.05	3.63	3.38	3.86	3.46	7.85	3.55
K_2O	3.34	2.33	2.18	3.63	3.03	3.29	3.13	3.09	2.97	2.18	3.63	3.04	3.78	3.72		4.30
P_2O_5	0.22	0.20	0.22	0.25	0.20	0.42	0.22	0.22	0.23	0.20	0.42	0.25	-	-	0.07	0.07
H_2O^+	3.30	3.30	3.15	2.82	2.04	3.13	3.15	3.05	3.30	2.04	3.30	2.96	2.15	4.00	3.46	-
LOI	3.22	3.27	3.03	4.22	3.45	3.69	3.37	4.07	4.27	3.03	4.27	3.72	-	-	-	1.10
Total	99.93	99.57	99.99	98.62	99.72	100.06	99.79	99.19	99.82	98.62	100.06	99.60	-	-	99.80	99.46

+ Al-Husam-Anes, *taken after*, **[11]**, ++ Kawlan, *taken after*, [12], * *av. Chemical composition of perlite from the Toloshi-Georgian perlite, taken after*, **[17]**, and 50 rhyolite sample *taken after*, [18].

Ta= Taiz Samples, Ib= Ibb Samples, Th=Thamar Samples and av. = average.

In a typical analysis, the composition of perlite is (SiO_2 = 70 - 75%, Al_2O_3 = 12 - 15%, Fe_2O_3 = 0.5 – 2.0%, MgO = 0.2 – 0.7%, CaO = 0.5 - 1.5 %, Na_2O+K_2O =6 - 9%, L.O.I (as combined water) = 3 - 5% [19], compared with Yemeni perlite values, Toloshi-Georgian perlite [17) and rhyolite [18] Table (1).

An average chemical composition of Toloshi-Georgian perlite and rhyolite are given for comparison to the Yemeni perlite values Table (1). This data shows that the TiO_2, Fe_2O_3 and P_2O_5 content of the Yemeni perlite averaging are 0.49%, 0.25, 2.62% respectively are higher than Toloshi-Georgian perlite that content average of TiO_2, Fe_2O_3 and P_2O_5 content

0.18%, 1.08%, 0.07%, respectively. In contrast, the Yemeni perlite have lower average content of Al_2O_3 (10.81%), CaO (0.61%), total Alk.= (6.42%) and water content (2.96%) than Toloshi-Georgian perlite that content average of Al_2O_3 (14.20%), CaO (1.30%), total Alk.= (7.85%) and water content (3.46%)

Based on Alk. = Na_2O+K_2O Vs. SiO_2 diagram [20] the all samples Showing rhyolitic nature with sub-alkaline affinity (Fig. 17), while on the AFM diagram [21] the samples are fall on calc-alkaline field (Fig. 18). Hence, the both diagrams chowing clearify all samples acidic, rhyolitc and on calc-alkaline nature. This will be confined as well as rhyolitic rocks.

PERLITE USES

Perlite is used in various applications, in many ways other than as a construction material. It is used in the agricultural, medical, chemical and nutritional, ceramics and glass and metal industries among other, as a filter material, a filler, an insulation material, an admixture …etc. However, almost all the ways in which perlite is used take advantage of its physical properties like low density, porous structure, fire resistance …etc. Even in the construction field, the most preferred usage of perlite is as an insulator or lightweight concrete aggregate.

Expanded perlite has porous texture which gives it unique characteristics. Physical properties of perlite that are exploited commercially include its chemistry (Si, Al); state (alkaline, inert and hydrated); habit (amorphous, fibrous) and physical behavior as thermal insulator, low density and porosity [22, 23, 24, 25]. In addition, due to many commercial applications, their low density and relatively low price for perlite have been developed these include Construction Applications, Horticultural Applications and Industrial Applications. Important factors for commercial perlite deposits are: the degree of expansion when heated, which is dependent on the water content; and lack of impurities, such as mineral and rock inclusions. In general deposits with suitable expansion characteristics and freedom from crystal/lithic fragments are rare [26, 27, 28, 29].

DISCUSSION

Perlite is not a trade name but a generic term for a naturally according siliceous rock. The commercial term perlite is used to describe any naturally igneous rock that upon rapid heating will expand or pop, in the geological usage term is reserved for a type of volcanic glass. In industry, the name perlite is used for both the raw material (rock) and the expanded material.

Perlite is a glassy volcanic rock which belongs to the rhyolite family of surface rocks with a water content of 2-5% and exhabits a concentric onion-skin in structure with a pearly luster. In the case of a rapid heating up to ~900^o C, it can expand up to 20 times of its original volume. It may have different appearances; compact, fine, porous, waxy to pearly luster, brittle, … etc., a colour of perlite is generally grey-greenish black or grey varieties occur, due to its heterogeneous structure, it is hard to identify by visual inspection. Hydrated volcanic glass formed through the secondary alteration (hydration) of obsidian by the incorporation of water into the glass silica structure [30, 31].

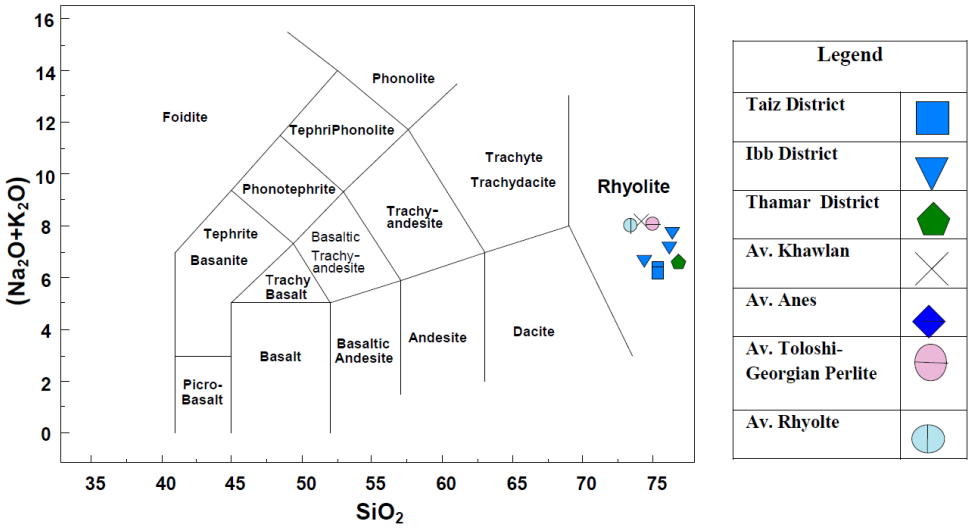

Fig. 17: Total alkali-silica classification diagram after IUGS [20] showing the rhyolitic composition of the studied perlite rocks.

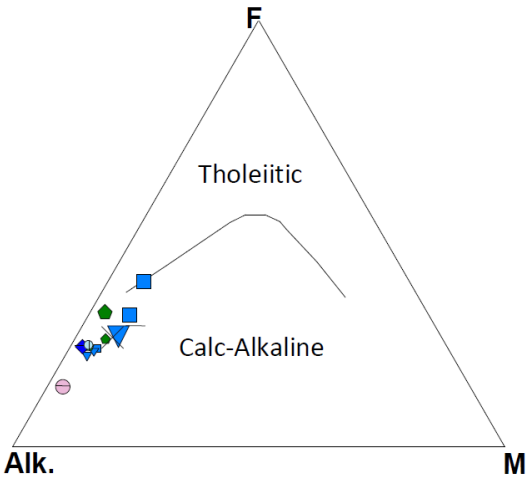

Fig. 18: AFM Ternary diagram [21] showing the composition of perlite rocks from the Kawlan area. Alk.=Na_2O+K2O, F= Fe_2O, and M=MgO. IUGS.

The alteration due to hydrothermal activity and dehydration later on was occur. In addition tectonic and climate affects. The final products of alteration is changes in colour of perlite rocks before produce zeolite after perlite, this phenomena noticed in the most occurrences. This approved the locality and time relationship between perlite and zeolite occurrences.

Perlite were formed during the acidic volcanism activity of the Tertiary and later Tertiary geologic periods. Volcanic formations are related with the existence of faults, and existence of faults depends on new dislocations. Perlite is one of the main constituents of volcanoes that moves with high pressure gases during magmatic events. In volcanic activities, melted magma moves upward via the collected gases in the center of magma. The non-homogenous structure of perlite may be explained with this variety. Perlite deposits are found in-situ together with acidic magmatic rocks and the chemical properties of SiO_2 - rich perlite proves its magmatic origin. The glassy texture of perlite is related to the quick cooling of the magma [32].

CONCLUSION

This study concluded that, the perlite deposits in Yemen occur in many districts as; Aden – Um-Sha'at, Thamar–Dhuran Annis, Taiz–Wazeyaah, Ibb–Al-Qa'idah, Al-Baydha–Al-Reyasheyah and Sana'a–Khawlan as well as mentioned above, they associated with Cenozoic volcanic rocks (Tertiary) common with acidic rocks (e.g: Rhyolite, dacite, obsidian, agglomerate, Tuffs…etc). Its petrochemical composition is a hydrated volcanic glass, formed during rapid cooling of acid fluid lavas at the surface associated with alternating in most times with zeolite deposits. The mineral composition of perlite rocks is chiefly composed of amorphous quarts as ground mass associated with alteration products as secondary minerals such as: chlorite, epidote, serpentine, chert, serecite and phenocrysts as: feldspars; plagioclase, orthoclase, sandine and pyroxene and they are characterized by perlitic, spheriolite, glomerophyric and vitrophyric textures. Perlite deposits are found in-situ together with acidic magmatic rocks and the chemical properties of SiO_2 - rich perlite proves its magmatic origin. The glassy texture of perlite is related to the quick cooling of the magma.

Chemical composition of Toloshi-Georgian perlite and rhyolite are given for comparison to the Yemeni perlite values see Table (1). This data shows that the increases in TiO_2, Fe_2O_3 and P_2O_5 content of the Yemeni perlite due to presence chlorite and iron oxides with its mineral composition. The similarity and differences in the chemical analysis due to the mineralogical composition for these rocks. A comparison between the results of chemical analysis of the Georgian perlite, a typical analysis and those of Yemeni perlite, revealed somewhat resemblance. This fact, together with the geological investigation, gives us ground to consider them products of as well as any other industrial material of acidic magma.

The studied perlite rocks were evaluated through chemical analysis and petrographic study to show their suitability for the industrial uses. Compared with the chemical properties of the commercial perlite silica > 65 wt.% and water content range from 2 – 5 wt.%. Perlite deposits in the Yemen volcanic districts were estimated to have resources of at least 65 – 335 million cubic meters.

RECOMONDATION

1- Evaluation, Testing and mapping of known perlite occurrences, exploration in the Tertiary volcanic is justified as it is a favorable host for expandable perlite.

2- More Examination of chemical and physical properties of perlite for industrial applications especially expanding factor.

3- Further Studies on the perlite occurrences in the western parts of Sana'a to Manakkah, Raymah, Ad Dali and Amran (Shuharah volcanic Field) Governorates.

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تواجدات رواسب البرليت في اليمن

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ملخص

تقع اليمن جنوب غرب أسيا، وفي السنوات الأخيرة ومن حين إلى أخر تحاول اليمن استغلال ثرواتها الطبيعية بإنتاج كميات صغيرة من الأطيان، الجرانيت، الحجر الجيري، الرخام ، الملح، الجبس، الماجنيزيت ، البيومس، البرليت، الرمل، المعادن الاقتصادية الأخرى وتشمل النحاس، الرصاص، الزنك، الذهب، والنيكل والحديد.

البرليت اهتم به حديثا وكان يوصف سابقا بأنه ريوليت زجاجي، ويتواجد البرليت عادة مصاحبا لصخور اليمن البركانية المنبثقة خلال حقب الحياة الحديثة وتحديداً في العصر الثلاثي مثل الريوليت والاجلوميريت والتوفا البركانية. وتوجد مكاشف البرليت في مناطق عديدة باليمن مثل مناطق ذمار، اب وتعز.....الخ. البرليت يتواجد في الصخور السيليكاتية وله تركيب كيميائي فريد وقريب إلى تركيب الجرانيت والابسيديان ويختلف عنه باحتوائه على كمية كبيرة من الماء، رواسب البرليت في اليمن تتدرج في اللون من الرمادي الأسود، الأسود المخضر إلى الأسود ولها نسيج زجاجي، وبريق شمعي إلى لؤلؤي وتشبه معالم صخر الابسيديان. رواسب البرليت تتفاوت بالسمك من أمتار قليله إلى عشرات الأمتار وتظهر كطبقات متقطعة وسميكة وتمتد إلى عدة أمتار وفي معظم الأحيان يتواجد مع رواسب الزيوليت. الحامضية مثل الريوليت، الابسيديان، والاجلوميرات والتف البركاني التابعة لمجوعة بركانيات اليمن المتمثلة بالعصر الثلاثي.

خلصت لدراسة الى وجود علاقة مكانية وزمانية في تواجد رواسب البرليت وتلاززمها مع رواسب الزيوليت ظمن الصخور البركانية.

ويقدر الاحتياطي المحتمل من رواسب البرليت في بعض المناطق المذكورة أعلاه بحوالي اكثر من 65 – 335 مليون متر مكعب. البرليت يتميز بخاصية التمدد والتي قد تصل إلى عشرين مرة من حجمه بالحرارة ولهذه الخاصية وكثافته المنخفضة من المكن استخدامه في الأغراض الإنشائية والزراعية والصناعية المختلفة والعديدة.....الخ.

الهدف من هذه الدراسة التحري عن تواجدات واصل البرليت في اليمن والقاء الضواء على استخدامات رواسب البرليت وإمكانية استخدامها في المجالات المختلفة.

كلمات مفتاحية: البيرليت اليمني ، البيرليت.