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C O N T E N T

INTERSTITIAL INFUSORIAN FAUNA IN THE NORTHERN APSHERON GULF AND NORTH - WESTERN PART OF THE SOUTHERN CASPIAN SEA

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Abstract. *The interstitial fauna of infusorians of the Northern Apsheron gulf and north-western part of the Southern Caspian Sea are studied and 126 species of the infusorians belonging to 14 groups are revealed. Ciliofauna is the richest (81 species) in North-Western part of the Southern Caspian Sea. Further distribution of infusorians on cuts, sand types, saprobity and pollution, on seasons and at depths (across and verticals) is considered.*

The animals occupying the surface layers of sand on the coast and at the bottom of reservoirs represent rather original ecological group. Community of organisms related to sand is called as interstitial fauna or psammon.

Recently, the study of psammon is of considerably increased interest. In particular, great attention of researchers is paid to the study of interstitial fauna of the sea psammon infusorians. It was found out that the interstitial fauna of infusorians of the different geographical areas possesses considerable degree of similarity of specific structure and, possibly, it is cosmopolite. However this question is not definitely solved yet. Therefore, the study of psammon of the seas with high degree of fauna endemism represents great ninterest. One of such seas is the Caspian Sea.

Along with systematical researches a number of ecological works have also been conducted on marine psammophilous infusorians. Nevertheless the ecology of interstitial infusorians is yet to be studied. So, there is no exact data about the relations of psammophilous infusorians with granularity of sand, temperature, pollution and with saprobity of ground.

During the last years of the XX century infusorians of sandy soils of some seas in the former USSR the (Barents Sea, the White Sea) I.B.Raikov (15, 16) I.V.Burkovsky (9, 10) the Sea of Japan - I.B.Raikov (17), I.B.Raikov, V.G.Kovaleva (18) the Black Sea - V.G.Kovaleva (13); V.G.Kovaleva, V.G.Golemanski (14); the Caspian Sea - F.G.Agamaliyev (1-6) F.G.Agamaliyev, I.A.Suleymanova (7, 8) the seas of the Western Europe and North America were investigated. The whole richest fauna of the interstitial infusorians which is of great zoogeographical and ecological interest is opened.

Along with the big theoretical interest, these organisms are of practical importance. Interstitial infusorians undoubtedly play an essential role in the food of benthic (especially burrowers) invertebrates. Thus, they occupy a certain place in the food chain of the seas and oceans. They also are of practical value as indicators to a biological estimation of a reservoir.

The beginning of researches on interstitial fauna of infusorians is connected with the names of such German researchers as Spiegel (29), Sauerbrey (28); Kashl (25, 26). Very many representatives of this fauna are described in the works of the specified authors without sufficient ecological characteristics.

The detailed ecological characteristics of the interstitial infusorians and some features of biology of its representatives are given in the works of Fauré-Fremiet (23, 24); Bock (19 20); Dragesco (21); Raikova (16 17); Swedmark (27); Agamaliyev (4); Burkovsky (10). These authors consider that the determining factor for the specific structure of fauna of psammophilous infusorians is the size of sand grains.

The present work is a research done on species structure and ecology of interstitial infusorians of Northern Apsheron gulf and the north-western part of the Southern Caspian Sea which are characterized by various sandy coasts.

The material for the given work is collected in 6 sites of the studied area (the Western coast of the gulf, the western coast of Pirallahy island, Shah spit, Turkan, Hovsan, Shikhov) during 2001-2008. Samplings were carricd out in places well protected from a surf, with the depth from 0 to 1,5 m, also with a special drag at the depth of 2,5 and 10 m.

Sand samplings were received scraping a surface layer of a ground in the thickness about 1 sm edge of a glass jar in the volume of 250 sm^3. Determination of infusorians was made, as a rule according to a live material. The nuclear device was studied by hemalaun or methyl green-pryonin.

For the definition of sand granularity degree we carried out a granulometrik analysis by the method of the French researchers (Fauré-Fremiet, (29); Dragesco, (21). The Sand was washed out by fresh water for the removal of salts and organic substances. The dried up sand samples (about 200 g) were sifted through a series of soil sieves with the size of apertures 0,12; 0,25; 0,5; 1; 2; 3 mm. Separate fractions of sand were weighed as well and their weight transformed in to percent. The results were expressed in the form of cumulative curves of the S-shaped form.

The short characteristic of the research area and sand granularity

The hydrological and hydrochemical mode of the Caspian Sea is rather original. There are rather more sulphates and carbonates and less chlorides in the waters of the Caspian Sea than in oceanic water.

At the investigated north-western coast and in Northern Apsheron gulf the temperature of coastal surface layers of water varied from 18 to 28^0C, in summer and salinity from 8,67 to 12,85 ‰.

Separate sites of the research area differed from each other. It is possible to roughly divide this area into 2 zones: Average zones (Northern Apsheron gulf) and zones of the Southern Caspian Sea (the Southern part of Shah spit, Tyurkan, Hovsan, Shikhov) which are well protected from surf action. The ground is often presented by fine sand, in some areas there was average, large and dirty sand with a seashell. Some areas considerably differed from each other by the content of organic substance and carbonate ($CaCO_3$) in sand, by granularity of sand, by the degree of breaking wave and by the pollution of the coast by mineral oil.

Data on granulometric analysis of 6 most typical sand samples of the studied areas are presented on fig. 1. In the figure on an axis of abscisses the size of grains of sand, that is the size of apertures of a soil sieve (a logarithmic scale), and on an axis of ordinates - cumulative percent of weight of sand (on Fauré-Fremiet, 27, by Draeeso, (21) are postponed; Raikov, (16 17) and Agamaliyev (4). On cumulative curves the place of the greatest steepness corresponds to the modal sizes of grains of sand, and the curve inclination specifies the uniformity degree of sand. The 7 more abrupt the inclination of a curve and shorter its branch, the more homogeneous in the

sand. The Curve shift to the left specifies that the sand is smaller, the shift to the right - larger.

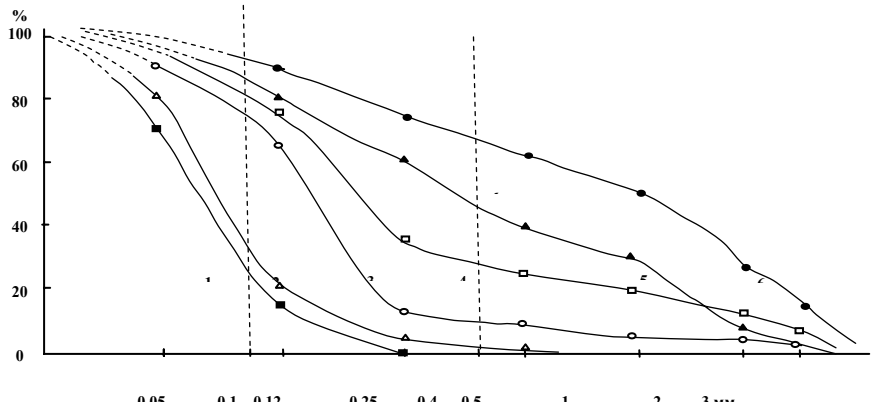

Fig. 1. Cumulative granulometric curves of 6 samples of sand of the Northern Apsheron gulf and northwest part of the Southern Caspian sea (curve 2, 3 corresponds to the sand samples, taken from the Northern Apsheron gulf, 1 - Hovsan, 4 - in Shikhov, 5 - in Turkan, 6 - in Shah spit); on an axis of abscisses - the sizes of grains of sand, a logarithmic scale; on an axis of ordinates - cumulative percent of weight of sand, and – developmental borders of microporal fauna.

Figure 1 shows the curves of the samples taken from Northern Apsheron gulf (curves 2, 3), the curve of sample 1 from Hovsan, the curve of sample 4 from Shikhov, the curve of sample 5 from Turkan, the curve of sample 6 from Shah spit.

The analysis of the curves shows that there are various sand types available around the research area. It is possible to allocate 4 types of sand which differ from each other in the modal size of sand grains: 1) very fine, it is light or moderate silted sand with the modal size of sand grains M_0=0,07-0,08 mm; 2) fine sand with M_0=0,1-0,4 mm; 3) average sand which differ on some heterogeneity with M_0=0,7 mm; 4) coarse sands with M_0=1,2-1,5 mm. In the studied area the fine sand considerably prevail.

Specific structure and ecology of infusorians

The Caspian Sea strongly differs from other reservoirs, such as the Black Sea, the Azov Sea, the Barents Sea, the White Sea and Sea of Japan on the salt condition. Salinity of water as it is specified above, varies from 9,46 to 13 ‰ in the research are. In such freshened basin it would be possible to expect some specificity in the development of interstitial fauna of infusorians. However, the species studied by us shows that the species in Northern Apsheron gulf and in the North-Western part of the Southern Caspian Sea simultaneously exits in other geographical areas of the World Ocean. As a part of fauna 126 species of the infusorians belonging to 14 groups (tab. 1) have been recorded. Simultaneously the table shows the occurrence of species in various types of sand, and the information on the distribution of infusorians (orders) on sections is supplied.

As table 1shows, the fauna of infusorians is richest (103 species) in small sand with the modal size of grains of sand 0,1-0,4 mm. Here ciliofauna makes 81,7 % from

total number of species. Then average and very fine sand (accordingly 51,5 % and 31,6 %) follows.

The picture of the specific structure of infusorians on sections is as below: the richest fauna is recorded in the southwest part of Shah spit (81 species), then the Northern Apsheron gulf (72 species) and Shikhov (69 species) follows. There are accordingly recorded 54 and 48 interstitial infusorians in Hovsan and Turkan.

As a result of fauna analysis on separate types of sand it is revealed that 32 species of infusorians are common for all types of sand. The following species have formed mass populations in the interstitial fauna: in fine sand – *Tracheloraphis prenanti, Tracheloraphis sarmaticus, Remanela rugosa, Lacrymaria coronata, Litonotus cygnus, Anigsteinia clarissima. Pleuronema coronatum, Uronema marinum, Holocticha manca. Euplotes raikovi, Aspidisca fusca. In very fine sand Trachelonema*
Oligostriata, Trithigmostoma cucullulus, Halteria grandinella; in average sand *Mesodinium pulex, Paraspathidium fuscum, Frontonia marina, Pleuronema marinum, Condylostoma arenarium. Euplotes charon, Diophris scutum;* in coarse sand *Loxophyllum setigerum, Condylostoma arenarium, Euplotes harpa, E. eurystomus var marinus, Diophrys appendiculatus, Uronychia transfuga,* etc.

Table 1

Structure of interstitial fauna of infusorians in the Northern Apsheron Gulf and the North-Western part of the Southern Caspian Sea, their distribution on groups

Orders	Number of similar species	Sand types				Sections				
		Very fine	fine	average	big	Cев. Absheron gulf	Shah spit	Tyurkan	Hovsan	Shikhovo
Cl.Kinetogminophora De Puyt. et al.		3	12	8	3	+	+	+	-	+
1. Prostomatida Schew.	15	4	13	10	3	+	+	+	+	+
2. Kariorelictida Corliss	15	8	11	6	5	+	+	+	-	+
3. Haptorida Corliss	7	2	7	4	2	+	+	-	-	+
4. Pleurostomatida Schew	2	1	2	0	0	+	+	+	+	+
5.Trichostomatida Büt.	3	0	2	1	0	+	+	-	+	+
6. Nassulida lank	2	0	1	2	0	+	+	+	-	+
7. Synhymeniida De Puyt.et al. 8. Syrtophorida F.Frem.	6	2	4	3	1	+	+	+	+	+
Cl.Oligohymenophora De Puyt et al.	6	2	5	4	2	+	+	+	+	+
9. Hymenostomatida Del. et Her.	7	3	6	3	4	+	+	+	+	+
10. Scuticociliatida Small 11. Peritrichida Stein.	3	0	0	1	2	+	+	-	-	+
Cl. Polyhymenophora Jank.										
12. Heterotrichida Stein	5	2	4	3	2	+	+	+	+	+
13. Oligotrichida Büt	8	3	6	4	5	+	+	+	+	+
14. Hypotrichida Stein	34	10	30	16	10	+	+	+	+	+
Total:	126	40	103	65	39	14	14	11	9	14

Comparison of all the found out species with data presented by Fauré-Fremiet (23, 24), Dragesco (21 22), Raikova (15, 16, 17), Kovalevoy (13), Burkovsky (9, 10, 11, 12), Agamalieva (4-8) shows that the main representatives of the fauna studied by us are typical microporal species. According to our data, this group includes the following species: *Holophrya vorax, Placus striatus, Pseudoprorodon arenicola, Lacrymaria coronata, Lacrymaria caudata, Tracheloraphis teissieri, Tracheloraphis striatus, Trachelonema longicollis, Dileptus aculeatus, Remanella granulosa. Chlamidodon triquetrus, Peritromus faurei, Blepharisma clarissimum f.arenicola, Urostyla marina, Euplotes balteatus, Aspidisca fusca*. The group includes the following new species: *Trachelonema binucleata, Remanella dragescoi, Euplotes raikovi, Euplotes poljanskyi, E.dogieli, E.strelkovi* and *Aspidisca caspica.*

Mesoporal species are occurred in average and coarse sand mainly, however they can be often met on fine and very fine sand. The following species can be considered typical for this group: *Loxophyllum setigerum, Mesodinium pulex f.pupula, Paraspathidium fuscum, Coelosomides marina, Frontonia macrostoma, Cardiostoma vermiforme, Condylostoma arenarium, Strombidium sauerbreyae, Euplotes harpa, Diophrys appendiculatus*. *Diophrys quadricaudatus*,is a new species of this group.

From the listed species *Mesodinium pulex f.pupula, Paraspathidium fuscum, Condylostoma arenarium* form the mass populations.

The following species belong to euryporal fauna: *Prorodon binucleatus, Tracheloraphis phoenicopterus, Tracheloraphis prenanti, Remanella rugosa, Criptopharynx setigerus, Frontonia arenaria, Pleuronema marinum, Blepharisma clarussimum* and *Condylostoma remanei. Diophrys scutoides* can be included into this group as a new species.

Besides the typical mesoporal species a group of facultative-mesoporal forms can be distinguished. It includes the following species: *Frontonia marina, Pleuronema coronatum, Keronopsis rubra, Diophrys scutum, Uronychia transfuga*.

Influence of the sizes of sand grains. Comparing fauna of four different sand types, it is necessary to notice that the richest both on specific structure of fauna, and on number of individuals is the 2nd type of sand (moderately fine with M_0=0,1-0,4 mm). There are 103 infusorian forms from all ecological groups in the 2nd type of sand, but they are mainly microporal and euryporal species (fig. 2, II).

It is possible to include the following species into mass forms: *Tracheloraphis prenanti, Remanella rugosa, Condylostoma remanei, Euplotes raikovi, Euplotes poljanskyi* and *Aspidisca fusca.*

The first type includes very fine sand (M_0 = 0,07-0,08 mm), the fauna there has appeared to be poorer (only 40 forms). In it there were some mesoporal, euryporal and facultative - psammophilouse species, such as *Loxophyllum setigerum, Remanella rugosa, Paraspathidium fuscum, Frontonia marina, Pleuronema marinum, Blepharisma clarissimum, Condylostoma remanei, Keronopsis rubra, Diophrys scutum,* etc.

Nevertheless the forms occupying this sand basically belong to microporal and euryporal groups (fig. 2, I).

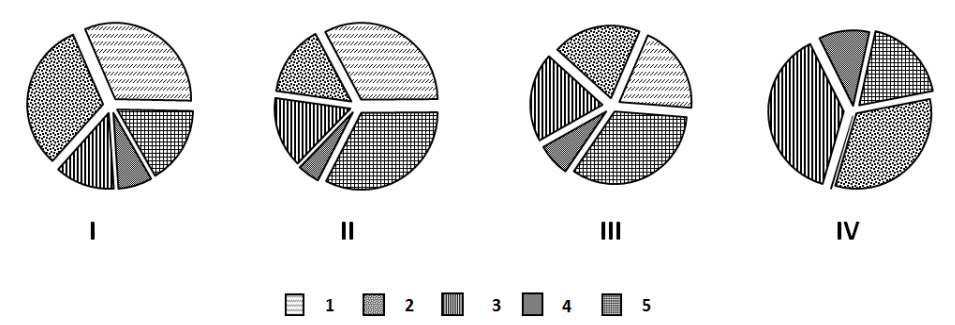

Fig. 2. Corelation of separate ecological groups of interstitional infusorians of the northwest part of the Southern Caspian Sea.
Sand: I - very fine (M_0=0,05-0,08 mm), II - fine (M_0=0,1-0,4 mm), III - average (M_0=0,5-0,8 mm), IV - coarse (M_0=0,9-1,5 mm). Species: 1 - microporal, 2 - euryporal, 3 mesoporal, 4 - facultative-psammophyl, 5 - with unclear ecological characteristic.

Two species described by us (*Tracheloraphis sarmaticus* and *Euplotes poljanskyi*) are often accured in the sand of this type. Such pauperization of fauna in too fine sand (M_0=0,07-0,08 mm), possibly, depends on excessive reduction of capillary spaces between grits of sand which are proportional to the size of grains of sand and are one of the most important factors necessary for the development of this fauna.

The Sand of the 3rd type (average, M_0=0,7 mm) is rather rich in the number of specimen of mesoporal, euryporal, and also facultatively-mezoporal species of infusorians (fig. 2, III). In this sand 65 forms were recorded. Mass populations here formed only *Tracheloraphis prenanti, Remanella rugosa, Paraspathidium fuscum, Diophrys scutum*, etc.

Finally, the sand of the 4th type (large, M_0=1,3 mm) is impoverished in the number of species, but mass populations of some species of infusorians are met here. Only 39 species of infusorians from mesoporal, euryporal and facultative - psammophilouse groups are recorded in this sand (fig. 2, IV). Mass populations here are formed by *Frontonia marina, Diophrys scutum* and *Uronychia transfuga.*

For obtaining a more concrete picture of the distribution of interstitial infusorians on different types of sand, the number of dominating species of infusorians of the Northern Apsheron gulf and the North-Western part of the Southern Caspian Sea is given in table 2. The table shows 25 species often registered in the samples taken from various types of sand. As the table shows, fine sand is the richest among the sands (homogeneous - 1 million 907 thousand ind./m^2, heterogeneous 4 million 162 thousand ind./m^2).

In fine homogeneous sand the *Tracheloraphis prenanti, Larymaria coronata, Remanella rugosa, Pleuronema coronatum, Holosticha manca, Euplotes raikovi, Diophrys scutum, Aspidisca caspica* reached a high development (70-515 thousand ind./m^2). In heterogeneous sand of *Trashcheloraphis prenanti, Loxophyllum setigerum, Remanella rugosa,* M*esodinium pulex, Paraspathidium fuscum, Dysteria monostyla, Uronema marinum, Frontonia marina, Pleuronema coronatum,*

Condylostom arenarium, Keronopsis rubra, Euplotes raikovi, Diophris scutum Aspidisa caspica formed mass populations (112-680 thousand spes. /m^2). Average sand also turned out rich in interstitial fauna of infusorians.

Table 2

Quantitative distribution of dominating species of infusorians on sand types (105 quantitative samples, thousand spes.m^2)

Infusorians	Sand types				
	Very fine	fine		average	coarse
		Homo-genous	Hetero-genous		
Prorodon diaphanus	1	4	8	62	87
Lacrymaria coronata	10	84	73	79	3
Coleps tesselatus	-	12	26	35	17
Tracheloraphis prenanti	82	515	680	148	7
Trachelonema oligostriata	27	40	23	-	-
Litonotus lamella	2	43	58	13	3
Loxophyllum setigerum	10	45	120	20	17
Remanella rugosa	12	87	330	450	123
Mesodinium pulex	-	12	450	230	230
Paraspathidiu fuscum	2	23	183	50	21
Dysteria monostyla	35	350	147	-	-
Uronema marinum	110	75	118	-	-
Frontonia marina	-	30	140	235	147
Pleuronema coronatum	20	69	150	180	43
Anigsteinia clarissima	2	33	68	4	-
Condylostoma arenarium	15	65	112	87	19
Holosticha manca	-	75	418	229	3
Keronopsis rubra	8	17	135	20	17
Trachcelostyla caudata	4	18	40	20	10
Euplotes raikovi	-	87	430	4	-
Euplotes harpa	-	-	4	25	83
Euplotes elegans	1	20	82	35	-
Diophrys scutum	3	70	171	101	370
Uronychia transfuga	4	4	8	80	135
Aspidisca caspica	6	129	188	10	-
Total, spes.	354	1907	4162	1817	1335

The number of infusorians here has reached 1 million 817 thousands ind./$м^2$ at the expense of mesoporal and euryporal ecological groups. In coarse sands the number of infusorians *Frontonia marina, Diophrys scutum* and *Uronychia transfuca* (1 million 335 thousands ind./m2) has raised at the expense of some mesoporal species, such as *Mesodinium pulex*. It is necessary to notice that for each type of sand the main species are characteristic. However, the last can be met on other types of sand as well, playing a supporting role.

Vertical distribution. At the study of vertical distribution of infusorians in sand of research area it is revealed that all nthe found out species numerically prevail in the upper layers of sand (0-1, 1-2, 2-3 sm). Quite a number of species (*Coleps similis, Loxophyllum setigerum, Pleuronema coronatum, Condylostoma remanei, Euplotes raikivi, Aspidisa caspica,* etc.) do not get into a ground deeper than 4-7 sm. However, some species, for example, *Kentrophoros ununucleatum, Remanella rugosa, Tracheloraphis prenanti, Trachelonema lanceolata, Chilodonella kalkinsi Spirostomum teres* can be met up to depth of 11-12 sm though their number decreases depending on depth.

Effect of saprobity and pollution. For normal development of interstitial fauna of infusorians any optimum degree of saprobity of sand is required. In the areas of research the quantity of organic substances (saprobity) varies in limits from 0,48 to 0,86 %, and the content of $SaSo_3$ from 13,66 to 32,11 %. It is possible to consider 0,65 % of organic substances as an optimum saprobity of a ground in the areas of research; at such saprobity there are rather various species of psammophilous infusorians. Optimum degree of saprobity is typical for the areas of Northern Apsheron gulf and Shah spit. It is necessary to notice that in interstitial fauna there are species of infusorians steady against different kinds of pollution. Some areas of Northern Apsheron gulf and the North-Western part of Southern Caspian Sea (the southwest part of the island Pirallahi, Hovsan, Zig, Shikhov) are polluted by oil, as well as domestic and industrial wastes.

Results of the study of interstitial infusorians in these areas have shown that the polluted sites differ from each other a little by their specific structure, and by the number of separate forms of infusorians. Probably, this result the fact that separate forms of infusorians react to various pollution differently. So some species – *Trachelocerca gracilis, Tracheloraphis prenanti, T.teisseri, Trachelonema oligostriata, T.binucleata, Coleps tesellatus, Paraspathidium fuscum, Spirostomum teres, Condylostoma arenarium, Keronopsis rubra, Euplotes raikovi,* etc. in a considerable quantity exist in the areas polluted by oil, while others, such as *Uronema marinum, Frontonia marina, Paramecium caudatum, Metobus contortus, Euplotes harpa, E.eurystomus var, marinus, Cyclidium citrullus, Diophrys scutum, Uronychia transfuca,* etc. formed mass populations in areas polluted by domestic sewage (fig. 3). As the drawing shows development peak is noted in clean zones, in fine sand (12 million ind./m^2). In the polluted areas development peak is noted in coarse sands polluted by domestic waste (6 million ind./m^2).

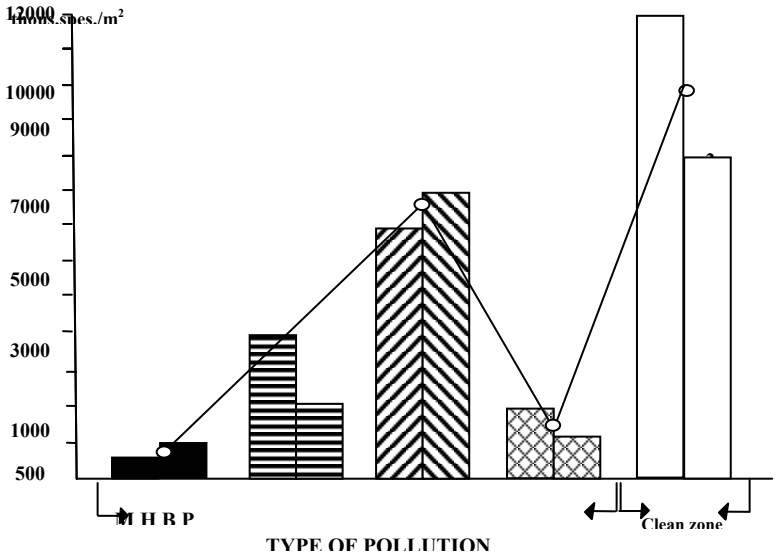

Fig.3. Development (number) of interstitional infusorians in the polluted and pure zones of the Northern Apsheron gulf and the northwest part of the Southern Caspian Sea. (M - black oil, H - oil, B - household and P - industrial pollution. 1 - small sand, 2 - a coarse sand). Continuous lines give the general average data of the number of infusorians.

Altogether 56 species of infusorians were recorded in the polluted areas of the Northern Apsheron gulf and the North-Western part of the Southern Caspian Sea. The picture of the distribution of infusorians on separate areas was as below: in the Shikhov area were recorded 32 species, in Zyh - 13 species, in Hovsan - 23 species, in the island of Pirallahy - 24 species. In all the areas representatives of the family of Trashcheloeridae, Spirostomatidae, Frontonidae, Ondjlostomatidae, Ohjtrishchidae predominated. It is necessary to notice that some species (*Tracheloraphis prenanti, Paraspathidium fuscum, Condylostoma arenarium, Frontonia marina, Diophrys scutum* etc.) were recorded by in clean areas as well. However, some of them form mass populations in the polluted areas. Thus, interstitial infusorians are of huge practical value. Developing in considerable quantities in the polluted and water-purifying constructions they can play great role in the biological treatment of sewage.

Temperature influence. As known temperature is one of the important factors defining seasonal changes of fauna. Temperature has huge impact on the life activity of organisms, in particular, on metabolism processes, on behaviour and distribution of organisms. In sea basins the life is possible at subzero temperature (-3,3^{0}S), while in hyperhaline reservoirs even at minus 7,5 ^{0}C.

As to temperature influence on interstitial fauna of infusorians of the Caspian Sea the conducted researches show that the majority of psammophilous infusorians can also stand their considerable fluctuations. Such properties of interstitial fauna of infusorians give them the chance to stand constant changes of physical and chemical structure in interstitial water. During our work the water temperature in all sites of the research area at the depth of 0,5-1,0 m changes from 17,5 ^{0}C to 28 ^{0}C. We noticed no

changes in the structure or in the number of infusorians at such fluctuations. At strongly raised water temperature (30-35 ^{0}C on shoal) in the samples the quantity of species of infusorians was insignificant.

The samples taken from under algae, from the covered places are usually richer in species and specimens of psammophilous infusorians in comparison with open places strongly warmed up by the sun.

We observed three peaks in the development of the infusorians (in spring, summer and autumn) on Northern Apsheron gulf and the North-Western part of the Southern Caspian Sea. Seasonal dynamics of number is various for different species. This allows to distinguish complexes of species, typical for various seasons of a year. For example, *Prorodon binucleatus, Larymaria coronata, Tracheloraphis prenanti, Litonotus lamella, Remanella rugosa, Paraspathidium fuscum, Pleuronema coronatum, Euplotes raikovi* and many other species in the conditions of the North-Western part of the Southern Caspian Sea are met all-the-year-round. The majoritig of them are eurythermic and stand the wide range of temperature (from 5 to 30 ^{0}C).

In spring at temperature 10-15 ^{0}C infusorians begin to reproduce intensively in separate types of sand. Their number in Northern Apsheron gulf and in the North-Western part of the Southern Caspian Sea reaches 8 and 12 million ind./m^2. In this season of the year the number of infusorians, basically rises at the expense of species of the following genera: *Trachelocerca, Tracheloraphis, Trachelonema, Prorodon, Lacrymaria, Mesodinium, Litonotus, Loxophyllum, Uronema, Cyclidium, Oxytricha, Euplotes, Diophrys, Aspidisca*, etc. the indicated genera formed mass populations in fine heterogeneous sand.

In summer with the a rise the temperature (25-28 ^{0}C) a big variety in qualitative and quantitative structure of infusorians is observed. For all types of sand typical forms of this season are species of families *Trachelocercidae, Enchelyidae, Loxodidae, Pleuronematidae, Oxytrichidae, Euplotidae and Aspidiscidae*. Their majority are eurythermic. Their significant amount in the conditions of Southern Caspian Sea are kept within October, and then with a water temperature fall (to 5-6 ^{0}C) their number decreases and the level of specific diversity falls. Many of these infusorians live till winter.

In autumn development of stenothermic, psychrophilic species of infusorians characteristic for this season is observed in the structure of interstitial fauna. Species of genera of ShCholopshchrja, Plaus, oleps, *Spathidium, Litonotus, Plagiopyla, Trachelostyla, Strombidium, Condylostoma, Oxytricha, Euplotes*, etc. were typical for this season. The number of populations in October - November after some decrease, again form the peak of development for this season (8-10 million ind./m2).

In winter when there is a cold snap and daily temperature fluctuation increases, while other abiotic factors change, on the littoral of the research area the number of interstitial infusorians quickly decreases (from 250 thousand to 1 million ind./m2). It is necessary to notice that in winter in the sand of the Caspian Sea there are active individual specimens of almost all species of the infusorians, forming populations, multitudinous in spring and in summer. In winter the samples usually include such species as *Tracheloraphis prenanti, Trashchelonema oligostriata, Litonotus lamella. Loxophillum helus, Paraspathidium fuscum, Mesodinium pulex, Frontonia marina, Uronema marinum, Euplotes raikovi,* etc.

Qualitative and quantitative impoverishment of interstitial fauna of infusorians at low temperature (in winter) is apparently explained by encystment of infusorians and decrease in the rate of their reproduction.

Horizontal distribution. High ecological plasticity of infusorians allows them to exist in all geographical zones and depths of the World Ocean. As to interstitial fauna of infusorians they are characterised by rather specific fauna adapted to the life in thin capillary spaces in sand. Besides sea sand they can be met in other biotopes, too. Such distribution rate is received by us at the study of horizontal distribution of interstitial fauna of infusorians in the North-Western part of the Southern Caspian Sea and in Northern Apsheron gulf of the Caspian Sea. It is necessary to notice that on separate cuts of the research area with depth an increase in depth the content of organic substances and the thin mineral fraction in sand gradually increases horizontally, gas regime falls and the structure of microflora changes thus directionally the structure of interstitial fauna changes. The Results of the analysis of the samples from different depths (0,5, 2, 4, 6 and 10 meters) and cuts (the island of Pirallahi, Shahj spit, Tyurkan, Shikhov and Hovsan) have shown that infusorians reach their high development in shoal (0,5-2 meters). The data of fig. 4 shows that the peak in the development of interstitial infusorians on sections of Shah spit and Shikhov is registered at the depth of 0,5 meters (accordingly 8 and 7 million ind./m^2). At the depths of 2 meters maximum number of infusorians is registered in Shah spit (6 million ind./m^2). With an increase in water depth (4, 6 and 10 meters) the number of infusorians gradually decreases. Thus, at 4 meter depth on all sections the average number makes 2,5 million ind./m^2, whereas at 6 meter depth - 275 thousand ind./m^2, at10 meter depth - 125 thousand ind./m^2 (fig. 4).

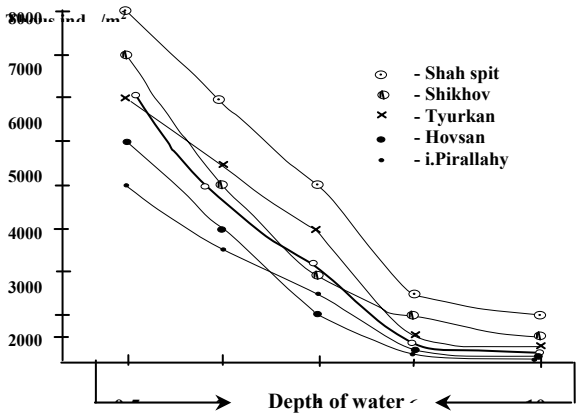

Fig.4. Horizontal distribution of the number of infusorians on depths of the western coast of the Caspian Sea (the heavy curve shows the general averaged number of infusorians on all cuts and depths)

Possible pauperization of interstitial fauna with depth increasing is connected not with influence of the depth, but with amplifying by depth the siltation of sand and

reduction of the content of oxygen in a ground, and also decrease of average temperature.

The study of horizontal distribution of interstitial fauna in separate seasons (in spring, in summer, in autumn and in winter) has shown that and change in water temperature causes certain impacts on the development of infusorians. So, in spring and especially in winter on the most coastal zones of the research area (depth of 0,5-1 m, water temperature 5-6 ^{0}C) the fauna of infusorians has appeared impoverished. And on the big depths (5-10 meters) a little risen development of the structure of ciliofauna among which psychrophilic stenothermic species prevail is observed. Such complexes of species are often met in Northern Apsheron gulf. As to summer and autumn seasons, in the most coastal zones (on the depth 0,5 and 1) interstitial infusorians reach high development (10-12 million ind./m^2). On the contrary, on the big depths (2, 5, 10 meters) their development gradually decreases. In these seasons thermophilic stenothermic forms prevail in ciliofauna. The species *Trashchelocercidae, Enchelyidae, Loxodidae, Pleuronematidae, Oxytrichidae, Euplotidae, Aspidiscidae* can be sampled as typical representatives, of the family. The majority of them are eurythermic and they form mass populations in warm months.

In conclusion we can tell that interstitial fauna of the Caspian Sea is basically of a sea character. However, there are some brackish water (*Nassula citrea, Chilodontopsis vorax, Paramecium woodruffi, Cladotricha koltzowi*), and fresh-water (*Prorodon laurenti, Litonotus anguilla, Dileptus aculeatus, Oxytricha aeruginosa, Euplotes patella f.latus*) species as a part of this fauna.

Thus, the analysis of interstitial fauna as a whole shows that the basic structure of the fauna of psammophilous infusorians in the investigated area is similar to other geographical areas of the World Ocean. During the researches in the sandy coasts of the North-Western part of the Southern Caspian Sea and Northern Apsheron gulf we recorded 51 genera of infusorians, and all of them have already been recorded in other geographical areas. As a result of comparison of interstitial fauna of all the investigated geographical areas it has appeared that from precisely determined 119 species of fauna of the Caspian Sea 64 species are similar to the areas of the Atlantic, 52 ones to the Mediterranean, 79 – to the Baltic, 35-55 accordingly – to the North Seas (Barents Sea, White Sea) and 34 one – to the Sea of Japan. 27 species have been found, except the area investigated by us, in all the five areas listed above.

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ИНТЕРСТИЦИАЛЬНАЯ ФАУНА ИНФУЗОРИЙ СЕВЕРНОГО АПШЕРОНСКОГО ЗАЛИВА И СЕВЕРО-ЗАПАДНОЙ ЧАСТИ ЮЖНОГО КАСПИЯ

Ф.Г.Агамалиев, И.А.Сулейманова

Изучены интерстициальная фауна инфузорий Северного Апшеронского залива и северо-западной части Южного Каспия и выявлено 126 видов инфузорий, относящихся к 14 отрядам. Цилиофауна наиболее богато (81 вид) представлена в северо-западной части Южного Каспия. Далее рассматривается распределение инфузорий по разрезам, типам песка, сапробности и загрязнений, сезонам и глубинам (по горизонтали и вертикали).

GEOCHEMISTRY OF TRACE ELEMENTS IN GALANDRUD COALS OF CENTRAL ALBORZ, IRAN

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Abstract. This study focuses on the geochemistry of trace elements and coal quality parameters of bituminous coals belonging to upper Triassic - lower Jurassic age and collected from Galandrud region in Central Alborz of northern Iran. The Galandrud coals on an air-dried basis are characterized by broad variation of ash (ranging from 6.4% to 12.73%), high content of volatile matter (33.32-37.45 %) and high gross calorific values (7430-8880 kcal/kg). The mineral matter of the studied coal samples is made up of dolomite (>90%), quartz, sphalerite, galena, pyrite and clay minerals. Major elements correlate positively with ash contents demonstrating an association with inorganic constituents. Based on statistical analyses, concentrations of the trace elements such as Co (51.3-152.9 ppm), Ba (368-3297.4 ppm), Cr (65.5-194.2 ppm), Mo (5.6-18.2 ppm), Ni (72.9-152.9 ppm) and V (245.5-520 ppm) are higher than world coal average. However, low concentration of some volatile elements such as As, Hg and U are present in the coals studied.

Keywords: Galandrud coals; Geochemistry; trace elements; Central Alborz; Iran.

1. Introduction. Coal is one of the primary energy source for many developed and developing countries, although its mining, processing, combustion and postcombustion waste products expedite thermal pollution, particulate release (smog), sulfur emissions, acid rain, greenhouse effect and trace elements emission; it may also cause environmental and human health problems [20, 3 and 11]. Recently scientists have become more interested in the causes of these problems to use of coal more efficiently [15, 25, 6, 24, 7, and 10].

Properties and characteristics of coal depend on its combustible organic and inorganic constituents. Among the coal quality parameters, trace elements may be of great impacts on the environment, human health, technology and economy [25, 6, and 10].

Numerous sources of trace elements can be classified into natural (e.g., weathering of rocks, volcanoes, thermal springs) and anthropogenic (e.g., metal mining and smelting, combustion of coal, agricultural activities). Trace elements are present in coal in either organic or inorganic forms and most of them occur simultaneously in both forms at concentrations that vary in different stages of coalification [24, 11 and 17]. Most trace elements are associated with the mineral matter in coal and are mostly concentrations in ash; however, certain elements have an organic affinity [8 and 11]. Finkelman (1995) discusses 25 potential environmental hazardous trace elements (PHTEs) in coal, including Ag, As, B, Ba, Be, Cd, Cl, Cr, Co, Cu, F, Hg, Mn, Mo, Ni, P, Pb, Sb, Se, Sn, Tl, Th, V, U and Zn; among which As, Be, Cd, Cr, Co, Hg, Mn, Ni, Pb, Sb, Se and radionuclides such as U, V and Th were

identified as potentially Hazardous Air Pollutants (HAPs) by the American Clean Air Act Amendments in 1990.

In Iran, coal deposits with upper Triassic-lower Jurassic age are limited to a few regions (Alborz, Kerman and Khorasan) and not enough studies have been conducted on the geochemistry of trace elements in Iranian coals. Two of the previous works on this subject are as follows: A preliminary study on geochemistry of coals in the Loshan coalfield by Yazdi and Shiravani (2004) and a brief reference for geochemistry of four coal samples from northern Iran by Goodarzi et al. (2006). The aim of the present study is to investigate the geochemistry of trace elements in Galandrud coals (located in Central Alborz, northern Iran).

2. Study area. The black coal deposits of world with upper Paleozoic and Cenozoic age are very common but Mesozoic and particularly Jurassic coals are rare [13 and 12]. In Iran, coals are belong to Mesozoic (upper Triassic-lower Jurassic) age and principal coalfields are located at Alborz and Khorasan (northern Iran) and in Kerman (central Iran) [27] (Fig. 1).

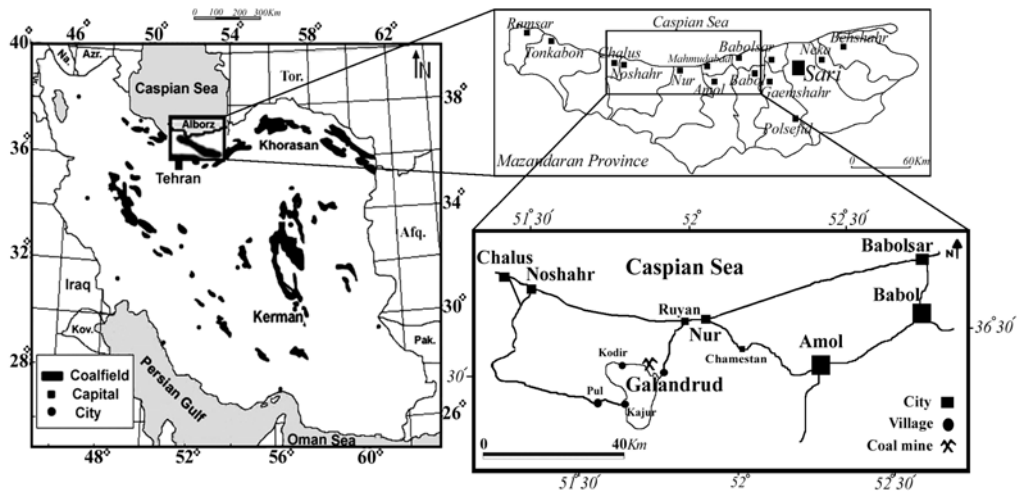

Fig. 1. Map showing location of Galandrud coals in the Central Alborz, Iran.

This study focuses on Central Alborz zone (northern Iran). Although, the coal deposits of the Central Alborz have been scattered in various points of this zone, the most extended coal beds were seen in Galandrud coalfield. The coal-bearing stratums of Galandrud are located on northern slopes of Alborz mountain range and are as far as 20 km south of Rooyan (Alamdeh) town (between 36°34′/36°40′N and 51°19′/51°56′E, Fig. 1) in Mazandaran province. Galandrud coalfield with longitudinal extension of about 100 km have deposited at an altitude of more than 1240 m. As a result of the humid climate (average annual rainfall of more than 850 mm) and consequently expansion of forest vegetation in Galandrud region, the coal beds are totally masked by the dense forest.

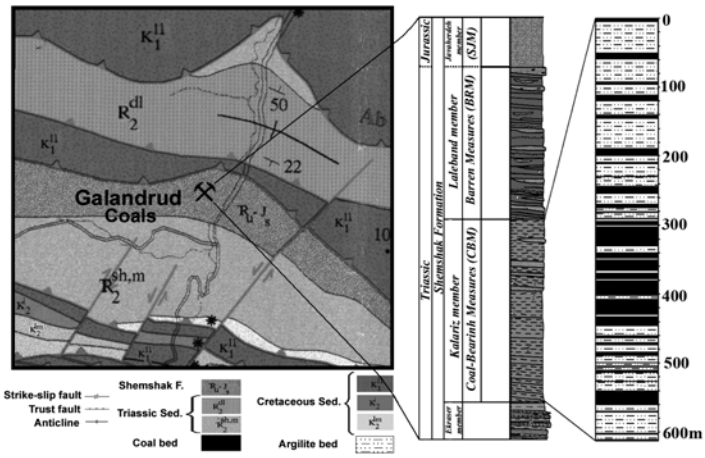

Fig. 2. The generalized map of geology and stratigraphic sequence of the Galandrud coalfield.

The coals in the Central Alborz are the part of Shemshak formation [2, 18 and 9], which comprises 4 parts (Ekraser, Lalehband, Kalariz and Javaherdeh) that are folded as syncline structure with axis of WNW-ESE [29] and are limited by Triassic limestone (Elika formation) and cretaceous limestone. In Galanderud region, the Kalarize part of Shemshak with a thickness of about 600-700 m has been located between two keybeds of sandstone [30] and has 32 coal seams with approximate thickness of 50 cm and with mainly atoctone origin, of which 17 layers are of thicknesses that are workable. Because of to these characteristics, this section of kalarize part is known as *CBM* (Coal-Bearing Measures) (Fig. 2).

3. Method of study. Six coal samples were taken from Galandrud mine. Standard proximate and ultimate analyses were carried out in Iranian Geological Institute for mineral survey and exploration. Mineralogy and petrographical analyses of each coal sample were performed on polished section of coals using a Leitz MPVSP microscope at Geology Department of Baku State University of Baku, Azerbaijan.

The major elements and most of trace elements were analyzed in bulk dried coal samples using ICP-AES (Al, F, Mg, Ca, K, Na, Ti, B, Ba, Cr, Cu, Mn, Sr and V) and ICP-MS (As, Ge, Li, Mo, Ni, Pb, Rb, Sn, Th and U) at the laboratories of Iranian Geological Institute for mineral survey and exploration.

Using SPSS statistical program, Pearson correlation coefficients were calculated to determine relationships between concentrations of trace elements and ash yields.

4. Results and discussion.

4.1. Proximate and ultimate analyses. Table (1) summarizes the results of proximate and ultimate analyses. The moisture content of the coal samples is low and ranges between 0.94% and 1.49%. The ash yield form coal is considered as one of the main characteristics of coals in Galandrud mine, which mainly is in the form of grey, compact particles, and varies from 6.40% to 12.73%. Its high content can be associated with coals′ formation environment. The coals forming in the marshy

environment have high ash yield due to pollution with clastic materials [27]. Generally, Galandrud coals have meltable ash, because of high content of ferroxide, calcium and magnesium (40-60%) [9].

The volatile matter contents on an air-dried are high value (33.32 - 37.45%) that based on the amount of coals volatile matter, according to ASTM (1991) classification, Galandrud coals belong to a group of high volatile bituminous B (>31%) [14]; the calorific value of Galandrud coals is 7430 - 8880 kcal/kg.

Table 1

Results of the proximate and ultimate analyses of the Galandrud coals from Central Alborz

	1	2	3	4	5	6	Avg.
Moisture (% , ad)	0.94	1.02	1.37	1.49	1.05	1.16	1.17
Ash (% , ad)	11.28	10.39	12.73	6.40	8.82	8.06	9.42
Volatile matter (% , ad)	35.93	37.12	33.32	33.53	34.15	37.45	35.25
Fixed carbon (% , ad)	51.85	51.47	52.58	57.88	55.59	53.33	53.78

Abbreviation: ad: air dried.

4.2. Mineralogy. Examination of polished section of the coals showed that the Galandrud coals mainly contain dolomite (>90%), quartz, sphalerite, galena, pyrite and clay minerals such as kaolinite. The carbonate minerals are commonly syngenetic or rarely epigenetic in origin. The epigenetic carbonates resulted from the carbonate bedrock geology occur as cleat-filling as in the Galandrud bituminous coals. The high carbonate content of these coals is reflective of a deposition affected by paleogeology, as the coal developed in a terrestrial environment upon an unconformity of eroded limestone and dolomitic rocks [18 and 8].

Pyrite in Galandrud coals is rare and is of epigenetic or syngenetic forms. The syngenetic pyrite was identified with its framboid texture (Fig. 3d) and the epigenetic type is fracture-filling in these coals (Fig. 3_c). Sphalerite was determined in the all the samples (Fig. 3_a), but galena is in only one of the coal sample (Fig. 3_b).

4.3. Modes of occurrence of the major elements and concentration. The major elements in coals are present in the minerals rather than the organic matter [10]. The major element geochemistry may therfore be used to document the mineralogical variation and to stablish the element-mineral associations [16, 21, 22, 17 and 10].

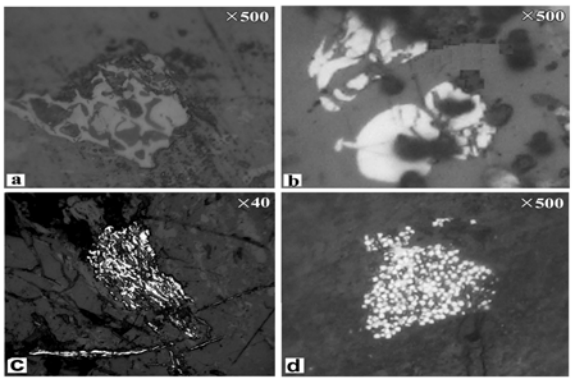

Fig. 3. Photomicrographs of minerals in Galandrud coals: (a) Sphalerite (b) Galena (c) fracture-filling pyrite and (d) pyrite with framboid texture.

Results of major element analyses of Galandrud coals are listed in Table (2). The major oxides in these coals are Al_2O_3 (45-77.41%), CaO (1.10-43.34%), Fe_2O_3 (6.46-12.80%), K_2O (1.56-5.96%), MgO (2.50-33.32%) and Na_2O (0.04-2.19%).

Table 2

Concentrations of major elements in coal samples of Galandrud region

Sample no.	Al_2O_3 (%)	CaO (%)	Fe_2O_3 (%)	K_2O (%)	MgO (%)	Na_2O (%)
1	45.00	43.34	6.46	2.50	2.50	0.20
2	45,90	1.98	12.80	5.96	33.32	0.04
3	64.26	1.86	11.89	4.83	17.09	0.07
4	54.33	19.39	11.67	2.20	10.75	1.75
5	65.05	9.78	9.94	4.92	8.12	2.19
6	77.41	1.10	8.54	1.65	11.03	0.27

Results of correlation between major elements of Galandrud coals have been provided in Table (3). Although, the element associations may vary by the coal type, a correlation analysis would demonstrate the general trends. Statically, a low positive correlation (at the 0.99% confidence level) between the element and the ash yield has only been established for K ($r_=0.30$) and the other major elements (Al, Fe, Ca, Mg and Na) show no correlation. Elements that do not correlate with the ash yields probably have different modes of occurrence in the coals studied.

Table 3

Pearson correlation coefficients (*r*) between the major elements and ash and fixed carbon content of Galandrud coals

	Ash	Fixed carbon	Al_2O_3	CaO	Fe_2O_3	K_2O	MgO	Na_2O
Ash	1							
Fixed carbon	-0.79	1						
Al_2O_3	-0.81*	0.85*	1					
CaO	-0.75	0.95**	0.75	1				
Fe_2O_3	-0.64	0.72	0.64	0.85*	1			
K_2O	0.03	0.06	0.30	-0.17	0.56	1		
MgO	-0.08	-0.11	-0.11	0.06	0.52	0.56	1	
Na_2O	-0.60	0.89*	0.93**	0.85*	0.75	0.42	-0.80	1

*Correlation is significant at the 0.05 level, **Correlation is significant at the 0.01 level

Table (3) shows that Fe, Na and Ca concentrations in the Galandrud coals are higher than those of the other major elements (Al, K and Mg); this observation seems to be mainly related to the Ca-Fe-Bearing minerals. The concentration of Fe in the coal samples show positive correlation with K ($r_=0.56$), Mg ($r_=0.52$) and Na ($r_=0.75$), which is in agreement with the presence of clay minerals. In coals studied, the highest correlation is between Al and Na elements. The content of these elements in the coal studied are probably controlled by the abundance of organic matters (macerals).

4.4. Models of trace elements occurrence and concentration

Trace elements are defined as elements present in coal in amounts of less than 1 percent of the coal weight and are reported in part per million (ppm) [24]. The concentration of 47 trace and Rare Earth Elements (REE) are determined (see Table

4). Although the Galandrud coal samples proved to be enriched of most of these elements, in this study, eighteen trace elements in coal including Ba, V, Mn, Cr, Ni, Co, Cu, Zn, Pb, Mo, As, Sb, Hg, Cd, Se, Be, B, Th, and U are evaluated. The range of these trace elements in studied coal samples are compared with the range of both Iranian [19] and world coals [24].

In Table 4, results of the coal samples analyses show significant amounts of Co (up to 51.3ppm), Cr (up to 65.5ppm), Cu (up to 59.2ppm), Mo (for three samples, up to 18.2ppm), Ni (up to 72.9ppm0, Pb (for three samples, up to 88.7ppm), Th (up to 11.9ppm) and Mn (for two samples, up to 409ppm). The higher concentration observed for B (up to 1438.2ppm) and Ba (up to 1172ppm) were associated with the organic affinity. Boron can be a useful index for indicating the palosalinity of coal depositional conditions [26]. The Galandrud coals are enriched in V (245.5-520ppm), Co (51.3-110.8ppm), Cr (65.5-194.2ppm), Cu (59.2-205.8ppm) and Ni (72.9-109.2ppm), compared with the range for most Iranian and world coals (Table 4). The result of the studies by Yudovich′s (1972) on geochemistry of coals showed that bituminous coals were of vanadium type and had high concentration of V, Ti, Ni, Co, Cu and some other trace elements [28].

Pearson′s correlation coefficients for element concentrations with and ash content may provide preliminary information for their organic and inorganic affinities (Table 5). The concentration of arsenic, which is one of the most important HAPs in coal, is from 19.8 ppm to 31 ppm and falls within the range of most Iranian and world coals (Table 4). Arsenic in the Galandrud coals shows no correlation with ash yields but has positive correlation with Hg ($r_{=}0.81$), U ($r_{=}0.87$), Ca ($r_{=}0.84$) and Fe ($r_{=}0.96$). In these coals, there is evidence for the organic affinity of As and it is thought that As may be related to Fe-As-oxide [1] and some minerals such as pyrite.

Cadmium, Se, Sb, Hg, U, Be and Zn are also included in the list of HAPs and their contents fall within the range of most world coals and show no correlation with ash yields. Among these elements the cadmium correlates with Sb ($r_{=}0.99$), Zn ($r_{=}0.89$), be ($r_{=}0.82$), Al ($r_{=}0.81$), and Na ($r_{=}0.86$). It appears that Cd may be related to Cd-bearing minerals, especially sphalerite. The concentration of Ni in Galandrud coal samples is higher than these of both Iranian and world coals. This element is the only element that has positive correlation with ash yield ($r_{=}0.91$). Manganese content is between 156.6 ppm and 532 ppm. Most of the Mn in coal, especially bituminous coals, occur in solid solution in the carbonate minerals [24 and 5]. In Galandrud coals, Mn correlates with U($r_{=}0.90$) and is possibly related to organic affinity.

The Pb content range from 45.1 ppm to 147.7 ppm which is higher the range of both Iranian and world coals. Lead occurs almost exclusively as galena (PbS) [4] and other Pb-bearing sulfides and possibly in pyrite as well [11]. In coal samples, this trace element shows positive correlation with Mo ($r_{=}0.91$). The Uranium content of Galandrud coals are low (1.2-4.8ppm) compared to the world coals (0.5-10ppm) [24] and Iranian coals (2.2-4.6ppm).

The correlation between ash and U content indicates that U has organic affinity. However, it has high correlation with Fe ($r_{=}0.95$), As ($r_{=}0.87$) and Mn ($r_{=}0.9$) and can be assocated with accessory minerals such as zicon and silicat minerals [5 and 10].

As can be seen in Table (4), the Th content is correlated with Mg ($r_{=}0.92$), suggesting an association with the clay minerals and monazite which is an accessory mineral in coal [6]. Selenium content in Galandrud coal samples is in the range of >0.05-0.94 ppm which is lower than Iranian coals (0.75-4ppm, shojaei et al. 2007) and is within the range for world coals [24]. Se has shows no correlation with ash yield, which shows organically associated, organic affinity as inferred by Glukoter et al (1977) and Finkelman (1994). However, Swiane (1990) states that Se occurs with sulfide minerals in coal, mainly pyrite [10].

5. Conclution. The study of geochemistry of galandrud coals indicates that the coals are upper Triassic-lower Jurassic age bituminous coals with high volatile matter (>33%), which were deposited into Shemshak formation. Geological setting have played key roles in determinig the geochemistry and mineralogy of Galandrud coals, so that, the mineras in these coals consist mainly of dolomite (>90%) and some other minerals.

The concentration of major elements (i.e. Al, Fe, Mg, Na and Ca) of Galandrud coal samples did not show correlation with ash yield and has only been established for K ($r_{=}0.30$). Elements which do not correlate with the ash yields probably have different modes of occurrence in the coals studied.

The contents of trace elements (As, Cd, Hg, Sb, Zn, Se, Be and W) in the Galandrud coals are low compared to both Iranian and world coals. Most of the trace elements (As, Cd, Co, Cr, Ca, Hg, Mn, Pb, Sb, Se, Zn, B, Ba, Be, Mn, Th, U and V) are of no correlation with ash yields indicating an organic association and only Ni has positive correlation with ash content indicating an inorganic affinity.

Boron contents in the coals studied were measured high (1438-3931.2 ppm), which indicates that these coals were influenced by sea water due to their deposition. Vanadium, Cr, Co, Cu and Ni in coal samples of Galandrud are also abundant, which indicates that these coals are V-type coals.

Teble 4

Trace element concentrations of Galandrud coals. Results are compared to the ranges for world coals (Swiane, 1990) and Iranian coals (Shojaei et al., 2007) (ppm)

Elements	1	2	3	4	5	6	Avg.	World coals [24]	Iranian coals [19]
As	21.50	26.90	19.80	31.00	27.10	23.20	24.91	0.5-80	0.4-31
B	1438.20	3931.20	3056.30	1321.00	2164.00	2641.90	2425.43	5-400	-
Ba	1758.60	3297.40	3056.30	368.00	1172.00	2641.90	2049	20-100	60-620
Be	7.60	9.10	14.30	21.24	25.13	4.30	13.61	0.10-15	0.27-5.17
Cd	0.10	0.10	0.10	0.64	21.60	0.10	1.00	0.10-15	0.015-1.37
Co	110.80	57.20	75.60	93.90	101.00	51.30	81.63	0.5-30	0.3-20.60
Cr	194.20	65.50	94.10	90.60	128.20	132.00	117.43	0.5-60	15-136
Cu	158.90	59.20	110.20	141.80	205.80	173.20	141.51	0.5-60	5.2-147
Hg	0.19	0.34	0.23	<1.00	<1.00	0.10	0.44	0.02-1.00	0.02-1.51
Mn	275.50	494.10	231.00	532.00	249.00	156.60	323.00	5-300	3.75-420
Mo	5.60	6.10	25.90	8.50	18.60	18.20	13.81	0.1-10	0.16-4.32
Ni	152.90	109.20	151.80	79.60	92.50	72.90	109.81	0.5-50	1.9-58.7
Pb	73.40	45.10	147.70	49.40	88.70	113.20	86.25	2-80	4.3-97.8
Sb	1.80	0.90	1.50	7.11	7.90	0.50	3.30	0.05-10	0.18-3.15
Se	<0.05	0.34	0.23	0.94	<0.20	0.29	0.32	0.2-10	0.75-4
Th	12.10	16.89	11.90	14.70	12.00	11.90	13.25	0.5-10	2.2-21.1
U	1.90	4.40	2.00	4.80	3.50	1.20	2.96	0.5-10	0.5-4.6
V	520.00	245.50	403.70	262.00	321.00	340.20	348.73	2-200	17-214
Zn	82.90	63.20	148.60	120.60	248.20	54.40	99.98	5-300	1.5-553

Table 5

Pearson correlation coefficients (r) between trace elements and ash content of Galandrud coals.

	As	B	Ba	Be	Cd	Co	Cr	Cu	Mn	Mo	Ni	Pb	Sb	Se	Th	U	V	Zn	Hg	Ash
As	1																			
B	-0.02	1																		
Ba	-0.62	0.85*	1																	
Be	0.56	-0.29	-0.67	1																
Cd	0.45	-0.25	-0.57	0.82*	1															
Co	0.10	-0.23	-0.72	0.53	0.46	1														
Cr	-0.43	-0.63	-0.25	-0.24	0.04	0.56	1													
Cu	0.02	-0.69	-0.60	0.33	0.62	0.48	0.64	1												
Mn	0.74	0.04	-0.28	0.27	-0.06	0.06	-0.55	-0.56	1											
Mo	-0.45	0.21	0.25	0.19	0.20	-0.22	-0.13	0.26	-0.66	1										
Ni	-0.71	0.11	0.36	-0.21	-0.35	0.33	0.30	-0.31	-0.18	0.05	1									
Pb	-0.75	0.15	0.39	-0.12	-0.09	-0.20	0.12	0.22	-0.81	0.91*	0.30	1								
Sb	0.49	-0.32	-0.64	0.87*	0.99**	0.53	0.04	0.61	0.01	0.16	-0.33	-0.12	1							
Se	0.71	-0.23	-0.45	0.30	-0.09	-0.09	-0.54	-0.22	0.71	-0.25	-0.52	-0.42	-0.02	1						
Th	0.24	0.75	0.52	-0.26	-0.25	-0.49	-0.57	-0.18	0.56	-0.46	-0.01	-0.52	-0.29	0.04	1					
U	0.78*	0.05	-0.40	0.59	0.34	0.14	-060	-0.33	0.90*	-0.47	-0.33	-0.75	0.39	-0.62	0.48	1				
V	-0.78	-0.37	0.07	-0.34	-0.24	0.47	0.83*	0.29	-0.58	0.08	0.73	0.41	-0.23	0.33	-0.50	0.48	1			
Zn	0.17	-0.18	-0.44	0.87*	0.89*	0.52	-0.01	0.50	-0.16	0.47	-0.01	0.21	0.89*	-0.16	-0.38	-0.21	-.05	1		
Hg	0.82*	-0.37	-0.78	0.93**	0.79	0.48	-0.26	0.31	0.48	-0.09	-0.45	-0.43	0.84*	0.48	-0.12	-0.75	-0.51	0.69	1	
Ash	-0.81	0.45	0.66	-0.32	-0.35	0.01	0.13	-0.39	-0.33	0.25	0.91*	0.47	-0.37	-0.67	0.15	-0.42	0.59	-0.02	-0.59	1

*Correlation is significant at the 0.05 level

**Correlation is significant at the 0.01 level

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MƏRKƏZI ƏLBORZUN GƏLƏNDRUD KÖMÜRLƏRININ NADIR ELEMENTLƏRININ GEOKIMYƏVI XÜSUSIYYƏTLƏRI

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Məqalədə İranın şimalındakı Mərkəzi Əlborz zonasının Gələndrud rayonunun trias-yura yaşlı kömürlərin nadir elementlərinin geokimyəvi xüsusiyyətləri tədqiq edilib. Bu kömürlər 6.4%-dən 12.73%-ə qədər külə və 33.32%-dən 37.45%-ə qədər üçucu kömponentlərə və yüksək faizdə (7430-8880 kcal/g) istilik dəyərinə malikdirlər. Tədqiq olan kömürlərdə, dolomit (>90%), kuvarz, sfalrit, qalen, pirit və gil mineralları təyin edilmişdir. Onlarda oksidləşmiş elementər yüksək miqdarda, kömürün qeyri-üzvi hissəsində toplanmışdır. İstatiska analizləri göstərir ki, bəzi nadir

elementlərin miqdarı o cümlədən Co (51.3-152.9 ppm), Ba (368-3297.4 ppm), Cr (65.5-194.2 ppm), Mo (5.6-18.2 ppm), Ni (72.9-152.9 ppm) və V (245.5-520 ppm)-mın miqdarı dünya standard ilə müqayisədə çox, As, Hg və U elemntlərin miqdarı azdır.

DYNAMICS OF THE POPULATION DISTRIBUTION OF BIRDS ON THE WESTERN COAST OF THE AZERBAIJAN SECTOR OF THE CASPIAN SEA

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Abstract. The article deals with the dynamics of the distribution of populations of selectively valuable species of birds in the western coast of the Azerbaijan sector of the Caspian sea. This zone partially or fully covers 6 zoogeographical regions of Azerbaijan: Samur-Davachy, Absheron Gobustan, Baku-Gobustan archipelagos, the eastern part of Kura-Araz plain and Lankaran lowland. Former and present population conditions of 45 species of birds in 6 regions have been emanated.

Keywords: biological species, region, population, seasons of a year, Distribution

Prior ornithological observations on the western coast of the Caspian sea have been made by some outstanding zoologists of the XIX-XX centuries (Radde, 1884; Satunin, 1912, 1916; Isakov, Vorobev, 1940; Tugarinov, Kozlova, 1935, 1938; Kozlova, 1950; Isakov, 1951; Ivanov, 1952; Gambarov, 1952, 1960; Dyunin, 1960; Zablotskiy, Zablotskaya, 1963; Mustafayev, Khanmammadov, 1965; Tuayev, 1957, 1965; Vinogradov, Chernyavskaya, 1965 etc.).

N.K.Vereshchagin (1947) observed the variety of the structure of species in the same area. However, he couldn't ecologically estimate this phenomenon. Later, it became common to call such groups of species as the elementary populations (Naumov, 1963).

Modern population distribution of birds have been studied by the authors of the presented paper (Mustafayev, Sadigova, 2006; Sadigova, 2008; Asgarov, Mustafayev, Babayev, 2009).

Material and methodology. Scientific reports of the last 20 years about the birds of the studied regions have been analyzed and compared with those of the present ones. Registration methods on flyways and sample areas have been applied. Monitorings have been conducted by contact method in several areas (Robert Howe, 1997). The study of the materials on the current state of birds presents 4 groups of species: A – prior multitudinous, present rare species; B – the species having already lost reproductive population; C – the species reproducing in the presented region for the last 50 years; D – the species earlier occurred in nesting spots or winter species presently lacking in the region. The dynamics of the character of the birds' stay in different regions and the number of the population of every species have been determined. Furthermore the authors try to determine limiting factors of population dynamics of the distribution of the considered birds.

Consideration of results. N.P.Naumov (1963) advanced a conception on 3 types of population. Of course, depending on the form of life realization there are

more population classes and species. Multipopulation of a species is the basic instrument of its adaptation to the environment. Crack-headed treatment to animals could result in plenty of losses (Table 1). The table shows that 3 species of birds on the Azerbaijan coast of the Caspian sea used to be multitudinous. Red-breasted goose (*Rufibrenta ruficollis*) massly hibernated here in droves but during the last 25-30 years completely disappeared. The same can be said about bustards (*Otis tarda*). They hibernated in droves on the western coast of the Caspian sea till the second half of the XX century. After 1970s they could be met only during their migration period, but during last 10 years they almost disappeared. The black-bellied sandgrouse (*Pteroclis orientalis*) was observed on flyby but on steppe and semidesert parts of the region reproduced as an ordinary bird. Presently, it nests only in Gobustan area as an endangered species.

Table 1

Longterm distribution dynamics of basic birds with 2 or more populations on the western coast of the Azerbaijan sector of the Caspian sea. Here and in the next tables: 1. Yalama-Khachmaz; 2. Gendob-Sumqait; 3. Absheron-Gobustan; 4. Baku-Absheron archipelago; 5. East Kura-Araz lowland 6. Lankaran plain: A – prior multitudinous, present rare species; B – the species having already lost reproductive population; C – the species reproducting in the presented region for the last 50 years; D – the species earlier met in nesting spots or winter species presently lacking in the region; E – endangered population (The dashes in the table indicates the absence of the species in the region both previously and presently).

Species of birds	Regions					
	1	2	3	4	5	6
Pelecanus crispus	–	–	–	–	A	A
Phalacrocorax carbo	B	B	C	C	C	A
Ph.pyqmaeus	B	B	C	C	C	A
Botaurus stellarus	A	A	–	C	A	A
Nycticorax nycticorax	B	B	–	–	B	A
Bubulcus ibis	B	B	–	–	A	A
Eqretta alba	A	A	C	C	A	A
E.qarzetta	B	B	–	C	A	A
Ardeola ralloides	B	B	–	–	A	A
Ardea purpurea	A	A	C	C	A	A
Pleqadis falcinellus	B	B	–	–	B	A
Ciconia niqra	B	B	–	–	–	B
Anser anser	–	B	–	B	B	B
Rufibrenta ruficollis	D	D	D	D	D	D
Tadorna feruginea	B	B	C	C	A	A
T.tadorna	B	B	B	A	A	A
Anas platrhynchos	B	B	C	A	A	A
Netta rufina	B	B	–	C	B	A
Aythya nyroca	B	B	–	C	B	A
Pandion haliaeetus	B	B	–	–	–	B
Pernis apivorus	B	–	–	–	–	B
Milvus miqrans	B	–	–	–	–	B
Circus macrorius	B	B	C	A	B	A
Aquila pomarina	B	–	–	–	–	A
Haliaetus albicilla	B	–	–	–	C	B

Falco tinnunculus	A	A	A	C	A	A
Fulica atra	B	A	C	A	A	A
Phasianus colchicus	E	–	–	–	–	E
Laruss ridibundus	B	B	C	C	B	B
Otis tarda	D	D	D	D	D	D
Larus cachinnans	–	B	C	C	–	C
Apus apus	C	C	C	C	C	C
Pterocles orientadis	D	D	D	D	D	D
Columba palumbus	A	–	–	–	–	B
Columba oeans	A	–	–	–	–	B
Streptopelia decaocto	C	C	C	C	C	C
S.seneqalensis	C	C	C	C	C	C
Delichon urbica	C	C	C	C	C	C
Motasilla alba	C	C	C	C	C	A
Sturnus vulqaris	C	C	C	C	C	C
Corvus fruqilequs	–	B	–	–	–	B
Turdus merula	C	C	C	C	C	C
Passer hispaniolensis	–	–	–	–	C	B
Frinqilla coeleps	A	C	C	–	–	C
Chloris chloris	A	C	C	C	–	C

The data in Tables 1-2 shows that prior multitudinous, present rare species prevail mostly in Lankaran lowland and in Kura-Araz lowland in the eastern part. The species of group B prevail in Samur-Davachy (from Yalama to Sumgayit) and Lankaran lowlands. Absheron-Gobustan and Baku-Absheron archipelagos are rich in group C birds, which is due to improvement of bird protection and the establishment of landscapes with arboreous-shrub vegetation.

Table 2

The number of bird species in groups due to populations in different regions

Regions	**Groups of birds**					**Total**
	A	**B**	**S**	**D**	**E**	
Yalama-Khachmaz	8	18	7	3	1	37
Gendab-Sumqayit	5	19	9	3	–	36
Absheron-Gobustan	1	1	15	3	–	20
Baku-Absheron archipelagos	4	1	20	3	–	28
Eastern part of Kura-Araz lowland	12	7	11	3	–	33
Lenkaran plain	22	12	8	3	1	46

The distribution character of the studied multipopulating bird species due to regions is presented in tables 3-4. The avifauna of Lankaran lowland leads in the number of populations of all groups. Trophic populations prevailing in Samur-Davachy lowland are exceptional for woodland choir flying to open landscapes for food (Ciconia *nigra, Pernis apivorus, Milvus migrans,Columba oeans, Falco tinnunclus* etc.) migrating population of birds qualitatively and quantitatively prevail in all the regions, which is conditioned by the geographical arrangement of the studied region. (migration direction of birds of Palearctic).

Table 3

Distribution character of basic multipopulating birds on the western coast of the Azerbaijan sector of the Caspian sea. Addition to conditional denotations: a –

sedentary population; b – population flying in for reproduction; c – population flying in for hibernating; d – migrating population; e – trophical population (fly in for food): f – endangered population

Species of birds	Regions					
	1	2	3	4	5	6
Pelecanus crispus	d	d	d	d	c, d	a, c, d
Phalacrocorax carbo	c–e	c–e	d	a, c, d	a, c, d	a, c, d
Ph.pyqmaeus	c–e	c–e	d	a, c, d	a, c, d	a, c, d
Botaurus stellarus	a–d	a–d	d	a, c, d	a, c, d	a, c, d
Nycticorax nycticorax	d–e	d–e	d	d	b, d	b, c, d
Bubulcus ibis	d, e	d, e	d, e	d	b, d	b, d
Eqretta alba	a–d	a–d	a–d	a–d	a–d	a–d
E.qarzetta	b–d	b–d	d	c–d	a–d	a–d
Ardeola ralloides	a, d, e	a, d, e	d	d	b, d	b, d
Ardea purpurea	a–d	a–d	c, d	c, d	a–d	a–d
Pleqadis falcinellus	d, e	d	d	d	d, e	a, d, e
Ciconia niqra	b, d, e	d, e	d	d	d	b, d, e
Anser anser	d	c, e	d	c, d, e	c, d, e	c, d, e
Tadorna feruginea	c, d, e	c, d, e	a–d	a–d	a–d	a–d
T.tadorna feruginea	c–e	c–e	c–e	a–d	a–d	a–d
Anas platrhynchos	c, d, e	c, d, e	a–d	a–d	a–d	a–d
Netta rufina	c, d	c, d	d	c, d	c, d	a–d
Aythya nyroca	c, d	c, d	d	a–d	c, d	a–d
Pandion haliaeetus	c, d, e	c, d, e	d	d	d	c, d
Pernis apivorus	a, d, e	d, e	d	d	d	d, e
Milvus miqrans	d, e	d, e	d	d	d	d, e
Circus macrorius	d, e	d, e	c–e	a–d	d, e	a–d
Aquila pomarina	d	d	d	d	d	a–d
Haliaetus albicilla	c–d, e	d	d	d	a–d	c–d, e
Falco tinnunculus	a–e	a–e	a–d	–	a–e	a–e
Fulica atra	c, d	a–d	a–d	a–d	a–d	a–d
Phasianus colchicus	f	–	–	–	–	f
Laruss ridibundus	d	c–e	a–d	a–d	c–e	c–e
Larus cachinnans	–	c–e	a–d	a–d	d	ae
Otis tarda	d	–	–	–	–	–
Pterokles orientalis	a, e	d	d	d	d	d
Columba palumbus	a, e	e	e	e	e	c, d, e
Columba oeans	b–e	e	e	e	e	c, d, e
Apus apus	a	b–e	b–e	b–e	b–e	b–e
Streptopelia decaocto	a	a	a, e	a	a	a
S.seneqalensis	d, e	a	a, e	a	a	a
Corvus truqilequs	–	c–e	d, e	d, e	d, e	c–e
Passer hispaniolensis	a–d	–	–	–	a–e	c–e
Motacilla alba	b, d, e	a–d	a–d	a–d	a–d	a–d
Delichon urbica	a–d	b, d, e	b, d, e	b, d, e	b, d, e	b, d, e
Sturnus vulqaris	a–e	a–d	a–e	a–d	a–e	a–d
Turdus merula	a–d	a–e	a–e	a–e	a–e	a–e
Frinqilla coeleps	a–d	a–d	a–d	c–d	c, d, e	a–d
Chloris chloris		a–d	a–d	a–d	d	a–d

Table 4

The number of populations of the studied species on regions

The character of the birds' stay	Quantity of birds on regions					
	1	**2**	**3**	**4**	**5**	**6**
Sedentary population	13	13	14	18	18	25
Population flying in for reproduction	16	14	12	14	17	23
Population flying in for hibernating	20	22	14	20	21	29
Migrating population	35	35	35	35	35	36
Trophical population (flying in for food)	20	20	8	4	9	13
Endangered population	1	–	–	–	–	1

The presented paper focuses on the fact that the same species of birds have a number of populations –from one to five, or more-in the same region. The conducted monitoring showed that different populations of the same species of birds distinctly vary for their behaviour.

Let's take *Sturnus vulgaris* (black starling) as an example. Sedentary population consists of few 10-15 species in each group (both in winter and summer). It propogates its kinds earlier than the other populations. To the end of summer after parturiating flocks of 50 and 60 species of parents and young clenches appear. Only small groups of 10-15 species feeding and overnighting apart from other populations hang over. This population of black starling reproduces synanthropically, mostly in residential landscapes, while in winter searchs food on the roads, near residents or sanitary fills.

Table 5

Birds from the western part of the Azerbaijan sector of the Caspian sea of two or more populations

Species of birds	Regions					
	1	**2**	**3**	**4**	**5**	**6**
Pelecanus crispus	1	1	1	1	2	3
Phalacrocorax carbo	3	3	1	3	3	3
Ph.pyqmaeus	3	3	1	3	3	3
Botaurus stellarus	4	4	1	3	3	3
Nycticorax nycticorax	3	3	1	1	2	3
Bubulcus ibis	3	3	1	1	2	2
Eqretta alba	4	4	4	4	4	4
E.qarzetta	3	3	2	1	2	2
Ardeola ralloides	3	3	1	1	2	2
Ardea purpurea	4	4	2	2	4	4
Pleqadis falcinellus	2	2	1	1	3	3
Ciconia niqra	3	1	1	1	1	3
Anser anser	1	3	1	3	3	3
Rufibrenta ruficollis	–	–	–	–	–	–
Tadorna feruginea	3	3	4	4	4	4
T.tadorna	3	3	3	4	4	4
Anas platrhynchos	3	3	4	4	4	4
Netta rufina	2	2	1	2	2	4
Aythya nyroca	2	2	1	4	2	2
Pandion haliaeetus	3	3	1	1	1	2
Pernis apivorus	3	2	1	1	1	2

Milvus miqrans	3	2	1	1	1	2
Circus macrorius	2	2	3	4	2	4
Aquila pomarina	1	1	1	1	1	4
Haliaetus albicilla	3	1	1	1	4	3
Falco tinnunculus	5	5	4	–	5	5
Fulica atra	2	4	4	4	4	4
Laruss ridibundus	3	3	4	4	3	3
Larus cachinnans	1	3	4	4	1	5
Pterocles orientadis	1	1	1	1	1	1
Columba palumbus	2	1	1	1	1	3
Columba oeans	2	1	1	1	1	3
Apus apus	3	3	3	3	3	3
Streptopelia decaocto	1	1	2	1	1	1
S.seneqalensis	1	1	2	1	1	1
Delichon urbica	3	3	3	3	3	3
Motasilla alba	4	4	4	4	4	4
Corvus truqilequs	2	3	2	2	2	3
Passer hispaniolensis	–	–	–	–	5	3
Sturnus vulqaris	4	4	5	4	5	4
Turdus merula	5	5	5	5	5	5
Frinqilla coeleps	4	4	4	4	4	4
Chloris chloris	4	4	4	4	1	4

The population of the black starling flying in for breeding are relatively more in number. They breed after 10-15 days, build nests in the hollows of tree trunks, in railway tubes, electric line stands, dig-ups of bee-eaters and under bridges. Their winter flyoffs begin in early August. They form large flocks before the flyoff. (120-150, or more pieces in every flock).

The population of the starling flying for hibernating appears in autumnal weather cooling (October-November). This are populations form lots of flocks with a large number of parties (200-300 in each), live in steppes and semi-deserts in the daytime searching for food (mainly insects) overnight in rush banks and shelterbelt plantings and fly for nesting areas in March.

The flying population (migrating) of the black starling is distinguished as it flies in large flocks of 200-300 pieces, sometimes of 500 in each. The flock fly low (10-15 m above the land) and nonstop. This species fly flock by flock to the southern direction. The spring flock of the migrants is consist ing of small groups of birds (from 10 to 40).

There are trophical populations of starlings as well. They are probably a part of the hibernating population. They differ for living not in rushes but on the roofs of buildings or on the trees of close towns. For instance, the flocks of these birds feed in semideserts of Absheron and Gobustan, but overnight in the city of Baku or Sumgayit. Hooded crows and rooks behave themselves the same way, while gulls feed in semideserts and overnight on the islands.

The multicharacter of the population of birds in the same region shows that the notion of «sedentism of a species» is conditional and refers not to the species but a specific population. Proceeding from this fact, all species of birds are classified into two main groups for the character of stay: migrants and nonmigrants (sedentary). The

francolin (*Franeolinus fra*ncolinus), gallinule (*Porphyrio porphyrio*), collared turtledove and laughing dove (*Streptopelia decaocto, S.senega-lensus*), eagle owl (*Bubo bubo*), owlet (*Athena noctua*), halcyon (*Alchedo atthis*) and most woodpeckers (*Picidae*) are strict sedentary species in the studied regions. These birds are of single population in any specific region and never migrate.

Multipopulating birds are rather plenty in number in the studied regions and their populations vary in number (Tables 5, 6).

The materials of tables 5, 6 are of great interest as they reflect the level of populations of bird species in different regions, by their same total number. Such a population structure of birds distinctly forwards to the decrease of intraspecific competition.

Table 6

The number of populations of multipopulating birds

Quantity of multipopulating species	**Regions**					
	1	**2**	**3**	**4**	**5**	**6**
Species with a single population	6	8	21	16	10	2
Species with two populations	8	6	5	3	9	7
Species with three populations	16	15	3	5	8	15
Species with four populations	8	9	11	11	9	14
Species with five populations	2	2	2	1	5	4
Total	40	40	40	36	40	41

The birds with a single population prevail in Absheron-Gobustan region (21 species) (Table 5). The list is followed by Baku and Absheron archipelagos (16 species). The limitation of a population of a number of bird species is conditioned by the strong impact of anthropical and anthropogenic factors as well as the lack of diversity of food reserves. The birds with 2 populations are relatively more in Kura-Araz plain and on the coast of the Caspian-from Yalama to Khachmaz, where low-woods have more or less been preserved. Species with 3 or 4 populations are relatively more In Samur-Davachy and Lankaran lowlands which include at least various landscape remains. The species of birds with five populations are multitudinous in all the regions (1-5 species).

The limiting factors in the population dynamics of the distribution of birds are by far not the same. For dendrophilous forests, for example, it is deforestation. Game birds suffer from double negative influence of people-direct pursuits accompanying the liquidation of stereotyped inhabitations. Predatory birds have become rare and endangered as a result of erroneous treatment of people. Excessive use of pesticides against pest agrecenosis cripples birds a great deal. Toxication and drainage of reservoirs destructively influence on the aquatic-and semiaquatic birds, while desert and semi-desert and steppe lands development superseded oreophils. All these negative impacts on birds have lasted throughout centuries and only for the last 40 years their comprehend elimination can be observed.

Inference

1. Multipopulation of a biological species is the key tool of its adaptation to the environment

2. The same species of birds in the same area can have up to 5 forms of population depending on the season of the year: sedentary population; population

flying in for reproduction; population flying in for hibernating; migrating population; trophical population (flying in for food)

3. Continuous inconsiderate treatment towards birds on the western coast of the Caspian Sea has caused drastic changes in the distribution of the populations of 45 bird species.

4. The arrangement of the dynamics of the population distribution of birds can be a scientific basis for the formation of optimum treatment of the population to them in any region

Recommendation. The ornithologists should necessarily set specific behavior of every form of bird population in separate regions and spread among the population where the life of a certain population needs changing in the required direction.

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CƏNUBİ XƏZƏRİN AZƏRBAYCAN SEKTORU SAHİLLƏRİNDƏ QUŞ POPULYASİYALARININYERLƏŞMƏ DİNAMİKASI

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Məqalədə ilk dəfədir ki, 45 növ çoxpopulyasiyalı quşun 6 zoocoğrafi sahədə yerləşməsinin çoxillik dinamikası verilir. Eyni ərazidə eyni növün oturaq, reproduksiya üçün gələn, qışlamağa gələn, yem üçün gələn və miqrant populyasiyalarının dinamikası onların konkret ərazidə nəsil verməkdən və ya qışlamaqdan məhrum olmasını, bəzi populyasiyaların yeni gəlməsini və onların kəmiyyət dəyişmələrini göstərir. Bu isə bərpa üçün taktiki tədbirlər hazırlamağı asanlaşdırır.

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CHANGE DETECTION OF THE GROUND WATER QUALITY IN MIGHAN PLAYA OF IRAN

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Abstract. The natural and, generally, high quality of ground water may be seriously affected by many types and sources and contamination associated with human activities and land use. Ground water pollution can arise from a variety of activities, notably. The watershed of Arax including Mughan playa in its central part contains an area about 5495.7 km^2 where is located in the western zone of the central Iran in the south west and center of "Markazi" province. Due to the ground water level declination for the agricultural and industrial activities its salinity was intensity increased because of the excessive exploitation of underground water. In the other hand doughtiness and the shortage of surface water during this two recent decades have caused an accelerated trend on salinity. In this study the variation trend, underground water level, the electrical capacity (EC) of water quality and CL investigated in different statistical period of 1985 to 2007. Therefore, the level of water fluctuations and also salinity were calculated with respect to the plain features. The results revealed that the average declination level has been 8.78 meter in the specified period. The level of salinity was about 1276.539 micromose in centimeter, and the quality of water was decreased to 60.788 micromose in centimeter annually in the study area. Statistical analysis is showing that there is a high relationship of 0.92 between CL and EC (r= 0.92). This circumstance shows that due to the decreasing of underground water level the EC was increased and subsequently its CL is increased as well.

Keywords: Ground water, salinity, EC, CL, Arak, Iran

Introduction. Salinization is one of the most devastating forms of land degradation threatening food production worldwide, especially in arid and semi-arid climates such as the Iranian Centre and Southern parts as well. In Iran, with climate change predictions indicating less rainfall and higher temperatures in the near future in most of the agricultural regions in Central parts, experts worry that the changes will lead to even more saline lands and less food. In many non-irrigated regions in the world, the extent and nature of salinity is influenced by a range of soil processes and climatic conditions. The major factors include the amount and frequency of rainfall, evapotranspiration (caused by climatic factors), water use by vegetation and how water moves through the soil. So in areas where lower rainfall and higher temperatures are predicted because of global warming, the change will be toward a more arid climate, which is conducive to salt accumulation. Lack of organic matter caused by drier climate can lead to further deterioration of the soil structure, which reduces the ease with which salts can be leached from the soil profile. Conversely, in areas where the changing climate is predicted to bring increased rainfall and lower temperatures, there may be less salt accumulation, which can thus reduce salinization. If only it were that simple. Unfortunately, the climate-soil interaction tends to make things more complicated. In locations where salinity is caused by perturbed

groundwater levels, higher rainfall and lower temperatures can enhance the groundwater perturbations, leading to an increase in soil salinity. A change to drier climates in this kind of system, though, can result in reduction of salinity levels in soil surfaces. While predictions on long-term climate change in Iran vary depending on the model, the general assumption is that most of the agricultural regions in Central Iran will experience lower rainfall, particularly in winter, and higher temperatures in summer. These conditions will be conducive for increasing salinization of productive lands. Decreasing water availability for crops due to low rainfall and salinity will force agricultural activities to move toward highlands where high rainfall is expected to continue.

Aquifer or alluvium area is a vital resource of water for drinking, agricultural and industrial activities, moreover in the past when the people were used the water of aquifer or recently who are using water from wells. Due to the global warming the droughts is increasing in arid and semiarid regions such as Iran, in the other hand the population grows and increasing of water demands, caused the quantity of water and lands with a declination trend and consequently water reservoir are decreased with changes in their quality.

Mighan playa in central part of Iran is a significant area which produces the main drinking water of Arak city and also irrigation for the agricultural land from water wells. But the recent drought, over using of unpermitted wells and the expansion of agricultural fields caused the ground water of Mayghan Kavir of Arak to decreased in quantity and quality which can be create a serious trouble in the future. In this study, the possibly crises of water salinity interference to aquifers was investigated since of over excavation of the water.

Paopleni and et al., (2003) in their studies have find that the quality of water resources in semi-arid region of Pampa in Argentina was reduced because of overusing of an existing low depth ground water as the main resource in this area with 60 percent of this region where is effected by saltiness density over 5 dsm^{-1}. Kapasiyoni and et al., (2005) were believed that increasing in demands of water by human factors was caused salinity water intrusion specially near the beaches and changing the natural process of the normal water in ground water of beach aquifer in the western Italy. Benets and et al., (2006) have studied about the process of ground water reservoir in the south west of Australia and where was find that two factors are important in creating this phenomena. Velayati (2001) has explained in his study about aquifer of a vegetated plain of Torbat Haydariyeh where is frequently declined of ground water or over using is caused gradually as saltiness of ground water and salt water intrusion to the normal water in the margin area and Kavir where is occurred in this region. Katibeh (2003) in his studies was found that an accelerated using of the Bam shallow water resources is caused to declined a reach storage of normal water to changed as a salty water in this aquifer. Zehtabian and Sarabiyan (2004) were found that some of the natural factors such as geology, precipitation deficiency and…) and also human impacts including of unsuitable irrigation systems are causes in salinity of water and soil in Iran.

Materials and Methods.

Introducing the area. Mayghan river basin is indicated with a width of more than 5495.7 km where is situated Arak plain with 2854.63 km from its width wheres 100-110 km from its width is Mayghan playa. The rested part is upland in western

zone of central Iran, in the center branch and the south west o Markazi province where is geographically coordinated with 49°20′ north to 50°18′ east and 34°44′ north to 33°49′ east (The general water organization of central province, 2003).

The highest point from the Persian Gulf level as an altitude base of the Middle East is indicated 3170 meter in Noghreh Kamar mountain and the lowest point is 1650 meter in Mayghan playa where is focused in this study. According to the regional and bioclimatic division of Iran, the study area has is same as Mediterranean region using Gaussian's method and in Ambridge's method, it is determined as a cold semi-arid region. (Solaimani and Sadeghi, 2009).

The annual average precipitation according to the climatic station records in the mountainous regions and the plain area are consequently 383.5 mm and 264 mm for a long period of 32 years and the annual average temperature in mountainous regions is 17.4°c and in Mayghan plain is 19.8°c where the minimum annual average is ranged between 2.3°c to 5.3°c (The general water organization of central province, 2004).

The study area of Mayghan watershed is identified as an individual area where is resulted and reminded from a playa of Mayghan Kavir lake. The investigation of features, condition and position is indicated that as evidence from the surface nature and the excavated wells and the results of exploration digging all confirmed that there is only one aquifer in Arak alluvium plain (the general water organization of central province 2004).

Ground water resources. The first used statistic data of the ground water resources in this area was recorded in 1970 which were identified in 265 deep and semi deep wells but they were increased to 103456 in 2003 after three decade.

Therefore, this accelerated growth of the wells and their annually increasing has been totally 531.5 million m^3 which has grown 15.63 million m^3 annually (the general water organization of central province, 2004).

Research Methods. The methods in this study were included; prepare of the basic maps, collection of the wells position and rivers and also as follow:

Collection of the wells data. For the quantity measurement of the depth of water 46 pysometry wells have used to gain an accurate level of water in the study area. For this purpose the depth of wells and their surface level for each pysometry well was measured for 12 mounts of a year. Then the statistical period of these wells were recorded for the 64 deep and semi deep wells as the selected points of the ground water resources with measurement of their quality parameters such as Anions; Kations, TDC, EC.

Water quality maps. To preparing of the water quality maps the selected wells were analysed and extended for the study area. Different parameter of water quality such as EC and CL which have measured from the extracted data of the identified period then used as input data in Arc view to produce separate maps of the water quality.

Calculation and Hydrograph drawing of Arak plain. Thiessen's mean method was used to find a generalised map of the numbers of hydrograph calculation in the study area. At first by using of Arc view and triangulating capability of drawing of Thiessen's (aerial rain) the condition of pysometer wells were identified on plain map. Then with using of GIS software triangulating was processed and polygon of each pysometer wells and α coefficient was distinguished. For drawing of this map

the absolute numbers of the water level of plain was used and calculation of the final numbers of hydrograph was drowning in the Excel software.

Survey of the zone based on quality of the plain. In this process, the classification of the basin was based on parameters which are used in Wilcox's classification (for Electrical conduction, Table 1) and Schoeller (for CL, Table 2). Where the C is showing the saltiness with the numbers of 1, 2, 3, 4 which are showing consequently low, moderate, high and very high ranges (Alizadeh, 2003).

Table 1

Agricultural water classification based on Wilcox's method (mic.m./cm)

C4	C3	C2	C1	Quality of water class
$2250 < EC \times 10^6 < 4000$	$750 < EC \times 10^6 < 2250$	$100 < EC \times 10^6 < 250$	$100 < EC \times 10^6 < 250$	EC amounts

Table 2

Drinking water classification based on Schoeller,s method (mil.gr/l.)

6	5	4	3	2	1	Quality of water class
is not safe to drink	bad and unfavoured	bad and little unfavoured	unfavoured and with little bad	acceptable	good	classification water for drinking
>2840	2840	1420	710	355	177/5	(Cl)

The statistic survey of variables. To gain coefficient of (R) and coefficient of (R^2) statistical data were analysed in Excel environment (Valizadeh, 2001).

Results. Due to the accelerated use of water and decline of ground water level of the wells it was caused a consequently falling of the level of ground water in 20 years period from 1985-2005 which is obviously identified in unit hydrograph of the plain. During this two decade the surface of ground water was decreased about 8.87 metres and despite of the rising of precipitation for this period the water level was decreased, due to an accelerated extraction of the wells and some of other reasons (Figure 1).

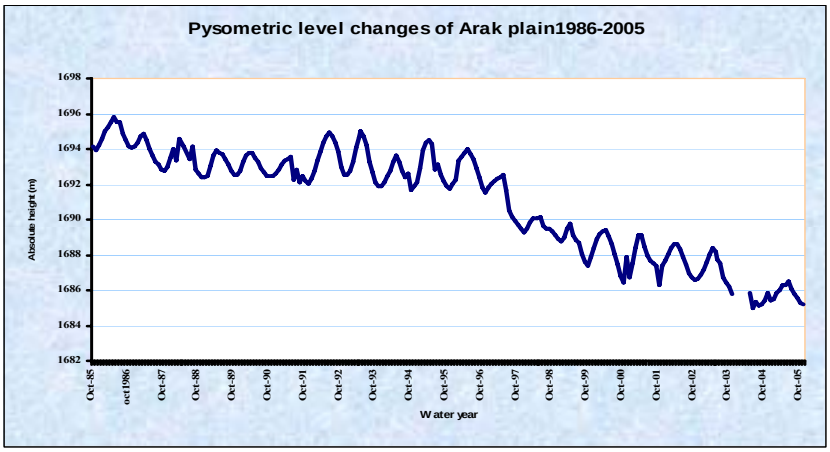

Fig.1. The Pysometric level changes of Arak plain ground water

Trend of the EC and CL changes . These two variables are change very similar to each other. In figures 2 and 3 is illustrate a general rising up but these two figures identified a different amount of EC at first is about 1100 and the end of the graph its increased to over 2500 (for 20 years statistical data), which is specified with a difference of 1276.539 micro mouse in centimetre and CL with 3.6176 miliokwalan in litter for the same period as well.

Statistical relationship of the water extraction and the trend of the ground water quality changes are shown a fluctuation with rapid changes during the first decade in Arak plain.

These changes were significant with a declination for the period of 1998-99 and 2002-2002 but during the years of 2002 to 2005 and the other years a rising of the water level was identified in the study area. The Electrical Conductivity graph in figure 2 is showing a declination trend for the period of 2006-7 while this trend was increased in CL for the same period (Figures 2 and 3).

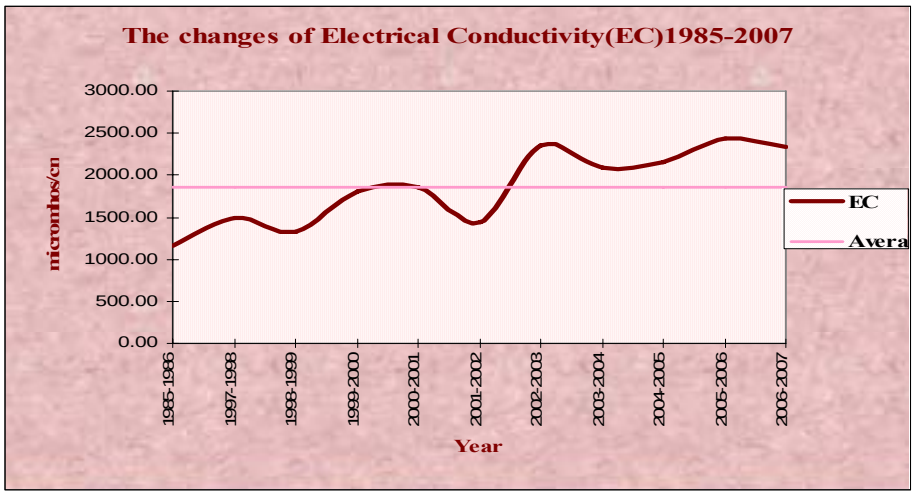

Fig.2. The changes of Electrical Conductivity in Arak plain

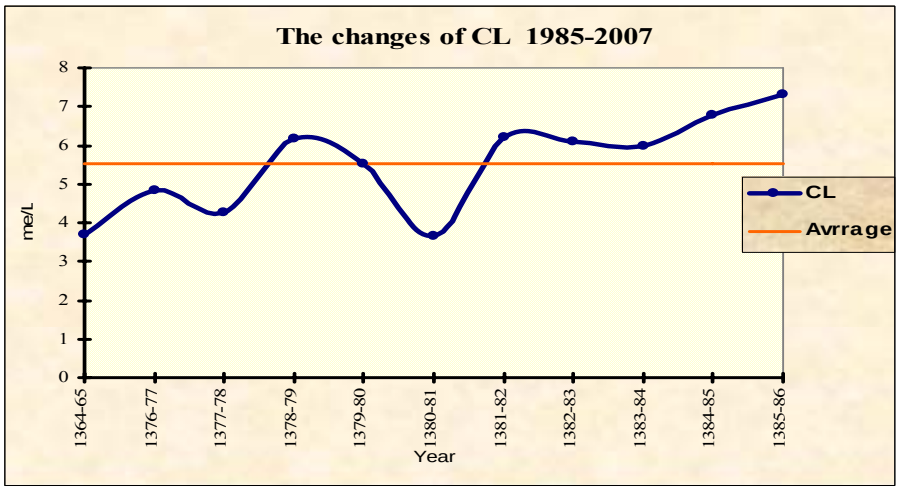

Fig.3. The changes of CL in Arak plain

Qualitative zonation of the study area

Electrical Conduction. The extracted EC from figure 2 is showing percentage of plain surface and classification, which is found that about % 50 of the plain during this period, is related to the class C_3 with a high saltiness which in years of 1998-9 the saltiness classes of C_3 and C_4 are almost the same surface of the plain, that means the saltiness surface was equal to the surface of plain and in years 2005 – 2006 saltiness class of C_4 with more than %1 than class of C_3 was dominated the surface plain. The incomparable saltiness with a very high rate of 4000 *u*/cm which was recorded in 2000-2001 and 2002-3 has no any explanation in Wilcox chart. In the other years the surface of the basin was contained this degree of saltiness (C_5).

The most area which is related to the class C_5 is identified for the year of 2004 with 15.43 percent from the whole surface of the plain and estimated about 44 thousands hectare. This extended area was reduced about 3 percent after one year in 2005 after an excavation control of the wells water resources. If we compare annual EC amount with maximum in Wilcox classification, then the average EC of the plain will classified in range of C_3 unit for the years of 2001 and 2002 of the recorded data from the wells which is increased to class C_4 up to now.

Changes in CL. Fortunately the most surface of the plain has dominated in class I in all the years expect of 1998-99, but by arising of this period in classes II and III, during a short period from 1998 to 2000 with declination trend, the most part of the study area was related to the classes II and III.

The surface of class II was increasing during 2001 to 2004 but with two declinations in 2001-2002 and 2002-2003, the amount of class III had a rapid increasing for the period of 2001, 2004 and 2005 in the study area.

About 1.4 percentages from the area of plain in 1997 was related to class IV and also in 2002 about 2.2 percent and 2 percent in 2005 was related to the same class (figures 4 & 5, tables 1 & 2).

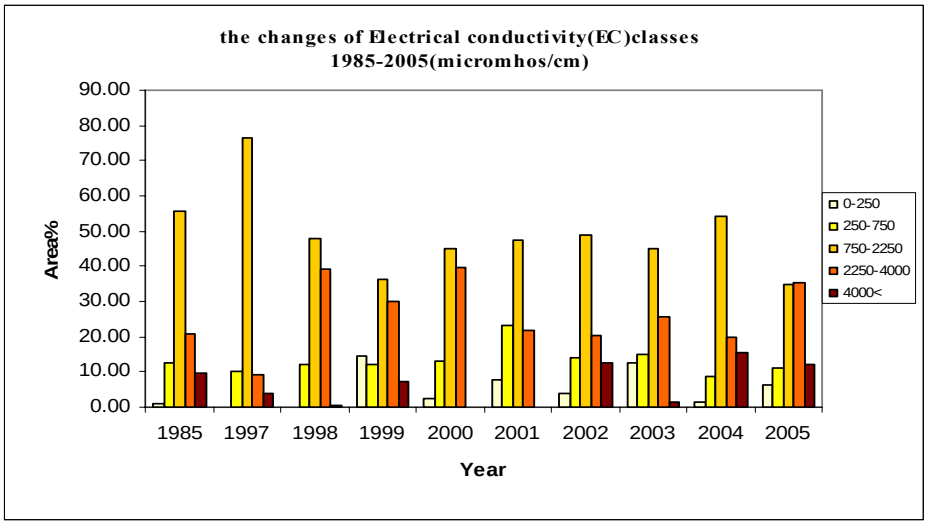

Fig.4. The changes of EC classes in Arak plain

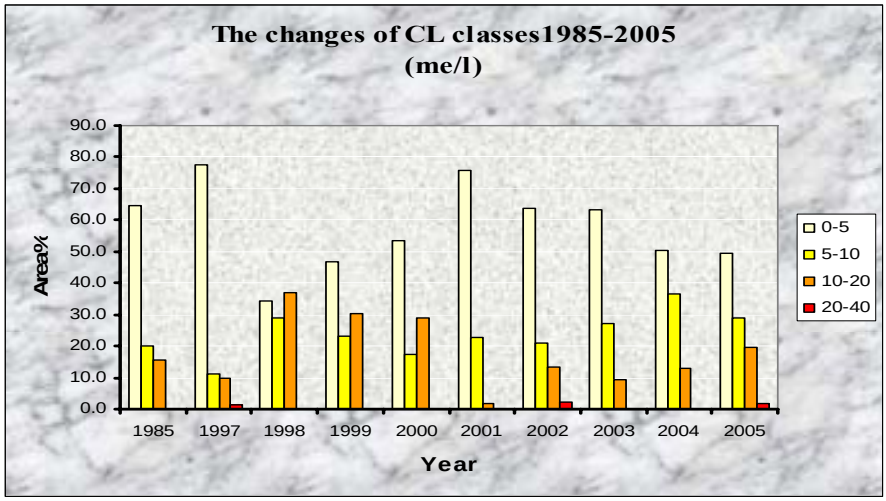

Fig.5. The changes of CL classes in Arak plain

Table 3

Relationship between absolute level of ground water and CL, EC

the type of solidarity	Percent of error 9.5	coefficient of solidarity (r)	coefficient of explanation	Parameter
None directional	Meaningful	0.7042	0.4959	CL
None directional	Meaningless	0.8128	0.667	EC

Table 4

Relationship between qualitative factors of ground water

type of solidarity	percent of error %5	percent of error %1	coefficient of solidarity (r)	coefficient of explanation	parameter
codirectional	meaningful	meaningful	0.9282	0.8617	EC, CL

Discussion. Generally the lowest quality of drinking water and agricultural use in parameters saltiness and CL is about the central regions (the North of Kavir Mayghan) and also the eastern part of the basin which is intensifying toward the north of plain, but the quality of water is getting better to high quality in the west and the southern parts of the study area.

The result of this study shows that based on Wilcox's classification method the rate of EC is 70.36 percent of the plain is identifies in class C_3 and C_4 and 12.13 of the area is in class 5 but only 17.51 percent from the plain is classified with a low saltiness to moderate saltiness which is predicted to reduced the agricultural production of the study area. The amount of EC with the rate of 1267.539 micro mouse/centimetre was increased during 1985-2005, which had an annual increasing trend of 60.788 micro mouse/centimetre during this period.

According to Schoeller classification that was investigated on CL of drinking water, it was determined that recently some about 57.9 percent of the plain has a good quality of drinking water and 23.17 percent from the surface of plain is in class 2 which has an acceptable quality of water.

The results extracted from statistical analysis of the quality and quantity of ground water of Arak plain is clarified that there is a meaningful relationship between

the absolute altitude of the ground water level and qualitative amounts such as EC and CL, which shows that by declination of ground water the electrical conductivity is increasing. The high statistical relation between CL and EC (r=0.92) is indicated that declination of groundwater is causing increasing of EC and it can be added the rate of CL in water quality as well.

Investigation of the unit hydrograph of the plain and also the trend of groundwater extraction shows that despite of the climatic conditions of Mayghan basin in semi-arid and arid area and also the recently drought which have reduced the level of water in basin, a large amount of the declination of water is affecting from human factors. The reasons such as unlimited extraction of water, low agricultural efficiency of traditional irrigation, lack of the performance of modern irrigation, lack of controlling and management in water resources, lack of any plan for the ground water recharging and etc, all together were caused a yearly declination about 0.439 meter and totally 8.78 meter declination of the ground water level during 20 recent years.

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ECONOMIC-MATHEMATICAL MODELLING IN OIL REFINING

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The peculiarity of the majority of technological objects of oil refining is their big complexity and participation of a person in a contour of their management. Complexity is shown in significant number and variety of parameters of the objects determining the current of various processes, in a great number of internal connections between parameters, in their mutual influence, in an insufficient level of study of properties of objects and processes proceeding in them, and also in non-formalizable actions of the person (the operator, the technologist, the industrial personnel), being frequently subjective.

Under these conditions while researching technological installations of oil refining with the purpose of construction of their mathematical models there is a problem of uncertainty as the initial information which is possibly collected for the mathematical description of researched installation, frequently appears to be substantially incomplete and indistinct. Besides, usually technological objects are quantitatively difficult describe as the special means of gathering and processing of necessary statistical data in industrial conditions are insufficient, have no necessary properties or are absent.

For example, technological installation consists of several units which are interconnected among themselves on material, thermal, power and information streams, and the change of parameters of one of them results in change of parameters of others which influences the quantity and quality of the received products. In this connection, for research and management of technological installations it is necessary to have connected mathematical models (a package of models) of separate units of installation considering the influence of parameters of a complex on each subsystem, on intermediate and final parameters of manufacture, on work of a technological complex as a whole.

Models of each unit of technological installation, depending on complexity of the accessible data can be constructed with application of various approaches (theoretical, experimentally - statistical, on the basis of methods of theories of indistinct sets, the combination), i.e. for each object it is possible to receive a set of models, for example, determinations, statistical, indistinct, combined, which are characterized by various opportunities, properties and expenses for development. For work modelling system of an industrial complex it is necessary to create models, i.e. to choose and construct one of the possible types of model and each object of system considering subsequent opportunity of association into unified system of models. The analysis of merits and demerits of each type of object is made for this purpose by an expert estimation, criteria of comparison and a choice of models are developed, principles of their association are determined.

As criteria of comparison of various types of models on which they are estimated, it is possible to choose the following: availability of the necessary

information; an opportunity of application to as prescribed, for example, in systems of decision-making; expenses for development; accuracy; simplicity in operation, etc.

Association of models of separate units of installation in a package is made according to structure of technological installation. Thus outputs of one model (results of calculation) are outputs {exits} (the initial data) of another. When models are polytypic problems can arise of transformation of the interconnected inputs and outputs to one kind. Thus, while selecting types of models of objects of a technological complex, except for the criteria considered above, it is necessary to take into account an opportunity of their joining and association in a uniformed package.

It is possible to deduce the following stages of procedure of construction of a package of models of a technological complex from the above mentioned reasons.

1. Studying of technological installation structure and revealing of key parameters determining a condition of an object and connection between them;
2. Gathering of the accessible information (theoretical data, the experimental-statistical data, qualitative information), characterizes key parameters of an object;
3. On the basis of the collected information definition of a set of models which can be constructed for each object of a complex;
4. Development of criteria and selection of models;
5. The analysis of the revealed models and selection of model for each technological unit;

Application of mathematical methods in economy has an old tradition. Actual problems of economy and need for the rational organization of economic activities always were basic points of mathematical researches in economic area of appendices.

Traditions and a subject of mathematical economy are formed under the influence of internal requirements of the economic theory and demands of economic policy. The subject of researches became the ways of measurement of the aggregated parameters of a condition of economy (economic indexes) and the models representing the systems of mathematical relations between these parameters. There were two types of models in the center: models of balance and models of growth investigated more deeply and thoroughly. The most important result of theories of balance was the discovery of deep interrelation between the tasks of market balance and distribution of resources. It turned out that , any task of resources distribution may be formulated as a task of balance, and under some conditions as a task of resources distribution.

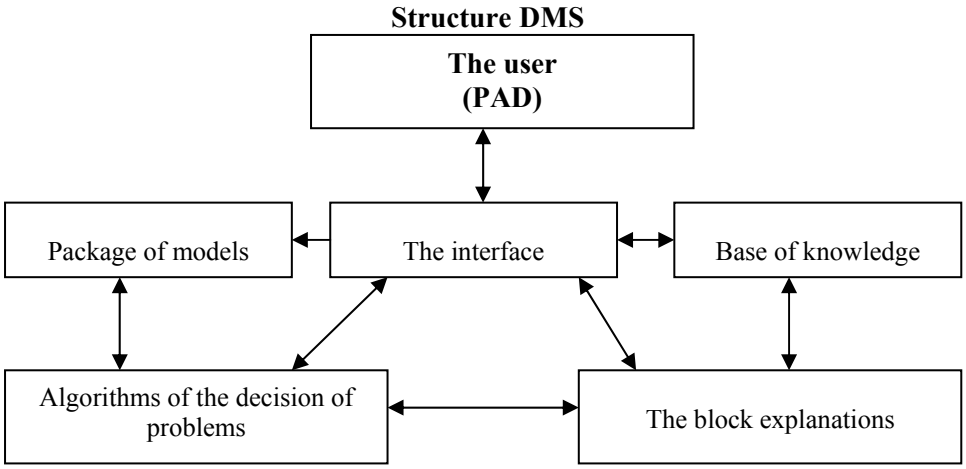
Models of economic growth describe the processes of manufacture, distribution and consumption on characteristic times during which tastes and preferences of consumers and also technologies aren't changed, but the volume of demand grows and new capacities are created.

The extensive section of mathematical economy forms the so-called microeconomic analysis; it is connected with the research of operations - a science about principles of decision-making in complex situations. The macroeconomic can be named as a theory of rational behavior of economic objects.

By the analysis and revision of theoretical and practical results of researches by the example of installation of slowed down coking of Atyrau oil refining factory the structure of information system for support of decision-making with basic components of the package models of technological installation, a database and

knowledge, a complex of algorithms of optimization and "Intellectual" interface of the user is offered.

For management of oil-and-gas manufactures objects, it is possible to present such structure of decision-making system (DMS) as shown below:



Functional purposes of the basic components DMS.

The user - (the person accepting the decision), chooses an operating mode of an object (variant of the decision), providing desirable points of criteria, basically, economic and ecological. The choice of the decision is carried out depending on a developed situation on manufacture (for example, from the plan of release, structure of initial raw material, requirements and quality of production, ecological safety, etc.), in view of importance of local criteria and the imposed restrictions. For the decision of this problem it is used the package of models of an object, algorithms of the decision of problem of mathematical forecasting and if necessary base of knowledge and the data, the block of an explanation of the decision, etc. The Block a package of models contains various models, separate elements of industrial system incorporated into a uniform package, allowing modeling of work of objects as a whole.

The interface is intended for maintenance of a convenient dialogue operating mode of the user with system at management of object, and also at realization of some other functions DMS.

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ЭКОНОМИКО-МАТЕМАТИЧЕСКОЕ МОДЕЛИРОВАНИЕ В НЕФТЕПЕРЕРАБОТКЕ

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Модели каждого агрегата технологической установки в нефтепереработке в зависимости от их сложности могут быть построены с применением различных подходов. Поэтому для каждого объекта можно получить набор моделей, одной из которых является предлагаемая структура моделирования.

THE PECULIARITIES OF THE REGULATION OF THE FUNCTIONING PROCESSES OF ANTROPOGENIC LANDSCAPES OF THE AZERBAIJAN

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In various natural landscapes of Azerbaijan creating of systematic regulation of the agro-irrigational, cultivated-plantational and dry-farming-agricultural landscapes have a tremendous significance. Many questions of the appropriateness of the formation, functioning, regulation of the anthropogenic landscapes in various regions of Azerbaijan have already been practically learned. It mainly concerns to the irrigational regions of the republic, where in most areas land-reclamation situation is unfavourable, without which it is impossible a rational planning of the formation of various anthropogenic landscapes.

The functioning of the anthropogenic landscapes are prolonged ones and are very complicated process covering great complex of concerted measures, the same time land-reclamation, engineering, agrotechnical, forestry, ecological, sanitary-hygienic and the others.

As a result of the hymus analysis, mechanical composition, water-physical and chemical property of different soils, and as well as the subsoil and the river waters of Kur-Araz, Samur-Davachy, Lankaran, Gusar-sloping plains eastablished main tendencies of the formation and development of the agroirrigational, dry-farming-agricultural, selitab-cultivated landscapes and their connection with surroundings practically, unchanged landscapes. With this purpose we compiled some large-scaled landscape maps with the purpose of anthropogenic loads, where singled out 132 variations of the different level of course. When singling out separate units of landscapes we took into consideration some complex ecological conditions in particular a granularmetric compositions and the phylrational ability of soils, the level and the degree of mineralization of subsoil waters, capacity of agroirrigational pumps, artificial separation of the surface, character of the cultivated crops. Singled out by us the little units allow us precisely estimate the ecological condition of the concrete territories, and as well as gives us a chance to determine natural potential of the anthropogenizing geosystem of a separate regions of Azerbaijan.

The qualitative and the quantitative data of various landscapes division thoroughly attract not only the ecological differentiations of territories, but the economical possibility of concrete PTK, i.e. functioning of the landscapes without which in the whole it is impossible rationally organizing and specializing of the farmer economy, carrying out the land-reclamation measures, planning of concrete areas, determining of the amount of used mineral and organic fertilizers, choosing of the cultivated crops etc. As a result of field or laboratory researches it was established that for creating of the ecologically steady landscapes in a highly developing regions of Azerbaijan it is necessary to establish anthropogenic load, i.e. the degree of the anthropogeny of the concrete regions and as well as the separate morphologo-typological units of the natural landscapes. Establishing of coefficient of the anthropologenity of (K3) natural landscapes have a great significance for defining the positive and negative consequences for defining of changings happened to be in PTK.

The researches show that the anthropogenization (Ka) of separate kinds, subkinds and the species of Kur-Araz landscapes of the lowlands and the other plains of Azerbaijan in connection with the developing of new territories is always increasing.

In the irrigating oases and in the seliteb landscape areas of the south-west and the south-eastern parts of the Mughan plains of the north and the north-western parts of Shirvan plains K_a is going up to the 0, 86-0, 91. But the average index of K_a on separate types of landscapes never goes up more than 0, 80. In central parts of Mughan and Mil and the eastern part of Shirvan plain in coastal zones of the Caspian Sea K_a makes not more than 0, 01-0, 10. In general K_a in more than 50% of species of landscapes of Kur-Araz lowlands, Gusar slope plains, Lankaran plain goes up than 0, 80, but approximately in 20% below than 0, 10 (Gobustan, South-Eastern Shirvan, Ajinohur-Jeyranchel).

In the strongly-anthropogenized complexes is usually forming and functioning some stable and rich agro-landscapes. In Garapagh, Mil, Mughan and the Shirvan plains dry-desert, bearded, cereals, ephemeral, mortley grass complexes under the influence of irrigation and phytomelioration get some hydromorphic signs.

In the old-irrigational areas of conic and in inter-conic decreases the rivers of Turyanchay, Geychay, Girdmanchay, Tartarchay, Khachinchay, Garachay instead of the light-chestnut, grey-lands, grey-land-meadow and the other soils are functioning some cultivated-hydromorphic soils. In agro-landscapes together with the single-species of agrosenoses grow secondary negophile and the holophite association, but clover gets occurring everywhere progress.

At the irrigated massifs, mostly in non-sewage lowerings and the hollows, where the mirror of subsoil waters are near the surface (more than 1,5 m.) and have a weak outlow, occurs noticeable remoistening, saltering, saltgathering, that in the end of all increases hydromorphization of the agro-landscape, but on the naturally drained areas, mostly on foot-hill slopes of plains, where the soil has a high filtrating ability are forming stable agrolandscapes with a powerful agro-irrigational horizons.

On the areas of Kur-Araz plains sharply changes the land-improvement conditions from west to east: intensifing the irrigationing of landscapes on the semi-desert landscapes of the Shirvan plains in this very direction the coefficient of the anthropogenization is decreasing from 0, 53-0, 65 to 0, 17-0, 33, but in Mugham-Salyan massifs from 0, 77-0, 86 to 0, 01-0, 03.

Cutting down of the Tugay forests brings to worsening of soil draining, and appearing of the secondary brushwoods of reed mace, rush, tamarisk and the others. On the deserted areas of pre-Kur stripe from Karpikand up to the town of Shirvan as a result of the changing of radiation balance and the direction of soilforming processes could be formed wormwood, elm and ephemeral complexes. For future preservation of the relative balance in the structure of pre-Kur Tugay forests it is necessary decreasing of anthropogenic loads to the concrete PTK and increase forest-rehabilitating and forestguiding measures of course.

Allround analysis of modern irrigated landscapes of Azerbaijan shows that in unstable intrazone, meadow-swamp, wood-shrub complexes, and as well as on a semi-desert and dry-step less-productive pastures and the ploughed-fields within the contemporary economic usage can be noticed decreasing of natural potentials and worsening of PTK structures, which manifested in the formation of numerous small-

contour modifications of landscapes of the anthropogenic origin. That is why the anthropogenic transformations of the local kinds have to be promoted to the creation of the optimum control of the natural-economic systems.

The analysis of landscape land-reclamation conditions of the irrigated regions of the Kur-Araz lowlands show that the land-reclamation conditions here are extremely unfavourable and stipulated rather large areas of the saline soils of the heavy mechanical structure with a low filtrated properties. To the anthropogenic factors worsening land-reclamating situation concerns some dissatisfied status of the irrigation sets, displanned irrigation areas, excessive extent of none-revetting canals etc.

As a result of the analysis of some experienced data the condition of heat and moisture-providing, the character of surface flowing, chemical composition of underground waters, lithological composition, filtrating property and salinization of the soil, mineralization and the depth of bedding of the subsoil waters, peculiarity of the economic usage were copiled some large-scale maps of optimisationing of the Kur-Araz landscape lowlands.

There were given some recommendations on the preventing of undesirable hydro-reclamation measures, phyto-reclamation, protecting of valuable complexes, and increasing of efficiency of the agrolandscape usage etc.

On the irrigated regions of Azerbaijan, mostly on the Kur-Araz lowlands stable agro-physical property of a soil and a high fertility can be met in the areas under the perennial plantations, mostly orchards. It can be plained by the marked accumulations with some organic substances in them, by some powerful development of miomass. Especially in most foothills inclined deserts, in naturally drained areas where the soil has a rather high filtrating ability is formed peculiar agro-irrigating horizon. The thickness of this horizon is determined not only by the natural-economic conditions, but by the remoteness of the irrigation of course. The research shows that on the basic agro-landscapes of Mughan, Mil, Shirvan and the Garabagh deserts the most favourable conditions in the formation and development of the ecologically stable agro-complexes created non-saline soils (th level of subsoil waters 1,5 mm) within the content of water-tight macro-agregates (more 0, 255 mm) about 60-80%, micro-agregates (less than 0, 25mm) about 30-40% within the moisture-holding capacity (from maximum molecular to the field) about 1,0-1,5gr/sm^3. In irrigated conditions with the aim of bettering and regulating of agrophysical properties of the soil and as well as increasing of efficiency of melioration of the saline and brachish soil of the heavy mechanical copmosition it is necessary to increase water-proof of the soil, ability of the collection and preserving of soil moisture by means of cultivating saline areas during their physical maturity and washing of saline areas, crease the system of field-protecting forestry zones and use soil-plaughing, to regulate applying of mineral and the chemical fertilizers, widely distributing of anti-erosive measures and chemical melioration directed against the work with the process of salinization of soil.

At present, the less productivity of the semi-desertous, dry-desert, xero-phytic-shrub of pasture can not provide the requirements of modern distant cattle-breeding. In connection with sharp drop of productivity of valuable fodder crops and growth of the amount of weed and the poisonous vegetation on winter pastures of Shirvan, Mughan, Mil plains, Ajinohur-Jeyranchel low-hills appear urgent necessity in

creating of complex meliorating measures (harrowing, sowing of valuable fodder plants, exterminating of weed and poisinous crops, cleaning of stones etc.).

On a seriously salined pastures of Shirvan, Mughan, Mil plains, and as well as on south-east of Shirvan the productivity of grassland is about 1,2 c/ha and less. By way of creating drainage systems and carrying out washing of 20-25000 c/ha seriously salined pastures probably needed to increase productivity in 2-3 times. At the expense of the impovement of the swamped areas in Mughan, Salyan, Shirvan and Mil plains it is necessarily needed to expand the territory of the existing low meadow and the meadow pastures up to 35-40 thousand ha, but the productivity in future can grow for 10-15c/ha and more. It would of course be advisably to expand cattle-breeding economy, mainly, horned-cattle of course. Within the Kur-Araz lowlands by the degree of the anthropogose of concrete territories there were distributed separate categories of landscapes, which accurately differ from each other by functioning and the modern amount of economic load.

The poorly untapped categories of landscapes.

Within the Kur long-maned plains, falls and western central Mughan, northern and eastern parts of South-Eastern Shirvan at the cones of great river drifts and in the interconic falls of the Shirvan plains etc. (Budagov, Garibov, 1980). This category of landscapes is about 10% of all the territories of the lowlands. At present, they are developing at a natural regime and weakly ruled out by a man. In most cases anthropogenic influence performs here some episodical character (cutting woods, shrubs, posturing of a cattle and etc.). Within this category on the degree of violation can be distinguuuuished some group and the variation.

Irregularly used naturally-anthropogenic categories of landscapes - cover weak indented, strong indented, washed away, degraded, wormwood, wormwood ephemeral, kengiz, differently-grass-ephemeral, and the other pastures of Mughan, Mil, Shirvan and Garabagh plains (Garibov, 1986). They cover more than 30% of all the territories of the lowlands. These complexes rather well preserve their natural structure. Anthropogenic influences are considerably less and they might be limited by an irregular posture usage. In connection with the development of the distant cattle in most cases some anthropogenic influence bears the seasonal character. In winter and the spring periods these complexes run maximum anthropogenic loads, but in summer periods anthropogenic influences (cattle posture) are approximately stopped.

To the intensively used (transformed) landscapes - belong to dry-farming land of agricultural, agroirrigational cultivated-plantational and the other complexes. They widely explanded along the river of Kur, Araz, Akusha, Geychay, Turyanchay, Tartar and the others, and as well as along the huge canals of (Upper-Shirvan, Upper-Garabagh, Azizbayov, Central Mughan and the others). In the irrigated conditional landscapes mostly depends on the degree of the artificial moistening. Just, this factor is determining main tendencies of the evaluation of oasis landscapes.

For recent 25 years the territory of the intensively used landscapes of Kur-Araz lowlands increase in 2,5 times, accordingly the territory irregularly used landscapes was considerebly diminished. Thanks to the favourable conditins and rich soils these categories long ago developed new lands, which bring to the strong anthropogenic-natural dry-desert, semi-desert and low-meadow swampy landscapes. The coefficient of the anthropogenity (K_3) of separate kinds of landscapes is about 0, 8-0, 9 (Garibov, 1986).

The regularly used agrolandscapes from the moment of their formation change into the functioning system and are under the regular influences of a man. Annual ploughing up, rooting out, irrigation, putting in the organic and the mineral fertilizers hay-mowing of the agricultural plants and the others renovate the artificial phitocenoses, appear a powerful agro-irrigational horizone (0, 5-1, 5m), and as well as a number of undesirable processes, as the irrigational erosion, secondary salinity and swamping (Garibov, Ismayilova, 2007).

In an unfavourable land-reclamating conditions of the Kur-Araz lowlands under the influences of the drainage, washing, irrigation, and as well as the road-communicational, town-planning works within the intensively used agro-landscapes are formed some secondary naturally-anthropogenic landscapes. On morphologo-typological symbols it reminds some primary dominant landscapes, existing here up to the openiing (secondary swamping, meadow swamping, saline land and etc.). In irrigated oasises of Shirvan, Mughan and Mil plains the ares of their distribution never exceed 30-50 ha and continually are under the control of a man. In connection with corrying out some land-reclamation measures they often change their own areas. In drained (mostly open) areas these complexes most completely disappeared.

In a high-anthropogenized (K_a, 0, 80) dry-desert, arid-rare-wood, forestry-shrub, semi-desert landscapes of foot-hills, low-lying, low-mountainous regions of Azerbaijan under the influence of irrigation, ploughing up, and the phyto-land-reclamating are formed various variations of agrotechnogenic provenance. The development of natural elements of landscapes more or less continue only in a narrow pre-canal and the pre-river stripes. Here on a wavy, hilly-ridge, strongly-dismembered plains of the chestnut, greyland, meadow, greyland-meadow, grey-brown and other soils accept hydro-morphic signs and are formed some powerful agro-irrigational horizones.

It was established that changing of regime and the character of subsoil waters in adjacent agro-landscapes of Mil, Mughan and the Shirvan plains increases the transformation of natural landscapes. On the ancient irrigational parts of cones of carryings out and the intercone lowerings the rivers of Turyanchay, the Geychay, the Girdmanchay, Tartar, Aghsuh, Kendelenchay and the others artificial moistering of soil strengthening the hydromorphization of landscapes. On the places of greysoil, greysoil-meadows, light-brownish, greysoil-brown and other soils is formed cultural-hydromorphic soils togethe with the singletype agro-coenosis are developing the secondary weed plants consisting of negophile and the halophile association of course.

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AZƏRBAYCANIN ANTROPOGEN LANDŞAFTLARINDA FUNKSİONAL PROSESLƏRİN TƏNZİMLƏNMƏSİ

Y.Ə. Qəribov

Məqalədə Azərbaycan Respublikasının kəskin mənimsənilmiş düzən regionlarının aqrolandşaftlarında funksional proseslərin tənzimlənməsindən bəhs edilir.

Antropogenləşmə xüsusiyyətlərindən asılı olaraq landşaftların və onların funksional proseslərinin sistemli idarə olunması yolları müəyyən edilmiş, təsərrüfat yüklərinin həcminə əsasən müasir landşaftların 5 kateqoriyası ayrılmışdır: praktiki olaraq tənzimləyən, qeyri-müntəzəm təmzinlənən, təmzinlənən, əsaslı transformasiya olunan və texnogen tənzimlənən.

SOCIO-ECONOMIC AND ENVIRONMENTAL PROBLEMS OF THE CASPIAN SEA ON THE AZERBAIJANI SECTOR

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Abstract. *Seashore areas of the Caspian Sea have been suitable for settlement and industrial activities of the people since the ancient times. In this connection, the article covers socio-economic and ecological problems of Azerbaijani sector of the Caspian Sea.*

Seashore areas of the Caspian Sea have developed more in comparison with other regions of the Republic of Azerbaijan. The population of the seashore areas makes 3/1 of the whole population of the country. Besides, 95% of the domestic industry is located in the costal areas. These factors influence environmental condition, social life and industrial activities of the population of the country.

The Caspian Sea has no natural connection with the World Ocean, and by the geographical definition it is calleda lake. The Caspian Sea is the biggest internal reservoir in the world containing 44% of lake water on the terrestrial globe. However, on the size, character of fauna and hydrometeorological mode the Caspian Sea is more like a sea. The area of the drained basin of the Caspian Sea is 3,6 million square kilometers, water level is approximately −28 meters below the norm of the World Ocean, and its area is 392600 square kilometers (the fluctuation range makes from 10 to 20%, depending on the sea level; therefore, the data on the surface area varies in different sources), the water is salty, from 0,05‰ (per mille) near the mouth of the Volga River till 11-13‰ in the southeast. The total length of the coastal line of the Caspian Sea makes 5778 km.

More than 130 rivers flow into the Caspian Sea through the territories of Azerbaijan, Armenia, Georgia, Kazakhstan, Iran, Russian Federation, Turkmenistan and Turkey, basically from the north and the west and no river runs out.

There are five states around the Caspian Sea: Azerbaijan, Iran, Kazakhstan, Russian Federation and Turkmenistan.

The socio-economic problems of the Caspian Sea basically depend on two factors: local population living in the coastal zone and its water level varying as a result of changes.

At present, more than 12 million people live in the coastal regions of the Caspian Sea. Basically cities are concentrated in the western and southern coasts.

The basic economic activities of the people in the Caspian basin include fishing and agriculture, oil and gas industry and the secondary branches connected with them. Besides, the Caspian Sea has a rich potential for creation of intercontinental transport corridors and ecotourism.

The economic activities of the people have considerable impact on the level of the Caspian Sea; such activity reduces the quantity of flows of the rivers into the sea and the evaporation volume from its surface. Anthropogenic influence on flows of the

rivers into the Caspian Sea basin was observed for 1940-1990 which is characterized by the directed reduction of the sea level and considerable influence on the river flows.

Table 1

Demographic Characteristics of the Caspian Sea Countries

	Population mln. people	**Area square km**	**Population density per square km**	**Coastal line length of the Caspian Sea, km**
Azerbaijan Republic	8,26	86600	92,2	825
Islamic Republic of Iran	69	1648000	38,8	738
Kazakhstan Republic	15,1	2717300	5,6	2320
Russian Federation	143,8	17075400	8,7	695
Turkmenistan Republic	6,55	491200	13,3	1200

Source: Statistical collections of the five Caspian Sea countries.

The below mentioned factors could be mentioned as the anthropogenic influence on the environment of the Caspian Sea: water storage basin; ponds; irrigated areas; illegal fishing; oil and oil product leakage.

Sudden increase in the sea level since 1978 caused the change of the coastal territories and nature management conditions, led to the breach of infrastructural connections and as a whole caused considerable economic damage to the economy. Increase in the level of the Caspian Sea in 1978-1996 is not an extraordinary phenomenon and occurred within the limits of the water level fluctuation observed throughout more than last hundred years.

In general, influence of sea level fluctuations is rather difficult and various on the economy of a person living in a coastal zone. Any changes in the sea level, whether being increase or decrease, are negative from the economic or ecological point of view.

1. Level Increase in the Caspian Sea will be negatively reflected in oil extraction and transportation, in sea transport, coastal communications and other branches of the economy. Increase of level to higher point would have even more essential impact and, probably, it would require considerably big expenses for the economy adaptation to it, and maybe, wider, combined technical and economic decisions.

As a result of level increase to 2,5 m. in 1978-1995 a critical situation developed in the coastal zone of the Azerbaijan Republic. As a result of the last transgression agriculture, oil and communal services, transport and many other branches were hugely damaged. A part of the settlements was submerged. Hundreds of families were obliged to leave their homes; there appeared the ecological "refugees". The economic damage caused to Azerbaijan is estimated in 2 billion US dollars; nearly 450 square kilometers areas of the coastal zone were submerged, many industrial, social and housing constructions remained under water.

2. Decrease in the level will also create many adequate economic-environmental problems. Sea bioresources are exposed to special influence, the shelf area that is inhabitation of almost all kinds of sea fauna is reduced.

The scientists established that during the modern change of level of the Caspian Sea there took place statistically significant reduction of the speed module of wind primary in zone directions during the fall-winter period which caused reduction of evaporation intensity in the region took.

Environmental problems of the Caspian Sea and its coast are the consequence of all history of the extensive economic development in the region countries. Heightened interest to hydrocarbon supply of the Caspian Sea, oil production development, population growth in the cities situated in the sea basin, application of new synthetic substances in life, chemicalization of agriculture and industry pollution continuously worsen the ecological situation in the Caspian Sea.

Oil pollution suppresses the development of phytobenthos and phytoplankton of the Caspian Sea basically presented in blue-green and diatomaceous seaweed which reduce oxygen production. Waterfowls have the most obvious influence of oil pollution. In contact with oil feathers lose water-repellent and heat-insulating features that quickly lead to death of birds.

As a result of all these, the ecological condition of the Caspian Sea carries strained, and in some places there is catastrophic character. Certain areas of the Caspian Sea turned to dead zones where there are almost no fish and invertebrates. For example, one of the most polluted areas of the Caspian Sea is the Sumgayit coast. The main reason and source of pollution of the dead zone are industrial and household dumping. It should be noted that the special damage to ecological balance is caused by Volga. Oil makes only 2,5% among all sources of pollution. Experts established that metals, pesticides, radioactive substances, and many other things get into the sea basically via a river flow.

Azerbaijan Republic – two biggest cities – Baku and Sumgayit are situated at the coast of the Caspian Sea. The territory is strongly urbanized; more than 80% of the coastal population lives in the cities. It is the most developed area in the country; the biggest cities, almost all industrial branches, and also the best agricultural territories are concentrated here. In the frameworks of the "Environment Programme of the Caspian Sea" the following was created: the control centre on pollution in Azerbaijan in Baku.

Russian Federation – two biggest cities – Astrakhan and Makhachkala are situated at the coast of the Caspian Sea. The pollution of the Volga River makes 80%, and in place where the Ural River flows it is 7-8%. In the frameworks of the "Environment Programme of the Caspian Sea" the following was created: the centre on studying of bioresources in Russia in Astrakhan.

Kazakhstan Republic – two biggest cities – Atirau and Aktau are situated at the coast of the Caspian Sea. On some oil deposits in the Kazakhstan water area of the Caspian Sea unutilized waste merges from wells into the sea. In the frameworks of the "Environment Programme of the Caspian Sea" the following was created: water level fluctuations is in Kazakhstan in Almaty.

Turkmenistan Republic – Turkmenbashy city is situated at the coast of the Caspian Sea. In the frameworks of the "Environment Programme of the Caspian Sea" the following was created: the centre on struggle against desertification in Turkmenistan in Ashkhabad.

Islamic Republic of Iran – the territory where agriculture prevails and where there are no very big city centers.

We know that the Caspian Sea is one of unique fish farming reservoir. Fishing plays the important role in the economy of coastal zones. About 0,3 million tones of fish are extracted from sea annually; sturgeon has special value among them which extraction makes 85% from their world haul. But it is possible to note two principal causes of reduction of sturgeon run:

- Sharp worsening of ecological conditions in the rivers flowing into the Caspian Sea, first of all the Volga River;
- Poaching, including sea haul.

Biological resources of the Caspian Sea are formed under the influence of natural and anthropogenic factors, as well as sea level fluctuation. Volga River also plays a big role in formation of biological resources of the Caspian Sea which brings 80 % of the general river flows falling into the sea. Its average annual drain makes 215-224 cube kilometers. I would like to note that by means of rivers city sewage, industrial and agricultural pollution get into the sea. Discharges from city economic sewage and industries are rather low and they, most likely, have local character for a certain zone. The main sources of heavy metals, pesticides and other weed and pest-killer chemicals in the Caspian Sea are annual drains of the Volga River, Ural Mountains, Kur River and other small rivers. For clearing the waters in Azerbaijani coastal territory of the Caspian Sea modular water-purifying installations were established meeting the international standards with the clearing capacity of 6140 cube meters of water per day.

At present, “biological pollution” in the form of new invaders is also included into the basic environmental problems in the Caspian region. Let’s note that moving (deliberate or accidental) new kinds of animals and plants can be the most essential and possibly the most irreversible for the Caspian Sea.

In whole, it could be possible to state that the overwhelming majority of invaders does not play a considerable role in the ecology of the Caspian Sea. The exception makes some kinds of bottom dwellers such as the lowest seaweed and invertebrates. Moving of diatomaceous seaweed caused considerable changes in food chains and reduction of many aboriginal kinds which were traditional feedstuff for majority of the lowest crustaceans.

The ecological condition of the Caspian Sea should worry all of the Caspian Sea countries. They should care of this unique reservoir rich with major resources to a possible degree. For not allowing the pollution of the Caspian Sea it is necessary to develop corresponding regulations for all Caspian Sea countries. Only then it is possible to speak about socio-economic and ecological security of the Caspian Sea.

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XƏZƏR DƏNİZİNİN AZƏRBAYCAN SEKTORUNDA MÖVCUD OLAN SOSİAL, İQTİSADİ VƏ EKOLOJİ PROBLEMLƏR

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Xəzər dənizinin sahil əraziləri qədim zamanlardan bəri insanların yaşaması və onların təsərrüfat fəaliyyəti üçün cəlbedici bir məkan olmuşdur. Məhz bu baxımdan təqdim olunan məqalə Xəzər dənizinin Azərbaycan sektorunda mövcud olan sosial, iqtisadi və ekoloji problemlərə həsr olunmuşdur.

Xəzərin sahil əraziləri Azərbaycan Respublikasının digər regionları ilə müqayisədə xeyli inkişaf etmişdir. Sahil zonada ümumi respublika əhalisinin 3/1 hissəsi, sənaye müəssisələrinin isə 95%-i cəmləşmişdir. Bu da onun ekologiyasına və əhalinin sosial həyat və təsərrüfat fəaliyyətinə təsir edir.

THE ESTIMATION OF THE DIETS WITH VARIOUS FAT CONTENTIONS FOR STURGEONS

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Abstract. Fat, treated with food, play a supreme role in the energetic metabolism of fish. Present paper should be considered as relevant, because the rate of administration the fatty acids ω3 and ω6 into the artificial diets for sturgeons was not determinate. The hybrids of sterlet and beluga (*Acipenser ruthenus x Huso huso*) at the age of two years were used as objects of investigations. Observations were carried out in the innovative center of Astrakhan state technical university (ASTU) «Bioaquapark — scientific technical center of aquaculture». In the production diet OT-7 for sturgeons the optimum rate of fat contention is 9%. The increasing of contention of the fat to 15% leads to the decreasing of piscicultural and biological features of breeding sturgeons.

Keywords hybrid· nutrition· fish oil· diet· piscicultural and biological features· hemoglobin· aquaculture.

Introduction. Nutrition is a basis of metabolism and, therefore, it is life of every organism. Matter and energy, coming into the organism as a food, transform in the digestive tract and provide for all the vital functions. The rational fish feeding is a main part of contemporary fish farming. Its role increases during the rising the level of intensification of fishery process (Gamygin et al., 1989). High productivity and rational using of diets is possible in case of supply the objects of fishery with the enough quantity of proteins, fats, carbohydrates, minerals, vitamins, microelements and energy for realization all the vital process (Sklyarov et al., 1984).

The supreme roles in the energetic metabolism play fats, treating with the food. They set free the energy two times more, then proteins during the oxidization and much more, then carbohydrates. Lipids also have high importance for tissue structure. They are the source of irreplaceable acids and constitute the basis of cell membrane in complex with proteins. The efficiency of transmissivity of tissue and its adaptation to various temperatures depend on the lipids (Ostroumova, 2001). Today the level of fats in fish diets increased from 20% to 36% (in the diets rich in energy), approximately (Albrektsen et al., 1988).

It's typical, that in spite of high importance of fats its excess is absolutely impossible (Ponomarev, 1996). The excess of fats leads to decreasing of growth rate and increasing of sturgeon mortality, disorder of several physiological functions, hepatocirrhosis, pathological changes in muscle's structure, kidneys, pancreas, destruction of mitochondrion, watering of tissue and decreasing the level of proteins and fats in body. It is also happens the watering of muscles and internal organs. That is why it is very important to determine the optimal contention of fish oil in the productive diets of sturgeon. Present paper should be considered as relevant, because the rate of administration the fatty acids ω3 and ω6 into the artificial diets for sturgeons was not determinate.

Materials and methods. The two-year hybrids of sterlet x beluga (*Acipenser ruthenus x Huso huso*) were used as objects of investigations. The experimental works were carried out in the innovative center of Astrakhan State Technical University (ASTU) «Bioaquapark — scientific technical center of aquaculture».

The elaboration of diets recepies, balancing of nutrient's composition was realized on basis of known needs of sturgeons and other fishes with the determination the rates of administration of fatty components (Ponomarevs et al., 2002).

The investigations of determination the rates of administration of fish oil into the sturgeon's diets were carried out in the laboratory conditions in tanks (size: 2 x 2 x 0,7 m) of recircular system with controlled parameters of environment.

The water temperature in tanks was 19,5 — 21,5^{0}C, the level of oxygen — 7,8-8,2 mg/l, pH- 7,3-7,5. The stocking density in tanks was established according to the indexes of water (Ponomarev et al., 2002). Fry of 200-250 gr were feeding with the pellets of artificial diets OT-7. The daily feeding rate was determined according to the body weight and water temperature. The number of feeding was 6 times for the fish of 200-250 gr. The tests batches of diets were prepared in the laboratory conditions with the method of dry compressing. The artificial diet — OT-7 was as a basis recipe with the 48% of proteins.

At the first stages of research work all the fish was separated to the test and control groups. During the period of investigations the fish was feeding with productive diet — OT-7 (contention of fats was — 9 and 18, respectively).

Feeding costs were counting with the formula:

$$K_3=C_e/(m_e-m_0),$$

where Ce – the quantity of diet, spending to fish breeding (costs of diet per growth rate unit).

$$C_e=R*m_i*t,$$

where R- daily feeding rate, %; $m_{\text{average initial weight}}$ — average initial weight, gr

The complex of piscicultural, biological, physiological, biochemical methods were used during the estimation of influence the new components on the character of breeding fish (Abrosimova et al., 2005).

Every 10-15 days the control over the growth rate was realized. Weighing and measuring of all the fish were carried out according to Pravdin's recommendation (1966). The daily growth rate was counted with the formula of Castell and Tiews, 1979:

$$A=[(m_e/m_0)^{1/t}-1]*100(\%),$$

where m_e and m_0 - the weight of fish at beginning and end of experiments;
t- duration of experiment, days.

The coefficient of weight accumulation was counted for nice calculation of growth rate (Reznikov et al., 1978; Kupinskiy et al., 1986).

$$K_w=((M_e^{1/3}-M_0^{1/3})*3)/t,$$

where K_w - total productive coefficient of growth rate;
M_e and M_0 — the initial and final weight of the fish, gr;
t- the time of breeding, days.

The absolute growth was counted with the formula:

$$P_{ab}=m_f-m_0,$$

where m_f - final weight of fry, gr
m_0 - initial weight of fry, gr

The average daily growth was counted with the formula:

$$P_{.gr} = (m_f - m_0)/\Delta t,$$

where Δt – the duration of breeding, days.

The indexes of hematocrit were determinate with Shklayr's microcentrifuge during the investigations of fish blood; the contention of hemoglobin was determinate with Sali's hemometr, the number of erythrocytes – with Goryaev's chamber (Yarzhombek et al., 1986). The contention of hemaglobin per one erythrocyte (CHE) was counted with the formula of Gitelzon and Terskov (1956):

CHE=(Hb gr%/n mln erythrocytes в 1 mm^3)*10 mkg/erytr

Determination of hematological indexes was carried out twice, at the beginning and in the end of tests, which is why we made an arbitrary selection of five individuals in every variant.

Results. On the first stage of experimental work it was very important to determinate the effects of fish oil in numbers of 18% (the total contention in ration) on piscicultural and biological indexes of breeding sturgeons. Fish oil contained 20% of saturated fatty acids, 45% of oleic acid (ω9), 25% of fatty acids of ω3 line and 10% of fatty acid of ω6 line. The quality of fish oil (peroxide number – 0,12 units, acid number – 15 units) (fig. 1).

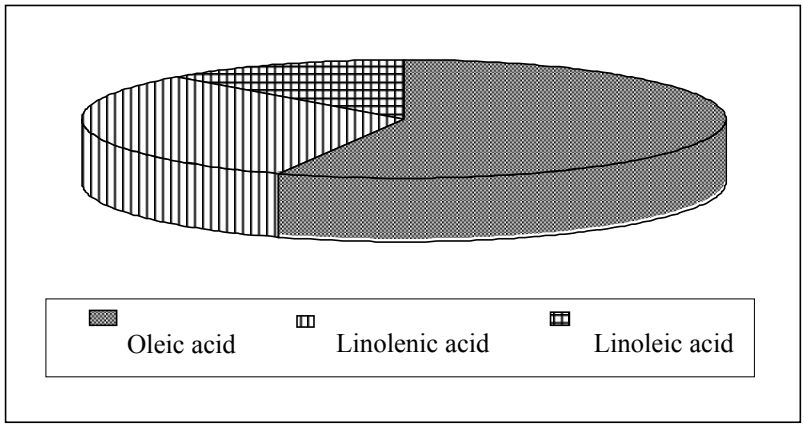

Fig. 1. The composition of unsaturated fatty acids of fish oil, using in diet, % of total amounts

As a result of investigations it was revealed, that increasing the level of fish oil in diets leads to decreasing the piscicultural and biological indexes. The best figures of fry's growth of hybrid were obtained in the test with the contention of fish oil in the diet of 9%. The growth of body weight of fish was on 27 gr more, than in the control group, where the contention of fish oil was 18%.The survival rate in both of variants was 100%. The behavior of fish in the test group was flabby and not active, the low mobility and decreasing of growth rate was registered (tabl.1).

Table 1. Piscicultural and biological indexes of hybrid (sterlet x beluga) breeding with the diets of different amount of fish oil

Indexes	Variants	
	Control (9%)	Test (15%)
Initial weight, gr	243	242
Final weight, gr	288	260
Absolute growth, gr	45	18
Average daily growth, gr	0,5	0,2
Average daily growth rate, %	5,44	4,94
Survival rate, %	100	100
Feeding rate, units	1,1	1,2
Time of breeding, days	30	30

The coefficient of weight accumulation in the control variant with the contention of fish oil - 9% was high and arranged 0,035 units, while in test with the contention of fish oil - 18% this index was 0,008 units (Fig.2).

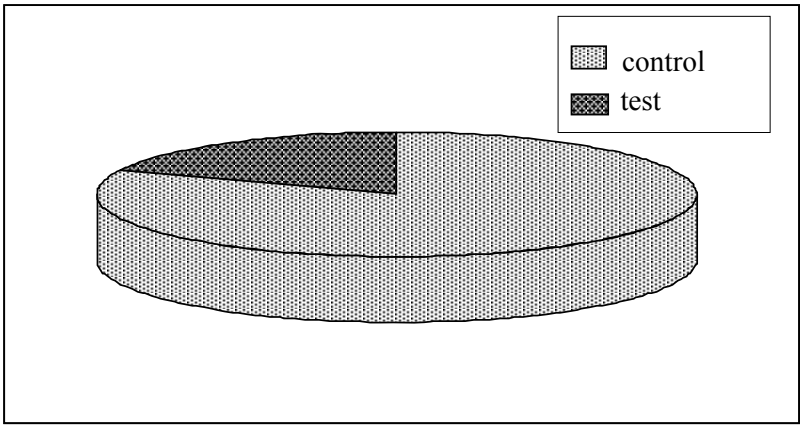

Fig.2. The coefficient of weight accumulation of sturgeon hybrids, breeded with the artifcial diets with different contention of fish oil

As a result of experiments it was revealed that supplement the fish oil into the diet of 18% leads to decreasing the growth rate (fig 3). Possible, it can be connected to excess of fats in the diets for objects of aquaculture. The accumulation of decay products in the liver and its further fatty degeneration takes place. The growth rate of hybrid (Acipenser ruthenus x Huso huso), breeded with productive diet of 9% of fish oil, was equally high during all the experiment. It is confirm the efficiency of this norm of fish oil contention.

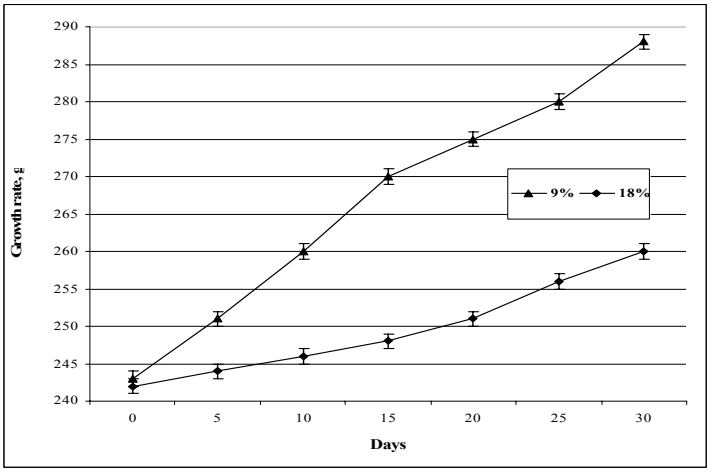

Fig.3. The growth rate of hybrid (Acipenser ruthenus x Huso huso), breeded with productive diet of different contention of fish oil

Under the elaboration of artificial rations, especially for composition the valuable recipes of diets, it is necessary to carry out the control under the fish physiological statement. Thus we can determinate the food value of artificial diets. There are some indexes which determinate the deficiency of diet during the investigation of physiological statement. The most important indices are the indices of blood: the contention of hemoglobin, the number of erythrocytes in the red blood, the protein of blood serum. The hematological estimation showed its reliability, especially during the working out the dry granulated diets. The contention of hemoglobin and erythrocytes is the most significant index.

During the sturgeon hybrids' breeding, using the diets with different contention of fish oil, the blood indices were defined with high concentration of hemoglobin – 78 and 74 g/l in control and test groups respectively. Hematocrit was 28% in test with 9% of fish oil, in control group this index was 24%. The number of erythrocytes was authentically higher than in control. The indices were authentically differ with $P \leq 0,05$; $P \leq 0,001$; $P \leq 0,01$ (tabl. 2).

Table 2

Hematological indices of hybrids (sterlet x beluga), breeding with diets of different contention of fish oil

Indices	**Variants**	
	Control	**Test**
Hemoglobin, g/l	78±0,2	74±0,1
Hematocrit, %	28±0,4	24±0,4*
Erythrocytes, mln/mm^3	0,894±0,002**	0,840±0,005***
Contention of hemoglobin in one erythrocyte, mkmkg/erytr.	6,8	6,2
Protein of blood serum, g %	78±0,2	74±0,1

Commentary: indices were authentically differ with $P \leq 0,05$; $P \leq 0,001$; $P \leq 0,01$

The compositions of fish fry blood describe the physiological statement very clear. Valuable diets improve the structure of blood and total physiological statement. The best indices of blood were usually noticed of fish, getting enough fresh valuable food. On basis of findings we can recommend to provide the contention of fish oil in quantity of 9%. The calculation of contention the irreplaceable fatty acids in such diet showed that these indices close to optimum ((Σ ω3 -2,1 (Σ ω6-0,94% from the mass of diet)), which was determined earlier.

It was revealed, that it is expedient to enter the fat components into productive diets for improvement the biological and piscicultural indices of breeding sturgeon fish. In productive sturgeon diet -OT-7 the optimal rate of fish oil contention is 9%. The increasing the level of fish oil until 18% leads to reducing the biological and piscicultural indices of sturgeons. The best physiological status of fish was also in test diet of 9% of fish oil. It was determined, using the hematological indices.

As a result, the combined analyses of findings let to consider the most favorable contention of fish oil for sturgeon productive diet as 9%.

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ОЦЕНКА ЭФФЕКТИВНОСТИ КОРМОВ РАЗЛИЧНОЙ ЖИРНОСТИ ДЛЯ ОСЕТРОВЫХ РЫБ

С.В.Пономарев, Ю.М.Баканева, Ю.В.Федоровых, Н.В.Болонина, Б.Т.Сариев, А.Н.Туменов

Первостепенную роль в энергетическом обмене рыб играют жиры, поступающие с кормом. Настоящее исследование следует считать актуальным, поскольку норма введения жирных кислот ряда ω3 и ω6 в коммерческие корма для осетровых рыб не установлена. В качестве объектов исследования использовали двухлетков гибрида стерлядь х белуга (Acipenser ruthenus x Huso huso). Экспериментальные работы проводили в инновационном центре Астраханского государственного технического университета (АГТУ) «Биоаквапарк – научно-технический центр аквакультуры». В продукционном комбикорме ОТ-7 для осетровых рыб оптимальная норма содержания рыбьего жира равна 9%. Повышение содержания рыбьего жира до 15% приводит к снижению рыбоводно-биологических показателей выращиваемых осетровых рыб.

GOLD DEPOSITS OF EGYPT AND FEATURES OF THEIR DISTRIBUTION

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Abstract . The gold deposits of Egypt are mostly in the Eastern Desert which is hosted by Precambrian rocks. Within the Eastern Desert the gold mineralization displays high clustering in the central and southern parts rather than the northern part. Eastern Desert of Egypt has been considered the main target for gold exploration and exploitation. The gold deposits can be divided into five groups based on their locations, five major gold bearing formations, and four mineralization episodes. Gold-bearing quartz veins in graphite schist contain more gold than veins in other rocks and the schists themselves are gold bearing. Zones of hydrothermal alteration are also gold-bearing. Main work at several Eastern Desert gold districts is briefly described. All the districts are thought to be worth further work, especially in new directions indicated by recent developments in the geology of gold deposits.

Key words: *Eastern Desert, gold, deposits, underground workings, Egypt metallogenic province*

Introduction. This paper covers the gold deposits of the Eastern Desert which considered as a gold metallogenic province. The Eastern Desert of Egypt is well known as a gold-mining area since ancient times and more than 90 gold deposits and occurrences are spread over the whole area covered by the basement rocks of Precambrian age (Fig. 1). Much information and data on the gold deposits in EGSMA publications and internal reports was used to prepare this paper. Records of mining for gold range back to pre-dynastic times and mining activity continued at different periods. In most mines, the ancient Egyptians extracted gold from quartz veins of various dimensions in open-pits and underground workings. At present, there is no production and activities are concentrated on the evaluation of the old gold mines and tailings.

Fig. 1. Distribution of basement outcrops in Egypt.

According to the mode of occurrence and the nature of mineralization, all the gold deposits and occurrences hosted by the Pan-African Late Proterozoic basement rocks are of the vein and dyke types. The vein type comprises the majority of the gold deposits. Most of the gold in these veins occurs as disseminations of native gold. Relative amounts, however, are found in the gold-bearing pyrites and generally in the sulphide minerals. The ore bodies of the vein type are usually of a more complicated form. They represent fissure fillings (arsenopyrite, pyrrhotite, chalcopyrite and sphalerite) associated with some wall-rock alterations in the contact zone of the host rock units. The distribution of the primary gold deposits and occurrences is structurally controlled fault planes or highly fractured zones (Moharram et al., 1970).

Gold Production. Gold production in Egypt started as early as pre-dynastic times (~ 4000 B.C.) and continued up to the fifth century A.D., from the fifth century A.D up to the 19th Century there were little sporadic gold exploitation from the southern part of the Eastern Desert. The ancient gold mining was confined to the gold-bearing quartz veins without any attention to the associated alteration zones. There are no records of the quantity of gold that had produced during that period. By the beginning of the year 1902 systematic gold production was established marked by documentation of the quantity of the exploited gold (Fig. 2). This period of gold production continued until the year of 1927 with cumulative production of about 2750 kg. of fine gold. Between 1927-1934 the gold production was nearly stopped due to definite technical reasons concerning the depth of the ores, the raising water table in the shafts and poor communications. The period between 1932-1958 represents a new stage of gold exploitation in Egypt (Table 1 and 2), during which a quantity of 4200 kg. of gold was produced from a number of deposits such as Sukari, Umm Ud, Hangaliya, Umm Rus, Barramiya, El Sid, Umm Garaiat, and others. The gold content of the exploited deposits ranges from 11 to 30 gm/t and the total production from 1902 to 1958 was about 7 tons of pure gold. By the end of 1958, gold production was stopped due to nationalization of Naser period, and also due to the lack of technology and capitals for mining investment.

Table 1.

Amounts of total Egyptian annual gold production in kg from 1902 to 1958 (Kochin et al. 1968)

Year	Gold (Kg)	Year	Gold (Kg)	Year	Gold (Kg)	Year	Gold (Kg)
1902	84.125	1917	103.221	1932	--------	1947	64.999
1903	108.29	1918	88.822	1933	--------	1948	119.828
1904	178.825	1919	60.894	1934	--------	1949	219.099
1905	315.292	1920	3.981	1935	1.804	1950	333.516
1906	174.72	1921	--------	1936	8.636	1951	516.217
1907	152.888	1922	7.495	1937	38.129	1952	531.126
1908	57.317	1923	15.052	1938	67.338	1953	449.426
1909	90.19	1924	29.047	1939	120.575	1954	540.736
1910	138.457	1925	11.258	1940	228.798	1955	188.155
1911	157.615	1926	20.433	1941	89.195	1956	239.377
1912	154.194	1927	1.897	1942	54.985	1957	519.659
1913	143.122	1928	--------	1943	27.679	1958	56.384
1914	190.83	1929	--------	1944	32.22		
1915	220.592	1930	18.371	1945	93.735		

1916	195.526	1931	--------	1946	86.862		

Table 2

Some basic descriptive statistics of Egyptian gold production at period (1902-1958)

Variable	Mean	Minimum	Median	Maximum	Sum
Gold (Kg)	147	1.8	98.5	540.7	7350.9

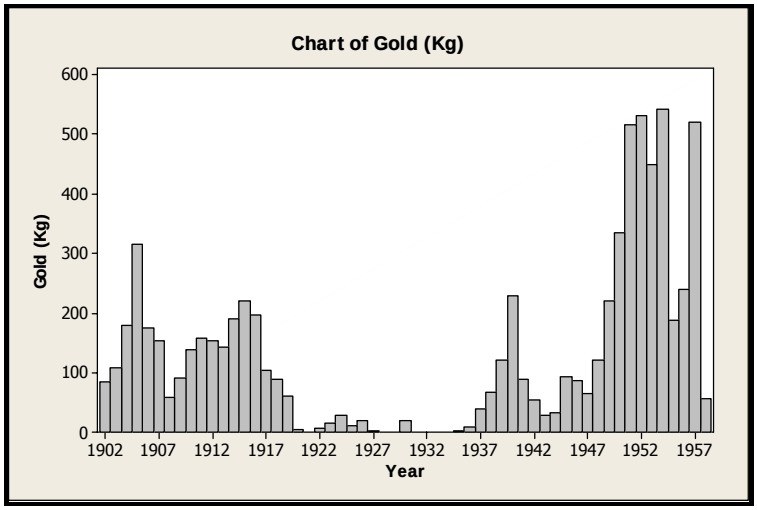

Fig. 2: Bar Chart of the gold annual production at period (1902-1958)

Overview of the basement rocks of eastern desert. The Precambrian basement complex of Egypt comprises about 10% of the total area of the country (cover an area of about 100.000 square kilometers). It is exposed mainly in the Eastern Desert along the Red Sea, and sporadic ones located in the Western Desert at Gebel Oweinat. A considerable part also covers the southern portion of Sinai (Fig. 1). In the Eastern Desert, the basement rocks extend as a belt parallel to the Red Sea coast for a distance of about 800 km. The basement rocks of Sinai, the Eastern and Western Deserts of Egypt in addition to portions located in Sudan, Ethiopia and Somalia are constitute the Nubian Shield that was formed as a contiguous part of the Arabian shield of the Arabian Peninsula before the opening of the Red Sea. It is generally accepted that the basement of the Nubian Shield was cratonized during the Pan-African orogeny around 570 Ma ago (El Gaby et al., 1988).

Geology. The gold deposits are enclosed in the Precambrian basement rocks of various compositions Kochin, et al (1968) including 1- schists, 2- metamorphosed mudstones, greywackes and conglomerates. 3- metavolcanics. 4- different types of granitic rocks. 5- granodiorites, 6- diorites 7- gabbros. 8-various kind of dykes of porphyries, felsites, felsite porphyries and trachytes. 9- the contacts between metamorphic and intrusive rocks. The majority of gold deposits and occurrences however are confined either to intrusive masses of granodiorites and diorites or to schists in the close vicinity of these masses (El Ramly et al. 1970).

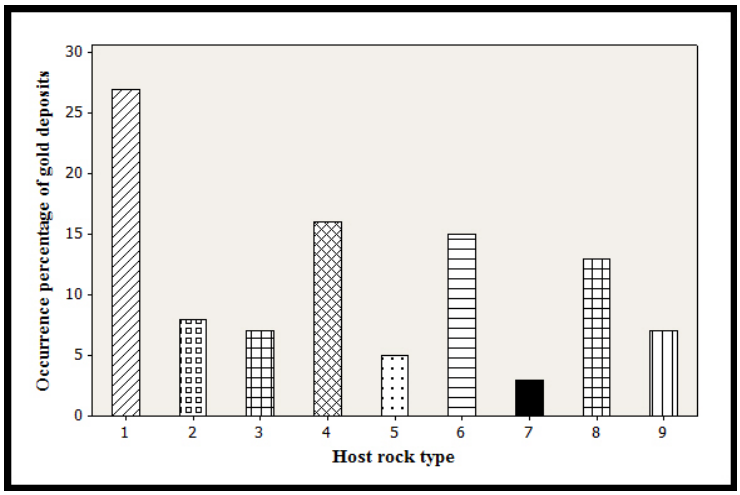

Fig. 3. Bar chart showing the percentage of gold deposits occurrences according to their host rocks.
1-Schists, 2-Metasediments, 3-Metavo1canics, 4-Granites, 5-Granodiorite, 6-Diorite, 7-Gabbro, 8-Various dyke rocks, 9-Contact zones

Spatial Distribution of the Gold Deposits in the Eastern Desert

According to the geologic distributions of these mines through the great part of the Eastern Desert of Egypt, Kochin et al.(1968) and El Ramly et al. (1970) divided most of the Egyptian gold deposits and occurrences into five major groups:1-Northwestern group. 2- Northern group. 3-Central group. 4- Southeastern group. 5-Southwestern group. The gold mines are restricted to the northern and central regions followed by the southwestern ones (Table 3). They also recognized a pattern in the areal distribution of the gold deposits consisting of three northwest trending belts (Fig. 4).

Table 3

Major Groups of Gold Deposits* (See Fig. 4 for location)

Group	**Locations**	**No of localities**
Northwestern group (I)	(1)Umm Mongul, (2)Umm Balad and (3)Wadi Dib	3
Northern group (II)	(4)Fatira, (5)Abu Marawat, (6)Semna, (7)Gabal (8)Semna, (9)Abu Qurahish, (10)Kab Amiri, (11)Sagi, (12)Gidami, (13)Hamama, (14)Erediya, (15)Abu Had, (16)Atalla, (17)El Rabshi, (18)Um Esh, (19)Fawakhir; (20)Hammamat, (21)Umm Had, (22)El Sid, (23)Umm Selimat, (24)Hammuda, (25)El Nur, (26)Kareim, (27)Kab El Abyad, (28)Tarafawi, (29)Sherm El Bahari, and (30)Zeidum;(31)WadiZeidum;	28

Central group (III)	(32)Umm Rus, (33)Sigdit, (34)Talat Gadalla, (35)Abu Mutwaad, (36)Daghbag, (37)El Hisinat, (38)Bokari, (39)UmmSamra, (40)Abu Dabbab, (41)Abu Qaria, (42)Umm Salatit, (43)Bezah, (44)Umm Selim, (45)Barramiya, (46)Dungash, (47)Samut, (48)Umm Hugab, (49)Urf El Fahid, (50)Atud, (51)Sukari, (52)Umm Tundeba, (53)Hangalia, (54)kurdeman, (55)Sabahiya, (56)Umm Ud, (57)Allawi, (58)Lewewi, (59)Dweig, and (60)Hamash	29
Southeastern group (IV)	(66)WadiKhashb; (67)Umm Eliga, (68)Betan, (69)Qurga Rayan, (70)Hutit, and (71)Umm kalib	6
Southwestern group (V)	(74)Hariari, (75)Umm Ashira, (76)Nekib, (77)Haimur, (78)Nile Valley "Block E" , (79)Umm Garaiat, (80)Marahib, (81)Atshani, (82)Murra, (83)Filat, (84)Seiga-1, (85)Seiga-II, (86)Umm Shashoba, (87)Abu Fass, (88)Umm Tuyur; (89)Betam, (90)UmmEgat.	17
Other occurrences	(61)Wadi Geli, (62)Qulan, (63)Kab El Rayan, (64)Sheialik, (65)Abu Rahaya, (72)Kurtunos, (73)El Hudi, (91)Korbiai, and (92)Romit	9

**Source*: Gabra, (1986).

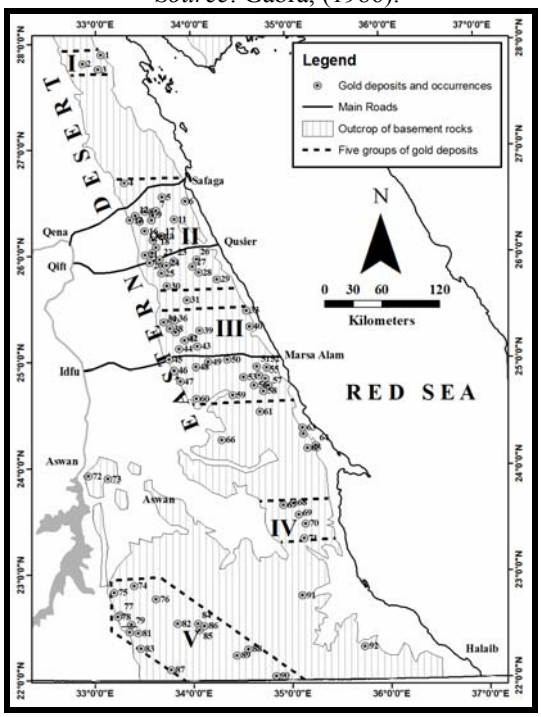

Fig.4. Gold deposits and occurrences in the Eastern Desert of Egypt (compiled from Kochine and Bassuni, 1968) and the. five groups of gold deposits after (Moharram et.al. 1970), (See table 3 for location names).

Gold classification . In Egypt, Kochine and Bassuni (1968) classified gold deposits, according to the mode of occurrence and the nature of mineralization, into three types: dyke-type, vein-type and placer-type. Another two types were recently defined, the gold-sulphide type and the gold-bearing ferruginous quartzite type.

Upon close inspection of this classification, it becomes clear that there is no sharp boundary between dyke-type and vein-type. For example, in dyke-type mineralization of Fatiri area, gold in these dykes is hosted in irregular veinlets of quartz veins traversing the whole mass of the dyke rocks (Botros, 1991).

Sabet and Bordonosov (1984) classified gold deposits in Egypt into three formations namely gold-sulphide formation, skarn gold-ferruginous quartzite formation and gold quartz formation. Although this classification is the first actual attempt at classifying gold deposits in Egypt, it ignores the tectonic setting of host rocks, as well as the source of the mineralizing fluids.

In addition to the auriferous quartz veins that constituted the main target for gold since ancient times, gold is associated with other ore deposit types in Egypt. As a consequence, a new classification of gold deposits of Egypt was proposed by Botros (2004) see Table 4. From this table, it is clear that gold deposits in Egypt according to Botros (2004) are classified into three categories. These are strata-bound deposits, non-strata-bound deposits and placer deposits.

Both strata-bound deposits and non-strata-bound deposits are hosted in igneous and metamorphic rocks and each has its own geological and tectonic environments, time of formation and type of the mineralizing fluids. The strata-bound deposits are hosted in island arc volcanic and volcaniclastic rocks of comparable composition formed in ensimatic island arcs.

They are thought to have formed by exhalative hydrothermal processes during the waning phases of sub-marine volcanic activity. Strata-bound deposits are sub-divided into three main types: gold-bearing Algoma-type Banded Iron Formation, gold-bearing tuffaceous sediments and gold-bearing volcanogenic massive sulphide deposits.

Non strata-bound deposits occur in a wide range of igneous and metamorphic rocks. They were formed during orogenic and post-cratonization periods by mineralizing fluids of different sources. Non-strata-bound deposits are divided into vein type mineralization, which constituted the main target for gold in Egypt since Pharaonic times, and disseminated-type mineralization hosted in hydrothermally altered rocks (alteration zones) which are taken recently into consideration as a new target for gold in Egypt. Placer gold deposits are divided into modern placers and lithified placers. The former are sub-divided into alluvial placers and beach placers. Conglomerates occurring on or near ancient eroded surfaces represent lithified placers.

Table 4

The classification of the different types of gold deposits in Egypt and their tectonic environment according to Botros (2004)

Class	Types of mineralization		Tectonic environment	Remarks
Strata-bound deposits	(A) Gold hosted in Algoma-type BIF		Immature island-arc environment	Syngenetic mineralization
	(B) Gold hosted in tuffaceous sediments		Mature island arc environment	
	(C) Gold hosted in volcanogenic massive sulphide deposits			
Non-stratabound deposits	(A) Vein-type mineralization	(1) Auriferous quartz veins hosted in metamorphic rocks and/or the granitic rocks surrounding them	Continental margin environment	Epigenetic mineralization
		(2) Auriferous quartz veins in sheared ophiolitic ultramafic rocks		
		(3)Auriferous quartz veins associated with porphyry coppe rmineralization		
		(4) Auriferous quartz veins at the contact between younger gabbros and granites	Intra-plate environment	
		(5) Small amounts of the element in quartz veins of Sn–W–Ta–Nb mineralization		
	(B) Disseminated-type mineralization hosted in hydrothermally altered rocks (alteration zones)		Continental margin environment and intra-plate environment	Epigenetic mineralization
Placer deposits	(A) Modern placers	(1) Alluvial gold in wadis and gullies	Intra-plate sedimentation	Uncertain?
		(2) Beach placers		
	(B) Lithified placers			

Generally, The gold mineralization in the Eastern Desert is reflected in the following types:-

1. **Vein type:** Most of the Eastern Desert gold mineralization is confined to gold-

bearing quartz veins of various dimensions and directions. In the most cases gold occurs in a free state within these veins (El Sid gold deposit).

2. **Dyke type:** In few cases the gold mineralization is confined to sheared and hydrothermally altered dykes mostly of felsite porphyry type. The mineralization is confined to gold-bearing quartz veinlets and silicified-pyritized zones scattered through the whole mass of the dyke (Fatiri gold deposit).
3. **Alteration zones type:** Relatively high concentrations of gold occur in alteration zones (Botros, 1993b; Osman and Dardir, 1989) where the mineralization is confined to gold-bearing alteration zones associated with auriferous quartz veins system sited in brittle-ductile shear zones. The gold concentration depends on the nature and intensity of the alteration and type of country rock (Barramiya, Dungash and Samut gold deposits).
4. **Gold -sulphides type:** Gold and silver mineralization was also recorded in association with gossonized polymetallic sulphides mineralization confined to sheared acidic-intermediate metavolcanics (Abu Marawat gold deposit).
5. **Gold-bearing BIF type:** Epigenetic gold mineralization is recorded recently in association with the banded iron formation (BIF) of the central Eastern Desert such as at Abu Marawat (Botros, 1991, 1993b, 1995a) and in the Um Nar area (Dardir and Elshimi, 1992).
6. **Placer type:** Small scale gold mineralization was also detected in some alluvial deposits in the Eastern Desert. It is found scattered in the whole thickness of the alluvial, not concentrated near the bedrocks.

Sabat, et al (1976) also divided the major gold formations in the Eastern Desert as follows.

1. Gold - sulphide formation
2. Gold-bearing ferruginous quartzite formation
3. Gold-quartz vein formation

Episodes of Gold Mineralization. There are different views dealing with the genesis and development stages of gold mineralizations in Egypt. Early researchers related gold mineralization in Egypt to the hydrothermal processes that accompanied the emplacement of the dioritic intrusions of Pre-Cambrian age (Hume, 1937). Amin (1955) and El Shazly (1956-1957) assumed that gold mineralization is of multi-staged nature and it was related to the intrusion of the Gattarian granites. Four episodes of gold mineralization including pre-orogenic, syngenetic to late orogenic, Riphean-Lower Paleozoic and Mesozoic-Cenozoic (Sabet et al 1976). The former author also divided the major gold formations in the Eastern Desert as follows: Gold - sulphide formation, Gold-bearing ferruginous quartzite formation, and Gold-quartz vein formation.

Recent investigations by El Shimi (1996).revealed that the Eastern Desert of Egypt is considered to be a gold metallogenic province since it comprises more than 120 gold deposits and occurrences enclosed in the Precambrian Pan-African basement rocks. There are three major gold mineralization phases were recognized in the Eastern Desert of Egypt. The earlier phase is reflected in gold-bearing quartz veins confined to brittleductile shear zones genetically related to the island arcs accretion tectonics. Auriferous veins are mostly enclosed in volcano-sedimentary sequences of

the accreted terrains. In most cases the mineralized veins are accompanied by gold bearing wall rock alteration zones of alteration pattern comprises silicification, sulphidization and carbonatization. The earlier gold mineralization was attributed to auriferous metamorphic fluids developed in association with the island arcs accretionary tectonics. The earlier gold mineralization phase is mainly concentrated at the southern part of the Eastern Desert of Egypt (e.g. Wadi Allaqi gold district). The mineralization is clearly predating the emplacement of the post- accretion younger granites-gabbros association (El Shimi 1996).

The second gold mineralization phase is reflected in gold-bearing quartz and carbonate veins developed along shear and tensional fractures related to the back arc basin closure tectonics in the central Eastern Desert (e.g. Barramiya-Umm Samra-Dungash – El Sid and W. Karim gold deposits).

The third gold mineralization phase is reflected in gold and copper -bearing quartz veins associated with barite veins and gossanes. The mineralization is confined to shear and tensional fractures system developed in Dokhan volcanics and their granitic equivalents intrusions in the northern part of the Eastern Desert of Egypt. The mineralization may related to the emplacement of younger granitic intrusions and the last E-W continental collision tectonics affected on the area at the end of the Arabo-Nubian Shield crsutal evolution (Umm Balad gold deposit).

Main Occurrences. In the following paragraphs, some of the more important occurrences are briefly described as examples.

1-Um Rus (latitude 27° 28', longitude 34° 34'). At Um Rus, a number of mineralized quartz veins are spread over an area of about 7 km2, where they cut through a granodiorite mass intruded into layered gabbros. The veins are enclosed mainly within the granidiorite, but may extend into the gabbro where they pinch out. The veins generally strike northeast and dip northwest at gentile angles. They vary in thickness but are generally about 40 cm thick, and are formed of massive milky quartz with occasional feldspars and carbonates. They carry minor amounts of pyrite and arsenopyrite. Gold is present in the native form, but about 4% of the total gold content is locked in pyrite (Amin M.S., 1955). The wall rocks to the veins are strongly altered, wherethe feldspar are sericitized and the ferromagnesian minerals are changed into chlorite. Pyrite is disseminated in the vicinity of the veins and is changed into red zones with hematite on alteration. The total assuredreserves are 16,000 tons assaying 11 g/t gold (Amin M.S., 1955).

2-Sukari (latitude 24° 56', longitude 34° 40'). This is an ancient working that was reopend and exploited this century. A gold-bearing quartz vein occupies the contact zone between a granophyre and the enclosing schists. The vein varies from 1 to 4 m in width, dips east (±45°) and extends in a north-south direction for about 500 m. the average grade is reported to be 52 g/t gold and 18 g/t silver (Hume 1973).

3-Samut (latitude 24° 41', longitude 33° 52'). A mineralized quartz vein strikes N-10-E and dips at 80°E. Iextends almost a kilometer and is 0.5 m wide, with frequent horsetaillings, pinches, and swells. The vein cuts across a granodiorite mass intruded into schists and basic volcanics. Propylitization and listwanitization are observed in the near vicinity of the vein and anomalous concentrations of pyrite, arsenopyrite and chalcopyrite are characteristic of the vein and its enclosing rocks.

The vein ws worked to a depth of 60 m but no data as to the grade or reserves are available. The information given by Bugrov (1972) indicates that gold occurs not only in the quartz vein but also in the hydrothermally altered rocks in close vicinity.

4-Hamash (latitude 24° 35', longitude 34° 05'). In the wider rea of Hmash, gold is known in the localities called Hamash, gold is known in the localities called Hamash, Um Hagalig and Um Hamr. The gold-bearing quartz veins strike northeast or east and dip northwest or north. They are a few hundred meters in strike length and 50 to 70 cm thick. The country rocks are granodiorites intruded into metavolcanics. On the surface, the veins carry malachite, azurite and chrysocolla, which grae into chalcopyrite, chalcocite and covellite with increasing depth. Workings went down to a depth of 60 m or more, but no estimate of reserves or grades are available (Moustafa and Hilmy 1959).

5-Atud district (latitude 24° 58', longitude 34° 40'). The deposit area is composed of metamorphic rocks, serpentine, and talc carbonates and some silicious mudstone and schist. These rocks are intruded by gabbro, olivine gabbro, and dykes of various composition. These rocks are cut by quartz veins, some of which are gold-bearing. The auriferous quartz includes pyrite, arsenopyrite, cha1copyrite, and ilmenite, in addition to free gold. The first and second mine levels of the main prospect are in the oxidised zone, wheras the third level contains sulphide minerals. The proven ore reserves are 8600 t averaging 12.68 g/t across an average thickness of 0.8 meter. The probable gold reserves total 13,500 t averaging 17.5 g/T with an average thickness of 0.7 m and total gold content of 240 Kgms.

6-Barramiya district (latitude 25° 05', longitude 33° 47'). The Barramiya District is underlain by tuffogene metasediments intruded by basalt, small bodies of granodiorite and granite-porphyry, all injected by quartz vein and dykes of various composition. The deposit area comprises calcareous and graphitic schist cut by several fractures systems that, in places, form long fracture zones generally conformable to the regional schistosity. The quartz veins are confined to these fracture systems and zones. Most of the veins, especially the auriferous ones, are in graphite schist. Some old reports indicate that the quartz veins, in places, cut diorite or quartz diorite dykes 20 m thick.

The four main Barramiya auriferous quartz veins, composed of grey and dark blue-grey transparent quartz containing finely-dispersed gold, were all extensively worked for many years. They were not completely exhausted and still contain important reserves.

Hydrothermally altered country rocks comprise a more important target with an estimated 16.1 million tons with average gold content of 1.2 g/t and total gold content of 19.5 t. A total of five higher grade mineralized bodies have been distinguished in three mineralized zones related to the Main Lode and comprising mostly graphite schist intercalated with listvenite and talc-carbonate rocks. They total 1,8500 tons of rock containing 3n average of 2.8 g/t for a total of 5.20 tons of gold. Other ore bodies include a tot31 tonnage of 253,000 tons with average gold content of 6.8 g/t gold giving. reserves of 1.74 tons. The tailings volume is bout 54,000 tons in three piles with a mean value of 5.67 g/t.

7-Southern eastern desert . Extensive workings and ruins at Umm Eleiga are in an area underlain by rocks ranging from metagabbro to metadiorite with some gabbro, metavolcanics, and "young granites", all cut by small white quartz veins and

acidic and basic dykes. The old workings cover about 2.5 km2. EGSMA sampled the area in 127 pits. As much as 28 g/t gold was detected in the concentrate from some pits and as much as 36 g/t in some of the wadi alluvium. No gold was detected in the bedrock.

The Hutit Mine (latitude 23° 30', longitude 35° 13'). This area was first worked by the ancients and again during the first decades of this century. Gold occurs in fissures filling quartz veins along shear planes. EGSMA

has performed considerable recent mapping in the area which is underlain by highly sheared acidic and bacic metavolcanic rocks and tuffs intruded by serpentines and gabbros. Surface samples from two veins ranged from 1 to 40 g/t gold. Gold is visible in some samples from the dump.

The Umm Tundeba (latitude 24° 56', longitude 34° 48'). This area is underlain mainly by metavolcanic tuffs intruded by metagabbro, granodiorite, and post-orogenic pink granite. Gold occurs in a milky quartz vein cutting the country rocks and is clearly visible in some dump samples. EGSMA has done detailied mapping and sampling in the area. Analyses showed that the quartz contains as much as 40 g/t gold but the country rock is barren.

Ancient ruins and grind stones are common over the G. El Anbat area. Wadi alluvium seems to have been turned over and panned, and the slopes of the low hills were excavated. The area is underlain by silicic and alkaline metavolcanic rocks intruded by metagabbro-diorite, serpentine and postorogenic pink granites, all intruded by a quartz carbonate dyke. Alteration includes silicification and calcification with abundant limonite but no quartz veins are known. EGSMA'S work has included mapping and geochemical sampling. The range of gold concentration in the country rock is 0.02 to 0.4 g/t and the area deserves more detailed work.

8-wadi allaqi district . The Wadi Allaqi area is southeast of Aswan and includes 12 gold occurrences most of which are near to and north of Wadi Allaqi. Table (5) summarizes the locations and gold occurrences in the area. The deposits are in Precambrian metavolcanic rocks or in placers apparently derived from those rocks. They were mined in dynastic times and a few were mined later.

Table 5

Gold Deposits at Wadi Allaqi Area

No.	Deposit	Latitude (N)	Longitude (E)	Deposit Type
1	Umm Greiyat	22° 24'	33° 23'	Quartz veins
2	Nile Valley Block E	22° 36'	33° 20'	Placer? on alluvial terraces
3	Haimur Gold Mine	22° 28'	33° 18'	Quartz veins
4	Abu Fass Mine	22° 08 '	33° 52'	Quartz veins
5	Atshan	22° 34'	33° 33'	Quartz veins and adjacent alteration zones
6	El Hude Mine	23° 57'	33° 08'	??
7	Filat Mine	22° 18'	33° 37'	Quartz veins
8	Hariari Mine	22° 57'	33° 27'	Alteration Zone
9	Marahik Mine	22° 30'	33° 27'	Quartz veins

10	Wadi Murra	22° 34'	33° 35'	Placer and alteration zones
11	Wadi Nagib	22° 48 '	33° 43'	Placer and alteration zones
12	Umm Ashira Mine	23° 08'	33° I5'	Quartz vein and Placer

Gold Investment in Egypt. Awareness of Egypt's rich gold source dates back to more than 4,000 years when ancient Egyptians made extravagant use of gold for jewelry, temples and tombs. Then gold held such religious and cultural significance that burial chambers became "Houses of Gold".

But over time many of Egypt's gold deposits were abandoned, with many untapped and removed from gold exploration for more than 2,000 years.

Egypt has returned to gold mining after many decades of inactivity. In the last few years, major developments in Egypt opened doors for gold exploration and gold mining and investing and renewed its commercial gold production. Now in 2010, the Egyptian government is aligning itself with foreign gold investors, which will spike Egypt's gold production up to around 300,000 ounces.

Today the country so tied to gold that its people once considered it the skin of their gods, derives only 1% of GDP from its mineral resources. The restructuring is predicted to make mineral resources such as gold approximately 10% to 12% of the gross domestic product.

Egypt's gold reserves soared to 70 million ounces (up from 3 million in 2005) as a result of gold exploration campaigns carried out by three international companies in the geographical areas of Jabal Al-Sokary and Hemsh in the Eastern Desert, one of which is SMW Gold, a subsidary of Pharaonic.

Conclusion. Gold was very highly prized by the ancient Egyptians. More than 90 gold occurrences are known in the country, spared over the Eastern Desert, and most of them were discovered and exploited by ancient Egyptians. According to their geographical location at the Eastern Desert, gold mineralization spreading sites are focused in five main groups. Gold occurrences are. Nevertheless, there are some occurrences where the ore is associated with dikes (mainly felsites).The gold mineralization in the Eastern Desert is reflected in the following types:- Vein type, dyke type, alteration zones type, gold -sulphides type, gold-bearing BIF type, and placer type which in most cases restricted to quartz veins. Eastern Desert of Egypt is considered to be a gold metallogenic province associated with three ajor gold mineralization phases. Recent researches founded that there are three major gold mineralization phases were recognized in the Eastern Desert of Egypt. Nowadays, most gold mines were investigated, re-evaluated by Egyptian Government, foreign and private companies, and many authors, all are interesting in gold exploration and exploitation studies, in a trial to re-open these mines and exploit the gold ore.

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MİSİRİN QIZIL YATAQLARI VƏ ONLARIN YERLƏŞMƏ XÜSUSİYYƏTLƏRİ

V.G.Ramazanov, M.H.Ali

Misirin qızıl yataqları əsasən onun Şərq Səhrasında yerləşib kembriyə qədər yaşlı süxurlarla əlaqədardırlar. Qızıl yataqları səhranın mərkəzi, cənub və qismən də

şimal hissələrində cəmləşiblər. Regionun qızıl yataqları beş əsas filiz formasiyası əmələ gətirərək coğrafi yerləşmə baxımından beş qrupa bölünür. Region üçün qızıl minerallaşmasının beş mərhələsi müəyyənləşdirilib. Qrafitli kristallik şistlərdə yerləşmiş qızıl-kvars damarları digər damar və kristallik şistlərlə müqayisədə qızılla daha zəngindirlər. Qızılın nisbətən yüksək miqdarı həm də hidrotermal dəyişilmiş zonalarda müəyyən edilib. Məqalədə Şərqi Səhranın bir sıra qızıldaşıyıcı filiz rayonlarının qısa təsviri verilir. Müəyyən edilib ki, təsvir edilmiş əksər filiz rayonları yüksək perspektivliyə malik olub gələcək geoloji-kəşfiyyat işləri üçüç əsas obyekt ola bilərlər.

NATURAL HYDROMETEOROLOGICAL PROCESSES IN THE CASPIAN SEA

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Abstract. The article covers the natural hydrometeorological events happening in the Caspian Sea. The article derives advantages from the works of many scientists. Besides, the article includes the damages caused by hydrometeorological events as well.

One of the main tasks of the World economy envisages prognostication of the natural calamities and at least their partial prevention. The main characteristic related to the extreme natural processes is the indeterminateness of their time of occurrence. The natural processes have great influence on people's safety, food and water supply, property, in general, on every aspects of life, and as well as on stable development of society. Extreme natural processes create certain difficulties in making decisions regarding socio-economic development and cause the environmental degradation. Therefore, each developed country in the modern society tries to prevent the socio-economic damage caused by the extreme natural processes and the environmental degradation or decrease the aftermath of natural calamities to minimum by means of establishing its defense conception.

The 90% of the natural calamities is related to the weather, climate and water. The removal of risks of the natural processes and decrease of their consequences are of important issues in every country. The world economy is damaged about by 25-30 billion USD yearly during the natural disasters, and it sometimes results in casualties. The analysis of the historical materials shows that the natural calamities have doubled for the last 15 years. These calamities have resulted in death of nearly 662 thousand people.

Our republic regularly suffers from the natural calamities and on average its economy survives 50-55 million USD each year. One part of this kind of damage relates to the extreme hydrometeorological processes in the Caspian Sea and the ecological contrasts caused by them. For instance, sudden increase of the water-level in the Caspian Sea in 1978-1995s damaged the country's economy by 2 billion USD a lot of allochthonic substances entered the sea and negatively influenced the ecological state of the sea. On October 22nd of 2002, as the result of the "Mercury-22" vessel sinking, 42 members of the personnel and 8 passengers died and a lot of oil flowed into the environment.

The water of the Caspian Sea surrounds the coasts of the Azerbaijan, Kazakhstan, Russia, Turkmenistan Republics and Islamic Republic of Iran. Total area is 390 thousand square kilometers, coastline length – 6380 kilometers, and water volume is 78 thousand cube kilometers. Water shed of the Caspian Sea makes 3.6 billion square kilometers, and the main part of its water balance falls to the share of the rivers (nearly 130 rivers flow into the Caspian Sea). The rivers make the main pollution sources of the Caspian Sea. More than 11 billion square meters slops are spilled into the sea and 10. 2 billion square meters of them fall to the share of the

Volga River, and 0. 7 billion cube meters to share of the Kur River. The rest part falls to the share of the rivers of Kazakhstan and Turkmenistan.

60% of the slops spilled into Azerbaijani sector of the Caspian Sea falls to the share of the waste waters. The southern part of the Absheron peninsula is considered the main pollution source. The main reasons of it are waste waters of Baku city and oil pollutions. More than 60 million cube meters polluting substances accumulated in Baku bay that nearly 40% of it make oil compounds. Here oxygen level fluctuates within 1.8-3.0 mg/l and this factor is below the norm for 3-5 times. The level of phenol (0.2-1.0 g/kg) and mercury (5.0-140 g/kg) is above the norm in the region.

Azerbaijan holds leading part for population (4.6 million people) in the Caspian Sea region among the Caspian Sea countries. The influence of the oil pollution of the sea to the environment, study of the damage to rare fauna and flora caused by the sea, as well as estimation of the probability of the pollution by oil should be carried out regarding the recent intensive offshore oil and gas exploration and production.

Squally winds creating huge waves for the Azerbaijani water area of the Caspian Sea and heavy ice movement from the Northern Caspian are one of the main factors in creation of the risky situation in the sea farming and ecological situation of the sea. From this point of view, during the estimation of the extreme hydrometeorological processes in the Azerbaijani sector of the Caspian Sea, the intensity of the natural calamities happening in the sea, their probability of occurrence, and the sensitiveness of the region to such happenings should be defined.

The main factors defining the extremity and sensitiveness levels for different economic spheres of the hydrometeorological processes creating natural calamities in the Caspian Sea depend on the probability of risk occurrence and influence level of the risk source on different objects. The water-level fluctuation in the Caspian Sea till 1940 hasn't caused considerable ecological problems and the biological resources of the sea lived stable development period from quantity and quality point of view. However, after 1950s the sensitiveness level of the ecological situation of the Caspian Sea and coastal regions changed regarding gradually increasing socio-economic situation in the region. Newly established settlements and huge industrial enterprises in the coastal regions had influence on it.

The stability and intensity of the heavy and squally winds observed in the Azerbaijani sector of the Caspian Sea are much stronger in the northern part than in the southern part. Thus, the winds in the north-west and north direction exceed here and their average annual repetition makes 50%. The heavy and squally winds in the southern coasts are mainly observed by south-east winds and their repetition makes only 1%.

One of the factors influencing the environment and creating natural calamities in the Caspian Sea water area is water-level fluctuation of the sea. The main reason of the water level fluctuation of the sea is the change in its water balance elements. The river flows make 80% of the water balance income and about 85% of it falls to the share of water from the Volga River. Observations show that the river flows are subjected to changes in high intervals on average. The reason of it is the hydrometeorological processes in wide water shed of the sea.

One of the main factors influencing the water level fluctuation are water ebb and flow processes in the coastal regions taking into consideration the wind and pressure. The heavy north and north-west winds define the water flow processes and

south-east winds define the water ebb processes in the Azerbaijani sector of the Caspian Sea. It should be noted that while the rapid cyclones pass over the sea, the linear dependence between the water level of the sea and the pressure is violated.

For the last 100 years, the sharpest water level fluctuations in the Caspian Sea were observed in 1930-1940s and 1969-1976s. As the result of the last increase in water level of the Caspian Sea, the sea port of Baku City, oil industry, treatment, recreation, and health resort economy of the Absheron region, sowing areas, roads, communication lines were damaged at great amount. 80.7 square kilometers territories were submerged as the result of the increase in water level and nearly 90% of it falls to the share of the territories of the Neftchala and Lankaran regions.

The last increase in water level of the Caspian Sea damaged the beaches as well as other spheres at great amount. The beach areas submerged, fine sand of the coastal territories was washed out, majority of the auxiliary buildings here became worthless and possibilities of beach forming infrastructures were limited. As the result of the water level fluctuation, sometimes sand in the appropriate parts of the beaches are washed out and become worthless coastal areas.

Some positive and negative influences were observed following the ecological results of the last sharp water increase period. By the increase in sea water the spawning area of the fish became wider, the oxygen in water increased and water exchange in various parts of the sea intensified. However, as the result of the pollution the fishery faced the threat of loss of its importance. Thus, the Caspian Sea is considered the main sturgeon population and caviar source in the world. 90% of sturgeon, long-nosed fish production and their caviars fall to the share of the Caspian Sea in the world. In general, sturgeon reserves run out in the Caspian Sea. It is impossible to multiply them naturally. 25 thousand tons of sturgeons were fished in 1980 and this indicator reduced to 7 thousand in 1994. At present, the Caspian Sea countries agreed in limiting the fishing of the sturgeons. Fishing quota for Azerbaijan is only 160 tons per pear. The main reason of it is connected with the sturgeon reserves' running out.

By analyzing the above mentioned, the followings are concluded:

– The ecological contrasts in the coastal zones caused during the sharp water level fluctuation in the Caspian Sea should be studied and classified;

– All risks regarding the damage of the coastal economies caused by the various extreme natural processes in the Caspian Sea should be defined and their happening probability should be studied;

– Occurrence possibilities of the squally winds creating dangerous situation for various economical spheres should be defined and the maximum strength of the wind should be noted;

– The estimation of oil pollution sources of the Caspian Sea and ecological risks connected with it should be made.

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XƏZƏR DƏNİZİNDƏ BAŞ VERƏN TƏBİİ HODROMETEOROLOJİ HADİSƏLƏR

K.Zeynalova

Məqalə Xəzər dənizində baş verən təbii hodrometeoroloji hadisələrə həsr olunmuşdur. Məqalədə bir çox alimlərin əsərlərindən istifadə olunmuş və hidrometeoroloji hadisələrin vuruqları zərərlər barədə məlumat verilmişdim.

THE BASIC PATTERNS OF FIELDS DISTRIBUTION FOR LESSER CAUCASUS NOBLEMETAL ORE-MAGMATIC SYSTEMS

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Abstract. Distribution patterns have been defined for deposits of noble metal ore-magmatic systems. It is noteworthy that principle role of structural factor can control both the distribution of gold mineralization and arrangement of endogenic regimes including optimal ones for noble metal mineralization. Especially knots of crossings and conjugations of rupture failures are favorable which ore-bearing structures for gold mineralization are.

On the basis of widespread gold-ore mineralization in Lesser Caucasus on different stratigraphic levels within some ore areas and knots considering earlier research as well the distribution patterns have been defined. Moreover, the perspectives have been evaluated and search criteria for gold-ore deposits have been substantiated by determination of structural-formational zones. It is noteworthy that prior role belongs to criteria and features which are caused by primary factors: stratigraphic-lithological, magmatic, formational material considering an important tectonic factor. Undoubtedly, the basic patterns providing the formation of gold-bearing and gold-ore deposits are transparent oreconcentrating structures and knots of long endogenic activity, time and peculiarities of manifested magmatism and in this case absolute attraction of gold mineralization to some tectonic structures can't be observed. By these parameters a number of long and complete processes of development are determined firstly which are uncoordinated in time but united in space, and various on type of oremagmatic systems.

Many ruptures forming lineaments are known as oreconcentrating. Majority of metallogenic provinces, ore areas, fields and deposits are within the lineaments concentrating in knots of their cross and conjugation. And in this case in the same knot the deposits of different formation types and age are neighbouring here and this can be explained by preservation of high permeability of such kind of knots during the long history of geological evolution. Taking into account the diversity of genetic types localized in lineaments of deposits, one can state that the source of metals for them was probably the upper mantle [5, 10]. In other words, ruptures forming these lineaments reached the upper mantle.

In this case structural factor is interpreted in two ways: first, as an important and independent space control over gold mineralization by fracture tectonics of different levels of organization and secondly, as a general cause managing endogenic regimes including optimal ones for endogenic accumulation of gold.

Planetary lineament net in which oreconcentrating structures can be defined appeared undoubtedly at the earliest stages of lithosphere formation. The data on the history of the development of the Lesser Caucasus ore-bearing structures properly coordinates with this idea, and in tectonic evolution a general line forms its main structural elements. In building of Archean, Riphean – Upper Proterozoic structural-

material complexes one can observe [16, 17] the beginnings of meridional oriented lineament structures which isolate by the time inside relatively homogenic crystalline substratum and then sedimentary cover as transparent zones with high heterogeneity of Earth Crust. They are ancient, buried north-north-west and north-east faults which need thorough study of facies thickness, magmatism nature and its location, orecontent, seismicity, study by complex geophysical and space methods [12; 13; 17]. As for longitudinal northwest and southeast faults they are widespread in alpine mountain-folded area of the Lesser Caucasus in particular in Somkhit-Garabagh zone.

They also perfectly correlate with anticlinal type of structural zonation when in nuclei of geoanticlinal arc uplifts more ancient geological formations are located, and on the slopes – younger ones (for example, Tfan horst – anticlinorium of the Greater Caucasus). In this case horst-anticlinorium structure properly coordinates with morphostructural zones of more and higher stages of mountain relief.

Particularly these transparent zones characterizing by anomalous heterogeneity of structural-material complexes forming them are ore-bearing structures [12; 14; 15].

It is shown [8] the important points in definition of transparent ore-bearing structures are the followings: 1) regional reduction or increase background heights of relief and chains of their local minimum or maximum; 2) chains of depressions, imposed troughs and transparent antecedent valleys of rivers; 3) zones of front junctions, shift, turns or bends of longitudinal morphostructural elements, change of general plan; 4) zone thickening of linear elements of relief cutting relatively to prevailing morphostructural plan; 5) chains of dome and ring morphostructures; 6) increased morphostructural dividing of systems of transverse blocks with prevailing background joint of corresponding direction; 7) confinement of zones with maximum differentiated structural-lithomorphic complexes relief forms and linearly stretched borders of these forms.

The relationship between magmatisms and mineralization manifested within ore-bearing structures is expressed in cycle directional and unreversible evolution process which led to numerous changes of riftogenic (stretching) tectonic tensions, compression caused orogenic movements. They control in many cases the borders of areals with different types of magmatism. Here one can see a specific priority of riftogenesis which many times concerned ancient structural sutures of crystalline basement and served as a conduction of basaltoid meltings and their differentiations.

General line of ore-bearing structures is closely connected with the movement of large blocks joining them which are specific barriers for magmatic reservoirs and their screening role probably provides concentration of mineralization; in this case local position of various rank of gold-bearing fields of the Lesser Caucasus – ore knots, fields and deposits can be defined by structures of less order. Such are inherited blocks uplifts accompanied by intrusion of granitoid massives, for example, Kedabek-Dalidag, Tejsar-Shamlug and Zod transparent zones of the Lesser Caucasus [7, 11], Biki zone of seaside, Klichkino-Darasun transparent zone of TransBaikal [6, 15], zones of front junctions, bending, turn of structures or sharp change of structural plan (Central Mongolian zone, zone Louis and Clark, lineament Texas, Enkorj Pradkho-bey in Alaska, and others). As a whole they separate large geoblocks of Earth Crust or some segments different by regimes of movements, set of structural-facial zones, phases of manifestation of intrusive and volcanic activity and other features [2, 8].

The connection between endogenic mineralization and fault tectonics is established for overwhelming majority of goldore and gold-bearing deposits of Samkhito-Garabagh insular arc. Particularly a systematic confinement of magmatic and ore matter to steeply falling regional rupture systems of block structure and this caused formation in field of tectono-magmatic structure crossing. As ore-bearing they represent fragments of large lineaments crossing various types of regional structures. Magmatic formations and endogenic ore accumulations are observed by author as derivatives of a whole longliving ore-magmatic system, formation stages of which reflected in formation of studied gold-bearing and goldore deposits. It this case localization of endogenic mineralization was controlled by the system of steeply falling ruptures of high orders conjugated with regional failures. These structures are transparent, transregional faults. Connection between mineralization and transregional zones of latitudinal and meridional extension was defined by M.A.Kashkai, E.Sh.Shikhalibeili [3, 9] in study of distribution patterns for economic minerals in Azerbaijan. Interesting data of distribution patterns of Somkhito-Garabagh zone ore masses were obtained by V.M.Baba-zade [3, 4, 1].

It has been defined that ore masses are located in knots of specific endogenic activity confining to knots of junctions of different directed buried submeridional and sublatitude faults.

As the last ones are represented by whole systems of rupture failures limited blocks with different mobility in this case their crossings form specific wedgelike blocks with very complex inside structure. Namely under these conditions interferention of different directions movements tendency occurs as a result of it productive blocks usually take intermediate position between maximum rised and maximum lowered blocks of basement sometimes forming stages limited by regular gradient zones. Orientation of blocks cannot coincide with the extension of surface structures (V.M.Yanovsky, 2004) at the same time conjugation can be observed in orientation of zones with ore-bearing dislocations and marks of buried blocks. Ore-bearing blocks accompany by negative gravimetric and positive magnitometric anomalies caused by buried magmatic bodies and halos of contact metamorphism.

Transregional faults are of big importance both for structural design and for structures of ore knots and fields. In regional structures frontal lineaments are of great importance – they are vivid type of morphological expression of large zones with deep faults. Here we can name such subhorizontal geological barriers as Kekhnamadan thrust in Major Caucasus Ridge, some fragments of it increase each other in wedge way and they were described by E.Sh.Shikhalibeili (1956); Mrovdag thrust (K.N.Paffengoltz, 1948) and other large systems of latitude faults. These main thrust structures of general caucasian direction as a rule are not ore-bearing but they control ore-bearing zones located on folded structures of II and III order accompanied by longitudinal and transversal faults. Typical peculiarity of these dislocations are their widespread in the area of folds bends rise, benches and turndown of folds, in initial points of subsidence of anticlines and anticlinoria, in points of conjugation of longitudinal and transversal folds. Due to it structures of block type are widespread where ore knots concentrate.

Kedabek-Dalidag lineament is an example of transregional faults, it is of ancient bedding age (lower Archean, Proterozoic) which many times renewed in other metallogenic periods of time and caused magmatic material supply with typical

endogenic ore mineralization. This lineament, the fragments of which renewed can be observed as oreconcentrating where various oreformative types of deposits are developed, is one of the more significant linear structure of Azerbaijan.

Metallogenic analysis of Azerbaijan shows [1;4] that the majority of endogenic deposits perfectly fit within fault structures and localize in knots of their orossings and conjugations. In this case transregional faults preserving their oreconcentrating individuality change metallogenic profile as soon as they cross different type and different age structures.

Analyzing the distribution patterns of ore fields relatively to systems of steeply falling ruptures one can detemine definite types of structural position of ore knots and the role of oreconcentrating structures in localization of gold mineralization. Such favourable structural knots are Kedabek, Kharkhar, Goshy, Dagkesaman, Chovdar and others. In localization of goldbearing hydrothermal-changed zones, gold-sulphide-quartz veins and vein-impregnated zones of studied deposits the main role was played by the systems of north-north-west submeridional extension.

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KIÇIK QAFQAZ NƏCIB METAL FILIZ-MAQMATIK SISTEMLƏRININ ƏSAS SAHƏLƏRININ YAYILMA QANUNAUYĞUNLUQLARI

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Məqalədə nəcib-metal filiz-maqmatik sistemlərinin yataqlarının paylanmasının qanunauyğunluqlarına baxılır. Nəcib metal o cümlədən qızıl filizləşməsi də daxil olmaqla endogen rejimin paylanmasında struktur faktorun prisipial rolu göstərilmişdir. Qızıl filizləşməsi üçün əlverişli olan qırılmaların qovuşma sahələrinə xüsusilə diqqət yetirilmişdir.