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Evolutions in Biosorption Using Different Types of Algae on Mylonite Rocks in the Abu Rusheid area, South Eastern Desert, Egypt

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--***ABSTRACT***--
The present study aims to apply new biotechnology for the extraction of the low-grade concentration of actinides elements by biosorption techniques from Abu Rusheid mylonite rocks. Therefore, Cystoseira osmundacea, Chondrus Crispus, and Palmaria elegant algae were used for this purpose. The biosorption capacity of thorium was close to about (81.66%, 80%, and 77.7%) in Cystoseira osmundacea, Chondrus Crispus, and Palmaria elegans respectively. On the other side, the uranium (U) absorption was not as high as thorium (Th). Holmium is completely absorbed by Chondrus Crispus and Palmaria elegans while europium has vanished by Cystoseira osmundacea. Finally, Cystoseira osmundacea is the best choice for the biosorption of thorium and europium from Abu Rusheid mylonite rocks.
Keywords: *Uranium, Thorium, REEs elements, Cystoseira osmundacea, Chondrus Crispus, and Palmaria elegans.*

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I. Introduction

The area of Wadi (W.) Nugrus and W. Sikait (covering about 320 km^2), compriseophiolite, separated, gabbros and granitic rocks (SALEH, 1997 ASSAF ET AL., 2000).The rocks are generally intensively deformed and show clear gradual variation from low -grade green schist facies, through the medium grade amphibolite facies (SUROUR, 1995). Biosorption is an innovative technology that employs inactive and dead biomass for the recovery of metals. As an alternative to traditional methods, its promising results are now being considered for application by scientists, they have focused especially on algae, due to its high sorption capacity and its availability in almost unlimited amounts (KLIMMEK ET AL., 2001). They are divided into several evolutionary pathways completely independent: a ‘‘red pathway’’ with red algae (Rhodophyta), a ‘‘brown pathway’’ with brown algae (inter alia, Chlorophyta), and a ‘‘green pathway’’ that includes green algae (Chlorophyta) along with mosses, ferns, and several plants. Differences between these types of algae are mainly in the cell wall, where sorption takes place. Research in the field of biosorption has mostly concerned itself with brown algae (HOLAN ET AL., 1993; CHONG AND VOLESKY, 1995; YU AND MATHEICKAL, 1999; MATHEICKAL ET AL., 1997; YU ET AL., 1999; LEUSCH ET AL., 1995) and to a less extent with green (AKSU ET AL., 1999, 1997) and red algae (HOLAN AND VOLESKY, 1994). The cell walls of brown algae generally contain three components: cellulose, the structural support; alginic acid, a polymer of mannuronic and guluronic acids and the corresponding salts of sodium, potassium, magnesium, and calcium; and sulfated polysaccharides. As a consequence, carboxyl and sulfate are the predominant active groups in this kind of algae. Red algae also contain cellulose, but their interest in connection with biosorption lies in the presence of sulfated polysaccharides made of Galatians. Green algae are mainly cellulose, and; a percentage of the cell wall is proteins bonded to polysaccharides to form glycoproteins. These compounds contain several functional groups (amino, carboxyl, sulfate, hydroxyl), which could play an important role in biosorption. The present work aimed to evaluate the sorption capacity of three different algae, Chondrus Crispus, Cystoseira osmundacea, and Palmaria elegans algae in respect of different metals: U, Th, REEs from the studied area.

II. Geological setting of the studied area

Abu Rusheid area lies in the south Eastern Desert of Egypt. It is limited by latitudes 24° 36` 29`` and 24° 39` 22``N and longitudes 34° 44` 40`` and 34° 47` 23``E. southwest of Marsa Alam City (Figure 1a). it is covered by Precambrian rocks ophiolitic metagabbros, ophiolitic mélange, cataclastic rocks, and biotite granites, which were intruded by lamprophyre dykes,pegmatite, and quartz veins (SALEH, 1997; ASSAF ET AL., 2000; IBRAHIM ET AL., 2004; KAMAR 2021) Figure 1b. The previous mineralogical studies revealed the presence of poly mineralization in cataclastic rocks, especially mylonite. The U-minerals (soddyite, uranophane, kasolite, and metazeunerite) (Figure 2b), Th- minerals (thorite and Urano-thorite), base metals (gold, cassiterite, and scheelite), and Nb- Ta minerals (Ishikawa site, columbite, and plumbopyrochlore) besides REEs (IBRAHIM ET AL., 2004, 2018; SALEH ET AL., 2013; KAMAR ET AL., 2018, 2020).

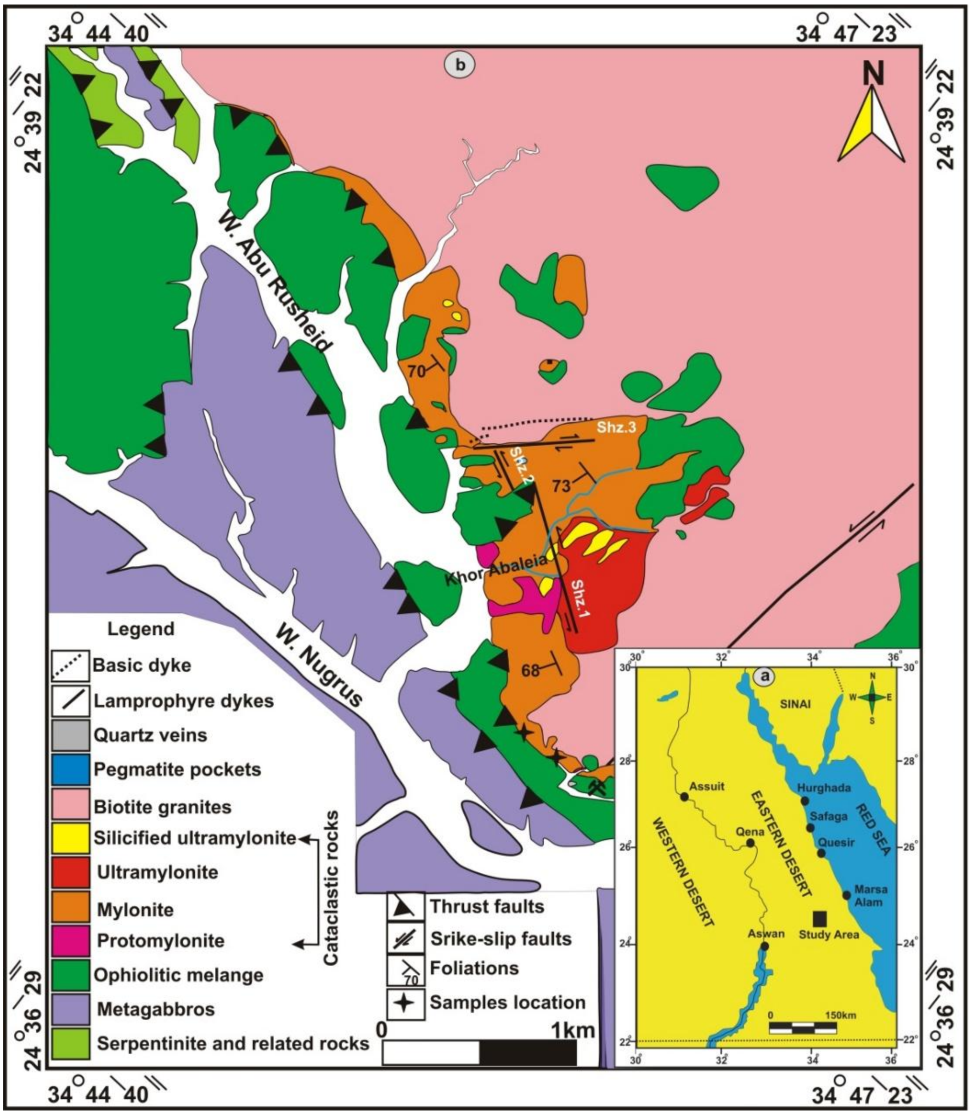


Figure 1: (a) Location map and (b) regional geological map of the Abu Rusheid area, south Eastern Desert, Egypt (after IBRAHIM ET AL., 2004).

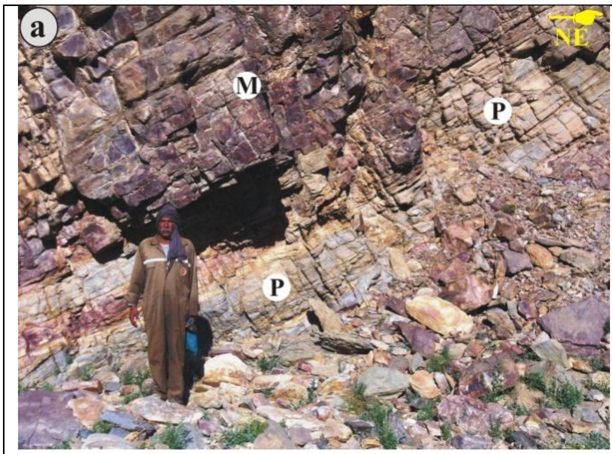


Figure 2a: Intercalation of protomylonite (P) and mylonite (M) at W. Nugrus, SED, Egypt.

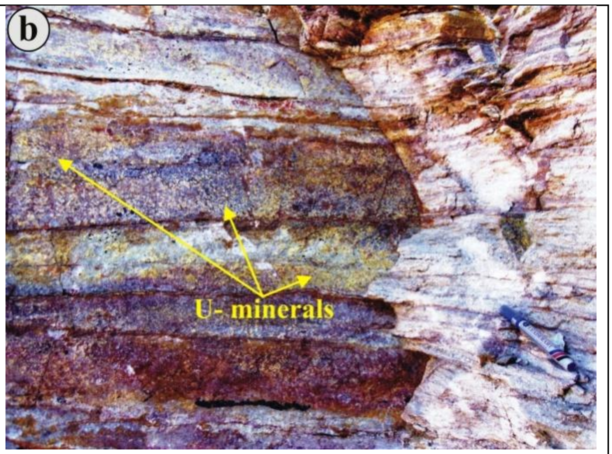


Figure 2b: Visible uranium mineralization in mylonite rocks at W. Abu Rusheid, SED, Egypt.

III. Material And Methods

The algal biomass was examined under Fourier transform Infra-red spectrum (FTIR) in a spectrum range of 400–4000 cm^{-1} for the sample to identify the functional groups at the Egyptian Petroleum Research Institute (EPRI), Furthermore, the morphological characteristics of the algal biomasses surfaces, the pore, and particles fractions were examined under an environmental scanning electron microscope (ESEM),) model FX250 using back-scatter detector (BSD), second detector (SE), and gaseous detector (GSE), and attached by Energy Dispersive analytical X-ray (EDX) units in Nuclear material Authority (NMA), finally the sizes of the grinded algal biomasses were determined using microscope type Olympus PX2020 attach with a digital camerain Nuclear Materials Authority.

IV. Algal collection and processing

Three algal species, namely (*C. osmundacea* belongs to Phaeophyta), (*Palmaria elegans* and *Chondrus Crispus* belong to Rhodophyta) were collected from the cost of the red Sea of Hurghada city Egypt, they are transferred to the laboratories in labeled polyethylene bags. The samples were washed several times with de-ionized water to remove dirt, and/or other impurities present in the raw materials. They were air-dried for 10 days, then ground and sieved at the pore size of 0.5 to 1 mm after (MATHEICKAL AND YU 1999; NORA SH GAD., 2021).

V. Adsorption experiments

To investigate the ability of the *C. osmundacea, Palmaria elegans, and Chondrus Crispus* biosorbent materials to absorb uranium, thorium, and REEs from the aqueous solutions in the selected samples frommylonite rocks in the Abu Rusheid area, experiments were conducted in batches by contacting the uranium, thorium, and REEs solutions with the adsorbent (1 g/l) The flasks were placed on a shaker with constant shaking for 100 rpm and then incubated at 30 ◦C for 5 days. The algal biomasses were washed several times as outlined in the work of ([KATO 2003 and NORA SH. GAD 2022) and then examined using ESEM to determine the uranium, thorium, and REEs concentration from the biomass, and photomicrographs finally were examined under (FTIR).

VI. Determination Of U, Th, And Rees In Algal Samples

To determine the biosorption of (*C. osmundacea, Palmaria elegans, and Chondrus Crispus* biosorbent material), for U, Th and REEs sorption was done by ICP-MS from the selected sample. (EL-SIKAILY 2007; AZIZ ET AL., 2015 AND NORA SH. GAD 2022).

VII. Result And Discussion

7.1. Chemical analysis

The dead cells go through and break the bonds in thecell wall, making more sites for the binding of metal ions (POHL ET AL., 2006) said, that we can detect the changes in the percentage of the uranium and thorium ions from the mylonite sample after biosorption with the dealing with the three biosorbent materials *Chondrus Crispus*, *Cystoseira osmundacea,* and *Palmaria elegans* algae.

7.1.1. Uranium and thorium data

Marine algae play a major role in biosorption represented by her interaction with mylonite samplewhich is characterized by high percent of thorium about (240 ppm) and uranium about (117 ppm) by dealing with the threebiosorbent materials give a variety of biosorption, *Cystoseira osmundacea* give the highest adsorption capacity in thorium biosorption about 81.66% (44 ppm since it was 240ppm),follow this the biosorbent materials *Chondrus Crispus.* It gave distinctive results compared to the *Cystoseira osmundacea*, as it was able to absorb about 80% (48 ppm compared with the mylonite 240ppm) from the proportion of thorium in the mylonite sample the last one is the biosorbent materials *Palmaria elegans* givea satisfactory result compared to the other two algae, as it gave a percentage77.7% about 53.5 ppm was left the biosorbent materials *Palmaria elegans*, it was unable to absorb more thorium from inside her cells, so this is her ability and effectiveness to absorb, which is a very satisfactory result, So we must say that the best type is the biosorbent materials *Cystoseira osmundacea* from the three types of algae as compared to the other two algal . This is due to studies that proved that this type has a high ability to absorb thorium (Nora Sh Gad andWaheeb 2022), and many other elements like uranium by (Gok and Aytas 2009).

The percentage of uranium present in the mylonite sample was about 117ppm as seen in (Table 1 & Figure 3), the three biosorbent materials of algal were treated to find out the highest absorption rate among them. The results showed that the biosorbent materials *Cystoseira osmundacea* are distinguished in the absorption of uranium as (GOK AND AYTAS 2009) mentionedIts unique ability to absorption, the results showed that the rate of absorption is about 47.56% (61.75ppm compared with the mylonite sample about

117ppm) and the following results of absorbing uranium from the mylonite sample showed that the biosorbent materials *Chondrus Crispus* algae can absorb about (38.82%, 71. 57ppm) compared with the mother sample, finally comes the third type (the biosorbent materials *Palmaria elegans*), it was noted that it is the lowest compared to the rest, where it was given a percentage of about (17.43% 96.6ppm) from the mylonite uranium content, so we can conclude that from the results of the biosorption of uranium and thorium by the three biosorbent materials of algal that *Cystoseira osmundacea* can absorb both uranium and thorium from the mylonite sample.

Table 1: Chemical analysis of Uranium and thorium from mylonite rocks in the Abu Rusheid area and % of biosorption by the three types of algae.

	U (ppm)	% of biosorption	Th (ppm)	% of biosorption
Mylonite sample	117		240	
Cystoseira osmundacea	61.35	47.56%	44	81.66%
Chondrus Crispus	71.57	38.82%	48	80%
Palmaria elegans	96.6	17.43%%	53.5	77.7%

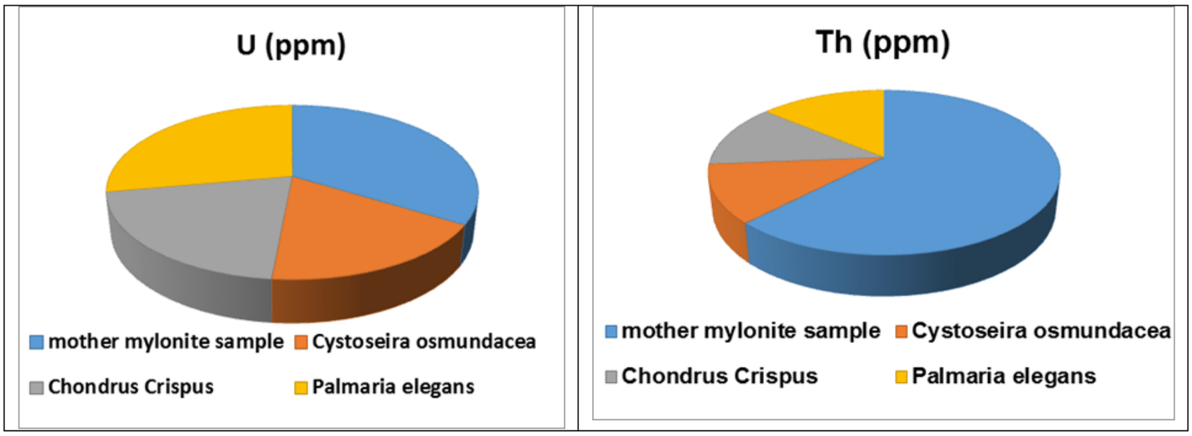


Figure 3: Pie-chart showing the chemical analysis of uranium and thorium from mylonite rocks in the Abu Rusheid area and % of biosorption by the three types of algae.

7.1.2. Rare earth elements biosorption data

7.1.2.1. *Cystoseira osmundacea*

C. osmundacea is considered as a type of Phaeophyta dealing with mylonite as shown in (Table 2 and Figure 4) complete biosorption capacity was noticed only with Europium as mentioned by ANDRES ET AL. (1993), while high biosorption capacity was noticed in four elements first in Cerium (Ce) 86.71% (14.68 ppm reach to 1.95 ppm) as seen by Masri and Friedman (1974), Lutetium (Lu) 53.75% (0.8 ppm 0.37 ppm), Lanthanum (La) 46.33% (103.48ppm reach to 55.73ppm) as BLOOM AND MCBRIDE (1979) andCRIST ET AL.(1994) work about Lanthanum biosorption and Praseodymium (Pr) 38.24% (13.91ppm reach to 8.59) in the same way moderate biosorption capacity was shown in Samarium (Sm) 23.82% (3.61ppm reach to 2.75), Dysprosium (Dy) 28.86 % (19.78 ppm reach to14.07 ppm), Holmium (Ho) 23.91 % (0.92 ppm reach to 0.7ppm) and finally Erbium (Er) 19.57% (8.99 ppm reach to 7.23ppm), low biosorption capacity was noticed with Neodymium (Nd) 6.1% (9.15ppm reach to 8.99ppm), Gadolinium (Gd) 10.1% (19.78 ppm reach to 17.39 ppm), Terbium (Tb) 1.76% (1.13 ppm reach to 1.11 ppm) and finally Ytterbium (Yb) 6.1 % (5.30 ppm reach to 4.98 ppm) as mentioned by ANDRES ET AL. (1993).

7.1.2.2. *Chondrus Crispus*

Chondrus Crispus is considered a type of Radophyta, the efficiency of these algae for biosorption was represented in (Table 2) and (Figure 4)when dealing with mylonite, and we find that there are elements that have been completely absorbed, as happened with Holmium. And other rare earth elements that were highly absorbed by the algae, and are as follows Pr 93.1% (13.91ppm reach to 0.97), Ce 88.91% (14.68 ppm reach to 1.62 ppm) MASRI AND FRIEDMAN (1974), study the effect of biosorption on Ce and Lu 73.75% (0.8 ppm reach to 0.2 ppm), moderate biosorption capacity was shown La 59.86% (103.84 ppm reach to 41.68 ppm), Nd 62.29% (9.15 reach to 3.45 ppm), Sm 60.95% (3.61 ppm reach to 1.41 ppm), Eu 62.61% (1.07 ppm reach to 0.4 ppm), Gd 67.29% (19.78 ppm reach to 6.47 ppm), Dy 59.20% (19.78 ppm reach to 8.07 ppm), Er 50.38% (8.99 ppm reach to 4.46 ppm) and finally Yb 30.95% (5.30 ppm reach to 3.66 ppm) Andres et al. (1993) wrote about Yb biosorption and low biosorption capacity by *Chondrus Crispus* was noticed only in Tb 16.8% (1.13 ppm reach to 0.94 ppm) as seen in (Table 2 and Figure 4).

7.1.2.3. *Palmaria elegans*

Biosorption was noticed in a complete capacity in three elements (Sm, Eu and Ho) while high absorption capacity by *Palmaria elegant* was noticed in seven elements first La 87.45% 103.84 ppm reach to 13.03 ppm), Pr 89.1% (13.91 ppm reach to 1.52 ppm), Gd 83.1% (19.78 ppm reach to 3.33 ppm), Lu 81.25 % (0.8 ppm reach to 0.15 ppm), Nd 69.94% (9.15 ppm reach to 2.75ppm), Dy 69.11% (19.78 ppm reach to 6.11 ppm) and Er 63.1% (8.99 ppm reach to 2.28ppm), moderate biosorption capacity was noticed only with Ce 46.93 % (14.68 ppm reach to 7.79 ppm) mentioned by MASRI AND FRIEDMAN (1974), no change in Tbabout it is quantity when handling with *Palmaria elegans* as seen in (Table 2 and Figure 4).

Table 2: Chemical analysis of REEs for mylonite rocks in the Abu Rusheid area band biosorption % by three types of algae.

REEs	Stander reference	Done in lab	*Cystoseira osmundacea*	Biosorption %	*Chondrus Crispus*	Biosorption %	*Palmaria elegans*	Biosorption %
La	145.05	103.84	55.73	46.33%	41.68	59.86%	13.03	87.45%
Ce	9.79	14.68	1.95	86.71%	1.62	88.96%	7.79	46.93%
Pr	13.2	13.91	8.59	38.24%	0.97	93.1%	1.52	89.1%
Nd	0.01	9.15	8.49	6.1%	3.45	62.29%	2.75	69.94%
Sm	0.01	3.61	2.75	23.82%	1.41	60.95%	N.D	100%
Eu	0.74	1.07	N.D	100%	0.4	62.61%	N.D	100%
Gd	32.59	19.78	17.39	10.1%	6.47	67.29%	3.33	83.1%
Tb	0.01	1.13	1.11	1.76%	0.94	16.8%	1.13	0%
Dy	14.36	19.78	14.07	28.86%	8.07	59.20%	6.11	69.11%
Ho	0.07	0.92	0.7	23.91%	N.D.	100%	N.D.	100%
Er	4.916	8.99	7.23	19.57%	4.46	50.38%	2.28	74.63%
Yb	4.07	5.30	4.98	6.1%	3.66	30.95%	1.96	63.1%
Lu	0.99	0.80	0.37	53.75%	0.21	73.75%	0.15	81.25%

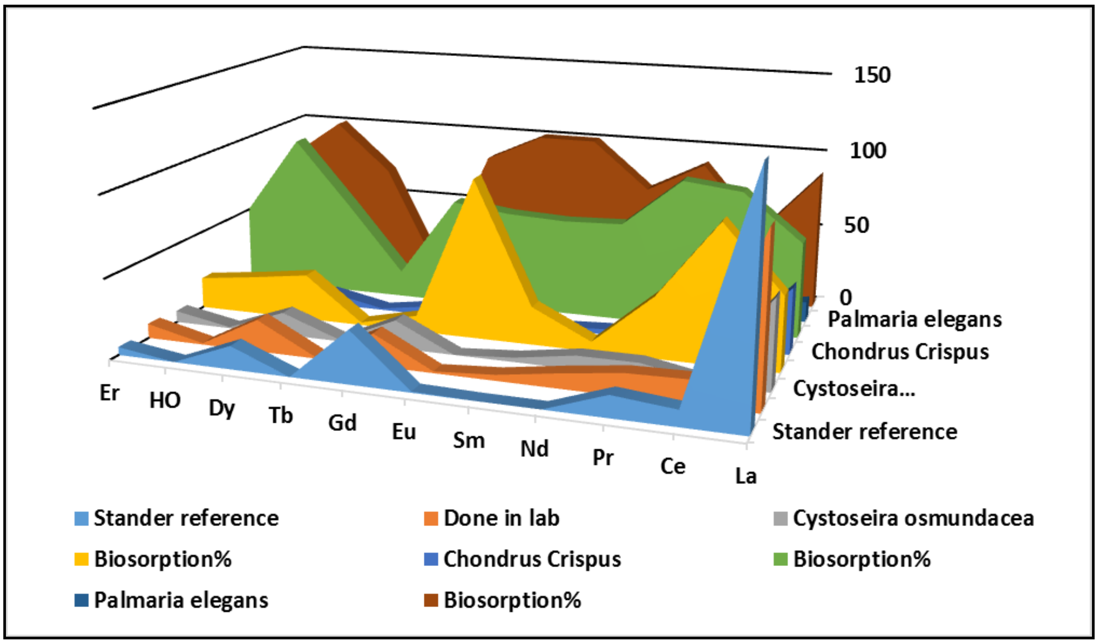


Figure 4: Histogram showing chemical analysis of REEs for mylonite rocks in the Abu Rusheid area and % of biosorption by three types of algae.

7.2. Fourier transforms Infrared (FTIR)

Metal biosorption depends especially on the cell wall components. IR spectrogram of the original biomass of the three algae was compared with the sample so we can detect the changes associated with the influence of metal sorption.

The surface characterization of mylonite rocks in the Abu Rusheid area with the help of FTIR spectrum showed the presence of OH at 3621.01 cm^{-1} it is range varied from 3500-3700 cm^{-1} H_2O-stretching mode could be mingled with external translation and liberation modes of H_2O, and the molecules are rotationally disordered around, a C=C is arising at 1647.79cm^{-1}, it is normal to place is between 1662-1626 cm^{-1}, The oxygen-containing functional groups are marked by C-O-C group noticed at the chart at 1070 cm^{-1} it is range varied from 1050-1150cm^{-1} The oxygen-containing functional groups are related by the peak at 1616–1624cm^{-1} that can be associated with C-O-C stretching band, two groups arise C-Br at 534.08 cm^{-1} it is range about 750-500cm^{-1}& C-I arises at 465cm^{-1} it is a range in the stander between 500±cm^{-1}.

7.2.1. *Cystoseira osmundacea*

The IR spectrogram of original biomass of *Cystoseira osmundacea* was compared with mylonite rocks in the Abu Rusheid area was mediated by change in the functional group which appears in Figure (5) the most notable functional group appeared is C-H strong at 2975.20cm^{-1} its present range from 3100-2900cm^{-1}. A CH_3 band at 1430cm^{-1} is normal range from 1465-1365cm^{-1} and finally, another band for C-H appeared at 876.79cm^{-1} it is range varied from 880+-20cm^{-1} with the disappearance of the C-I functional group as seen in figure (5). The wide variety of active functional groups in algae biomass of *Palmaria elegans*, *Cystoseira osmundacea,* and *Chondrus Crispus* was compared with Mylonite rocks in the Abu Rusheid area indicating the change so the shifts of bands related to involvement in the lanthanides and actinides biosorption especially uranium, thorium, Holmium, and Europium. Which it was able to know by FTIR. This provided us with information that the algae cell-secreted enzymes are represented by functional groups during the digestion of these elements.This was explained by the microscope for the appearance of algae that absorbed the elements and digested them internally.

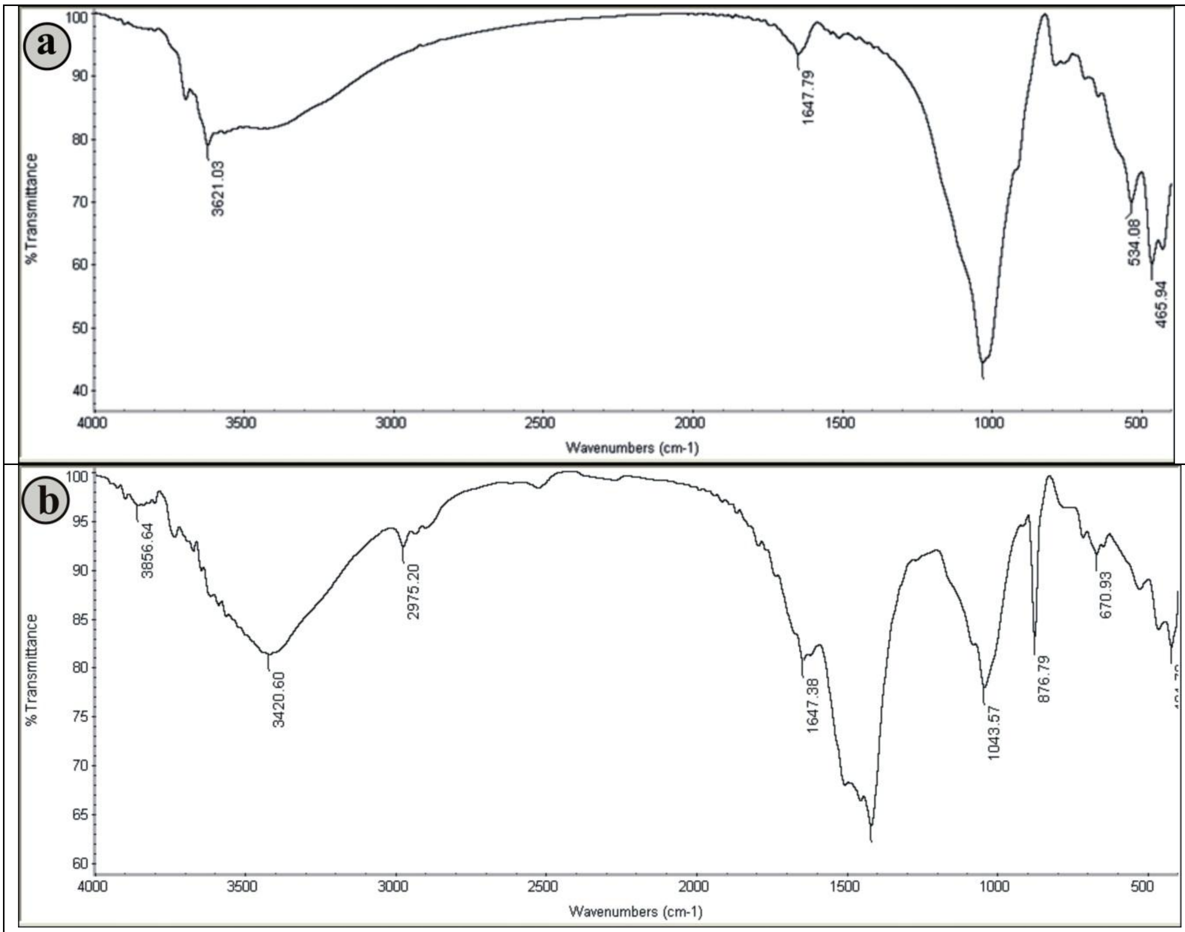


Figure 5: FTIR spectra for vibrational stretches of functional groups of the adsorbate of mylonite (a) in

the infrared spectroscopy analysis with the biosorbent materials *Cystoseira osmundacea* (b).

7.2.2. ***Chondrus Crispus***

The shift in the IR vibration showed that the binding of metal ion on the surface of *Chondrus Crispus* was mediated by change in the functional groups which was represented by the appearance of the C-Cl group at 782.26 cm^{-1} varied it is a range between 850-500 and N-O at 1511.36 strong nitro compound ranges from 1550-1500 cm^{-1} (Figure 6).

7.2.3. *Palmaria elegans*

IR spectrogram of original biomass of *Palmaria elegans* was compared with the surface characterization of mylonite rocks in the Abu Rusheid area some changes of the functional groups appear which indicate the influence of REEs sorption by *Palmaria elegans*which has functional groups as seen in figure (7), represented by the appearance of two functional groups first anther beak for OH and second a C-H band at 791.12cm^{-1} its normal range from 780± 20 cm^{-1} (Figure 7).

Therefore, we must discuss the ability of the three algae to absorb (uranium, thorium, Holmium, and Europium) through its outer wall and its analysis, which showed noticeable changes as a result of the algae's saturation of the elements as an example (Lanthanum, Samarium).

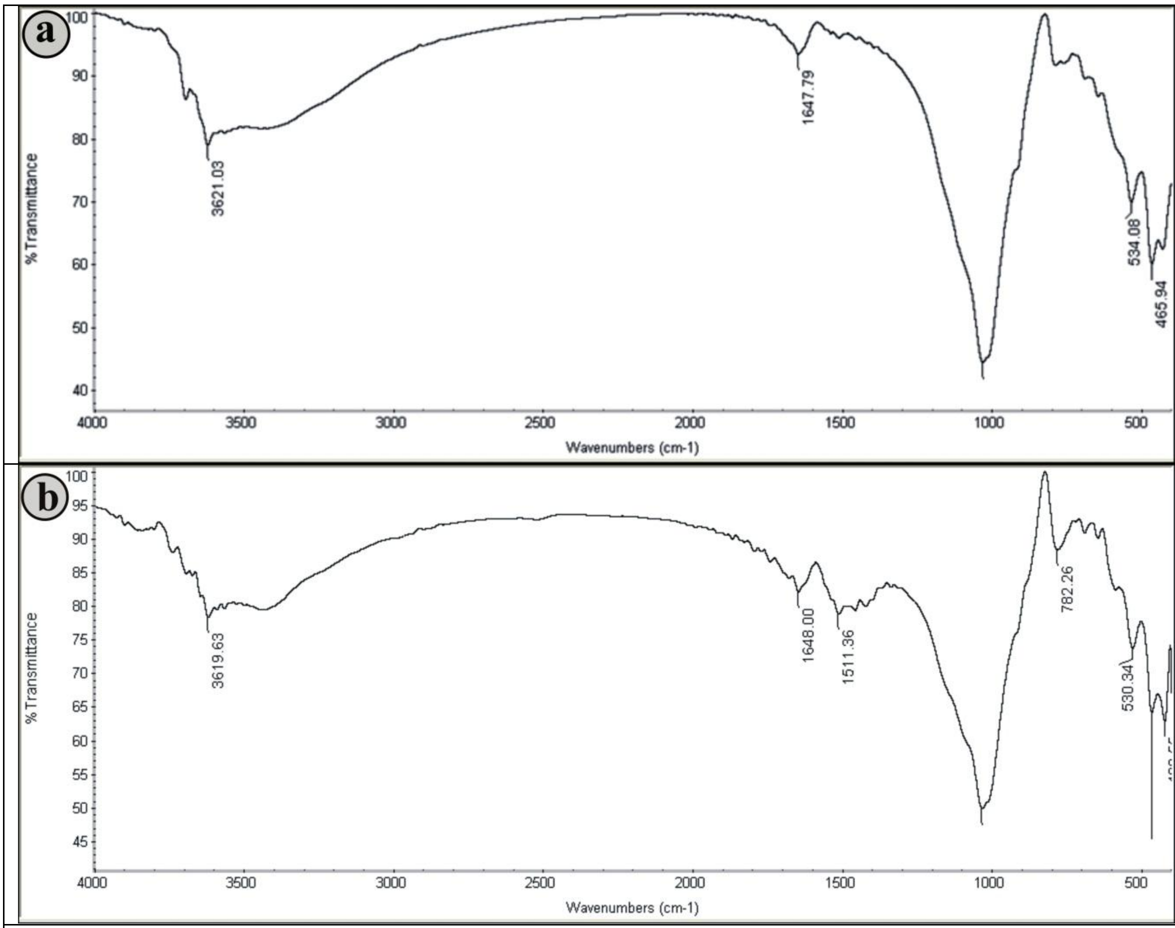


Figure 6: FTIR spectra for vibrational stretches of functional groups of the adsorbate of mylonite (a) in the infrared spectroscopy analysis with the biosorbent materials *Chondrus Crispus* (b).

Some functional groups act as a ligand during the biosorption of uranium, thorium, lanthanides, actinides like F^-, O_2^-, OH^-, H_2O, CO_3^{-2}, SO_4^-, $ROSO_3^-$, NO_3^-, HPO_4^{-2}, PO_4^{-3}, ROH, $RCOO^-$, C=O, ROR, type of metal bind by these functional groups, i.e.: Li, Be, Na, Mg, K, Ca, Sc, Rb, Sr, Y, Cs, Ba, La, Fr, Ra, Ac, Al, Lanthanides, Actinides as mentioned by(NIERBOER AND RICHARDSON 1969; VOLESKY, BOCA RATON, 1990).

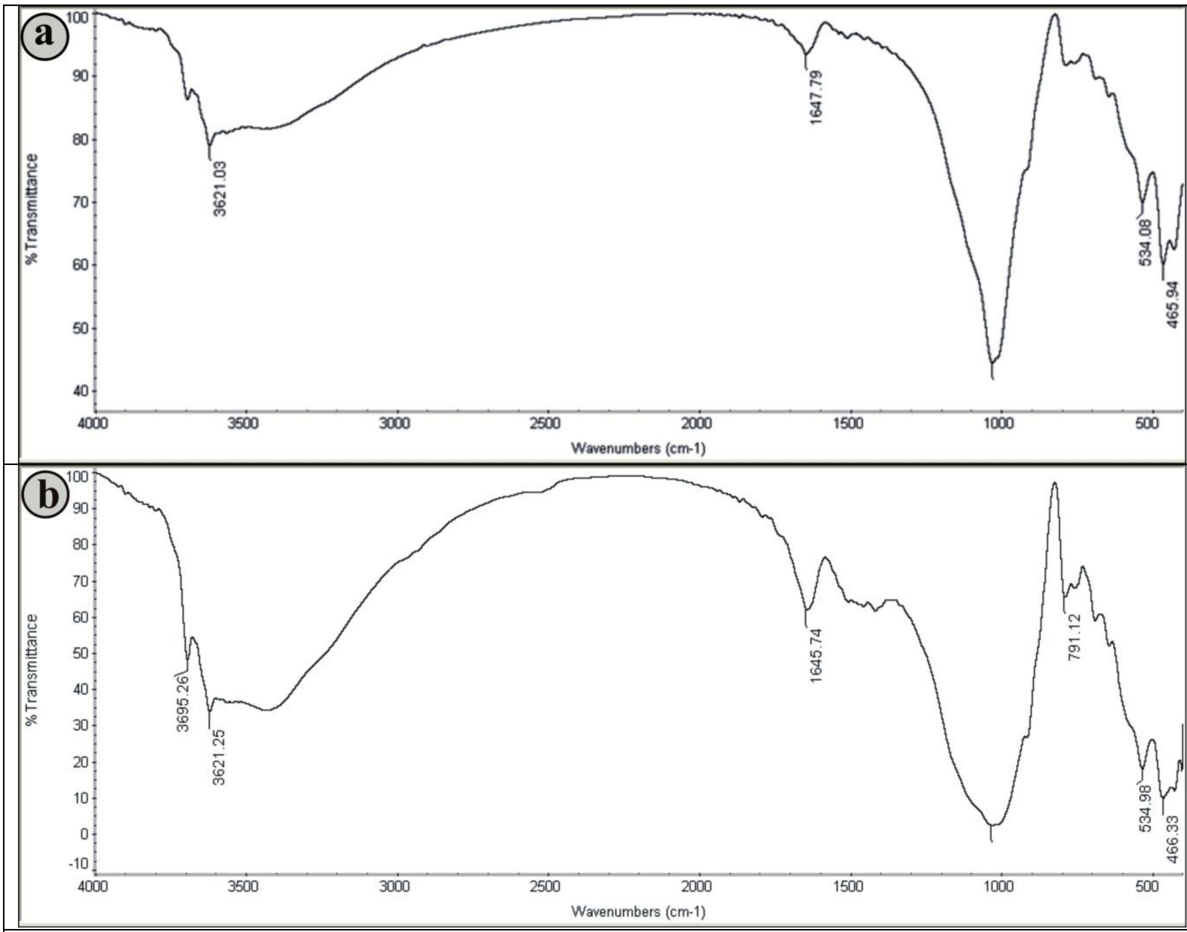


Figure 7: FTIR spectra for vibrational stretches of functional groups of the adsorbate of mylonite (a) in the infrared spectroscopy analysis with the biosorbent materials *Palmaria elegans* (b).

7.3. Field emission gun (FIG) data analysis and Photomicrograph

Biosorption mechanisms are classified by VEGLIO AND BEOLCHINI (1997) into two main categories, according to their cell functionality, i.e., metabolism-dependent and non-metabolism-dependent. The metabolism-dependent mechanism involves transport across the cell membrane and a precipitation step (BRIERLEY, 1990; COSTA AND LEITE, 1990), these include some elements by each one of the algae first *Cystoseira osmundacea* capability to biosorb (Fe, Nb & O) to form columbite and (Ce, La, Ca, Mg, Fe, Si, O& H) for cerite as seen in the plate (1), while *Chondrus Crispus* ability to biosorb (Pb, U, O, Si & H) to form of kasolite as seen in the plate (2). Finally, *Palmaria elegans* ability to accumulate (Th, U, O & Si) for thorite (Plate 3) these elements enter in the second stage whereas is called the non-metabolism-dependent mechanism, which consists of precipitation as mentioned by (HOLAN ET AL., 1993; SCOTT AND PALMER, 1990), or physical adsorption as stated by (AKSU ET AL., 1992; ZHOU AND KIFF, 1991), ion exchange as mentioned by (FRISS AND MYERS -KEITH, 1986; MURALEEDHARAN AND VENKOBACHAR, 1990) and complexation as stated by (CABRAL, 1992; TSEZOS AND VOLESKY, 1981). This happens by the three algae to form a complexation to those elements to formcolumbite and cerite by *Cystoseira osmundacea* as seen in the plate (1), while *Chondrus Crispus* capability to form of kasolite. Finally, cerite was accumulated by *Palmaria elegans* to more explanations to this formation anther mechanism is based on the location where the extracted metal accumulates these is called intracellular accumulation (transport across the membrane), cell surface adsorption/precipitation (ion exchange, complexation, physical adsorption, precipitation), and extracellular accumulation/precipitation (VEGLIO AND BOELCHINI, 1997).

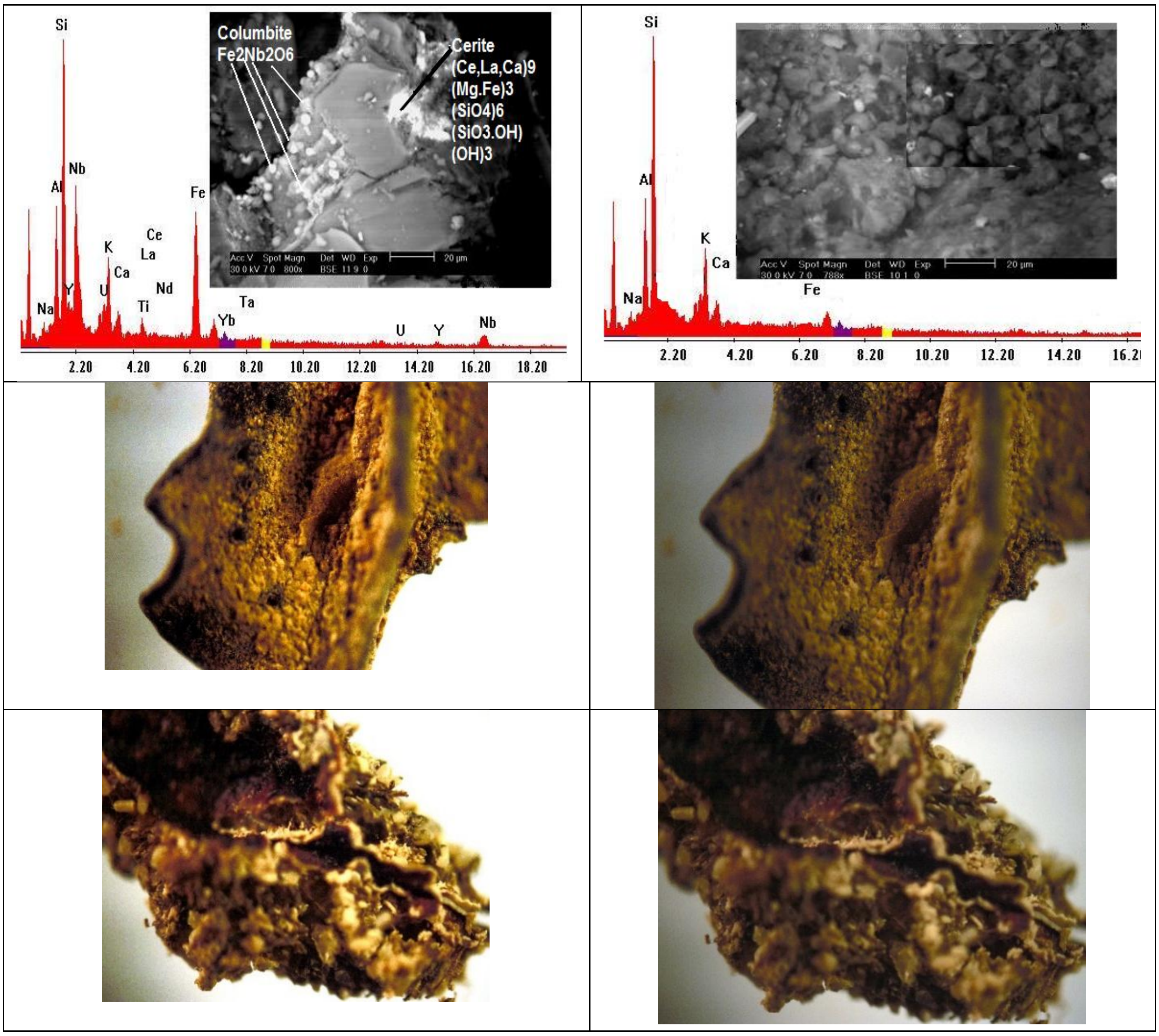
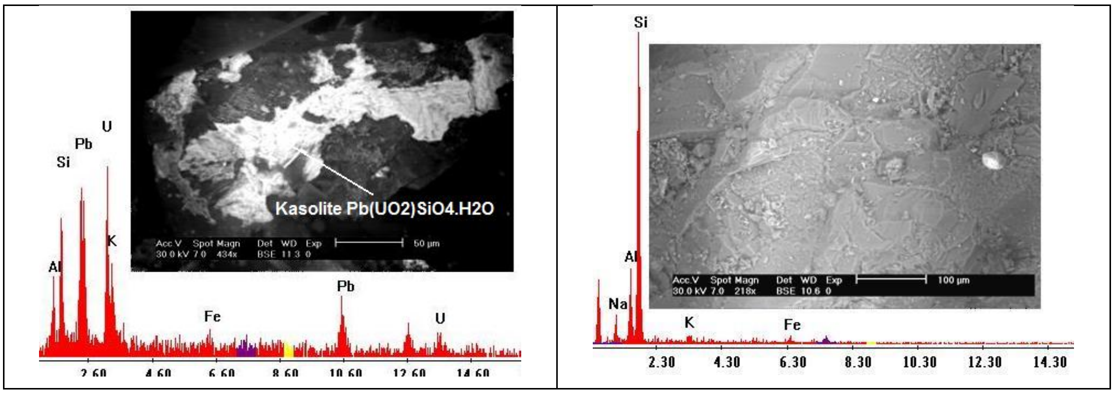


Plate (1): BSD image for (a) columbite and cerite minerals and EDX chart, (b) a sample before treatment by *Cystoseira osmundacea* and EDX chart. Photomicrograph showing (c) *Cystoseira osmundacea* before absorption of thorite mineral, (d) *Cystoseira osmundacea* after absorption, (e) *Cystoseira osmundacea*before absorption of columbite mineral, (f) *Cystoseira osmundacea* after absorption.



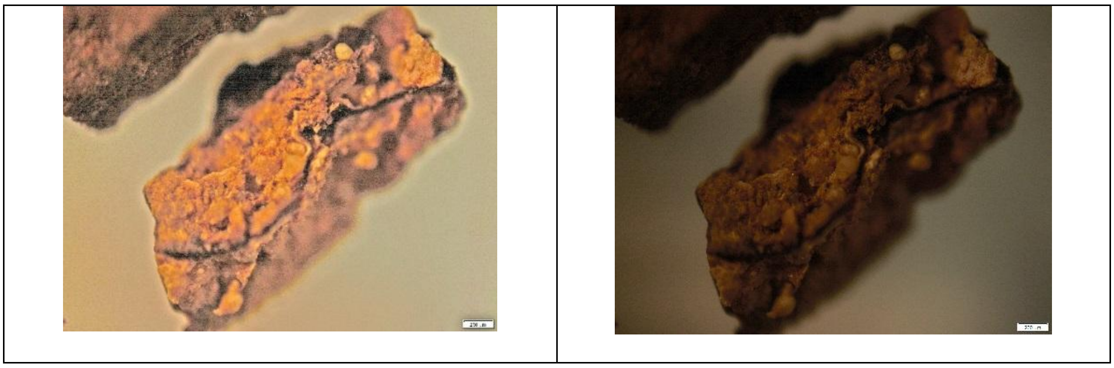


Plate (2): BSD image for (a) Kasolite mineral and EDX chart, (b) A sample before treatment by Chondrus *Crispus* and EDX chart. Photomicrograph showing *(c) Chondrus Crispus* before absorption of kasolite, (d) *Chondrus Crispus* after absorption.

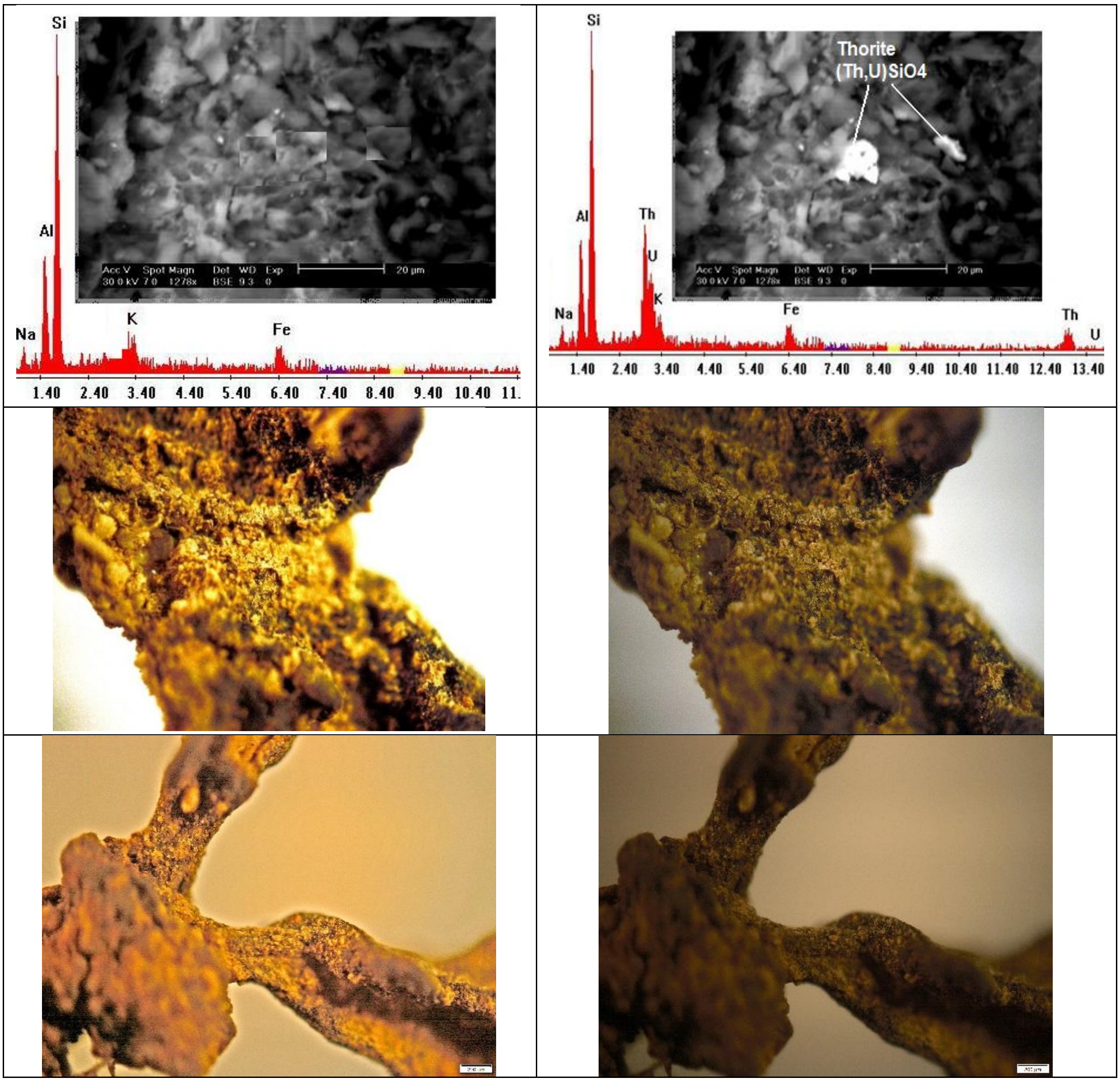


Plate (3): BSD image for (a) a sample before treatment by Palmaria *elegans* and EDX chart, (b) a sample after treatment by*Palmaria elegans* and EDX chart. Photomicrograph showing (c) *Palmaria elegans* before absorption of Th element, (d) *Palmaria elegans* after absorption, (e) *Palmaria elegans* before element absorption, (f)*Palmaria elegans* after absorption.

VIII. Conclusion

Abu Rusheid area lies in the south Eastern Desert of Egypt and is covered by ophiolitic metagabbros, ophiolitic mélange, cataclastic rocks, biotite granites, lamprophyre dykes and pegmatite, and quartz veins.The cataclastic rocks are subdivided into protomylonite, mylonite, ultramylonite, and quartzite with gradational contacts. The Mylonite covers a large area with fine to medium-grained and well-banded. These rocks are intercalated with protomylonite and affected by weathering in variable degrees producing red to yellow colors due to the alteration of sulfides producing iron oxides (hematite-limonite). Some pyrite crystals were removed leaving vugs filled with quartz, carbonates, and yellow uranium minerals. The previous mineralogical studies revealed the presence of poly uranium, thorium mineralization as well as rare earth elements in mylonite.

Alga is a suitable candidate for biosorption and its suitable properties for large-scale, as high metal ion uptake, metal selectivity, and Low-cost, elements were absorbed by the three algae internally by functional groups bonded to these elements inside the cells of *Cystoseira osmundacea*, *Chondrus Crispus, and Palmaria*, inside the cells of the algae internal biosorption occurred as in *Cystoseira osmundacea* (Fe, Nb & O) to form columbite and (Ce, La, Ca, Mg, Fe, Si, O& H) for cerite while *Chondrus Crispus* ability to biosorb (Pb, U, O, Si & H) to form of kasolite, finally *Palmaria elegans* ability to accumulate (Th, U, O& Si) these absorbed elements coordinated together to form kasolite, columbite, thorite, and cerite as seen by ESEM and photomicrograph, Biosorption is a passive accumulation process, which includes adsorption, ion exchange, complexation, chelation, and micro precipitation.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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