UO‘T: 631.4

OROL DENGIZINING QURIGAN TUBI SHARQIY QISMIDA OG‘IR METALLARNING MIQDORIY TAHLILI VA GEOKIMYOVIY DINAMIKASI

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Annotatsiya. Ushbu tadqiqotda 1960-yillardan boshlab quriy boshlagan Orol dengizining sharqiy qismida joylashgan qurigan tub tuproqlarida og‘ir metallarning miqdori, geokimyoviy akkumulatsiyasi va tarqalishi o‘rganildi. Tadqiqot natijalari shuni ko‘rsatdiki, hududlar bo‘yicha og‘ir metallarning to‘planish darajasi bir xil emas. Ayrim nuqtalarda Cd, Cu, Mo, Zn, Mn, Co, va V elementlarining klark konsentratsiyasi (Kk) 1 dan yuqori bo‘lib, ularning akkumulatsiyasi yuqori ekani aniqlandi. Eng yuqori tarqalish koeffitsiyenti (Kt) esa Co (6.5), Mn (5.43), Cu (4.02), V (3.27), va Zn (3.03) elementlarida kuzatildi.

Kalit so‘zlar: Orol dengizi, og‘ir metall, geokimyoviy akkumulatsiya, klark koeffitsiyenti, tuproq, tarqalish.

Аннотация. В данном исследовании изучалось количество, геохимическое накопление и распределение тяжелых металлов в осушенных донных грунтах восточной части Аральского моря, начавшего высыхать в 1960-х годах. Результаты исследования показали, что накопление тяжелых металлов в разных регионах неодинаково. В некоторых точках кларковая концентратsiя (Кк) элементов Cd, Cu, Mo, Zn, Mn, Co и V превышала 1, что свидетельствует о высокой степени накопления. Наибольший коэффициент распределения (Кт) наблюдался для элементов Co (6,5), Mn (5,43), Cu (4,02), V (3,27) и Zn (3,03).

Ключевые слова: Аральское море, тяжелые металлы, геохимическое накопление, коэффициент Кларка, почва, распределение.

Annotation. This study investigated the amount, geochemical accumulation, and distribution of heavy metals in the dried bottom soils of the eastern part of the Aral Sea, which began to dry up in the 1960s. The results of the study showed that the accumulation of heavy metals is not the same in different regions. In some points, the Clark concentration (Kk) of the elements Cd, Cu, Mo, Zn, Mn, Co, and V was higher than 1, indicating high accumulation. The highest distribution coefficient (Kt) was observed for the elements Co (6.5), Mn (5.43), Cu (4.02), V (3.27), and Zn (3.03).

Key words: Aral Sea, heavy metal, geochemical accumulation, Clark coefficient, soil, distribution.

Kirish. Orol dengizi Markaziy Osiyoda O‘zbekiston va Qozog‘iston Respublikalarining chegaralarida joylashgan, dunyodagi to‘rtinchi yirik ko‘l bo‘lib, uning maydoni 66 000 km2, hajmi 1070 km3, maksimal chuqurligi 66 metrni tashkil qilgan, u 10 ming yillikda tabiiy va antropogen ta’sirlar oqibatida qayta qayta quriydi va suv bilan to‘ladi [1,2], uning so‘ngi qurishi 1960 yildan boshlangan [3]), hozirgi kunga kelib uning 10% suvi qolgan[8] tuzlarning yillar davomida to‘planishi o‘simliklar tarqalishiga kuchli ta’sir qilgan [5].

Orol dengizining qurishi natijasida hozirgi kunda uning o‘rnida Orol qum paydo bo‘lgan va bu qumlar turli darajada sho‘rlangan [4], yer osti suvlari satxining pasayishi natijasida tuzlar miqdori ortgan (16), suvning sho‘rlanishi 126-244 % ga etgan (17,5), tuzlarning miqdori qumli va loyli tuproqlarda bir-biridan farq qiladi, jumladan, Orol dengizining janubiy-sharqiy qismidagi tuproqlarda evgsterit ($2Na2SO4{\cdot}CaSO4{\cdot}2H2O$), astraxanit ($Na2SO4{\cdot}MgSO4{\cdot}4H2O$) va mirabilit ($Na2SO4{\cdot}10H2O$) hosil bo‘lgan (6,7). Orol dengizining qurigan tubida quyidagilarning miqdori turlicha ekanligi aniqlangan ammonium nitrate 171 mg/100 g; (NH4)3 PO4 206 mg/100g; K2SO4 140 mg/100g; CoSO4 5,5 mg/100g; H3 BO3 39 mg/100 g; ZnSO4 7,8 mg/100g; FeSO4 242 mg/100 g; CuSO4 15,6 mg/100g; MnSO4 163 mg/100 g; CaSO4 2700 mg/100g, albatta bu miqdor turli hududlarda turlichadir [8,10,11]. Orol dengizining qurigan tubidagi tuproqlarda elementlarning turlicha bo‘lishi eol, loy, allyuvial yotqizilardan meros qilib olingan [12,9], shahar, sanoat oqova suvlarining yillar davomida drenaj suvlarining kelib tushishi natijasida ifloslanish vujudga kelgan [11,12,25,48], jumladan, Pb va Cd sanoatlar faoliyati natijasida, qishloq xo‘jaligida pestitsidlar, o‘g‘itlar qo‘llash natijasida NO3, Zn, Ni, Hg va Mn kabi elementlar bilan ifloslanishi vujudga kelgan [13,33,34].

Orol dengizi Amudaryo va Sirdaryo daryolaridan to‘yingan va yillar davomida turli elementlar bilan ifloslanish va ularning to‘planishi kuzatilgan [14,15,16,37,38, 39],bu ko‘proq daryolarning quyi oqimida kuchli seziladi[15,16,17 30]. Orolga quyiluvchi Sirdaryo suvining boshlanish nuqtasi Qirg‘iziston hududidagi suvning tarkibi o‘rganilgan, natijalar shuni ko‘rsatganki, elementlarning miqdori xalqaro standartdan past ko‘rsatkichga ega, biroq Orol dengizi suvida Cu, Pb, Zn va Cd kabi og‘ir metallarning miqdori ortgan, bu inson faoliyati bilan bog‘liq bo‘lishi mumkin (18,19,20,22). Orol dengizining tubida paydo bo‘lgan tuproqlar turli darajada sho‘rlangan, ular natriy, magniy va kalsiy bilan to‘yingan va Cd va Zn og‘ir metallar bilan ifloslangan [21], ko‘proq qishloq xo‘jaligida kimyoviy o‘g‘itlarni qo‘llash natijasida ifloslangan bo‘lishi mumkin [23].

Bu tuproqlarda xloridlar, sulfatlar, natriy va gidrokarbonatlar kabi eruvchan tuzlarning yuqori konsentratsiyasi mavjud. Tuproqning sho‘rlanish natijalariga ko‘ra, 1 m chuqurlikda sulfat-xloridlar ustunlik qiladi: sulfat-xlorid (57%), xlorid-sulfat (28%) va soda-sulfat (14%). O‘rganilayotgan tuproqdagi kation va anion tarkibini quyidagicha tartiblash mumkin: $Cl > SO4 > HCO3 > Ca > Na + K > Mg$. Tuproqning sho‘rlanish darajasiga ko‘ra qurigan Orol tubidagi tuproq qoplamida yuqori (kuchli) sho‘rlangan tuproqlar va sho‘rlangan tuproqlar ustunlik qiladi [24,25]. Orol dengizining qurigan tubida noyob yer elementlari turlicha bo‘lib,

bu geologik joylashuvi bilan farq qiladi [26]. Orol dengiziga quyiluvchi Sirdaryo daryosi suvi va unga bog‘liq bo‘lgan hududlardagi tuproqlarda Cd, Co, Cu, Ni, Zn og‘ir metallari va Mn elementining tarqalishi hamda, to‘planish o‘rganilgan, natijada ularning miqdori me’yordan ortiq ekanligi aniqlangan [27,28,29]. Orol dengizining qurigan tubidagi tuproqlarda Ca2+, K+, Mg2+ va Na+ almashinuvchi kationlar miqdori o‘simliklar ekish natijasida ularning miqdorini o‘zgarishiga olib kelgan [30]. Orol dengizining qurigan tubini Qozog‘iston hududida elementlarning tarqalishi, jumladan, Sirdaryo suvi orqali kelib quyiladigan suvning tarkibida og‘ir metallar va boshqalarning miqdori o‘rganib chiqilgan, natijada Al, As, B, Ba, Cd, Cr, Cu, Ni, Pb, Sb, Ce, Eu, Er, Gd, La, Nd, Pr, Sc, Sm, Dy, Ho, Lu, Tb, Tm, Y, Yb kabi elementlar o‘rganilganda, ularning orasidan Al (o’rtacha 851 mkgL-1), As (35,8 mkgL-1), Cd (2,8 mkgL-1), Pb (10,1 mkg) me’yordan ko‘p ekanligi aniqlangan [31], sug‘orish suvi tarkibida magniyning miqdori ortadi va bu xavfli hisoblanadi [32]. Orol dengizining qurigan qismini shimoliy hududlarida tuproqlarning 1970-yildan boshlab ifloslanishi kuzatilgan, bunda V, Cr, Zn, Co, Pb, Ni, Cu va Cd elementlarning akkumulyatsiyasi aniqlangan [33]. Orol dengizining cho‘kindilari tarkibida yillar davomida o‘simliklar qoldig‘i hisobiga organik uglerod to‘planib ortib borgan [34]. Yuqoridagi adabiyotlar tahlili asosida aytish mumkinki, Orol dengizining suvi qurishi va uning o‘rnida qumliklarni paydo bo‘lishi, vaqt o‘tib tuproqlarni shakllanishi mobaynida elementlarning to‘planishi va tarqalishi kuzatilgan, ayrim hududlarda og‘ir metallar bilan ifloslanishi aniqlangan.

Tadqiqot materiali va metodi. Tadqiqot hududi Markaziy Osiyoda O‘zbekiston va Qozog‘iston respublikalarining chegaralarida joylashgan, Orol dengizining qurigan tubida turli darajada sho‘rlangan tuproqlar tarqalgan. Tadqiqotlar Orol dengizining sharqiy qismini qurigan tubida shakllangan tuproq-gruntlarida olib borildi, bunda tuproq namunalari sharqiy hududda janubdan shimolga tomon quyidagi 25 ta nuqtadan kesmalar qazildi va namunalar olindi (1-jadval).

1-jadval

Tadqiqot hududi va tuproq namunalarini joylashishi

Tuproq kesmalari	Koordinatlar (N / E)	WRB tuproq tasnifi bo‘yicha nomi	Tadqiqot hududi
P1	43°41′81.57″N / 60°18′10.42″E	Arenosols	I
P2	43°43′74.09″N / 60°17′93.05″E	Arenosols	I
P3	43°47′05.46″N / 60°15′90.07″E	Arenosols	I
P4	43°59′31.49″N / 60°16′61.37″E	Arenosols	I
P5	43°67′43.37″N / 60°17′17.23″E	Arenosols	I
P6	43°67′43.37″N / 60°17′17.23″E	Arenosols	I
P7	43°78′71.65″N / 60°19′12.02″E	Arenosols	I
P8	43°82′89.45″N / 60°19′95.43″E	Arenosols	I
P9	43°86′09.66″N / 60°22′54.35″E	Arenosols	I
P10	43°93′26.33″N / 60°25′45.61″E	Arenosols	I
P11	43°95′70.27″N / 60°28′11.69″E	Arenosols	I
P12	43°95′73.42″N / 60°28′07.56″E	Arenosols	I
P13	43°95′52.54″N / 60°28′29.81″E	Arenosols	I
P14	43°95′50.79″N / 60°28′38.87″E	Arenosols	I
P15	43°99′97.30″N / 60°11′24.33″E	Arenosols	II
P16	44°03′97.49″N / 60°34′80.65″E	Arenosols	II
P17	44°04′01.75″N / 60°34′74.79″E	Arenosols	II

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Tuproq kesmalari	Koordinatlar (N / E)	WRB tuproq tasnifi bo‘yicha nomi	Tadqiqot hududi
P18	44°04′11.65″N / 60°34′65.11″E	Arenosols	II
P19	44°04′22.33″N / 60°34′48.91″E	Arenosols	II
P20	44°04′16.57″N / 60°34′61.70″E	Solonchaks	II
P21	44°06′40.60″N / 60°37′16.72″E	Solonchaks	III
P22	44°11′40.62″N / 60°17′16.57″E	Solonchaks	III
P23	44°15′27.41″N / 60°12′19.38″E	Solonchaks	III
P24	44°20′39.33″N / 60°16′14.24″E	Solonchaks	III
P25	44°28′25.09″N / 60°26′18.16″E	Solonchaks	III

Tuproq namunalari olingan hududlarda tuproqlarning paydo bo‘lishi bir xil emas, R1-R13 nuqtalar orasidagi hudud Orol dengizining birinchi qurigan hududi bo‘lib, uning quriganiga 50 yil bo‘lgan, R14-R19 orasidagi hududlar shamol yordamida qumlarning to‘planishi natijasida shakllangan tuproqlar hisoblanadi va uning quriganiga 30 yil bo‘lgan, R20-R25 orasidagi hududlar shimoliy hududda joylashgan, tuzlar miqdori yuqori bo‘lgan solanchaklar shakllangan va uning quriganiga 25 yil bo‘lgan.

Geologiyasi va tuproq paydo qiluvchi ona jinslar. Orol dengizi havzasi 2,2–2,0 million yil avval ekzogen va endogen relyef shakllanishi jarayonlarining birgalikdagi ta’siri tufayli vujudga kelgan. Bu jarayonlardagi asosiy ahamiyat tektonik harakatlar bilan bog‘liq bo‘lgan ekzogen jarayonlarning faol rivojlanishiga tegishlidir [35]. Olimlarning fikriga ko‘ra, agar deflyatsiya natijasida qayta chuqurlashtirish o‘rtacha 150 metr bo‘lsa, havza shakllanish davrida 15 000 km^3 material yo‘qolgan bo‘lishi mumkin. 1957-yilgacha Orol dengizi suv hajmi 1 075 km^3 bo‘lgan. Chuqurlashish tezligi yiliga 4 sm deb hisoblansa, havza 3 750 yil yoki taxminan to‘rt ming yil ichida chuqurlashgan, bu esa ilmiy adabiyotlarda keltirilgan ma’lumotlarga mos keladi [36]. Shu vaqtda Orol bo‘yicha allyuvial-ko‘l qoramtir gilllari va och sariq rangli dala-shpat kvarsli qumlar yig‘ilgan. Bu vaqtni Ustyurtning sharqiy chinqasida abraziv terassaning ishlab chiqilishiga bog‘lash mumkin, bu Yu.M. Kleyner va V.I. Kravchuk tomonidan 70 +73 metr absolyut belgilarda aniqlangan [37]. A.S. Kes fikriga ko‘ra, Orolning erta va o‘rta pleystotsen davridagi rivojlanishi subaeral sharoitlarda sodir bo‘lgan[39]. Ilk akkumulyativ eopleystotsen yuzasi eol jarayonlar ta’sirida kuchli o‘zgarishga uchragan va bu chuqur bo‘lingan yotqiziq-o‘simlik relyefining shakllanishiga olib kelgan. Markaziy qism va chinqoviy o‘rkan bir necha o‘n metrga deflyatsiya tufayli qayta chuqurlashtirilgan [38].

Geomorfologiyasida tadqiqot relyefni ajratishda A.K.Kurbaniyazov fikriga ko‘ra, uning yoshi, genezi va morfologiyasi inobatga olinishi kerak[42,43,44,45]. Qirg‘oqlar va dengiz tubining qurigan relyefi o‘z paydo bo‘lishini qadimgi va yangi Orol transgressiyalari bilan bog‘liq[54]. Orolning qurigan tubi suvga tomon qisman bo‘lingan, 0–1 metr chuqurlikda va tuz bilan qoplangan qumli qumloqloqlar boshlang‘ich akkumulyativ dengiz tepaligidan iborat [41,53]. Kesning fikriga ko‘ra, qadimgi Orol transgressiyasi natijasida hosil bo‘lgan relyef taxminan 3 ming yil oldin yuzaga kelgan bo‘lib, uning tarqalishi juda cheklangan [50].

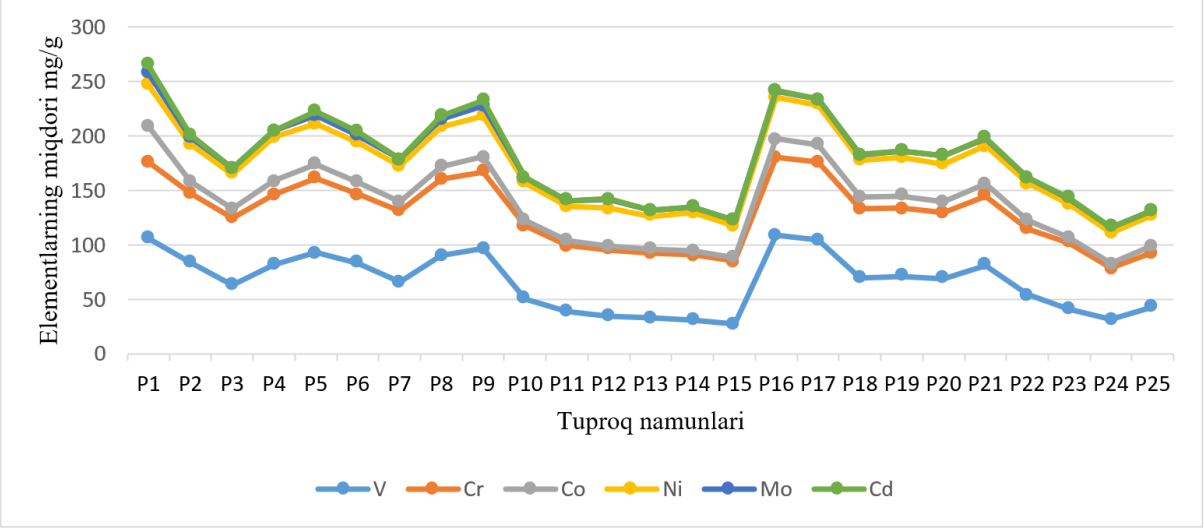
Orol dengizining qurigan tubida tuproqlar shakllanishi davom etmoqda, tuproq paydo bo‘lishi nazariyasiga ko‘ra hozirda tuproqlar mavjud bo‘lishi mumkin emas, chunki 200 yilda 1 sm tuproq paydo bo‘ladi, Orol dengizining qurishi 1960-yildan boshlangan, hozirgacha 65 yil o‘tgan bo‘lsa tuproqlar endi shakllanishini ko‘rish mumkin[46,47,48]. Biroq Orol

dengizining qurishi qayta - qayta kuzatiladi, dastlabki qurish davri eramizdan avvalgi XV asrda, ikkinchi qurish davri 1211-yillarda kuzatilgan va uchinchi qurishi 1960-yildan boshlangan [56]. Bundan ko‘rinadiki, Orol dengizi bir necha ming yillar davomida qurishi va qayta to‘lishi oqibatida uning o‘rnida tuproq shakllangan va ayrim tuproqlar paydo bo‘lgan bo‘lishi mumkin.

Maqolada Orol dengizining qurigan tubidagi tuproqlarning geokimyoviy elementlarning akkumilyatsiyasi va tarqalishi o‘rganildi, bunda elementlar turlicha bo‘lib, xech qanday qonuniyatga bo‘ysunmaydi[49]. Elementlarning tarqalishi va to‘planishi har xil, ayrim og‘ir metallarning ko‘p uchrashi, ifloslanishi aniqlandi. Ayrim kimyoviy elementlarning klark konsentratsiyasi katta bo‘lsada, klark tarqalishi past ko‘rsatkichga ega.

Tuproqlarni paydo bo‘lishida ona jinslari turli o‘zgarishga uchraydi, jumladan, gipergenez (yer qobig‘ining yuqori qismida va uning yuzasida minerallar va jinslarning kimyoviy va fizik o‘zgarishi), singenez (suv havzasining tubida cho‘kindilarni ortiqcha to‘planishi), diagenez (erkin sedimentlarning boshlang‘ich bosqichi va sedimentar tog‘ jinslariga o‘tishi), katagenez (diagenez va metamorfizm zonasidan tashqarida turli sedimentar jinslarning petrografik va geokimyoviy o‘zaro ta’siri natijasida jinslarning kimyoviy, mineralogik o‘zgarishi), epigenez (mavjud sedimentar jinslardagi ikkinchi darajali o‘zgarishi), galogenez (tabiiy suv havzalaridan tuzlarning tortilganligi), gidrogenez (suvning litosferaga kirib kelishi va tog‘ jinslarini o‘zgarishi), mexanogenez (sentrifual kuchlar va relyefdagi katta o‘q burchaklari ta’siri ostida jinslarning mexanik harakati natijasida kimyoviy elementlarning tortilishi), pedogenez (tuproq va tuproq gorizontlarining fiziko-kimyoviy va biokimyoviy jarayonlar ta’sirida hosil bo‘lishi), biogenez (tirik moddalar hosil bo‘lishi, ularning ichida ko‘p kimyoviy elementlarning konsentratsiyalashishi) jarayonlari amalga oshadi[40,49]. Bu jarayonlar ko‘p yillar davomida sodir bo‘ladi, elementlarning to‘planishi va tarqalishi ham oxirgi bosqichlarda amalga oshadi.

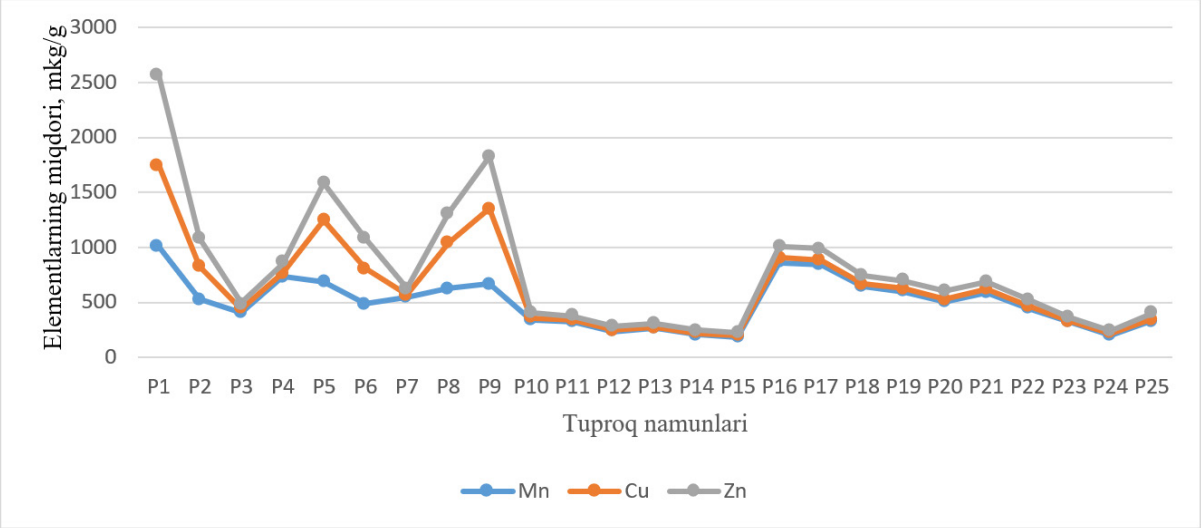
Natija va muhokama. Elementlarning miqdori Orol dengizining qurigan tubida og‘ir metallarning miqdori bir hil tarqalmagan, bunga ko‘ra I hududda eng ko‘p tarqalgan, aynan Cd, Mo, Ni, Cr og‘ir metallari P1 tuproqlarida eng ko‘p miqdorni tashkil qilgan, shuningdek, R5 va R9 tuproqlarida ham ularning miqdori yuqori ekanligi aniqlandi. II hududda ularning miqdori kamaygan, jumladan, R11, R12, R13, R14, R15 tuproqlarda miqdori keskin kamaygan, III hududda esa bir muncha yuqori bo‘lib, R24 va R25 tuproqlarida yana kamaygan (1-rasm).



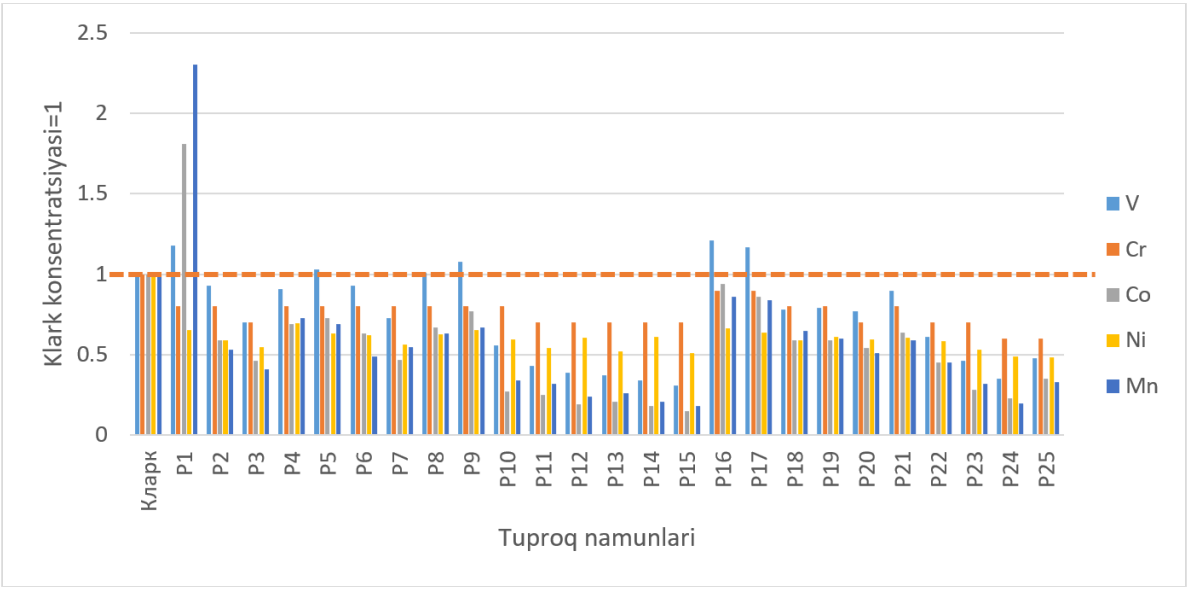
1-rasm. Orol dengizining qurigan tubida og‘ir metallarning miqdori, mkg/g

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Huddi shu hududlarda Mn, Cu, Zn og‘ir metallarining miqdori ham yuqoridagi elementlar singari bo‘lib, I hududda R1, R5, R9 tuproqlarida eng ko‘p miqdorni tashkil qilgan, II hudud tuproqlari, jumladan, R10, R11, R12, R13, R14, R15 tuproqlarida keskin kamaygan va III hududda biroz ortishi kuzatildi (-rasm).



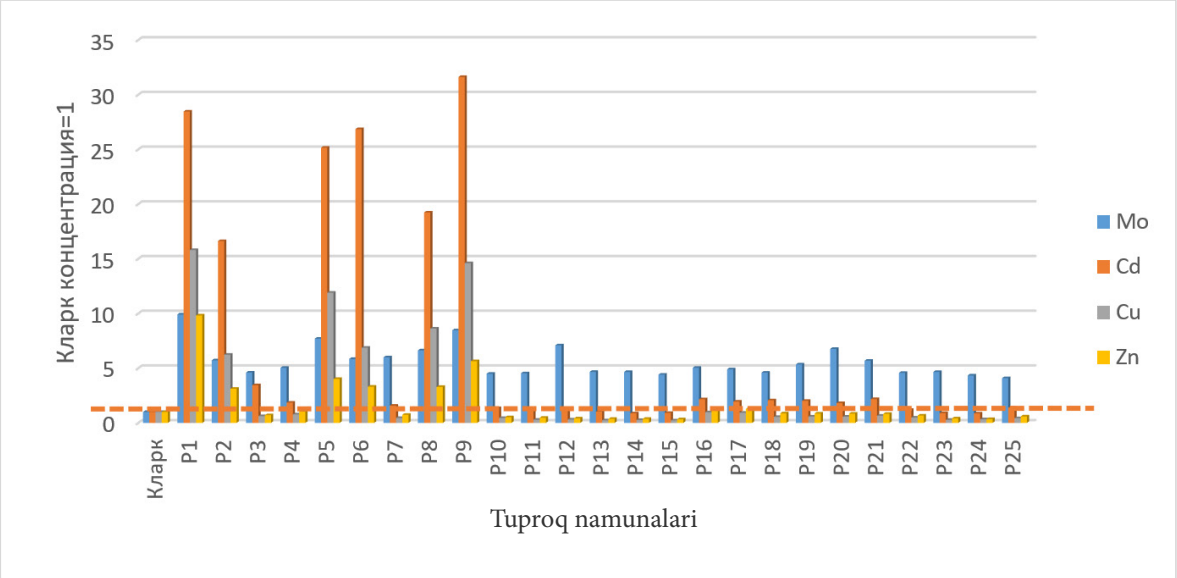
Elementlarning klark konsentratsiyasi Orol dengizining qurigan tubida tarqalgan tuproqlarda og‘ir metallarning klark konsentratsiyasi hisoblandi, natijalarga ko‘ra, faqatgina So, V, Mn og‘ir metallari klarkdan katta ko‘rsatkichga ega ekanligi aniqlandi. Ushbu elementlar R1, R9, R16, R17 tuproqlarida klark konsentratsiyadan ortgan, qolgan R2, R3, R4, R5, R6, R7, R8, R10, R11, R12, R13, R14, R15, R18, R19, R20, R21, R22, R23, R24, R25 nuqtalardagi tuproqlarda klark konsentratsiyasidan past ko‘rsatkichga ega ekanligi aniqlandi (-rasm). Natijalar orasida og‘ir metallarning miqdori I hududda eng yuqori ekanligi, II hududda eng past va III hududda ushbu og‘ir metallarning miqdori nisbatan ko‘tarilgan.



2-rasm. Og‘ir metallarning klark konsentratsiya ko‘rsatkichlari

Og‘ir metalllardan Cd, Cu, Mo, Zn elementlarining klark konsentratsiyasi hududlar bo‘yicha turlicha ekanligini ko‘rish mumkin, jumladan, I hududdagi R1, R2, R5, R6, R8, R9 tuproqlarda klark konsentratsiya 1 dan katta, R3, R4

tuproqlarda esa faqatgina Mo, Cd og‘ir metallarining miqdori klarkdan oshgan, qolgan elementlarni klark konsentratsiyasi 1 dan kichik. II va III hududlarda esa Mo og‘ir metalning klark konsentratsiyasi 1 dan katta, Cd elementiniki esa faqatgina R16, R17, R18, R19, R20 larda klark ko‘rsatkichiga yaqin hisoblanadi (3-rasm).

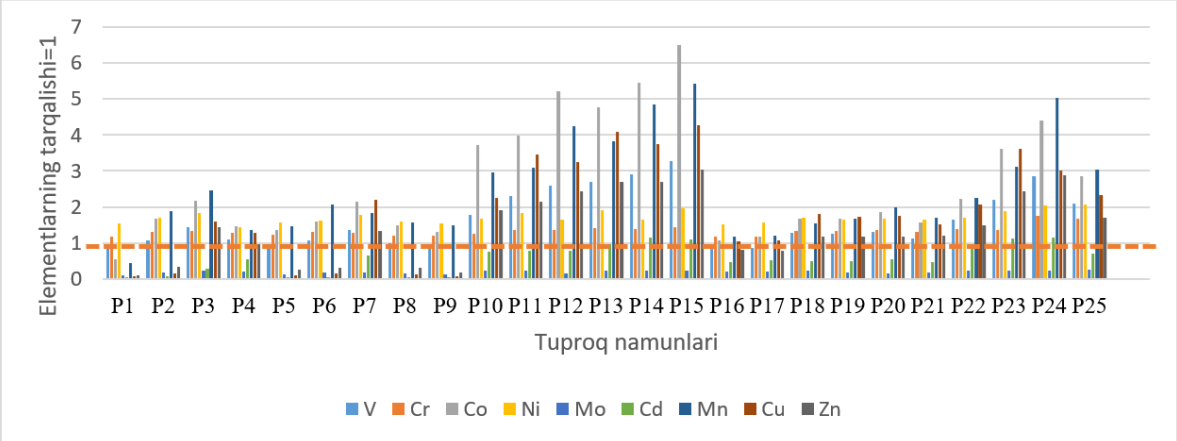


3-rasm. Og‘ir metallarning klark konsentratsiya ko‘rsatkichlari

Yuqoridagi natijalardan ko‘rinadiki, og‘ir metallarning klark konsentratsiyasi elementlar bo‘yicha turlicha bo‘lib, bu og‘ir metallarning hududlar bo‘yicha akkumulyatsiyalanish darajasini belgilab beradi.

Elementlarning tarqalishi Orol dengizining qurigan tubida og‘ir metallarning klark konsentratsiyasi turlicha ekanligini yuqorida ko‘rdik, shuningdek, ushbu og‘ir metallarning Klark tarqalish (Kt) ko‘rsatkichi ham turlichadir. Klark tarqalish ko‘rsatkichi Orol dengizining qurigan tubida turlicha, ya’ni ayrim Cd, Cu, Mo, Zn, So, V, Mn og‘ir metallarining Kk ko‘rsatkichi yuqori bo‘lsada Kt ko‘rsatkichi 1 dan kichik.

Kt ko‘rsatkichiga ko‘ra og‘ir metallarning tarqalishi II hududda yuqori ekanligi aniqlandi, jumladan, R10, R11, R12, R13, R14, R15 tuproqlarida eng yuqori natijalar aniqlanib, og‘ir metallar aynan shu hududlarda keng tarqalgan hisoblanadi (4-rasm).



Tadqiqot hududining III hududiga tegishli R22, R23, R24, R25 tuproqlarida ham og‘ir metallarning tarqalishi kuzatildi, og‘ir metallarning eng kam tarqalishi R1, R2, R3, R4, R5, R6, R7, R8, R9, R16, R17, R18, R19, R20, R21, R22 nuqtalardan olingan tuproqlarda ekanligi aniqlandi. Umumiy tahlil qilganda og‘ir metallarning

ISSN 2181-0826 MAXSUS SON 4/2025 y.

tarqalishida Orol dengizining qurigan tubida to‘planishi va tarqalishi turlicha bo‘lib, janubdan shimolga tomon kamayib borishi yoki dengiz sathidan joylashish koordinatiga ko‘ra ortish yoki kamayish qonuniyatiga ega emas.

Muhokama. Tuproqdagi og‘ir metallarning eng yuqori miqdori turlicha bo‘lib, jumladan, V ning tuproqdagi miqdori 109 mgk/g (Klark=90), Cr ning miqdori 71,4 mkg/g (Klark=83), Mn ning miqdori 2299 mkg/g (Klark=1000), Co ning miqdori 32,6 mkg/g (Klark=18), Ni ning miqdori 40,5 mkg/g (58), Mo ning miqdori 10,9 (Klark=1,1), Cu ning miqdori 741 mkg/g (Klark=47), Zn ning miqdori 815 mkg/g (Klark=83) ni tashkil qiladi. Og‘ir metallarning Klark konsentratsiyasi bo‘yicha ketma-ketlikda joylashtirganda quyidagi holatni ko‘rish mumkin: elementlarning Klark konsentratsiyasi ko‘rsatkichlari bo‘yicha joylashuvi Cd (56,46) - Cu (15,8) - Mo (9,9) – Zn (9,82) - Mn (2,3) - Co (1,81) - V (1,21) - Cr (0,8) - Ni (0,69) bundan ko‘rinadiki, og‘ir metallarning akkumulyatsiyasida eng yuqori natija Cd og‘ir metaliga, eng past akkumulyatsiya V og‘ir metaliga to‘g‘ri keladi. Tadqiqot hududi bo‘yicha eng ko‘p akkumulyatsiyalangan hudud I hudud bo‘lib, bu hudud Orol dengizining quriganiga 50 yil bo‘lgan bo‘lib, og‘ir metallarning eng ko‘p akkumulyatsiyalangan nuqtasi hisoblanadi. Chunki bu hududda suvning qurishi natijasida ona jins minerallaridan tuproq paydo bo‘lish jarayoni faol kechganligi va tuproq-gruntlari paydo bo‘lganligi, geokimyoviy jarayonlar ketganligini bildiradi. Ya’ni tuproq hosil qiluvchi ona jinslaridan tuproq paydo bo‘lish jarayoni kuzatilgan, kimyoviy va fizikaviy nurashlar faol kechgan, shu jarayonda tuproqlarda elementlar, jumladan, og‘ir metallar to‘planishi kuzatilgan, shuningdek, suvning tarkibida bo‘lgan og‘ir metallar ham bu hududda to‘plangan. II hududda og‘ir metallarning eng kam akkumulyatsiyalanganini ko‘rish mumkin, chunki bu huddudagi tuproqlar shamollar yordamida shakllangan qumliklar bo‘lib, og‘ir metallarning akkumulyatsiyalanishi past ko‘rsatkichga ega. III hududda esa bir muncha og‘ir metallarning akkumulyatsiyalanishi yuqori, bu joyning quriganiga 30 yil bo‘lgan bo‘lib, hududda tuproqlar shakllanishi ketmoqda. O‘rganilgan hududlarda og‘ir metallarning akkumulyatsiyalanishini ortib borish tartibida joylashtirganda quyidagi holatni ko‘rish mumkin: II hudud → III hudud → I hudud. Og‘ir metallarning akkumulyatsiyalanishida Orol dengizining qurish vaqti o‘rni katta, ya’ni bunda tuproq paydo bo‘lish jarayonining ya’ni ona jinslarning geokimyoviy o‘zgarishi muhim hisoblanadi.

Tuproqlarda og‘ir metallarning miqdori Klarkdan ortgan bo‘lsada, ularning tarqalishi muhim, natijalarga ko‘ra og‘ir metallarning miqdori ayrim nuqtalarda to‘plangan xolos, tarqalish kengligi esa boshqacha. Orol dengizining qurigan tubida elementlarning tarqalishini kamayish tartibda joylashtirilganda quyidagi natijani ko‘rish mumkin: Co (6,5) - Mn (5,43) - Cu (4,02) - V (3,27)- Zn (3,03) - Ni (2,07)- Cr (1,76) Cd (1,15) Mo (0,24). Demak eng ko‘p tarqalgan og‘ir metall Co, Mn, Cu, V, Zn, Ni elementlari bo‘lib, ularning tarqalishi keng diapazonga ega, biroq ularning Klark konsentratsiyasi yuqori emas, ya’ni kam miqdorining tarqalish maydoni katta hisoblanadi. Tarqalishi bo‘yicha hudud tuproqlari og‘ir metallar bilan ifloslangan deb xulosa chiqarib bo‘lmaydi, ya’ni og‘ir metallarning kam miqdori tarqalgan, yuqori miqdori esa ma’lum nuqtalarda akkumulyatsiyalangandir.

Xulosa. Orol dengizining so‘ngi qurish davrini 1960-yildan hisoblasak, bugungi kunga qadar 65 yil vaqt o‘tdi, bu vaqt davomida sekin asta suvning kamayishi va qumliklarni paydo bo‘lishi kuzatildi. Qurigan tubida tuproq paydo bo‘lishi kuzatildi va tuproq-gruntlari shakllandi. Orol dengizining bir necha ming yillar avval ham qurishini inobatga olsak, bu hududlarda o‘n ming yillar mobaynida tuproqlar paydo bo‘lgan va qayta suv bilan to‘lishi natijasida hosil bo‘lgan tuproqlar suv ostida qolib ketgan,

shu evolyusiya mobaynida elementlarning paydo bo‘lishi, ayniqsa og‘ir metallarning to‘planishi kuzatilgan. V, Co, Mn, Mo, Cd, Cu, Zn kabi og‘ir metallarning hududda paydo bo‘lishi, akkumulyatsiyasi va tarqalishiga ikki sababni ko‘rsatish mumkin. Birinchi sabab, bu og‘ir metallar tuproq payd hosil qiluvchi ona jinslar (minerallar) tarkibi, ikkinchi sabab, yillar davomida Orol dengiziga quyiluvchi Sirdaryo va Amudaryo suvlariga oqova, sanoat suvlarini chiqarilishi, mineral o‘g‘itlarni qo‘llanishi natijasida suv bilan birga olib kelingan va cho‘kma hosil bo‘lishini ko‘rsatish mumkin. Bunda Orol dengizining qurigan tubining sharqiy qismida tuproqlarning barchasi bir xil og‘ir metallar bilan ifloslanmaganligi aniqlangan, faqatgina ayrim nuqtalarda og‘ir metallarning akkumulyatsiya bo‘lganligi ilmiy asoslangan, ayrim og‘ir metallarning tarqalishi aniqlangan. Natijalarga ko‘ra, II hududda barcha elementlarning Klark konsentratsiyasi (Kk) 1 dan kichik ko‘rsatkichga ega, faqatgina V, Co, Mn, Mo, Cd, Cu, Zn og‘ir metallari I va III hududlarida Kk 1 dan ortgan, ya’ni shu hududlarda akkumilyatsiyasi yuqori. Klark tarqalishi (Kt) esa boshqacha, ya’ni og‘ir metallar II va III hududlarda ko‘proq tarqalgan, jumladan, Ni, Mn, Co, Cu, Cr, Zn og‘ir metallarining tarqalishi aniqlandi. Dastlabki qurigan joylarida og‘ir metallarning tarqalish ko‘rsatkichi, Klark konsentratsiyasi 1 dan kichik hisoblanadi. Orol dengizining qurigan tubini sharqiy qismi bo‘yicha elementlarning Klark konsentratsiyasi bo‘yicha ketma-ketlikda joylashtirganda quyidagi holatni ko‘rish mumkin - Cd (56,46) - Cu (15,8) - Mo (9,9) – Zn (9,82) - Mn (2,3) - Co (1,81) - V (1,21) - Cr (0,8) - Ni (0,69), ushbu elementlarining tuproqlarda akkumilyatsiyasi yuqori, tarqalishi bo‘yicha esa quyidagi natijani ko‘rish mumkin - Co (6,5) - Mn (5,43) - Cu (4,02) - V (3,27)- Zn (3,03) - Ni (2,07) - Cr (1,76) Cd (1,15) Mo (0,24). Tarqalishi yuqori bo‘lgan og‘ir metallarning miqdori yuqori emas, ularning miqdori Klark ko‘rsatkichiga yaqin hisoblanadi. Dastlabki qurigan hududlarda, o‘simliklarning o‘sishi va tuproq qatlami yaxshi shakllangan I hududda ularning tarqalishi past hisoblanadi. Shu bois, Orol dengizining qurigan tubidagi tuproqlarni og‘ir metallar bilan ifloslanishida Kt ko‘rsatkichi emas Kk ko‘rsatkichi bo‘yicha fikr yuritilsa to‘g‘ri bo‘ladi.

Ushbu maqola FL-8323102111 “Orol dengizining qurigan tubi hududida tarqalgan tuproq-gruntlarining sho‘rlanganlik holati, fizik, kimyoviy va biologik xossalariga ko‘ra o‘simliklar ekish hududlarini guruhlashning ilmiy asosini yaratish” mavzusidagi loyiha doirasida amalga oshirilgan.

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