放射能環境動態・影響評価
ネットワーク共同研究拠点（ERAN）

FY2025 Final Report

【海外/International 共同研究】

海外共同研究（外国機関所属研究者）

採択No.	研究代表者名	所属機関	職名・学年	課題名	受入研究者	受入機関	共同研究者
I-25-01	Feng Bin	Fudan University/China	Professor	Impact of different land use along the Kasumigaura lake on suspended sediment and particulate 137Cs discharge	恩田 裕一	CRiES	
I-25-02	Smith Jim	University of Portsmouth/UK	Professor	Long term changes in radiocaesium and radiostrontium in the environment.	恩田 裕一 五十嵐 康記	CRiES	
I-25-03	Johnson Edward Thomas	Colorado State University/USA	Professor	Radiocesium Contamination within Japanese Rivers, Sediment and Runoff	恩田 裕一	CRiES	
I-25-04	Shinkarev Sergey	State Research Center - Burnasyan Federal Medical Biophysical Center of Federal Medical Biological Agency/Russia	Head of Department of Industrial Radiation Hygiene	Current methodology for estimating whole-body doses to the representative residents of the settlements exposed to radioactive fallout from nuclear detonations at the Semipalatinsk Nuclear Test Site	坂口 綾	CRiES	Stepanenko Valeriy Hoshi Masaharu
I-25-05	Bauer Michael	European Organization for Nuclear Research/Switzerland	Researcher	Evaluation and modeling of factors controlling Cs-137 concentration in river	五十嵐 康記 脇山 義史	CRiES	辻 英樹
I-25-06	Clark Kasey	University of Liverpool/UK	Professor	Quantifying the impact of extreme rainfall events on the erosion of terrestrial organic carbon exported by rivers: Exploring radiocesium as a tracer	五十嵐 康記 丸岡 照幸 脇山 義史	CRiES	
I-25-07	Siregar Nawi Rahmat	Sumatera Institute of Technology/Indonesia	Associate Professor	Natural and environmental radioactivity	ロフィクル ウマム 山中 勤	CRiES	
I-25-08	Ananthanarayanan Chandrasekaran	Sri Sivasubramaniya Nadar College of Engineering (Autonomous)/India	Assistant professor	Natural radioactivity and its radiation hazards in organic and inorganic agricultural soils of Tamil Nadu, India	ラハマン モハマド モフィズル イスマイル	IER	Begum Zinnat Ara
I-25-09	Saiyad Musthafa M.	The New College (Autonomous)/India	Assistant Professor	Estimation of uranium ions concentration in drinking water sources around the Natural High Background Radiation Area of Chavara, Kerala, India.	ラハマン モハマド モフィズル イスマイル	IER	Begum Zinnat Ara
I-25-10	Mahiuddin Md.	Khulna University/Bangladesh	Associate Professor	Development of magnetic carbonaceous materials from agro-waste for the removal of radionuclides	ラハマン モハマド モフィズル イスマイル	IER	Begum Zinnat Ara
I-25-11	Rahman Md Rezaur	University Malaysia Sarawak/Malaysia	Associate Professor	Synthesis of High-Quality Graphene from Borneo Bamboo for Selective Sorptive Separation of Lead Isotopes	ラハマン モハマド モフィズル イスマイル	IER	Begum Zinnat Ara Mohamad Said Khairul Anwar
I-25-12	Nhan Duc Dang	Institute For Nuclear Science And Technology/Viet Nam	Principal Researcher	Application of analytical methodology of Cs-137 in seawater for Vietnam coastal fish to estimate background level	高田 兵衛	IER	GIAP DINH NGUYEN 立田 穣
I-25-13	Kopka Piotr	National Centre For Nuclear Research/Poland	Assistant professor	Modeling the Transport of Radionuclides in the Niida River using the WRF-Hydro Model	グシエフ マキシム	IER	Potempski Sławomir
I-25-14	Baklanova Yuliya	, branch 'Institute of Radiation Safety and Ecology' of RSE NNC RK/Kazakhstan	Head of group (physicist)	Modeling soil contamination of 90Sr and 137Cs radionuclides due to a ground nuclear test explosion conducted on September 24, 1951 on the Semipalatinsk test site territory.	グシエフ マキシム	IER	Aidarkhanov Assan
I-25-15	Novák Máté	University of Pannonia/Hungary	2 grade	Tritium measurement in the terrestrial surface waters of the Carpathian Basin (EU) and Hamadori-Nakadori (Japan) mountain ranges	グシエフ マキシム	IER	Hegedűs Miklós Piroska Tóth
I-25-16	Autsavapromporn Narongchai	Chiang Mai University/Thailand	Associate Professor	The Biological Effects of Indoor Radon Exposure in Humans	床次 眞司 三浦 富智 クランロッド チュティマ	IREM	
I-25-17	Prasad Ganesh	B.L.J. Govt. (P.G.) College Purola, Uttarkashi, Uttarakhand/India	Assistant Professor	Environmental Radioactivity, Radiation Physics	床次 眞司 大森 康孝	IREM	Singh Deepak
I-25-18	Jacob Mbarndouka Taamté	Institute of Geological and Mining Research/Cameroon	Research Officer	Design and realization of a smart survey meter based on low-cost electronic components for simultaneous ambient equivalent dose rate and radon concentration measurement: Calibration with a stable radon gas in low, medium and high concentration	床次 眞司 細田 正洋	IREM	SÄIDOU Omar Bobbo Modibo
I-25-19	Rattanapongs Chanis	Kasetsart University/Thailand	lecturer	Evaluation of the effective dose from radon thoron decay products in Hin Dat natural hot springs, Thong Pha Phum district, Kanchanaburi province	床次 眞司 クランロッド チュティマ	IREM	
I-25-20	Lusiyanti Yanti	Research and Innovation National Agency (BRIN)/Indonesia	Senior Researcher	Detection of Metabolomic and Genomic Biomarkers as a Radiation Response to Support Risk Analysis Safety: A Study of Nuclear Fasility Radiation Workers	三浦 富智	IREM	Tetriana Devita Yusuf Darlina Purnami Sofiati Rahajeng Nastiti Hartiasa Rustin Tatin
I-25-21	Chuenbubpar Darunwan	Office of Atoms for Peace /Thailand	Nuclear Chemist	A Study of Method for the Determination of Low-Level Organic-Bound Tritium Activities in seafoods and Ready-to-Eat food	赤田 尚史	IREM	Itthipoonthanakorn Thawatchai

海外共同研究（外国機関所属研究者）

採択No.	研究代表者名	所属機関	職名・学年	課題名	受入研究者	受入機関	共同研究者
I-25-22	Yongprawat Monthon	Thailand Institute of Nuclear Technology (Public Organization)/Thailand	Nuclear Scientist, Professional Level,	Assessment of Tritium Levels in Imported Seafood Products	赤田 尚史	IREM	Chuenbubpar Darunwan
I-25-23	Vuong Thi Thu Hang	Dalat Nuclear Research Institute/Vietnam	Researcher	Comparison of Activity concentration of Sr-90 in seawater, sediment and fish samples between the South China Sea - Vietnam and Fukushima Prefecture - Japan	田副 博文	IREM	Le Xuan Thang
I-25-24	Lesbek Anel	Astana Medical University/Kazakhstan	Junior Research Fellow	Analysis of the Association Between Inflammatory Biomarkers and Exposure to Elevated Radon Levels in Children and Adolescents	大森 康孝	IREM	
I-25-25	Kazhiyakhmetova Baglan	NCJSC Astana Medical University/Kazakhstan	PhD student	Impact of Technogenic Radiation Factors on the Development of Tumor and Non-Tumor Bronchopulmonary Diseases in the Population of Northern Kazakhstan Based on Molecular-Genetic Analysis	大森 康孝	IREM	
I-25-26	Prasad Mukesh	Swami Rama Himalayan University/India	Assistant Professor	Vertical distribution of primordial radionuclides in soil profiles in Doon valley, Garhwal Himalaya, India	クランロッド チュティマ 大森 康孝 細田 正洋 床次 眞司	IREM	Prasad Ganesh

I-25-01

Impact of different land use along the Kasumigaura lake on suspended sediment and particulate 137Cs discharge

研究代表者：Feng Bin
受入研究者：恩田 裕一

1．成果

Large amounts of 137Cs released from the Fukushima Daiichi nuclear power plant are continuously entering Lake Kasumigaura (Ibaraki Prefecture) from surrounding rivers, which could pose a potential radiation threat to drinking water safety and local fishing products. Given that more than 95% of 137Cs in rivers are tightly bound to suspended sediments (SS), understanding the dynamics of particulate 137Cs input/emission and the mechanisms behind controlling their transport is critical for the region. Land use is often considered a key factor affecting sediment yield and 137Cs inventory. Especially during the rainy season, its differences in soil erodibility can be greatly amplified, thus altering the supply of river sediment and the discharge of particulate 137Cs. Significant differences in land use composition have been identified in two sub-basins adjacent to Lake Kasumigaura (i.e., the Koise River basin and Sakura River basin), but due to the lack of long-term river monitoring data along the Kasumigaura Lake area, it remains difficult to evaluate the effect of such land use differences on sediment supply, river suspended sediment and particulate 137Cs fluxes.

To fill this knowledge gap, we conducted a six-year monitoring campaign in two sub-basins (i.e., Koise River basin and Sakura River basin) and combined hysteresis analysis and 137Cs tracing to specifically explore differences in sediment supply and transport across land-use basins. We found that sediment loads were more significantly correlated with discharge/rainfall in the Koise River (a higher proportion of forest fraction), and the dynamics of particulate 137Cs were more consistent over the same period. In contrast, the control of water flow/rainfall on sediment transport with 137Cs is relatively weaker in Sakura River (a higher PFU fraction). Hysteresis analysis shows that the frequency of clockwise event (CW) in the Koise exceeded 50%, while the figure of eight (F8) hysteresis occurred more frequently. We thus hypothesize that rainfall promotes sediment outflow from the forest edge in the Koise catchment, while the Sakura catchment has more paddy land, which leads to a more complex sediment composition due to its higher connectivity. To further study the location of sediment sources in two catchments, we propose a novel index to describe the spatial distribution of 137Cs loss using meteorological radar data, quantified land use, and 137Cs inventories. We found a significant positive correlation between this metric and 137Cs

dynamics in the Koise, rather than Sakura, which well-supports our explanation of highly 137Cs contaminated sediment in Koise mainly from the forest. Overall, our results suggest that forested areas in Kasumigaura lake may continue to discharge particulate 137Cs in the future. Moreover, the new index would be a useful tool to locate the potential sediment sources and benefit future catchment management.

2．論文

I-25-03

Radiocesium Contamination within Japanese Rivers, Sediment and Runoff

研究代表者：Johnson Edward Thomas
受入研究者：恩田 裕一

1．成果

We found that relief ratio and area are not predictors for erosion and redeposition of radiocesium impacting air dose rates following water level events across different watersheds. Relief ratio and area are not predictors for erosion and redeposition of radiocesium impacting air dose rates following water level events across individual watersheds. We did find a difference in physcial decay of dose rates and actual dose rate decay. Actual dose rate reduction was greater than that of physical decal for all locations.

2．論文

We hgave presentations at the Central Rocky Mountain Chapter of the Health Physics Society, as well as the CSU Research day. No peer reviewed publications at this time.

I-25-04

Current methodology for estimating whole-body doses to the representative residents of the settlements exposed to radioactive fallout from nuclear detonations at the Semipalatinsk Nuclear Test Site

研究代表者：Shinkarev Sergey
受入研究者：坂口 綾
共同研究者：Stepanenko Valeriy
Hoshi Masaharu

1．成果

Intensive atmospheric nuclear weapons testing at the Semipalatinsk Nuclear Test Site in 1949-1962 resulted in radioactive fallout in settlements located neighboring to this test site and exposure to the residents of those settlements. Up-to-date methodology has been adjacent to assess whole-body doses to the representative children of six age-groups (according to the ICRP recommendations: fetus, 3 mo, 1 y, 5 y, 10 y, 15 y) in 18 settlements from 12 tests. Input data were determined as follows: (1) settlement-average dose to air at the settlement considered, (2) the conversion coefficient from dose to air to whole-body dose, which varies according to the age of a representative child, (3) the behavioral factor of a representative child. In turn, the behavioral factor includes the location factors for outdoors and indoors and the fractions of time spent outdoors and indoors. The location factor for outdoors is assumed to be equal to 1. While, the location factor for indoors depends upon the degree of gamma-ray attenuation by the building material: 0.33 – for wooden houses; 0.1 – for brick houses and 0.077 – for adobe houses. The fractions of time spent outdoors and indoors depend upon the age-group of the representative children and the season.

Results: The estimates of the average-settlement dose for 18 settlements included in the project from 12 tests at the SNTS that affected those settlements have been clarified. The best estimates of the settlement-average dose to air are in the range (1-600) mGy. The estimates of the whole-body doses for majority of representative children from different age-groups were lower by a factor of approximately 2-5 than the estimates of the settlement-average dose to air in the settlements considered. About (45-75) % of life-time whole-body dose from external exposure for the representative children have been realized during three first days after fallout arrival time.

2．論文

1. Valeriy Stepanenko, Sergey Shinkarev, Andrey Kaprin, Kazbek Apsalikov, Sergey Ivanov, Peter Shegay, Evgenia Ostroumova, Ausrele Kesminiene, Alexandra Lipikhina, Viktoria Bogacheva, Kassym Zhumadilov, Masayoshi Yamamoto, Aya Sakaguchi, Satoru Endo, Nariaki Fujimoto, Bernd Groshe, Vladimir Iatsenko, Alla Androsova, Zukhra Apsalikova, Noriyuki Kawano, Masaharu Hoshi. Comparison of external dose estimates using different retrospective dosimetry methods in the settlements located nearby Semipalatinsk nuclear test site, Republic of Kazakhstan. J. Radiat. Res. 2024, 65, N 1, pp. 36-46. https://doi.org/10.1093/jrr/rrad082.

2.Valeriy Stepanenko, Sergey Shinkarev, Alexandra Lipikhina, Kazbek Apsalikov, Andrey Kaprin, Sergey Ivanov, Peter Shegay, Evgenia Ostroumova, Viktoria Bogacheva, Yuliya Brait, Kassym Zhumadilov, Masayoshi Yamamoto, Aya Sakaguchi, Satoru Endo, Nariaki Fujimoto, Bernd Grosche, Vladimir Iatsenko, Alla Androsova, Noriyuki Kawano and Masaharu Hoshi. External radiation dose reconstruction for settlements near the Semipalatinsk nuclear test site, Kazakhstan, in the international multicenter study: A detailed review and comparative analysis of the initial data. J. Radiat. Res. 2025, 66, N 5, pp. 496-508. https://doi.org/10.1093/jrr/rraf049.

Evaluation and modeling of factors controlling Cs-137 concentration in river

研究代表者：Bauer Michael
受入研究者：五十嵐 康記
脇山 義史
共同研究者：辻 英樹

1．成果

研究課題名: 河川における Cs-137 濃度を支配する要因の評価とモデリング

研究代表者: Michael Bauer

研究概要

福島第一原発事故およびチェルノブイリ事故由来の放射性セシウム（Cs-137）は、現在も森林および河川環境において移行を続けている。特に河川においては、水および懸濁物質を介した下流輸送により二次的な汚染拡散が生じることが知られている。本研究では、河川における Cs-137 濃度を支配する主要プロセスを明らかにするため、現地観測・室内実験・数値モデリングを統合した解析を行い、流域スケールでの Cs 動態の理解と予測精度の向上を目的とした。

研究内容および方法

（1）観測および実験

上流域から下流域に至る複数地点において河川水および懸濁物質を採取し、Cs-137 濃度の時系列変動を解析した。また、室内実験により、Cs の固液分配係数（Kd）の温度依存性を評価し、熱力学的関係（van’t Hoff プロット）に基づく整理を行った。

（2）モデル開発

河川を一次元場として扱い、以下のプロセスを組み込んだ数値モデルを構築した。

- 流下輸送および拡散
- 粒子の沈降・再懸濁（Shields 数に基づく）
- 河床と水中間の交換過程
- 粒径依存の輸送挙動
- 固液間分配（K_d）による Cs 挙動

特に、粒子ごとの履歴を追跡するラグランジュ型アプローチを導入し、粒径ごとの輸送特性およびばらつきを再現した。

主な成果

- 河川中の Cs-137 濃度は、単純な平均的挙動ではなく、粒径依存の輸送過程および履歴効果に強く支配されることを明らかにした。
- 河床―水中間の交換（再懸濁・沈降）が Cs 動態において重要な役割を果たすことを定量的に示した。

•固液分配係数 Kd の温度依存性が、溶存態 Cs 濃度の季節変動を説明する主要因の一つであることを確認した。

•開発したモデルは、福島阿武隈川およびチェルノブイリ流域の観測データを良好に再現し、異なる流域間での適用可能性を示した。

学術的意義

本研究は、河川における Cs-137 動態を、

•水理過程

•粒子輸送

•熱力学的分配

を統合した枠組みで理解した点に新規性がある。

特に、粒子スケールの過程（履歴・粒径）を流域スケールの挙動に結びつけた点は、従来の平均場モデルを超えるアプローチであり、放射性物質輸送の理解を大きく前進させるものである。

今後の展開

今後は、有機物からの Cs 供給過程（リター由来溶出など）をモデルに組み込むことで、流域における Cs 循環の包括的理解を目指す。また、本モデルは将来的な原子力事故時の環境影響評価やリスク予測にも応用可能である。

2．論文

I-25-06

Quantifying the impact of extreme rainfall events on the erosion of terrestrial organic carbon exported by rivers: Exploring radiocesium as a tracer

研究代表者：Clark Kasey
受入研究者：五十嵐 康記
丸岡 照幸
脇山 義史
共同研究者：

１．成果

研究概要

本研究では、福島県内流域を対象に、放射性セシウム（^137Cs）をトレーサーとして用い、河川における有機炭素動態と極端降雨イベントとの関係を明らかにすることを目的とした。特に、懸濁物質および溶存態における^137Cs の分配特性に着目し、これを陸域起源有機炭素（terrestrial organic carbon）の輸送指標として活用可能かを検討した。

研究内容および方法

対象流域として、気候および地質条件が類似しつつも土地利用が異なる福島県請戸川流域を選定した。本流域は森林（約 80%）を主体としつつ、農地および居住域が混在しており、土地利用の違いが物質輸送に与える影響を評価することが可能である。

観測は以下の 4 地点で実施した：

1）上流森林域

2）農地・回復途上農地を含む上流域

3）中流域（ダム上流）

4）下流低地（沿岸水田域）

各地点において、通常時および出水時を含む条件下で河川水および懸濁物質を採取し、^137Cs 濃度および分配特性を解析した。

主な成果

•137Cs の固液分配特性は流況条件に応じて変化し、特に高強度降雨時に顕著な変動を示すことが確認された。

•懸濁態および溶存態の^137Cs の挙動は、有機物由来成分と密接に関連しており、^137Cs が陸域起源有機炭素の輸送を反映する有効なトレーサーとなる可能性が示された。

•土地利用の違い（森林・農地・都市域）は、炭素および^137Cs の輸送特性に明確な影響を与えることが示唆された。

•極端降雨イベントは、河川を通じた有機炭素および^137Cs の輸送を強く促進し、その影響は流域特性に依存して異なることが明らかとなった。

学術的意義

本研究は、放射性セシウムを用いて河川における有機炭素輸送を評価する新たなアプローチを提示した点に新規性がある。特に、極端降雨イベント下における物質輸送過程を定量的に理解する枠組みを提供し、炭素循環および放射性物質動態の統合的理解に貢献する。

今後の展開

今後は、より高頻度観測およびモデル解析を組み合わせることで、極端降雨イベントが炭素フラックスおよび放射性物質輸送に与える影響の定量化を進める。また、本研究成果は、気候変動に伴う降雨強度の増加に対する流域管理および炭素収支評価の高度化に資することが期待される。

2．論文

Natural radioactivity and its radiation hazards in organic and inorganic agricultural soils of Tamil Nadu, India

研究代表者：Ananthanarayanan Chandrasekaran
受入研究者：ラハマン モハマド モフィズル イスマイル
共同研究者：Begum Zinnat Ara

1．成果

☒Research objective☒

The application of organic and inorganic fertilizers alters natural radionuclide concentrations in agricultural soils, which are influenced by regional geological and geographical factors. This research investigates the concentrations and activities of 238U, 232Th, and 40K in soil samples, along with measurements of absorbed dose rate, radium equivalent activity, annual effective dose, internal hazard index, and excess lifetime cancer risk, to assess radiological impacts. Findings are contextualized with international data and compared to UNSCEAR guidelines; multivariate statistical analyses are employed to evaluate interrelationships among radioactive parameters.

☒Experimental☒

In this study, twenty-one soil samples were systematically collected from diverse locations across Tamil Nadu. Each sample was placed in a polythene bag, clearly labeled, and transported to the laboratory for pre-treatment. To ensure homogeneity and facilitate precise gamma-ray spectrometric analysis, the samples were ground into a fine, uniform powder. Subsequently, the powdered samples were oven-dried at 105 ° C for 2 h to remove moisture, then packed into 250 mL Marinelli beakers. The beakers were securely sealed with screw caps and Teflon tape and stored in an undisturbed environment for 4 weeks to achieve secular equilibrium among natural radionuclides and their short-lived progeny. Finally, the samples underwent NaI (Tl) gamma-ray spectroscopic analysis to determine the activity concentrations of primordial radionuclides, specifically 238U, 232Th, and 40K.

☒Observations☒

The activity concentrations of 238U, 232Th, and 40K in soil samples were quantified using a gamma-ray spectrometer equipped with a NaI (Tl) detector. Results indicate that these concentrations were generally elevated. Specifically, in organic soil samples, the activity concentrations of 238U ranged from below detection limit (BDL) to 68 Bq/kg, 232Th ranged from 23 to 165 Bq/kg, and 40K ranged from 340 to 1040 Bq/kg. For inorganic soil samples, the activity concentrations of 238U ranged from 11 to 72 Bq/kg,

232Th from 35 to 230 Bq/kg, and 40K from 543 to 1243 Bq/kg. Additionally, the absorbed dose rate and annual effective dose rate were calculated for both organic and inorganic soils. These values exceeded the recommended limits for the study area by a slight margin.

２．論文

1. Chandrasekaran, A. and Rahman, I.M., 2025. Radiological profiling of modern building materials: A case study of natural radionuclides in vitrified tiles from Tamil Nadu, India and their health implications. Nuclear Engineering and Technology, 57(11), p.103754.

2. Chandrasekaran, A. and Rahman, I.M., 2024. Effect of natural radioactivity along the southern coastal area of Tamil Nadu with statistical approach. Journal of Radioanalytical and Nuclear Chemistry, 333(12), pp.6155-6165.

Estimation of uranium ions concentration in drinking water sources around the Natural High Background Radiation Area of Chavara, Kerala, India.

研究代表者：Saiyad Musthafa M.
受入研究者：ラハマン モハマド モフィズル イスマイル
共同研究者：Begum Zinnat Ara

１．成果

☒Research objective☒

Uranium, a radioactive element, is naturally found in the environment as minerals with varying concentration levels. Contamination of drinking water with uranium poses a significant risk due to its chemical and radioactive properties. The purpose of this research is to estimate the concentration of uranium ions in drinking water sources around the Natural High Background Radiation Area (NHBRA) of Chavara, Kerala, India. The study aims to the following: (a) Determine the levels of uranium contamination in groundwater and assess the potential health risks to the population in the NHBRA of Chavara, Kerala; (b) Investigate the geological and anthropogenic factors contributing to uranium contamination in the region; (c) Evaluate the effectiveness of current monitoring and management strategies for uranium contamination in India; (d) Generate baseline data for future research on uranium contamination and remediation efforts in similar areas.

☒Experimental☒

For this study, ten locations were selected along the Chavara coasal stretch. 100 mL of drinking water samples were systematically collected & filtered using 0.45-μm Whatman filter paper and acidified with nitric acid (HNO3). Uranium was measured using LED fluorimeter (LF-Quantalase) within a range of 0.5–1000 μg/L, with an accuracy of ±10 % or 0.05 μg/L. The physio-chemical indices were measured using a multi-parameter water quality probe (Hanna Multi Probe). Mass concentration of Uranium manipulated with conversion factors to obtain Activity Concentration of Uranium & Annual Effective Dose to general public due to consumption of drinking water in the Natural High Background Radiation Area of Chavara, Kerala, India.

☒Observations☒

In this study, an LED flourimeter was used to estimate the amount of uranium present in the drinking water samples taken from the NHBRA of Chavara, Kerala, India. The results infers, the uranium content in groundwater varies in different orders of magnitude which may be due to the kind of geological formation and anthropogenic activities. Uranium levels in drinking water were measured between 0.76 and 230.5 μg/L, with about 12% of the samples exceeding the AERB's radiological limit (RBL) of 60 μg/L. The uranium activity concentration in drinking

water ranged from 0.02 to 6.02 Bq/L. Annual Effective Dose (AED) values ranged from 1.2 to 95.0 μSv/y, remaining within the WHO's recommended limit of 100 μSv/y . This benchmark data on uranium levels in groundwater sources in the NHBRA of Chavara, Kerala, and assessed health risks to the population is pivotal for further studies.

２．論文

PUBLISHED RESEARCH ARTICLES

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2.Priyadharshini, M., Santhanabharathi, B., Chandrasekaran, A., Ahmed, M.S., Pradhoshini, K.P., Aarthi, M., Duong, V.H., Nguyen, X.Q., Begum, Z.A., Rahman, I. and Musthafa, M.S., (2025). Assessment of Gross Alpha, Gross Beta, 210Po, and 210Pb in Rice and their Associated Health Risks in Tamil Nadu, India: A Baseline Study. Applied Radiation and Isotopes, p.112253. https://doi.org/10.1016/j.apradiso.2025.112253

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Development of magnetic carbonaceous materials from agro-waste for the removal of radionuclides

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1．成果

Report

This report details the successful progress and accomplishments of the research project focused on developing magnetic carbonaceous materials (MCMs) from agro-waste for radionuclide remediation. Following the proposed research plan, mahogany (Swietenia mahagoni) seed shells were utilized as a sustainable precursor to create high-performance adsorbents. To date, the project has successfully synthesized these materials and demonstrated a significant adsorption capacity of 47 mg/g for the removal of Strontium (Sr(II)) from aqueous solutions.

The project transitioned from the conceptual framework of renewable resource use to the practical application of circular economy principles. The following milestones have been achieved:

☒Mahogany seed shells, an abundant agro-waste, were processed into carbonaceous materials and incorporated with iron-based nanoparticles to impart magnetic properties.

☒Advanced analytical techniques have been employed to confirm the structural and functional integrity of the MCMs:

- •XRD confirmed the crystalline structure and the successful incorporation of magnetic phases.
- •VSM and use of an external magnet confirm the magnetic character of MCMs.
- •SEM revealed the co-existence of nano-sized magnetic and carbonaceous parts that are essential for effective adsorption.
- •FTIR identified the presence of functional groups responsible for chemical interactions with radionuclides.

☒Initial batch experiments targeting Sr(II) have yielded an adsorption capacity of 47 mg/g. This aligns with the expected result of producing materials with high surface area and customized pore structures.

Ongoing Work and Outlook

While the primary structural characteristics have been established, further characterization (including BET, Raman, and XPS analysis) is currently ongoing to map the precise surface area and elemental composition. Future phases will focus on reusability testing to evaluate

the stability of the MCMs over multiple adsorption-desorption cycles, ensuring economic feasibility for large-scale environmental applications.

Upon completion of the remaining characterization and analysis, a manuscript detailing these findings will be submitted to a peer-reviewed journal for publication.

2．論文

1. Magnetic graphene nanocomposites: a new frontier in radioactive waste remediation (https://pubs.rsc.org/en/content/articlelanding/2026/va/d5va00319a).

2. Environmentally sustainable synthesis of reduced graphene oxide using Piper chaba stem extract and its adsorbent efficacy towards wastewater treatment. (https://www.sciencedirect.com/science/article/pii/S221171562600007X?via%3Dihub.)

Synthesis of High-Quality Graphene from Borneo Bamboo for Selective Sorptive Separation of Lead Isotopes

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受入研究者：ラハマン モハマド モフィズル イスマイル
共同研究者：Begum Zinnat Ara
Mohamad Said Khairul Anwar

1．成果

The core outcome of this research is the successful conversion of Borneo Bamboo into high-quality graphene designed for the selective removal of lead (Pb) isotopes from contaminated water. The research produces graphene characterized by a high surface area and a tunable pore structure, which are essential for effective adsorption. The graphene is functionalized with oxygen-containing groups to significantly improve its ability to bind with and remove Pb isotopes. The study identifies that the removal of lead occurs through complex interactions, specifically electrostatic forces and ion exchange between the lead isotopes and the functionalized graphene surface. According to the findings, authors manage to published journal article.

2．論文

Submitted in previous report

I-25-12

Application of analytical methodology of Cs-137 in seawater for Vietnam coastal fish to estimate background level

研究代表者：Nhan Duc Dang
受入研究者：高田 兵衛
共同研究者：GIAP DINH NGUYEN
立田 穣

1．成果

The Ammonium Phosphomolybdate (AMP) co-precipitation for more selective isolation of 137Cs from seawater and digested solution of fish samples that could improve the sensitivity of the gamma-spectrometry for 137Cs quantification was adapted since 2025 by the INST for 20 L of seawater and 1 kg-wet of marine fish.

In the Joint Research Project, a training course was held at the IER Institute on AMP procedure for 137Cs separation from seawater and from biota digested solution, ICP-MS procedure for analyzing stable Cs and field sampling.

The activity concentrations of 137Cs in fish ashes (450oC, 48h) were quantified using the gamma-spectrometry with HpGe. Subsequently, the fish ash samples were processed using the AMP/CS method.

A total 2 seawater and 14 fish samples were measured by the INST under the study. The analysis results showed an average activity concentration value of 0.48 Bq/kg-dry. By AMP/Cs process, the results were 0.97 ± 0.17 mBq/L and 0.089 ± 0.019 Bq/kg-wet respectively (approximately 0.39 ± 0.08 Bq/kg-dry) for seawater and marine fish from Vietnam.

The results show that the activity concentrations were similar to those using large volumes of seawater and marine fish.

2．論文

Not yet

I-25-13

Modeling the Transport of Radionuclides in the Niida River using the WRF-Hydro Model

研究代表者：Kopka Piotr
受入研究者：グシエフ マキシム
共同研究者：Potempski Sławomir

1．成果

This pilot ERAN International project aims to develop the WRF-Hydro model transport mechanisms for tritium (^{3}H) and cesium-137 (^{137}Cs) radionuclides deposited in the Niida River basin. Since the original WRF-Hydro model lacks radionuclide and sediment transport modules, there is a need to develop radionuclide transport and dispersion modules for understanding tritium and cesium-137 movement in riverine systems.

The Niida River has measurements of both tritium and cesium-137 radionuclides including suspended sediments and river water levels, which were converted to river discharge, and we focused on ^{3}H and ^{137}Cs data due to their significant long-term environmental impact following the Fukushima Daiichi Nuclear Power Plant (FDNPP) accident. In this first ERAN project, we conducted the initial WRF-Hydro model setup, river discharge calibration and validation, and plan to integrate radionuclide module into the source code of the original WRF-Hydro model. The radionuclide transport of the modified WRF-Hydro model will include groundwater–surface water interactions, adsorption/desorption dynamics, and sediment transport mechanisms to be match tritium and Cs-137 radionuclide data in the Niida River Basin under different hydrological conditions. These findings will be crucial for predicting the long-term fate of radioactive contaminants in river systems and for designing better environmental protection policies. Additionally, the research will support ongoing international efforts between Poland and Japan to understand radionuclide behavior in freshwater environments, with implications for nuclear disaster prevention and recovery. The final results will be submitted to a high-impact scientific journal, ensuring widespread dissemination of the findings. This ERAN project's outcomes will also serve as a foundation for future studies in hydrological modeling, environmental radioactivity, and ecological risk assessment, strengthening the scientific basis for long-term environmental monitoring programs in contaminated regions.

2．論文

None

I-25-14

Modeling soil contamination of 90Sr and 137Cs radionuclides due to a ground nuclear test explosion conducted on September 24, 1951 on the Semipalatinsk test site territory.

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共同研究者：Aidarkhanov Assan

1．成果

Nuclear weapons testing leaves behind radioactive contamination as a long-lasting legacy and public health hazard at the Semipalatinsk Test Site (STS), which had 116 nuclear tests between 1949 and 1963 with the 90Sr and 137Cs main dose-forming radionuclides. To address, we investigated 90Sr and 137Cs activity concentrations and 90Sr/137Cs ratios in topsoil and soil particle-size fractions collected in the fallout plumes from the 38 kt aboveground nuclear test conducted on September 24th, 1951 (the Southern plume - No. 1) and the 400 kt first thermonuclear test on August 12th, 1953 (the Southeastern plume - No. 2).

In the STS, Southern and Southeastern topsoil locations were sampled up to 5 cm using an envelope technique and 3.0-3.5 kg collected samples were dried at 105 o C removing <1 mm fraction. By quartering, a soil sub-sample of ~150 g was collected from the separated fraction for grounding by PULVERISETTE 9 and sent for γ-spectrometric analysis with a high-purity germanium solid-state detector GEM-FX5825P4. To separate soil fractions, 'wet' sieving and sedimentation techniques were sequentially used. From each soil sample that underwent γ-spectrometric analysis, a 5 g subsample was calcinated in a muffle furnace at 550 oC for 9h removing organic matter and used for 90Sr separation by addition of SrCl2, sequentially treated with concentrated solutions of hydrofluoric, nitric, and hydrochloric acids. The resultant solution was used to isolate and purify Sr-isotopes by sequential precipitation (iron hydroxide and strontium carbonate). After the chemical precipitation steps, 90Sr re-dissolved into the solution was let to reach the radioactive equilibrium with its decay progeny 90Y after 14 days, precipitated in the form of yttrium Y(OH)3, transferred to a muriatic acid solution and then to a vial before the 90Y activity was measured. The activity of 90Sr was determined from accumulated 90Y by Tri-Carb 2900 TR liquid-scintillation analyzer of 2 h. Following beta-spectrometric analysis, the chemical yield of 90Sr was determined in the filtrate solution remaining after 90Y co-precipitation by inductively coupled plasma-optical emission spectrometry iCAP-6000.

Results show that activity levels of radioactive 137Cs contamination were comparable

in the two plumes, but the Southeastern plume had higher 90Sr levels. The estimated 90Sr/137Cs ratios were between 0.4 and 1.7 for the Southern plume, while the ratios of thermonuclear test's plume ranged between 1.1 and 5.4, which are assumed to be due to the different types and yields of the nuclear charges. In the Southern plume, radionuclides were concentrated in the 250-100 μm fraction, without variability of the radionuclide ratios based on particle-size fractions. The maximum 90Sr/137Cs ratio for the Southern plume did not exceed 3, and was less than 1 for finer fractions. For the Southeastern plume, the values of the 90Sr/137Cs ratios in soil particle-size fractions reduce as the size of the fractions decreased from 1000 to 40 μm. High activity concentration ratios of up to 6.2 were observed for fractions ranging from 250 to 1000 μm. The research results of a comprehensive environmental survey of the STS provided insight into the distribution of 90Sr and 137Cs radionuclides in the atmosphere-soil system during ground-based nuclear tests and were published in a reputable journal (Baklanova et al., 2025).

Reference:

Baklanova Y.V., Kabdyrakova A.M., Aidarkhanov A.O., Krivitskiy P.Y., Kunduzbayeva A.Y., Abisheva M.T., Salmenbayev S.Y., Larionova N.V., and Gusyev M. (2025). Comparison of 90Sr/137Cs activity ratios in the soil of fallout plumes from aboveground nuclear and thermonuclear tests at the Semipalatinsk Test Site. Journal of Environmental Radioactivity 287, 107726, DOI: 10.1016/j.jenvrad.2025.107726

2．論文

Baklanova Y.V., Kabdyrakova A.M., Aidarkhanov A.O., Krivitskiy P.Y., Kunduzbayeva A.Y., Abisheva M.T., Salmenbayev S.Y., Larionova N.V., and Gusyev M. (2025). Comparison of 90Sr/137Cs activity ratios in the soil of fallout plumes from aboveground nuclear and thermonuclear tests at the Semipalatinsk Test Site. Journal of Environmental Radioactivity 287, 107726, DOI: 10.1016/j.jenvrad.2025.107726

Tritium measurement in the terrestrial surface waters of the Carpathian Basin (EU) and Hamadori-Nakadori (Japan) mountain ranges

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共同研究者：Hegedűs Miklós
Piroska Tóth

1．成果

The Carpathian basin, similar to Japan, is the home of a large number of natural springs and termal water resources, which offer a potential interest for tritium measurement. By measuring tritium concentrations in such waters, we can improve our understanding of hydrodynamics and provide data for climate change research and a baseline for assessing the potential effects of nuclear facilities. In our research, water samples were collected from Hungary and Romania, from rivers, thermal springs, wells, and precipitation in the Carpathian Basin. All samples were stored in 2 L polyethylene containers and transported to the laboratory under controlled conditions. Tritium activity concentrations were determined at the IAEA Isotope Hydrology Laboratory using a standard procedure for low-level environmental samples. The analytical method consists of distillation, electrolytic enrichment using a polymer electrolyte membrane (PEM) system, and liquid scintillation counting (LSC). Electrolytic enrichment was applied to increase tritium concentration. Following enrichment, samples were mixed with scintillation cocktails (Ultima Gold LLT) and measured using ultra-low-level liquid scintillation counting (LSC) systems. Tritium activity concentrations were calculated from net count rates of the sample relative to standards, considering background subtraction, the enrichment factor, and radioactive decay correction.

Tritium activity concentrations in surface and thermal waters ranged between 0.036 ± 0.004 and 0.981 ± 0.014 Bq/L (≈ 0.30–8.25 TU) in line with usual worldwide activity concentration data. The highest activity was observed in the precipitation sample: 1.046 ± 0.015 Bq/L (8.79 TU). Several thermal waters exhibited low tritium concentrations, including Hévíz outflow (0.136 ± 0.005 Bq/L ≈ 1.14 TU), the Szent Mihály well (0.061 Bq/L) and selected springs in Transylvania (<0.06 Bq/L). Elevated values were identified at specific locations, notably a private thermal well in Érd and a hot spring at Bálványos, indicating recent contact with the atmosphere. In our findings, low tritium concentrations indicate limited recent recharge and longer groundwater residence times. In contrast, elevated tritium values suggest a stronger contribution

from recent precipitation and more active hydrological turnover. The rainwater sample shows slightly higher tritium activity compared to regional long-term averages but remains within the expected seasonal variability. Overall, the measured range is consistent with typical environmental tritium levels reported worldwide. Hévíz, Europe's largest thermal lake, is known to be fed by 3 hot and 1 cold underwater springs, selective sampling of them might be of interest.

The main findings were

- •Tritium variability reflects mixed groundwater systems
- •Thermal waters generally show low modern water contributions
- •Local anomalies indicate site-specific recharge conditions
- •Results are consistent with global environmental datasets

Further work will focus on detailed comparison between European and Japanese datasets and on identifying the controlling hydrological processes. The results are currently being processed to publish a joint manuscript on investigating the possible causes of our observations in this research, and there is a possibility of establishing possible background water resources based on our activity concentration results, waters containing activity concentrations less than <0.06 Bq/L might be convenient background waters for atmospheric or surface water research and can possibly incorporated into laboratories working on limited amounts of organic samples.

2．論文

None

I-25-16

The Biological Effects of Indoor Radon Exposure in Humans

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三浦 富智
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1．成果

Humans spend a substantial proportion of their time in indoor environments, where exposure to environmental pollutants such as radon and household dust is common. Radon is a well-established risk factor for lung cancer, while household dust can act as a reservoir for a wide range of particulate contaminants originating from both indoor and outdoor sources. In indoor environments, radon progeny may attach to airborne particles, including components of household dust, potentially enhancing their deposition in the respiratory tract. However, the potential combined biological effects of radon and household dust exposure on lung epithelial cells remain poorly understood. Therefore, this study aimed to investigate the cytotoxic and genotoxic effects of co-exposure to radon and household dust in human lung epithelial cells. Household dust samples were collected from residential environments in Lampang Province, Thailand. Dust extracts were prepared using water and methanol–water (1:1, v/v) and applied to A549 human lung epithelial cells. A549 cells were divided into four groups: control, radon exposure alone (45 min/day for two consecutive days), household dust extract treatment alone (24 h), and combined exposure in which cells were first treated with dust extracts for 24 h followed by radon exposure. Cellular responses were evaluated using cell viability assays, cytokinesis-block micronucleus analysis, and Western blotting to examine oxidative stress (Nrf2/HO-1), DNA damage (γ-H2AX), autophagy (LC3), and inflammation (IL-6). Household dust extracts significantly reduced cell viability and increased micronucleus formation in A549 cells. Co-exposure to radon and household dust further enhanced oxidative stress, as indicated by activation of the Nrf2/HO-1 signaling pathway. Increased γ-H2AX expression and micronucleus frequency suggested enhanced DNA damage. In addition, co-exposure induced autophagy activation and inflammatory responses, as evidenced by an increased LC3 II/I ratio and elevated IL-6 expression. These findings demonstrate that combined exposure to radon and household dust induces oxidative stress–mediated cytotoxic and genotoxic effects in lung epithelial cells. The results provide mechanistic evidence that interactions between indoor radon and particulate contaminants in household dust may contribute to health risks associated with indoor environmental pollution.

2．論文　　N.A.

Environmental Radioactivity, Radiation Physics

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大森 康孝
共同研究者：Singh Deepak

1．成果

Progress Report

This project was aimed to assess uranium and other potentially toxic elements (PTEs) in potable water of Yamuna and Tons valleys of Garhwal Himalaya, India. For this purpose, a total of 40 potable groundwater samples were collected from the study area. The collected samples prepared and analyzed for uranium and potentially toxic elements using Inductively Coupled Plasma Mass Spectrometry (ICPMS). The measured values of uranium concentration in potable groundwater samples were observed to range from 0.01 to 23.42 µg L-1in the Yamuna valley and BDL to 2.95 µg L-1in Tons valley of Garhwal Himalaya. The concentration of uranium in all the investigated water samples were found below the prescription limit of 30 µg L-1 suggested by the World Health Organization (WHO). The radiological (carcinogenic) and chemical (non-carcinogenic) risks associated with uranium consumption through drinking water were also estimated and found below the safe limits.The mean values of concentrations of PTEs such as Cr, Mn, Fe, Ni, Cu, Zn, As, Mo, Cd, Sb, Ba and Pb in the investigated groundwater samples were found to be 0.827µg L-1, 4.590µg L-1, 1.612µg L-1, 0.667µg L-1, 0.688µg L-1, 20.926µg L-1, 1.112µg L-1, 1.178µg L-1, 0.008µg L-1, 0.399µg L-1, 44.252µg L-1, 2.165µg L-1 and 1.871µg L-1, respectively. The concentrations of these PTEs (except Pb) were found to be below the guideline values prescribed by WHO. However, Pb concentrations in a few samples exceeded the recommended limit. The findings of the project also provide a baseline database for future hydrogeochemical studies beyond the immediate implications for public health. The findings provide baseline data for regulatory authorities aligned with United Nations Sustainable Development Goal 6 (i.e. clean water and sanitation).

2．論文

1.Deepak Singh, Ganesh Prasad, Sanjeev Kimothi, Subhash Chandra, Yasutaka Omori, Masahiro Hosoda, G. Anil Kumar , Shinji Tokonami and Rakesh C Ramola. Occurrence, correlation and health implications of uranium and other potentially toxic elements (PTEs) in Himalayan springs. J RadioanalNuclChem334, 7497–7506 (2025).

https://doi.org/10.1007/s10967-025-10279-9
2.Ganesh Prasad, Krishna Pal Singh, Deepak Singh, Mukesh Prasad, Vivek Anand, Subhash Chandra, Yasutaka Omori, Masahiro Hosoda, G. Anil Kumar, Shinji Tokonami & R.C. Ramola. Health risk assessment of uranium in drinking water of Tons Valley in Garhwal Himalaya, India. J Radioanal NuclChem (2025).
https://doi.org/10.1007/s10967-025-10679-x

Design and realization of a smart survey meter based on low-cost electronic components for simultaneous ambient equivalent dose rate and radon concentration measurement: Calibration with a stable radon gas in low, medium and high concentration

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共同研究者：SÄIDOU
Omar Bobbo Modibo

1．成果

Our projet reports the radon tracing using a low-cost, locally manufactured smart electronic device with comparison to a reference radon measuring device. Developed for radiation protection and nuclear security, the proposed device consists of a ZP 1200 Geiger-Müller (GM) tube detector, low-cost components namely the Arduino microcontroller board, the DHT11 temperature (T) and relative humidity (RH) sensor and XBee-based Internet of Things (IoT) wireless transmission modules. The reference device measures radon concentration, temperature, and relative humidity in indoor spaces. Typically, the developed device provides data of atmospheric parameters (T, RH) and the ambient dose equivalent rate. From the ambient dose equivalent rate (in μSv/h), radon activity concentration (in Bq/m3) is deducted using standard and recognized conversion coefficients. The coefficients vary according to the ambient radiation strength and are ranging from 5500 to 8900 (Bq/m3)/(μSv/h). The developed device and the reference instrument were exposed during one month in several dwellings in the city of Yaoundé-Cameroon, and periodic average values of 27.51 ° C (developed device) and 26.19 ° C (RadonEye) for temperature, 74.10 % (developed device) and 73.00 % (RadonEye) for relative humidity, and 1499.19 Bq/m3 (developed device) and 1464.91 Bq/m3 (RadonEye) of cumulated radon activity concentrations, for a 24 hours of exposure period were evaluated. Statistical analyzes carried out on the results of the two devices provide a linear regression coefficient of R2 = 0.9978. This shows a good agreement between the data of the developed device and the reference instrument RadonEye.

Keywords: Radon tracing, radon monitoring, relative humidity sensor, temperature measurement

2．論文

Publications that have cited the ERAN projects

ERAN 2025: I-25-18

[1] Jacob Mbarndouka Taamté, Yvette Flore Tchuente Siaka, Soumayah Bachirou, Gouroudja Ahmadou, Dieu Souffit Gondji, François Koyang, Modibo Oumar Bobbo, Saïdou "Water Quality Assessment in the Lakes of Yaoundé City of Cameroon for Environmental Monitoring and Human Health" African Journal of Aquatic Science, 2025, https://doi.org/10.2989/16085914.2025.2602727　(Taylor and Francis)(accepted and in process).

[2] Jacob Mbarndouka Taamté, Yvette Flore Tchuente Siaka, Saïdou "An overview of air quality monitoring based on low-cost electronic sensors in Cameroon", Journal of Instrumentation, 2025, DOI: 10.1088/1748-0221/21/02/T02005　(IOP).

Evaluation of the effective dose from radon thoron decay products in Hin Dat natural hot springs, Thong Pha Phum district, Kanchanaburi province

研究代表者：Rattanapongs Chanis
受入研究者：床次 眞司
クランロッド チュティマ

1．成果

Radon (Rn) and thoron (Tn) are radioactive noble gases that are produced by uranium (U) and thorium (Th), which occur naturally in geological formations, including hot springs. Upon inhalation, radon decays, emitting high-energy alpha radiation (4.869 MeV) and generating radioactive progeny that may pose significant health risks, particularly to the respiratory system. Although thoron has a relatively short half-life (5.5 seconds) and is generally less important than radon, exposure to thorium-rich soil may increase the health risks of thoron inhalation. The decay products of radon and thoron accumulate in the alveoli, where they are difficult to expel, potentially causing cellular damage from alpha radiation and lead toxicity, thereby increasing the risk of lung cancer. This research studies the efficiency of passive detectors as an alternative method for detecting radon-thoron decay products in open areas with high background radiation levels in Thailand. Hin Dat Hot Springs was initially selected as a research site due to its high background radiation levels and its status as a significant tourist attraction in Thong Pha Phum District, Kanchanaburi Province. RnPTnP monitoring detectors with a solid-state alpha track detector were installed around the Hin Dat Hot Springs for about three months to monitor the amount of radon and thoron progeny in the air, along with a radon-thoron concentration monitor (RADUET) for result comparison. However, all results showed that the concentration of radon progeny in the area ranged from 0.8 to 21 Bq m $^{-3}$, with a mean of 7.6 Bq m $^{-3}$, while the concentration of thoron progeny ranged from 0.8 to 3.5 Bq m $^{-3}$, with a mean of 1.8 Bq m $^{-3}$. The annual radiation dose values for radon progeny were found to be 7.5 - 219.9 μSv y-1, with an average of 79.4 μSv y-1. The radiation dose values for thoron progeny were 0.4 - 1.4 μSv y-1, with an average of 0.9 μSv y-1. The test results showed that the measured radon-thoron decay product concentration exceeded the lower limit of detection, indicating that passive radon-thoron decay product detection is feasible for use in open areas with high background radiation.

2．論文

I-25-20

Detection of Metabolomic and Genomic Biomarkers as a Radiation Response to Support Risk Analysis Safety: A Study of Nuclear Fasility Radiation Workers

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1．成果

The health consequences of continuous exposure to low doses of IR are still a topic of great scientific interest. Research on the biological effects of chronic occupational exposure to ionizing radiation has become a widely developed topic by analyzing selected genomic and metabolomic biomarkers. Workers who work in nuclear facilities, either as researchers or as operators, are potentially at risk of long-term exposure to ionizing radiation at low to moderate doses. Although these exposures are generally within regulatory safety limits, cumulative biological effects may still occur, particularly at the molecular and cellular levels. Therefore, identifying sensitive and reliable biomarkers is essential to support early detection of radiation-induced damage, improve occupational health surveillance, and strengthen risk assessment strategies. Oxidative stress and genomic instability are central mechanisms in radiation-induced health risks. Malondialdehyde (MDA) is a reliable marker of lipid peroxidation, while reduced glutathione (GSH) reflects antioxidant defense. Micronucleus (MN) frequency in lymphocytes is a validated cytogenetic biomarker of genotoxicity. The study focuses on both genomic damage indicators and oxidative stress-related metabolomic markers to provide a comprehensive evaluation of radiation response. A cross-sectional study was conducted among 40 exposed worker who worked as researchers at Nuclear Facilities with varying radiation usage backgrounds, including X-rays, Gamma Rays, and Neutrons, and 30 age- and sex-matched controls from administrative staff. Peripheral blood lymphocytes were analyzed for micronucleus frequency using the cytokinesis-block method. Plasma MDA, GSH, and TAOC, were quantified by standard biochemical assay. The result show exposed workers demonstrated a relatively higher micronucleus frequency but statistically not significant, and relatively elevated MDA levels, statistically it is not significant. In contrast, GSH were significantly reduced in the

exposed group. TAOC levels showed a mild, non-significant decrease. Based on the correlation between years of exposure the result show that Micronucleus frequency and MDA correlated positively with years of exposure. Whereas GSH and TAOC showed negative correlations. In terms of correlation with the dose received it shows that micronucleus frequency correlated negative. Meanwhile MDA, GSH and TAOC showed positive correlations. These findings indicate that chronic exposure to ionizing radiation, even at regulated occupational levels, may induce oxidative stress and genomic instability. The integration of genomic and metabolomic biomarkers provides a multidimensional assessment of radiation effects, capturing both molecular damage and systemic biochemical alterations. Conclusion and Implications: The combining cytogenetic and biochemical biomarkers offers a sensitive and comprehensive approach for biological monitoring of radiation worker. These biomarkers can support early detection of subclinical radiation effects, enhance occupational health surveillance programs, and contribute to evidence-based risk analysis and safety management policies.

2．論文

Not Yet Publish

I-25-21

A Study of Method for the Determination of Low-Level Organic-Bound Tritium Activities in seafoods and Ready-to-Eat food

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共同研究者：Itthipoonthanakorn Thawatchai

1．成果

Introduction

Following the Japanese government's decision to release treated radioactive waste from the Fukushima nuclear power plant, concerns regarding environmental and human health impacts have increased globally. While the Advanced Liquid Processing System (ALPS) is designed to remove most radioactive contaminants, tritium remains diluted below 1,500 becquerels per liter. As Thailand’s nuclear safety regulatory agency, the Office of Atoms for Peace (OAP) seeks to establish continuous environmental monitoring to prevent radiological hazards and ensure the safety of food products such as seafood and ready-to-eat meals.

Objectives

•To establish a standardized protocol for determining low-level Organic-Bound Tritium (OBT) in diverse food matrices.

•To compare and contrast sample preparation and combustion techniques between the Hirosaki University method and the OAP laboratory.

•To optimize combustion conditions for maximum recovery and achieve results above the detection limit.

Methodology and Comparative Analysis

The study compares two specialized analytical workflows:

•Hirosaki University: Employs Freeze drying for pretreatment, followed by a dedicated Combustion process, distillation, and Liquid Scintillation Counting (LSC) analysis using a 100 mL vial.

•Office of Atoms for Peace: Utilizes Oven drying for pretreatment, followed by Pyrolysis, distillation, and LSC analysis using a 20 mL vial.

Technical Results

Experimental runs comparing initial sample weights of 10 g and 15 g found that the 15 g sample mass is most effective and compatible with the required temperature profile. A detailed 13-segment temperature profile has been developed, ranging from 25° C to 800° C, with precise control over air and oxygen flow to ensure optimal sample recovery.

Execution Timeline (2025)

The project follows a structured timeline for implementation at OAP and Hirosaki University:

- Mar–Sep 2025: Procurement of the Pyrolyser equipment.
- Oct–Nov 2025: Study of sample preparation and extraction techniques.
- Dec 2025 : Laboratory visit to Hirosaki University to master specialized methodologies and transfer technical knowledge for implementation at OAP.
- Jan–July 2026: Optimization of methods and continued study of detection limits at the OAP laboratory.

Future Work

To optimize the method, OAP will validate the Hirosaki University parameters to evaluate results. Liquid Scintillation Counting (LSC) with a low-background counter will be employed to maintain results within the established Minimum Detectable Activity (MDA) threshold. Additionally, a comparative analysis of sample preparation and combustion techniques will be conducted between the Hirosaki University protocol and the OAP laboratory's existing methods.

2．論文

I-25-22

Assessment of Tritium Levels in Imported Seafood Products

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共同研究者：Chuenbubpar Darunwan

1．成果

Thailand currently lacks standardized protocols for analyzing radioactive nuclides in food products, particularly Organically Bound Tritium (OBT). Understanding the behavior of tritium in food is crucial, as it can be incorporated into biological molecules, leading to longer retention times in the human body compared to tritiated water. To gain practical expertise and technical insights into OBT analytical methodologies into OBT analysis techniques, a representative from Thailand institute of Nuclear Technology (TINT) conducted a technical visit to Tritium laboratory at the Institute of Radiation Emergency Medicine (IREM), Hirosaki University in Aomori, Japan, from on 8 - 12 December 2025.

This study aims to 1) investigate sample preparation methodologies for the extraction of Tissue Free Water Tritium (TFWT) and OBT extraction from various complex food matrices., 2) evaluate the efficiency of the water purification and distillation/reflux techniques post-extraction to ensure high-purity samples for analysis for liquid scintillation counting (LSC)., and 3) comprehensive analytical workflow for low-level tritium detection, facilitating the future implementation of these protocols within Thailand's national laboratory framework.

This technical visit, technical proficiency was achieved in the complete analytical workflow for tritium analysis in food. The training began with comprehensive pre-treatment protocols, including samples collection, long-term preservation, and preparation. The main of the technical transfer focused on specialized extraction methods. Tissue Free Water Tritium (TFWT) was isolated from food matrices via freeze-drying techniques. Conversely, Organically Bound Tritium (OBT) was extracted by thermal combustion under controlled oxidative conditions, subsequently recovering the tritium in the form of tritiated water.

Additionally, comprehensive understanding of water purification and reflux protocols was acquired, ensuring the removal of organic impurities and interfering with radio nuclides to enhance analytical precision. Including gain the valuable information for minimize analytical uncertainties and enhance the precision and accuracy of measurements.

The Future plan, the visitor will set up the instrument of Chemical and Combustion.

Following the equipment setup, the focus will shift toward the formal implementation of a Proficiency Testing (PT) Program.

2．論文

Comparison of Activity concentration of Sr-90 in seawater, sediment and fish samples between the South China Sea - Vietnam and Fukushima Prefecture - Japan

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受入研究者：田副 博文
共同研究者：Le Xuan Thang

1．成果

The research was conducted to determine the activity concentrations of Strontium-90 (Sr-90) in samples collected from various sites in the South China Sea-Vietnam and compare the sample results to those reported of Fukushima Prefecture, Japan, following the Fukushima Daiichi Nuclear Power Plant (FDNPP) 2011 accident.

Surface seawater, marine sediment, and fish samples were collected from Ninh Thuan, Phu Quy, Vung Tau, and Phu Quoc in the South China Sea, Vietnam, in 2025. The Sr-90 activity concentrations ranged from 0.99 to 1.18 mBq/L in seawater, from 0.44 to 0.53 Bq/kg dry weight in sediments, and from <0.03 to 0.04 Bq/kg fresh weight in fishes. These results are consistent with the ranges reported in previous studies conducted in Vietnam and the data of the Asia-Pacific region and lower than the Sr-90 index from the Fukushima coast. This indicates that the study area is influenced primarily by global atmospheric fallout rather than by recent regional contamination.

Pearson correlation analysis shows that Sr-90 activity concentrations in seawater exhibit moderate negative correlations with pH ($r = -0.67$) and electrical conductance ($r = -0.53$); however, these relationships are not statistically significant ($p > 0.05$). The absence of significant correlations with salinity and other physicochemical parameters suggests that Sr-90 behaves largely conservatively in the marine environment, with its distribution primarily reflecting background inputs from global atmospheric fallout rather than being controlled by local seawater chemistry.

In addition, correlations between Sr-90 activity concentrations and organic carbon content in sediments were examined, revealing a weak relationship, indicating a limited influence of organic matter on Sr-90 accumulation in sediments. The low activities detected in fish further confirm minimal bioaccumulation and the absence of recent radiological inputs. Overall, these results provide a reliable baseline for future monitoring and demonstrate that radiological conditions in the South China Sea, Vietnam, remain at natural background levels.

In conclusion, Sr-90 activity concentrations in seawater, marine sediments, and fish from the South China Sea, Vietnam, are low and consistent with previously reported

background levels, indicating no significant radioactive contamination. The values are much lower than those observed near Fukushima and show no significant correlation with seawater physicochemical parameters, with only a weak relationship to sediment organic carbon. These results confirm the conservative behavior of Sr-90 and its primary origin from long-term atmospheric fallout, providing reliable baseline data for future marine radioactivity monitoring.
Keywords: strontium, marine environment, environmental radioactivity

2．論文

I-25-24

Analysis of the Association Between Inflammatory Biomarkers and Exposure to Elevated Radon Levels in Children and Adolescents

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共同研究者：

1．成果

The activities conducted under this ERAN grant were focused on assessing residential radon exposure and its potential biological effects among children and adolescents living in uranium-affected regions of Kazakhstan.

Within the framework of the project, 100 passive radon detectors (CR-39 type) were procured and deployed for long-term indoor radon monitoring. Field measurements were carried out in settlements representing the main study groups.

During the summer measurement period, 25 detectors were installed in 25 households in the settlement of Aqsu, Akmola Region, northern Kazakhstan. These households were selected based on the residence of children and adolescents participating in the biomarker study, from whom blood samples had been collected for the analysis of inflammatory interleukins. The detectors were placed indoors in accordance with established radon monitoring protocols. To assess seasonal variability, detectors were subsequently replaced during the autumn and winter periods.

Additional monitoring was conducted in the settlement of Akmol, Akmola Region, northern Kazakhstan, where 14 CR-39 detectors were installed in 14 households of participating children and adolescents. The study population included 42 participants from Aqsu and 45 participants from Akmol, forming the primary cohorts for exposure–biomarker analysis.

At present, validated measurement results are available for the summer and autumn monitoring periods. Laboratory processing and dose assessment were performed using standard radon dosimetry methodologies. Data from the winter monitoring cycle are currently under processing, and a full seasonal comparison is in progress.

The implementation of the grant also supported scientific dissemination. During the reporting period, two peer-reviewed publications relevant to the research topic were completed:

1. Lesbek A., Omori Y., Bakhtin M., et al. (2025). Systematic Review and Meta-Analysis of Inflammatory Biomarkers in Individuals Exposed to Radon. Biomedicines, 13(2), 499.
2. Lesbek A., Omori Y., Bakhtin M., et al. (2025). Seasonal Variations in Effective Radiation Dose in Residential Buildings of the Akmola Region: Assessing the Impact of

Basement Presence and Proximity to Uranium Tailings. Environments, 12(10), 357.

An additional original research article presenting the CR-39 measurement results from the Aqsu and Akmol settlements is currently in preparation and is expected to be submitted following completion of the full seasonal analysis.

Overall, the grant enabled the establishment of a residential radon exposure dataset linked to inflammatory biomarker profiles in children and adolescents. The findings contribute to a better understanding of environmental radiation-related health risks in uranium-impacted areas and provide a basis for further epidemiological and radiobiological research.

2．論文

1. Lesbek, A., Omori, Y., Bakhtin, M., Kazymbet, P., Tokonami, S., Altaeva, N., Ibrayeva, D., & Kashkinbayev, Y. (2025). Systematic Review and Meta-Analysis of Inflammatory Biomarkers in Individuals Exposed to Radon. Biomedicines, 13(2), 499. https://doi.org/10.3390/biomedicines13020499

2. Lesbek, A., Omori, Y., Bakhtin, M., Ibrayeva, D., Tokonami, S., Kazhiyakhmetova, B., Aumalikova, M., Saifulina, E., Mussaeva, E., Altaeva, N., Nygymanova, A., & Kashkinbayev, Y. (2025). Seasonal Variations in Effective Radiation Dose in Residential Buildings of the Akmola Region: Assessing the Impact of Basement Presence and Proximity to Uranium Tailings. Environments, 12(10), 357. https://doi.org/10.3390/environments12100357

Impact of Technogenic Radiation Factors on the Development of Tumor and Non-Tumor Bronchopulmonary Diseases in the Population of Northern Kazakhstan Based on Molecular-Genetic Analysis

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受入研究者：大森 康孝

1．成果

Project objectives

The project aimed to investigate the role of environmental radon exposure in lung cancer risk among populations residing in uranium-affected regions of Northern Kazakhstan. The specific objectives were (1) to assess indoor radon concentrations and corresponding radiation doses in residential dwellings of lung cancer patients and control subjects living near legacy uranium mining sites, and (2) to identify circulating protein biomarkers associated with lung cancer in individuals chronically exposed to elevated radon levels.

Use of ERAN funding

Funds provided by the ERAN program were used to purchase passive CR-39 solid-state nuclear track detectors (Raduet type) for long-term measurement of indoor radon concentrations. The detectors were deployed in residential buildings of settlements located in the Akmola Region and in the settlement of Saumalkol (North Kazakhstan Region), areas situated in proximity to uranium mining and tailings legacy sites known to have increased radon potential.

The acquisition of CR-39 detectors enabled reliable, integrated assessment of indoor radon exposure under real living conditions without disturbing residents and allowed the estimation of effective radiation doses from radon progeny for study participants.

Work performed

Indoor radon concentrations were measured in dwellings of lung cancer patients and control subjects permanently residing in the investigated regions. Based on measured values, individual exposure levels and corresponding effective doses were estimated. This allowed comparison of environmental radiation exposure between study groups living in uranium-affected territories.

In parallel, venous blood samples were collected from lung cancer patients and controls. Plasma proteins were extracted and analyzed using liquid chromatography–tandem mass spectrometry (LC–MS/MS). Proteomic profiling enabled identification of circulating proteins associated with lung cancer in populations residing in areas with elevated radon exposure.

Results

The project generated new environmental exposure data demonstrating spatial variability of indoor radon concentrations and radiation doses in residential areas of the Akmola and North Kazakhstan regions located near legacy uranium mining sites.

Proteomic analysis identified distinct plasma protein profiles in lung cancer patients compared with controls. Differentially expressed proteins included molecules involved in inflammation and acute-phase response (HP, ORM1/ORM2, SERPINA1), coagulation pathways (FGA, FGB, FGG, F2, KNG1), complement activation (C3), and metal and lipid transport and metabolism (CP, TF, APOA1/APOA2). Many of these proteins are established or candidate circulating cancer biomarkers.

The coexistence of elevated radon exposure and cancer-associated proteomic signatures supports a potential link between chronic radon exposure and systemic molecular alterations detectable in blood.

Scientific and public health significance

The ERAN-supported work provides the first combined environmental and molecular evidence of radon-related lung cancer risk in Northern Kazakhstan. The integration of indoor radon measurements with circulating protein biomarkers demonstrates the feasibility of biomarker-based risk assessment in populations living near uranium legacy sites.

These findings contribute to understanding the environmental determinants of lung cancer in Kazakhstan and support future development of screening and prevention strategies for radon-associated lung cancer in high-risk populations.

2．論文

Radon Exposure and Cancer Risk: Assessing Genetic and Protein

Markers in Affected Populations Yerlan Kashkinbayev 1, Baglan Kazhiyakhmetova 1,*, Nursulu Altaeva 2, Meirat Bakhtin 1, Pavel Tarlykov 3

Elena Saifulina 1 , Moldir Aumalikova 1, Danara Ibrayeva 1 and Aidos Bolatov 4, Biology 2025, 14, 506.

https://doi.org/10.3390/biology14050506

I-25-26

Vertical distribution of primordial radionuclides in soil profiles in Doon valley, Garhwal Himalaya, India

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1．成果

Several studies have focused on the distribution of natural radionuclides in soil and rocks across the world, including the Garhwal Himalaya, India. The purpose of these studies was to provide an overview of the typical radionuclide levels in top surface soils and to see whether there was reason for concern from a radioprotection point of view. However, no studies exist on vertical distributions of radionuclides in soil profiles in the Garhwal Himalaya, India. The understanding of the vertical distribution is crucial for ithe dentification of geogenic and anthropogenic sources of radionuclides. This project was aimed and designed to study the vertical distribution of radionuclides in soil profiles in non-agricultural and agricultural lands in the Doon valley of Garhwal Himalaya.

The field survey was conducted to collect a total of 84 soil samples from different depth profiles across selected locations in the Doon Valley of Garhwal Himalaya. A total of 12 geographical locations were identified for sampling and both agricultural and non-agricultural sites were selected at each location. Soil samples from both land use types were collected at three depth intervals: 0 to 10 cm, 11 to 20 cm and 21 to 30 cm, with 12 samples from each land use category at each depth, resulting in 24 samples per depth interval. These layers were considered to evaluate the geogenic and anthropogenic variations in surface and subsurface soils. In addition, deeper soil samples were collected exclusively from agricultural land at depth intervals of 51 to 60 cm and 81 to 90 cm, with 6 samples at each depth. These deeper profiles were included to assess the possible downward migration and transport of anthropogenically derived radionuclides within the soil column. Overall, the sampling comprised 36 samples from non-agricultural land and 48 samples from agricultural land, totaling 84 soil samples.

The field sampling for soil sample collection was delayed due to prolonged and continuous rainfall in 2025 compared to other years in the region. Gamma-ray spectroscopic analysis of soil samples is in progress, with completion of experimental work expected by June, 2026. Meanwhile, the potable groundwater samples were

collected from the study area and the adjacent region of the Kumaun Sub Himalayan Plain for the analysis of uranium and potentially toxic elements (PTEs) using Inductively Coupled Plasma Mass Spectrometry (ICPMS). The concentrations of uranium in groundwater samples from the Doon valley were found within the WHO guideline value of 30 μg L-1. The results of the potable groundwater quality assessment have been communicated for publication in the Scientific Reports journal.

Publications:

M. Prasad, R.S. Negi, A. Joshi, Y. Omori, G. Prasad, Satish C. Uniyal, C. Kranord, M. Hosoda, S. Tokonami, R.C. Ramola. Geospatial, index-based and statistical framework for health risk assessment and sustainable management of potentially toxic elements in groundwater of Kumaun Sub-Himalayan Plain, India, Scientific Reports, Under Review.

2．論文

Publications (Under Review)

M. Prasad, R.S. Negi, A. Joshi, Y. Omori, G. Prasad, Satish C. Uniyal, C. Kranord, M. Hosoda, S. Tokonami, R.C. Ramola. Geospatial, index-based and statistical framework for health risk assessment and sustainable management of potentially toxic elements in groundwater of Kumaun Sub-Himalayan Plain, India, Scientific Reports, Under Review.