IRKUTSK SCIENTIFIC CENTER
THE SIBERIAN BRANCH OF
THE RUSSIAN ACADEMY OF SCIENCES

DIVISION OF SCIENCE, EDUCATION AND EXPERT ASSESSMENT

MULTIDISCIPLINARY YOUTH ACADEMIC RESEARCH CONFERENCE

«SCIENCE PRESENT AND FUTURE:

RESEARCH LANDSCAPE IN THE 21ST CENTURY»

Irkutsk, 2023

УДК 811.111'27
ББК Ш13(Англ)я7

Оргкомитет:
Председатель оргкомитета – Свердлова Н. А., кандидат филологических наук, доцент, ведущий научный сотрудник, заведующий отделом научно-образовательной деятельности и экспертной оценки, заведующий кафедрой педагогики и экспертной оценки ИНЦ СО РАН (Иркутск);
Учёный секретарь – Андреянова Е. Л., кандидат экономических наук, старший научный сотрудник, ИНЦ СО РАН (Иркутск).

Ответственные редакторы:
Свердлова Н. А., кандидат филологических наук, доцент, ведущий научный сотрудник, заведующий отделом научно-образовательной деятельности и экспертной оценки, заведующий кафедрой педагогики и экспертной оценки ИНЦ СО РАН (Иркутск);
Марьясова Е. П., младший научный сотрудник, старший преподаватель кафедры иностранных языков и философии ИНЦ СО РАН (Иркутск);
Ефимова Н. Н., кандидат филологических наук, доцент, заведующий кафедрой иностранных языков и философии ИНЦ СО РАН (Иркутск);
Виолина М. И., кандидат филологических наук, доцент кафедры иностранных языков и философии ИНЦ СО РАН (Иркутск).

Science Present and Future: Research Landscape in the 21st Century: материалы научно-практической конференции с международным участием (18 мая 2023 г.) / Иркутский научный центр Сибирского отделения Российской академии наук. – Иркутск, 2023. – 92 с.

Утверждено к печати Учёным советом
Иркутского научного центра СО РАН

ISSN

© ИНЦ СО РАН, 2023

Содержание

Секция 1. Life-sciences on the Cutting Edge of Science

Секция 2. IT, Engineering, Digital Science

Секция 3. Geosciences, Solar Sciences and Hydrosciences: New Frontiers

Секция 4. Linguistics and Educational Sciences

Life-sciences on the Cutting Edge of Science

UDC 633.358:577.73

Petr A. Bizikov*, Lyudmila E. Makarova, Aleksey A. Ischenko, Irina G. Petrova

*****bizikov.piotr@mail.ru

Siberian Institute of Plant Physiology and Biochemistry SB RAS, Irkutsk, Russian Federation

NAPHTALENE IS ESSENTIAL METABOLITE FOR SYNTHESIS OF N-PHENYL-2-NAPHTHYLAMINE AND PHTHALATES IN *PISUM SATIVUM* L.

Keywords*: Pisum sativum L., N-phenyl-2-naphthylamine, phthalates.*

Currently, there is no information about the biosynthesis of N-phenyl-2-naphthylamine and phthalates in plant cells in the literature. There is no evidence of the synthesis of N-phenyl-2-naphthylamine in bacteria, at the same time, soil bacteria were able to degrade this compound with the formation of phthalates (Makarova et al., 2020). Degradation of N-phenyl-2-naphthylamine to phthalates can also be performed by endophytic bacteria of pea plants (Makarova et al., 2021). Consequently, in pea plants, one of the sources of phthalates appearance in their tissues may be bacteria settling in their organs, which are capable of degrading polycyclic aromatic hydrocarbons (PAHs).

Currently, there is no data on the plant degradation of PAHs to phthalates in the scientific literature. Previously, the presence of these compounds in root tissues and root exudates in legumes was established [1]. The aim of this study was to find the ability of *Pisum sativum* to utilize naphthalene as a precursor for the synthesis of chemicals with toxic effect on living organisms (N-phenyl-2-naphthylamine and

phthalates). As an object of study, roots of the etiolated pea seedlings, grown on 10-4 M naphthalene for 24 h, were used. Roots of seedlings grown on water were used as a control. Extracts containing aromatic compounds were obtained by successive extraction with 80% ethanol and ethyl acetate from root seedlings, fixated with 95% ethanol.

Using HPLC the concentrations of N-phenyl-2-naphthylamine, diethyl-, dibutyl- and bis (2-ethyl-hexyl) phthalates were estimated. To confirm the presence of phthalates in extracts, standard samples of corresponding compounds were used. Significant increases of N-phenyl-2-naphthylamine and phthalates concentrations in roots of pea plants, grown on naphthalene solution (compared to control plants), have shown that plant cells seem to use this compound as a necessary metabolite in biosynthesis of compounds mentioned above (Figure 1.).

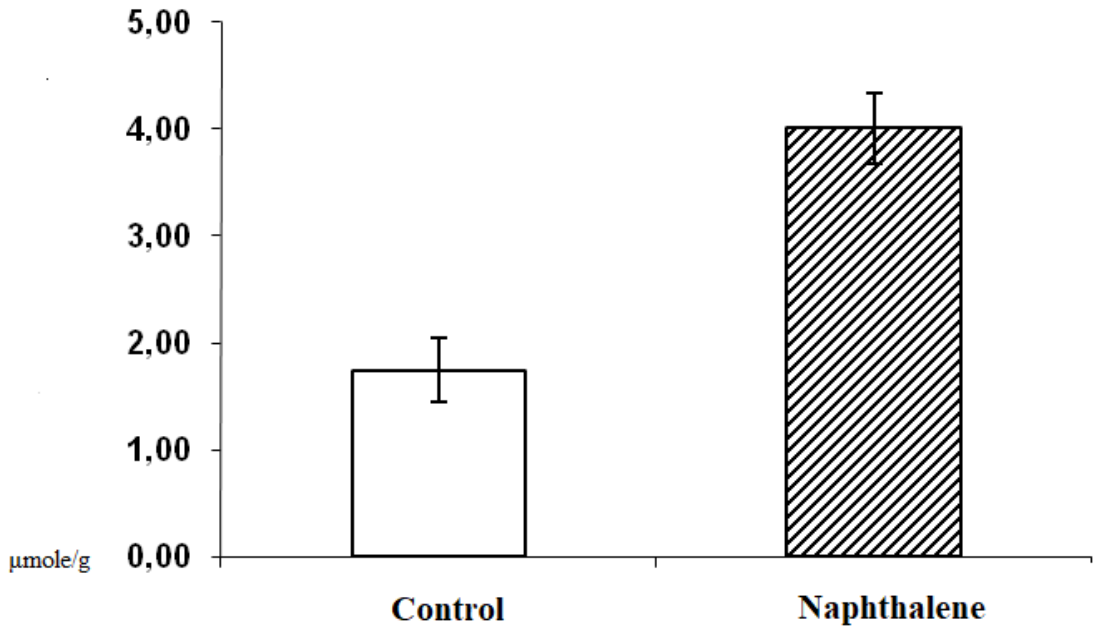


Figure 1. The concentration of N-phenyl-2-naphthylamine in the roots of pea seedlings grown on water and on naphthalene solution.

References:

1. Makarova L.E, Morits A.S, Sokolova N.A, Nesterkina I.S. Issledovaniye sostava ftalatov v kornevykh ekssudatakh prorostkov gorokha, inokulirovannykh *Rhizobium leguminosarum* bv. *viceae* i *Pseudomonas syringae* pv. *pisi* pri raznykh temperaturakh [Study of the phthalates composition in the pea seedlings root exudates inoculated with rhizobium leguminosarum bv. viceae and pseudomonas syringae pv. pisi at different temperatures]. Proceedings of the All-Russian Scientific Conference with International Participation and Schools of Young Scientists "Mechanisms of

resistance of plants and microorganisms to unfavorable environmental". Irkutsk, 10-15 July 2018. Irkutsk: Institute of geography SB RAS, 2018. Pp. 488-491. DOI: 10.31255/978-5-94797-319-8-488-491 (in Russ).

UDC 616-001.34:616-008.9:577.15

Nadezhda P. Chistova*, Anastasia A. Lysenko
**chist1nad2pavl3@gmail.com*
East-Siberian Institute of Medical and Ecological Research,
Angarsk, Russian Federation

LIPID METABOLISM MARKERS IN PATIENTS WITH VIBRATION DISEASE AND METABOLIC SYNDROME

Kew words: *vibration disease, metabolic syndrome, lipid metabolism.*

The World Health Organization indicates a "pandemic" of obesity and metabolic syndrome, the prevalence of which among the adult population, according to the Interheart study, is 26%. Metabolic syndrome (MS) is diagnosed in the presence of the main component - abdominal obesity and two additional: arterial hypertension, high levels of triglycerides (TG≥1.7 mmol/L) and low–density lipoprotein cholesterol (LDL cholesterol ≥3.0 mmol/L), low high-density lipoprotein cholesterol (HDL cholesterol <1.0 mmol/L), a decrease in glucose tolerance. In turn, vibration disease (VD) may be accompanied by lipid metabolism disorders [2]. In this regard, it is important to study the combined course of VD and MS [1].

The purpose of the study is to evaluate the state of lipid metabolism in patients with MS and VD, depending on the type of vibration.

The lipid profile status in blood serum was evaluated using the appropriate test systems (Human, Germany) on a «Labio 200» biochemical analyzer. Statistical processing was carried out using STATISTICA10, the results are presented as a proportion and confidence interval, Fisher's exact test was used to compare frequencies.

An analysis of lipid metabolism in the examined patients in accordance with the criteria values given above, made it possible to establish that the results proportion with an excess of the TG level in patients with VD from exposure to local vibration (62 people) was 69.1 [56.0-82.2]%, which is statistically significant differed from the values in the group of persons who had VD from the combined vibration (102 people) - 50.0 [39.3-60.7]% (p=0.02).

The proportion of cases with an excess of the criterion value of LDL cholesterol in the group of examined, exposed to local vibration, took the value of 67.8 [54.6-

81.0]%, and in the group exposed to combined vibration - 76.4 [67.2-85.6]% (p=0.3). Deviation from the criterion value of HDL cholesterol was recorded in 32.3 [19.1-45.5]% of patients with VD from exposure to local vibration and 35.3 [25.1-45.5]% of patients with VD from exposure to combined vibration (p = 0.7).

Conclusion. Patients with VD and MS are characterized by pronounced changes in lipid metabolism. A feature characteristic of the group of individuals with VD from exposure to local vibration and MS was an increase in the results proportion above the criterion value for triglycerides.

References:

1. Artamonova V. G. Nekotoryye sovremennyye aspekty patogeneza vibratsionnoy bolezni [Some modern aspects of the pathogenesis of vibration disease]. Meditsina truda i promyshlennoy ekologii. 2000; 2:1-4. (in Russ).
2. Gorenkov R. V. Issledovaniye lipidnogo obmena i profilaktika ego narusheniy s pomoshchyu pishchevykh dobavok iz morskikh zhivotnykh u bolnykh vibratsionnoy boleznyu [Study of lipid metabolism and prevention of its disorders with the help of dietary supplements from marine animals in patients with vibration disease]. Almanakh klinicheskoy meditsiny. 2000; 3:137-143. (in Russ).

Scientific supervisor:
Irina V. Kudaeva,
D. Sc. (Medicine),
East-Siberian Institute of Medical
and Ecological Research

UDC 582.675.5

Polina A. Kuzmina
polinazaremba@bk.ru
Siberian Institute of Plant Physiology and Biochemistry, SB RAS,
Irkutsk, Russian Federation

KARYOGEOGRAPHIC DISTRIBUTION OF *CHELIDONIUM MAJUS* AGG. (PAPAVERACEAE)

Keywords: *Karyogeography, cytotypes, chromosome numbers, hybridization.*

The number of chromosomes is the most important characteristic of the karyotype and is considered as a feature of the species. Chromosomal numbers are very significant in studies of evolution and plant taxonomy, therefore modern botanical sources include data on chromosome numbers and use this information when analyzing the relationships of species, reflecting the features of their adaptation and evolution. Karyological races may indicate the relative age of the taxon, reflect

the genetic changes occurring within the species and chromosomal instability [1]. The morphology and number of chromosomes in the karyotype of closely related species are similar or identical, while in some species they differ to some extent [2].

The goal of the study is to determine the karyogeographic distribution of the cytotypes of the aggregate complex of *Chelidonium majus* L.

According to POWO [3], the modern taxonomic composition of the genus *Chelidonium* L. is represented by two species *Ch. majus* and *Ch. asiaticum* (Hara) Krahulc.

Species of the genus *Chelidonium* have been studied karyologically from the beginning of the 20th century to the present day, from various regions of the Northern Hemisphere: Europe, Asia, and North America (Fig. 1). On the basis of our own (chromosome numbers were calculated for 60 samples) and literature karyological data (161 literature sources were analyzed, which contain information on chromosome numbers for *Ch. majus* agg.), a dot map of the karyographic distribution of taxa/cytotypes of Ch. majus agg. (Fig. 1). We noted that the cytotype *Ch. majus* agg. with $2n = 12$ in most cases found in Europe, Central Asia and the Caucasus, as well as in North America. In turn, the cytotype of *Ch. majus* agg. with $2n = 10$ was found in the Far East (China, Korea, Russia and Japan).

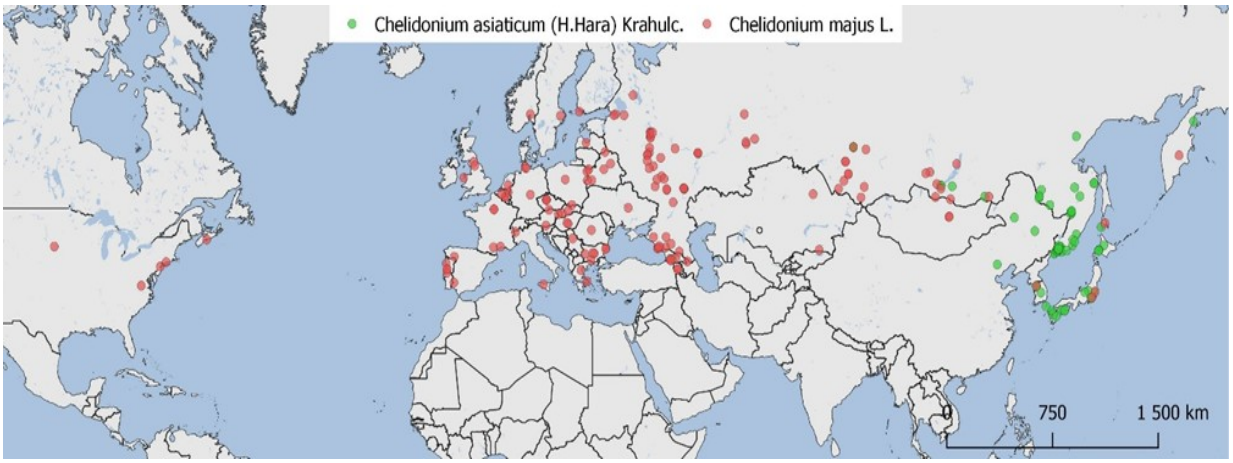


Figure 1. Dot map of the karyogeographic distribution of *Chelidonium majus* agg. cytotypes, characterized by the corresponding number of chromosomes: *Ch. asiaticum* - $2n = 10$, *Ch. majus* - $2n = 12$

Different cytotypes of *Ch. majus* agg. have differences in morphological characteristics and their geographical confinement. Therefore, there are sufficient grounds for recognizing cytotypes $2n = 10$ and $2n = 12$ as independent species of *Ch. asiaticum* and *Ch. majus* respectively.

In the course of studies by Krahulcova [4] with artificial crossing of *Ch. asiaticum* with $2n = 10$ chromosomes and *Ch. majus* s.l. with a chromosome number of $2n = 12$ produced a hybrid that had $2n = 11$. Nakamura and Suzuki [5] found a

natural existence of a hybrid in Japan, between *Ch. asiaticum* (2*n* = 10) and *Ch. majus* (2*n* = 12), which also had 2*n* = 11. It can be expected that at the junction of the ranges of *Ch. asiaticum* and *Ch. majus* will also reveal a hybrid of *Ch*. spp. with 2*n* = 11.

References:

1. Probatova N.S. Chisla khromosom rasteniy kak istochnik informatsii pri izuchenii flory Dalnego Vostoka Rossii [The chromosome numbers as a source information in studies of the Russian Far East flora]. Vestnik DVO RAN. 2003; 3:54–67. (in Russ).
2. Shneer V.S., Punin E.O., Rodionov A.V. Intraspecific differences in ploidy in angiosperms and their taxonomic interpretation. Botanical journal. 2018; 103(5):555–585.
3. Govaerts R., Lughadha E. N., Black N., Turner R., Paton A. The World Checklist of Vascular Plants, a continuously updated resource for exploring global plant diversity. Scientific Data. 2021; 8(1):215. Available from: https://www.researchgate.net/publication/353906815_The_World_Checklist_of_Vascular_Plants_a_continuously_updated_resource_for_exploring_global_plant_diversity DOI: https://doi.org/10.1038/s41597-021-00997-6
4. Krahulcova A. Cytotaxonomic study of *Chelidonium majus* L. s. l. Flora Geobot. Phytotax. 1982; 17(3): 237–268.
5. Nakamura N., Suzuki M. Biological studies in *Chelidonium japonica* Thunb. (sensu lato) [広義のヤマブキソウの分類学的研究 in origin]. University of Ibaraki Faculty of Education Protocols (Natural Sciences). 1985; 34:75-84. (in Japan).

UDC 630*612(571.53)

Dennis V. Dayneko
ddayneko@oresp.irk.ru
Irkutsk Scientific Center, SB RAS,
Irkutsk, Russian Federation

THE ECOLOGICAL SIGNIFICANCE OF THE FORESTS: IRKUTSK PROVINCE CASE STUDY

Key words: *ecological significance, forest, Irkutsk province.*

The economic importance of forests in meeting the demand for wood is well known. However, along with the important role of forests in the socio-economic development of society, the ecological significance of forests is of great relevance. The ecological resource of forests implies regulatory functions (water and heat regimes of the Earth's surface, water protection and water regulation functions);

formation and preservation of soil cover; regulation and conservation of biodiversity; climate and weather changes; global carbon cycle; sanitary and hygienic, balneological and recreational roles.

The ecological value of Irkutsk province forests is not limited to the territory of the region where they mature. Irkutsk province forests have a planetary significance and play an important role in global processes of environmental regulation and prevention of negative climate changes. Forests sequester a large share of the world's carbon dioxide emissions, For example, forests of Irkutsk province account for up to 1/3 of the net carbon deposition of all the world's forests [1].

Another global role of the forest is photocatalytic transformation, carbon dioxide sequestration, and oxygen release. Thus, according to approximate calculations, the forests of the Irkutsk province only produce more than 72 billion m^3 of oxygen annually [2]. In addition, the forests of the region growing in the catchment area of the lake Baikal and along the river banks play the water protection role, providing regulation and filtration of wastewater and a constant water level. Forests that grow in mountainous areas protect weak soils on the slopes from flushing, weathering, snow avalanches and mudslides too.

It is worth noting the sanitary and hygienic significance and protective function of forests from dust, soot, and noise. Forest plantations protect crops and gardens from cold winds and improve the climate. Forests largely neutralize the effects of harmful emissions from industrial enterprises. It is known that staying in the forest has a beneficial effect on human health and creativity. Given the diverse significance of forests, they should be considered not only natural, but also cultural heritage of the country.

Haphazard actions in forest management have led to the destruction of most of the forests in Western Europe and in central regions of Russia. As a result of excessive use of natural resources, there is a threat of destruction of the existing ecosystems, climate and water balance degradation. Forest conservation is the condition required to contain the ecological crisis on Earth. Forest as an exhausted but renewable resource is in the sphere of close attention of ecologists and economists. In the era of globalization of commodity and raw materials markets, when most of the forests in the United States and Europe are undergoing conservation and preservation, the sustainable environmental management practices are especially relevant for Russia and its regions, such as the Irkutsk province, which is the first among the country's logging regions.

The problem of nature degradation is related to the anthropogenic impact on forests. First, direct impact (deforestation, forest fires, construction of facilities, mass tourism, atmospheric emissions). Secondly, indirect impact, when the living conditions change as a result of air and water pollution, the use of mineral fertilizers

and pesticides, which leads to changes in the plants composition). In addition, radioactive contamination is becoming a new factor in forests and vegetation degradation.

Currently, the complexity of forest management and reforestation is due to specific factors. First of all, a long period of forest cultivation. The age of mature large-sized valuable trees is at least 70 years. It is necessary to observe the proportionality of forest use to the scale and timing of its reproduction. Compliance with the principle of "continuous, non-destructive use of forests" (CUUF) is stated in the Forest code [3] and is the main postulate of the organization of sustainable forest management [4].

Another specific factor is the multi-purpose use of the forests. Russian forests and the land they occupy perform various functions, ensuring the reproduction of resources, commodity and non-commodity products. Using the forest as a source of wood, it is necessary to take into account other previously noted useful functions: protective, recreational, and other. The multi-purpose forest management approach is the basis for sustainable biodiversity conservation and is consistent with international agreements on forests.

References:

1. Dayneko D., Zykov S. Forest Industry of Russia: Smart Innovations and Success Stories. Book in the series Smart and Innovative Systems and Technologies. Singapore: Springer; 2022. 229 p. DOI: https://doi.org/10.1007/978-981-16-9861-3

2. Vashchuk L. N., Popov L. V., Krasny N. M. Lesa i lesnoye khozyaystvo Irkutskoy oblasti [Forests and forestry of the Irkutsk province]. Irkutsk; 1997. 288 p. (in Russ).

3. Forest Code of the Russian Federation, dated 15 March 2012. Moscow: Prospect, Kno-Rus; 2012. (in Russ).

4. The official website of the United Nations. Rio Declaration on environment and development. Available from: http://www.un.org/ru/documents/decl_conv/declarations/riodecl.stml [Accessed 14 April 2023].

UDC 544.43

Grigorii R. Gnatovskii*, Vladimir B. Orel

**gnat140299@yandex.ru*

A.E. Favorsky Irkutsk Institute of Chemistry SB RAS,

Irkutsk, Russian Federation

COMPARATIVE QUANTUM-CHEMICAL STUDY OF 1-FORMYL-2-PYRAZOLINE ASSEMBLY PATHWAYS FROM UNSATURATED KETONES, HYDRAZINE AND FORMIC ACID

Keywords: *1-formyl-2-pyrazoline; unsaturated ketone; hydrazine; formic acid; quantum chemical calculations; reaction mechanisms.*

It was experimentally shown [1] that the interaction of acetophenone, phenylacetylene, hydrazine and formic acid in the superbasic medium (KOBu^t/DMSO) afforded 1-formyl-2-pyrazolines in yields up to 81%. Among the key intermediates of this reaction are *β,γ*- and *α,β*-unsaturated ketones, which are formed via the C-vinylation of the starting ketones with phenylacetylene.

Previously, the reaction of the 1-formyl-2-pyrazoline formation from *α,β*- and *β,γ*-unsaturated ketones, hydrazine and formic acid by the hydrazination of the carbonyl group has already been investigated using the methods of quantum chemistry [2]. All calculations were carried out using the B2PLYP/6-311+G**//B3LYP/6-31+G* method, taking into account the solvation effects of the DMSO at the PCM model. It was demonstrated that the assembly can be performed via hydrazination of *β,γ*-unsaturated ketone ($\Delta G^{\ddagger}$ = 21.7 kcal/mol, ΔG = –1.8 kcal/mol), cyclization of *β,γ*-unsaturated hydrazone ($\Delta G^{\ddagger}$ = 29.6 kcal/mol, ΔG = –14.7 kcal/mol) and formylation of 2-pyrazoline ($\Delta G^{\ddagger}$ = 21.3 kcal/mol, ΔG = –19.5 kcal/mol).

In the present work, we studied an alternative assembly mechanism of 1-formyl-2-pyrazoline **7**, associated with the addition of hydrazine **1** or formylhydrazine **4** to the C=C bond of the *α,β*-unsaturated ketone **2** by the same method (Fig. 1). The kinetically preferred pathway was shown to involve the addition of hydrazine **1** at the *β*-carbon of ketone **2** ($\Delta G^{\ddagger}$ = 18.0 kcal/mol) and the cyclization of the resulting *β*-hydrazinyl ketone **3** ($\Delta G^{\ddagger}$ = 14.4 kcal/mol) to 2-pyrazoline **6**. Further formylation of **6** ($\Delta G^{\ddagger}$ = 21.3 kcal/mol) is the rate-determining stage of this pathway and leads to the final 1-formyl-2-pyrazoline **7** (Fig. 1).

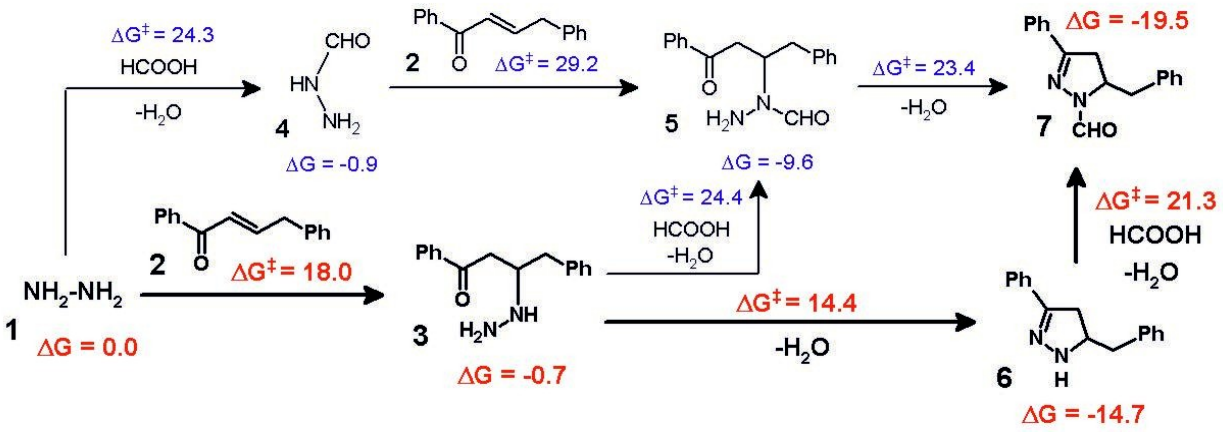


Figure 1. Formation of 1-formyl-2-pyrazoline via hydrazination of the C=C bond

Moreover, comparison of the 1-formyl-2-pyrazoline assembly mechanisms through hydrazination of the C=O and C=C bonds shows that the transformations sequence associated with the addition of hydrazine to the C=C bond of *α,β*-unsaturated ketone, the cyclization of *β*-hydrazinyl ketone and the formylation of 2-pyrazoline is also kinetically more preferable ($\Delta\Delta G^{\ddagger}$ = 8.3 kcal/mol).

Authors gratefully acknowledge Grant No FZZE–2020–0025 from the Ministry of Science and Higher Education of the Russian Federation.

References:

1. Schmidt E. Yu., Ivanova E. V., Tatarinova I.V. et al. Base-catalyzed addition of ketones to alkynes as a key step in the one-pot synthesis of 1-formyl-2-pyrazolines. Chemistry of Heteroclytic Compounds. Synthesis. 2015; 47(09):1329-1336.

2. Gnatovsky G. R., Orel V. B. Sborka 1-formil-2-pirazolinov iz nenasyshchennykh ketonov. gidrazina i muravinoy kisloty: kvantovokhimicheskoye issledovaniye [Assembling 1-formyl-2-pyrazolines from unsaturated ketones, hydrazine and formic acid: a quantum chemical study]. Khimicheskaya termodinamika i kinetika: Sbornik nauchnykh trudov XII Mezhdunarodnoy nauchnoy konferentsii [Chemical thermodynamics and kinetics: Collection of materials of the Twelfth International Scientific Conference]. Tver, 16 – 20 May, 2022. Pp. 83-84. (in Russ).

Scientific supervisor:
Vladimir B. Orel,
Ph.D. (Chemistry),
Leading researcher,
Laboratory of Quantum
Chemical Modeling of Molecular Systems,
Irkutsk State University

UDC 579.6:663.18

Dmitriy S. Belousov*, Yury A. Malkov, Ludmila A. Belovezhets
*belousov_off@mail.ru
A.E. Favorsky Irkutsk Institute of Chemistry SB RAS,
Irkutsk, Russian Federation

TECHNOLOGY OF SUBMERGED CULTIVATION OF HIGHER BASIDIOMYCETES MUSHROOMS

Keywords*: mushrooms, compost, sawdust, submerged cultivation, higher basidiomycetes.*

According to FAOSTAT data for 2019-2021, over 22 million m^3 of wood waste is generated annually by the timber industry and wood processing plants in Russia [1]. Due to the low demand, forestry waste accumulates in large quantities. Such waste creates a high level of negative environmental impact, releasing large amounts of decomposition products (phenols, acids) into soil and groundwater. Also due to the ability to spontaneous combustion, they create a high fire hazard. Thus, recycling of sawmill waste is one of the important environmental problems.

A promising direction for the utilization and neutralization of wood waste is the development of biotechnology for aerobic and anaerobic biothermal composting, in which organic waste is processed and converted into valuable organic fertilizer (biohumus or compost).

The higher basidiomycetes are the most active decomposers of plant polymers and of the greatest practical importance. Fungi such as *Phanerochate chrysosporium* (*Sporotrichum pulverulentum*), *Trametes versicolor* are able to decompose all components of plant mass due to their synthesis of a large set of hydrolytic and oxidative enzymes, as well as the high penetration ability of mycelium into the substrate [3].

The A.E. Favorsky Irkutsk Institute of Chemistry SB RAS has developed a technology for microbial processing of sawdust, using the association of non-pathogenic higher basidiomycetes [2]. This technology allows to obtain a complex organic and mineral fertilizer, which, in terms of its agrochemical indicators, is close to high-moor peat.

To apply this technology, a large amount of biomass of higher basidiomycetes is required. Therefore, at the Institute of Chemistry SB RAS, in cooperation with the Scientific and Educational Center «Baikal», the facility of submerged cultivation of fungi with periodic action was created. Submerged cultivation is carried out in a 100 l fermenter with a working volume of 70 l on a culture medium of the following

composition: glucose – 20 g/l, yeast autolysate – 10 g/l. The cultivation conditions are as follows: temperature – 26-37°C (depending on the strain of the mushroom), initial pH – 6.9-7.1, final pH – 4.5-4.7, agitation rate – 20 rpm (0.3 m/sec), incubation time – 7 days. The culture medium is inoculated with 10% (v/v) of seeds culture.

In the process of fermentation, a stepwise aeration of the culture medium with sterile air occurs. During the lag phase, the air flow rate is 0.15 $l \bullet l^{-1} \bullet min^{-1}$ and then in the exponential growth phase, the flow rate rises to 0.7 $l \bullet l^{-1} \bullet min^{-1}$. This aeration allows for foam control and reduces energy costs.

At the moment, the achieved facility productivity is 500-800 g of absolutely dry mushrooms per month, which is enough for composting up to 1000 m^3 of sawdust.

References:

1. FAOSTAT. Available from: https://www.fao.org/faostat/ru/#data/FO [Accessed 22 April 2023].
2. Belovezhets L.A. Sposob Utilizatsii Drevesnykh Opilok s Primenenyem Kompozitsii Derevorazrushayushchikh Mikroorganizmov dlya Polucheniya Kompleksnogo Organo-mineralnogo udobreniya. Patent Rossiyskaya Federatsiya № 2701942, МПК C05F 11/08 (2006.01), C05F 11/08 (2019.08) [A method for the disposal of sawdust using a composition of wood-destroying microorganisms to obtain a complex organic and mineral fertilizer: № 2019103074: appl. 05.02.2019: publ. 02.10.2019]. 8 p.
3. Kuznetsov A.E., Gradova N.B., Lushnikov S.V. et al. Prikladnaya ekobiotekhnologiya : ucheb. posobiye v 2 t., T.1 [Applied Environmental Biotechnology: textbook in 2 vols., Vol. 1]. Moscow: BINOM. Knowledge Laboratory; 2017. 629 p. (in Russ).

UDC 57.083.12

Ekaterina Ol. Pristavka*, Aleksey Al. Levchuk, Ekaterina S. Shadrina

*****katya-i-95@mail.ru*

A.E. Favorsky Irkutsk Institute of Chemistry SB RAS,

Irkutsk, Russian Federation

SCREENING OF SOIL MICROORGANISMS-DESTRUCTORS OF IMAZAMOX

Keywords: *biodegradation, pesticides, imazamox, screening of microorganism.*

Recently, soil pollution with pesticides is a serious environmental problem due to their widespread use. Residual quantities of pesticides in the soil lead to changes in

soil properties and reduce the number of living microorganisms, thereby leading to its degradation. In this regard, of great practical interest is the search for environmentally safe, effective and inexpensive ways to clean up contaminated areas [1]. One such alternative method is biological remediation or bioremediation, which involves the use of microorganisms to remove and clean soil from pollutants.

The aim of this study was to isolate degrading microorganisms from soil contaminated with imazamox (5-(methoxymethyl)-2-(4-methyl-5-oxo-4-propan-2-yl-1H-imidazol-2-yl) pyridine-3-carboxylic acid). The object of the study was soil samples taken from the territory of the agricultural sector of the Irkutsk region, where, at various intervals, the soil was subjected to seasonal treatment with herbicide. The isolation of microorganisms from soil samples was carried out by the Koch method [2]. Sowing was carried out on agarized nutrient media: for fungi – Saburo medium, for bacteria – MPA, for actinomycetes – Chapek medium, each of which contained a pesticide as the only carbon source. Further, individual colonies were screened out to obtain pure cultures. As a result, we isolated 30 strains of microorganisms, of which 20 strains are microscopic fungi, 7 strains are bacteria and 2 strains are actinomycetes. To select the most promising of them, we took five strains of fungi and seeded them in Kirk's liquid mineral medium with the addition of a pesticide at a concentration of 0.16 g/l as the only source of carbon. Microorganisms were cultivated at 26°C for 14 days with daily sampling to determine pesticide residues. The samples were centrifuged to separate the biomass and analyzed by HPLC. The mass fraction of imazamox was determined using the Agilent 1260 chromatographic system with a UV detector and a reversed-phase column. As an eluent, a mixture of acetonitrile – 0.1% orthophosphoric acid was used in a ratio of 22:78, by volume. The conditions were the following: analytical wavelength 240 nm, mobile phase flow rate 1 ml/min, chromatogram recording time 6.3 min. The control was a sterile nutrient medium without microorganism.

As a result, it was shown that after 14 days of cultivation of microorganisms in a nutrient medium with imazamox, the maximum pesticide loss was 25% and 35% for U-21 and CH-25 cultures, respectively. Thus, as a result of our research, two promising microorganisms have been identified for the biodegradation of the pesticide imazamox.

References:

1. Hidiyatullina A. Ya., Yapparov I. A., Degtyareva I. A. Vydeleniye mikroorganizmov-destruktorov. adaptirovannykh k razlichnym kontsentratsiyam uglevodorodnogo zagryazneniya, iz pochv Respubliki Tatarstan [Isolation of microorganisms-destructors adapted to different concentrations of hydrocarbon

pollution from the soils of the Republic of Tatarstan]. Dostizheniya nauki i tekhniki APK. 2014; 3:30-32. (in Russ).
2. Zvyagintsev D.G. Metody pochvennoy mikrobiologii i biokhimii [Methods of soil microbiology and biochemistry]. Moscow: MSU; 1991. 302 p. (in Russ).

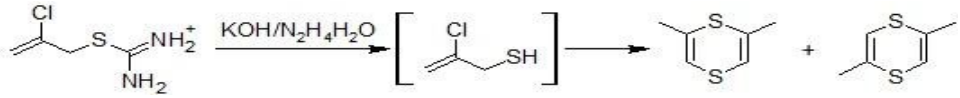
UDC 544.18, 544.43, 547.75

Nikita V. Teplyashin*, Alexander S. Bobkov
**teplyashin@cc.isu.ru*
A.E. Favorsky Irkutsk Institute of Chemistry, SB RAS,
Irkutsk, Russian Federation

QUANTUM CHEMICAL STUDY OF THE REACTION MECHANISM OF 2,6-DIMETHYL-1,4-DITHIINE ASSEMBLY FROM 2-CHLOROPROP-2-ENTHIOL IN KOH/$N_2H_4 \cdot H_2O$ MEDIUM

Keywords: *DFT study; hydrazine hydrate; 2,6-dimethyl-1,4-dithiine; 2-chloroprop-2-enthiol; cyclization.*

A preparative method for obtaining thiols by alkaline hydrolysis of isothiuronium salts is known. However, the hydrolysis of (2-chloroprop-2-enyl)isothiuronium salt in a KOH/$N_2H_4 \cdot H_2O$ medium can lead to the formation of cyclic products, a mixture of 2,5- and 2,6-dimethyl-1,4-dithiines (Scheme 1).

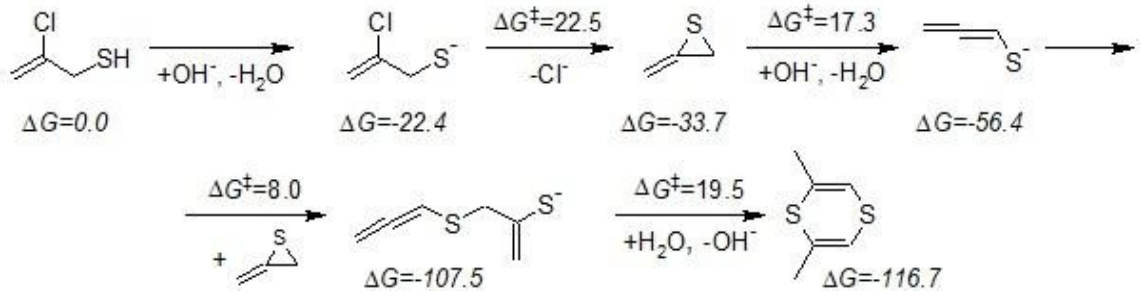


Scheme 1. Hydrolysis of (2-chloroprop-2-enyl) isothiuronium salt

Quantum chemical modeling of the reaction mechanism of 2,6-dimethyl-1,4-dithiine formation from 2-chloroprop-2-enthiol in KOH/$N_2H_4 \cdot H_2O$ medium was carried out using the combined approach B2PLYP-D/6-311+G**//B3LYP/6-31+G*+ PCM (B3LYP/6-31+G*).

Thiol is deprotonated to form a stable thiolate ion $\Delta G = 22.4$ kcal/mol in an alkaline medium (Scheme 2). The subsequent formation of methylidenethiirane occurs *via* intramolecular nucleophilic substitution of the chloride ion by a sulfur one with an activation barrier $\Delta G^{\ddagger}$=22.5 kcal/mol. Opening of the thiirane ring under the action of hydroxide ion leads to allenylthiolate with an activation barrier $\Delta G^{\ddagger}$=17.3 kcal/mol. Allenylthiolate, in turn, attacks methylidenethiirane to the third position with a low activation energy $\Delta G^{\ddagger}$=8.0 kcal/mol and cycle opening. The

intramolecular addition of a sulfur-centered anion to the internal atom of the allenyl fragment with the formation of 2,6-dimethyl-1,4-dithiine is characterized by the activation energy $\Delta G^{\ddagger}$=19.5 kcal/mol. The free energy of 2,6-dimethyl-1,4-dithiine formation from two 2-chloroprop-2-enthiol molecules is ΔG = -116.7 kcal/mol.



Scheme 2. Assembly mechanism of 2,6-dimethyl-1,4-dithiine from 2-chloroprop-2-enithiol. ΔG and $\Delta G^{\ddagger}$ in kcal/mol

The formation mechanism of 2,5-dimethyl-1,4-dithiine from 2-chloroprop-2-enthiol will be investigated further.

The work was carried out under the guidance of Prof. Nadezhda M. Vitkovskaya within the framework of the grant No. FZZE-2020-0025 from the Ministry of Science and Higher Education of the Russian Federation.

UDC 547.379

Maxim V. Musalov, Vladimir A. Potapov, Anna A. Pakeeva*

**draganoza@rambler.ru*

A.E. Favorsky Irkutsk Institute of Chemistry SB RAS,

Irkutsk, Russian Federation

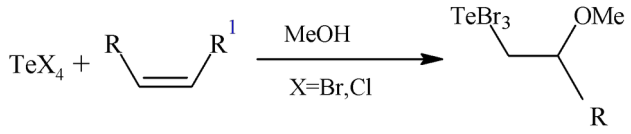
REACTIONS OF TELLURIUM TETRAHALOGENIDES WITH UNSATURATED COMPOUNDS: AN EFFECTIVE ROUTE TO NEW ORGANOMETALLIC PRODUCTS

Keywords: *organotin compounds, electrophilic addition, tellurium tetrabromide, alkenes.*

Organo-tungsten compounds have proven themselves not only as models for the study of theoretical questions of organic chemistry, but also as important compounds in practical terms. They are used in the production of nanomaterials, photoresistors, optical devices, solar cells, semiconductor materials, films, and coatings.

We have found tellurium compounds that are highly biologically active and have all the prerequisites to become new medical drugs. Since this field of science had

hardly been developed before, the search and study of the biological activity of organ-telluranic compounds led to the creation of new highly effective drugs with an unexpected complex of properties. Little information on the reactions of tellurium tetrachloride and tellurium tetrabromide with alkenes is available in the literature [1]. It was found that tellurium tetrachloride is attached at the double bond of alkenes to form corresponding monoadducts in high yields depending on the ratio of $TeCl_4$: alkene. Mono-adducts are formed at equimolar ratios, while reactions with an excess of alkene in relation to $TeCl_4$ tend to form a bi-adduct. Chloroform, acetonitrile, and carbon tetrachloride are most commonly used as solvents at reaction temperatures ranging from zero to room temperature. Earlier it was thought that tellurium tetrabromide does not attach to double bonds. Reactions of tellurium tetrabromide with alkenes in methanol were first carried out and studied [2]. The reactions proceed chemically and regioselectively with the formation of 2-(organyl) tellurtribromides in high yields. No formation of bis-adducts as well as possible alcoholization of the Te-Br bond was observed. The data obtained open up new opportunities in the chemistry of tellurium tetrabromide, which can find wide application in the synthesis of organotin compounds. It should be noted that tellurium tetrabromide is a very accessible compound, which can be obtained by reacting tellurium with bromine at room temperature. Tellurium tetrachloride is available by the reaction of elemental tellurium and sulfuryl chloride. The conditions for the planned reactions of tellurium tetrahalogenides are found. Examples of regio- and stereoselective reactions are shown in the scheme.



R= Bu; Pent; Hex; Me-eugenol;anetol

R^1= Í

Thus, the first unique examples of chemo-regio- and stereoselective syntheses of organotin compounds have been shown. Further development of these studies and new approaches will serve as the basis for the creation of accessible, practically valuable preparations for medicine, electronics, and fine organic synthesis. The studied reactions are technological and based on available starting compounds.

References:

1. Patra A., Wijsboom Y. H., Leitus G., Bendikov M. Synthesis, Structure, and Electropolymerization of 3,4-Dimethoxytellurophene: Comparison with Selenium Analogue. Organic Letters. 2009; 11(7):1487-1490. DOI:10.1021/ol9000608

2. Potapov V. A., Musalov M. V., Musalova M. V., Amosova S. V., Recent Advances in Organochalcogen Synthesis Based on Reactions of Chalcogen Halides with

Alkynes and Alkenes. Current Organic Chemistry. 2015; 19(999):1-1. DOI:10.2174/1385272819666150810222454

UDC 577.212.8

Anzhelika V. Yudinceva*, Yury S. Bukin, Dmitry Yu. Shcherbakov, Elena V. Romanova
**udinceva.a@yandex.ru*
Limnological Institute, SB RAS,
Irkutsk, Russian Federation

REMOLDING OF TRNA GENES AS ONE OF THE MECHANISMS FOR AMINO ACID CHANGES IN MITOCHONDRIAL PROTEINS

Keywords: *remolding, Baikal amphipods, mitochondrial genome.*

The mitochondrial (mt) genome of the majority of animals is a single circular or linear molecule that encodes 13 protein-coding genes, 22 tRNA genes, and 2 ribosomal genes. It has its system of DNA replication, transcription, and protein translation. The protein-coding genes of the mitochondrial genome are the components of the electron transfer chain and ATP synthesis. There are 13 currently known types of the mt genetic code. Such a high diversity of the genetic code reveals the underestimated variability of mitochondrial genomes in different animal groups. One of the evolutionary mechanisms of the mt genetic code change (codon reassignment) is the remolding of tRNA genes. The remolding of tRNA genes is the phenomenon of tRNA identity change through the point mutations in the anticodon sequence [1]. Such remolded tRNAs may be charged by another amino acid leading to changes in genetic code. Although the remolding of tRNA genes has been shown in many groups of animals [2, 4], its impact on the primary amino acid sequence and physicochemical properties of mt proteins remain unclear. The previous studies of mt genomes in Baikal amphipods showed numerous cases of tRNA gene duplications and remolding [3].

The mt genomes of three Baikalian species with numerous cases of remolded tRNA genes were taken in a current study. These species are: *Acanthogammarus victorii* (trnI(GAU)→trnA(UGC), trnD(GUC)→trnY(GUA), trnH(GUG)→trnD(GUC)), *Eulimnogammarus vittatus* (trnL(UAG)→trnP(UGG)), *Gmelinoides fasciatus* (trnH(GUG)→trnQ(UUG)) [3].

The study aimed to calculate the impact of amino acid changes caused by the alternative charging of remolded tRNA genes on the spatial structure of the protein

cytochrome b and the value of its isoelectric point (*pI*) in *A. victorii*, *E. vittatus*, *G. fasciatus*.

The modeling and the optimization of the three-dimensional protein structure of the protein cytochrome b by the amino acid sequence were performed on the SWISS-MODEL web server. The comparative analysis of the cytochrome b protein structure was carried out in the Swiss-PdbViewer v4.1.0 program. The Prediction of isoelectric point (*pI*) values of the cytochrome b protein was conducted using packages seqinr, ape, and pIR for the R programming language.

It was determined that the amino acid changes have the greatest impact on both spatial structure and value isoelectric point (*pI*) of the cytochrome b protein in *A. victorii*. This may be explained by the fact that *A. victorii* has three cases of remolded tRNA genes in its mitochondrial genome, whereas *E. vittatus* and *G. fasciatus* have only one remolded tRNA gene. In addition, the possible reassignment of remolded tRNA genes should have a significant impact on the studied protein due to the different physicochemical properties of alternative amino acids.

References:

1. Cantatore P. et al. Duplication and remoulding of tRNA genes during the evolutionary rearrangement of mitochondrial genomes. Nature. 1987; 329(6142): 853-855.
2. Liu C. et al. Mitochondrial genomes of two Sinochlora species (Orthoptera): novel genome rearrangements and recognition sequence of replication origin. BMC genomics. 2013; 14:1-13.
3. Romanova E. V. et al. Hidden cases of tRNA gene duplication and remolding in mitochondrial genomes of amphipods. Molecular phylogenetics and evolution. 2020; 144:106710. DOI: 10.1016/j.ympev.2019.106710
4. Xu X., Wu X., Yu Z. Comparative studies of the complete mitochondrial genomes of four Paphia clams and reconsideration of subgenus Neotapes (Bivalvia: Veneridae). Gene. 2012; 494(1):17-23.

Scientific Supervisor:
Yury S. Bukin,
Ph.D. (Biology), Senior Researcher,
Limnological Institute, SB RAS

UDC 582.738

Evgeny S. Kharin
kharin.eugene@yandex.ru
Siberian Institute of Plant Physiology and Biochemistry, SB RAS,
Irkutsk, Russian Federation

KARYOTYPE AS A TAXONOMIC TRAIT OF SPECIES OF THE TRIBE *FABEAE* RCHB. (FABACEAE)

Keywords: *chromosome numbers, chromosome races, cytotype, karyosystematics, legumes.*

Tribe *Fabeae* Rchb. includes genera *Vicia* L. and *Lathyrus* L. and about 380 species, including the most ancient and valuable agricultural grain legumes - peas (*Lathyrus oleraceus* Lam. ≡ *Pisum sativum* L.) and beans (*Vicia faba* L. ≡ *Faba vulgaris* Moench.) [2].

Karyological data serve as an excellent tool for the systematics of vascular plants. The karyotype of plants is a species-specific trait, which allows in some cases to clarify the taxonomic affiliation. Also, the study of chromosome numbers can be an additional source of data for identifying migration pathways, centers of origin, and adaptive abilities of species [5].

In some species, chromosomal races (cytotypes) have been identified, which differ in various levels of ploidy. The study of polyploid races is of particular importance from the adaptation point of view, since a multiple increase in the number of chromosomes (autopolyploidy) is one of the factors that allow plants to increase their tolerance to environmental conditions, including anthropogenic factors and to expand their areal. The increase in the number of chromosomes due to hybridization (allopolyploidy) is an important evolutionary mechanism leading to potential speciation.

The representatives of the tribe in the diploid set ($2x$) have a relatively small number of chromosomes ($2n$ = 10, 12, 14) which in turn have large sizes. This makes them a convenient object for karyosystem studies: the number of chromosomes and their morphology.

The diploid lineage in *Vicia* species is represented by $2n$ = 10, 12, 14, with the basic number of chromosomes (x) 5, 6, 7 respectively [1]. In *V. sativa* L. s. l. the polybasic state of the karyotype is revealed: *V. sativa* subsp. *cordata* (Hoppe) Asch. & Graebn. has $2n$ = 10, at x = 5, *V. sativa* subsp. *amphicarpa* (Dorthes) Asch., *V. sativa* subsp. *macrocarpa* (Moris) Arcang., and *V. sativa* subsp. *nigra* (L.) Ehrh. – $2n$ = 12, at x = 6, *V. sativa* subsp. *incisa* (M. Bieb.) Arcang. – $2n$ = 14, at x = 7. In the genus *Vicia* species with high ploidy level are rare. Tetraploid and octaploid cytotypes were found in some of them, for example, in *V. tetrasperma* (L.) Schreb. along with a diploid set of chromosomes (2n = 2x = 14), a tetraploid (2n = 4x = 28) and octaploid (2n = 8x = 56) sets were also identified [1].

All *Lathyrus* species have $2n$ = 14, chromosomes in the diploid set, with x = 7 [1, 9]. This constancy in the number of chromosomes does not allow this trait to be considered taxonomic within the genus. The study by Suman et al. [3] showed that

cytotypes with high ploidy are rare among *Lathyrus* species: *L. pratensis* L., *L. nevadensi* S.Watson, and *L. venosus* Muhl. ex Willd. – tetraploid set of chromosomes ($2n = 4x = 28$), and *L. palustris* L.– tetraploid and hexaploid ($2n = 6x = 42$) sets.

On the territory of Baikal Siberia, 31 species of the tribe *Fabeaea* were identified, of which 20 are representatives of the genus *Vicia* and 11 – *Lathyrus*. [4]. Based on the local material, chromosome numbers were counted for 14 of 20 species of *Vicia* L. and for 4 of 11 species of the genus *Lathyrus* [6].

To present day, no comprehensive karyosystemic studies of representatives of the tribe *Fabaeae* of Baikal Siberia have been carried out. Therefore, this is an urgent problem.

References:

1. Rice A., Glick L., Abadi S., Einhorn M., Kopelman N.M., Salman-Minkov A., Mayzel J., Chay O., Mayrose I. The Chromosome Counts Database (CCDB) – a community resource of plant chromosome numbers. New Phytologist. 2015; 206(1):19–26.

2. Schaefer H., Hechenleitner P., Santos-Guerra, A., de Sequeira, M.M., Pennington, R.T., Kenicer, G., Carine, M. A. Systematics, biogeography, and character evolution of the legume tribe *Fabea*e with special focus on the middle-Atlantic island lineages. BMC Evolutionary Biology. 2012; 12:1–19.

3. Suman P., Biplab B., Bhushan B.D., Badal K.D. Assessing karyotype diversity in the genus Lathyrus L. (Fabaceae). Feddes Repertorium. 2022; 133:199–214.

4. Malyshev L.I., Doronkin V.M., Zuev V.V. et al. Konspekt flory Aziatskoy Rossii: sosudistyye rasteniya [Conspectus florae Rossiae Asiaticae: plantae vasculares]. Novosibirsk: Publishing house of the Siberian branch of the Russian academy of sciences; 2012. 640 p. (in Russ).

5. Probatova N.S. Chisla khromosom rasteniy kak istochnik informatsii pri izuchenii flory Dalnego Vostoka Rossii [The chromosome numbers as a source information in studies of the Russian Far East flora]. Vestnik DVO RAN. 2003; 3:54–67. (in Russ).

6. Chepinoga V.V. Khromosomnyye chisla rasteniy flory Baykalskoy Sibiri [Chromosome numbers of plant species from Baikal Siberia]. Novosibirsk: Nauka; 2014. 419 p. (in Russ).

Scientific Supervisor:
Denis A. Krivenko,
Ph.D. (Biology),
Curator of the IRK Herbarium,
Siberian Institute of Plant Physiology
and Biochemistry, SB RAS

IT, Engineering, Digital Science

UDC 620.92

Ilya K. Sosnovsky*, Vladislav V. Badenko, Alexander N. Kozlov**
*sosnovsky@isem.irk.ru,
**badenko@isem.irk.ru
The Institute for System Dynamics and Control Theory, SB RAS, Irkutsk, Russian Federation

STUDY OF OPERATION MODES OF A HYBRID MICROGRID WITH A RENEWABLE ENERGY SOURCE

Keywords: *Hybrid energy, solar power, energy systems.*

Hybrid energy systems combine different technologies for energy production, storage and consumption into a single system, improving the overall benefits compared to a single-source dependent system [1]. The incorporation of solar energy technologies into hybrid energy systems plays an increasingly important role in reducing energy supply shortages in decentralized areas and solving environmental problems [2]. However, the low efficiency of solar energy and the limited territory for deployment of the system, the inability to accumulate excess energy, as well as low reliability significantly limit the development of hybrid energy systems operating with the use of solar energy. In this regard, it was proposed to develop a laboratory microgrid for research and modernization of hybrid energy systems in order to improve their reliability and efficiency.

It has been proposed to investigate part of a hybrid power plant (HPP) based on photovoltaic converters (PV) with the ability to store excess energy. The system includes PV modules, a gasoline/gas generator, and energy storage components. The hybrid plant will allow to study these systems in detail, including the development of

optimal modes of operation, as well as to minimize the risks of accidents during the operation of hybrid power systems and increase their reliability.

The aim of the work was to analyze different scenarios of solar hybrid power systems: emergency mode and stationary mode.

We have modes of HPP operation, one of which simulates the shutdown of all energy sources except the photovoltaic converter and energy storage system (Mode #1), the second mode simulates the normal operation of the hybrid microgrid with power from the external network (Mode #2). Before starting the analysis of the first mode, the battery charge was brought to 100%.

According to the study of the autonomous operation mode, it was found that the duration of operation of the HEP significantly increased due to the operation of the PEP during the daytime and the accumulation system at night. In the future, a number of adjustments should be made in the installation: to investigate the intensity of solar radiation at the location of the PEP, as well as to calibrate the position of the PEP relative to the sun.

Based on the data obtained, we can conclude that the developed hybrid microgrid functions properly and allows for research in improving the reliability and efficiency of hybrid power systems using renewable energy sources.

References:

1. Konstantinou G., Hredzak B. Power electronics for hybrid energy systems. In: Ersan Kabalci (ed.) Hybrid Renewable Energy Systems and Microgrids. Turkey: Academic Press; 2021. Pp. 215-234. DOI: https://doi.org/10.1016/B978-0-12-821724-5.00008-8

2. Majorova Yu. A., Mihajlenko E.A., Putilin K.P., Smoktal N.N. Obzor gibridnykh fotoelektricheskikh i vetrovykh energeticheskikh sistem [Review of hybrid photovoltaic and wind power systems]. Energeticheskiye ustanovki i tekhnologii Power Plants and Technologies. 2020; 6(3): 40-49. (in Russ).

Scientific supervisor:
Alexander N. Kozlov,
Ph.D. (Technical Sciences),
Melentiev Energy Systems Institute, SB RAS

UDC 004.852

Aleksey R. Tsibikov
tsibikow@mail.ru
Melentiev Energy Systems Institute, SB RAS,
Irkutsk, Russian Federation

PREDICTING DATA WITH RECURRENT NEURAL NETWORKS

Keywords: *artificial intelligence, neural network, intelligent information technologies, recurrent neural network.*

In this paper, we consider in detail the prediction of time series using recurrent neural networks (RNNs) in the context of meteorological data analysis. A time series of meteorological characteristics consisting of 106,000 hourly observations was chosen as the basis for the study.

Recurrent Neural Networks (RNNs) are a class of neural networks designed specifically to handle sequential data such as time series or text. The main difference between RNNs and traditional full-link and convolutional neural networks is the presence of feedback that allows information to be passed from the current time step to previous time steps. This makes RNNs particularly suitable for the analysis and prediction of data in which temporal dependencies and patterns are present.

However, RNNs have a number of drawbacks associated with the problem of fading and exploding gradients, which can occur during network training. These problems are related to the fact that during back propagation of the error, the gradients may become too large or too small, resulting in slower convergence or training instability.

Variations of recurrent neural networks, such as LSTM (Long Short-Term Memory) and GRU (Gated Recurrent Unit), have been developed to solve these problems. These architectures include special mechanisms called "gates" that regulate the flow of information within the network and prevent gradients from fading or exploding.

LSTM and GRU networks outperform conventional RNNs in time series and other sequential data forecasting tasks because they are capable of capturing long-term dependencies and patterns that may not be available to conventional RNNs. This makes them more powerful and flexible tools for analyzing and forecasting complex data. In this study, long-term short-term memory networks (LSTMs) were applied to predict meteorological data with short-term and long-term trends.

The architecture of LSTM networks is characterized by the presence of "memory blocks" that are controlled by special elements called "gates". The neural network is trained in three stages: the first stage is to identify information that should be removed from the memory block; the second stage is to select and store new information to update the state of the memory block; the third stage is to calculate output values from the "memory block" based on the information obtained.

Two types of input data were used in constructing the model for analyzing meteorological data: time and solar radiation. Thanks to this approach, the constructed

network was able to take into account both short-term trends related to the time of day and long-term trends characterizing changes throughout the year.

However, it is worth noting that the network has difficulty accounting for peak values: the maximum value produced by the network is 800, while the actual value is 976. A possible solution to this problem could be to further tune the network to account for the actual values, which would improve its performance and increase the prediction accuracy. This could include changing hyperparameters, network architecture or data preprocessing to better recognize peak values.

It is also important to conduct a comparative analysis with other types of neural networks such as GRU (Gated Recurrent Unit) or Convolutional Neural Networks (CNN) to determine their effectiveness in time series forecasting tasks and identify the possible advantages and disadvantages of each approach.

In conclusion, this study shows the significant potential of using recurrent neural networks, in particular LSTM, for weather data time series forecasting. However, to achieve the best results, additional research and experiments are needed to optimize the network parameters and architecture, as well as to expand the input data set to provide more accurate and reliable weather forecasting.

References:

1. Recurrent Neural Networks (RNN) with Keras. Available from: https://www.tensorflow.org/guide/keras/rnn [Accessed 12 April 2023].
2. Olah C. Understanding LSTM Networks. Available from: https://colah.github.io/posts/2015-08 - Understanding-LSTMs. [Accessed 10 April 2023].
3. Wei W., Li P. Multi-Channel LSTM with Different Time Scales for Foreign Exchange Rate Prediction. Proceedings of the 1st International Conference on Advanced Information Science and System, 15 November 2019. Pp. 1-7. DOI: 10.1145/3373477.3373693

UDC 66.092-977-922

Vladislav V. Badenko*, Ilya K. Kozlov, Ilya K. Sosnovsky**
**badenko@isem.irk.ru,*
***sosnovsky@isem.irk.ru*
Melentiev Energy Systems Institute, SB RAS,
Irkutsk, Russian Federation

KINETIC ANALYSIS OF BIOMASS COMBUSTION PRODUCTS FORMATION IN TG-MS

Keywords: *biomass, kinetic analysis, combustion, mathematical analysis.*

Thermochemical conversion of biomass is a complex process involving a large variety of chemical reactions. Chemical reactions in the thermal decomposition of biomass are directly related to the conversion rate parameter [1]. Known computational methods allow to calculate the value of total activation energy on the basis of the mass loss signal, such calculations are not provided for the analysis of individual substances. In this work, we proposed a method for calculating the activation energy and the pre-exponential multiplier for a particular compound based on the equations of heterogeneous kinetics and data from thermogravimetry and mass spectrometry.

The material used in the study was the wood waste of pine (Pínus sylvéstris). Wood waste was shredded by cross sawing, and then using a sieve analysis, fractions of different sizes were selected for the study. Then, the material was analyzed using a STA 449 F1 Jupiter synchronous thermal analyzer (NETZSCH, Germany) and a QMS 403 C Aeolos quadrupole mass spectrometer (NETZSCH, Germany). For quantitative determination of combustion products, a method for processing and normalization of mass spectra is proposed. The temperature dependences of the ionic current I(T) for each component under study and the experiment parameters are used as input data.

Similar to the methods [2] based on the application of the conversion degree parameter for thermogravimetry, the calculated intermediate parameter F can be used as a characteristic of the gas-specific extraction process. Therefore, the activation energy and pre-exponential multiplier are calculated from the dependence of $\ln$ -F1-nT2(1-n) at n>1 or $\ln$ -lnFT2 at n=1 on the inverse temperature. When plotting $\ln$ -ln(1-F)T2 as a function of inverse temperature, the point of intersection of this function with the axis is $\ln$ AREa , and the tangent of the slope is -EaR. From these relations it is possible to calculate A and Ea.

As a result, the kinetic coefficients can be calculated as the coefficients of the tangent to the function f-ln F T2= $\ln$ AREa-EaRT of the inverse temperature. Tangentials must be plotted for each stage of conversion, each of which is characterized by both peaks on the ion current curves and characteristic stepped sections on the weight loss curve.

The combination of TGA and MS with the calculation of kinetic and quantitative process characteristics on their basis significantly increases the possibilities of analytical investigation of biomass.

References:

1. Rego F., Soares Dias A. P., Casquilho M., Rosa F. C., Rodrigues A. Pyrolysis kinetics of short rotation coppice poplar biomass. Energy. 2020; 207: 118191. DOI: https://doi.org/10.1016/j.energy.2020.118191
2. Özsin G., Pütün A. E. TGA/MS/FT-IR study for kinetic evaluation and evolved gas analysis of a biomass/PVC co-pyrolysis process. Energy Conversion and Management.2019;182:143-153.DOI:doi.org/10.1016/j.enconman.2018.12.060

Scientific supervisor:
Alexander N. Kozlov,
Ph.D. (Technical Sciences),
Melentiev Energy Systems Institute, SB RAS

UDC 621.316

Maria A. Kozlova*, Alexander A. Trushin, Ivan V. Sergeenko, Evgeny V. Boloyev
*mariakozlova-2001@yandex.ru
Melentiev Energy Systems Institute, SB RAS,
Irkutsk, Russian Federation

CONTROL AND LIMITATION OF CONSUMER LOADS IN LOW VOLTAGE DISTRIBUTION NETWORKS

Keywords: *distribution networks, load control, smart meters, load forecasting.*

Modern consumers do not deny themselves the use of electricity, increasingly using all kinds of electrical household appliances in their economic activities. The operating low-voltage distribution networks, which were designed more than ten years ago, are not designed for the electrical loads of modern consumers. When the electrical loads of consumers increase above the limit values established during the design, overloads occur in the electrical network, leading to a disruption in the power supply. To prevent overloads in the electrical network, a power supply agreement is concluded between the consumer and the power company, which indicates the maximum load of the consumer. To control and limit the electrical loads of consumers, smart electricity meters with a load control function are used. The permissible load value in the meter is set by the operator of the intelligent electricity metering system. When the consumer exceeds the maximum load, the meter disconnects the consumer from the network. The consumer will be able to connect to

the network only when the load drops below the maximum, giving signals to turn on the meter.

Disconnection of the consumer from the network leads to losses due to undersupply of electricity. If the electrical network is underloaded, then it is possible to avoid commercial losses due to consumer disconnection by increasing the permissible load values in the meter, preventing overload in the network.

The permissible customer load is determined from the inequality

$$P_{\text{per}} < \frac{min(P_{\max} - P_{\text{pred}i})}{nk_s}, (i = 1...24)$$

where – number of consumers; – the maximum allowable load value in the electrical network; – predicted average hourly load in the electric network for day ahead ; – coefficient of simultaneity of electric load of consumers.

The coefficient is calculated

$$k_s = \frac{max(P_{\text{pn}j})}{\sum_{i=1}^{n} P_{\text{pc}i,j}}, \ (i = 1...24), (j = 1 \dots 365)$$

where – network peak load per day ; – peak consumer load per day.

For short-term forecasting of electrical loads of the network for 24 hours in advance, based on average hourly readings of consumer smart meters and retrospective weather data, a locally weighted group data processing method is used [1, 2].

References:

1. Elattar E.E., Goulermas J.Y., Wu Q.H., Generalized Locally Weighted GMDH for Short Term Load Forecasting. IEEE Transactions on Systems, Man, and Cybernetics, Part C (Applications and Reviews). 2012; 42(3):345-356. DOI: https://doi.org/10.1109/TSMCC.2011.2109378

2. Zor K., Çelik Ö., Timur O., Teke A. Short-Term Building Electrical Energy Consumption Forecasting by Employing Gene Expression Programming and GMDH Networks. Energies. 2020; 13(5):1102. DOI: https://doi.org/10.3390/en13051102

Scientific supervisor:
Evgeny V. Boloyev,
Ph.D. (Technical Sciences),
Melentiev Energy Systems Institute, SB RAS

UDC 004.942

Mikhail A. Chekan
chekoopa@mail.ru
Matrosov Institute for System Dynamics and Control Theory, SB RAS,
Irkutsk, Russian Federation

DEVELOPMENT OF THE ARCHITECTURE OF THE AGENT-BASED MODELING SYSTEM OF MICROGRID INTERACTION

Keywords: *microgrid, modeling, automation, software tools.*

The report discusses issues related to the development of a multi-agent system for modeling the microgrids interaction based on market mechanisms for regulating their supply and demand in the conditions of cooperation and conflict of agents representing different categories of network subjects. The problem relevance is due to the shortcomings of the existing microgrid modeling software, examined earlier in [1]. Also in the course of this examination, relevant areas of development were identified: support of microgrid cluster modeling, integration with external models (including those that implement the grid units behavior), support for distributed computing environments (e.g. cloud, HPC clusters). Based on this, the use of multi-agent technology seems favorable.

Next, a review of software tools for designing and developing multi-agent systems [2] was carried out. A wide range of software solutions was considered, the vast majority of which is a framework for a programming language (mainly Python). Among them, it is worth highlighting the Opal++ language [3], developed within the framework of the OPTIMUS platform. The language supports both a text view (whose syntax is vaguely reminiscent of Python) and a visual-graphical environment. Due to the public unavailability of the platform, it is impossible to evaluate its functionality, as well as to apply it in solving the task, but the described paradigm seems to be convenient and effective in terms of working without advanced programming skills. This makes Opal++ a benchmark in the design of a new software solution.

There are quite a few multi-agent frameworks with an open license. Among them, it is worth highlighting MESA [4], JADE [5], and AgentPy [6], which in general have an architecture that contains a runtime environment and tools for implementing agents as software modules. There is also a specialized framework,

such as FAME [7], which scopes in energy systems modeling. Most of the considered tools have sufficient functionality to serve as the basis for the technology being developed to support modeling the interaction of microgrids. Some software solutions are based on an interpreted programming language, which can affect the performance of the final system, but simplifies the development of add-ons and the integration of third-party models. Given the limitations, including those related to the platform and license, JADE is considered to be the most appropriate framework.

The architecture of the software tool is presented as a multi-agent environment that simulates the functioning of microgrids and their interaction, featuring multicriteria analysis. It is supposed that the model behavior is to be determined by a domain specialist using additional tools (plug-ins, programming languages, and/or visual environments) based on the base classes of agents corresponding to microgrids and their components. Moreover, the microgrid interaction model can be encapsulated at the agents core behavior level.

It is presumed that the agent model will be a network of interacting microgrids with the common knowledge storage containing a weather forecast, historical weather and energy exchange data. When required, one of the agents is assigned as the trade manager (auctioneer) and implements the configured economic mechanism.

References:

1. Chekan M.A. Sravnitel'nyj analiz programmnogo obespecheniya dlya avtomatizacii processa modelirovaniya mikrosetej [Comparative analysis of software for automating the process of microgrid modeling]. Sovremennye naukoemkie tekhnologii. 2022; 9:33-38. DOI: 10.17513/snt.39305
2. Chekan M.A. Analiz primeneniya sredstv sozdaniya mul'tiagentnyh sistem v zadache modelirovaniya vzaimodejstviya mikrosetej. Lyapunovskie chteniya: Materialy konferencii [Analysis of the use of means of creating multi-agent systems in the task of modeling the interaction of micro-networks. Lyapunov readings: Materials of the conference]. Irkutsk: Publishing House of IDSTU SB RAS, 2022. Pp. 153-154.
3. Sobanin D.S., Kryuchkov I.A., Ogorodnikov A.V., Kovalenko O.V. Yazyk programmirovaniya Agentov Opal++ Vizualizacionno-integracionnoj platformy «Optimus» [Agent Programming Language Opal++ Visualization And Integration Platform "OPTIMUS"]. DOI 10.53403/9785951505071_2022_426
4. Pigorev D.P. Sreda Mesa dlya agent-orientirovannogo modelirovaniya na baze Python [Mesa environment for agent-oriented modeling based on Python. Artificial societies]. Iskusstvennye obshchestva. 2021; 16(3). DOI: 10.18254/S207751800008176-2

5. Bellifemine F., Poggi A., Rimassa G. JADE: A FIPA2000 compliant agent development environment. Proceedings of the Fifth International Conference on Autonomous Agents, 28 May 2001. Pp. 216–217. DOI: 10.1145/375735.376120
6. Foramitti J. AgentPy: A package for agent-based modeling in Python. Journal of Open Source Software. 2021; 6(62):3065. DOI: 10.21105/joss.03065
7. FAME-Framework. Gitlab. Available from: https://gitlab.com/fame-framework/ [Accessed 22 November 2022].

Scientific supervisor:
Alexander G. Feoktistov,
Ph.D. (Technical Sciences),
Matrosov Institute for System Dynamics and
Control Theory, SB RAS

UDC 004.8

Yuliya V. Pestova*, Nikita Ol. Dorodnykh, Olga A. Nikolaichuk,
Alexander Yu. Yurin
**yupest@gmail.com*
Matrosov Institute for System Dynamics and Control Theory, SB RAS,
Irkutsk, Russian Federation

ASSESSMENT OF FORECASTING THE RISK OF FIRES IN FOREST AREAS BASED ON THE ANALYSIS OF PRECEDENTS

Keywords*: forest fire, precedents, prediction.*

Fires, both natural and man-made, remain a serious problem worldwide. They cause significant damage to biodiversity and the quality of the environment, which can lead to ecosystem degradation [2]. Monitoring and predicting fire incidents and their spread play a crucial role in planning and decision-making, including the use of remote sensing methods [3]. Currently, the problem of predicting the risk of fires is particularly relevant for many regions, including the Irkutsk region, where forest cover constitutes 78% of all forests in Russia. Additionally, a large part of the Irkutsk region's forested area (more than 90% of the total forested area) consists of coniferous forests, which are most susceptible to fires [4]. Massive forest fires have caused significant changes in the landscapes of the Lake Baikal watershed and the reduction of forest reserves [1]. Various methods and tools are used to address this prediction challenge, including machine learning, decision-making methods, fuzzy logic, and more.

The work aims to solve the problem of predicting the risk of forest fires using a precedent-based approach and consists of the following stages: formation of a precedent model, collection of statistical, climatic, and fire incident data in the region, data preprocessing, creation of a prototype precedent expert system, and analysis of the obtained prediction results. The main results of the study are: a precedent model that provides a compact representation of information on weather conditions, vegetation type, and infrastructure in the region regarding the possible risk of forest fires; a database containing information on forest fires in the Irkutsk region for the period from 2017 to 2020; an evaluation of the accuracy of the proposed approach.

The result of the precedent-based approach is a measure of the risk of forest fires occurrence in forest quarters, ranging from highly unlikely to most likely. The accuracy assessment was conducted on the results of the precedent-based approach on datasets including historical fire data in 2019, with information on forest quarters, forest seed zoning, forest vegetation zone, forest fire danger class, distances to the nearest roads and settlements, population density, meteorological conditions, and forest quarter characteristics. Information on weather conditions on the date of actual fires during the summer of 2020 and fire danger classes based on weather conditions were also used. Therefore, the expected result was a high risk of fire occurrence in all considered quarters. The presence of precedents with a similarity of 0.8 – 1 determines the most likely risk of fire in the quarter. The quantitative assessment of the accuracy of the forecast is the ratio of the number of events with high risk P to all events N (formula 1). The accuracy of the proposed approach was 87.4% for all events.

$$\text{Accuracy} = PN, \text{ with } \begin{cases} P=1, & 0.8>0 \\ P=0, & 0.8=0 \end{cases} \quad (1)$$

The approach was tested for individual forest districts, namely Bodaybo and Kazachensko-Lensk. The evaluation results showed that the use of the precedent approach can be considered as an initial stage for more in-depth research using various methods (such as intelligent data analysis, neural networks) for more accurate prediction.

References:

1. Bazha S.N., Danzhalova E.V., Drobyshev Yu.I. et al. Transformatsiya nazemnykh ekosistem yuzhnoy chasti basseyna Baykala [Transformation of terrestrial ecosystems in the southern part of the Baikal basin]. Proceedings of the conference Ecological Problems of Lake Baikal Basin, January 2022. Available from

http://dx.doi.org/10.31554/978-5-7925-0621-3-2022-17-21 [Accessed 10 April 2023]. DOI:10.31554/978-5-7925-0621-3-2022-17-21 (in Russ).
2. Ferreira-Leite F., Lourenço L., Bento-Gonçalves A. Large forest fires in mainland Portugal, brief characterization. Journal of Mediterranean Geography. 2013; 19:53–65.
3. Gheshlaghi H.A., Feizizadeh B., Blaschke T. GIS-based forest fire risk mapping using the analytical network process and fuzzy logic. Journal of Environmental Planning and Management. 2019; 63 (3): 481-499.
4. Timofeeva S.S., Garmyshev V.V. Ekologicheskiye posledstviya lesnykh pozharov na territorii Irkutskoy oblasti [Ecological consequences of forest fires in the territory of the Irkutsk region]. Ekologiya i promyshlennost Rossii. 2017; 21(3): 46-49. (in Russ).

Scientific supervisor:
Olga A. Nikolaichuk,
D.Sc. (Technical Sciences), Associate professor,
Matrosov Institute for System Dynamics and
Control Theory, SB RAS

Geosciences, Solar Sciences and Hydrosciences: New Frontiers

UDC 624.131.4

Egor P. Dushkin*, VarvaraV. Akulova
*egor.dushkin.99@mail.ru
Institute of the Earth's Crust, SB RAS,
Irkutsk, Russian Federation

LABORATORY STUDIES OF PROPERTIES OF TECHNOGENIC SOILS OF THE AIKHAL MINE

Keywords: *engineering geology, technogenic soils, frost-thaw cycles, filtration coefficient, swelling, Aikhal mine.*

In 2017, an accident occurred at the Mir mine as a result of a water breakthrough from an exhausted pit, which led to flooding of the mine. The accident was caused by the abnormal complexity of the deposit's hydro-geological conditions, as well as a combination of technical and organizational factors. In this regard, the diamond mining company ALROSA began to take measures to prevent similar situations at its other deposits. The Aikhal pipe is located in the Mirninsky District of Yakutia, 400 km north of the city of Mirny in the zone of permafrost with a thickness of more than 700 meters, which complicates safe and efficient mining of under-pit diamond reserves. The purpose of the study is to assess the stability of the technogenic soil stratum located at the bottom of the open pit to natural and technogenic impacts (weathering, drilling and blasting, etc.) and to identify the most sensitive soils. To achieve this goal, such properties as water absorption, frost resistance, filtration coefficient and swelling were investigated.

For water absorption tests 4 samples of rocky soils with their duplicates without visible signs of deformation were used. The specimens were dried in an oven at a temperature of 105^{0}C, weighed and immersed in water and brine for 10 days. Then the samples were re-weighed. The water absorption parameters were calculated according to [3] using the formula (1):

$$W_п = \frac{g_в - g_c}{g_c} * 100 \quad (1),$$

where $g_в$ is the weight of the sample after water saturation, g_c is the weight of the sample skeleton (dried). Water absorption parameter varied from 2,5 to 6,1 %.

Frost resistance was determined by conducting freeze-thaw cycles of water-saturated/brine-saturated rocky soils. The rocks were first frozen in a freezer at -10^{0}C for 7 days, and then thawed at room temperature for 3 days. As a result of three such cycles, the samples didn’t show any signs of destruction.

The filtration coefficient was measured on a compression-filtration apparatus for clay soils. Clay filler from 2 samples was taken as samples. The filtration coefficient was calculated according to GOST 25584 – 2016 [2] using the formula (2):

$$K = \frac{\Delta \ln ln\left(\frac{H_0}{H_0 - S}\right)}{\Delta(Ct)} \quad (2),$$

where H_0 – the initial water pressure in the piezometer (cm); S – the water level decrease in the piezometer (cm); t – the time during which the water level decreased by S (s); coefficient $C = F_k / (F_п l_k)$, where F_k –

the area of the ring (cm^2), F_n – the cross-sectional area of the piezometer (cm^2), l_k – the height of the soil sample (cm). The filtration coefficient for samples 4-7 and 3-6,7,9 at $H_0 = 10$ was 0.0365 and 0.0061 m/day, respectively.

Swelling was measured according to GOST 12248.6 – 2020 [1]. The soil with a moisture content of 10% placed in the ring with an indicator installed on it was placed in a tray, which was filled with water. Measurements were recorded every five minutes for half an hour and the next day. The relative swelling deformation was measured according to the formula (3):

$$\varepsilon_{sw} = \frac{\Delta h_i}{h} \quad (3),$$

where Δh_i – the increase in the height of the soil sample after swelling, h – the initial height of the sample. ε_{sw} for samples 1-2, 2-5, 3-9, 4-8 are 0.102, 0.129, 0.139, and 0.056, respectively.

Thus, the first stage of laboratory studies revealed low water absorption values of fragments of rocky soils, which indicates their low susceptibility to the softening effect of water, as well as high frost resistance. The latter is also confirmed by the absence of destruction after freeze-thaw cycles. The filtration coefficient showed that the clay filler is practically waterproof, while in terms of swelling, the filler material is presented by strongly swelling (2-5, 3-6), medium swelling (1-2) and weakly swelling (4-8) clays. These investigations will form the basis for subsequent measurements of the properties of technogenic soils.

References:

1. GOST 12248.6 Grunty. Metod opredeleniya nabukhaniya i usadki [GOST (National State standard) 12248.6 Soils. Method for determining swelling and shrinkage]. Moscow: Standardtinform; 2020. 21 p.
2. GOST 25584. Grunty. Metody laboratornogo opredeleniya koeffitsienta fil'tratsii[GOST (National State standard) 25584. Soils. Methods for laboratory determination of the filtration coefficient]. Moscow: Standartinform; 2016. 22 p.
3. Lomtadze V.D. Fiziko-mekhanicheskie svoistva gornykh porod. Metody laboratornykh issledovanii [Physical and mechanical properties of rocks. Methods of laboratory research]. Leningrad: Nedra; 1990. 327 p.

Scientific supervisor:
Varvara V. Akulova,
Ph.D. (Geology and Mineralogy),
Institute of the Earth's Crust, SB RAS

UDC 551.87

Maksim V. Smirnov
smv.38@mail.ru
Institute of the Earth's Crust, SB RAS,
Irkutsk, Russian Federation

FLUVIAL DEPOSITS IN THE SELENGA RIVER BASIN

***Keywords**: alluvium, sedimentation, soil formation, Holocene, the Selenga River basin.*

The Selenga River is the most important tributary of Lake Baikal, which contributes about 50 to 60% of its surface water influx. Moreover, the Selenga's 447060 km^2 watershed covers 82% of the Lake Baikal basin, which means that any environmental changes along the Selenga and its tributaries may ultimately impact Lake Baikal.

Fluvial sediments provide an important link between weathering and slope processes in source areas as well as sedimentation processes within depositional basins [1]. In this regard, much attention is paid to the study of alluvium. There are numerous studies on the forming conditions, structure and age of alluvium on the territory of Baikal region and Mongolia. However, much less investigation is devoted to the study of floodplain deposits and the timing of their accumulation in the Selenga River basin [2].

The core idea of this study is to assess the chronology of floodplain deposits accumulation in the Selenga River basin as a reflection of the dynamics of hydrological conditions during the Holocene.

The study territory is located in the Middle Mountains of Selenga's basin and Mongolia (fig. 1). A detailed morphogenetic and stratigraphic description of floodplain deposits as well as sampling for further laboratory studies were carried out during the fieldworks. The sections are located within the floodplains of different heights.

The floodplains of large rivers are related to the Holocene period. [3]. Floodplain deposits of rivers of smaller orders accumulated mainly during the second half of the Holocene [3]. The alluvium of the high floodplain accumulated in the first half – the middle of the Holocene, while the low floodplain accumulated in the second half of the Holocene according to [2].

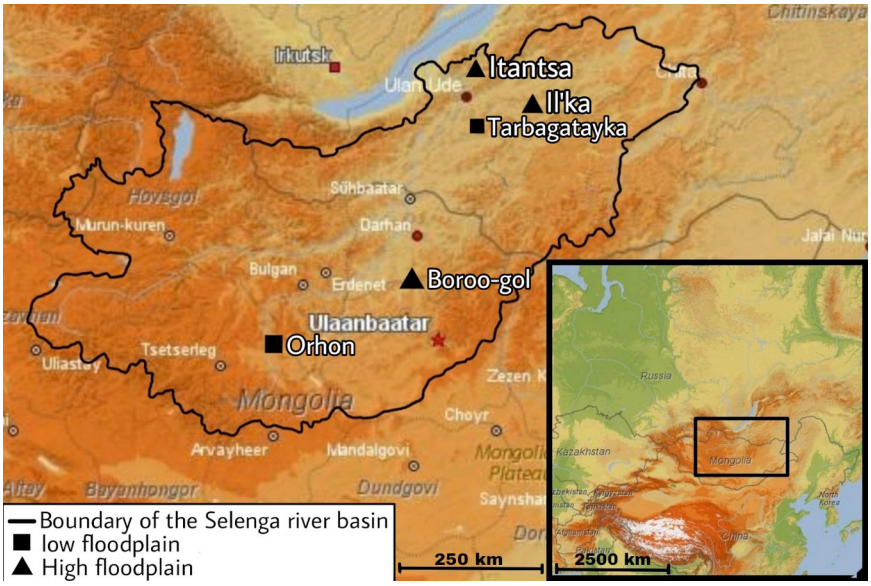


Figure 1. Location of the study territory and investigated floodplain sections.

Low and middle floodplains up to 2 m high and high floodplains (2–4(5) m high) are distinguished in the Selenga river basin. Floodplain deposits were formed in various dynamic conditions, have a horizontal, wavy, inclined bedding and are represented by sediments of channel, floodplain and oxbow facies of different thickness and grain size composition. Organogenic deposits (sandy loam and loam enriched in organic matter, peat bogs) were accumulated on the floodplain with a decrease in river flood intensity.

In conclusion, when accumulating during the period of Holocene, the floodplain deposits in the Selenga River basin were formatted under hydrological fluctuations.

References:

1. Allen J.L. A review of the origin and characteristics of recent alluvial sediments. Sedimentology. 1965; 5: 91–191. Available from https://onlinelibrary.wiley.com/doi/10.1111/j.1365-3091.1965.tb01561.x [Accessed 05 April 2023].

2. Bazarov D.B. Chetvertichnye otlozheniya i osnovnye etapy razvitiya rel'efa Selenginskogo srednegor'ya [Quaternary deposits and the main stages of the relief development of the Selenga middle mountains]. Ulan-Ude: Buryat book Publishing; 1968. 156 p. (in Russ).

3. Endrikhinskii A.S. Pozdnii pleistotsen i golotsen yuga Vostochnoi Sibiri [The sequence of the main geological events in the territory of Southern Siberia in the Late Pleistocene and Holocene]. Novosibirsk: Nauka Publishing; 1982. Pp. 6–35. (in Russ).

UDC 551.89

Eseniya A. Shchipanova
eseniya.shipanova@mail.ru
Institute of the Earth's Crust, SB RAS,
Irkutsk, Russian Federation

CRYOGENIC PROCESSES IN THE UPPER ANGARA REGION IN THE LATE PLEISTOCENE (THE CASE OF THE LATE PALEOLITHIC SITE MALTA-BRIDGE 3)

Keywords: *Malta site, Late Pleistocene, SEM, environmental interpretation.*

Introduction. The Late Paleolithic site Malta-Bridge 3, locate on the right bank of the Belaya River in the Usolsky district of the Irkutsk region. In 2020-2021, conservation and rescue archaeological work was carried out at this geoarchaeological site under the leadership of G.V. Turkin and A.S. Kozyrev. The Malta-Bridge 3 site belongs to the group of Upper Paleolithic sites of the Maltese type, the first of which, the Malta site, was opened in 1928 by M.M. Gerasimov in the village of Malta on the left bank of the Belaya River.

Materials and methods. Excavations in 2020 to a depth of 4 m revealed a section of sediments composing the high terrace of the Belaya River. In this section, the thickness of water-sedimentary and subaerial sediments (aeolias) separated by buried soil is revealed. 19 samples for granulometric analysis and morphoscopy of sand grains were selected to determine the genesis (water-sedimentary/aeolian) of sediments uncovered by excavations in 2020 at the Malta-Bridge 3 archaeological site, as well as to indicate ancient cryogenic processes. When studying the surface (morphoscopy) of sand grains, fractions of 0.315–0.125 mm and 0.5–0.63 mm were used, in which traces of cryogenic destruction of quartz/K-feldspar and traces of aeolian processing are most reliably manifested. The analysis was carried out using the Hitachi TM3000 SEM at 40-400-fold magnification on a sample of 30-50 grains.

Results and their discussion. At the base of section No. 1, there are light brown fine-grained silty sands with an apparent thickness of more than 0.15 m. Buried soil (correlate of the cultural layer) is developed in the roof of these sands – humusized sandy siltstone with a thickness of 0.0 to 0.12 m. On the buried soil, non-layered sandy siltstones with a thickness of 0.56 m are deposited rest erosively; they gradually turn into a rhythmic layering of horizontal and wavy-layered sandy siltstones and

fine-grained sand with a total thicknessof 1.1 m. The nature of the surface of sand grains (Fig. 1a) with conchoidal fractures indicates the formation of this layer under cryogenic conditions. Small cryoturbations and numerous medium–sized wedge-shaped cracks developed here, with a vertical length of up to 0.3-0.4 m and a width at the mouth of up to the first cm. The mouths of these cracks are located at different elevations and are not associated with any single stratigraphic level. The upper contact can be abrupt or gradual with a gradient transition to the overlying layer, represented by non–layered fine-grained silty sands and fine-sand siltstones with a total thickness of about 1.0 m. The sand grains in this layer have obvious traces of aeolian processing – characteristic microdepressions with the formation of bulbous edges between the depressions (Fig. 1b).

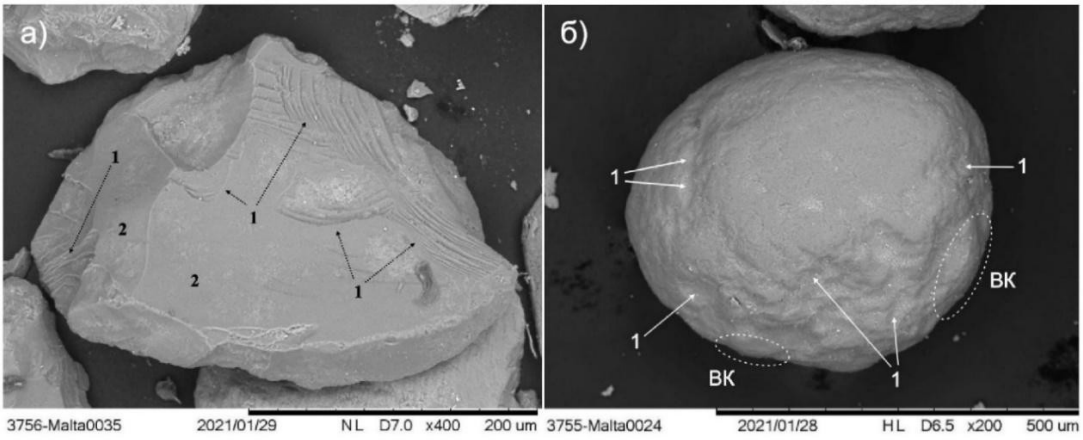


Рис. 2. Морфоскопия песчаных зёрен. а) Поверхность кварцевого зерна из пачки №3.2; (1 – конхоидальные сколы, 2 – участки гладкой полированной поверхности). б) Поверхность кварцевого зерна из пачки №4.1; (1 – микроямчатость, ВК – выпуклые края).

Figure 1. a) Quartz grain surface from water-sedimentary sediments (1- conchoidal fractures, 2-areas of smooth polished surface); b) Quartz grain surface from subaerial sediments (1- microdepressions, BK-bulbous edges).

The quaternary stratum in the area of the Malta-Bridge 3 geoarchaeological monument records several stages of the development of the natural environment. After the subaerial break and the formation of the buried soil, the accumulation of the water-sedimentary sediments occurred, which compose the upper part of the section of the high terrace of the Belaya river. The nature of the stratification and traces of seasonal freezing in the form of miniature cracks indicate sedimentation in a sedentary shallow water environment in floodplain or lake-alluvial conditions. Traces of cryogenesis are clearly recorded at the macro- and microscopic levels, but no evidence of permafrost and the establishment of harsh cryoarid conditions has been revealed. A sharp deterioration of natural conditions – cooling and aridization of the climate – is recorded by the formation of subaerial sediments, from which large ground veins originate.

UDC 627.141.1

Anton A. Yur'ev[1], Artem A. Rybchenko
[1]*zuzua2016@gmail.com*
Institute of the Earth's Crust, SB RAS,
Irkutsk, Russian Federation

GRANULOMETRIC AND MINERAL COMPOSITION OF DEBRIS FLOW DEPOSITS OF TUNKA RIDGE

Keywords: *debris flow, Tunka Ridge, accumulation zone, transit zone, stall zone, granulometric analysis, mineral analysis.*

The purpose of the study was to determine the granulometric and mineral composition of the filler of loose unbound soils in the zones of formation, feeding and accumulation of debris flow of Tunka Ridge, near the village of Arshan. The descent of debris flow from the southern slope of the Tunka Ridge occurred on June 28, 2014. Of the seven streams formed, the sediments of two mudflow basins were studied in this work. One in the pool of the stream is the Pervyy Bezymyanny, and the second in the pool of the stream is the Pervaya Shikhtolaika. The difference between the basins lies in the different geomorphological structure of the basins [1].

To perform granulometric analysis and quantitative mineral analysis of the aggregate, samples were taken in the accumulation zone, transit zone and Stall zone of sediments of the debris flow basin of the Pervyy Bezymyanny stream and the accumulation zone, transit zone of sediments of the debris flow basin of the Pervaya Shikhtolaika stream. 61 samples were taken from various microforms of the relief.

The sieve granulometric analysis consisted in the separation of the filler particles into fractions by size from <0.25 mm to >3 mm. (tables 1, 2).

According to the data of the sieve granulometric analysis, the quantitative content of fractions was determined. The infiller selected in the accumulation zone of the sediments of the debris flow basin of the Pervaya Shikhtolayka stream is characterized by the highest content of sandy and dusty particles (less than 0.5 mm) - 37.58%, and in the sediments of the debris flow basin of the Pervyy Bezymyanny stream – 27.57%, which is confirmed by a stronger destructive effect of the debris flow along the Pervaya Shikhtolayka.

Table 1

The average percentage of fractions in the aggregate in the basin of the stream Pervyy Bezymyanny

Zones/mm.	<0,25	0,25-0,5	0,5-1	1-2	2-3	>3
Transit zone	15,36%	13,72%	22,60%	22,63%	9,84%	15,80%
Accumulation zone	12,89%	14,68%	24,67%	17,56%	14,92%	15,22%

Table 2

The average percentage of fractions in the aggregate in the basin of the stream Pervaya Shikhtolaika

Zones/mm.	<0,25	0,25-0,5	0,5-1,0	1-2	2-3	>3
Stall zone	17,06%	17,36%	12,93%	16,85%	10,57%	25,21%
Transit zone	11,98%	17,57%	23,09%	18,62%	15,85%	12,85%
Accumulation zone	15,71%	21,87%	18,01%	19,63%	14,08%	10,67%

Quantitative mineralogical analysis made it possible to determine the minerals of the filler using a microscope with the involvement of special software (tables 3, 4).

Table 3

Average percentage of minerals in fill material in the creek basin Pervyy Bezymyannyi

	Quartz	Mica	Feldspars	Carbonates	Sulfides	Other
Transit zone	59%	7%	6%	13%	3%	1%
Accumulation zone	74%	6%	7%	5%	2%	1%

Table 4

Average percentage of minerals in fill material in the creek basin Pervaya Shikhtolayka stream

	Quartz	Mica	Feldspars	Carbonates	Sulfides	Other
Stall zone	76%	7%	6%	4%	2%	1%
Transit zone	59%	5%	5%	14%	2%	1%

Accumulation zone	73%	6%	6%	6%	2%	1%

A comparison of the sediments of the mudflow basins of the streams of the Pervaya Shikhtolaika and the Pervyy Bezymyanny, showed that the carbonate filler is more contained in the sediments of the debris flow basin of the stream of the Pervaya Shikhtolaika. This is explained by the fact that the debris flow along the basin of the Pervaya Shikhtolaika stream had a stronger destructive effect on carbonate rocks. This is confirmed by the calculated data of a higher velocity and flow rate of the debris flow [1].

The complex mineral composition of debris flow deposits on the slopes of the Tunka Ridge is characterized mainly by a stable content of the main rock-forming minerals, as well as the inclusion of such heavy minerals as garnet, distene, rutile, tourmaline and magnetite.

References:

1. Kadetova, A.V., Rybchenko, A.A., Kozireva, E.A., Pellinen, V.A. Debris flows on 28 June 2014 near the Arshan village (Siberia, Republic of Buryatia, Russia). Landslides. 2016; 13(1):129-140.

Scientific supervisor:
Artem A. Rybchenko,
Ph.D. (Geology and Mineralogy),
Senior Researcher,
Institute of the Earth's Crust, SB RAS

UDC 537.86 + 537.874

Vladimir A. Ivonin
volodyaivonin@gmail.com
Institute of Solar-Terrestrial Physics, SB RAS,
Irkutsk, Russian Federation

STUDYING RADAR SIGNAL POWER FROM STARLINK SATELLITES, ACCORDING TO DATA FROM IRKUTSK INCOHERENT SCATTER RADAR

Keywords: *Starlink, Faraday effect, ionosphere, radar equation, radar cross section.*

The power of the radar signal received by the antenna from satellite (P_r), considering that the Irkutsk Incoherent Scatter Radar (IISR) radiates and receives only radio waves with linear polarization and without considering noise, is expressed by formula (1) [2]:

$$P_r(R) = \underbrace{\frac{P_{tr}G(\varphi,\theta)}{4\pi R^2}}_{Radiation} \cdot \underbrace{\frac{\sigma}{4\pi R^2}}_{Reflection} \cdot \underbrace{\frac{\lambda^2 G(\varphi,\theta)}{4\pi}(\Omega(R))}_{Receiving}, \quad (1)$$

where P_{tr} is the power of the signal transmitted by the antenna, G is the antenna gain, φ is the azimuth of the aim, θ is the elevation of the aim, R is the distance from radar antenna to the aim, σ is the radar cross section (RCS), λ is the wavelength of the carrier signal, Ω is the radio wave polarization ellipse semi-major axis rotation angle due to Faraday effect by propagating from radar to the aim and back. The latter can be expressed by formula (2) [1]:

$$s=qe3c0me220sNes'Bs'\cos s'\ ds', \qquad (2)$$

where ds' is a length element along the radio wave beam, q_e is the elementary charge, c is the speed of light in vacuum, m_e is the electron mass, ω is the angular operating frequency of the radio wave, N_e is the ionospheric electron density, B is the magnetic induction of geomagnetic field, α is the angle between the wavevector of the radio wave and B.

Satellites of «Starlink» constellation, which orbit altitude is about 550 km, fly in large dense streams in IISR field of view. Nowadays there are about four thousand satellites of this constellation on the orbit [Starlink Statistics]. That's why the radar signal received by the IISR from these satellites can be used for ionospheric measurements correction, conducted by IISR, and developing the method of determination of unknown RCS of other spacecrafts.

Fig. 1 illustrates comparison average diurnal dynamics for 2022 of the power of the radar signal received by the IISR from satellites of «Starlink» constellation with average diurnal dynamics for 2022. The latter was calculated with IISR ionospheric data using formula (2).

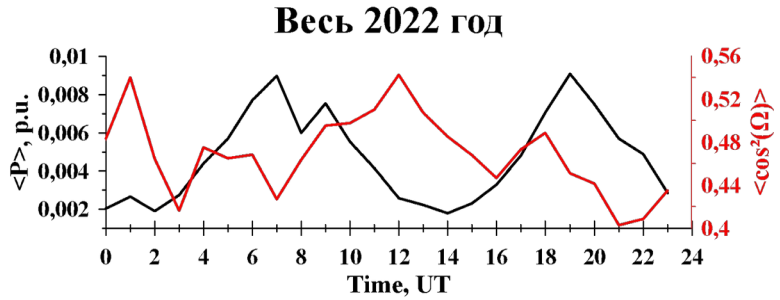


Figure 1. Comparison average diurnal dynamics for 2022 of the power of the radar signal received by the IISR from satellites of «Starlink» constellation with average diurnal dynamics for 2022.

References:

1. Ivonin V. A. Simulation of radar signals in the VHF range, taking account of their propagation effects in the troposphere and ionosphere. Proceedings of 2021 Photonics & Electromagnetics Research Symposium (PIERS). 20-21 November, 2021. Hangzhou, China, IEEE Xplore, 2022. Pp. 2519–2525.

2. Lebedev V.P. Razvitie diagnosticheskikh vozmozhnostei irkutskogo radara nekogerentnogo rasseyaniya dlya resheniya zadach kontrolya kosmicheskikh apparatov i provedeniya aktivnykh kosmicheskikh eksperimentov. Dis. kand. fiz.–mat. nauk [Development of diagnostic capabilities of Irkutsk incoherent scattering radar for spacecraft control and active space experiments. Ph. D. (Physics and Mathematics) thesis]. Irkutsk, 2015. 118 p. Available from https://www.dissercat.com/content/razvitie-diagnosticheskikh-vozmozhnostei-irkutskogo-radara-nekogerentnogo-rasseyaniya-dlya [Accessed 03 April 2023]. (in Russ).

3. Starlink Statistics [Internet]. Jonathan's Space Pages. Available from https://planet4589.org/space/con/star/stats.html [Accessed 27 April 2023].

Scientific supervisor:
Valentin P. Lebedev
Ph. D. (Physics and Mathematics)
Senior Researcher,
Institute of Solar-Terrestrial Physics, SB RAS

UDC 004

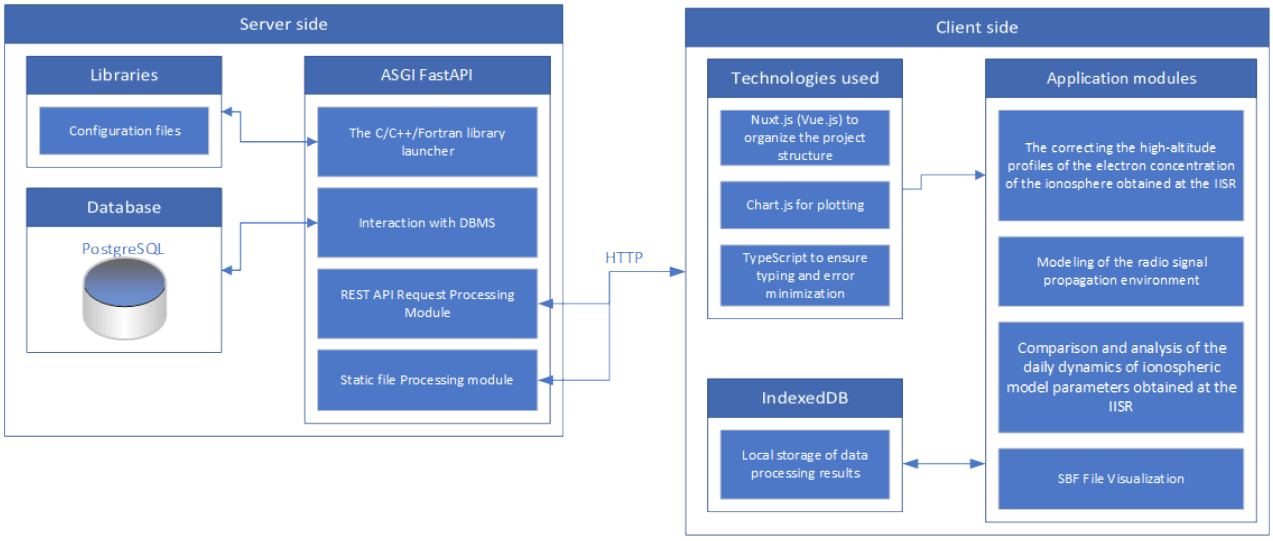
Nikita A. Gromik
nikita.1911@yandex.ru
Institute of Solar-Terrestrial Physics Institute, SB RAS,
Irkutsk, Russian Federation

DEVELOPMENT OF AN INFORMATION SYSTEM FOR THE ANALYSIS OF GEOPHYSICAL DATA OBTAINED BY RADIO-PHYSICAL INSTRUMENTS OF THE ISTP SB RAS

Keywords: *IT, information system, data analysis.*

The information system being developed is a software package for visualization and analysis of information obtained by geophysical means of the ISTP SB RAS.

The software package is a web application with a client-server architecture, the interaction between which is carried out through the REST API. The structure of the software package is shown in the figure:



To date, the following functions of the information system have been implemented: processing of electronic concentration profiles with the possibility of adjusting the model profile and subsequent export of edited data; flexible configuration of the model environment, including the troposphere, magnetic field and ionosphere; parallel comparison and analysis of daily parameters of model profiles; simulation of changes in the polarization state of a radio wave as it passes through the Earth's atmosphere.

Potential use cases of the system under development require a careful approach to the selection of the tools and libraries used. The FastAPI framework was chosen for the server component. This framework is more productive and more convenient than many standard solutions (Drupal, WordPress, Laravel, Django, etc.). Peak processing performance reaches several hundred thousand requests per second (RPS) [1]. To ensure maximum performance when running models of the magnetic field, ionosphere, etc., pre-compiled modules developed in C/C++/Fortran are used. The Nuxt framework was used as a client component, which is an add-on over Vue.js.

This is a modern and powerful solution that will allow to implement not only a beautiful, but also a functional interface that can function correctly on most browsers.

The information system is already undergoing closed testing. All wishes are taken into account, since the functionality of the system depends, among other things, on the convenience of working with it, for example, a "Night mode" was added to work in poor light conditions.

The information system is being improved and modernized, in the future it is planned to implement a system for storing initial data and the results of experiments, as well as to organize an interface for monitoring the state of the information system itself.

References:

1. Benchmarks. FastAPI. Available from: https://fastapi.tiangolo.com/benchmarks/ [Accessed 21 April 2023].

UDC 520.274.3

Ruslan R. Karakotov
r.r.karakotov97@mail.iszf.irk.ru
Institute of Solar-Terrestrial Physics, SB RAS,
Irkutsk, Russian Federation

SUN IMAGE SYNTHESIS USING DATA OF SIBERIAN RADIO HELIOGRAPH 3-6 GHZ ARRAY

Keywords: *radio interferometer, solar radiotelescope, visibility, gain function.*

Radio observations play a significant role in solar physics. It provides information about solar activity and allows us to solve various tasks in the space weather field. Siberian Radio Heliograph (SRH) [Altyntsev et al., 2020] makes it possible to observe the Sun in 3 wavebands (3-6, 6-12 and 12-24 GHz) and even to construct 3D maps of active regions.

In this study we present a result of antenna gain calibration using redundant baselines. We used the SRH observation data of 2022-06-09 02:20 UT. Double baselines are needed to obtain more reliable images with less visible artifacts [Globa, 2021]. Despite this, considering the visibilities of the only shortest baselines provides with us an opportunity to detect and roughly analyze the sun radio sources.

SRH data contains visibilities measured by different antenna pairs. Visibilite is the part of the spatial spectrum of image measured by an individual pair. There are 8128 visibilities for each of 20 times and 16 frequencies in the single raw SRH FITS

file. Each visibility can be easily converted into a part of the origin image via Fourier transform.

The first step is performing a phase and amplitude calibration [Arnot, 1985]. In the simplest case observed visibility Vobs, true visibility Vtrue and gain function of antenna g are connected by an equation:

$$Vklobs=gkgl*Vkltrue+kl,$$

where subscripts k,l refers to antennas forming the pair, is a thermal noise with zero mean. Observed visibility is a complex value due to the fact that the gain function is a complex value. Therefore, linearization makes it possible to provide the calibrations independently due to distinction between the phase and amplitude operators. The result of calibration is shown in fig. 1. On the second and third panels Sun is clearly seen, but there are artifacts on the last panel associated with the method of calibration (only the shortest redundant baselines are used for calibration).

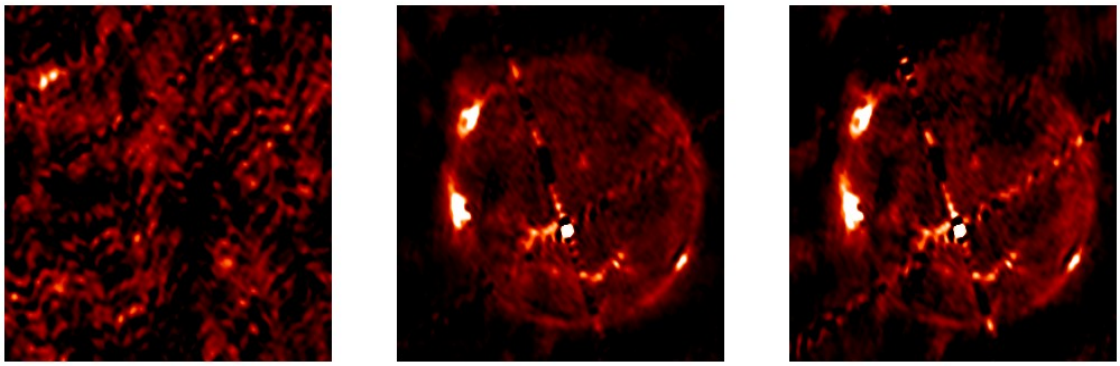


Figure 1. (a) Reconstructed image of Sun (without phase and amplitude calibration); (b) the same image, but with phase calibration; (c) image of the Sun after all calibrations performed.

Developed algorithm provides an opportunity to reconstruct images of Sun from SRH data using only the shortest redundant baselines for gain calibration. It is primarily limited by the linear approach of calibration tasks. The visibilities observed by other antenna pairs can be used to construct more relevant images of the Sun, but a non-linear approach is required to solve the calibration task.

References:

1. Altyntsev A., Lesovoi S., Globa M. et al. Multiwave Siberian Radioheliograph. Solar-Terrestrial Physics. 2020; 6 (2): 30–40.

2. Arnot N.R., Greenaway A.L., and Noordam J.E. Phase closure in optical astronomy. Traitement du signal, Recherches. 1985; 2:129–135.

3. Globa M.V., Lesovoi S.V. Calibration of Siberian Radioheliograph antenna gains using redundancy. Solar-Terrestrial Physics. 2021; 7(4): 104–110.

UDC 631.1

Ekaterina I. Nagovitsina
katya.nagovitsina@yandex.ru
V. B. Sochava Institute of Geography, SB RAS,
Irkutsk, Russian Federation

AGRICULTURAL DEVELOPMENT IN USOLSKIY DISTRICT

Keywords: *Usolskiy district, agriculture, deep processing of agricultural products, agricultural organizations.*

Usolskiy district is one of the largest agricultural districts of the Irkutsk region. The district is part of the Irkutsk-Cheremkhovo agglomeration and forms its food base on the basis of the largest agricultural enterprises in the region [2].

According to the strategy of socio-economic development of the Irkutsk region, the main specialization of the Usolskiy district is the development of agriculture (agricultural production, food processing industry development). [4].

The strengths of Usolskiy district district are associated with its favorable economic and geographical location, its natural resource potential, flat terrain, and areas with fertile soils suitable for agriculture [3].

The weaknesses of the area are caused by a low share of deep processing industries, insufficient innovative entrepreneurship, and a lack of qualified labor resources. As a result, there is an outflow of the most ambitious and qualified part of the population, especially young people [5]. Therefore, the main problem hindering the development of Usolskiy district is youth migration outflow.

Relief features affect the movement of air masses, distribution of atmospheric precipitation and temperatures. From northeast to southwest, there is an increase in precipitation against the background of a decrease in heat availability, which leads to a decrease in evaporation [3]. Agricultural lands are located within the Irkutsk-Cheremkhovo plain, along the main settlement band of the Usolskiy district. It is here that fertile gray forest, leached chernozems, sod and sod-podzol soils are found [2].

Agriculture is highly developed despite unfavorable climatic factors, particularly harsh long winters with deep soil freezing (up to 250 cm); late spring and early fall frosts; short hot summers with low relative humidity in the beginning of the growing season (May-June) and significant amount of precipitation in the end of the growing season (August-September); high wind speed in spring [2].

Agricultural production is represented by the following types of enterprises [1]:

1. large pork and poultry production enterprises (SPC "Usolskiy Pork Complex" and SPC "Belorechenskoye");

2. medium-sized enterprises specializing in meat and dairy production (JSC Bolshelanskoe, JSC Zheleznodorozhnik) and production of seeds of the highest reproductions (FGUP Buretskoe);

3. Small enterprises for the production of elite seeds of grain crops (CJSC Telminskoye) and grain processing facilities (SKh Naslediye LLC, Kartagon KKh LLC).

In 2022 the gross output of agricultural production in Usolskiy district was 17 billion rubles, which is 54% of the total revenue of the district for all types of economic activity. The index of production output in agricultural organizations in 2022 was 104.7% [1].

In 2022, there were 3755 people employed in agriculture (32% of all employed in the district); in 2017 there were 3832 people employed (also 37% of all employed in the district). The decrease in the number of employees over the past five years was the result of a migration outflow [1].

According to the level of the average monthly salary in Usolskiy district in 2022, «agriculture" was in 4th place and amounted to 77 thousand rubles, compared with 43 thousand rubles in 2017. Over the past 5 years, wages have almost doubled [1].

The development and expansion of the branches of agriculture is planned to be implemented with the following measures specified in the strategy [4]:

- development of the municipal program of providing support measures for agricultural producers, primarily for small and medium-sized businesses;
- development of livestock breeding in private subsidiary plots of citizens and organization of private farms;
- organization of production for processing wild-growing crops harvested in the area;
- to developing new territories to support small and medium-size businesses in the agricultural sector;
- creation of new enterprises for deep processing of agricultural products, with the creation of new jobs.

The development of small and medium-sized businesses, as well as the creation of advanced processing facilities for agricultural products, is a priority for the district's agricultural sector. As a result, new jobs and favorable conditions for youth employment will emerge, which in turn will reduce the migration outflow from the Usolskiy district.

Currently, the Ministry of Agriculture of the Irkutsk Region together with the agricultural enterprises of the district has formed an action plan for the implementation of investment projects.

The Development Strategy of the Irkutsk Region [4] identifies two groups of settlements with the potential to develop agricultural production. The first group includes Belorechenskoye, Bolsheelanskoye, Zheleznodorozhnoye, Telminskoye and Taiturskoye settlements. The prospective direction of economic development of the group is development through modernization and increase in production of large agricultural enterprises, as well as development of small and medium enterprises, including development of small forms of agriculture.

The second group includes the following settlements: Novozhilkinskoye, Sredninskoye, Mishelevskoye, Novomaltinskoye, Sosnovskoye. This group will be developed at the expense of existing small-scale industries (peasant farms) [4].

References:

1. Administration of Usolskiy District : official website. Usolskiy district. Updated within a day. Available from URL: http://www.usolie-raion.ru/ [Accessed 26 May 2018]. (in Russ).

2. Berkin N.S., Filipova S.A., Boyarkin V.M. et al. Geography of the Irkutsk region: Physical-geographical zoning of the Irkutsk region. Irkutsk: Publishing house of IGU; 1973. 328 p. (in Russ).

3. The territorial planning document of the Usolskiy municipal district № 39, dated 28 February 2023 "O vnesenii izmenenii v reshenie Dumy munitsipal'nogo raiona Usol'skogo raionnogo munitsipal'nogo obrazovaniya № 73 "Ob utverzhdenii skhemy territorial'nogo planirovaniya munitsipal'nogo raiona Usol'skogo raionnogo munitsipal'nogo obrazovaniya" [[On amendments to the decision of the Duma of the municipal district of Usolskiy district municipality № 73 dated 28 Feb. 2013 "On approval of the territorial planning scheme of the municipal district of Usolskiy district municipality"]. Available from http://duma.uoura.ru/index.php/deyatelnost-2/resheniya-dumy/48-resheniya-dumy-73-ot-28-05-13g-ob-utverzhdenii-skhemy-territorialnogo-planirovaniya-munitsipalnogo-rajona-usolskogo-rajonnogo-munitsipalnogo-obrazovaniya [Accessed 11 April 2023]. (in Russ).

4. Strategic planning document of the Irkutsk region № 15-OZ, dated 10 Jan. 2022. Strategiya sotsial'no-ekonomicheskogo razvitiya Irkutskoi oblasti na period do 2036 goda [Strategy for socio-economic development of the Irkutsk region for the period up to 2036]. Available from http://publication.pravo.gov.ru/Document/View/3800202201110007 [Accessed 10 April 2023]. (in Russ).

5. Tsykunov G.A. Sel'skoe khozyaistvo Irkutskoi oblasti: neprostaya sud'ba v industrial'nom regione [Agriculture of the Irkutsk Region: Hard Experience in the Industrial Region]. Istoriko-ekonomicheskie issledovaniya = Journal of Economic

History & History of Economics, 2021;22(2):345–361. DOI: 10.17150/2308-2488.2021.22(2).345-361. (in Russ).

***Scientific supervisor**:*
VictorM. Plyusnin
D. Sc. (Geography),
Deputy Director for Science,
V.B. Sochava Institute of Geography, SB RAS

UDC 523.985-125

Pavel N. Kirichkov
atompacific@gmail.com
Institute of Solar-Terrestrial Physics, SB RAS,
Irkutsk, Russia Federation

SPACE WEATHER PREDICTION UNDER VARIOUS LOW BOUNDARY CONDITIONS

Keywords: *space weather, solar wind.*

A forecast of space weather conditions in the near-Earth environment is an actual scientific and practical task, and there are several teams in the world who actively work in this direction. Different model approaches, often connected with tremendous numerical calculations, are used for this purpose. But all these efforts make sense only if reliable sources of initial data — synoptic maps of solar magnetic fields — are available.

However, there are other data sets with full-disk solar magnetic field observations (e.g. WSO, SDO/HMI and SOLIS at USA, SMAT in China, IRmaag at Mitaka in Japan, STOPs in Russia) as well, and it has a sense to compare the results of solar wind parameters calculations using data from these instruments. On the example of Carrington Rotation CR 2164. and some observatories (WSO, GONG, SDO/HMI, STOP SSO) this is a goal of this study [1].

The knowledge of the evolving ambient solar wind is an essential component of successful space weather forecasting. The ambient solar wind flows and field play an important role in understanding the propagation of coronal mass ejections (CMEs) and are themselves an important drive of recurrent geomagnetic activity [2]. Furthermore, the topology of open magnetic field lines along which the solar wind propagates and accelerates plays a fundamental role in understanding the phenomenon that shows the evolution of space weather.

To date, there are no routine measurements of the coronal magnetic fields. Models of the magnetic field of the solar corona are based on data line-of-sight from observations of the photospheric field. The most widely applied extrapolation technique to reconstruct global solutions for the coronal magnetic field is the Potential Field Source Surface (PFSS) model [3] (Fig.1).

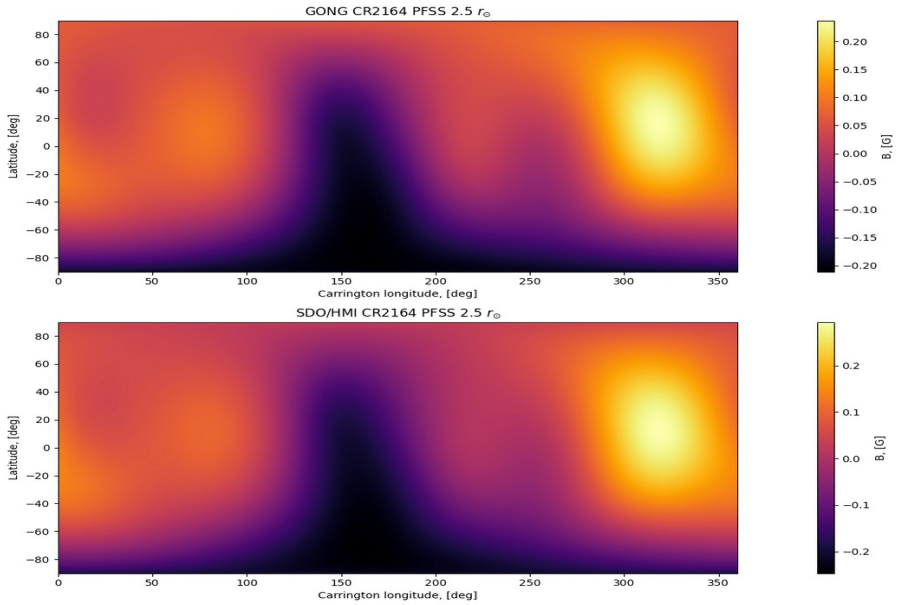


Figure 1. PFSS solution as a function of the heliographic latitude and Carrington longitude for CR2164

A correlation between solar wind speed at Earth and the amount of magnetic field line expansion in the corona was verified in 1989 using 22 years of solar and interplanetary observations [4]. In the literature, this empirical pattern is known as the Wang-Sheeley model. Thus, our task is to determine the topology of the magnetic field in the solar corona using PFSS and calculate the solar wind speed near the Sun based on the Wang-Sheeley model. Then the bulk speed on the Earth orbit is calculated using the Heliospheric Upwind eXtrapolation (HUX) model and comparisons of predictions with observable data are made. It is shown that better coincidence between calculated and empirical results can be achieved with some corrections of the formulas used.

References:

1. Demidov M.L., Hanaoka Y., Wang X., Kirichkov P. On the differences in the space weather forecasting caused by different low boundary conditions. Proceedings of 44th COSPARScientific Assembly 2022, 16-24 July, Athenes, Greece. 2022. D2.5-0007-22. Available from https://www.cosparathens2022.org/ [Accessed 22 April 2023].

2. Martin A. Reiss, Peter J. MacNeice, Leila M. Mays et al. Forecasting the Ambient Solar Wind with Numerical Models: I. On the Implementation of an Operational Framework. The Astrophysical Journal Supplement Series. 2019; 240(2). DOI:10.3847/1538-4365/aaf8b3. Available from https://arxiv.org/abs/1905.04353 [Accessed 10 May 20203].
3. Schatten K. H., Current sheet magnetic model for the solar corona. Cosmic Electrodynamics. 1971.
4. Sheeley Jr., N. R. Origin of the Wang–Sheeley–Arge solar wind model. Hist. Geo Space. Sci. 2017; 8:21–28. DOI: https://doi.org/10.5194/hgss-8-21-2017.
Available from https://hgss.copernicus.org/articles/8/21/2017/ [Accessed 15 April 2023].

UDC 520.88

Tatyana N. Marshalkina
tatiana.marshalkina@yandex.ru
Institute of Solar-Terrestrial Physics, SB RAS,
Irkutsk, Russian Federation

SHORT-TERM DST INDEX FORECASTING WITH NEURAL NETWORKS: A REVIEW

Keywords: *geomagnetic storms, Dst index, neural networks.*

Geomagnetic storms, especially intense ones, are able to cause significant harm not only to space technology systems, but also to human activities on the ground. [1] An important indicator of size and intensity of storm is the disturbance storm time (Dst) index - negative Dst value means that the Earth's magnetic field is weakened, which happens during storms. [2] Therefore, it is crucial to have methods that are able to give fast and precise predictions of Dst index. One of those methods is Artificial Neural Networks (ANNs).

This review discusses various neural network models that have been used for prediction of Dst index for the last 30 years.

ANN designed to forecast Dst was first introduced in 1993 by Lundstedt. Following this, different algorithms were implemented, with most popular being backpropagation neural networks and Elman NNs. We can also note radial basis function networks, recurrent neural networks, neuro-fuzzy networks, hybridized neural networks, ANNs with bio-inspired algorithms [1] and one of the most recent advances - Transformer networks. [2]

Most works take as input data interplanetary magnetic field (IMF) and solar wind plasma parameters, such as the concentration of the solar wind particles, solar wind speed, and the southward component of the IMF and related parameters. The other approach is to directly use previous values of the Dst index as input.

It is important to point out that at the present times NNs have the ability to achieve simular or even better performance than more traditional methods.

Due to the constantly increasing computing power, the use of neural networks is becoming a more and more efficient method of forecasting of the Dst index.

References:

1. Lazzus J.A., Vega-Jorquera P., Palma-Chilla L. et al. Dst index forecast based on ground-level data aided by bio-inspired algorithms. Space Weather. 2019;17 (11): 1487-1506. DOI:10.1029/2019SW002215

2. Abduallah Y., Wang J.T., Bose P. et al. A deep learning approach to Dst index prediction. Computer Science. Machine learning. 05 May 2022. . ArXiv. – 2022. – abs/2205.02447. Available from https://arxiv.org/pdf/2205.02447.pdf [Accessed 10 May 2023].

Scientific supervisor:
Yuri V. Yasukevich,
Ph.D. (Physics and Mathematics),
Senior Researcher,
Institute of Solar-Terrestrial Physics, SB RAS

UDC 911.3:33

Ilya S. Kruchinin
lekecone@gmail.com
V. B. Sochava Institute of Geography, SB RAS,
Irkutsk, Russian Federation

ASSESSING THE ENERGY POTENTIAL OF EASTERN SIBERIA'S GAS AND OIL COMPLEX: AN EMPIRICAL INVESTIGATION AND PROSPECTS FOR FUTURE RESEARCH

Keywords: *oil, gas, Eastern Siberia, turn to the East, global energy sector.*

The future of Eastern Siberia's oil and gas complex is uncertain due to a number of factors, including low logistical accessibility, high production costs, and low demographic potential. However, the region's vast reserves of oil and gas resources offer potential for economic development. The changing global energy sector presents new opportunities and challenges for the regional industry.

To fully understand the potential of Eastern Siberia's oil and gas complex, it is important to consider the specifics of the global oil market [4], as well as the region's role as an oil producer in the Asian oil market. It is also crucial to recognize the local challenges and opportunities within the industry.

Despite the challenges faced by the region, its strategic location in close proximity to Asia and abundant natural resources make it a highly desirable destination for economic investments. This is particularly true in the current climate, as Russia shifts its focus towards the East. However, the issue of resistance to sanctions on necessary equipment remains a concern. Additionally, some experts [3] warn that Eastern Siberia risks losing its current position in the global economy if it continues to rely solely on its resources without significant investment in other sectors of economy. A stable Eastern Siberian region is not only important for the future of Russia, but also for the entire Asian continent.

The author of this paper extensively researched relevant data sources to define Eastern Siberia as a region [5] and determine the amount of oil production and its impact on the global economy [1, 2]. The study identified geo-economic factors that significantly influence the development of the oil extraction and processing industry, highlighting potential risks and opportunities for the regional industry. Consequently, a more in-depth analysis of oil production and reserves in the region is necessary. The next step for the researcher is to collect data on oil reserves and production companies within the region and examine the historical development of the area over the past 30 years.

According to the author's definition, Eastern Siberia encompasses the Irkutsk Oblast, the Zabaykalsky krai, and the Krasnoyarsky krai, as well as the republics of Buryatia, Tyva, and Yakutia. This region is responsible for producing 11% of Russia's oil, with significant contributions coming from Krasnoyarsky krai, Yakutia, and Irkutsk Oblast.

Despite its relatively small share of production outputs, Eastern Siberia’s yearly output alone can fulfill global demand for oil for up to four days, underscoring the region's importance in the global market.

References:

1. Maksakovskii V.P. Obshchaya ekonomicheskaya i sotsial'naya geografiya. Kurs lektsii v dvukh chastyakh [General economic and social geography. Course of lectures in two parts]. Moscow: VLADOS; 2009. 367 p.
2. Khrushchev A.T. Ekonomicheskaya i sotsial'naya geografiya Rossii : uchebnik [Economic and social geography of Russia : textbook]. Moscow: Drofa; 2006. 667 p.
3. Zeihan P. The End of the World Is Just the Beginning: Mapping the Collapse of Globalization. New York: Harper-Collins Publishers; 2022. 481 p.
4. Ikenberry J.A. World Safe for Democracy Liberal Internationalism and the Crises of Global Order. New Haven: Yale University Press; 2020. 408 p.
5. Tochenov V.V. Atlas SSSR [Atlas of the USSR]. Moscow : Glavnoe upravlenie geodezii i geografii pri sovete SSSR; 1983. 155 p.

UDC 330, 332.13

Mongush S.P[1],[2]
fqkey@mail.ru
[1] *Tuva Institute of Integrated Development of Natural Resources SB RAS*
[2] *V. B. Sochava Institute of Geography, SB RAS,*
Irkutsk, Russian Federation

INTERREGIONAL RELATIONS (BY THE EXAMPLE OF THE REPUBLIC OF THE ANGARA-YENISEI MACRO-REGION)

Keywords: *interregional relations, integration processes, AYEM (Angaro-Yenisei macroregion), low-development region, Tuva Republic.*

The transition to a market economy caused a deep crisis, which some less developed regions could not overcome. On this basis, interregional differences in socio-economic development indicators were identified, which exacerbate low integration of regions in interregional relations. We believe that the main disadvantage of such a position in the system of regional governance is associated with different conditions for entry into the market economy, based on the internal potential of territorial and economic structures of the regions' economies. Therefore, regional authorities need to pay more attention to such a factor as «interregional relations», which plays a crucial role in the integration processes in the area**s** of the country, which is important when implementing modern regional state development programs with federal funding [2].

The purpose of the study is to assess the level and significance of interregional relations in the management system of a region with low development. In the course of the study methods of statistical analysis were used: dynamics analysis, comparison, grouping, and cartographic methods. To determine different directions of integration processes in Tuva we studied the strategic document of the Russian Federation [7] and the region of Tuva. To assess interregional socio-economic differentiation, the data of the Federal State Statistics Service (Rosstat) were used [5]. The object of the study is one of the subjects of AYeM - the Tuva Republic, defined as a region with a slower rate of development [3].

The Republic borders on five subjects of the Russian Federation (see fig.1).

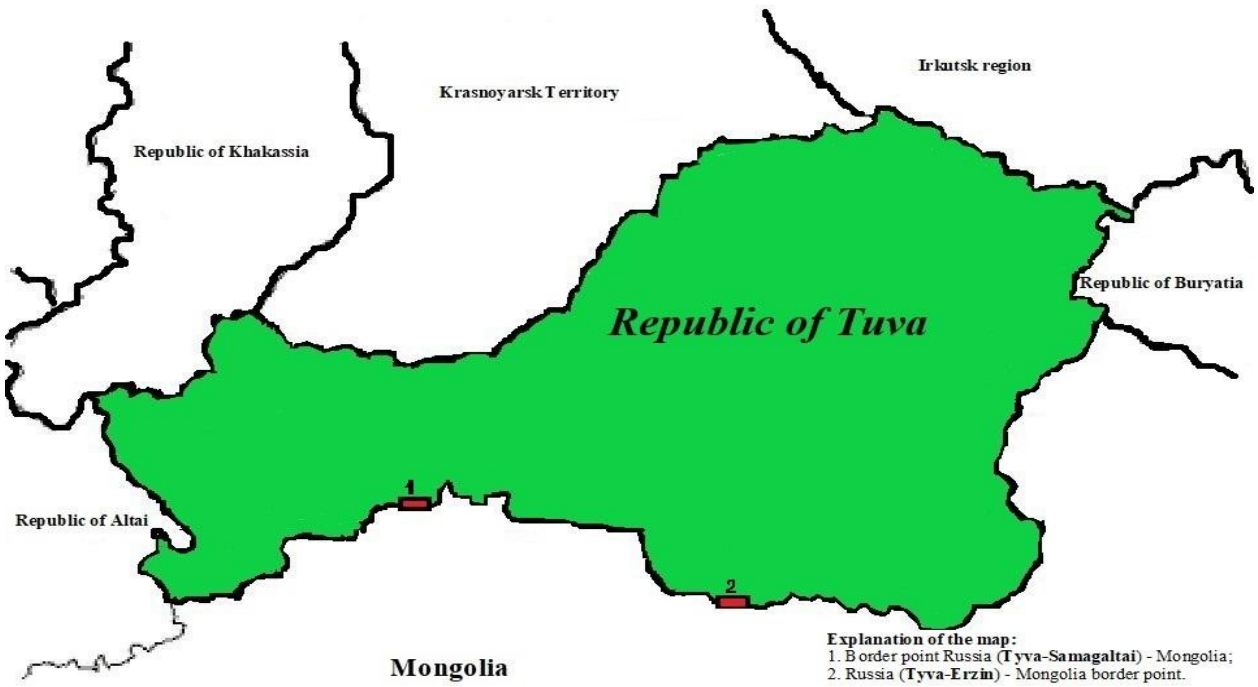


Figure 1. Territorial and administrative boundary

As stated in the «Strategy ... to 2030» [6], the main goal of the development of interregional and foreign economic relations is the development of interregional and foreign economic cooperation with the subjects of the Russian Federation, with the countries of the Eurasian Economic Union, and with the countries of the Asia-Pacific region in trade and economic, scientific and technical, social and cultural spheres. We have found that currently the integration processes of interregional nature are carried out in the various spheres (see fig. 2), though the level of integration processes is still low.

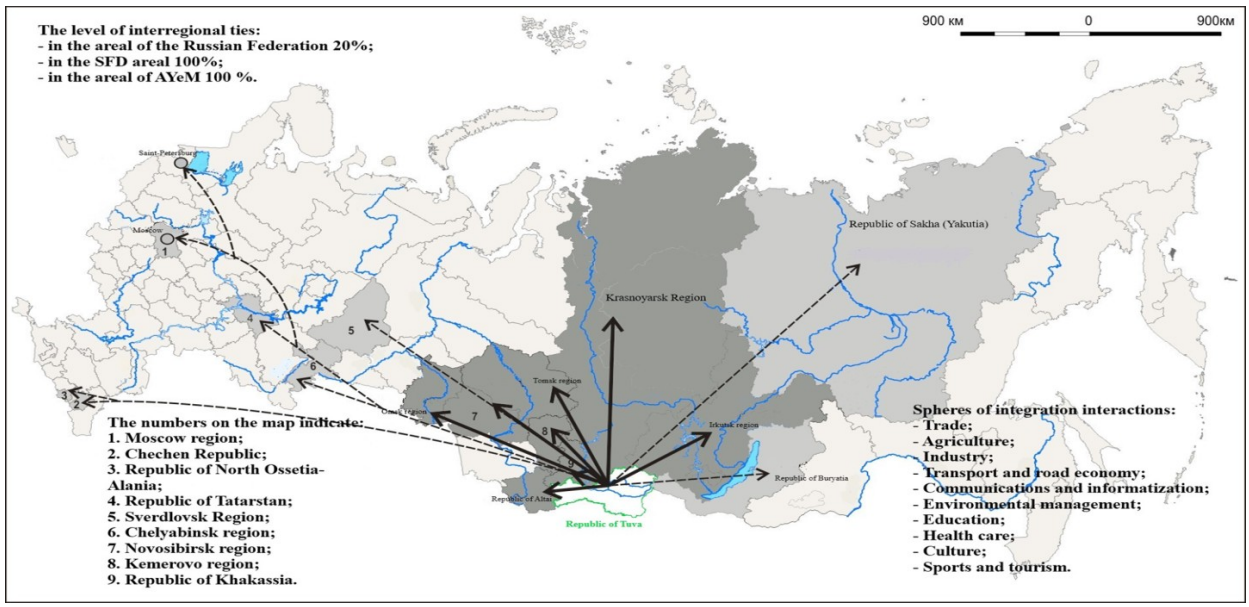


Figure 2. Interregional ties

The results of the study show that the degree of integration processes in the area of the country is 20% (Moscow region, Moscow, St. Petersburg, Chechen Republic, Republic of North Ossetia-Alania, Republic of Tatarstan, Sverdlovsk region, Chelyabinsk region and SFD (Siberian Federal District) regions). Here it should be noted that 50% of the above interacting regions are part of the SFD (Krasnoyarsk Territory, Republic of Khakassia, Republic of Altai, Altai Territory, Tomsk Region, Omsk Region, Novosibirsk Region, Irkutsk Region, Kemerovo Region, Republic of Tuva), with four of them, including the Republic of Tuva, being part of AYeM (100%).

On this basis, we have identified the factors that directly influence the low degree of interregional integration of the Republic of Tuva:

- Boundary of the administrative-territorial border (Mongolia);
- Geographical location of the territory (remoteness from the main economic centers of the country);
- Extreme natural conditions - since 1994 the region is attributed to the Far North regions of Russia and equated areas [4];
- Weak transport and logistics (road and air service);
- Low level of domestic economic potential when entering the market economy.

These factors have led to the peripheral economic development of the republic. Therefore, the expansion of integration processes in the aspect of interregional relations is one of the priority tasks, the solution of which will lead to the integration of Tuva into the current general economic space of the country, which is especially relevant under the current sanctions policy [1]. Thus, the strengthening of

interregional links on the basis of expansion will allow the region with a low level of development to increase its production potential by attracting investment resources and subsequently minimize the infrastructure transport and logistics constraints, which are clearly seen from the above-mentioned factors. The focus of regional authorities on solving the problem of insufficient interregional connections will increase the competitive potential of the region, which in the future may increase the economic significance of the Republic of Tuva for the Russian Federation.

References:

1. Mongush S.P., Avramchikova N.T., Maslova O.V., Zakharova L.N. Prospects of Economic Development of Republic Tyva Project "Yenisei Siberia". European proceedings of SOCIAL and behavioural sciences EPSBS. Krasnoyarsk Science and Technology City Hall. Krasnoyarsk; 2020. (90): 67-73.
2. Decree of the Government of the Russian Federation 972-r, dated 10 April 2020, "Ob utverzhdenii individual'noi programmy sotsial'no-ekonomicheskogo razvitiya Respubliki Tyva na 2020-2024 [On approval of the individual program of socio-economic development of the Republic of Tyva for 2020-2024]". Available from https://docs.cntd.ru/document/564652912 [Accessed 02 February 2023]. (in Russ).
3. Order of the Ministry of Economic Development of Russia № 698, dated 25 October 2019, "Ob utverzhdenii Metodicheskikh rekomendatsii po organizatsii raboty po razrabotke individual'nykh programm sotsial'no-ekonomicheskogo razvitiya sub"ektov Rossiiskoi Federatsii s nizkim urovnem sotsial'no-ekonomicheskogo razvitiya [On approval of Methodological recommendations on the organization of work on the development of individual programs of socio-economic development of the subjects of the Russian Federation with a low level of socio-economic development]". Available from https://legalacts.ru/doc/prikaz-minekonomrazvitija-rossii-ot-25102019-n-698-ob-utverzhdenii/ [Accessed 02 February 2023]. (in Russ).
4. Presidential Decree № 945, dated 16 May 1994, "Ob otnesenii territorii Respubliki Tyva k raionam Krainego Severa i priravnennym k nim mestnostyam [On Attributing the Territory of the Republic of Tyva to the Areas of the Far North and Equated Localities]". Available bfrom http://pravo.gov.ru/proxy/ips/?docbody=&link_id=13&nd=102030039&bpa=cd00000&bpas=cd00000&intelsearch=%F3%EA%E0%E7+++ [Accessed 02 February 2023]. (in Russ).
5. Resolution of the Government of the Republic of Tuva № 638, dated 24 December 2018, "O Strategii sotsial'no-ekonomicheskogo razvitiya Respubliki Tyva do 2030 goda [On the Strategy of socio-economic development of the Republic of Tuva until 2030]"

https://www.economy.gov.ru/material/file/e5d7757d02411b83d11bedda5f064078/61218rt.pdf [Accessed 02 February 2023].(in Russ).
6. Regions of Russia. Socio-economic Indicators: Statistical Collection. Rosstat. Moscow: IITs "Statistika Rossii"; 2022. 1112 p. (in Russ).
7. Order of the Government of the Russian Federation No. 207-r, dated 13February 2019, "Strategiya prostranstvennogo razvitiya Rossiiskoi Federatsii na period do 2025 goda [Strategy for the Spatial Development of the Russian Federation for the period up to 2025] ". Available from: https://www.economy.gov.ru/material/directions/regionalnoe_razvitie/strategicheskoe_planirovanie_prostranstvennogo_razvitiya/strategiya_prostranstvennogo_razvitiya_rossiyskoy_federacii_na_period_do_2025_goda/ [Accessed 02 February 2023]. (in Russ).

Scientific supervisor:
Tatyana I. Zabortseva,
D. Sc. (Geography), Professor,
Economic and Social Geography Laboratory,
V.B. Sochava Institute of Geography, SB RAS

Linguistics and Educational Sciences

UDC 81

Daria A. Potapova
89500818988@mail.ru
Department of foreign languages and philosophy,
Irkutsk Scientific Center, SB RAS,
Irkutsk, Russian Federation

EMOTIONALLY COLORED ARGUMENTATION

Abstract: The article considers emotionally argumentation and its influence on the interlocutor's persuasion.

Keywords: *argumentation, emotionally colored argumentation, argumentative task.*

Introduction. Emotional argumentation (as well as rational one) is based on appeal to motives, which are the rationale for the beneficiary / non-beneficial activity of the state of affairs relevant to the participants in communication, a means of persuading the interlocutor. If we consider the system of values as the basis of the behavior of the recipient, then the speech impact is primarily aimed at a shift in this system of values. And therefore, everything that is unacceptable in the "correct" discussion - illegitimate speech actions, deliberately aimed at misleading or discrediting the other side, are common methods of persuading the addressee, influencing his system of values, his picture of the world [2, p. 8].

Objective. The purpose of the work is to prove the effect of the process of emotional argumentation.

Discussion. Speech acts of emotional impact are statements of emotional self-expression, the reason for which is the speaker's feeling that the addressee and his behavior do not correspond to the norm or the speaker's ideas about it [2]. They express feelings and relationships that are inextricably linked with a rational assessment of what is perceived, passed through the emotional sphere of the psyche [1].

Emotional impacts are always impacts directed outward, associated with norms, social (integrating people into society) and role (the rights and obligations of one person in relation to another, forming a system of social interaction). These influences act as a tool for regulating the joint activities of people: they can change the way of thinking, behavior and actions of the interlocutors. Some of them represent, on the one hand, an interference in the sphere of the recipient's living space, harm the social status of a linguistic personality (for example, an insult), while others participate in the improvement of human relations and forms of communication by elevating (exaggerating) the merits of a partner (for example, a compliment). The perlocutionary effect of performing speech acts of emotional impact is represented by such final results as the emergence of emotional states of joy, delight, inspiration or discontent, irritation, insults, etc.

Emotional argumentation during the implementation of such speech acts most often only accompanies, supports the main intention, but at the same time it can be the only verbalized, “bulging out” element of the statement, the most important for the “here and now” situation. The main intention is easy to read from the context. Here is an example from which it is clear that a person is going to deliberately criticize an opponent:

«I think that all these units belong to non-equivalent vocabulary. When translating non-equivalent vocabulary, there are a lot of inaccuracies, because literally every unit requires a careful approach. Some of these examples are very aptly presented. Others can be debatable. But in general, the artistic value of the stories is not lost from this. Where "lush" is taken - the idea is to create a vivid image, and maybe it covers some inaccuracy. A shoe of incredible size - that's just been an accurate and important comment for me that you need to look at the actual sizes of shoes, clothes, and maybe for that period it seemed incredible, so here I'm always scared of the position of criticism. I always want to find different justifications. And why, and how, and given the highest professional level of these translators, I read about them all, they are people of high culture, they were characterized by a transdisciplinary approach, because they were editors, publishers. That is, for myself, I perceive such a study as rather self-development and something to convey to students, rather than criticize great people. They were great people, if only because they worked so hard on each story.» [3].

Here we see a very vivid emotion - the fear of criticizing someone. But here it slips that the author wants to convince everyone of the correctness of her own position and the correctness of her own translation. This is how one inconspicuous detail can position the audience towards the author of the statement. In this quote, there is just a “bulging out” element of the statement, and we can easily catch the essence of the main intention.

Conclusions. Thus, we come to the conclusion that the assessment of the perceived, passed through emotions, affects the process of argumentation and helps the author of the statement to achieve a positive response from his speech, that is, it helps to prove his position.

References:

1. Grafova T. A. Rol' emotivnoj konnotacii v semantike slova: dis. ... kand. filol. nauk: filol. nauk: 10.02.19 [The role of emotive connotation in the semantics of the word. Candidate’s thesis]. Moscow; 1987. 197 p.
2. Trofimova N. A. Aktualizaciya komponentov smysla vyskazyvaniya v ekspressivnyh rechevyh aktah (na materiale sovremennogo nemeckogo yazyka): Diss. ... dokt. filol. nauk: 10.02.04 [Actualization of the components of the meaning of the statement in expressive speech acts (on the material of the modern German language). Doctor’s thesis]. St. Petersburg; 2009. 420 p.
3. Video recording of the section "Semiotic aspects of the interaction of language, culture and society", which took place within the framework of the international scientific conference "VI Gottlieb Readings: Oriental and Regional Studies of the Asia-Pacific Region" (December 6-8, 2022) part 1 under the guidance of prof.

Evgenia Fedorovna Serebrennikova and Assoc. Natalia Yurievna Trazanova. Available from: https://gotlib.ru/2023/01/25/semiotics-2022/

Scientific supervisor:
Galina M. Kostyushkina,
D. Sc. (Philology), Professor,
Department of Foreign Languages
and Philosophy, Irkutsk Scientific Center, SB RAS

UDC 37.022

Egor A. Denisov[1],[2]
Egoralexandrovich91@yandex.ru
[1] *Department of pedagogics and expertise, Irkutsk Scientific Center, SB RAS*
[2] *Educational Complex "Point of Future",*
Irkutsk, Russian Federation

FORMATION OF INTERCULTURAL COMPETENCE OF FOREIGN STUDENTS: TO THE PROBLEM STATEMENT

Abstract. The students learning Russian as a foreign language need special pedagogical assistance in overcoming difficulties that arise in the process of language and culture learning.

Keywords: *intercultural competence, intercultural scientific competence.*

Introduction. In this regard, the development of intercultural scientific competence of the students becomes relevant, which is conditioned by the requirements put forward today to the specialists in different fields.

Objective. The goal of this research is to study the influence of culture on the language and prove that the cultural role is a significant one while studying Russian as a foreign language.

Materials and methods. The material for the research was selected out of the variety of scientific works and studies as well as the methodological materials for students studying Russian as a foreign language. The methods applied in the study include:

· structural analysis consists in revealing peculiarities of conveying culture while studying Russian as a foreign language;

· morphological analysis lies in finding out general lexical and syntactic characteristics;

Discussion. The analysis of scientific literature shows that the problem of intercultural competence is actively studied by scientists all over the world. This can serve as a proof that the research topic is relevant and important for the theory and methodology of teaching foreign languages, including Russian as a foreign language.

E. L. Golovleva defines intercultural competence as an in-demand quality of our time. It is a complex of elements consisting of knowledge of peculiarities of cultures entering into interaction and skills in implementing this knowledge in a particular cultural and non-cultural environment. "It is a positive attitude towards the presence of different ethno-cultural groups in society and voluntary adaptation of social institutions of society to the needs of different cultural groups"[1].

Peculiarities of forming intercultural scientific competence when teaching Russian as a foreign language using journal articles reveals a step-by-step model of forming intercultural scientific competence; reveals psychological and pedagogical features of forming intercultural scientific competence when using articles, also describes experiential learning based on the created model.

It should be noted that the main goal of didactic communication is the formation of beliefs by organising activities and selecting those procedures that contribute to the formation of beliefs in all areas of human practice. In turn, intercultural didactic communication is based on understanding, taking into account spiritual (cultural differences) or other specificities (gender, social, economic, etc.), in order to avoid conflicts between the communicators.

A much clearer and simpler classification of types of intercultural competence has been made by Professor M. Barrett, based on proposed research and conceptual models [2]:

- Attitudes towards other cultures, expressed in respect, curiosity, desire to learn more about them, openness, refusal to judge, adaptation to the unknown and appreciation of differences in cultural diversity.

Active listening and full interaction skills related to the use of language; skills related to empathy, the existence of multiple perspectives as well as critical appraisal skills.

- Knowledge of one's own culture above all, but also knowledge of the importance of communication of other cultures, shared culture and other knowledge that helps in processes of intercultural interaction and individual interaction.

- The most important behaviors in terms of what underlies their determinants; how to communicate, react and act in general when encountering people from different cultures, and expressing easy behavioral and communicative adaptation in order to easily reach a common and mutually beneficial agreement.

Some of M. Barrett 's models have been confirmed by studies, for example, by Russian and Chinese scientists, which emphasizes the universal nature of his conclusions. [3, P. 124]

Exploring the role of journal articles in the formation of intercultural competence it is worth noting their role and complexity caused by the following factors: 1) the presence of a large array of unfamiliar vocabulary 2) genre diversity 3) the use of a particular vocabulary and colloquial style as well as means of expression. [1]

Conclusions. To conclude, we would like to note that the role of journal articles in the formation of intercultural competence when learning Russian as a foreign language is great and needs to be studied in detail. The ultimate goal of this process is to form an intercultural speaker, a person capable of seeing, establishing and understanding the links between the language and the culture of the people who speak the language. Intercultural competence implies knowledge and acceptance of other cultures in order to discern how a particular culture can be a source of value not only for native speakers, but also for members of other cultural groups.

References:

1. Elizarova G. V. Formirovanie mezhkul'turnoj kompetencii studentov v processe obucheniya inoyazychnomu obshcheniyu: Diss. ...dokt. filol.nauk: 13.00.02 [The formation of intercultural competence of students in the process of teaching foreign language communication. Doctor's thesis]. St. Petersburg; 2001. 371p. (in Russ).
2. Sadokhin A. P. Vvedenie v teoriyu mezhkul'turnoj kommunikacii: uchebnoe posobie [Introduction to the theory of intercultural communication: textbook]. Moscow: Alpha-M; Infra-M; 2009. 288 p. (in Russ).
3. Sverdlova N. A., Piao M. Sociolinguistic competence of Russian-Chinese bilinguals: Features of the formation (on the example of the figure of speech etiquette "Greeting"). Russian Linguistic Bulletin. 2020; 2(22):124-127.

UDC 37.022

Vadim S. Istomin[1],[2]
vadim.istomin@yandex.ru
[1] *Department of pedagogics and expertise, Irkutsk Scientific Center, SB RAS*
[2] *Educational Complex "Point of Future",*
Irkutsk, Russian Federation

TO THE PROBLEM OF DEFINITIONS OF COMPENSATORY AND STRATEGIC COMPETENCES

Abstract. The article is devoted to the problem of definitions of compensatory and strategic competences.

Keywords: *compensatory competence, strategic competence.*

Introduction. Studying contemporary verbal and non-verbal ways and strategies for compensating deficits in one's foreign language knowledge and skills we are confronted with definitions of compensatory and strategic. Studying the definitions presented by the researchers, an opinion begins to emerge that these two definitions of competences are identical and interchangeable. In this paper we propose to differentiate and distinguish them by analyzing and finding points of difference between these definitions.

Objective. The purpose of the work is to differentiate and distinguish compensatory and strategic competences by analyzing and finding points of difference between these definitions.

Discussion. Compensatory and strategic competences are objectively very close, which is why there is a problem of differentiation in the conceptual apparatus. Studying studies of verbal and non-verbal strategies in the conditions of insufficient linguistic knowledge, one can see a complete identification of the concepts, the authors literary writing "strategic (in brackets compensatory) competence" or "compensatory (in brackets strategic) competence". When comparing and analyzing the definitions, the common concept of using one or the other is indeed evident. In the definitions of the terms of both competences we can see that they are used under: insufficient language proficiency, overcoming deficits in language proficiency, conditions of deficit in language means and foreign language knowledge, lack of necessary language knowledge, compensating for insufficient language knowledge. Thus, we can conclude that both competences are part of the conceptual apparatus of communicative strategies used as "a means of overcoming what appear to be individual difficulties in achieving a certain communicative goal" [1].

When asked where to look for differences, we turn to the definitions of the terms separately. When analyzing the definitions given to the term "compensatory competence", the following general ideas can be traced: "overcoming difficulties in communication and profile-oriented communication situations", "overcoming different situations in the process", "in receiving and transmitting information", "for continuing communication", "readiness to overcome difficulties in the process of communication... flexible application in communicative and problematic situations", "overcoming difficulties encountered in the process of foreign language communication". Thus, we can conclude that compensatory competence helps an

individual to cope with a deficit of language knowledge when communicative failure occurs directly during a speech act.

When analyzing the definitions given to the term "strategic competence", the following ideas can be traced: "to avoid communicative failure", "the speaker evaluates, plans and executes the goals set", "the ability to develop programmes and plans", "related to a greater extent to speech planning". Accordingly, we can say that strategic competence helps an individual to cope with the deficit of language knowledge in preparation for a speech act in order to predict and avoid the occurrence of communicative failure.

Conclusions. Thus, we can conclude that the main distinguishing feature of the definitions of the terms compensatory and strategic competence is the temporal aspect. By differentiating the terms in this way, we open up the possibility of studying these competences separately, with the possibility of assessing them at a specific moment of use by an individual. However, it should be noted that the formed tandem of competences in a pair will help foreign language learners to minimize difficulties and misunderstandings more fully when communicating with native speakers of the target language.

References:

1. Faerch C., Kasper G. On identifying communication strategies. Strategies in Interlanguage Communication. London: Longman, 1983; 260 p.

UDC 373

Egor E. Nikulin[1],[2]
nikulinyegor97@mail.ru
[1] *Educational Complex "Point of Future"*
[2] *Irkutsk State University, Pedagogical Institute,*
Irkutsk, Russian Federation

HIGH SCHOOL STUDENTS' PROJECT WORK ON CHINESE FOOD PHRASEOLOGICAL UNITS "CHENYUY"

Keywords: *project activity of students, extracurricular activity, pedagogical support.*

Project activity as a scientific direction began to exist at the beginning of the XX century. It is believed that the project method arose from the method of problems,

which was developed in the XX century by American educator J. Dewey and his student W. H. Kilpatrick [2].

In the modern literature there are two main approaches to the definition of project activity: systemic and activity-based. The Private Educational Complex "Point of Future" defines project activity as a type of educational activity aimed at achieving a pre-planned result by students in an optimal way taking into account the available resources and risks [1].

We consider the implementation of project activities in the Private Educational Complex "Point of Future" for tenth-grade students on the example of working with Chinese phraseological units (hereinafter referred to as PU) "Chenyuy" with the component "food".

Teachers organize a project fair as a part of the extracurricular course "Technology of Life Design". At this stage one of the students of the tenth-grade determined the basis of her project to work with the Chinese language PU "Chenyuy". Chenyuy (成语) is a steady turn, most often consisting of four characters.Further project activity of the student consists of the following stages: problematization, goal-setting, planning, implementation, result fixation, reflection, project defense.

Project supervisors provide pedagogical support for the implementation of students' projects at different stages. The choice of project supervisors is made by the authors of the project in the framework of the project fair, including with the help of the project environment [1].

The work of a tenth-grade student with the Chinese language PU "Chenyuy" consisted of two components: identification of theoretical and methodological foundations of vocabulary expansion in the extracurricular course "Chinese language", as well as the practical part – development of a set of exercises using the PU "Chenyuy" with the component "food".

It is important to note that the results of each stage are recorded in the project environment – a subsystem of information and educational environment of the educational complex, providing online support for projects. The results of the projects are presented by the students at the stage of project defense.

In this case, it was decided to present the results at the first scientific forum of the educational complex "Scientific Start Point". Thus, we selected 17 PU "Chenyuy" with the component "food", using which we developed a set of conditional speech exercises aimed at the formation of the lexical skill. The defense of the projects is evaluated by independent internal and invited experts.

References:

1. Local Statutory Act 11-09/0211-09/02, dated 09 November 2020, "Polozhenie o proektnoi deyatel'nosti studentov Chastnogo obrazovatel'nogo kompleksa Tochka budushchego [Regulations on Project Activities of the Students of The Private Educational Complex Point of Future]". Internal Documents of The Private Educational Complex “Point of Future”. (in Russ).
2. Yakovleva N. F. Proektnaya deyatel'nost' v obrazovatel'nom uchrezhdenii: uchebnoe posobie [Project activity in an educational institution: a training manual]. 2nd edition, stereotyped. Moscow: "FLINTA" Publishing; 2014. 144 p. (in Russ).

UDC 371.13/16

Egor E. Nikulin[1],[2]
nikulinyegor97@mail.ru
[1] *Educational Complex “Point of Future”*
[2] *Irkutsk State University, Pedagogical Institute,*
Irkutsk, Russian Federation

THE INSTITUTE OF MENTORING IN THE MODERN REGIONAL EDUCATION SYSTEM: PROBLEMS AND PERSPECTIVES

Abstract. This article discusses the problems of mentoring system in the Irkutsk region. The main problems are adaptation of young specialists, lack of financial incentive system for mentor, methods of mentoring program effectiveness evaluation, etc. Despite these problems mentoring institution is a perspective direction.

Keywords: *mentoring, freshman teacher, professional development of a teacher, regional education system, problems of mentoring system.*

Introduction. With continuous modernization of the regional education system each year the teacher's role and requirements to his/her personal and professional qualities are increasing. Mentoring system is a necessary tool for successful development of freshman teachers.

Objective. The purpose of the work is to describe the problems of mentoring system in the Irkutsk region and define the potential of a regional mentoring system.

Material and Methods. In preparing the article, the official documents regulating the regional mentoring system, books and articles on the topic of mentoring in school were used. The analysis of the official documents and scientific literature was conducted to identify problems in the regional mentoring system. According to the results of the analysis, problems and promising areas of development of the

regional mentoring system were highlighted. Based on the analysis, conclusions were made about the prospects of the regional mentoring system.

Discussion. Despite numerous advantages, the mentoring institute in Irkutsk region has certain problems: lack of a unified regional database of mentors and proven methods of mentoring; lack of a system of financial incentives for mentors, as a consequence the competitive environment failure, etc. [1].

Moreover, qualification, motivation, responsibility and experience of a mentor are of great importance when implementing a mentoring system. Different forms of mentoring can help, where there can be several mentors for different purposes [3].

According to recent data at the regional level, a working group was created to implement the targeted mentoring model in the Irkutsk region, a list of mentors according to the profile is formed, a road map – step-by-step implementation of the program was developed, mentoring pairs were formed, etc. [2].

Promising directions for development of mentoring sphere at the regional level were identified: drawing up a unified regulatory and legal framework; formation of professional environment, community of experienced teachers, freshmen teachers and students; possibility for educational organizations to become a point of attraction for young specialists and to minimize migration of teaching staff. Mentoring system implies effective and fast acquisition of new skills, abilities, competencies, professional experience, as compared to other methods of transfer (methodological recommendations, literature review, independent and project work) – this will allow avoiding future mistakes, under supervision of a competent mentor and realizing set goals in a short time [1].

Conclusion. In conclusion, it should be noted that the institute of mentoring plays a crucial role in the modern regional education system. Despite the challenges that the mentoring system faces, there are also significant opportunities for growth and development.

References:

1. Ignatieva E. V., Bazarnova E. V. Nastavnichestvo v sovremennoj shkole: mif ili real'nost'? [Mentoring in a modern school: myth or reality?] Vestnik Mininskogo universiteta. 2018; 2:1-17 (in Russ).

2. Letter of the Ministry of Education of Russia AZ-1128/08, dated 21 January 2021, “Methodological recommendations on the introduction (implementation) of the system (target model) of mentoring of teachers in educational organizations”. Available from: https://www.consultant.ru/document/cons_doc_LAW_418547/?ysclid=lbm8f69v9p586837933 / [Accessed 14 March 23] (in Russ).

3. Kovalevsky V. A. (ed.). Nastavnichestvo v sisteme obrazovaniya. Rukovoditeli obrazovatel'nyh uchrezhdenij, metodisty, nastavniki i molodye uchitelya: ucheb. posobie [Mentoring in the education system. Heads of educational institutions,

methodologists, mentors and young teachers: textbook]. Krasnoyarsk: Liter-print; 2018. 98 p. (in Russ).
4. Order of the Ministry of Education of the Irkutsk region 982-mr, dated 24 Dec. 2020. "Ob utverzhdenii regional'noi tselevoi modeli nastavnichestva" [On approval of the regional target mentoring model]. Available from https://kapelka.edukuitun.ru/upload/file/rasporyazhenie_982_mr_ot_24_(1).12.2020.pdf [Accessed 12 March 2023] (in Russ).

Scientific supervisor:
Olga B. Istomina,
Ph.D. (Philosophy), Head of the Department
of Socio-Economic Disciplines,
Pedagogical Institute, Irkutsk State University

UDC 81-26

Elena P. Mariasova
mariaselena@yandex.ru
Scientific Laboratory of Linguistic and Pedagogical Research,
Irkutsk Scientific Center, SB RAS,
Irkutsk, Russian Federation

A STUDY ON SEMANTIC AND STRUCTURAL RELATIONS BETWEEN TERMS (THE ENGLISH TERMINOLOGY OF EARTH SCIENCES)

Abstract. One of the understudied problems of terminology is the systematicity of terminology. The hyper-hyponymic approach to the systematization of terms in geology will help not only to hierarchically arrange the terminological apparatus of this science, but also to give an organized and clear view of its conceptual structure.

Key words: *terms, terminology, geology, Earth sciences, hyper-hyponymic relations, generic relations.*

Introduction. Setting intellectual boundaries for the term "*geology*" is far from easy. Although traditionally *geology* has meant the study of rocks, those who have been studying the structure and composition of the Earth for the previous almost two hundred years have had to deal with a wide range of scientific disciplines such as chemistry, natural philosophy, mineralogy, zoology, comparative anatomy, botany

and others. Thus, *geology* described all of Earth's explorations. Later, in the late 19th and early 20th centuries, "Earth sciences" (introduced by T.K. Chamberlain, an American geologist) emerged to cover astronomy and cosmogony. In the 1960s, *Earth sciences* became commonly used both in plural and singular forms, along with synonyms *geoscience* and *geology,* though the latter is much more limited semantics-wise. Nowadays, the term embraces a great number of disciplines and sciences, including *geology, geochemistry, geophysics, structural geology, economic geology, technical geology, planetary geology, geomorphology, mineralogy, petrology, pedology, sedimentology, stratigraphy, tectonics, volcanology, geochronology, paleography, paleontology, earth science philosophy and history, hydrology, oceanography, meteorology, climatology, paleoclimatology, paleontology, paleoecology*. This number of terms - names of fields of geological knowledge - alone brings an understanding of the complexity structure of the term geology. All the listed disciplines, in turn, have a vast arsenal of terms both specific to each science, and those that function in the field of the general integrative concept *Earth science*.

Obviously, for effective use of such special lexical units, it will be worth analyzing semantic-structural relations as a pattern to form the semantic field of *Earth science*. Doing so will contribute to a clear vision of the conceptual structure of geology as a discipline. In addition, the results of such research might be applied in terminography, terminology studies and linguistic didactics. Language material and the results of the study could be implemented in teaching Special English, English as a Foreign Language, and Earth Sciences.

Objective. The study is aimed at justifying the assertion that the representation and understanding of the conceptual structure of each of the listed sciences might be facilitated by hypernym/hyponym analysis of semantic and structural relations of the terms constituting the English scientific terminology in the field of each discipline. This could help map out the structure of geoterminology, identify the systematic nature of the term, and define lexical groups and semantic fields.

Material and methods. To map out the structure of geoteminology, the terminological content of scientific literature in special terminological dictionaries, research articles or textbooks should be examined using definitional, component, structural-semantic and statistical analysis methods.

Discussion. The term *geology* has traditionally been understood as the science which studies the structure, composition and history of the Earth. More recently, subsections of geology have been established as separate sciences with their own names. In the hyponymic hierarchical structure of geoterminology, *geology* is a first-level item with a set of hyponymically related components in its hierarchy. Any element of *geology* hierarchy functions in the same way, being both a hyponym for a higher-level component and a hypernym for a lower-level one. The depth of the

hierarchy, i.e. the number of levels, may vary. Thus, general *geology* includes *theoretical* and *practical geology*. *Theoretical geology* has three main branches - *geochemical disciplines, historical geology, and geodynamics* [3]. Each of these areas in turn is divided into numerous subsections. In particular, the *geochemical cycle* encompasses such sciences as *mineralogy, petrography, lithography*, etc. *Historical geology* includes *stratigraphy, palaeography, paleontology*. *Dynamic geology* involves *tectonics, volcanology, seismology* and a number of other sciences. *Practical geology* refers to *engineering geology, petroleum geology, hydrogeology*, etc. Thus, in the above division of geology into subdivisions a certain vertical structure of relations between the terms naming different areas of geological knowledge is already drawn.

The genus-species relations (hypernym-hyponym) are characterized as vertical relations from genus to species and from species to genus. The complex conceptual structure of the field of knowledge creates a multilevel genus-species relationship and different vectors of opposition. On various grounds, each generic concept – hypernym – receives a detailed meaning represented by a group of more specific species concepts – hyponyms [1].

In this way, *volcanoes* (as an example) refers to the concept category "geological objects" and is a generic term for five (5) groups of hyponyms at least. Taking into account eruptive history (1), the term *volcanoes* gets three hyponyms: *active volcanoes, inactive volcanoes, dormant volcanoes.* Based on their geodynamic setting (2), volcanoes receive the following branching of specific terms: *convergent boundary volcanoes, divergent boundary volcanoes, and hot spots*. According to the type of eruption (3), volcanoes are classified by the group of co-hyponyms: *effusive volcanoes, explosive volcanoes*. Based on the volcano shape (4) the following hyper-hyponymic "vertical" is observed: *strato-volcanoes, shield-volcanoes, lava domes, scoria cones (ash cone, cinder cone)*. The fifth group of hyponyms based on vent (5) is *volcanoes - central vent volcanoes, fissure vents (fissures)*.

There are two types of opposition between the hyper-hyponymic members: privative and equipollent [4]. The formation of privative oppositions can be observed between a hypernym and each of the hyponyms. Whereas, each of these hyponyms can act as a hypernym to a number of other hyponym terms, according to the distinctive content component. Such oppositions are called equipollent oppositions.

As an example, the hypernym *volcanoes*, according to the type of vent, would have the hyponyms *central vent volcanoes, fissure vents*, which in turn comprise a number of other hyponyms, including *fissure vents (fissures)- fumaroles, geysers, hot springs;* each of these terms would then serve as a hyperonym for a number of other hyponyms: *fumaroles – mofette, soltara* (by gas composition); *geysers – cone geysers, fountain geysers, bubble shower geysers*; *hot springs – magmatic hot springs, telluric hot springs* by type of geological origin, or *cold waters, hypothermal*

waters, mesothermal waters, hyperthermal waters, superthermal waters by temperature as well as by mineral composition- *ferruginous waters, chlorinated waters, sulfurous waters, sulfated waters, carbonated waters.*

Conclusions. Thus, the depth of hierarchical relations between terms may not be limited to one or two levels, but the structure of the hyper-hyponymic paradigm might be extended by equipollent oppositions. Besides, the current analysis of English geoterminology suggests that many geological concepts have more than one name, hence co-hyponymy and synonymy of terms in geological terminology are widely represented.

References:

1. Gurdaeva N.A. Printsipy strukturnoi organizatsii leksicheskikh terminov kak rezul'tat rodo-vidovykh otnoshenii sistemy ponyatii [Principles of structural organisation of lexical terms as a result of genus-species relations of the concept system].Vestnik Taganrogskogo instituta imeni A. P. Chekhova. 2011; 1:23–26. Available from: https://cyberleninka.ru/article/n/printsipy-strukturnoy-organizatsii-leksicheskih-terminov-kak-rezultat-rodo-vidovyh-otnosheniy-sistemy-ponyatiy [Accessed 02 June 2023]

2. Caldera, J., Wirasinghe, S. C. Analysis and Classification of Volcanic Eruptions. In Randy R. Rapp & William Harland (Eds.), Proceedings of the 10th International Conference of the International Institute for Infrastructure Resilience and Reconstruction (I3R2), 20-22 May 2014. West Lafayette, Indiana: Purdue University. Pp.128-133.

3. Nurizyanov R.M. Geologiya. Mineraly i gornye porody: Uchebnoe posobie po distsipline «Geologiya i litologiya» dlya bakalavrov napravleniya 131000 «Neftegazovoe delo» vsekh form obucheniya [Geology. Minerals and rocks: Textbook on the discipline "Geology and Lithology" for bachelors in the direction of 131000 "Oil and Gas Business" of all forms of training]. Almetyevsk: Almetyevsk State Petroleum Institute; 2012. 84 p. (in Russ).

4. Zherebilo T. V. Slovar' lingvisticheskikh terminov [Glossary of Linguistic Terms]. Nazran': Piligrim; 2010. 486 p. (in Russ).

5. Michael Allaby. A Dictionary of Geology and Earth Sciences. 4th ed. Oxford University Press; 2013. 636 p.

6. Glossary of seismological terms. The official web-site of the Government of Canada. Available from: https://www.earthquakescanada.nrcan.gc.ca/info-gen/glossa-en.php [Accessed 30 May 2023].

Scientific supervisor:
Nataliya A. Sverdlova,
Ph.D. (Philology), Associate Professor,

Leading Researcher,
Head of the Division
of scientific, education activity and expertise,
Irkutsk Scientific Center, SB RAS

UDC 81’33

Tatyana S. Paderina
jana-pad@mail.ru
Scientific Laboratory of Linguistic and Pedagogical Research,
Irkutsk Scientific Center, SB RAS,
Irkutsk, Russian Federation

THEMATIC TEXT MODELING BY TERMINOLOGY EXTRACTION (BASED ON SCIENTIFIC TEXTS)

Abstract. The article is devoted to the description of theoretical and applied provisions of the initial stage of automatic terminology extraction. The principle of text selecting of specific orientations is due to the state assignment of the Scientific Laboratory of Linguistic and Pedagogical research on "Linguistic-semiotic heterogeneity of the scientific picture of the world: theoretical and linguistic-didactic description.

Keywords: *thematic modeling, terminology, terminology extraction, scientific communication.*

Introduction. The increase in the volume of scientific information and the variety of options for its presentation determine the use of digital software for text processing and extraction of the necessary information from them. In our work, we consider digital interfaces that can help researchers by working with the texts of scientific articles.

Objective. The purpose of this stage of the study:

1. To carry out an experiment on thematic modeling of the corpus of texts.
2. Determine the content of the topics.
3 Terminology extraction on a particular subject area.

By analyzing terminology from a subset of randomly sampled texts using keywords, we hope to form the basis for further empirical research into narrow-specialty terminology and the creation of a software product.

Material and methods. As material for thematic modeling, we used a corpus of scientific texts from 2015-2022 in the field of Earth Sciences from following

specialized journals: *Landslides; Natural Hazards and Earth System Sciences; Journal of Geophysical research: Earth Surface; Geophysical Research Letters and others*, prepared by the Semantic Scholar application. This application is a free artificial intelligence-based research tool for working with scientific literature. A demo version of the application and its functionality can be found on the product website.

Discussion. As dealing with large amounts of text manually is a rather complicated process, many software products have recently been developed to automate the process [1, 2].

In our research we have turned to MALLET (MAchine Learning for LanguagE Toolkit). MALLET is a thematic modeling tool useful for statistical processing of natural language texts, document classification, sequence markup, cluster analysis, information extraction, etc.

Thematic modeling is a way of analyzing large amounts of unmarked text. The researcher sets a "theme", for example, groups of words that often occur together (terms, terminological phrases) and, using contextual cues, thematic models connect words with similar meanings or distinguish the use of words with multiple meanings. It should be noted that thematic modeling allows to solve several problems, such as:

- to identify the meaning or subject of the document by their contents;
- to classify documents according to the specified parameters;
- perform indexing and automatic annotation, etc.

Of the obvious disadvantages at this stage of the research, we note that in fact a rather large list of candidate words is extracted from the texts, which must still be further analyzed and confirmed by an expert in the subject area.

Text research is the process of analyzing and evaluating the content of a text. The research methods can vary depending on the purpose of the study and the type of text. In our study, special attention was paid to selecting texts with a short length, as the test annotation showed that text length can negatively affect the consistency of terms. There was also a restriction on the samples, that had to be comparable in size and taken over the same period. This helped to obtain more accurate research results.

Conclusions. The research perspectives are related to the improvement of existing automatic text processing tools (ATP). The terminology extraction using ATP simplifies the process of creating terminology systems or ontologies for highly specialized subject areas, which is certainly relevant in a rapidly changing information flow.

References:

1. Bruches E.P. Metod avtomaticheskogo izvlecheniya terminov iz nauchnykh statei na osnove slabo kontroliruemogo obucheniya [Method for automatic term extraction from scientific articles based on weak supervision]. NSU Vestnik. Series:

Information Technology. 2021; 19 (2):5-16. DOI 10.25205/1818-7900-2021-19-2-5-16. (in Russ).
2. Eckart de Castilho, R., Mújdricza-Maydt, É. et al. A Web-based Tool for the Integrated Annotation of Semantic and Syntactic Structures. Proceedings of the Workshop on Language Technology Resources and Tools for Digital Humanities (LT4DH), 11-17 December 2016. Osaka, Japan. Pp. 76–84.

Scientific supervisor:
Nataliya A. Sverdlova,
Ph.D. (Philology), Associate Professor,
Leading Researcher,
Head of the Division
of scientific, education activity and expertise,
Irkutsk Scientific Center, SB RAS

UDC 81-26

Liu Chunwei
1332635128@qq.com
Department of foreign languages and philosophy,
Irkutsk Scientific Center, SB RAS, Irkutsk, Russian Federation;
Changchun, China

ABOUT TRANSLATION COMPETENCE: ANALYSIS OF ADVERTISING IN CHINESE ONLINE MAGAZINES

Abstract. The article is devoted to the specification of translation competences, the features of translation competence are considered on the example of Russian-Chinese translations in Chinese journals.

Key words: *translation, components of translation competence, Russian-English Chinese translation.*

Introduction. Translation competence is a collection of skills and metrics for judging them that analyzes translation work at a much finer level than simple success or failure. «This is one of those terms that is difficult to define for many, but my chosen definition is very simple: translation competence is the collection of skills that allow you to produce professional, world-class translation work that adheres to client specs and passes the “local” test in your target region» [8]. This is the opinion of an International SEO and Content Expert, which reflects the essence of the problem posed.

Anyone who is reasonably fluent in two languages can perform translation. Without any specific training, someone who grew up in a household that spoke both, for example, Chinese and English, would be able to take a text written in English and translate it into Chinese, and the work would have to be called translation. In this case, we can talk, first of all, about the problems of interlanguage contacts, about the linguistic and cultural transformation of the individual [3, P. 344]. In the case of a bilingual, you can follow the approach developed by PACTE GROUP12 [6]. But to differentiate the problem field, first we need to imagine what translation competence is. In the table we will present various approaches to determining the composition of communicative and professional translation competencies (Tab.1)

Table 1

Components of translation competence

Components of translation competence	Author(s) of the approach
linguistic, communicative, textual, personal and technical	V.N. Komissarov [2].
the basic part (conceptual and technological) and the pragmatic part (specific and special)	L.K. Latyshev [1].
target-language competence, text-type knowledge, source-language knowledge, subject area knowledge, contrastive knowledge, decoding and encoding skills (communicative competence) including grammar, sociolinguistics and discourse	Bell R. [4].
domain/subject specific competence, research, transfer	Ch. Schäffner [5].
lexical and grammatical competence, textual competence, socio-cultural competence, content-content competence, high-tech, research /search, strategic, monitoring and self-improving competence	Chi-Chiang Shei [7].

Obviously, this is an incomplete list of authors who consider translation competence, but it is important for us to trace the main characteristics of translation competence by the example of translations of Russian and English advertising in Chinese magazines.

Objective. The purpose of the work is to describe the translation competence by the example of the study of the features of the translation of short advertising slogans.

Discussion. Advertising in magazines is an integral part of any economic process, it exists in various market systems and influences the behavior of society. And in this case, the goal of translators of advertising messages, together with the solution of linguistic tasks, is not only to promote goods, works and services, but also to influence the attitude, beliefs and behavior of the audience.

In this way, the translator has many tasks that require him to choose a certain translation strategy that takes into account the pragmatic meaning of advertising, the original advertising concept and the possibility of its implementation in a different national-cultural target audience. His work is embedded in the mechanisms of advertising influence, where he needs to know semiotics, symbolism and various theories related to the translation of advertising, to know sociological, cultural and even ideological trends.

Different genres of media texts are characterized by a different ratio and embodiment of the elements of communication and impact, different specific gravity of the actual information and expressive means. A truly professional translator should not only be aware of this correlation in every text he translates, but also be able to adequately convey it in translation.

Before proceeding to the process of translation, along with the classification of source texts, genre-stylistic features of the translated texts, their similarities and differences in Chinese and Russian, language means that are preferable in a particular style in the source language and the translating language, as well as factors limiting the range of language means in the target culture, an idea of the conceptual, technological and special components of translation competence is given adapted to the source texts.

In light of the problem of translation, the correct definition of the genre belonging to a particular text is of significant practical importance, since the communicative orientation of the text and its linguistic/ stylistic features depend on the genre belonging. Thus, within the framework of the translation of an advertising message, it is important not only to correctly convey the actual and purely informative content of the text by means of the target language, but also its communicative functions.

To achieve the correctness of the translation, it is often necessary to work not only on the text, but also on the form of the text. To this end, he uses translation techniques and transformations. In addition to knowledge of the language, the translator will need knowledge of consumer psychology, the psychological portrait of the advertising consumer, the cultural and historical realities of the country of his residence. Very often in advertising texts in Russian there are phonetic (onomatopoeia, rhyme, alliteration), lexical (terms, personification, epithets, language game), grammatical and stylistic techniques that change the structure of the text.

The Chinese Internet resources analyzed by us have become sources of various advertising material. The analyzed material in these sources – translations from Russian into Chinese (and vice versa), from Chinese into English emphasizes the need for careful selection of translation tools and tactics, realizing that in order to achieve advertising goals, information must be as accurate as possible, as expressive

as possible, timely and correlate with parts of the worldview of the audience for which this project is designed material.

The analysis of examples of the use of various techniques in advertising texts allowed us to draw some conclusions and confirm the validity of a number of hypotheses.

The most important task of the translator of advertising messages is to preserve the image of the original. In this case, the translation of various means of language used in advertising is one of the problems, because it is necessary to preserve the function of the reception used in the original language, and linguistic and cultural features can be a barrier in this case. Translation techniques and transformations help to achieve translation equivalence. Of particular interest are the results of translation work that we observe when translating into languages of very distant cultures, for example, Russian and Chinese.

The peculiarities of the advertising language require a certain translation strategy that takes into account the pragmatic meaning of advertising, the original advertising concept and the possibility of its implementation in a different national-cultural target audience.

The magazine advertising text should be considered primarily from the point of view of its communicative value when translating. The power of influence, expression, the ability to cause a strictly defined from the point of view of its communicative value when translating.

Conclusions. Thus, in order to achieve the effectiveness and success of advertising, the translated advertising text must combine both linguistic and extralinguistic components. When choosing a particular translation technique, the purpose of the advertising message, the composition, nature, language features and cultural characteristics of the target audience should be taken into account. Advertising will be considered effective when using various means of expression in it, giving advertising even more emotionality. Successful translation of advertising is associated with predicting the linguo-ethnic reaction of the recipient of the text in the target language; it is important to rely on knowledge of the peculiarities of national psychology and differences in cultural and historical traditions.

References:

1. Latyshev L.K. Tekhnologiya perevoda: Ucheb. posobie po podgotovke perevodchikov (s nem. yaz.) [Translation technology: Textbook on the training of translators (from German)]. Moscow: NVI - Tezaurus Publ.; 2000. 280 p.
2. Komissarov V.N. Sovremennoe perevodovedenie: Ucheb. posobie. [Modern Translation Studies: Textbook]. Moscow: ETS; 2002. 424 p.

3. Sverdlova N.A. Lingvosemioticheskaya Geterogennost' kommunikativnogo povedeniya bilingva: Sbornik statej Mezhdunarodnoj nauchno-prakticheskoj konferencii [Linguosemiotic heterogeneity of bilingual communicative behavior]. Yazyk kak iskusstvo: funkcional'naya semantika i poetika [Language as Art: Functional Semantics and Poetics : Collection of articles of the International Scientific and Practical Conference]. Moscow, 14-15 April 2022. Moscow: RUDN, 2022. Pp.344-352.
4. Bell R.T. Translation and Translating. London and New York: Longman, 1991. 298 p.
5. Schäffner Ch., Adab B. (eds.). Developing translation competence. Amsterdam: John Benjamin; 2000. 260 p.
6. Investigating Translation Competence: Conceptual and Methodological Issues. Meta. 2005; 50(2):609-619. DOI: https://doi.org/10.7202/011004ar
7. Shei Chi-Chiang. (2003). Combining translation into the second language and second language learning : an integrated computational approach. [PhD thesis, Edinburgh University]. Retrieved from http://hdl.handle.net/1842/27373
8. Postan L. Translation competence. Submitted 11 Jan. 2020 . Available from https://www.getblend.com/blog/translation-competence/ [Accessed 05 May 2023].

Scientific supervisor:
Nataliya A. Sverdlova,
Ph.D. (Philology), Associate Professor,
Leading Researcher,
Head of the Division
of Scientific, Education activity and Expertise,
Irkutsk Scientific Center, SB RAS

UDC 81-11

Dmitry S. Milgunov
milgunov_86_d@mail.ru
Department of foreign languages and philosophy,
Irkutsk Scientific Center, SB RAS,
Irkutsk, Russian Federation

LINGUOPSYCHOLOGICAL FEATURES OF COMMUNICATIVE FAILURE

Keywords*: cognitive linguistics, psychology, communication, communicative failure, stereotypical model, cognitive construction.*

The issue of failure in the communicative process has been in the focus of attention of domestic and foreign language researchers for a long time. Various scientists have considered the specifics of this phenomenon within the framework of various scientific paradigms, noting the presence of a number of specific features that distinguish a communicative failure from a number of communication interruption phenomena caused rather by the biological characteristics of communication participants, such as speech and pronunciation.

So, at the beginning of the twentieth century, Lev S. Vygodsky raised this issue in the context of his study of the relationship between thinking and speech. According to the scientist's thought, human thinking demonstrates syncretism in areas where an individual does not have sufficient experience to build an analytical connection between an object, the context of its functioning and a conceptual basis on the basis of which he is able to fully understand the specifics of interaction with it. [1, p. 109].

Thus, already at an early stage of the development of Russian linguopsychology, a communicative failure was seen as a phenomenon characteristic not only of the external expression of errors in communicative interaction, but as a phenomenon specific to the functioning of internal structures of thinking.

Continuing the line of Vygotsky's research, the outstanding Soviet scientist Nikolai Ivanovich Zhinkin, in his works devoted to the study of the universally subject code underlying speech-thinking activity, noted that the semantic dictionary, which forms the basis for constructing a stereotypical model, is heterogeneous in nature [2, p. 28]. This circumstance is explained by the different emotional labeling of its constituent units. Accordingly, the mismatch of stereotypical models generated by different semantic dictionaries certainly serves as one of the reasons for the failure in communication.

Due to the specifics of the functioning of the stereotypical model, subordinated to the principle of resource saving, and, in fact, being a reflex reaction to an irritant, it can be noted that the specifics of the communicative failure also affect the mechanism of the second signaling system, without a specific relationship with the process of analytical thinking.

In foreign linguistics, the issue of communication has also been raised, and consequently, errors during this process.

Thus, in the context of the issue under consideration, the point of view of the pillars of modern cognitive linguistics, George Lakoff and Mark Johnson, is of interest.

According to the position of scientists, the communication process implies the presence of a communicative identity determined by the specifics of the anthropic principle of cognition generation. However, this identity does not imply a qualitative

component of the communication process due to the fact that one of the sources of cognition generation is the linguocultural substrate, which determines the emergence of connections and the nature of relations between concepts [3, p. 29].

Thus, cognitive models generated within the framework of various linguistic and cultural substrates, even at the basic conceptual level, can detect inconsistencies leading to a failure of the communicative process.

We observe a similar view of the problem of the occurrence of a communicative failure in the works of Gilles Fauconnier. The scientist, in particular, notes the role of discourse, within which such a complex mental structure as bland is generated, as a source of failure in the communication process. Thus, discourse acts as a socio-cognitive factor that determines the specifics of mental constructions generated in the minds of communication participants. According to the scientist, discourses that are in opposition when constructing a bland will highlight different criteria of parental models for this mental construction, which will eventually lead to a failure in the communicative process, due to the fact that its participants will interpret the same objects differently [4, p. 39].

Summing up the above, it seems that a failure in the communication process is a complex linguopsychological phenomenon that manifests itself at all levels of speech production. And as its main features, it seems possible to single out:

1) Its stage development from the level of deep structures to the verbal expression of thought.

2) The structural complexity of this phenomenon, affecting both the psychological aspects of the individual and the thinking apparatus of the individual, which does not allow limiting the scope of research to one scientific discipline.

3) The immanence of this phenomenon for the process of communicative interaction in general and human thinking in particular.

References:

1. Vygotsky L. S. Myshlenie i rech' [Thinking and speech]. Moscow: AST:Hranitel' Publishing; 2008. 668 p .

2. Zhinkin N. I. Mekhanizmy rechi [Mechanisms of speech]. Moscow: Akademiya ped. nauk RSFSR Publishing; 1958. 370 p.

3. Lakoff J., Johnson M. Metafory, kotorymi my zhivem [Metaphors we live by]. Moscow: URSS Publishing; 2004. 252 p.

4. Gilles Fauconnier. Mental Spaces: Aspects of Meaning Construction in Natural Language. Cambridge University Press; 1994. 190 p.

Scientific supervisor:
Galina M. Kostyushkina,
D.Sc. (Philology), Professor,
Department of Foreign Languages
and Philosophy, Irkutsk Scientific Center, SB RAS

UDC 378.14

Oksana V. Lovchagina
o.lovchagina@gmail.com
Department of foreign languages and philosophy,
Irkutsk Scientific Center, SB RAS,
Irkutsk, Russian Federation

THE PRACTICE OF A COMPETENT APPROACH IN THE PEDAGOGICAL SUPPORT OF BILINGUALS

Abstract. The need for effective participation in intercultural communication in order to obtain subject (professional) information poses the task of bilingual language training of students, being the initial stage of creating a mechanism of bilingualism. The main features of understanding the competence approach in teaching Russian as a foreign language are described in this paper.

Keywords: *intercultural communication, pedagogical support**,** bilingual language training of students.*

Introduction. One of the most important tasks of bilingual education is "the interrelated and equivalent mastery of two languages by students (native and non-native), the development of native and non-native/foreign language culture, the development of the student as a bilingual and biocultural (multicultural) personality and awareness of his bilingual and biocultural belonging" [1]. It is the level of mastery of a foreign language that will allow students to begin studying the features of the language of special communication for the development of their personality in the professional sphere.

The use of foreign language teaching models in the context of bilingualism tasks is associated with the degree of forcing of a number of competencies. Readiness to master other language systems also depends on non-linguistic factors. Thus, "foreign specialists who live in Russia and have not received special training show a smaller increase in intercultural and communicative competencies, feel less adapted to the new environment compared to those who have received special training" [5, P.70].

Discussion. Defining the main purpose of teaching Russian as a foreign language as the possession of a certain level of communicative competence by students,

scientists define a number of "accompanying" both linguistic and non-linguistic competencies. The achievement of these competencies by students will contribute not only to the integration of an individual into a new cultural environment, but also to their functioning at an adequate level in a professional, in our case medical, environment.

Objective. The purpose of the work is to describe the ways of forming communicative competence at the initial stage of bilingual education. "Communicative competence," according to Yu. E. Prokhorov, "as a generic concept includes three specific concepts: existential competence, textual competence and discursive competence". A separate place is given to scientists of language and speech competencies: they "serve" all three species, since species – both in the process of learning and in the process of implementation – can be explicated only in their forms; country studies – part of the existential; professional and subject – forms of manifestation of the subject and discursive, depending on the type of communicative space in which they are implemented, etc." [3].

Russian as a foreign language is important, in our opinion, and fundamental in understanding the organization of courses of Russian as a foreign language, is the remark of Yu.E. Prokhorov that "in the structure and content of the educational process, defined as "teaching Russian as a foreign language", three components should coexist, ensuring the mastery of these three competencies. Moreover, like the structure of communication itself, they should be interconnected, but not coincide: they are interconnected, because only this relationship will ensure ownership of real communication, and not coincide, because they have their own content." We agree with his opinion that "a native speaker should also know (i.e. have competence) these three parameters of communication are: "what is it" – a figure of reality / existential competence; "what does it mean in this situation and what does it matter for it" – text / textual competence, "how to say it correctly to ensure communication"– discourse / discursive competence" [3].

Intercultural competence plays a special role in the context of the subject of teaching Russian as a foreign language under consideration. Communication, in the aspect of possession of intercultural competence described by us, is based on the same principles as any communication process, that is, the effect of success / failure of the act of communication. That is, in this case, we should talk about an act of intercultural communication, which is defined as a dialogue between speakers of different ethno-cultural groups. Scientists seriously approached the study of the problems of intercultural or cross-cultural communication in the early 1970s, singling it out as an independent scientific direction. Later, as a result of these scientific studies, it became possible to reformat the prevailing direction of ethno-cultural centrism at that time into the study of the processes of polyethnocultural communication as "a complex of

analytical and strategic abilities that expands the interpretative spectrum of an individual in the process of interpersonal interactions with representatives of another culture" [2, P. 83].

In the course of the development of science studying intercultural communication, scientists have suggested that the possession of intercultural competence is possible only in the process of familiarization with the ethno-cultural characteristics of representatives of a particular socio-cultural environment, tolerant attitude to the traditional cultural values of these representatives, as well as the possession of universal general cultural knowledge. Based on this, it is possible to consider intercultural competence as follows:

– through the prism of someone else's cultural identity, when a communicant is able, with the help of knowledge of language, norms of behavior, traditional values, is able not only to communicate as effectively as possible with a representative of another socio-cultural group, but with the existing task to fully integrate into a foreign cultural environment, i.e. fully acculturate;

– through the ability of intercultural communication, even in the case of insufficient knowledge of the ethnocultural characteristics of the opponent, which does not interfere, however, with the effectiveness of the process of the act of communication.

In the second case, we can talk about the use of "compensatory strategies" that allow us to eliminate barriers that arise during this kind of communication.

Analyzing the above, we can distinguish three constituent groups of elements of intercultural competence:

– affective, including empathy and tolerance, which are the basis for the success of the process of intercultural communication;

– cognitive, which include knowledge about the socio-cultural characteristics of the communicating parties, allowing timely correction of the communication process, avoiding misinterpretation and misunderstanding of various aspects of this process;

– procedural, combining strategies, situationally applied in acts of intercultural communication, which are aimed at overcoming barriers associated with the socio-cultural characteristics of the communicating parties.

In accordance with these groups, methods for the formation of intercultural competence are defined:

– the development of the ability to reflect one's own and someone else's culture,
which initially prepares for a benevolent attitude to the manifestations of someone else's culture;

– replenishment of knowledge about the relevant culture for a deep understanding of the diachronic and synchronic relations between one's own and someone else 's cultures;

– obtaining knowledge about the conditions of socialization and inculturation in one's own and someone else's culture, about social stratification, socio-cultural forms of interaction accepted in both cultures" [4, P. 137].

Conclusions. In the process of mastering intercultural competence, the student must have the following abilities:

– critically approach their own assessment of the socio-cultural characteristics of representatives of other cultures, rejecting stereotypes; be able to overcome cultural barriers, have the ability to find common features in different cultures;

– have the ability to correlate their own experience of intercultural communication with existing socio-cultural stereotypes;

– be able to integrate socio-cultural knowledge about other cultures into their own, thereby expanding their socio-cultural horizons;

– tolerant of the cultural characteristics of representatives of other ethno-social groups;

– possess the ability to synthesize, systematize and generalize socio-cultural facts of representatives of other ethnic groups in order to increase the effectiveness of intercultural communication.

References:

1. Galskova N. D., Koryakovtseva N. F., Musnitskaya E. V., Nechaev N. N. Dvuyazychnoe obrazovanie kak komponent uglublennogo yazykovogo obrazovaniya [Bilingual education as a component of advanced language education]. Inostrannye yazyki v shkole. 2003; 2:12-16 (in Russ).

2. Knapp K., Knapp-Potthoff A. Interkulturelle Kommunikation. In: Zeitschrift fur Fremdsprachenforschung. 1990; 1:62-93.

3. Prokhorov Yu. E. Metodika prepodavaniya russkogo yazyka kak inostrannogo. Kul'turnye osnovy prepodavaniya russkogo yazyka kak inostrannogo. Uchebnoe posobie po russkomu yazyku kak inostrannomu dlya distancionnogo kursa obucheniya prepodavatelej russkogo yazyka kak inostrannogo [Methods of teaching Russian as a foreign language. In: Cultural foundations of teaching Russian as a foreign language. Russian as a Foreign Language Teaching manual for a distance learning course for teachers of Russian as a foreign language]. Moscow: MAKS Press; 2004. Pp. 70–101 (in Russ).

4. Sadokhin A. P. Mezhkul'turnaya kompetentnost': ponyatie, struktura, puti formirovaniya [Intercultural competence: concept, structure, ways of formation]. Zhurnal sociologii i social'noj antropologii. 2007; X (1):125-139 (in Russ).

5. Sverdlova N. A., Baryshnikova U. N. K voprosu o lingvisticheskom neravenstve v polilingval'nom obrazovatel'nom prostranstve. Sovremennye problemy nauki i obrazovaniya [On the question of models of learning Russian as a non-native

language. Modern problems of science and education]. Russkij lingvisticheskij byulleten'. 2022; 6(1) DOI 10.17513/spno.32324 (in Russ).

Scientific supervisor:
Nataliya A. Sverdlova,
Ph.D. (Philology), Associate Professor,
Leading Researcher,
Head of the Division
of scientific, education activity and expertise,
Irkutsk Scientific Center, SB RAS

Научное издание

Тираж 300 эз.

Подготовлено к печати
Отделом научно-образовательной деятельности
экспертной оценки ИНЦ СО РАН

Отдано в печать 23.06.2023.