



مجلة التربوي

مجلة علمية محكمة تصدر عن كلية التربية جامعة المرقب

المجلد الثالث والعشرون
يوليو 2023م

هيئة التحرير

رئيس هيئة التحرير: د. مصطفى المهدي القط
مدير التحرير: د. عطية رمضان الكيلاني
سكرتير المجلة: أ. سالم مصطفى الديب

- المجلة ترحب بما يرد عليها من أبحاث وعلى استعداد لنشرها بعد التحكيم .
 - المجلة تحترم كل الاحترام آراء المحكمين وتعمل بمقتضاها .
 - كافة الآراء والأفكار المنشورة تعبر عن آراء أصحابها ولا تتحمل المجلة تبعاتها .
 - يتحمل الباحث مسؤولية الأمانة العلمية وهو المسؤول عما ينشر له .
 - البحوث المقدمة للنشر لا ترد لأصحابها نشرت أو لم تنشر .
- (حقوق الطبع محفوظة للكلية)



ضوابط النشر:

- يشترط في البحوث العلمية المقدمة للنشر أن يراعى فيها ما يأتي :
- أصول البحث العلمي وقواعده .
- ألا تكون المادة العلمية قد سبق نشرها أو كانت جزءا من رسالة علمية .
- يرفق بالبحث تزكية لغوية وفق أنموذج معد .
- تعدل البحوث المقبولة وتصحح وفق ما يراه المحكمون .
- التزام الباحث بالضوابط التي وضعتها المجلة من عدد الصفحات ، ونوع الخط ورقمه ، والفترات الزمنية الممنوحة للتعديل ، وما يستجد من ضوابط تضعها المجلة مستقبلا .

تنبيهات :

- للمجلة الحق في تعديل البحث أو طلب تعديله أو رفضه .
- يخضع البحث في النشر لأولويات المجلة وسياستها .
- البحوث المنشورة تعبر عن وجهة نظر أصحابها ، ولا تعبر عن وجهة نظر المجلة .

Information for authors

- 1- Authors of the articles being accepted are required to respect the regulations and the rules of the scientific research.
- 2- The research articles or manuscripts should be original and have not been published previously. Materials that are currently being considered by another journal or is a part of scientific dissertation are requested not to be submitted.
- 3- The research articles should be approved by a linguistic reviewer.
- 4- All research articles in the journal undergo rigorous peer review based on initial editor screening.
- 5- All authors are requested to follow the regulations of publication in the template paper prepared by the editorial board of the journal.

Attention

- 1- The editor reserves the right to make any necessary changes in the papers, or request the author to do so, or reject the paper submitted.
- 2- The research articles undergo to the policy of the editorial board regarding the priority of publication.
- 3- The published articles represent only the authors' viewpoints.





Study of chemical and biological weathering effects on building stones of the Ancient City of Sabratha, NW-Libya

Ismail Elforjani Shushan¹, Saddik Bashir Kamyra², Hitham A. Minas³
^{1,2}Geology Dept., Faculty of Sciences, University Elmergib-Alkoms-Libya
³Former Geology Dept. staff member, Elmergib University
elforjismail@yahoo.com

Abstract: This paper dealt with the study of chemical and biological weathering factors and their damages on different types of building stones of Sabratha Archaeological City. This study is based on discussing group-2 of weathering that proposed by Fitzner and Heinrichs (1999, 2000 and 2004) which known as "Discoloration/Deposit". According to field observations, six (6) main weathering forms has been found to effect the building stones of Sabratha archaeological City which specifically are: soiling effect, biological colonization effect, biological colonization to crust effect, discoloration effect, loose salt deposits effect and hard crust deposit effect. These included nine (9) individual weathering forms which precisely are: soiling due to anthropogenic impact, soiling by droppings, colonization by higher plants, microbiological colonization, colonization to dark-colored crust tracing the surface, bleaching, coloration, efflorescence and light-colored crust tracing the surface. The damage degrees of these weathering forms varied from non-visible to moderate with spreading degrees varied from very-limited to widespread. The linear and progradational indices of this group of weathering showed damage degrees varied from non-visible to moderate and from very-slight to moderate respectively and were widespread. Generally, the obtained results concerning biological and chemical damages on the building stones of Sabratha Archaeological City mentioned in this research, portending to some more deterioration in future and in order to protect the monuments of the city, some kind of remediation should be intervening.

Keywords: *chemical & biochemical weathering effects, ancient building stones, ancient city of Sabratha*

المخلص

عنيت الورقة الحالية بدراسة أثر التجوية الكيميائية والحياتية وكذلك أضرارها المختلفة على أحجار البناء المتنوعة بمدينة صبراتة الأثرية. إعتمدت هذه الدراسة على مناقشة المجموعة الثانية للتجوية المقترحة من قبل (Fitzner و Heinrichs -1999, 2000, 2004) والمعروفة باسم: التلون/ ترسيب. بالاستناد الى الملاحظات الحقلية, تم التعرف على (6) أشكال رئيسية للتجوية الكيميائية والحياتية والتي أثرت على أحجار بناء مدينة صبراتة الأثرية حيث تضمنت: أثر طمس المعالم (عبارة عن ترسيبات أوساخ على مواد البناء), أثر استعمار المباني بالاحياء المختلفة, أثر الاستعمار الحياتي المتحول الى قشور, أثر تغير الالوان أو التبقع اللوني, أثر الترسبات الملحية الغير متماسكة وأخيرا أثر التجوية بالقشرة الصلبة. كما تضمنت هذه الاشكال الرئيسية المذكورة لعدد (9) أشكال للتجوية المؤثرة وهي كما يلي: طمس المعالم بواسطة الانسان, طمس المعالم بواسطة فضلات الطيور, الاستعمار بواسطة النباتات الراقية, الاستعمار بالاحياء الدقيقة, مستعمرة احياء دقيقة تتحول الى قشرة داكنة تزخر سطح الصخر, التجوية بازالة الالوان, التجوية بالتلون, التجوية بالترهر الملحي وأخيرا التجوية بقشور فاتحة اللون ترصع السطح. تم تحديد درجة أضرار هذه الأشكال من التجوية والتي إتحصرت فيما بين الأضرار الغير مرئية و المعتدلة والتي تراوحت درجة انتشارها من المحدودة جدا الى واسعة الانتشار. والتي تراوحت درجة انتشارها من المحدودة جدا الى واسعة الانتشار. كما تم تحديد درجة أضرار كل من دليلي التجوية الخطي والتقدمي (غير مرئية الى معتدلة و ضعيفة جدا الى معتدلة على التوالي) وقد كانت واسعة الانتشار. الدراسة الحالية ومن خلال النتائج المتحصل عليها تتوقع المزيد من التدهور



لاحجار البناء لمدينة صبراتة الاثرية, ولكي يتم الحفاظ على المباني الاثرية للمدينة لابد من وضع برامج للترميم والمعالجة السريعة التي تتناسب مع طبيعة هذه الأحجار.
الكلمات الدالة: أثر التجوية الكيميائية والحياتية, أحجار البناء الأثرية, مدينة صبراتة الأثرية.

1- Introduction

Following the classification of weathering damages on archaeological building stones proposed by Fitzner and Heinrichs (2001, 2004) and Fitzner et. al., (1999, 2002), accordingly, weathering damages of Sabratha ancient city building stones are classified into four (4) main groups. Group-1 (Loss of stone material) which has been discussed by Ismail F., Shushan, et. al., (2019a), Group-2 (discoloration/deposit) which is the purpose of this paper, Group-3 (detachment) which has been also discussed by Ismail F. Shushan et. al., (2019b) and Group-4 (fissures and deformation) which planned to be discussed in future.

Weathering is the natural way of stone decay into smaller particles. It is a slow continuous process that affects all substances exposed to the atmosphere. Chemical weathering results from chemical changes of minerals that become unstable when they are exposed to surface conditions. Some minerals, like quartz, are almost unaffected by chemical weathering, while others, like feldspar, are easily altered. In general, the degree of chemical weathering is greatest in warm and wet climates, and least in cold and dry climates. The important characteristics of surface conditions that lead to chemical weathering are the presence of water (in the air and on the ground surface), the abundance of oxygen, and the presence of carbon dioxide, which produces weak carbonic acid when combined with water. Processes by chemical weathering may include: Hydrolysis "the breakdown of rock by acidic water to produce clay and soluble salts", Oxidation " the breakdown of rock by oxygen and water, often giving iron-rich rocks a rusty-coloured weathered surface", Solution " the removal of rock in solution by acidic rainwater, Carbonation " the weathering of limestone by rainwater containing dissolved CO₂ (Gore, Pamela J. W., 2013, Earle, S., 2015). Biological weathering is the process by which minerals of the rocks become broken down and altered as a result of physical and chemical agents of organisms. Organisms may react chemically with rocks in order to obtain different types of minerals which as a result changing and altering the original material of the rocks. It has been thought that the secretion of chemical materials and weak acids by lichens and bacteria on rocks is the manner by which these organisms may obtain their diet to persist and in such way could harm and alter the rock substrate (Roger D. Finlay et. al., 2019, Jie Chen et. al., 2000. Plant roots may act as destructive mediator for rocks through secretion of organic acids and enlarging the cracks. When water inter the cracks between rock blocks and become frozen, rocks will break down. Wastes of bats, animals and birds can be also a destructive mediator for rocks as they contain chemical materials able to affect mineral particles that form the rocks. The decomposition and deterioration of organism's residues (in the form of humus) may produce acids and gases (e.g.: CO₂, NH₃, HNO₃, and organic acids) which change and weaken the original rock material and soils. All these factors may enhance the ability of water to break down and dissolve rock materials, and as a result, the rates of weathering become accelerated.

2- Location of Study Area

The ancient City of Sabratha is located along the Mediterranean Sea coast, northern Libya and is situated about 70 km west of the Capital City of Tripoli within



coordinates 32°47'32"N and 12°29'03"E. It is surrounded by the sea from north, Zawia City to the east, Jafara to the southeast, Yefren to the south and Zuwarah City to the west (Figure-1). 18 buildings were selected for this study (Figure-2).



Figure-1: Location of the study area (yellow arrows)

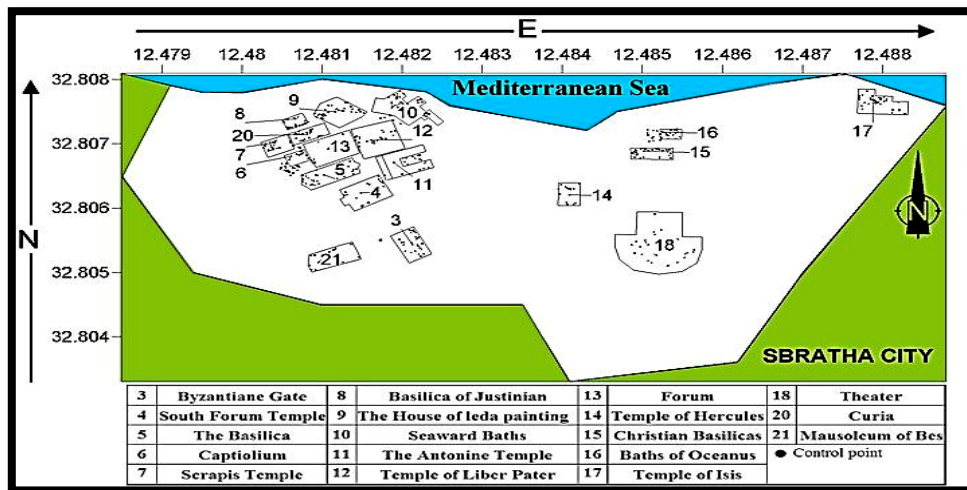


Figure-2: The (18) buildings selected for study within Sabratha Archaeological City

3- Aims of Study

This study aims to investigate the effects of chemical and biological weathering features on building stones that establishing the ancient City of Sabratha. The study will determine the main and individual weathering forms that collaborating in the destruction of building stones of the city. Likewise, the degree of damages and their distributions will be identified in order to appraise the risks that the City might challenges. Moreover, the study discusses the effect of linear and progradational



indices of this group of weathering and determine their damage intensities on building stones of the ancient City of Sabratha.

4- Method of Study

This research will apply the systematic scheme used to classify the group-2 of weathering so-called "Discoloration / Deposit" introduced by (Fitzner and Heinrichs, 2002, 2004). Intensity of different individual weathering form damages will be estimated and contour maps for every kind of damages throw-out the city will be constructed. Linear and progradational indices will be estimated according to (Fitzner and Heinrichs, 2002, 2004).

5- Stratigraphy of the Study Area

The area of study is covered by rock units limited between the Late Triassic and Quaternary. The rock succession scheme of the area of study is the same as that used to classify the rock succession of Gharyan area "Jabal Nafusa" and surrounding areas suggested by El-Hinnawy and Cheshitev (1975) shown on Figure-3.

Lithologic and Thickness(m) columns	Formation. Member.	Age	
25	Aeolian deposits Sand dunes	Holocene	
65 - 45	Qasr alhaj Gargaresh and .Jeffara Formation	Pleistocene	
50- 30	Al Assah Formation	Pleistocene	
50	Nalut Formation	Cenomanian - Turonian	
60 - 55	Sidi assid Fm . Yefrin Member	Cenomanian	
70 - 60			Ayn tobi Member
60 - 45	Kiklah Formation	Albian	
85 - 70	Ar Rajban Formation Cabao Member	Bathonian- Neocomian	
75 - 20			Shakshuk Member
150 - 30			Khashm az Zarzur Member
35 - 30	Takbal Formation	Bathonian	
100 - 140	Bī R al ghanam Fm. Abregh Member	Carnian -Bathonian	
20			Abu Niran Mb.
> 150			Jafar Member

Figure-3: The stratigraphic succession of study area (El-Hinnawy and Cheshitev, 1975)



6- Presentation of Results

According to field investigations done within the area of study and referring to the scheme proposed by (Fitzner & Heinrichs, 2002, 2004) concerning group-2 of weathering "Discoloration/Deposits", the following results were reported in table-1 and table-2 as follows:

Table-1: Results of the main and individual biological and chemical weathering forms and their damage effects on building stones of Sabratha Ancient City, in accordance with (Fitzner et. al., 2002).

Group of Weathering Forms					
Group-2: Discoloration/Deposits					
Main Weathering Form	Individual Weathering Form	Damage Degree	Effect Type	Widespread Degree	Occurrence and Characters
Soiling (dirt deposits on stone surface)	Soiling due to anthropogenic impact	very-slight to non-visible	Chemical	widespread	southern parts of Arch. Sabratha City= very-slight damage, Temple of Isis + middle & northern parts= non-visible damage (PI-1"Map-1")
	Soiling by droppings	non-visible	Bio-chemical	very-limited	SE Temple of Isis + NE Theater (PI-1"Map-2"), (PI-3"Fig-1")
Biological Colonization (colonization of stone buildings by plants & micro-organisms)	Colonization by higher plants	moderate to very-slight	Biological	widespread	Centre +SW= moderate NW+NE= slight E+SE= very-slight (PI-1"Map-3"), (PI-3"Fig-2")
	Microbiologic al colonization		Bio-Chemical		S-Centre= moderate SE+SW+Centre= slight NE+NW+E= very-slight (PI-1"Map-4"), (PI-3"Fig-3")
Biological Colonization to Crust (transitional form between	Microbiologic al colonization to dark-colored crust	very-slight to non-visible	Biological		Centre +S + NW + SE = very-slight damage, N-C+ NE= non-



biological colonization & crust)	tracing the surface				visible (Pl-1"Map-5"), (Pl-4"Fig-1")
Discoloration "Staining" (change of the original color of stone building)	Bleaching		Chemical	very-limited	NW + W-C = very-slight Rest of buildings = non-visible, (Pl-1"Map-6")
	Coloration	moderate to very-slight	Bio-Chemical	widespread	S = moderate N = very-slight C = slight, (Pl-2"Map-7"), (Pl-4"Fig-2")
Loose Salt Deposits (deposition of less consolidated salt clusters)	Efflorescence	non-visible	Chemical	limited	Temple of Isis, Christian Baslicas, Temple of Hercules, Baths of Oceanus, Theater, Forum, Byzantinane Gate, Curia, Mausoleum of Bes (Pl-2"Map-8")
Crust (deposition of highly consolidated crusts on stone surfaces)	Light-colored crust tracing the surface	very-slight to non-visible		Less widespread	Scrapis Temple = very-slight. Rest of buildings = non-visible. (Pl-2,"Map-9"), (Pl-4"Fig-3")

Table-2: Results of the linear and progradational indices and their damage effects on building stones of Sabratha Ancient City.

Group-2: Discoloration/Deposits			
Weathering by Chemical & Biological Agents			
<i>Weathering Index</i>	<i>Damage Degree</i>	<i>Widespread Degree</i>	<i>Occurrence and Characters</i>
Linear Index	Moderate to Non-visible	widespread	S-C parts + Byzantinane Gate = (moderate) , SE, SW, NE, W-C parts = slight NE, NW = very-slight Isis Temple, Sea Baths = (non-visible) , (Pl-2,"Map-10") Note: increasing damage intensity away from sea coast.



Progradational Index	Moderate to very-slight		<p>S, Byzantine Gate = (moderate) Forum, Baslicas, Temple of Hercules, Baths of Oceanus, Curia, Scrapis Temple, Mausoleum of Bes, Christian Baslicas, Theater, Captiolium, Antonine Temple, Bisilicas of Justinine (slight) Rest of buildings = (very-slight) (PI-2"Map-11") Note: increasing damage intensity away from sea coast.</p>
-----------------------------	-------------------------	--	--

Table-3: (%) estimations of deterioration intensities caused by different types of damages belonging to group-2 of weathering (discoloration/deposits) that effects buiding stones within Sabratha Archaeological City in accordance with (Fitzner et. al., 2002).

Group-II	Sites	Coordinates		Group-II Damage Categories				
		X - (Eastern)	Y - (Northern)	Very slight %	slight %	Moderate %	Sever %	Very sever %
A	Byzantine Gate	12.48213	32.80544	8	14	25	53	0
B	South Forum Temple	12.48149	32.80624	5	77	18	0	0
C	The Basilica	12.48103	32.80652	17	46	14	23	0
D	Captiolium	12.48062	32.80681	18	28	54	0	0
E	Scrapis Temple	12.48041	32.80702	22	61	18	0	0
F	Basilica of Justinian	12.48067	32.80739	42	17	41	0	0
G	The House of Ieda painting	12.48117	32.8075	59	41	0	0	0
H	Seaward Baths	12.48195	32.80757	84	16	0	0	0
I	The Antonine Temple	12.4819	32.80671	43	13	44	0	0
J	Temple of Liber Pater	12.48162	32.80706	47	29	24	0	0
K	Forum	12.48108	32.80692	20	39	42	0	0
L	Temple of Hercules	12.48409	32.80621	23	32	0	44	0
M	Christian Basileas	12.48502	32.80689	53	16	31	0	0
N	Baths of Oceanus	12.48526	32.80718	38	0	62	0	0
O	Temple of Isis	12.48788	32.80764	59	41	0	0	0
P	Theater	12.48518	32.80527	23	64	13	0	0
Q	Curia	12.48082	32.80715	19	44	37	0	0
R	Mausoleum of Bes	12.48096	32.80516	27	44	29	0	0

Table-4: Estimations of deterioration intensities caused by different types of damages belonging to group-2 of weathering (discoloration/deposits) that effects buiding stones within Sabratha Archaeological City in accordance with (Fitzner et. al., 2002).



Location details			Weathering Deterioration - Group 2																										
			Discoloration / Deposits																										
			Soiling										Microbiological colonization																
No.	Site	Coordinates	Coloration (Dc)	Blacking (Db)	Soiling										Microbiological colonization (B1)	Microbiological colonization (B2)	Microbiological colonization (B3)	Microbiological colonization (B4)	Microbiological colonization (B5)										
					by particles from the atmosphere (a)	by particles from the atmosphere (b)	by particles from the atmosphere (c)	by particles from the atmosphere (d)	by particles from the atmosphere (e)	by particles from the atmosphere (f)	by particles from the atmosphere (g)	by particles from the atmosphere (h)	by particles from the atmosphere (i)	by particles from the atmosphere (j)						by particles from the atmosphere (k)	by particles from the atmosphere (l)	by particles from the atmosphere (m)	by particles from the atmosphere (n)	by particles from the atmosphere (o)	by particles from the atmosphere (p)	by particles from the atmosphere (q)	by particles from the atmosphere (r)		
3	Byzantine Gate	12.48213 32.80544	4	1	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	0	0	0	0	2
4	South Forum Temple	12.48149 32.80624	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	0	0	0	0	2
5	The Basilica	12.48103 32.80652	3	1	2	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	2	4	0	0	0	0	2
6	Captiolium	12.48062 32.80681	3	1	2	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	3	3	0	0	0	0	2
7	Scrapis Temple	12.48041 32.80702	2	1	2	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	3	0	0	0	0	2
8	Basilica of Justinian	12.48067 32.80739	2	1	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	3	0	0	0	0	1
9	The House of Ieda painting	12.48117 32.8075	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	1
10	Seaward Baths	12.48195 32.80757	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	1
11	The Antonine Temple	12.4819	3	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	0	0	0	0	1
12	Temple of Liber Pater	12.48162 32.80706	2	1	1	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0	0	1
13	Forum	12.48108 32.80692	1	1	2	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	3	0	0	0	0	2
14	Temple of Hercules	12.48409 32.80621	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	4	0	0	0	0	1
15	Christian Basilicas	12.48502 32.80689	2	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0	0	1
16	Baths of Oceanus	12.48526 32.80718	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0	0	0
17	Temple of Isis	12.48788 32.80764	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0
18	Theater	12.48518 32.80527	3	0	2	0	0	2	1	0	0	1	0	0	0	1	0	0	0	1	0	0	2	1	0	0	0	0	2
20	Curia	12.48082 32.80715	2	1	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	2	3	0	0	0	0	1
21	Mausoleum of Bes	12.48096 32.80516	3	1	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	0	0	0	0	1

Table-5: Approximations of the linear (Lin) and progradational (Prog) deterioration indices for group-2 of weathering that effecting building stones within Sabratha Archaeological City.

Code	Sites	X-Axis	Y-Axis	Lin (Group-II)	Prog (Group-II)
A	Byzantine Gate	12.4821	32.8054	3.2	3.4
B	South Forum Temple	12.4815	32.8062	2.1	2.2
C	The Basilica	12.481	32.8065	2.4	2.6
D	Captiolium	12.4806	32.8068	2.4	2.5
E	Scrapis Temple	12.4804	32.807	2.0	2.1
F	Basilica of Justinian	12.4807	32.8074	2.0	2.2
G	The House of Ieda painting	12.4812	32.8075	1.4	1.5
H	Seaward Baths	12.482	32.8076	1.2	1.2
I	The Antonine Temple	12.4819	32.8067	2.0	2.2
J	Temple of Liber Pater	12.4816	32.8071	1.8	1.9
K	Forum	12.4811	32.8069	2.2	2.3
L	Temple of Hercules	12.4841	32.8062	2.7	2.9
M	Christian Basilicas	12.485	32.8069	1.8	2.0
N	Baths of Oceanus	12.4853	32.8072	2.2	2.4
O	Temple of Isis	12.4879	32.8076	1.4	1.5
P	Theater	12.4852	32.8053	1.9	2.0
Q	Curia	12.4808	32.8072	2.2	2.3
R	Mausoleum of Bes	12.481	32.8052	2.0	2.2

Table-6: Assessment of the weathering damage categories and the recognition of linear (DI-lin) and progradational (DI-prog) indices of group-2 of weathering



(discoloration/deposits) that influence building stones within Sabratha Archaeological City in accordance with (Fitzner et. al., 2002).

No.	Groups of Weathering	Sites	X-Axis	Y-Axis	Weathering damage categories					DI-lin	DI-prog
					Very slight damage	slight damage	Moderate damage	Severe damage	Very Severe damage		
A	GII	Byzantine Gate	12.4821	32.8054	8	14	25	53	0	3.2	3.4
B	GII	South Forum Temple	12.4815	32.8062	5	77	18	0	0	2.1	2.2
C	GII	The Basilica	12.481	32.8065	17	46	14	23	0	2.4	2.6
D	GII	Captiolium	12.4806	32.8068	18	28	54	0	0	2.4	2.5
E	GIII	Scrapis Temple	12.4804	32.807	48	9	33	11	0	2.1	2.3
F	GII	Basilica of Justinian	12.4807	32.8074	42	17	41	0	0	2.0	2.2
G	GII	The House of Ieda painting	12.4812	32.8075	59	41	0	0	0	1.4	1.5
H	GII	Seaward Baths	12.482	32.8076	84	16	0	0	0	1.2	1.2
I	GII	The Antonine Temple	12.4819	32.8067	43	13	44	0	0	2.0	2.2
J	GII	Temple of Liber Pater	12.4816	32.8071	47	29	24	0	0	1.8	1.9
K	GII	Forum	12.4811	32.8069	20	39	42	0	0	2.2	2.3
L	GII	Temple of Hercules	12.4841	32.8062	23	32	0	44	0	2.7	2.9
M	GII	Christian Basilicas	12.485	32.8069	53	16	31	0	0	1.8	2.0
N	GII	Baths of Oceanus	12.4853	32.8072	38	0	62	0	0	2.2	2.4
O	GI	Temple of Isis	12.4879	32.8076	9	25	15	7	44	3.5	3.8
P	GII	Theater	12.4852	32.8053	23	64	13	0	0	1.9	2.0
Q	GII	Curia	12.4808	32.8072	19	44	37	0	0	2.2	2.3
R	GII	Mausoleum of Bes	12.481	32.8052	27	44	29	0	0	2.0	2.2

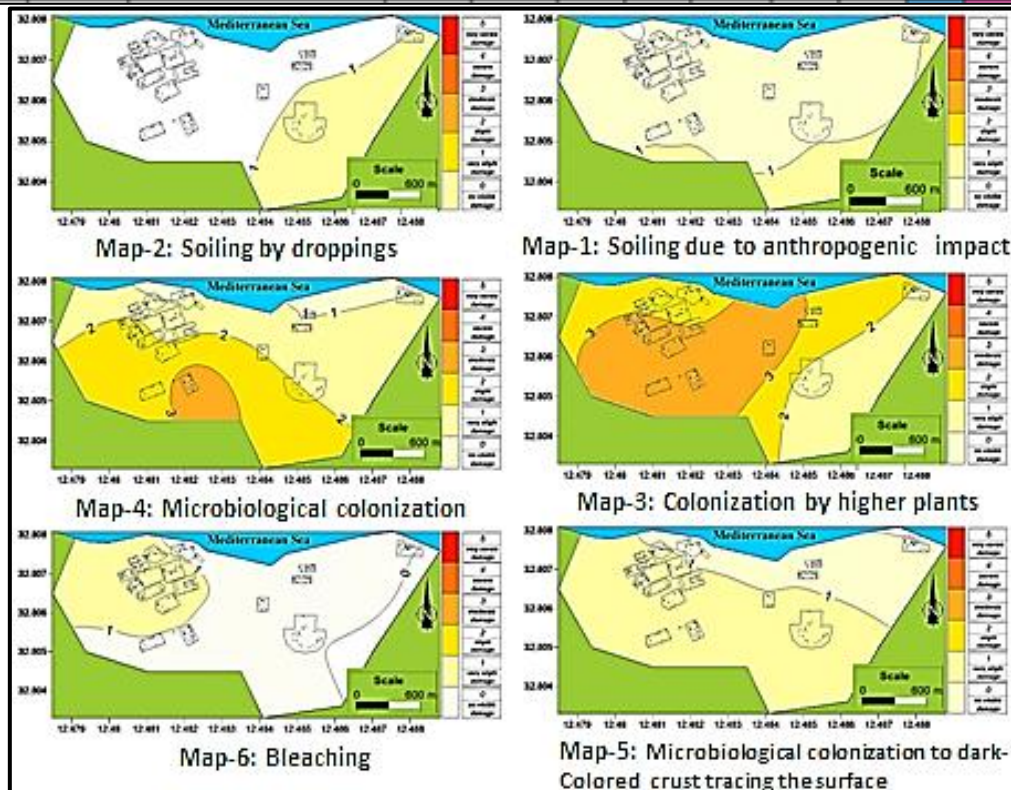


Plate-1: Contour maps showing the distribution of damage intensities of different biological and chemical individual weathering forms that influence building stones of Sabratha Archaeological City (map-1 to map-6).

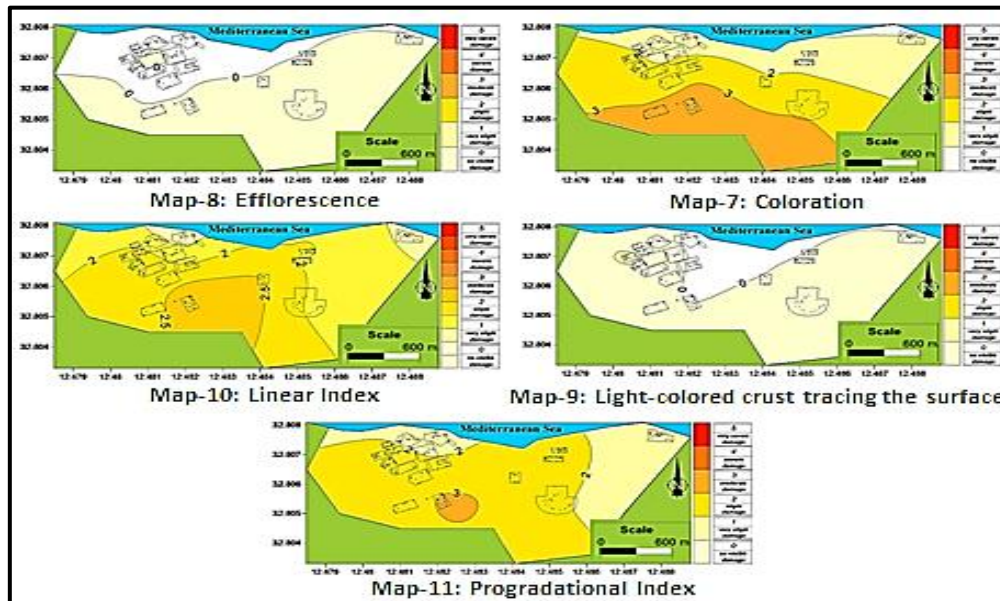


Plate-2: Contour maps showing the distribution of damage intensities of different biological and chemical individual weathering forms that influence building stones of Sabratha Archaeological City (map-7, map-8, map-9). Maps (10 & 11) representing the distribution of damage intensities of the linear and progradational indices of group-2 of weathering (discoloration/deposits). Note: {the color and degree of damage intensities as indicated from bottom to top as follows: white color = 0 (no visible damage), cream color = 0-1 (very-slight damage), yellow color = 1-2 (slight damage), orange color = 2-3 (moderate damage), light red color = 3-4 (sever damage), dark red color = 4-5 (very sever)}.

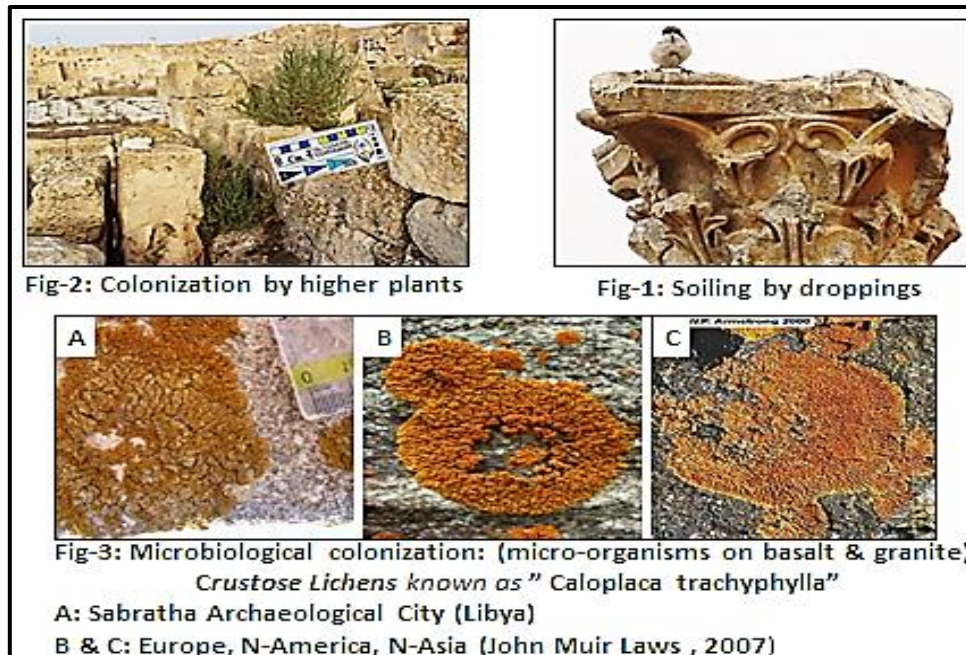


Plate-3: Soiling and biological colonization weathering forms that effect building stones of Sabratha Archaeological City. Fig-3B & 3C are comparable examples of microbiological colonization from Europe, North America and Northern Asia.

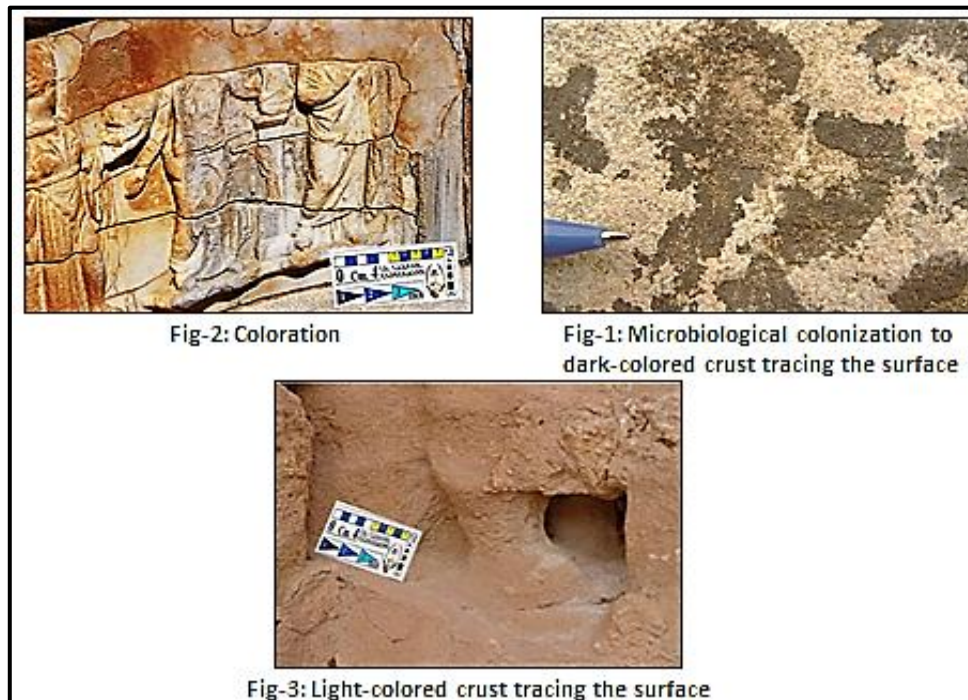


Plate-4: Biological colonization to crust, discoloration and crust weathering forms that effect building stones of Sabratha Archaeological City.

7- Discussion

Weathering of ancient stone buildings in Sabratha City through "soiling" was apparent in two ways: 1- "soiling due to anthropogenic impact" which was resulted by human activities and included different types of inscriptions, decorations, paintings and sculpturing that used different types of chemical materials which altered the origin color of stone buildings 2- "soiling by droppings" resulted by wastes of the different birds that colonize the City of ancient Sabratha buildings which as a result changing the color of stone surfaces and may grooving them as well due to the reaction between chemical materials that composes bird wastes and between minerals that constitutes building stones of the city.

Weathering through "Biological Colonization" was evident by tow means: 1- "Colonization by higher plants", which had a biological effect where plants and trees grown between stone or rock fractures that form the buildings. As trees or plants grown-up, walls of buildings became departed and broken. 2- "Microbiological colonization", which had a bio-chemical effect on the building stones and has taken place by the action of a variety of micro-organisms such as: bacteria, fungi, algae, lichens and biofilms. These micro-organisms secrete weak acids which could dissolve and destroy minerals that constitute the building stones (Roger D. Finlay et. al., 2019, Jie Chen et. al., 2000). Weathering through "Biological Colonization to Crust" is observed to have a biological effect through an individual weathering form known as "Microbiological colonization to dark-colored crust tracing the surface". It is a transitional form between biological colonization and crust and takes place when humidity missing from the environment where micro-organisms lived (in this case walls of buildings are the environment). During summer and due to high temperatures, walls became dry and black remnants left over wall surfaces which may harm the building (its known that, humidity considered to be the main source for



micro-organisms to extract their diet from rock material. If humidity missed, they will no longer survive). Another weathering form that was notable during field investigations within Sabratha archaeological City is the "Discoloration" or "Staining" that worked out through two (2) individual weathering forms known as "Bleaching" and "Coloration". Bleaching is the process by which the original color of building stones is washed out or leached and as a result minerals that compose rock stones become weathered by chemical means (ex: reduction of iron and manganese compounds). While coloration is the process by which the external surfaces of ancient buildings become colored, either through chemical weathering of rock minerals that form the buildings (ex: oxidation of iron and manganese compounds) or through staining by biogenic pigments and other coloring materials coming from surrounding medium (Siegesmund, S. et.al. 2019). Deposition of less consolidated salt clusters (designated as "weathering by loose salt deposits") as well as deposition of highly consolidated crusts (designated as "weathering by crust") on stone surfaces are two additional weathering forms that observed to effect buildings of Ancient Sabratha City by chemical means. Efflorescence phenomenon (belonging to the first weathering form) which is the deposition of loose salt clusters on building stone surfaces or within pore spaces of the stones have been found to affect Sabratha monuments. The source of salts is thought to be come from limestone rock blocks that used in construction or come as a result of chemical decay processes of rock blocks when come in contact with contaminated atmosphere. The growth of these salt crystals will damage the framework of the building stones slowly until become demolished. Salts have long been known to damage porous materials, mainly through the production of physical stress resulting from the crystallization of salts in pores. Salts can also damage stone through a range of other mechanisms, such as differential thermal expansion, osmotic swelling of clays, and enhanced wet/dry cycling due to deliquescent salts (Rothert, E. et. al., 2007, Siegesmund, S. et.al., 2019). The combined effect of physical degradation by lichen hyphae penetrating in a rock and chemical attack by organic acid with associated growth of inorganic salts leads to accelerated weathering. Different types of weathering discolorations associated with fungal and bacterial activities were observed to yield extensive corrosion and dissolution of mineral surfaces beneath them (Siegesmund, S. et.al. 2019). Basically all types of building materials are colonizable by microorganisms. Often, surfaces are covered with a rigid layer composed of microbial cells and extracellular biofilm. Bio-deterioration of building material is determined by the metabolic activities of the cells as well as the impact of the extracellular biofilm (Roger D. Finlay et. al., 2019). Deposition of Light-colored crust tracing the surface of building stones of Sabratha monuments (belonging to the second weathering form) has worked through the deposition of light-colored and massive mineral crusts as a result of precipitation processes by rain. The overall rating of weathering damages of the archaeological buildings and monuments can be delineated by the estimation of the linear and progradational damage indices. According to (Fitzner et. al., 2002, and 2004), the damage indices range between 0 and 5.0. (0: no visible damage), (0-1: very slight damage), (1-2: slight damage), (2-3: moderate damage), (3-4: severe damage), (4-5: very severe damage).

The linear damage index corresponds to the average damage category, whereas the progradational damage index emphasizes the proportion of higher damage categories



(Heinrichs, K. & Fitzner, B, 1999 and Fitzner et. al., 2000). Linear and progressive damage indices in Sabratha archaeological City is varied from (non-visible to moderate "from 0 to 3") and from slight to moderate "from 2 to 3") respectively, which alerts to the necessity and urgency of remediation and restoration intervention, in order to protect the archaeological buildings of Sabratha City.

8- Conclusions

According to the chemical and biological weathering factors that led to the deterioration of building stones of Sabratha archaeological City and based on the previous discussion, we conclude the following: It has been found six (6) main and nine (9) individual weathering forms were found to deteriorate the building stones of the Ancient City of Sabratha somehow chemically, biochemically and biologically. These were known as: a) Soiling, which involved two individual weathering forms specifically: "soiling due to anthropogenic impact" and "soiling by droppings", b) Biological colonization, which involved two individual weathering forms specifically: "colonization by higher plants" and "Microbiological colonization". c) Biological colonization to crust, which acted through an individual weathering form designated as "microbiological colonization to dark-colored crust tracing the surface". d) Discoloration or "Staining", which performed through two individual weathering forms namely: "bleaching" and "coloration". e) Loose salt deposits, which performed through an individual weathering form namely: "efflorescence". f) Crust, which acted through "light-colored crust tracing the surface" individual weathering form. The damage degree of these weathered forms varied from non-visible to moderate with degree of distribution varied from very-limited to widespread.

The linear and progradational weathering indices of this group of weathering showed varied degrees of damage, which was from non-visible to moderate with increasing effect away from sea coast and were widespread in such case alarming to the necessity of building stone remediation and restitutions of the archaeological City of Sabratha.

Acknowledgments

The authors of this research are very much grateful to the "Authority of Natural Science Research and Technology" for the financial support they offered to this research.

References

1. Earle, S., (2015). Physical Geology. Victoria, B.C.: BCcampus. Retrieved from <https://opentextbc.ca/geology/>
2. El Hinnawy & Cheshitev ,(1975) Explanatory Booklet for geological map of Libya(sheet Tripoli , industrial research centre. Libya.
3. Fitzner, B., Heinrichs, K. & La Bouchardiere, D., (2000). Damage index for stone monuments, Proceedings of the 5th International Symposium on the Conservation of Monuments in the Mediterranean Basin, Seville, 5-8.
4. Fitzner, B., Heinrichs, K., (2001). Damage diagnosis of stone monuments - weathering forms, damage categories and damage indices. -In: Prikryl,R., Viles, H.A. (eds.): Understanding and managing stone decay. - Proceedings of the International Conference 'Stone weathering and atmospheric pollution network (Swapnet 2001).
5. Fitzner, B., Heinrichs, K., La Bouchanjiere, D., (2002). Limestone weathering of historical monuments in Cairo, Egypt. -In: Siegesmund, S., Weiss, T., VolXbrecht,



- A. (eds.): Natural stone, weathering phenomena, conservation strategies and case studies. - Geological Society London, Special Publication1, 205, 217-239.
6. Fitzner, B. and, Heinrichs, k, (2004). Photos, atlas of weathering forms on stone monuments.
7. Gore, Pamela J. W., (2013). Weathering Archived at the Wayback Machine. Georgia Perimeter College.
8. Heinrichs, K. & Fitzner, B., (1999). Comprehensive characterization and rating of weathering state at monuments carved from bedrocks in Petra/Jordan – weathering forms, damage categories and damage index, Annual of the Department of Antiquities of Jordan, XLIII, pp. 321-351, Amman.
9. Ismail F. Shushan, Sadik B. Akhmyra, Haitham A. Minas., (2019a). Evaluation of the physical weathering damages on building stone materials at the Archaeological Site of Sabratha, Northwest Libya, Journal of Academic Researches, No. (13), Jan-2019, The Libyan Academy of Misuratha, pp. 345-357.
10. Ismail F. Shushan, Sadik B. Akhmyra, Haitham A. Minas., (2019b). The Detachment Physical Weathering Form Group Affecting Stone Building Materials At The Archaeological Site of Sabratha, Northwest Libya, 2019. Journal Of Marine Sciences & Environmental Technologies, Vol. 5, Issue No. 1, June-2019, (pages:E-1:E-14).
11. Jie Chen, Hans-Peter Blume, Lothar Beyer, (2000). Weathering of rocks induced by lichen colonization — a review, 0341-8162r00r\$ - see front matter q 2000 Elsevier Science B.V. All rights reserved.PII: S0341- 8162 99 00085- 5
12. John M. L. (2007). The Laws Field Guide to the Sierra Nevada, Sierra Nevada of California, <https://www2.palomar.edu/users/warmstrong/pljan98b.htm>.
13. Roger D. Finlay, Shahid Mahmood , Nicholas Rosenstock , Emile B. Bolou-Bi , Stephan J. Köhler, Zaenab Fahad, Anna Rosling, Hokan Wallander, Salim Belyazid, Kevin Bishop, and Bin Lian., (2019). Biological weathering and its consequences at different spatial levels from nanoscale to global scale. Manuscript under review for journal Biogeosciences Discuss., <https://doi.org/10.5194/bg-2019-41c> ,CC BY 4.0 License.
14. Rothert E. T., Eggers, J. Cassar, J. Ruedrich, B. Fitzner, & S. Siegesmund, (2007). Stone properties and weathering induced by salt crystallization of Maltese Globigerina Limestone. Geological Society, London, Special Publications, 271, 189–198., 0305-.
15. Siegesmund, S., Weiss, T. & Vollbrechr, A., (2002). Natural Stone, Weathering Phenomena, Conservation Strategies and Case Studies. Geological Society, London, Special Publications, 205, 1-7.



الفهرس

الصفحة	اسم الباحث	عنوان البحث	رت
1-10	Manal Mohammed bilkour	An optimal fuzzy zero point method for solving fuzzy transportation problem	1
11-24	Mohamed Bashir M. Ismail	Assessing the Adaptability of Students and Teachers in the Faculty of Arts at Alasmarya Islamic University to the Sudden Transition to Online Teaching and Learning Processes during the COVID- 19 Pandemic	2
25-34	Dawi Muftah Ageel	Environmental study for Cyanobacteria Blooms using Envisat data at the western coastal of Libya	3
35-53	Nuria Mohamed Hider	Possible solutions to ensure data protection in cloud computing to avoid security problems	4
54-60	Gharsa Ali Elmarash Najla Mokhtar	A printed book or an e-book? Student Preferences & Reasons	5
61-75	هدية سليمان هويدي نادية عطية القدار دعاء عبد الباسط باكير	التشهير الإلكتروني عبر مواقع التواصل الاجتماعي من وجهة نظر طلبة كلية طب الأسنان بمدينة زليتن	6
76-89	Hamza A. Juma Saif Allah M. Abgenah Mustafa Almahdi Algaet Munayr Mohammed Amir	Designing an Autonomous Embedded System for Temperature Monitoring and Warning in Medical Warehouses	7
90-101	Salem Msaoud Adrugi Tareg Abdusalam Elawaj Milad Mohamed Alhwat	The effect of using electronic mind maps in learning visual programming through e-learning platforms An experimental study of computer departments students at Elmergib University	8
102-110	Suad Mohamed Ramadan Zainab Ahmed Dali Ahlam Mohammad Aljarray Zenoba Saleh Shubar	Performance analysis of different anode materials of double chamber Microbial Fuel Cell technology using different types of wastewater	9
111-116	Faiza Farag Aljaray Saad Belaid Ghidhan	Evaluation of Hardness for Electroless Ni-P Coatings	10
117-128	Saleh Meftah Albouri Hadya S Hawedi Mansur Ali Jaba	Using Smartphone in Education: How Smartphone has impacted in Education, A Review Paper	11
129-139	Ibrahim O, Sabri	The Concept of Illegal Immigration and Its Causes in North Africa Region	12
140-151	A.S. Deeb I.A.S. Gjam	Solution of a problem of linear plane elasticity in region between a circular boundary with slot by boundary integrals	13



152-173	Musbah Ramadan Elkut	Transforming TESOL Pedagogy: Navigation Emerging Technology and Innovative Process	14
174-192	سالم علي سالم شخطور	آراء أبي محمد القيسي في خزانة الأدب "دراسة وتحليل"	15
193-217	نورية صالح إفريج	اعتراضات النحاة على حجية الشواهد في مسألة إعادة حرف الجر مع حتى العاطفة	16
218-238	نجاه صالح اليسير	الازدواجية اللغوية وأثرها في تعليم اللغة العربية الصفوف الأولى من المرحلة الابتدائية (أنموذجاً)	17
239-256	محمود محمد رحومة الهوش	الرضا الوظيفي وأثره على الاداء المهني لدى معلمي ومعلمات التربية البدنية ببلدية العجيلات	18
257-272	إبراهيم رمضان هدية	السرد الروائي عند إبراهيم الكوني في رواية الدنيا أيام ثلاثة	19
273-279	ابراهيم علي احمدودة ابراهيم علي ارحومة	التحليل الاستراتيجي لشركة الخطوط الجوية الليبية دراسة تطبيقية على الشركة باستخدام النماذج	20
280-294	Ismail F. Shushan Emad Eldin A. Dagdag Salah Eldin M. Elgarmadi	Petrography of Abushyba Formation columnar-jointed sandstones (Triassic-Jurassic) from Jabal Nafusa- Gharian, NW-Libya	21
295-307	Samera Albghil	Multimodal discourse analysis of variations in Islamic dress code in Bo-Kaap, Cape Town	22
308-317	عبداللطيف بشير المكي الديب رجب فرج سالم اقنيير	(استخدام نظم المعلومات الجغرافية والاستشعار عن بعد في تقدير النمو العمراني وأثره على البيئة المحلية بمنطقة سوق الخميس - الخمس / ليبيا)	23
318-331	حنان عبد السلام سليم عائشة حسن حويل	تطوير الخدمات العقارية باستخدام تقنية المعلومات (تطبيق أندرويد للخدمات العقارية أنموذجاً)	24
332-338	Mahmoud Mohamed Howas	Hepatoprotective Potential of Propolis on Carbontetrachloride-Induced Hepatic Damages in Rats	25
339-352	نورية محمد النائب الشريف	البناء العشوائي في مدينة الخمس (مفهومه - أسبابه - تأثيره على المخطط)	26
353-371	إسماعيل حامد الشعاب معمر فرج الطاهر سالم العامري	اختلاف القراء السبعة في البناء للفاعل وغير الفاعل وأثره في توجيه المعنى "نماذج مختارة"	27
372-376	عبد السلام صالح أبوسديل عطية رمضان الكيلاني	دراسة على مدى انتشار Gnathia sp. في بعض الأسماك البحرية المصطادة من شواطئ الخمس- ليبيا	28
377-392	الصغير محمد المجري	(بيان فعل الخير إذا دخل مكة من حج عن الغير) للملا علي القاري المتوفي سنة 1014هـ دراسة وتحقيق	29
393-421	نجيب منصور ساسي	فضل المواهب في شرح عيون المذاهب لعبد الرؤوف الأنطاكي (1009هـ) (الاستنجا ونواقض الوضوء من كتاب الطهارة) دراسة وتحقيقا	30
422-439	حنان ميلاد عطية	برنامج ارشادي معرفي سلوكي في خفض مستوى الوحدة النفسية لأبناء النازحين الليبيين	31
440-457	Hanan A. Algrbaa,	Speaker recognition from speech using Gaussian mixture model (GMM) and (MFCC)	32
458-467	هشام علي مرعي	علاقة المنطق بالعلوم الشرعية عند الغزالي	33



468-476	خالد الهادي الفيتوري زينب أحمد زوليه	الحلول العددية للمعادلات التفاضلية الملزمة باستخدام ب-سبلين التكعيبية	34
478-500	خميس ميلاد الدزيري	تأثير نظم معلومات التسويقية على توزيع السلعة " دراسة تطبيقية على إدارة مصنع إسمنت المرقب "	35
501-517	منصور عمر سالم فرعون	إدارة الوقت في الإدارة المدرسية في ضوء مهامهم الإدارية	36
518-533	فائزة محمد الكوت	أراء العلامة الدماميني النحوية في باب الظروف في كتاب خزانة الأدب ولب لباب لسان العرب	37
534-547	محمد محمد مولود الأنصاري حمزة مسعود محمد مكاري	"فوائد الفرائد في الاستعارة " عبد الجواد بن إبراهيم بن شعيب الأنصاري (1073هـ)	38
548-559	عبدالرحمن بشير الصابري إبراهيم عبد الرحمن الصغير أبوبكر أحمد الصغير	حروف الجر بين التناوب والتضمين دراسة تطبيقية على آيات من القرآن الكريم "دراسة وصفية تحليلية"	39
560-565	Ayda Saad Elagili Abdualah Ibrahim Sultan	An Application of "Kushare Transform" to Partial Differential Equations	40
566-598	أمل إجمد إقميع فاطمة محمد ابوراس	الأداء الوظيفي للمعلم وأثره على العملية التربوية دراسة سوسولوجية على عينة من معلمين ومعلمات مرحلة التعليم الأساسي	41
599-623	خيري عبدالسلام كليب عبدالسلام بشير اشتوي طارق أبوفارس العجيلي محمد عبدالسلام الأسطي فتحية خليل طحيشات	مدى التزام المصارف التجارية بتطبيق مبادئ إدارة الجودة الشاملة (دراسة ميدانية على مصرف الجمهورية فرع المرقب)	42
624-633	Abdulrhman Iqneebir Khaled Muftah Elsherif	Determination of Some Physical and Chemical Parameters of Groundwater in Ashafyeen-Masallata Area	43
634-650	أحمد على معتوق الزائدي	أحكام الأهلية وعوارضها عند الإنسان	44
651-671	عمر مصطفى النعاس السيد مصطفى السنباطي	الثقة بالنفس وعلاقته بالتوجه نحو الحياة لدى طالبات كلية الآداب	45
672-700	فاطمة جمعة الناكوع	معايير جودة آليات التدريب الميداني	46
701-718	إيمان عمر بن سعد بثينة علي أبو حليقة عمر محمد بشينه وليد حسين الفقيه	أثر المخاطر المالية في الأداء المالي للمصارف التجارية الليبية للفترة من (2011-2017)	47
719-730	هدي الهادي عويطي	دور مداخل ادارة المعرفة في تحسين ادارة الموارد البشرية في المؤسسات الحديثة	48
731-739	Khaled Abdusalam B. A Eman Mohammed Alshadhli Tasnim Adel Betro Amera Lutfi Kara Mawada Almashloukh	Antimicrobial Activities of Methanol Extract of Peganum harmala Leaves and Seeds against Urinary Tract Infection Bacteria	49
740-750	فتحية زايد شنيبه نجاة بشير الصابري	الصور البيانية في سورة الواقعة	50



751-757	Afifa Milad Omeman	Phytochemical, Heavy Metals and Antimicrobial Study of the Leaves of Amaranthus viridis	51
758-765	أسماء جمعة القلعي	قواعد المنهج عند ديكرت	52
766-777	فرج مجد صالح الدريع	النفط والاقتصاد الليبي 1963م - 1969م	53
778-789	عمر عبدالسلام الصغير رضا القدافي الأسمر	تقويم دية القتل الخطأ بغير الأصل	54
790-804	أبو عجيبة رمضان عويلي أحمد عبد الجليل إبراهيم	مناقشة المسألة الأربعين من كتاب المسائل المشكلة للفارسي	55
805-823	فتحية أبو عجيبة جبران صالحة عمر الخرارزة	في منطقة سوق الخميس التلوث البيئي الناتج عن محطات الوقود (بحث مقدم للحصول على ترقية عضو هيئة تدريس)	56
824-856	هنية عبدالسلام البالوص	بعض المشكلات الضغط النفسي وعلاقتها بالصحة النفسية	57
857-871	احمد علي عزيز علي مفتاح بن عروس	تطبيقات البرمجة الخطية ونماذج صفوف الانتظار في مراقبة وتحسين الأداء دراسة إحصائية تطبيقية على القطاع الصحي بمدينة الخمس	58
872-879	Mona A. Sauf Fathi Shakurfow Sana Ali Soof Abdel-kareem El-Basheer	Isolation of Staphylococcus Aureus From Different Clinical Samples And Detects on Its Antibiotic Resistance	59
880-885	Wafa Mohamed Alabeid Omar Alamari Alshbaili	Combined Method of Wavelet Regression with Local Linear Quantile Regression in enhancing the performance of stock ending-prices in Financial Time Series	60
886-901	خالد مجد بالنور خالد أحمد قناو	حجم الدولة الليبية وأثره عليها طبيعياً وبشرياً	61
902-918	Amna Ali Almashrgy Hawa Faraj Al-Burrki Khadija Ali AlHebshi	EFL Instructors' and Students' Attitudes towards Using PowerPoint Presentation in EFL Classrooms	62
919-934	سالمة عبد العالي السيليني	اضطرابات الشخصية الحدية وعلاقتها بالجمود المعرفي	63
935-952	Samah Taleb	Common English Pronunciation Difficulties Encountered by Third Year Students at the Faculty of Education- English Department- Elmergib University	64
953-958	Hassan M. Krifa	A Study on Bacterial Contamination of Libyan Currency in Al-Khoms, Libya	65
959-964	Jamal Hassn Frjani	A New Application of Kushare Transform for Solving Systems of Volterra Integral Equations and Systems of Volterra Integro-differential Equations	66
965-978	Ismail Elforjani Shushan Saddik Bashir Kamyra Hitham A. Minas	Study of chemical and biological weathering effects on building stones of the Ancient City of Sabratha, NW-Libya	67
979-991	مجد عبد السلام دخيل	الآثار الاجتماعية والثقافية المصاحبة للتغير الاجتماعي في المجتمعات النامية	68



992-998	Ismael Abd-Elaziz Fatma Kahel	Molecularly imprinted polymer (poly-pyrrole) modified glassy carbon electrode on based electrochemical sensor for the Sensitive Detection of Pharmaceutical Drug Naproxen	69
999-1008	خالد رمضان الجربوع علي إبراهيم بن محسن صلاح الدين أبوغالية	علي الجمل وقصيدته (اليوم الأربعاء في رثاء النورس الكبير)	70
1009-1014	نادية مجد الدالي ايمان احمد اخميرة	Comparing Review between Wireless Communication Technologies	71
1015-1024	Khairi Alarbi Zaglom Foad Ashur Elbakay	The importance of Using Classroom Language in Teaching English language as a Foreign Language	72
1025-1042	حمزة بن ربيع لقرون	الأدلة المختلف فيها التي نُسب الاختصاص بها إلى مذهب مُعَيَّن (دراسة تحليلية مقارنة)	73
1043-1052	أسماء السنوسي لحيو	معدل انتشار بعض الأوليات المعوية الطفيلية في مدينة الخمس، ليبيا	74
1053-1067	برنية صالح إمام صالح	استعمالات (ما) النافية في سورة البقرة	75
1068-1085	اسماعيل عبدالكريم اعطية	عوامل نجاح وفشل نظام المعلومات دراسة تطبيقية على شركة الأشغال العامة بني وليد	76
1086-1098	نجوى الغويلي	"الرعاية الاجتماعية والدعم الاجتماعي والتربية الإيجابية للطفل"	77
1099-1105	Seham Ibrahim abosoria Fatheia Masood Alsharif Abdussalam Ali Mousa Hamzah Ali Zagloun	The Error Correction in second language writing	78
1106-1128	ميسون خيري عقيلة	أساليب المعاملة الوالدية وعلاقتها بالتحصيل الدراسي لدى عينة من طلبة كليات جامعة المرقب بمدينة (الخمس)	79
1129-1135	Majdi Ibrahim Alashhb Mohammed Alsunousi Salem Mustafa Aldeep	Quality of E-Learning Learning Based on Student Perception Al Asmarya University	80
1136-1150	Ekram Gebрил Khalil	The Importance of Corrective Feedback in leaning a Foreign Language	81
1151-1164	سكينة الهادي الحوات فوزي مجد الحوات سلمية رمضان الكوت	شكل العلاقات الاجتماعية في ظل انتشار الأوبئة والأمراض السارية (جائحة كوفيد 19 نموذجاً)	82
1165-1175	Salma Mohammad Abad	A comparative study of the effects of Rhazya stricta plant residue on Raphanus sativus plant at the age of 15 and 30 days	83
1176-1191	مجد عمر مجد الفقيه الشريف	توظيف الاعتزال عند الزمخشري وانتصاره له من خلال تفسيره	84
1192	الفهرس		