日本温泉科学会第 56 回大会

一般講演要旨（ポスター発表）

P-1. Measurement of Radium Isotopes in Hokutolite from Tamagawa Hot Spring

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The concentrations of radium isotopes and the progenies (^{226}Ra, ^{228}Ra and ^{228}Th) in two hokutolite samples from Tamagawa hot spring were measured. These isotopes were analyzed by a well-type HPGe γ-ray spectrometer for the 351, 911 and 583 keV γ-ray from ^{214}Pb, ^{228}Ac and ^{208}Tl, respectively, each being in radioactive equilibrium with precursors. Concentration of ^{226}Ra and ^{228}Ra were observed to be in the range of 52–85 and 7.1–85 Bq/g, respectively. The activity ratios of ^{228}Ra/^{226}Ra and ^{228}Th/^{226}Ra provided the estimation of the growth rate (0.09–0.10 mm/y).

P-2. The Characteristic of Exercise Intensity in Underwater Treadmill Walking

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Objective : The purpose of this study was to investigate the characteristic of exercise intensity in underwater treadmill walking.

Method : This study compared the oxygen consumption of ten healthy male volunteers (mean age 22.9 years) to walking on land treadmill and underwater treadmills at three water levels (xiphoid process, navel and trochanter major) and three walking speeds (2 km/hr, 3 km/hr, and 4 km/hr). All measurements were accomplished in atmosphere controlled 25 degrees C and water controlled 30 degree C. Oxygen consumption (VO_2) were measured using Vmax 29 c.

Results : According to increasing walking speed, VO_2 increased significantly both water and land walking. According to falling water level, VO_2 increased in underwater treadmill walking. When gate speeds were 3km/hr and 4km/hr, VO_2 was significantly higher than on land at all water levels. Though, there was not significant difference of VO_2 between on land and in water at the 2 km/hr of gait speed.

Conclusion : It was suggested that the exercise intensity in underwater treadmill walking is

controllable by adjusting the gait speed and water level.

P-3. Negative Air Ions Improve Efficiency of Ergometric Exercise

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Negative air ions have a purifying effect on hazardous substances, such as dust, bacteria. Many negative ions are detected in forests, at spas, and near waterfalls. Many reports have been published that the negative ions improve the subjective feeling, comfort, fatigue and occupational efficiency, but few evidence of the mechanism have been reported yet. To investigate the physiological effect of negative air ion for humans, we analyzed the hormonal and immunological changes during the ergo metric exercise.

In the artificial climate room (25℃, 50% humidity), ten young healthy volunteer were double-blindly exposed in negative-ion rich air (＞10,000 counts/cc : produced by ionizer equipment) or not. They were installed the caldiopulmonary testing instrument (Sensormedics Co, Vmax29c) and tried their limit by ergo metric exercise (gradually increased 20 W/min). We sampled 3 times their bloods before the exercise, at the maximum point and at recovery point (15 minutes after the end of the exercise). We tested hormonal (adrenalin, noradrenalin, dopamine, cortisol and serotonin), immunological stress responses (white blood cell and lymphocyte subsets) and metabolic products (pyrubic acids and lactic acids). Paired t-test was used for statistical analysis. There were no statistical differences in O_2 consumption of maximum and of VT (ventilatory threshold) points. Negative air ions decreased the hormonal stress response and decreased dopamine level at 15 min after exercise ($p < 0.05$) and diminished the pyrubic acid and lactic acid at the max exercise ($p < 0.05$). And negative air ions diminished the immunological stress response (total white blood cells, NK subsets).

This supported many reviews and suggested that the negative ions improved the metabolic efficiency of human. So we would need the further evidence of the ions effects.

P-4. 日本の酸性温泉に生育する微細藻類の分布とその系統

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Distribution and Phylogeny of Microalgae Living in Acid Hot Springs in Japan

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これまでの調査で，日本の酸性温泉には，主に単細胞藻類であるイデユコゴメ *Cyanidium caldarium* とガルディエリア *Galdieria sulphuraria* が分布していることが明らかになってきた．これらの藻類のうちイデユコゴメは最も分布域が広く，ガルディエリアがいくつかの限られた温泉で認められた．さらに，今回，秋田県乳頭温泉郷の黒湯温泉からシアニディオシゾン *Cyanidioschy-*

zon merolae が新たに発見された．これら 3 種（*Cyanidium* RK-1 株，日光湯元温泉産 ; *Galdieria* M-8 株，北海道登別温泉産 ; *Cyanidioschyzon* JV-95 株，インドネシア，ジャワ島産）から DNA を抽出し，18S リボソーム RNA 遺伝子 18S Ribosome RNA Gene の塩基配列を決定し，他の藻類における同一遺伝子のデータベースと比較して分子系統樹を作成すると，イデユコゴメとシアニディオシゾンは単一のクラスターを形成し，ガルディエリアとはかなり離れた分岐を形成した．このことから，ガルディエリアは他の 2 種と比べて分類階級において科 Family 以上の隔たりがあることが推定された．

P-5.　日本における温泉資源とその利用状況

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Thermal Springs Resources and its Utilization in Japan

Hot Spring Research Center　Yasuo KANROJI

この報告は，環境省の平成 14 年末の資料から，資源と利用状況の概要を抜粋したものである．

⑴　温泉地，源泉，および湧出量の総数

温泉地 : 3,023，源泉 ; 利用泉 : 18,294（うち自噴 : 5,186），未利用泉 : 8,552（うち自噴 : 3,000），総湧出量 : 2,610,547（うち自噴 : 819,328）L/min

⑵　泉　温

25℃以下 : 3,590，25～42℃ : 6,486，42℃以上 : 13,226，蒸気等 : 1,077

⑶　泉　質

斉藤氏の報告（1989）から，単純温泉 : 8,136，塩化物泉 : 5,857，炭酸水素塩泉 : 1,531，硫酸塩泉 : 1,159，二酸化炭素泉 : 41，鉄泉 : 213，硫黄泉 : 2,218，酸性泉 : 432，放射能泉 : 588，総数 : 20,175

⑷　利用施設関係

収容定員 : 1,373,318 人，宿泊施設数 : 15,558 軒，公衆浴場 : 6,433 軒

文献 : 斉藤幾久次郎，（財）日本健康開発財団研究年報，XI，10～14（平成元年 5 月）

P-6.　Measurement of $^{228}Ra/^{226}Ra$ Activity Ratio in Hot-Spring Water and in River Water around Okutama, Tokyo, Japan

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The activity ratios of $^{228}Ra/^{226}Ra$ in hot-spring waters and in river waters around Okutama area, Tokyo, Japan, were measured. The activity ratio ranged from 0.9 to 1.6 in hot-spring waters and from 1.1 to 2.4 in river waters, respectively.

P-7.　山地小流域流出地下水中ラドン濃度の経年変化

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Variation of Radon Concentration in the Groundwater Flowing Out from Small Mountainside Area

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From June in 1998, we have studied seasonal variation of radon concentration in groundwater from the 3 different types of small mountainside area (Basin I, II, III) which including a landslide and an artificial change area. At same time we have analyzed some kinds of chemical elements such as Na^+, K^+, Mg^{2+}, Ca^{2+}, HCO_3^-, Cl^-, NO_3^-, SiO_2 and others.

At the Basin I (natural area), we did not measure radon concentration, because of the shortage of sample water. Continuous measuring of Radon concentration and the water temperature in the groundwater of Basin II (artificial change area) shows clear seasonal variation. For draining groundwater from the Basin III (landslide area), the horizontal 13 holes, from N1 to N13, radiating in all directions were bored through the river side of the Basin Ⅲ. But only from the N1, N6, N7, N8, N9, N13 holes, groundwater flow out regularly. According to the season, amount of radon and temperature of N1 and N6 water have changed, but the other holes water have not shown clear variation.

In conclusion, we have reasoned that the almost groundwater in the Basin II would depend on the surface water and in the Basin III, N1 and N6 holes groundwater would mainly depend on the shallow free water and the other holes one on the deep confined water.

P-8. 温浴の F 波に及ぼす影響

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Change of Tibial Nerve F-Waves by Warm Water Bathing (41℃, 10 min) in Healthy Subjects

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【目的】温浴は神経伝導速度を増す一方，痙性を抑制すると考えられている．F 波は神経伝導や脊髄前角細胞の興奮性を観察することに用いられており，今回我々は温浴による F 波の変化を検討した．

【対象と方法】対象は健常成人男性 17 名（年齢 35.7±8.4 歳）の 34 肢．十分な安静後に，41℃ で 10

分間入浴させ，入浴前，出浴直後・30 分後の F 波を記録した．脛骨神経を足関節で刺激し，母趾外転筋に記録電極を設置した．20 回の反応の最短潜時を用いて F 波の伝導速度を求め，出現率・振幅・F/M 比も求めた．また同時に舌下温（深部体温）・大腿部皮膚温・皮膚血流も経時的に測定した．

【結果】温浴による舌下温，大腿部皮膚温や皮膚血流の上昇に平行して F 波の伝導速度が約 5% 有意に増加した．入浴前後で 2.9 m/sec の増加を示し，入浴直後と 30 分後では 1.8 m/sec の低下を示した．また，入浴後に F 波振幅と F/M 比の低下傾向がみられたが，出現頻度は変化しなかった．

【結論と考察】Johnson and Oslen らの報告の通り，温浴による体温の上昇に平行して F 波の伝導速度が増した．入浴後の F 波振幅と F/M 比の低下傾向は脊髄前角細胞の興奮性の抑制を意味するかは不明であるが，今後，脳卒中や脊髄損傷などの痙性の強い患者における詳細な評価・研究が期待される．

P-9.　箱根温泉の水位，温度，湧出量についての経年変化

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Variation of Water Level, Temperature and Discharge on Hot Springs in Hakone Volcano

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Hakone Town Government　Nobuo Yamaguchi

箱根温泉は 100 年前には年間約 10 万人の来浴客であったが，現在は年間 2000 万人の訪問客と 600 万人の宿泊客を迎えている．これに伴い温泉の採取形態は自然湧泉から掘削した深度数 100 m の温泉井での機械揚湯に移っている．温泉量は自然湧泉に比べれば一桁以上増大しているが，一方では多くの自然湧泉が消滅し，温泉の水位と温度の低下，溶存成分の変化が危惧されている．箱根火山の中央火口丘の神山東麓は開発が進み温泉と地下水の利用が活発である．箱根温泉の約 60% は神山東麓で採取されている．

箱根温泉の資源保護対策の一つとして，温泉井戸の水位，水温，湧出量等を連続観測することはもっとも重要なことである．そこで箱根町では観測井を設けて 1990 年から計測調査を続けている．本観測井は主要な流れをなす中央火口丘の温泉（二の平，姥子）とその付近の浅層地下水（小涌谷）である．

箱根周辺の二の平，小涌谷等の温泉井戸と浅層地下水井戸の水位と温度，および自然湧泉の姥子温泉における湧出量の経年変化を観測した結果，水位と降水量，温度と降水量や水位と温度との間に密接な関係あり，また湧出量と降水量とは指数関数的な関係があることを明らかにした．さらに水温が 2002 年に急激に変化する現象が観察され，箱根周辺における 2001 年の群発地震等の地殻変動との関連を考える必要が示唆された．

P-10. 山陰・山陽地方における温泉の特徴的な分布

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Characteristic Distribution of Hot Springs in San-in and San-yo Areas, Western Japan

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Chugoku district, western Honshu, Japan, is divided to San-in and San-yo areas by Chugoku Mountains of an altitude over 1,000 m above sea level. Hot springs of high water temperature up to about boiling point distribute linearly over a distance of one hundred kilometer in the lower basins in San-in area. The characteristic linear distribution corresponds to the distribution of hypocenter of earthquakes. Several Quaternary volcanoes such as Mt. Daisen and Mt. Sanbe distribute in the same direction in the San-in area. On the other hand, there are no Quaternary volcanoes, very few earthquakes, and no hot springs of high temperature over 50℃ in San-yo area. Such the difference of geothermal aspects between San-in and San-yo areas must be owing to whether deep water circulations are formed or not. Many wide and deep fractured systems which can bring deep water circulations driven through hydraulic potential formed by high mountains must exist in the San-in area. To the contrary, there must be hardly any deep water circulation systems in the San-yo area.

P-11. 岡山県湯原温泉の温泉流出が河川に与える影響

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Effects of Hot Spring Discharge on a Stream Environment —A Case Study at Yubara Spa, Okayama Prefecture, Japan—

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Distributions of river water temperature in cross sections along Asahi River at Yubara Spa, Okayama prefecture, were observed in August, 2002. A higher temperature zone was found near the outlet of hot spring water. The high temperature zone disappeared at only about 12 m downstream from the point.

The water temperature and EC were increased with distance downstream within the spa area. An estimation of total discharge of hot spring water was made to be around 3 ton per minute by mass and water balance. It was considered that the contribution of hot spring water to the rise in river water temperature was small. The temperature of river water may

be controlled mainly by air temperature.

P-12.　日本における伝統的な温泉療法についての医療人類学的考察

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Medical Anthropological Discussion on the Effect of Traditional Spa - Therapy in Japan

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日本における温泉（鉱泉）の代替医療的な利用の理由を明らかにする目的で，大分県の塚野鉱泉における現地調査と，一般市民に対する質問紙調査を行った．まず，現地調査では，参与観察と湯治客に対する聞き取りを実施した．塚野鉱泉では，深夜から早朝にかけ，下痢を起こすまで大量に飲泉するという特異的な湯治法が確立していた．この場合，湯治客は，下痢によって腸内の“宿便”が洗い流され，そのことが病気の治癒や健康の増進につながると信じていた．そこで，一般市民 379 名に対し，宿便についての質問紙調査を実施した．110 名（29%）が宿便に関する何らかの知識を有していた．また，8 割以上の者が，宿便は消化器系もしくは消化器以外の病気の原因になると答え，そのうちの 6 割以上は「自分にも宿便がある」と考えていた．さらに，そのうちの約半数が，何らかの対策を取った経験があると答えた．取られた対処法としては，「市販の薬」がもっとも多かった．対処の結果，80% が「宿便が取れた」と答えたが，その判断の根拠としては，「残便感やお腹が張った感じが取れた」など，何らかの身体感覚に基づいたものが多かった．伝統的な温泉の効果の背景には，宿便のような独特な身体認識とイメージの形成，および身体感覚に基づいた認知の過程が存在すると考えられた．このようなメカニズムは，温泉に限らず，広く代替医療が利用される理由になっていると予想された．

P-13.　鉱泥浴と温泉浴の保護効果並びに生体に及ぼす効果

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Spa-Mud-Bath in Beppu has Effects of Elevation in β-Endorphin as Well as Heat Protective Effects in Healthy People

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鉱泥浴はミネラルを多く含んだ温泉種であり，鎮痛作用や鎮静作用が知られている．また，熱伝導度が小さく，流動性が少ないために長く入浴が可能である．今回，鉱泥浴の持つ保温効果を科学

的に検証すると共に，入浴における生理的影響と内分泌ホルモンの変化について研究をおこなった．

健康成人 7 名（男 5 名，女 2 名，平均年齢 32.8 才）を対象とし，鉱泥浴（40–42℃）に 10 分間入浴後の保温効果は熱画像検査装置を用いた．入浴前後における心拍数，血圧，末梢酸素分圧，血糖値は入浴前より各 10 分毎に測定した．一方，血清中のカテコーラミン，β–エンドルフィン濃度は入浴直後，および入浴後 30 分後に測定した．

入浴後の保温効果は浴後 30 分まで続き，温水に比し有意に長かった．心拍数は入浴直後に入浴前に比し 18% の増加を認め，一過性の収縮期血圧の上昇（前値に比し 32%）は浴後 20 分で見られた．しかし，酸素分圧，血糖値，血中カテコーラミン値は入浴各時点での変動は認めなかった．一方，β–エンドルフィン濃度は浴後 30 分で有意な増加を認めた．

β–エンドルフィン濃度の上昇より，鉱泥浴には保温効果の外に精神安定化作用もあると推察され，今後の健康維持のために有用な手段となると思う．

P–14. Balneological Properties of Slovene Natural Mineral Waters

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Definite quantities of inorganic dissolved salts are present in all waters, therefore all waters in nature are mineralized. However it is very hard to distinguish so called natural mineral waters from drinking water. This article considers the older and the newest EEC's definition of natural mineral waters. As a difference from drinking water, natural mineral waters have a protected natural underground source, which contains characteristic harmless compounds and should not be technologically processed or disinfected except in the case of climination of iron by aeration.

The survey of some natural thermal mineral waters in Slovenia is given as an illustration of their difference concerning the level of mineralization, spring temperature as well as balneological characteristics.

P–15. Heat Transfer by Fluids of Mud Volcanoes and Hydrothermal Processes

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Mud volcanism is one of the most interesting nature phenomena encountered in many countries of the world. A number of geological factors stipulate development of mud volcanism in the South Caspian basin. The general region of onshore and offshore Azerbaijan is home to over 200 mud diapirs and/or mud volcanoes. Among special features of the basin are low heat flow, abnormally high formation pressure, high degree of dislocation and seismicity etc.

The different anomalies of geothermal field were defined in area of mud volcanism development. Against the overall low heat flow backgrounds across the basin, mud volcano localities stand out by comparatively high values of the parameter. Values of temperature gradients defined in depth interval 0.3–1.5 m are very high and wary within 0.02–21.25 K/m. Was revealed the diminution of temperature gradient by the depth.

In the theory of thermal conductivity the results can be hardly explained. So the process of simultaneous transportation of substance and heat through the channel of mud volcanoes should be considered. This process can be modeled as a thermal jet or as pressure filtration of fluids. That is described by the system of differential equations. The solving of this system in followed by the temperature dependence from the depth.

Taking into consideration the heat peculiarities of fluids and rocks and the temperature along the channel gives an opportunity to explain the high temperature gradients on surface and decrease of gradient according to depth. It is similar of temperature distributions on contours of area of a mud volcano ; zones of formation of hydrocarbons are accordingly displaced upwards.

Thus, in the neck of mud volcano, in its deep parts there are high temperatures and low gradient. With approach to the surface the gradient is sharply increased, and temperature falls. It is necessary to take into consideration these conditions for estimation of parameters of hydrothermal formation of minerals (temperature applicable depth and the age) in the neck of the volcano.

P–16.　Bio-Climatic Zones of Hot Springs and Sanatorium, Mongolia, 2003

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P–18.　The Situation of Spa Tourism and Its Problems in China

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Tourism is ever expanding in the contemporary world. And yet tourism, particularly Chinese Spa Tourism remains a mystery to the world outside China. In this paper, we shall discuss Spa Tourism, its origins and why it is relatively unknown. We also analyze the phenomenon in order to supply background information and, in so doing, we shall give some basic data to researchers who have an interest in China's tourist industry. Indeed, China's potential development of tourism is so large, as is our subject, covering more than 2,500 spas (hot spring), we believe it should be researched and evaluated. This paper attempts to do that.

P-19. Geochemistry of the Surface Waters of Some Hidrothermal Areas of Kuril Islands

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The purpose of this investigation is to evaluate the influence of hydrothermal volcanic activity on the geochemistry of surrounding surface water. The work is based on the study of several regions on Kunashir and Paramushir islands. The primary subjects of the research were surface waters, associated with the hydrothermal activity : on Kunashir and Paramushir islands. Two samples of the rain water were taken to evaluate the composition of atmospheric precipitation and a sample of the snow from glacier near north-eastern crater of Ebeko volcano. A value of pH, Eh, conductivity, HCO_3 and dissolved oxygen were measured in situ. All samples were filtrated right away through the 0.45(m pore filter. The volcanic and hydrothermal activity significantly influences the chemical composition of surface water of the area studied. The distribution of microelements in the surface waters depends on the trace element composition of the nearest hydrothermal systems. The prevalent form of the microelements is dissolved. Atmospheric precipitation in the area of Kuril Islands carries a large amount of trace elements in dissolved and particulate forms. The fumaroles of the nearby volcanoes were the most likely source of these trace elements.

P-23. 温泉水と生体水の ORP（酸化還元電位）-pH 関係について

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ORP (Oxidation-Reduction Potential)-pH Relationship between Hot Spring Waters and Human Body Fluids

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演者らはこれまでに，ORP（酸化還元電位）-pH 関係に基づく新たな水評価法を提案してきた．通常大気環境下で平衡にある水の ORP は pH の関数で表され，これを平衡 ORP と決定した．そして，水の ORP が平衡 ORP より高ければ酸化系，低ければ還元系と分類できることを提案した．この関係に基づき全国約 200 の温泉水の ORP-pH 関係を調査した結果，温泉水の pH は強酸性から強アルカリ性まで広く分布しているが，ORP は平衡 ORP より低い還元系であることを明らかにした．さらに，温泉水は湧出後時間経過とともにエージングを起こし平衡 ORP に近づくことを明らかにし，還元系であることが温泉源泉の本質的特徴であることを提案してきた．我々人間の皮膚の pH は弱酸性で ORP は還元系であり，還元系にある温泉水に浴用することで，皮膚はより還元系になることから，皮膚の加齢に伴う酸化や老化を抑制できる可能性を示唆してきた．

今回，皮膚の内側の水，すなわち生体関連の水として血漿，羊水，唾液および尿の ORP-pH 関係

を測定した．これらサンプルの全ては還元系で，弱酸性から弱アルカリ性の範囲にあることが分かった．これら測定結果に基づき，ORP-pH 関係で生体に望ましく，そして生体に類似した新たな考えの水を“生体水”として定義した．二酸化炭素泉（炭酸泉）は温泉の泉質の中で，ORP-pH 関係において“生体水”に類似している泉質を有する結果が得られた．

P-24.　縞状北投石の分類と成因

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A Classification and Formation Mechanism of Banded Structure Formed in Hokutolite Crust

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わが国の秋田県玉川温泉や台湾の北投温泉で生成する北投石の中には褐色の結晶層と白色の結晶層が交互に成長してできたと思われる縞状構造をもつものが存在する．そのような縞状北投石には褐色相が白色層より鉛含有量が大きいものと白色層の方が褐色層より鉛含有量が大きいものの 2 つのタイプが存在する．

今回このような縞状構造をなす北投石について各結晶層の化学分析ならびに X 線回折を行ったところ，各結晶層間で化学組成や格子定数に明瞭な違いが認められ，化学組成と格子定数には相関があり，Vegard 則をみたしていること，また，各結晶層間の化学組成の関係には 3 通りの関係があることが判明した．これらの結果をもとに，縞状構造の成因として 2 つのタイプの成因を考えた．

1 つは各結晶層中の北投石の化学組成変化によるものであり，もう 1 つは各結晶層中の北投石相以外に褐色や白色の色をもたらす原因となる物質が併存し，それらの量の変化によるものである．

P-25.　Investigation of the Effects of an Artificial Carbon Dioxide Footbath : A Study of Body Temperature and Thermosensory

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In order to investigate the effects on body temperature and thermosensory, we have carried out the carbon dioxide (CO_2) and normal footbath. Two volunteers participated in this experiment. One session consisted of 20 min. footbath and 10 min. pre-resting and observation and 30 min. post-observation period. Each volunteer took a footbath using CO_2 enriched and normal hot water (40℃), respectively.

The skin surface temperature on calf measured by the thermography increased approximately one Celsius degree compared with the pre footbath, and decreased slowly after 15 min. on planta. This change of the surface temperature was showed clearly in CO_2 footbath. The perception about “warm” has dropped with the decline of the surface temperature. The deep temperature was stable throughout the observation time.

We could not conclude thermal outcomes from CO_2 and normal footbath. However, it was

found that it needed to consider legs exposure. This may be meaningful to maintain the effects and to operate for patients.

P-26. 鹿児島県の地熱水中のヒ素，アンチモンおよび水銀濃度

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The Concentrations of Arsenic, Antimony and Mercury in the Geothermal Waters around Kagoshima, Southern Kyushu, Japan

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鹿児島県は，中央部を南北に霧島火山帯が縦断し，北部の霧島から南海のトカラ列島まで 7 つの火山がある．

温泉の泉源数が全国で第 2 位を占めている．県内の北東部（霧島地区から南西部（指宿・山川地区）の地熱水（温泉水）を採取し，ヒ素，アンチモンおよび水銀濃度を調べた．これらの地域から採取した地熱水（61〜157 試料）中のヒ素（Ⅲ＋Ⅴ），アンチモン（Ⅲ＋Ⅴおよび総水銀濃度の範囲は，＜0.1〜8,390 $\mu g/l$, ＜0.05〜231 $\mu g/l$, 0.3〜65.5 ng/l であり，それぞれの算術平均値は 249 $\mu g/l$, 14.2 $\mu g/l$, 9.2 ng/l で，幾何平均値は 20.0 $\mu g/l$, 0.96 $\mu g/l$, 6.7 ng/l であった．

As/Sb（重量比）の値は，酸性泉では 50〜100 と言われているが，測定した試料の pH の範囲は 2.0〜9.9 と広く，その平均値（重量比）は 60 であった．地熱水中のヒ素とアンチモンの間には高い正の相関（相関係数 0.98）があることが分かった．しかし，ヒ素と水銀，アンチモンと水銀の相関係数は 0.58，0.62 であり，あまり高い相関は見られなかった．

以上のことから，地熱水中では水銀はヒ素やアンチモンとは異なった挙動をしていることが分かった．また，深部熱水の特異性の一つに，ヒ素およびアンチモン濃度が高いものがあることが分かった．

P-27. Helium Bearing Capacity of Mineral Waters of Mongolia

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The authors carried out the gas-hydrogenic survey on the territory of Mongolia to determine the content of helium directly on the water object using the nonstandard field device INGEM-1 with determining the absolute (ml/dm^3) and relative concentration (number of units of atmospheric background consisting of 5.4×10^{-5} ml/dm^3) of water soluble helium. It is known that helium is a very informative indicator of permeability of tectonic faults, which are the main channels conducting mineral waters to the earth surface. It was established that the mineral waters of Mongolia can be divided into four groups by the

helium indicators as follows :

1. Hot waters with temperature from 43°to 69℃ (Khujirt, Shivert,Tsagaab, Soum, Khuremt, Chuluut and other mineral springs).

2. Very hot waters with temperature ranging from 76°to 88℃ (Shargaljuut, Tsenkher, Onon and others).

3. Carbonic cold waters with the 4.5–8.5℃ temperature. Two main subgroups of carbonic waters can be distinguished :

a) rare springs located within the Cenozoic Khangai neotectonic hydorthem distribution elevation ;

b) springs within the Mesozoic low mountain relief and “gobi” type depression.

4. Submineral (the content of active components lower than in balneological norms)cold waters with temperature of 4.5–15℃ are very popular with the population as medicinal springs.

P-28.　人工炭酸温水濃度別にみた皮膚血流量増大効果

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The Concentration of Artificial CO_2 Warm Water Bathing and The Skin Blood Flow

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人工炭酸温水の血管拡張作用に及ぼす有効二酸化炭素濃度を調べるために，一定温度で濃度設定できる人工炭酸温水を用いて健常成人 12 名を対象に検討した．

方法は，37℃ の水道水温水と人工炭酸温水（三菱レイヨン KK 製 MRE-SPA で作製）を溶存炭酸濃度計を用い 0（水道水のみ），100，300，600，800，1,000 ppm に設定した．入浴は全身浴を行った．測定は，大腿内側部にレーザ組織血流計，左胸部に表面皮膚体温計，血圧・脈拍の変化を同時測定した．測定は前値 5 分，入浴 15 分間に 1 分間隔で施行．室温 25±2℃.

その結果，血圧は 0〜1,000 ppm 各濃度間で差がなく，収縮期 17.1，拡張期 23.9 mmHg の低下を認め，水道水温水（0 ppm）と差はなかった．しかし，炭酸濃度別の組織血流量の変化は入浴直後から 0 ppm に比し 1,000 ppm まで濃度依存性に増加を認めた．

従って，健常人における 37℃炭酸温水の効果は，血圧・脈拍は水道水と差はなく，双方とも血管拡張により過度に血圧が低下しないよう調整していた．しかし，組織血流量は炭酸温水で増加し，皮膚表面組織に近い血液循環を増すことで血管抵抗を減少させていると考えられることから，炭酸温水は水道水に比べ皮膚表面に近い，組織循環の改善が期待できると思われた．加えて，炭酸温水で組織血流量の増加から濃度依存性に組織循環・代謝が改善されると示唆された．

P-29.　MPT Influences Serum Selection Levels in Osteoarthrosic Patients

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Osteoarthritis (OA) is an important rheumatic condition accompanied by synovial inflammation. Numerous leucocytes are recruited and their migration to the inflamed arthritic joints is mediated by adhesion molecules such as E-, P-, and L-selections. We measured the serum selection values in OA patients undergoing Mud Pack Treatment (MPT) or treated with anti-inflammatory drugs to test whether the effect of the treatments may be monitored by the level of serum selections.

50 OA patients were randomly divided in Group A (30 patients undergoing MPT) and Group B (20 patients receiving 50 mg diclofenac twice daily p.o.). Blood samples were collected in both groups before and after the treatments to test serum E-, P-, and L-selection by ELISA methods.

In Group B sE-selection level shows a significant modification after the drug assumption ; in Group A a significant change of sL-selection after MPT is evident, while sP-selection level does not present any significant variation.

The study indicates that MPT and diclofenac are able to influence different adhesion molecules in OA patients. The combination of these two treatments may constitute a safe and effective anti-inflammatory therapy in rheumatic diseases.

P-30. The Age of Geothermal Water at Spas of Serbia as an Indicator of Their Sustainable Development

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Mihailo Milivojevic

Climatic changes influence on surface water resources directly and in that way, more or less, more quickly or more slowly, by means of waterfalls, the quantity and quality of ground waters or hydrogeological resources, namely their sustenation. The conclusion about the influence of climatic changes on ground waters can be drawn on the basis of isotope research (^{2}H, ^{14}C) by means of which their origin and age are determined most reliably. Present investigation results of the origin and age of ground water resources at the most famous hydrogeothermal regions, as well as the sustenance forecast of their quality and reserves depending on still existing and future climatic changes will be shown in this paper.

P-31. Thermomineral Water of Serbia, Montenegro and Republic of Srpska

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Serbia and Montenegro and Republic of Srpska are relatively small countries. Their total surface area are 127.000 km^2, but geological composition are very complex. Due to this complexity, 250 natural springs and 100 wells with thermal water are situated at the territory of this counters. Reservoirs of this water are varies rocks with varies chemical composition. The pH values of thermomineral water varies from 2.5 (hyperacid) up to 12 (hyperalcaline). Values of TDS varies from 0.2 gr/kg to 20 gr/kg. Maximal temperature of the natural springs is 96℃. Maximal temperature of thermal water from wells are 111℃. According to the geothermometers the maximal expected temperature of the geothermal water is 150℃. Total discharged amount of thermal water from natural springs and wells is 5.000 l/s. Utilization of thermomineral water is mainly for balneotherapeutic purposes and tourism in 60 spas.

P-32.　北投石を産出する特異な二温泉

立正大学　綿　抜　邦　彦

Two Characteristic Hot Spring Waters That Produce Hokutolite

Rissho University　Kunihiko Watanuki

Tamagawa and Peitou hot springs are famous to produce hokutolilte, radio active lead bearing barite. Characteristic chemical features of these hot spring waters were analyzed in various point of view. The features of these hot spring waters are summarized as follows :

1) high temperature 95–98℃
2) strong acid pH 1.2–1.4
3) chloride rich $Cl^- > SO_4^{2-}$
4) Ba content 0.3–0.8 ppm
5) Pb content 1–1.5 ppm
6) Radioactive

In Tamagawa hot spring microcrystal of hokutolite can be found both in the hot spring water and sulfurous sinter.

P-33.　Current Biomedical Research and Industrial Application of Hot spring in Taiwan

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Taiwan is a natural gateway to and within Asia, and has being famous as Formosa due to its abundant and various nature resources of hot springs and the related. Today in Taiwan,

there are many fields of biomedical-related utilization with hot springs and related applications, including the applications in thermotherapy and chemotherapy bathing, cosmetics industry, spa equipments industry, hot spring related engineering industry, food and pharmerceutical bioindustry, agriculture and sightseeing-related industry etc. Furthermore, it is getting more and more popular than it had been before due to the effective promotion and renovation by the Union of Fooyin University, the Taiwan National Hot Spring Association (TNHSA) and the Taiwan Government in these years.

However, far from enough of scientific research has been performed to study the fundamental physiological and pathogenic mechanisms of the clinical effects shown by various kinds of hot springs and their related therapeutic mediums, although Hot Springs and related therapy are widely applied for public health and therapeutic purposes in Taiwan. In order to study the fundamental mechanisms of the physiological effects demonstrated, the scientific research has been performed for a couple of years. The most critical techniques developed include the standardization and processing of the hot spring sampling for analysis, the standardization and comparison for related experimental methodology, the separation and identification of some preliminary active components in various Hot Springs and so on.

To further crytalize the physiological effects of indivisual species, it is critical to study hot springs by using the modern techniques of engineering biochemistry, and cellular and molecular biology. By using these modern scientific techniques, the thorough analysis of the compositions of microbial community in various Hot Springs and the interaction between the bacteria species with the environmental conditions were further studied and shed light on the mechanism of the indivisual physiological and medical effects of the Hot Springs.

These results would be critical for our understanding of this natural resources and greatly enhanced the further applications, and therefore, be beneficial to the huge numbers of public hot spring users, the government hygienic department, and related bio-industry. Most of all, it should be critically important to provide the detailed information for establishing further fundamental academic basis of the physiological, molecular, and industrialized study of Hot Springs and related application.

P-34. Salinity Problem in the Lowland Areas of Mahaweli Development Scheme (System H)

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Paddy cultivation has been established in Kalawewa, H Area receives Mahaweli irrigation water since 1975. Following problems have been found to affect the plants in this area. Chlorosis, lack of vigour, premature death was the symptoms, farmers complained of salinity as a reason for this. Study to identify possible causes contributing to build up of salinity in fields and to suggest of economical and feasible remedial measures were the objectives of this study. Salinity status of soil and water in the concerned areas and the impact of irrigation

scheme on salinity in H Area were also studied. A review of the literature on salinity and it's effects on the rice plant is also made.

P-35. Hot Sptring in Thailand Case : Sankamphaeng Hot Spring

Tourism Authority of Thailand　Noppadon Pakprot

講演番号 P-17，P-20，P-21，P-22 はキャンセル．P-16，P-35 はタイトルのみ．