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N-ALKANES IN SOIL OF WEST QURNA-1 OIL FIELD IN BASRA CITY, SOUTHERN IRAQ

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ABSTRACT

N-alkanes concentrations in soil showed that, the higher regional mean concertation in Location 5 was (17.004 μg/g) and the lowest in Location 10 was (7.956 μg/g). The highest mean concentration of n-alkanes was during Winter (13.879 μg/g dry weigh) and the lowest was during Summer (9.335μg/g dry weight). The carbon chain length of n-alkanes in soil and plant samples were recorded from C14-C37). According to Carbon Preference Index **(**CPI), and Pristine/Phytane values the source of n- alkanes hydrocarbons in the West Qurna-1 oil field was mainly biogenic and anthropogenicwhile C17 / Pristane and C18 / Phytane Ratios the source of nalkanes in soil was an indication of weathering and oldness of existing petroleum in soil" while C17 / Pristane and C18 / Phytane Ratios the source of nalkanes in soil was an indication of weathering and oldness of existing petroleum in soil".

Keyword: N-alkanes, soil pollution; West Qurna- 1 oil field; southern Basrah

No: of Tables: 8	No: of Figures:01	No: of References:
27		

INTRODUCTION

The super-giant West Qurna oil field in southern Iraq is located in Basrah Governorate, around 65 km North West of the city of Basrah. The West Qurna field is situated in a long, sinuous North South trending structure. The field is comprised of two separate license areas, 1 and 2. The West Qurna field was discovered in August 1973 and a total of 13 wells have been drilled in the West Qurna 1 area.

Petroleum hydrocarbons come into the earth through accidents, spills or leaks, from industrial discharges, or by items from business or residential employments [1]. Normal alkanes are open chain saturated hydrocarbons (aliphatic hydrocarbons) single covalent bond is bonded all carbon atoms. They divided into aliphatic and cyclic alkanes (alicyclic) that typically have a carbon number extent from one to around 60 carbons. Saturates usually are the most abundant constituents in crude oils. Normal alkanes generally constitute the major part of saturated hydrocarbons and their distribution patterns are characterized by the predominance of a range of C-numbers depending on the nature of the source material and its microbial or geochemical alteration.

Normal alkanes are ubiquitous in sedimentary samples, and often exhibit distributions with an odd C-number predominance, which is lost during the maturation of the organic matter [2]. N-Alkane is a kind of hydrocarbons which comprises of odd and even carbon numbers which can be up to 64 carbons with no alkyl branch or alternatives. The odd carbon numbers come fundamentally from the biogenic sources, while even carbon numbers are typically gotten from the anthropogenic sources. [3]

The aim of Study was investigating the seasonal variation of the concentration and sources in N-alkanes in soil at West Qurna -1 oil field.

Material and methodes:

Soil samples were collected seasonally during the period from September 2015 to March 2016 at ten stations in West Qurna-1 oil field at Basrah city, samples were warped with aluminum foil then transferred to the laboratory for analysis (Fig.1).

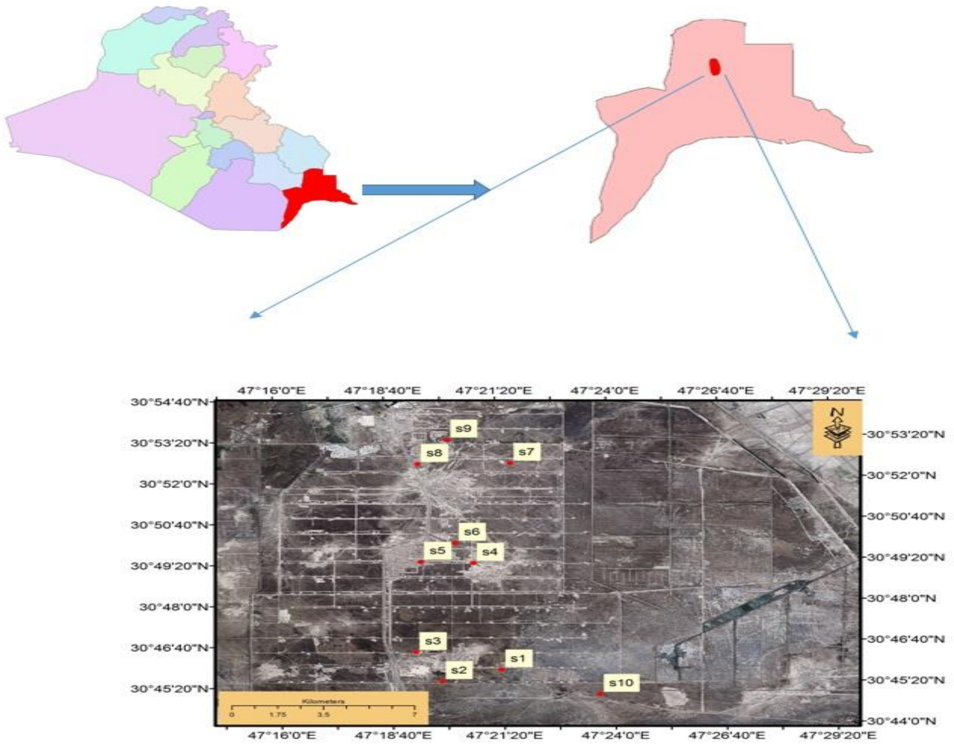
The procedure which described by [10,11] was used to extracted the Hydrocarbons from soil. Twenty-five grams of soil were Soxhlet extracted for 24 hours with 250 ml Methanol: Benzen (1:1). Elemental sulfur was removed from the extracts using activated elemental copper in order to avoid sulfur interferences when using gas chromatography. The extracts were then fractionated into aliphatic and aromatic hydrocarbons by chromatography column. The column was prepared by slurry packing 10 g of silica (100-200 mesh), followed by 10 g of alumina (100-200 mesh) (silica-gel and alumina were activated at 200° C for 4 hours and then partially deactivated with 5 % water) and finally 1 g of anhydrous sodium sulphate was added to the surface to avoid disturbance of the top layer when pouring the solvent. The extract was then applied to the head of the column and eluted with 25 ml n-hexane to obtain on the aliphatic. The aliphatic fractions were concentrated on a rotary evaporator, transferred to a vial, and the volume was adjusted to 1 ml exactly using a stream of N2. An aliquot of 1 µl of extract of aliphatic hydrocarbons was subjected to analysis by an allegiant capillary gas chromatography with flam ionization detector (FID). Column (model Agilent 19091J-101HP-5 5% phenyl Methyl silicone with dimensions (50 m. *200µm *0.33 µm) was used for aliphatic separation, while the fused silica capillary column (100 m x 250 µm x 0. 5µm) used was a wall coated open tubular (methyl silicone) (Agilent US2463233H DB-petrp), with helium as gas carrier at flow rate of 1.5 ml/minute.

individual of aliphatic were identified based on the retention time of an authentic mixed standard procured from Supelco, USA. The concentrations of aliphatic compounds were calculated based on the standard calibration curve of corresponding standard compounds. 80 % to 92 % are the range of recovery assays for standards compounds. Standard deviation for the method was less than 10 % based on replicate analysis. Great care was taken to avoid contamination of the samples throughout the analytical procedure. All solvents were distilled twice before use; glassware was rinsed with distilled water and heated in an oven at 250 °C for 24 hours. However, procedural blanks consisting of all reagents and glassware used during the analysis were periodically determined which had shown no detectable interference

Carbon Preference Index (CPI) is defined as ratio of concentrations of sum

odd to sum even carbon number of n-alkanes. It can be used to evaluate biogenic and anthropogenic contributions to n-alkanes in an environment (Weifang *et al.*, 2010). Typically, n-alkanes from an anthropogenic source have a CPI value less than 1 or close to 1, while n-alkanes from biogenic source have CPI values greater than 1 (Cripps, 1989).

Pristine (2, 6, 10, 14-tetramethyl pentadecane, C19) and Phytane (2, 6, 10, 14-tetramethylhexadecane, C20) are also important indicators of petroleum hydrocarbons contamination If the proportion of the Pristine to the Phytane is greater than one, the origin is biogenic, and if one or less is the human anthropogenic origin. (NRC, 2003). If the value of C17/Prstane and C18/Phytan less than 1 that indicates the presence of weathering of oil and hydrocarbons, while the high value of this ratio indicates the presence of oil compounds [4].



Fig; (1) The study area

Results:

The carbon chains length of n-alkanes in soil samples were recorded from C14 - C37. Numbers of other hydrocarbons compounds are present in the aliphatic fraction, including pristine and phytane. The seasonal values of n-alkanes in soil at the studied presented in Tables (1-4).

The result of total N-alkane concentrations in soil samples at ten locations ranged as following: location 1 from 10.352 µg/g during Summer to 17.788µg/g during Winter. Whereas in location 2 from 8.466µg/g during Summer to 12.170µg/g during Winter. While in location 3 from 9.703µg/g during Summer to 12.171µg/g during Autumn. location 4 from 9.169µg/g during Summer to 13.380µg/g during Winter. In location 5 from 9.950µg/g during Summer to 17.004 µg/g during Winter. location 6 from 10.922µg/g during Summer to 15.019µg/g during Winter. location 7 from 10.765µg/g during Summer to 15.711 µg/g during Winter. location 8 from 8.400µg/g during Summer to 11.286µg/g during Winter. location 9 from 9.778µg/g during Summer to 15.677µg/g during Winter and location 10 from 5.868µg/g during Summer to 8.712µg/g during Winter, Tables (1-4).

The highest concentrations of total n-alkanes in soil are recorded at Location 5 (17.004 µg/g) during Winter, while the lowest concentrations (7.956 µg/g) are recorded at Location 10 during Autumn Tables (1-4). The result of Seasonal variations of N-alkanes are observed in this study. The highest of seasonal mean concentrations were detected during Winter season while lower seasonal mean concentration noticed during Summer season table (5).

Table (1) Spatial concentration of n-alkanes (mg/g dry weight) in soil samples of West Qurna-1 field during Winter season 2018.

Carbon number	Location 1	2	3	4	5	6	7	8	9	10
N-C14	0.101	0.041	0.099	0.132	0.133	0.035	0.096	1.079	0.112	0.026
N-C15	5.880	0.125	0.029	1.602	0.338	0.059	0.157	1.056	0.264	0.228
N-C16	0.183	0.043	0.201	1.159	0.095	0.137	0.073	0.159	0.078	0.137
N-C17	0.348	0.071	0.201	0.186	0.241	1.873	0.205	0.132	0.773	0.080
N-C18	0.066	0.490	0.579	0.138	5.034	0.784	1.449	0.079	0.115	0.084
N-C19	0.155	0.593	0.087	1.106	0.525	0.395	1.262	1.084	0.078	0.157
N-C20	0.665	1.442	1.506	0.163	3.459	0.159	2.868	0.420	0.032	0.131
N-C21	0.051	0.515	0.319	0.143	1.250	0.318	0.515	0.116	0.314	1.168
N-C22	1.043	0.508	0.451	0.291	3.065	1.769	3.400	0.605	4.803	0.765
N-C23	0.722	0.547	0.525	0.400	0.420	0.485	1.199	0.121	0.289	0.031
N-C24	1.067	0.858	0.591	0.150	0.098	2.213	1.941	1.028	0.462	0.029
N-C25	0.492	0.679	0.425	1.156	0.080	0.367	0.534	0.271	0.183	0.398
N-C26	0.302	0.579	0.271	0.049	0.045	0.896	0.233	0.340	0.198	0.640
N-C27	0.165	0.669	0.931	0.026	0.025	0.395	0.118	0.045	0.220	0.076
N-c28	1.310	0.794	0.211	1.112	0.163	0.709	0.054	1.037	0.422	1.119
N-C29	0.954	0.457	0.237	0.044	0.141	0.530	0.063	0.073	1.087	0.062
N-C30	0.634	0.853	1.260	0.662	1.224	0.703	0.061	0.513	1.183	1.049
N-C31	0.502	0.542	0.401	0.819	0.198	0.740	0.715	0.311	1.336	2.031
N-C32	0.516	0.482	0.407	0.033	0.110	0.293	0.036	0.081	1.432	0.029
N-C33	0.756	0.649	1.276	1.542	0.083	0.427	0.409	0.550	1.413	0.083
n-C34	0.612	0.336	0.327	0.137	0.085	0.076	0.121	1.081	0.746	1.129
N-C35	0.034	0.417	1.326	1.150	0.028	0.101	0.116	1.031	0.033	0.046
N-C36	0.161	0.362	1.127	1.126	0.084	0.110	0.043	0.055	0.037	0.141
N-C37	0.069	0.327	0.036	0.054	0.058	1.445	0.043	0.046	0.070	0.073
Total	**17.788**	**12.170**	**12.046**	**13.380**	**17.004**	**15.019**	**15.711**	**11.286**	**15.677**	**8.712**
odd	10.128	5.591	5.793	8.228	3.387	7.135	5.336	4.836	6.060	4.433
even	7.660	6.579	6.253	5.152	13.617	7.884	10.375	6.450	9.617	3.279
Pristine	0.053	0.294	0.103	0.109	0.181	0.790	0.171	0,.123	0.314	0.093
Phytane	0.025	0.069	0.123	0.333	0.840	0.395	0.636	0.085	0.236	0.070

Table (2) Spatial concentration of n-alkanes (mg/g dry weight) in soil samples of West Qurna-1 field during Spring season 2018

Carbon number	Location 1	2	3	4	5	6	7	8	9	10
-C14	0.092	1.021	0.120	1.113	0.196	0.100	0.084	0.064	0.110	0.136
N-C15	1.421	1.137	0.130	0.984	0.316	0.047	0.152	0.051	0.142	0.153
N-C16	0.173	0.033	0.115	0.137	0.100	0.124	0.064	0.142	0.061	0.126
N-C17	0.219	0.104	0.100	0.182	0.231	1.742	1.201	0.125	0.641	0.163
N-C18	0.112	0.251	0.527	0.133	3.257	0.631	1.572	0.113	0.103	0.132
N-C19	0.142	0.091	0.075	0.104	0.436	0.386	2.426	1.081	0.114	0.142
N-C20	1.521	0.975	1.431	0.154	2.537	0.147	1.421	0.411	0.031	0.225
N-C21	1.041	0.211	0.305	1.137	1.032	0.314	0.438	0.113	0.295	0.247
N-C22	0.931	0.199	0.216	0.228	2.470	1.350	1.163	1.601	4.220	0.646
N-C23	0.617	0.342	0.318	0.387	0.386	0.410	1.125	0.110	0.211	0.129
N-C24	0.954	0.649	1.532	1.134	0.093	1.983	1.730	0.021	0.431	0.360
N-C25	0.411	0.210	1.210	0.095	0.043	0.437	0.421	0.205	0.175	0.321
N-C26	0.274	1.163	1.162	0.460	0.042	0.754	0.211	1.296	0.171	0.590
N-C27	0.143	1.165	0.826	0.022	0.022	0.360	0.101	0.039	0.120	0.281
N-c28	1.210	0.375	0.205	0.110	0.147	0.680	0.042	0.031	0.328	0.312
N-C29	0.842	0.162	0.031	1.038	0.126	0.450	0.052	1.110	1.943	0.530
N-C30	0.543	0.821	0.975	1.561	1.036	0.650	0.052	1.411	1.142	0.303
N-C31	0.419	0.041	1.100	0.719	0.164	0.521	0.554	1.411	1.020	0.353
N-C32	0.318	0.102	0.102	0.021	0.109	0.254	0.021	0.074	0.411	0.225
N-C33	0.517	0.552	1.138	0.471	0.031	0.327	0.351	0.631	0.310	0.275
N-C34	0.518	0.031	0.022	0.122	0.073	0.064	0.112	0.154	0.631	0.326
N-C35	0.021	0.201	0.026	0.148	0.021	0.100	0.113	0.153	0.031	0.241
N-C36	0.137	0.153	0.123	0.122	0.075	0.100	0.040	0.051	0.031	0.214
N-C37	0.031	0.121	0.110	0.051	0.062	1.022	0.047	0.075	0.042	0.262
Total	**12.610**	**10.110**	**11.899**	**10.633**	**13.005**	**12.952**	**13.493**	**10.473**	**12.572**	**6.719**
odd	5.827	4.337	5.369	5.338	2.870	6.116	6.981	5.104	4.902	3.124
even	6.783	5.773	6.530	5.295	10.135	6.836	6.512	5.369	7.670	3.595
Pristine	0.537	0.597	0.326	0.253	0.649	0.639	0.322	0.530	0.751	0.083
Phytane	0.284	0.318	0.736	0.763	0.624	0.420	0.486	0.431	0.418	0.063

Table (3) Spatial concentration of n-alkanes (mg/g dry weight) in soil samples of West Qurna-1 field uring

Carbon number	Location 1	2	3	4	5	6	7	8	9	10
N-C14	0.085	0.098	0.117	1.041	0.175	0.083	0.053	0.053	0.103	0.132
N-C15	1.310	0.094	0.114	0.921	0.276	0.041	0.094	0.041	0.128	0.120
N-C16	0.153	1.051	0.102	0.112	0.085	0.110	0.036	0.125	0.053	0.146
N-C17	0.196	0.031	0.096	0.165	0.194	1.530	0.936	0.131	0.512	0.120
N-C18	0.094	0.094	0.317	0.116	2.865	0.527	0.972	0.102	0.095	0.152
N-C19	0.126	0.206	0.041	0.098	0.326	0.342	1.964	0.094	0.093	0.128
N-C20	1.421	0.084	1.132	0.134	1.331	0.132	1.328	0.374	0.030	0.132
N-C21	0.943	0.812	0.289	1.115	0.093	0.295	0.422	0.097	0.210	0.193
N-C22	0.831	0.203	0.194	0.210	0.327	1.119	1.133	1.380	2.166	0.210
N-C23	0.549	0.176	0.300	0.344	2.375	0.386	0.715	0.113	0.200	0.529
N-C24	0.854	0.331	1.438	1.120	0.094	1.879	0.540	0.230	1.275	0.112
N-C25	0.362	0.587	1.154	0.101	0.032	0.412	0.321	0.172	0.410	0.295
N-C26	0.233	0.200	0.122	0.412	0.035	0.684	0.586	1.027	0.144	0.302
N-C27	0.128	1.049	0.719	0.180	0.021	0.343	0.104	0.024	0.138	0.530
N-c28	0.103	1.122	0.197	0.095	0.139	0.641	0.023	0.021	0.117	0.247
N-C29	0.640	0.360	0.024	0.011	0.115	0.421	0.137	0.920	0.312	0.293
N-C30	0.411	0.155	0.816	1.409	1.000	0.630	0.231	1.272	0.152	0.492
N-C31	0.317	0.769	1.064	0.688	0.147	0.492	0.378	1.341	1.121	0.289
N-C32	0.288	0.042	0.095	0.023	0.094	0.227	0.030	0.048	1.104	0.331
N-C33	0.489	0.094	1.122	0.462	0.033	0.311	0.285	0.493	0.317	0.210
N-C34	0.478	0.533	0.017	0.114	0.053	0.045	0.102	0.135	0.266	0.251
N-C35	0.190	0.034	0.016	0.135	0.021	0.089	0.110	0.138	0.532	0.210
N-C36	0.126	0.197	0.115	0.116	0.057	0.092	0.131	0.033	0.024	0.195
N-C37	0.025	0.144	0.102	0.047	0.062	0.091	0.134	0.036	0.276	0.249
Total	**10.352**	**8.466**	**9.703**	**9.169**	**9.950**	**10.922**	**10.765**	**8.400**	**9.778**	**5.868**
odd	5.275	4.356	5.041	4.267	3.695	4.753	5.600	3.600	4.249	3.166
even	5.077	4.110	4.662	4.902	6.255	6.169	5.165	4.800	5.529	2.702
Pristine	0.041	0.184	0.113	0.116	0.152	0.410	0.153	0.143	0.417	0.086
Phytane	0.185	0.013	0.117	0.396	0.631	0.410	0.515	0.104	0.264	0.063

Summer season 2018.

Carbon number	Location 1	2	3	4	5	6	7	8	9	10
N-C14	0.212	0.964	0.126	1.054	0.204	0.219	0.054	0.058	0.047	0.122
N-C15	0.367	1.151	0.362	0.913	0.241	0.113	0.167	0.062	0.042	0.147
N-C16	0.169	0.072	0.462	0.123	0.219	0.093	0.110	0.230	0.563	0.136
N-C17	0.310	0.115	1.275	0.165	0.125	1.348	1.956	0.131	0.322	0.144
N-C18	0.302	0.260	0.463	0.120	1.543	0.731	1.431	0.124	0.396	0.153
N-C19	0.137	0.100	0.251	0.096	1.265	0.216	1.984	0.093	1.120	1.552
N-C20	1.459	1.021	0.310	0.138	1.274	0.231	1.318	0.362	1.025	0.212
N-C21	1.364	0.203	1.025	1.115	1.865	0.428	0.517	0.114	1.753	0.241
N-C22	0.865	0.185	1.219	0.197	1.542	1.320	1.318	0.158	0.294	0.428
N-C23	0.557	0.427	0.212	0.356	1.532	0.510	1.311	0.102	0.118	0.112
N-C24	1.064	0.628	1.372	1.132	1.280	0.149	1.546	1.035	0.252	0.532
N-C25	0.572	0.372	1.023	0.102	0.184	0.438	0.163	0.195	0.166	0.293
N-C26	0.248	1.114	0.277	0.417	0.141	0.593	0.383	1.300	0.597	0.310
N-C27	0.427	1.110	0.662	0.013	0.018	0.470	0.126	0.042	0.274	0.489
N-c28	0.118	0.372	0.183	0.094	0.038	0.771	0.055	0.041	0.368	0.530
N-C29	0.743	0.210	0.228	1.033	0.016	0.309	0.047	1.063	0.301	0.488
N-C30	0.361	0.728	0.636	1.376	0.162	1.476	0.034	1.376	0.164	0.290
N-C31	0.316	0.530	0.165	0.595	0.116	0.640	0.469	1.372	0.108	0.327
N-C32	0.401	0.094	0.095	0.16	1.022	1.371	0.035	0.628	1.241	0.197
N-C33	0.421	0.643	1.053	0.431	0.173	1.299	0.351	0.528	0.527	0.303
N-C34	0.411	0.052	0.065	0.117	0.093	0.066	0.105	0.173	1.243	0.347
N-C35	0.130	0.220	0.052	0.135	0.025	0.050	0.107	0.162	0.132	0.300
N-C36	0.140	0.166	0.135	0.116	0.082	0.104	0.063	0.033	0.102	0.165
N-C37	0.124	0.143	0.120	0.080	0.036	1.093	0.052	0.058	0.036	0.138
Total	**11.218**	**10.906**	**12.171**	**11.771**	**13.196**	**13.038**	**13.702**	**9.440**	**11.191**	**7.956**
odd	5.468	5.224	6.428	5.034	5.596	5.914	7.250	3.922	4.899	4.534
even	5.750	5.682	5.743	6.737	7.600	7.124	6.452	5.518	6.292	3.422
Pristine	0.451	0.418	0.337	0.319	0.430	0.518	0.297	0.438	0.594	0.0751
Phytane	0.304	0.290	0.621	0.571	0.317	0.428	0.377	0.362	0.320	0.0551

Table (4) Spatial concentration of n-alkanes (mg/g dry weight) in soil samples of West Qurna-1 field during Autumn season 2018.

Locations	Winter	Spring	Summer	Autumn	Sp. mean	±SD
1	17.788	12.610	10.352	11.218	12.992	3.329
2	12.170	10.110	8.466	10.906	10.413	1.550
3	12.046	11.899	9.703	12.171	11.457	1.173
4	13.380	10.633	9.169	11.771	11.238	1.781
5	17.004	13.005	9.950	13.196	13.288	2.889
6	15.019	12.952	10.922	13.038	12.982	1.673
7	15.711	13.493	10.765	13.702	13.417	2.031
8	11.286	10.473	8,400	9.440	9.899	1.253
9	15.677	12.572	9.778	11.191	12.304	2.521
10	8.712	6.719	5.868	7.956	7.313	1.266
S. Mean	13.879	11.446	9.337	11.458	-	-

Table (5) Seasonal variations of n-Alkanes (µg/g) in soil with mean at West Qurna-1 oil field.

Sp=Spatial mean, S. Mean=seasonal mean.

N-alkanes Indices:

Carbon Preference Index (CPI):

The CPI values range from (0.248) at Location5 during Winter to (1.594) at Location2 during Winter Table (6).

Pristane / Phytane Ratio:

Pristane / phytane ratio range from (0.215) at Location 5 in Winter to (4.260) at Location 2 in Winter Table (6).

C17 / Pristane and C18 / Phytane Ratio:

C17 / pri ratio ranges from (0.174) at Location 2 in Winter to (6.117) at Location 2 in Summer Table (7).

C18 / phy ratio ranges from (0.148) at Location 4 in Spring to (5.992) at Location 5 in Winter Table (7).

Table (6) N-Alkanes pollution indices values and its origin source descriptions in soil samples at the studied Locations during the studied periods.

Locations	Seasons	CPI	Description	Pri/Phy	Description
1	Winter	1.332	Biogenic	2.120	Biogenic
	Spring	0.859	Anthropogenic	1.890	Biogenic
	Summer	1.038	Biogenic	0.221	Anthropogenic
	Autumn	0.950	Anthropogenic	1.483	Biogenic
2	Winter	0.849	Anthropogenic	4.260	Biogenic
	Spring	0.751	Anthropogenic	1.877	Biogenic
	Summer	1.059	Biogenic	1.628	Biogenic
	Autumn	0.919	Anthropogenic	1.441	Biogenic
3	Winter	0.926	Anthropogenic	0.837	Anthropogenic
	Spring	0.822	Anthropogenic	0.442	Anthropogenic
	Summer	1.081	Biogenic	0.965	Anthropogenic
	Autumn	1.119	Biogenic	0.542	Anthropogenic
4	Winter	1.597	Biogenic	0.327	Anthropogenic
	Spring	1.008	Biogenic	0.331	Anthropogenic
	Summer	0.870	Anthropogenic	0.292	Anthropogenic
	Autumn	0.747	Anthropogenic	0.558	Anthropogenic
5	Winter	0.248	Anthropogenic	0.215	Anthropogenic
	Spring	0.283	Anthropogenic	1.040	Anthropogenic
	Summer	0.590	Anthropogenic	0.240	Anthropogenic
	Autumn	0.736	Anthropogenic	1.356	Biogenic
6	Winter	0.904	Anthropogenic	2.000	Biogenic
	Spring	0.894	Anthropogenic	1.521	Biogenic
	Summer	0.770	Anthropogenic	1.000	Anthropogenic
	Autumn	0.830	Anthropogenic	1.210	Biogenic
7	Winter	0.514	Anthropogenic	0.268	Anthropogenic
	Spring	1.072	Biogenic	0.662	Anthropogenic
	Summer	1.084	Biogenic	0.297	Anthropogenic
	Autumn	1.123	Biogenic	0.787	Biogenic
8	Winter	0.749	Anthropogenic	1.447	Biogenic
	Spring	0.950	Anthropogenic	1.226	Biogenic
	Summer	0.750	Anthropogenic	0.871	Anthropogenic
	Autumn	0.710	Anthropogenic	0.779	Biogenic
9	Winter	0.630	Anthropogenic	1.330	Biogenic
	Spring	0.639	Anthropogenic	1.796	Biogenic
	Summer	0.768	Anthropogenic	.0.739	Anthropogenic
	Autumn	0.777	Anthropogenic	0.958	Anthropogenic
10	Winter	1.351	Biogenic	1.328	Biogenic
	Spring	0.868	Anthropogenic	1.317	Biogenic
	Summer	1.171	Biogenic	0.888	Anthropogenic
	Autumn	1.324	Biogenic	0.925	Anthropogenic

Table (7) N-Alkanes pollution indices values in soil samples at the studied Locations during the studied periods.

Locations	Seasons	C17/Pristine	C18/Phytane	Locations	Seasons	C17/Pristine	C18/Phytane
1	Winter	6.566	2.640	6	Winter	2.370	1.984
	Spring	0.407	0.394		Spring	2.726	1.502
	Summer	4.780	0.508		Summer	3.731	1.285
	Autumn	0.687	0.993		Autumn	2.602	1.707
2	Winter	0.710	4.202	7	Winter	1.198	8.567
	Spring	0.174	0.789		Spring	3.729	5.292
	Summer	0.510	0.831		Summer	6.117	1.800
	Autumn	0.275	0.896		Autumn	6.595	3.795
3	Winter	0.980	4.707	8	Winter	1.073	0.929
	Spring	0.306	0.716		Spring	0.235	0.262
	Summer	0.849	2.709		Summer	0.916	0.621
	Autumn	3.783	0.745		Autumn	0.299	0.220
4	Winter	1.706	0.414	9	Winter	2.461	0.487
	Spring	0.719	0.148		Spring	0.853	0.246
	Summer	1.422	0.292		Summer	0.512	0.168
	Autumn	0.517	0.232		Autumn	0.542	0.656
5	Winter	1.331	5.992	10	Winter	0.860	1.200
	Spring	0.355	5.219		Spring	1.963	2.095
	Summer	1.276	4.540		Summer	2.142	2.412
	Autumn	0.290	4.867		Autumn	1.920	1.888

Discussion:

The chromatograms of aliphatic hydrocarbons for the different Locations showed that aliphatic hydrocarbons comprised of a series of compounds, mainly n-alkanes from C14 –C37 with bimodal distribution first the Low Molecular Weight (C14-C25) with predominance of (C21-C25) which indicate a bacterial activity, and secondly the High Molecular Weight (C26-C37) which predominance of carbon number (C29-C32) indicating source of higher plant wax. The result wasin agreement with [5] who found that C17, C18 and C19 were started from green growth and microscopic organisms, though[6] points that sedimentary aliphatic hydrocarbons consisted of C12 to C33 and [7] who found that the high values of odd carbon number chains of C17 in sediments is a result of the presence sulfuric reducer bacteria (*Desulfovibrio desulforicans*) in the sediments, while the C19 indicating the algal origin . The high values of C25 , C27 , and C29 in sediments indicating decomposition of the higher plant tissues ,this finding was in agreement with[8] [9]and [10] Biogenic sources of hydrocarbons are indicated by the dominance of the odd carbon n-alkanes, C15, C17, and C19 which are usually found in algae, C20 to C28 n-alkanes, maximizing around C23 which may be combined by bacterial activity [11], and C25 to C32 odd carbon number n-alkanes are synthesized by higher plants[12] .

The seasonal variation of N- alkanes at the present study showed Winter >Autumn>Spring>Summer .

That the total concentrations of n-alkanes in soil during Winter are more than Summer. The results of the present study show a highest mean concentration of n-alkanes during Winter (13.879 µg/g dry weigh) and the lowest during Summer (9.337 µg/g dry weigh), while Spring is (11.446 µg/g) and Autumn (11.458 µg/g), the seasonal mean concentration arrange as following: Winter >Autumn>Spring >Summer.

This is due to fluctuation in temperature which plays an important role in evaporation processes of these compounds and biodegradation processes which occur by the bacteria and fungi. Although hydrocarbon compounds biodegrade over an extensive variety of temperatures, the rate of biodegradation for the most part decreases with decreasing[13] [14] [15] ;and [8] show that the total n-alkanes concentrations in surficial soils of Basrah city are higher in Winter and Autumn than that recorded in Spring and Summer so that the result was in agreement with the previous studied on soil.

[16]found that temperature is the most important variables limited the rates of hydrocarbons microbial degradation in the Winter. Also the weather impacted the activities of the microorganisms in the soils causes degradation in the hydrocarbons. The highest rates of hydrocarbons biodegradation are caused by the high temperature. So that hydrocarbons biodegradation is rapid during the warmer months while during the colder month the biodegradation process is less efficient. Therefore, biodegradation is the most effective in the Spring and Summer seasons of Basrah city soils.

There are non-significant correlation between the n-alkanes in soil and each of the soil texture compounds (sand, silt and clay). This result was in agreement with [5]; [7] and [8] who found that non-significant correlation between the n-alkanes in sediments and each of the sediments texture compounds (sand , silt and clay) .While there is significant correlation between the n-alkanes in soil and TOC% (r=0.754, p< 0.01) that is agreement with [17] who found a significant correlation between the n-alkanes in sediments and TOC% .

Table (8): Correlation coefficient(r) between different parameters at study area.

Pearson Correlation	TOC%	TPHs	N-alkanes	PAH	Clay%	Silt%	Sand%
TPHs	0.816**						
N-alkanes	0.763**	0.854**					
PAH	0.890**	0.841**	0.901**				
Clay%	-0.312	-0.342 **	-0.240	-0.144			
Silt%	-0.052	-0.043	-0.079	0.116	0.381		
Sand%	0.064	0.055	0.090	-0.106	-0.415	-.997-**	

****. Correlation is significant at the 0.01 level (2-tailed).**

Our data indicate that the level of PAHs which observed in West Qurna -1 oil field lie within the range of values reported for comparable areas Table (8).

If we compared our data of N-alkanes with previous studies on the area during the last two decades , we found that it is located within the ranges of the previous studies.

Carbon Preference Index (CPI) is a measure ratio of aum of add carbon number to sum of even carbon number. The dominance of symmetric compound series which is useful to make an estimation of plant wax contribution versus fuel contamination [18] . Most of the studies [19] ; [7]; [20] , [21] , [7] , [17] calculate the CPI to indicate the sources of n-alkanes in the environments. The CPI values at Location 2, 5,6.8,9 less than one number indicates referred to anthropogenic origin, , while other Locations 1,3,4 and7 have CPI around or more than one number referred to biogenic origin from algae, bacterial activity, and wax of vascular higher plant leaves[22] ; [23]; [24] ; [12]; [25] ; [26].

Another useful indicator of the n-alkanes origin is the ratio of the isoprenoids pristane and phytane. Pristane is usually found in zooplankton, while phytane is reported as a normal component of oil [27]. When pristane /phytane ratio <1 referred to a reducing condition (pyrogenic origin), and the ratio >1 referred to an oxic conditions (biogenic origin).

The pristine /phytane ratio at Location 2, 6,8 exceeds one number according to high value of pristane indicating biogenic origin of n-alkanes, while other Locations have pristane/phytane ratio less than one number referred to Anthropogenic origin, . According to the ratio values, the source of n-alkanes in soil is biogenic and anthropogenic.

If the value of C17 / pri and C18 / phy less than 1 that indicates the presence of weathering of oil and hydrocarbons, while

the high value of this ratio indicates the presence of oil compounds[4] .
According to C17 / pri and C18/Phy ratio values, the source of n-alkanes in soil is indication of weathering and oldness of existing petroleum in soil.

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