GeoZS

Annual Report *2024*

Address by *the Director*

Geoscience is becoming increasingly important in society, enhancing all GeoZS activities.

The importance of geoscience is increasing in society, positively affecting all areas of GeoZS operations. Research into the sustainable use of natural resources has received additional impetus, partly due to the European Critical Raw Materials (CRM) Act and the Net-Zero Industry (NZI) Act. The challenges of climate change, reducing the impacts of natural hazards, and implementing green transition principles are leading us to address new and increasingly complex research issues, to which we must respond with the highest scientific and professional standards.

With its knowledge, research achievements, and partnerships, GeoZS demonstrated in 2024 that it is a reliable and responsible driver of scientific and professional development in key strategic areas concerning the sustainable management of the subsurface of Slovenia and the European Union.

In 2024, GeoZS once again demonstrated its combination of scientific excellence, financial stability, international recognition, and ethical responsibility.

Ensuring sufficient financial stability is central to excellent scientific research operations. For the first time, we concluded the year with revenue exceeding EUR 8 million and a surplus of revenue over expenses. This result demonstrates responsible financial management, prudent planning, and successful implementation of tasks across all our areas of operation. The surplus enables us to make additional investment in research equipment and development, thereby strengthening our long-term competitiveness. In 2024, we allocated nearly 1 million EUR in new research and laboratory equipment. Such investments are essential for us to remain at the forefront of current research practices and to support the development of the next generation of researchers.

More so than by its financial indicators, GeoZS is defined by its scientific excellence. We increased the total number of active research projects from 31 in 2023 to 41 in 2024. Of these, 21 were Slovenian Research and Innovation Agency (ARIS) projects, 12 were from the finance development pillar, and 8 were international projects. These figures do not include the project initiated at the start of 2025 but secured in 2024 through excellent work. This major research project is titled ExtremEarth – a comprehensive approach to the study of the impact of extreme weather events on processes on Earth's surface. Together with a consortium of leading Slovenian research organisations, our well-prepared application convinced the reviewers and, as the leading partner in the first ARIS tender, we gained the opportunity to implement one of only four selected major research projects in Slovenia.

Although we at GeoZS are not inclined to quantify scientific results, we believe that this year's demonstration of our research performance is so significant that it deserves to be highlighted. The number of citations of our researchers' works increased by 21% in 2024, and the total number of scientific performance points rose by 43% compared to 2023. In accordance with open science guidelines, a significant portion of our scientific results has been published with open access, making our knowledge freely accessible to the broader society.

At GeoZS, we are dedicated to staff development. We support the younger generation of researchers through the young researchers system and beyond, carefully nurturing scientific excellence through systematic mentoring, knowledge transfer, and the creation of a stimulating research environment.

The international integration of GeoZS is very important for our development and for tackling global challenges. In 2024, we participated in 27 international projects, eight of which were within the Horizon Europe programme. Our extensive involvement in the EuroGeoSurveys network and the Geological Service for Europe (GSEU) demonstrates that GeoZS is an important co-creator of European and global solutions in geoscience. Our participation focused on projects addressing the energy transition, the sustainable use of mineral resources, geothermal energy, and responses to climate change. These topics already characterise the present and will continue to shape the future of Slovenia, Europe, and the world.

We are also proud of the expansion of interdisciplinary partnerships, as geoscience is increasingly integrated into interdisciplinary research projects, from the use of space technologies in monitoring natural disasters to links with energy and agriculture sectors in the sustainable management of natural resources. GeoZS is also participating in Slovenian and international interdisciplinary projects.

Projects for public and private clients were successfully implemented at high quality and received positive evaluations. Client satisfaction is a key indicator that GeoZS maintains its professional independence, credibility, and reliability. It is also important to emphasise our active role in supporting ministries and other public institutions in the development and implementation of policies and legislation in the mining, natural resources, and environmental sectors.

We also recognise the significant value of transferring knowledge at various levels within the company. Through consultations, workshops, and presentations for different audiences, we have brought research results closer to scientists, decision-makers, the business sector, and young people. We have hosted students, organised training sessions, and thus strengthened the link between research and practical application. In addition to our research activities, we are developing various information platforms that provide public access to data on geological events and resources. Our aim remains clear: to generate accessible and valuable knowledge, contributing long-term benefits to society. Finally, our participation in events aimed at popularising science, along with our strong relationships with the media, which shows increasing interest in our work each year, also supports this goal.

In 2024, GeoZS further committed itself to ethics and integrity in science. We continued preparing the GeoZS code of ethics and integrity, which was adopted at the beginning of 2025. The document set clear guidelines for responsible scientific work and contributed to the professional credibility of the institution, thereby following European guidelines and best practices in scientific integrity.

We are pleased to announce that we achieved and exceeded our set goals in 2024. GeoZS once again demonstrated a combination of scientific excellence, financial stability, international recognition, ethical responsibility, and responsible resource management.

This success would not have been possible without our dedicated employees, whose energy, enthusiasm and commitment have been invaluable. We also need to thank our partners, who have entrusted us with their challenges and have sought solutions together with us. I am convinced that we will continue to realise our mission successfully, that is to use excellent science as a platform to ensure professional foundations for the sustainable use of the Earth's subsurface, the responsible management of our geological heritage, and contribute to a safe and healthy living environment.

Dr. Miloš Bavec,
GeoZS Director

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We understand the processes that take place on and below the Earth's surface.

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01

Operational Highlights in 2024

The 2024 annual report of GeoZS is presented through social, intellectual, human, production, natural and financial capital.

In 2024, we increased the number of all ARIS research projects by 32%.

We also increased the total number of scientific performance points for employed researchers by 43% according to SICRIS records. Scientific performance increased as the number of citations increased by 21%.

In 2024, we achieved our planned goals in terms of financial performance by increasing generated revenue and profit, allowing us to have stable operations and carry out GeoZS activities, as well as increase investment in laboratory and research equipment.

Annual Report Summary

Social Capital

4
ARIS research programmes

1
ARIS infrastructure programmes

21
ARIS research projects

12
Internally supported research projects

8
Horizon 2020 and Horizon Europe international projects

5
European structural and investment funds

27
All international projects

80
Commercial projects

25
Public services and expertise

Intellectual Capital

1
Patents

0
Internal innovations

5
Internally developed data web platforms

10117
Citations (number of citations according to the SICRIS records as of 3 February 2025)

2540
Total number of points for scientific performance (points according to the ARIS criteria for researchers employed according to the SICRIS records as of 3 February 2025)

11
Publications

Human Capital

132
All employees

58
Researchers

8
Young researchers

11
Participants in teaching processes

Production Capital

914,765.62 EUR
Investment in research and laboratory equipment

Natural Capital

The research activity of GeoZS is focused on the geological structure of soil, mineral resource deposits and other resources – mainly groundwater and geothermal energy, geological phenomena, geologically-induced hazards, climate change in the past and present, and geochemistry – natural geochemical backgrounds and environmental pollution. Through these activities, we are setting guidelines and defining expert and scientific groundwork for the sustainable use of natural resources and the protection of the environment, responding to natural disasters and spatial arrangements.

Financial Capital

8,030,616 EUR
Revenue

7,909,447 EUR
Expenses

121,169 EUR
Generated profit (before tax and corporation tax)

More than in 2023 · Less than in 2023 · The same as in 2023

ANNUAL REPORT GeoZS 2024
Operational Highlights in 2024

Ensuring financial stability is the foundation of excellent scientific research. In 2024, we closed the year with revenues exceeding €8 million for the first time.

Financial Indicators

Total revenue

8,030,616
EUR

Total expenditure

7,909,447
EUR

Operating Profit

121,169
EUR

Revenue from ARIS

4,497,667
EUR

Revenue from public services and expertise in support of the country's operations

1,566,289
EUR

Revenue from international activities

932,194
EUR

Revenue from commercial activities and cooperation with the business sector

903,122
EUR

Non-Financial Indicators

Number of Research Projects

In 2024, GeoZS carried out 21 Slovenian Research and Innovation Agency (ARIS) projects. This included eight core projects, of which GeoZS led five, took part in one applied project, nine CRP projects, of which three were led by GeoZS, and three post-doctoral research projects. In addition, we carried out five research projects funded by the European structural and investment funds, of which GeoZS led one.

The scope of funds for research projects amounted to 8.22 FTE.

Number of Research Programmes

In 2024 we carried out research under the scope of four ARIS research programmes:

- P1 – 0011 – Regional Geology
- P1 – 0020 – Groundwater and Geochemistry
- P1 – 0025 – Mineral Raw Materials, and
- P1 – 0419 – Dynamic Earth

We also implemented the infrastructure programme IO – 0007 – Geological Information Centre.

International Activities

GeoZS is actively operating in the EU as a member of EuroGeoSurveys (EGS), which brings together national and regional geological institutes, which are generally public sector institutions that conduct research in the field of geoscience. These organisations have a long-lasting tradition for acquiring data, preparing information and implementing research focused on their national or regional subsurface. With the other EGS members, GeoZS provides expert, independent and applicable consultations and information to European institutions to help them tackle challenges, draft policies, regulations and programmes in geoscience-related areas. GeoZS is taking part in the implementation of the comprehensive EGS research and innovation programme, which, as per the priority tasks of the European Commission and sustainable development goals, is focused on several areas, such as preserving and managing natural and strategic resources of Europe, energy transition and decarbonisation, climate change consequences, improving the safety, protection and well-being of citizens, and the European digital twin – digital transition and open science.

Within the EGS framework, in 2024 we continued to implement the five-year programme to establish the Geological Survey of Europe (GSEU) and continued activities to establish the European International Centre of Excellence for Sustainable Resource Management (EU ICE SRM).

In 2024, we implemented and participated in 27 international projects, including eight Horizon Europe projects with a total value of EUR 342,786.78. We carried out ten research and development projects, funded by European Structural and Investment Funds. Nine projects were co-financed within the scope of the Interreg programmes, namely: three in the transnational Interreg Danube 2021-2027 programme, two in the transnational Interreg Alpine Space 2021-2027 programme, one in the transnational Interreg Central Europe 2021-2027 programme, one in the transnational Interreg IPA Adrion programme, one in the cross-border Interreg Slovenia-Austria 2021-2027 programme, and one in the cross-border Interreg Slovenia-Italy 2021-2027 programme. One project was co-funded by the European Regional Development Fund (ESRR). The total amount of funds from projects funded by the European Structural and Investment Funds was EUR 241,735.53 in 2024.

We participated in the PanAfGeo-2 project, which establishes cooperation and the transfer of knowledge and experiences between EGS and the Organisation of African Geological Surveys (OAGS). In 2024, we participated in two workshops on African soil. At the first one in Zambia, we presented circular economy content to the participants – sustainability in the mining industry, the UNFC and AMREC classification of mineral resources, development of autonomous equipment for underground mining, and the use of geophysical methods in researching minerals. At the second one in Uganda, the focus was on presenting the characteristics of thermal waters and deep geothermal resources, the geochemistry of groundwater, environmental hazards, development of geothermal projects, concepts of shallow geothermal systems, and hydrogeological methods for planning open-loop geothermal systems. We also participated in the application for the continuation of the PanAfGeo+ programme, which will significantly expand both EGS and GeoZS activities in Africa in the coming years.

As part of the infrastructure programme, we continued our cooperation in the development and maintenance of the European Geological Data Infrastructure (EGDI; https://www.europe-geology.eu). We are part of the international consortium that oversees the operation of EGDI. This work is being carried out as part of the Europe-wide GSEU project.

The European Plate Observing System (EPOS) is a large-scale European research infrastructure project in the field of geosciences. GeoZS is a member of the consortium tasked with the construction and operation of the thematic cluster of geological information and modelling, providing access to data and services, such as geological maps, mineral resources, 3D geological models and a borehole index. Eight GeoZS services for geological data are available on the EPOS ICS portal.

Implementation of Public Services and Professional Projects

On behalf of the ministry responsible for the mining sector – the Ministry of Natural Resources and Spatial Planning (MNVP), we carried out professional and development tasks, including the preparation, collection, evaluation and transmission of geological and other data and documentation, and the preparation of expert groundwork in geology and mining. We prepared solid foundations, including monitoring of goals, directions and conditions of the National Mining Strategy for the harmonised exploration and exploitation of mineral resources, and participated in the preparation of the legal framework, expert opinions and consents in mining. We provided support in the issuing permits, reviewing applications and conducting checks prior to the signing of concession contracts and determined the compliance of sites with the National Mining Strategy. We carried out activities in the field of mineral resources in the EU and beyond, including European projects, and as stakeholders we actively participated in the process of preparing and implementing Regulation (EU) 2024/1252 of the European Parliament and of the Council establishing a framework for ensuring a secure and sustainable supply of critical raw materials. GeoZS took an active part in the harmonisation and co-creation of the Act through national ministries, to which support was offered as needed, and through coordinated responses via EGS. Following the adoption of the Act and in agreement with the competent ministries, we took an active part in subgroups to monitor its implementation and, at the end of the year, in agreement with the Ministry of the Economy, Tourism and Sport and the Ministry of Natural Resources and Environment, we began preparing a National Research Programme in accordance with Article 19 of the Regulation on establishing a framework for ensuring a secure and sustainable supply of critical raw materials.

As part of establishing the information infrastructure, we developed and maintained the Mining Database and Mining Registry Book. We provided and managed geological data for the mining industry, and we prepared an overview map of exploration and extraction sites, as well as an inventory of mineral reserves and resources in Slovenia. On behalf of the Ministry of the Environment, Climate and Energy (MOPE), we monitored the condition of closed mining waste disposal sites and prepared expert bases for planning the remediation of four mining waste disposal sites of the former mine at Mežica and produced geochemical maps of certain elements in the soil with interpretation.

On behalf of the Slovenian Water Agency (DRSV), we carried out a project to create data layers in the field of landslide susceptibility and warning maps of the probability of slope mass movements, which

are important documents for investors and spatial planners, as part of the Green Slovenian Location Framework project. By the end of 2024 we had created expert bases for 95 Slovenian municipalities. The DRSV published the maps on the "eVode" portal in August, and they are also accessible via the "Atlas Voda" online viewer. In parallel with this, we prepared instructions for using the maps during in procedures for issuing water permits or expert opinions and in spatial planning processes.

As part of our cooperation with the Slovenian Environment Agency (ARSO), we continued our research into active faults, which provides us with data for the creation of the next generation of seismic hazard maps in Slovenia. The most up-to-date map of seismic hazards, already based on geological data, has been part of the legislation for earthquake-resilient construction activities since 1 May 2022, and serves as the basis for spatial planning, property valuations, etc. In 2024, we continued our research in the Raška Fault zone in the Karst region, where we carried out two palaeoseismological excavations and continued geological mapping. We also reviewed and analysed groundwater quality monitoring measurement sites for ARSO and prepared them for sampling, upgraded the hydrogeological mathematical model of heat transfer in the deep geothermal groundwater body of northeastern Slovenia, and performed simultaneous groundwater measurements in the area of the 4016 Murska kotlina body.

We prepared expert bases and support for the preparation of regulations on water protection areas, and for groundwater use and concession regulations for the Ministry of Environment and Spatial Planning (MNVP). On behalf of the MNVP, we also began preparing definitions of contributing water source areas intended for drinking water supply.

On behalf of the MOPE, we performed an analysis of operational monitoring programmes for groundwater conditions in landfill areas and reviewed assessments of potential soil and groundwater contamination, partial baseline reports, and baseline reports in the area covered by IED obligations. For the same ministry, we prepared an update of the balance of shallow and deep geothermal energy usage for the previous year (2023), taking into account all available detailed data and recorded changes and developments in the use of geothermal energy by existing and new users.

On behalf of the Ministry of Agriculture, Forestry and Food (MKGP), we prepared a climate report on the State of Agriculture in 2024.

Commercial Activities

In 2024, GeoZS was one of the key partners in complex infrastructure projects of national importance. We carried out the structural geological monitoring of excavations in the second tube of the Karavanke road tunnel, where we participated in ongoing interpretations and short-term forecasts of geological conditions that affected construction. After the completion of excavation works, we collaborated on the production of the final report, in which we described the structural geological conditions on the eastern tube route, reinterpreted the data from the western tube, and supplemented the interpretation of the structural geological conditions in the broader area of the tunnel tubes.

On the route of the second track of the Divača Koper railway line, we carried out nature conservation geological supervision at the construction sites of all eight tunnels and other earthworks, and were actively involved in interpreting the geological conditions along the entire route, which is crucial for the smooth running of the project. We also performed VDP tests, the results of which are crucial for planning further construction work. After completing the excavation works on the tunnels, we continued with hydrogeological surveys of the tunnel linings and hydrological conditions in the vicinity of the tunnels. We also carried out extensive sampling of groundwater for chemical analysis.

We performed assessment of seismic hazard for the design of the second block of the Krško Nuclear Power Plant, with an emphasis on the parameterisation of seismic sources.

We prepared a report on the calculated classified and categorised reserves and sources of crushed stone deposits – limestone for the Črnotiče and Solkan extraction areas.

We continued systematic research works at the Anhovo quarry extraction area, which included further activities related to geological mapping, depth reviews, and the creation of a precise 3D model with the aim of creating a precise 3D geological model to assist in the assessment of raw material resources and technical extraction solutions.

We performed geological and hydrogeological work during the construction of the K-3A724 geothermal well in Laško.

We carried out geological and hydrogeological work during the construction of the Mt-9 reinjection well in Moravske Toplice.

We participated in geothermal well monitoring programmes and implementation processes for various concessionaires using thermal water and natural mineral water, and we prepared hydrogeological expert bases for the construction of geothermal wells at Žitkovci.

We performed core sampling and video inspections in boreholes for various clients.

We conducted hydrogeological surveys in water source areas in the municipality of Bohinj and in areas surrounding Ovčja Jama, Peričnik in the Vrata Valley, and Krvavec.

We conducted hydrogeological surveys and analysed groundwater level fluctuations in the Vrhovo hydroelectric power plant area.

We began hydrogeological surveys in the water source area at Završnice. In addition to regular stable isotope measurements, we also conducted a tracer test.

As part of the DPN upgrade of regional railway line no. 21: Ljubljana Šiška–Kamnik Graben, we participated in geological and hydrogeological surveys. We also prepared a risk analysis and assessment of the impact of the upgrade on groundwater.

We performed hydrogeological work for the preparation of project documentation for new construction and maintenance work on the section of the main road Mengeš–Žeje–Komenda.

We conducted research to determine the geological and hydrogeological conditions for underground heat storage using a geosond field in selected areas in Trbovlje.

We participated in the preparation of proposals for operational monitoring programmes of groundwater status for the Industrial Emissions Directive facilities for various clients.

We continued to carry out supplementary hydrogeological surveys for the study of variants/pre-investment design and the national spatial plan for the Ptuj–Markovci main road.

We continued pilot measurements of microplastics in groundwater in the Municipality of Ljubljana and in the Karst region.

We cooperated with the forestry department on research and ensuring the protective function of forests against the consequences of slope mass movements, including the integration of expert bases into forest management plans.

We continue to maintain, implement and interpret existing geotechnical and hydrogeological monitoring of large landslides in the hinterland of Koroška Bela.

Key Scientific Achievements

We continued to identify and characterise active geological structures, including quantify their activity. We published an article on the definition of late Pleistocene activity of the Sava Fault and participated in the evaluation of seismogenic depths and seismicity in Slovenia. We continued with post-earthquake geomorphological, geophysical, and palaeoseismological research of the Petrinja Fault in Croatia, as well as interdisciplinary research activities and seismic history studies of the Raša Fault in western Slovenia. We integrated our earthquake source database into the European earthquake source database to calculate earthquake hazards in Europe.

In the field of geological hazards, we also presented a methodology for determining active landslide-prone areas based on satellite data. Building on the established monitoring system for tracking rockfalls, we continued to analyse the susceptibility of crack formation to geological and meteorological factors.

In basic geology, we highlight an interesting palaeontological study in the field of conodontology and a study on the Pliocene and early Pleistocene development of fluvial sedimentation in the Velenje Basin.

In 2024, GeoZS continued its research into geogenic and anthropogenic factors affecting the chemical and mineral composition of various media, pollution, and the environmental impact of industrial activities in the past.

We studied the content of heavy minerals and rare earth elements (REE) in soil and moss to establish a key baseline for distinguishing between geogenic and anthropogenic sources of substances, as well as identifying indicators of the geological substrate in cultivated soil.

We also highlighted research on the chemical composition of honey, in which traces of geological background have been identified. At GeoZS, we attach particular importance to the research of modern pollutants in groundwater, including research on microplastics in the geosphere and research on the spread of pollutants in urban environments.

During the last two years, GeoZS has begun to focus on marine geology and geological research in archaeology, where we expect to see further development of our research work.

Investment in Research Equipment

In 2024 we made the following major purchases of research equipment with a total value of EUR 914,765.62:

- Confocal Raman microscope with an interface for in-situ SEM-Raman analysis
- Laser particle measurement system and dynamic image analysis system
- Geoelectric measurement system
- SIP-COMPACT-S – Instrument for measuring the impedance of sediments and rocks

In 2024, GeoZS conducted 21 research projects, participated in 27 international projects, and supported the state with public services and key expertise. We invested more than €900,000 in research equipment.

Research Projects in 2024

Project Type	Lead Partner, Coordinator	Participant, Partner	Total
Scientific Research Activity 2024 (stable financing)			
Infrastructure pillar – ISF			
Infrastructure programme ARIS	1	0	1
Programme pillar – PSF			
Research programmes ARIS	4	0	4
ARIS young researchers	8	0	8
Scientific Research Activity 2024 (other financing sources)			
Basic research projects	5	3	8
Applied research projects	0	1	1
Post-doctoral research projects	3	0	3
Targeted research programmes (ARIS-MKGP; ARIS-MOPE; ARIS-MORS)	3	6	9
Research projects for European Structural and Investment Funds (European Regional Development Fund (ERDF), the European Agricultural Fund for Rural Development (EAFRD) and the Recovery and Resilience Plan (RRP))	1	4	5
Internally supported projects (development pillar)	12	0	12
Public Services and Expertise			
Public Mining Service (MzIP)	1	0	1
Public Services and Expertise (ARSO, DRSV, MOPE, MKGP, MORS)	24	0	24
Commercial Projects			
Commercial projects total	80	0	80
International Projects			
Framework programme (Horizon 2020, Horizon Europe, MSCA and COST)	0	8	8
Other centralised projects (DG INTPA, LIFE, EIT RawMaterials, EASME)	1	5	6
Decentralised projects (Interreg – European territorial cooperation)	0	9	9
Other international projects (EEA and Norway Grants, ESA)	3	1	4
TOTAL	**146**	**37**	**183**

02

Event Highlights in 2024

We strengthen the importance of geoscience by organising events and fostering collaboration.

March

PanAfGeo-2 training on Mineral Resources Assessment in Kitwe, Zambia, 11-21 March 2024

GeoZS experts in the field of mineral resources, Dr. Duška Rokavec and Emil Pučko, participated as instructors in a workshop that made an important contribution to the development of knowledge in the field of mineral resources in Zambia. They shared their experience with 20 African colleagues who participated in the training.

The training provided an opportunity to learn about the latest trends and approaches in the exploration and exploitation of mineral resources, which has contributed significantly to the further development of this very important economic area for Zambia.

The workshop was hosted by the Portuguese National Laboratory of Energy and Geology (LNEG) and in collaboration with colleagues from the Polish geological institute.

Consultation on the implementation of the EU Regulation on establishing a framework for ensuring a secure and sustainable supply of critical raw materials in Ljubljana, 29 March 2024

The consultation was organised by the Ministry of Natural Resources and Spatial Planning of the Republic of Slovenia in collaboration with GeoZS. At the consultation, representatives of the Ministry of the Economy, Tourism and Sport and the Ministry of Higher Education, Science and Innovation presented activities related to the implementation of the upcoming regulation.

GeoZS presented the potential of primary critical raw materials in Slovenia, an initiative to establish a European International Centre of Excellence for Sustainable Resource Management, and examples of good practices in mineral resources exploration from other EU countries. The Slovenian National Building and Civil Engineering Institute presented secondary resources as a possible source of critical raw materials. The National Institute of Chemistry, the Regional Development Agency of Gorenjska, and the non-governmental organisation Focus also presented their activities.

April

GeoZS Awards and Honorary Titles Ceremony for outstanding Scientific Research and Development Achievements for the period 2022–2023

On World Earth Day, 22 April 2024, GeoZS presented awards outstanding scientific and research achievements in geology for the 2022–2023 period. The Mark Vincenc Lipold Medal for long-standing outstanding scientific research achievements in geology was awarded to Prof Dr. Andrej Gosar, director of the Seismology Office at the Slovenian Environment Agency, who has also served as full professor at the Faculty of Natural Sciences and Engineering, University of Ljubljana, since 2013. The recipients of the Mark Vincenc Lipold Plaque for outstanding scientific research achievements in geology were Dr. Petra Jamšek Rupnik, Dr..Luka Serianz and Dr. Martin Gaberšek, all researchers at GeoZS. The Slovenian Geological Society (SGD), which has been closely associated with GeoZS since its establishment in 1951, received an honorary certificate for its merits in developing cooperation with GeoZS and for its significant contribution to promoting the social importance of geological research activities.

April

Training on the use of the United Nations Framework Classification for Resources (UNFC) in Ljubljana

As part of the GSEU (Geological Service for Europe) project, the European International Centre of Excellence for Sustainable Resource Management (EU ICE SRM) team organised a three-stage training session for experts from European geological institutions on the use of the United Nations Framework Classification for Resources (UNCF) (Train-the-Trainer programme). The training was aimed at using the UNFC classification for reporting purposes under the Regulation, and training experts to transfer knowledge at national level. GeoZS hosted a meeting of lecturers in March, a hybrid workshop in April and two workshops at our premises in May and June 2024. A total of 44 participants from 20 European countries took part, as well as observers from the United Nations Economic Commission for Europe (UNECE).

Final conference of the project INFO-GEOTHERMAL in Lukovica, 25 April 2024

For the final conference of the project, we hosted Marko Koprivc, State Secretary responsible for cohesion policy at the Ministry of Cohesion and Regional Development of the Republic of Slovenia. We presented activities involving more than 120 Slovenian experts and local community representatives, along with more than 30 colleagues from Europe and the USA. One of the key achievements of the project is the new 3D geothermal model viewer for northeastern Slovenia, which provides easier access to subsurface information essential for new investments. We also presented proposals for new geothermal investment initiatives.

Using the example of three pilot municipalities (Beltinci, Turnišče, and Dobrovnik), we highlighted the challenges posed by the construction of new geothermal wells and sustainable industrial greenhouses, as well as the need to better position the geothermal sector within the energy sector. We submitted concrete proposals for eliminate inconsistencies between laws governing the use of thermal waters and emphasised the importance of the continued operation of the interdisciplinary group for geothermal energy and the new geothermal association for faster development of the sector in Slovenia.

Consultation on the use of space technologies during natural disasters, 22 April 2024

GeoZS, together with the Faculty of Civil Engineering and Geodesy, University of Ljubljana, GeoCodis, and the Ministry of Defence, organised a workshop titled "Use of space technologies during natural disasters". The workshop aimed to familiarise participants with existing EU and ESA services for supporting the assessment of the extent of natural disasters and to present the EO4MASRISK project. During the workshop, a discussion was held on the challenges and the need to establish a geoinformation centre for natural disasters, which would support crisis management using remote sensing data. The workshop was attended by representatives of government authorities, data providers, developers, field experts, educational institutions, and users of space technology data. The discussion concluded that the proposal to establish a geoinformation centre for natural and other crisis situations should be submitted to decision-makers in the relevant ministries and the Government of the Republic of Slovenia.

May

June

10th Neogene Meeting of the NCSEE, Podčetrtek, May 27–31, 2024

Together with the Ivan Rakovec Institute of Palaeontology, part of the Scientific Research Centre of the Slovenian Academy of Sciences and Arts (ZRC SAZU), GeoZS organised the 10th anniversary Neogene workshop of NCSEE (Neogene of Central and South-Eastern Europe) in Podčetrtek. The meeting takes place every two years and brings together researchers in sedimentology, palaeontology, stratigraphy and structural geology, who study the development of the Central and East Paratethys, the Mediterranean, and the Pannonian Basin. The event was attended by university students, young researchers, experienced scientists and retired geologists from eleven countries. In addition to lectures and poster presentations, the event also included palaeontological workshops and an excursion that included a tour of outcrops in the vicinity of Rogaška Slatina and Podčetrtek.

Dr. Tea Kolar Jurkovšek became an honorary member of the Geological Society of America

The Geological Society of America selected our researcher Dr. Tea Kolar Jurkovšek as the honorary member of 2024. Honorary membership is awarded to geologists who have made outstanding and internationally recognised contributions to geological science over many years and have communicated their research findings to the wider community.

The selection of Dr. Tea Kolar Jurkovšek as an honorary member is based not only on her research achievements, but also on her commitment to research integrity and adherence to high ethical standards in geoscience.

PanAfGeo-2 Geothermal training in Uganda, 24-29 June 2024

Dr. Nina Rman and Dr. Mitja Janža, members of the groundwater department, participated in the training of geologists from fifteen African countries, which took place in Uganda as part of the PanAfGeo-2 project. In collaboration with colleagues from the Polish geological institute PGI-NRI, they presented to students the possibilities for using geothermal energy, and carried out a series of field studies in the vicinity of Hoima. The PanAfGeo-2 project strengthens international cooperation and transfers important knowledge for sustainable development on the African continent.

August

37th International Geological Congress in Busan, South Korea, 25-31 August 2024

Representatives of GeoZS attended the 37th International geological congress IGC2024, which took place at the end of August in Busan, South Korea, where they participated in the congress section entitled Bridging geoscience & policy: land use planning, data and digitalisation for a better future and at the meeting of the World Community of Geological Surveys (WCOGS).

The global meeting of geologists, hosted by the International Union of Geological Sciences (IUGS), was organised by the Geological Society of Korea, the Korean Institute of Geoscience and Mineral Resources, and the City of Busan.

September

Adria Innovation Day at the TBMCE 2024 conference in Portorož, 4-6 September 2024

In 2024, the traditional annual event for the raw materials innovation ecosystem and all stakeholders in the knowledge triangle of Slovenia, Croatia, and the Western Balkans – Adria Innovation Day – was combined with the Technologies and Business Models for the Circular Economy (TMBCE) conference, an international scientific research, expert and development conference organised by the Faculty of Chemistry and Chemical Engineering at the University of Maribor in collaboration with SRIP – Circular Economy. By linking the two events, synergies were achieved, expanding the circle of active stakeholders, and increasing awareness of the importance of the raw material value chain in the circular economy sector.

The EIT RawMaterials RIS Hub Adria hosted an expert panel at the TBMCE conference, dedicated to the adopted European Regulation on critical raw materials, which also introduces an obligation to recycle 25% of critical raw materials consumed annually in the European Union.

October

Improving Water Resource Management Capacity Project workshop, 2 October 2024

In cooperation with the Jožef Stefan Institute, GeoZS hosted a national workshop on Improving the Capacities for Managing Water Sources on 2 October 2024. The aim of the workshop was to share experiences and good practices for establishing a network for the systematic monitoring of the isotopic composition of the water cycle in Slovenia, and to develop a public database for associated data. The workshop was attended by 39 water resource managers, researchers, experts, and students, as well as representatives of the Permanent Mission of the Republic of Slovenia to the United Nations, the OSCE and other international organisations in Vienna, the Slovenian Nuclear Safety Administration, the Ministry of Natural Resources and Spatial Planning, the Ministry of Foreign and European Affairs, and guests from Hungary, Malta, and the International Atomic Energy Agency.

Presentation of the draft EuroGeoSurveys SRIA's Goals & Priorities and SRIA's Experts Dialogues: a Geological Service for Europe, in Brussels, October 16 - 17, 2024

The October meeting of the GSEU (Geological Service for Europe) project team, for which GeoZS is an important partner, was focused on discussion of the draft Strategic Research and Innovation Agenda (SRIA). Jasna Šinigoj and Dr Mateja Jemec Auflič represented GeoZS during the panel discussion on "Subsurface Digital Transition" and a presentation of the SRIA objective "Managing Environmental Risks & Geohazards".

November

EIT Community RIS HUB Slovenia established, 7 November 2024

The European Institute of Technology (EIT) has established its latest EIT Community RIS Hub in Slovenia. The Ljubljana University Incubator (LUI) has been assigned to host the hub. The new EIT Community RIS Hub will serve as a central point for connecting leading companies, educational and research institutions, as well as local talent, providing them with access to numerous resources in the fields of education, entrepreneurship, and innovation. The purpose of the centre is to reduce regional disparities in innovation performance, increase Slovenia's competitiveness, and contribute to sustainable economic growth. The opening event, held on 7 November 2024 at the University of Ljubljana, was attended by partners, stakeholders, startups, and entrepreneurs. GeoZS participated in the event as representatives of the EIT RawMaterials RIS Hub Adria, which they manage in Slovenia in collaboration with the Slovenian National Building and Civil Engineering Institute and LUI.

Consultation on the potential, use, transport, and storage of CO_2 in Slovenia, November 21, 2024

In cooperation with the SRIP – Circular Economy network (Strategic Development and Innovation Partnership – Networks for the Transition to a Circular Economy), GeoZS held a consultation on the potential for the capture, use, transport, and storage of CO_2 in Slovenia, which focused on a long-term vision for the circular use of CO_2, methods of transporting captured CO_2, cross-border cooperation, financial and fiscal mechanisms, and the preparation of a carbon management strategy.

November

Geochemical properties of the water and sediments of the Mura river, 29 November 2024

At the end of November, as part of the MURmap GeoZS project, an expert event entitled Geochemical Properties of the Water and Sediments of the Mura River, with an emphasis on modern pollutants, was held in Radenci. 25 participants including project partners, guests, and various stakeholders attended the event, which presented the main results of the project, led by GeoZS in collaboration with the University of Leoben and the National Institute of Chemistry. Partners from the Institute of the Republic of Slovenia for Nature Conservation, Maribor Regional Unit, participated in organising the event. Attendees were introduced to the research equipment used in the project, as well as other tools used by geologists and chemists in their work.

December

European Raw Materials Week in Brussels, 9-13 December 2024

During the European Raw Materials Week in Brussels, the importance of a common geological service for Europe was emphasised, to ensure Europe's resilience in the sustainable supply of critical raw materials. Representatives of GeoZS attended the event, with Dr. Slavko Šolar presenting the Critical Raw Materials Act (CRMA) and the section relating to the United Nations Framework Classification for Resources (UNFC), while Dr. Meta Dobnikar and Snježana Miletić presented the European International Centre of Excellence for Sustainable Resource Management (EU ICE SRM), which is being established as part of the Geological Service for Europe, as well as the Train-the-Trainer programme to support the implementation of the CRMA at the national level.

International Expert Forum and second project meeting of the AIMS Project, Ljubljana–Koroška Bela, December 10–12, 2024

As part of the AIMS project, which is developing and testing a model for predicting landslides using AI tools, a project meeting was held in Ljubljana, an international expert forum in Jesenice, and a field trip to landslides in the Koroška Bela area. The events were attended by experts from seven countries in the Adriatic-Ionian region. Pilot locations in all participating countries were presented, along with the challenges inherent in landslide monitoring and the possibilities for using machine learning in forecasting and risk assessment.

03

About *GeoZS*

Our core values are intellectual freedom, research integrity and the creation of an inclusive environment in which we can address the needs of society and our business partners.

Mission

The fundamental task of GeoZS is to conduct basic and applied research in the field of geoscience, with the aim of gaining a precise understanding of the geosphere—its origin and history, physical and chemical structure, its dynamics and interactions with the hydrosphere, biosphere, cryosphere, atmosphere, and, increasingly, the anthroposphere. At GeoZS, we collect and interpret data, presenting it in the form of published research findings, including fundamental and thematic geological maps and models, as well as expert reports and studies. Our information is disseminated to the industrial sector, policy-makers, and the public. Based on the results of our research, GeoZS provides expertise and technical advice to support sustainable land use, responsible natural resource management, and the maintenance of a healthy and safe living environment on Earth. A comprehensive understanding of the Earth in its broadest sense is crucial for the well-being and prosperity of humanity.

Vision

Geological research, the data obtained, and their interpretation play a key role in planning the future development of human society in harmony with the Earth's capacity and limited natural resources.

Based on fundamental and applied research and expertise, GeoZS supports national and European decision-makers in all activities related to sustainable and environmentally friendly management and planning of land use on and below the Earth's surface, including the use of natural resources, vulnerability and risk assessment, and ensuring a healthy and safe living environment.

We will continuously provide the critical mass of knowledge, research capabilities and capacity, data and equipment needed to fulfil this role.

Ethics and Integrity in Science

GeoZS is committed to upholding the highest standards of ethics, integrity, and equal opportunities in research. We understand research ethics as fostering a respectful and accountable approach towards society, ecosystems, cultural and natural heritage, and the environment. Integrity in research also includes an unwavering commitment to reliability, honesty, and responsibility in the design, conduct, publication, and reporting of research, nurturing respectful relationships between colleagues, and the utmost sense of responsibility to the profession and society.

At GeoZS we build relationships based on trust, transparency, and professional credibility. We operate in accordance with the ethical standards in geoscience adopted by the International Association for Promoting Geoethics. Remaining true to the principles of geoethics, we uphold our values whilst recognising our role and responsibility to society as a whole, while adhering to the European Code of Conduct for Research Integrity. In 2024, we continued to prepare the GeoZS Code of Ethics and Integrity, with the involvement of the whole staff team. The draft was discussed by the Scientific Council and adopted by the GeoZS Management Board in early 2025. It includes recommendations in line with the European Code of Conduct for Research Integrity and will help achieve our set goals, enhance the reputation of GeoZS, and contribute to the development of the research environment.

Our core values include intellectual freedom, research integrity, and the creation of an inclusive environment that is sensitive to the needs of the broader society and our business partners.

The target-specific results of our endeavours aim to foster sustainable development and a circular economy, mitigate the effects of global environmental and climate change, and reduce and manage natural hazards and those caused by anthropogenic interference in the natural environment.

Through continuous learning we deepen our expertise and improve our professional knowledge, enabling us to achieve a professional recognition and competency in international research projects, which in turn fosters and maintains the trust of our business partners.

GeoZS promotes ethics, research integrity, and sustainable development in an inclusive environment.

Creating a Value Chain

GeoZS is a research organisation that provides expert knowledge and technical advice, based on the results of its own scientific research, to ensure the sustainable of space, the sustainable management of natural resources, and the creation of a healthy and safe living environment on Earth.

Input GeoZS Capitals for implementing activities	Activities Activity Examples	Output Output Examples	Outcome Outcome Examples
Social Capital	Scientific research projects, the provision of public and expert services, and commercial projects	183 implemented projects (146 as leader, 37 as partner)	Providing key data and expert support for the safe management of natural resources, spatial planning, protection against natural disasters, health and environmental protection, and the supply of drinking water. Stakeholder/client satisfaction: 5 (of 5)
Intellectual Capital	In-house knowledge development	Patents and internal innovations, data platforms, citation index, ISO 9001:2015	Publicly accessible scientific publications, collected geological data
Human Capital	Human resources management	132 employees	Employee satisfaction = organisational climate 3.3 (of 5)
Natural Capital	Activity implementation	Completed projects	Reduction of environmental impacts in accordance with the implemented projects
Production Capital	Investments	Procurement of research and laboratory equipment	Modern infrastructure for the efficient completion of projects
Financial Capital	Financial resource management	Surplus of income over expenses generated	Development of activities, enabling mission fulfillment

Management and Organisational Structure

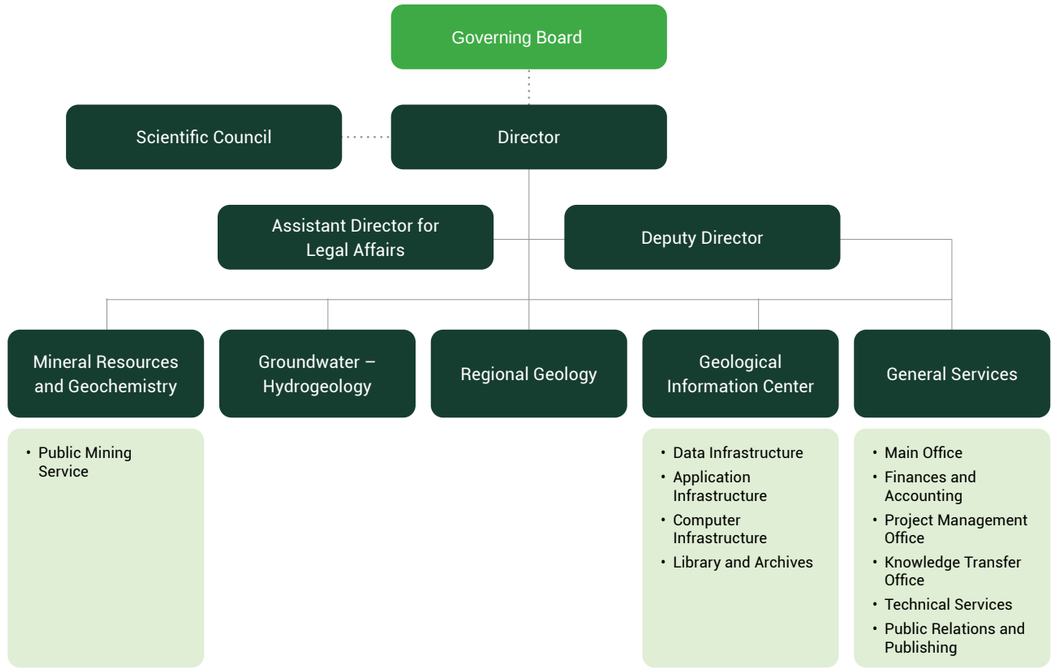
GeoZS is governed by a seven-member Governing Board. Three members are appointed by the founder, the Government of the Republic of Slovenia; one is appointed by the ministry responsible for science, one by the ministry responsible for the environment and the third by the ministry responsible for mining. Three members are appointed by the GeoZS Scientific Council from among the survey's users or the interested public.
The final member is elected by the staff from among themselves.

GeoZS is led by a director who serves as both leader and representative. The survey is organised into five departments: the Geological Information Centre, Mineral Resources and Geochemistry, Groundwater – Hydrogeology, Regional Geology, and General Services. The Public Mining Service operates within the Department of Mineral Resources and Geochemistry.

The Geological Information Centre manages the Application Infrastructure, Data Infrastructure, Computer Infrastructure, Archives, and Library. General Services Department comprises the Head Office, Finance and Accounting, Project Office, Knowledge Transfer Office, Public Relations Services and Publishing, and Technical Services.

Serving as the survey's professional body, the Scientific Council convenes to deliberate and make decisions concerning matters related to the survey's professional activities.

The survey has formed research groups representing individual research areas: Basic Geology, Geohazards, Regional Geology, Mineral Resources, Geochemistry and Environmental Geology, Groundwater, Geoinformatics, and GeoEnergy.



Scientific Council

- Dr. Nina Mali, Chair
- Doc. Dr. Gorazd Žibret, Vice-Chair
- Dr. Miloš Bavec, Director, GeoZS
- Dr. Mateja Gosar, Member
- Dr. Mitja Janža, Member
- Doc. Dr. Mateja Jemec Auflič, Member
- Dr. Matevž Novak, Member
- Jasna Šinigoj, Member
- Dr. Klemen Teran, Member

Management

- Dr. Miloš Bavec, Director, GeoZS
- Dr. Jure Krivic, Deputy Director, GeoZS

Department Heads

- Dr. Meta Dobnikar, Mineral Resources and Geochemistry
- Dr. Sonja Cerar, Groundwater – Hydrogeology
- Dr. Klemen Teran, Regional Geology
- Jasna Šinigoj, Geological Information Centre
- Dr. Jure Krivic, General Services

Governing Board

- Mag. Djordje Žebeljan, Chair
  HSE, Holding Slovenske elektrarne, d. o. o.
- Dr. Andreja Umek Venturini, Vice-Chair
  Ministry of Higher Education, Science and Innovation
- Mag. Katja Buda, Member
  Ministry of the Environment, Climate and Energy
- Marko Fatur, Member
  LUZ, Ljubljana Urban Planning Institute, d. d.
- Tatjana Dizdarević, Member
  Public Institute of the Idrija Mercury Heritage Management Centre
- Jurij Crnkovič, Member
  Ministry of Natural Resources and Spatial Planning
- Doc. Dr. Nina Rman, Member
  GeoZS

Membership of Organisations and Associations

Due to the nature of its work, GeoZS depends on building and strengthening its network of partners, both domestically and internationally. Through successful cooperation in high-quality partnerships, we increase our contribution to societal development and strengthen our international reputation. Responses to key challenges in science and societal development are no longer divided into individual scientific disciplines, which is why we are increasingly focusing on expanding interdisciplinary partnership networks..

EGS	EuroGeoSurveys
IUGS	International Union of Geological Sciences
WCOGS	World Community of Geological Surveys
EIT RawMaterials	European Institute of Innovation and Technology – RawMaterials
ERMA	European Raw Materials Alliance
RMSG	Raw materials Supply Group
INTRAW	International Raw Materials Observatory
ICL	International Consortium on Landslides
EGEC	European Geothermal Energy Council
GIC	Geoscience Information Consortium
GISIG	Geographical information systems international group
PILA	Crossref
SRIP Circular Economy	Strategic Development and Innovation Partnership of the Network for the Transition to Circular Economy

04

Strategic Direction and Objectives in 2024

By monitoring key performance indicators, we measure the achievement of the set financial and non-financial goals for 2024.

Key Performance Indicators in 2024

The table below shows the key performance indicators used to measure the success of GeoZS in achieving its operational goals for 2024. The indicators relate to all aspects of our scientific and research work, human resources policy, knowledge transfer to society, and the financial aspects of our operations.

Increase in the number of research projects from Slovenian and international sources **32%**	Number of published scientific articles and monographs **56**	Increase in the share of published articles in open-access peer-reviewed scientific publications **9%**
Increase in the number of citations **21%**	Increase in the total number of scientific performance points for employed researchers according to SICRIS **43%**	Growth in the number of scientific research staff **12%**
Number of doctoral students among employees **8**	Number of researchers who are actively included in the education process **11**	Increase in the number of international projects **17%**
Number of commercial projects **80**	Number of public and expert service projects **25**	Doubled investment in research and laboratory equipment **2 ×**

Objectives set, Actions identified to achieve them, and Measurement and Evaluation of Achievements in 2024

Objective	Activities Performed	Measuring Method	Assessment
Securing funding, vital for stability and growth	Timely and high-quality performance of tasks, increased activity in securing assignments on domestic and foreign markets, and cost rationalisation	Financial outcome in the public service area and on the market; ensuring liquidity	GeoZS's financial performance was positive, with 94.4% of planned revenue and 99.7% of planned expenditure achieved, resulting in a surplus of revenue over expenditure of EUR 121,169 before corporation tax. This includes EUR 62,736 from commercial activities (EUR 22,845 more than planned) and EUR 58,433 from public service activities (EUR 472,726 less than planned). The deviation is due to the formation of short-term deferred income for ARIS PSF-O and RSF-O, and to a lesser extent, co-financing of ARIS research projects. For RSF-O, we are still compensating for the delay in the start of stable financing in the first year. For PSF, MR, and co-financing research projects, there were delays due to content-related reasons and the absence of key researchers. Scientific research activities are proceeding as planned, and the compensation plan for time delays is being implemented.
Cultivating cutting-edge science through increased publication and citations	Providing a stimulating, supportive environment for conducting research and ensuring time for preparation of scientific articles	Number of publications and citations	We have increased the number of citations by 21%. The total number of scientific performance points was again significantly increased compared to 2023 (+43%).
Training of Top-level staff	Providing a stimulating, supportive environment for conducting research and implementing exemplary cooperation with higher education institutions	Number of successful doctoral defences and number of young researchers	Staff development proceeded as expected. One young researcher successfully completed her doctoral studies. The deadline for the completion of the doctoral studies was extended for two further young researchers until 2025. We achieved five promotions to higher positions. 6 employees received their research titles for the first time.
Maintaining and increasing visibility in the international and domestic environment – inclusion in new projects with more than 50 percent of newly acquired projects based on submitted applications and bids in the calendar year	Networking with potential partners, monitoring of calls for proposals and submitting high-quality applications to international calls for proposals	Number of newly awarded projects	In 2024, we were awarded 5 projects, of which 1 is for the EU DG INTPA programme and 4 projects for the Interreg programme, with a total value of EUR 4,083,780.09. 14 project applications were rejected and 5 are still pending.
Knowledge transfer to users – at least 3 workshops/meetings for different users (scientific, expert and lay public) and one hosting of geology students at GeoZS	Organisation of workshops and meetings	Number of consultations and workshops organised and conducted for users	We held more than three planned consultations and two major presentations for students.
Continuous organisational optimisation for improved flexibility and streamlined flow of information	Continuous improvement of the interdepartmental information flow (for more coordinated operations) and adapting the organisation to the changing requirements of project implementation requirements (for work process optimisation)	Successful completion of assessment audit in accordance with the ISO 9001:2015 certificate	By continuing to optimise our internal organisation and the use of the information system for project monitoring, we have significantly improved project management. We have successfully completed a control assessment of the quality management system audit in accordance with the ISO 9001:2015 standard.
Improving equipment and expanding infrastructure – replacing as much of the depreciated field and office equipment as possible, purchasing new additional premises at 14 Dimičeva Street	Securing funding and implementing public procurement	New equipment procurement, new investigations and fewer outsourced services	In 2024, we allocated EUR 1,475,253 for the purchase of equipment, means of transport and intangible assets, and EUR 96,089 for investment maintenance, totalling 98.3% realisation of the planned investment expenditure.
Sustaining market activities	Keeping staff well-informed, encouraging the further acquisition of commercial projects	Number and scope of commercial projects	Income from commercial projects was 16% lower compared to 2023. Achieved surplus of revenue over expenditure for commercial activities of EUR 62,736.

Physical, Descriptive and Financial Indicators for Achieving Objectives in 2024

Business objectives	Financial indicators	2024 Objectives	2024 Results
Positive operating result in the accounting period	Statement of revenue and expenditure	Surplus in revenue over expenditure	Surplus of revenue over expenses in the amount of EUR 121,169
Fulfilment of all the public service contractual obligations for ARIS, MNVP, MOPE, ARSO, DRSV and EU institutions.	Review and analysis of the scope of the delivery of services in relation to the plan and contractual milestones	All contractual obligations assessed positively	All contractual obligations assessed positively
Fulfilment of all contractual obligations for market contracts	Review and analysis of the scope of the delivery of services in relation to the plan and contractual milestones	All contractual obligations assessed positively	All contractual obligations assessed positively
Scientific Publishing	Regular publishing of scientific articles Regular reviews of publications and citations of researchers	Increase in the total number of scientific performance points and citations	2540* points taken into account 10,117** citations (10-year period)*
Maintaining and increasing visibility in the international and domestic environment	Percentage of newly awarded projects based on submitted applications and bids in a calendar year	The percentage of newly awarded projects is above 50%	59.33%
Implementation of the research programme defined in the contracts with ARIS	Amount of funding for research and infrastructure programmes	Maintaining the volume of funds	EUR 1,640,955.51
Implementation of market activities	Scope of assignments for commercial clients, revenue/expenditure monitored separately on a monthly basis against the plan	Revenue retention Surplus of revenue over expenditure from commercial activities	The volume of funds raised from commercial projects is 16% lower compared to 2023. Surplus in revenue over expenditure from commercial activities EUR 62,736
Cost-effective operations during the financial year	Cost management	Cost-effectiveness index greater than 1	Cost-effectiveness index: 1.14
High-quality equipment	Equipment upgrades	New equipment in line with planning	Appropriate equipment, new equipment purchased with deviations from the plan
GeoZS reorganisation	Continuation of the reorganisation process	Further steps in towards optimal organisation	Successfully passed the ISO 9001:2015 audit.
Organisational climate	Staff evaluation	Score at least 3 out of 5	3.3***
Exemplary cooperation with relevant trade unions	Trade union score	Score at least 3 out of 5	5
Ensuring solvency	Prudent business management	Sustainable solvency	Solvency guaranteed
Client satisfaction	Client satisfaction score	Score at least 4 out of 5	5
Maintaining international cooperation	New project applications	Apply for at least 10 international projects	11 projects applied for

* Points according to the ARIS criteria for researchers employed according to the SICRIS records as of 3 February 2025.
** Number of citations according to the SICRIS records as of 3 February 2025.
*** In 2024, we analysed the organisational climate using a different methodology than in prior years, therefore a direct numerical comparison with previous measurements is not possible. The methodology will likely change in 2025 as well. We are preserving the score of 4.0 for 2022 as an orientational quantitative target value (2023: 3.9)..

The last analysis yielded the following indicative results:

- eNPS – the indicator of the overall engagement, affiliation and satisfaction of employees is 16% on the scale from -100% to 100%. This value is informatively converted to 3.3 on the scale of 1-5
- the atmosphere indicator is 68% on the scale from 0 to 100%. This value is informatively converted to 3.4 on the scale of 1-5
- the compliance of motivational factors indicator is 81% on the scale from 0 to 100%. This value is informatively converted to 4.05 on the scale of 1-5.

Comparison of Key Performance Indicators between 2023 and 2024

Indicator	2023	2024
Financial result in EUR	72,510	121,169
Total number of scientific performance points*	1737.29	2540**
Citation index (10 years)	8824	10117***
Number of financed young researchers	10	10
Number of successfully completed doctoral programmes	2	1
Number of ARIS projects implemented	17	23
ARIS funding in EUR	3,933,084.16	4,771,987.92
Number of international projects implemented	26	32
Revenue from international projects in EUR	1,262,243	932,194
Performance of public funding in EUR	18,845	58,433
Performance of commercial activity in EUR	53,665	62,736

* The number of points in the 2023 annual report differs. The difference is attributed to changes in the JCR data used by SICRIS to calculate the points, which are subject to a mid-year adjustment for the previous year, and to departures/retirements of researchers.

** Points according to the ARIS criteria for researchers employed according to SICRIS records as of 3 February 2025.

*** Number of citations according to the SICRIS records as of 3 February 2025.

05

Employees

The fulfilment of GeoZS' s mission relies on a highly educated and motivated workforce operating in an inclusive and pleasant work environment. Through continuous training, we support the professional and personal development of our employees.

Employee Data

At the end of 2024, GeoZS employed 132 staff members, with a total of 127.4 FTE, achieving the planned number of employees for the end of the year.

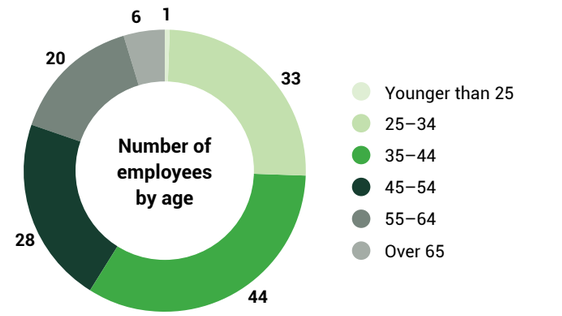
The number of employees increased slightly at the end of 2024 compared to 2023, both among researchers and within the groups of experts and support staff. The number of young researchers decreased by one, while the number of personnel in the management bodies and administrative and other professional and technical staff groups remained the same. According to the plan, the number of employees on 31 December 2024 remained unchanged in the groups of management, researchers, young researchers, experts, administrative workers, and other expert technical workers. The planned number of researchers was reduced by two, while the number of employees in the support team increased by two compared to the plan.

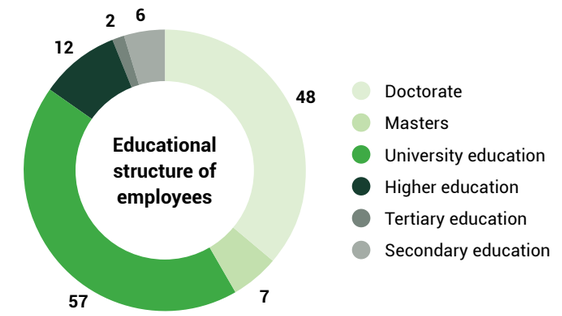
At the end of 2024, GeoZS employed 22 more women than men. Women lead in the groups of researchers, young researchers, experts, and the support team. There are more women than men in both the group of younger researchers and the group of older researchers. More women than men hold scientific titles, while more men than women hold scientific research and development titles.

On 31 December 2024, GeoZS employed 55 researchers in H01 group positions, of whom 34 were women and 21 were men. Together with researchers in other job groups, there were 65 researchers employed, namely 40 female researchers and 25 male researchers.

Number of employees by gender

All employees		Researchers	
Women	77	Women	40
Men	55	Men	25





Ensuring Gender Equality

To ensure equal opportunities for both genders even more effectively, GeoZS follows the Action Plan for the Promotion of Gender Equality. This area is also regulated by the Rules on Employer Measures to Protect Public Servants from Sexual and Other Harassment and Bullying in the Workplace. The Action Plan is updated annually by the Gender Equality Group. Its content is determined on the basis of research into broader social factors that affect the opportunities of researchers in Slovenian society and a study of the specific features of the organisational structure, culture, and prevailing practices at GeoZS. Achieving its goals leads to even greater gender equality at GeoZS. It addresses five thematic areas:

- Work-life balance
- Balanced representation of genders in leadership positions and in the recognition of scientific excellence
- Equal opportunities in employment and career advancement
- The use of gender-inclusive language in official documents, research and promotional materials
- Measures to prevent violence (raising awareness regarding gender equality).

For each of the thematic areas, activities necessary to achieve the strategic objectives and indicators to measure the effects of the activities are defined.

The use of gender-inclusive language in official documents, research and promotional materials is increasing. We used gender-inclusive language in revising documents during 2024 where it was not already present. New documents already include gender-inclusive language.

Employee Satisfaction at Work

Based on the analysis of the employee satisfaction survey, carried out at the end of 2024, we can say that the majority of employees, of both genders, are satisfied with the conditions in the workplace. The results showed that employees are most satisfied with flexible working hours, which facilitates their work-life balance, as well as with alternative ways of working.

06

Review of Activities in 2024

Using our research and professional experience, we support national and European stakeholders in all activities related to the sustainable and environmentally sound management and planning of land use on and beneath the Earth's surface.

Scientific Research Projects

The basis and foundation of GeoZS operations are high-quality scientific research, followed by the transfer of knowledge into practical applications. Research focuses on fundamental geoscience, applied studies, and the development of innovative methodologies.

Fundamental geological research forms the basis for understanding natural processes and phenomena, providing appropriate scientific explanations and transferring useful knowledge to applied projects. At GeoZS, we strive to strengthen the position and importance of fundamental knowledge, follow the principles of open science, and continuously increase the quality and citation rate of our scientific work.

Scientific research is the core activity of GeoZS, underpinning and connecting all its operations. It encompasses cutting-edge scientific research, expert and high-quality implementation of applied studies, investigations and expert assessments based on the results of scientific research, the strengthening of international cooperation through research, commercial, and other projects, and the effective transfer of newly generated knowledge into practice for the needs of state and local authorities and economic entities. The scientific and professional research programme focuses on the development and implementation of geoscientific research aimed at addressing societal challenges and needs that depend on a sound understanding of the Earth's surface and subsurface.

The main framework for conducting fundamental research, enhanced by GeoZS through national and international research projects, consists of GeoZS research programmes and programme groups. Our guiding principle is to maintain and, in accordance with legal frameworks, gradually upgrade the stable financing of programme pillars and continuously increase the scientific excellence of researchers, reflected in a greater number of high-quality scientific publications, publications in influential journals, and the number of scientific citations. We intend to allocate a significant portion of the development pillar of financing towards the development of basic research. In the context of scientific research, we strive for the greatest possible public accessibility and adherence to the principles of open science when publishing research results.

The foundation of GeoZS' s work is high-quality scientific research and the transfer of knowledge into practice.

Organisation of Scientific Research activities at GeoZS

Strategic Thematic Research Areas

Environmental change and quality of life

Geohazard – geologically-induced hazards

Energy transition and the use of carbon-free resources

Sustainable use of mineral and energy resources

Digital transformation with the goal of a digital twin

Research Programmes

Regional geology

Groundwater and Geochemistry

Mineral Resources

Dynamic Earth

Infrastructure Programme

Strategic Thematic Research Areas

Fundamental geological research, including palaeontology, mineralogy, petrology, sedimentology, stratigraphy, geological mapping, the creation and preparation of various maps, and structural geology, forms the basis for understanding natural processes and phenomena, providing appropriate scientific interpretation and transfer into useful knowledge and practical applications. Fundamental geological research underpins the five strategic thematic research areas defined in the GeoZS 2030 Strategy. Therefore we strive to strengthen the position and importance of the fundamental knowledge on which all our products are based.
To enhance the quality of our results, we have established the GeoZS Research Fund, which is primarily intended to integrate the fundamental and specialised knowledge within GeoZS.

GeoZS's strategic directions in the field of scientific research are therefore classified into five thematic areas in accordance with the GeoZS 2030 Strategy, reflecting the global and European challenges of our time.

Environmental Change and Quality of Life

GeoZS recognises current environmental issues and seeks solutions through multidisciplinary collaboration and active cooperation in the formulation of policies that will enable a cleaner environment, clean air, an uncontaminated drinking water supply, preservation of soil quality, improved quality of life, and the provision of geothermal energy sources for sustainable food production.

A crucial aspect of addressing environmental issues is having a thorough understanding of the natural background environments which is why we strive to characterise them in both natural and urban environments. We will expand our research on pollution from classic to modern pollutants, which are on the rise, and include microplastics, organic pollutants, and technogenic elements. We will comprehensively study the material flow of pollutants between different mediums as well as the processes that influence their distribution and occurrence. We already devote considerable attention to the quantity and quality of groundwater, as it is vital for Slovenia's drinking water supply. Studying the catchment areas and the factors that affect them, as well as cooperating with relevant institutions in adopting measures for their protection and monitoring, play an important role.

Research Projects on Environmental Change and Quality of Life

GeoZS as the leading partner in national research projects

Past climate change and glaciation at the Alps-Dinarides junction
led by Dr. Manja Žebre, 9/2020–8/2024

NFormerly glaciated mountain landscapes are increasingly recognised as important archives for studying climate change during the Quaternary. The European Alps are among the regions where geological markers of past glaciations are extensive and well-researched. However, this is not the case for the south-eastern corner of the Alps and the neighbouring northern Dinarides. In this project, we have enhanced our understanding of past dynamics in relation to climate change at the Alps–Dinarides junction by combining fieldwork and model-based approaches. In particular, we have examined the spatial-temporal patterns of glacier fluctuations during the last Ice Age, the influence of different geological substrates on subglacial conditions and glacier dynamics, and the past climate conditions that drove glacier growth and recession. Overall, this project has yielded new insights into the influence of Pleistocene and Holocene glaciers on landscape formation and how they responded to past climate variability.

MURmap – Holistic geochemical tracking of inorganic pollutants in the Mura River catchment
led by Doc. Dr. Gorazd Žibret, 1/2018 12/2024

The MURmap project, in which GeoZS partnered with the University of Leoben, Austria, and the Slovenian National Institute of Chemistry, aimed to provide a comprehensive overview of the geochemical composition of the water and sediments of the River Mura and its tributaries. Mining, industrialisation, urbanisation, and intensive farming have strained the environment in the past, and, today, modern technological development, especially in telecommunications, medicine, and green technologies, relies heavily on the use of technology-critical elements (TCEs), which include rare earth elements (REEs) such as yttrium, titanium, niobium, tantalum, and indium etc. We determined the natural geochemical background of the river basin, the influence of different lithological units on the elemental and isotopic composition of water and sediments, the historical and possible current anthropogenic sources of elements in the environment, and the differences in the elemental composition of water and suspended sediments between different water regimes.

Karst3Dge – 3D Geological modeling for unveiling the Cenozoic evolution of the contact between the Adriatic microplate and Dinarides and the structural influence on groundwater occurrence at the Kraški rob area
led by Dr. Ana Novak, 11/2021–12/2024

The steady convergence of the Adriatic and Eurasian plates has been, and continues to be, the driving force behind many significant geodynamic events and mountain formations in the wider Adriatic region. During the Cenozoic, this convergence led to a compression phase that formed the Dinaric fold-and-thrust belt. At the end of the Miocene, the external Dinarides experienced an additional contraction episode, which persists today. Although considerable research has focused on Cenozoic compression in the Dinarides, the distinction between the different compression phases and the assessment of contractions in this mountain range remain debated. This post-doctoral project aimed to provide new insights into the Cenozoic structural evolution of the Dinarides. The project focused on the area of Slovenian Istria, a key transitional point between the Adriatic plate and the external Dinarides. The study specifically concentrated on the Karst Edge, a prominent geomorphological feature formed between the two units. This area is particularly interesting due to its complex multiphase tectonic history and its significant groundwater reserves, often located at the structurally controlled contact zone between permeable and poorly permeable lithological units.

Use of non-invasive ground-penetrating radar and remote sensing for determining the vulnerability of groundwater to anthropogenic impacts
led by Doc. Dr. Marjana Zajc, 10/2022–9/2025

Diffuse pollution from agriculture is one of the greatest pressures on groundwater. Knowledge of the geological substrate, soil properties, and the dynamics of hydrogeological processes is key to reducing this pressure. Non-invasive GPR and aerial drone data were integrated with hydrogeological parameters, soil pedological analyses, and computer models on selected agricultural land. As knowledge of percolation water chemistry is a prerequisite for understanding the impact of agricultural activities on groundwater quality, percolation water samples from lysimeters were also periodically collected and analysed. Additionally, data on soil water content were collected and statistically analysed using buried dielectric probes. By combining these techniques we were able to generate final spatial models in GIS, including data on the natural characteristics of the areas and on anthropogenic influences on the transfer of contaminants to groundwater.

Development of a warning system for detecting the impacts of military activities on groundwater, financed by ARIS and MORS
led by Dr. Anja Koroša, 10/2023 9/2025

The main aim of the project was the establishment of a warning system to monitor or supervise the potential impact of military training grounds on groundwater and drinking water sources. As part of the warning system, the monitoring of the relevant chemical, bacteriological and isotopic parameters was implemented, allowing for an ongoing assessment of the possible impact of military training grounds on the aquifer system in the hinterland of drinking water sources. The monitoring comprised two components: federal monitoring of the chosen physical-chemical parameters and detailed, more in-depth monitoring of the parameters impacted by military activity in the aquifer area. As part of the in-depth monitoring, we supervised a broader range of parameters that could be characteristic of emissions from military activities or facilities. We identified indicator parameters that are particularly characteristic of military activities. Based on the results gained, the warning system for detecting the impact of military activities on groundwater will be optimised.

EvoQ the past – Evolution of the Pliocene-Quaternary landscape in the south-eastern Alpine foothills (Slovenia): establishing allostratigraphy by employing geochronology, sedimentology and geomorphology
led by Dr. Eva Mencin Gale, 10/2023 9/2025

The main objective of the post-doctoral project was to fill the gaps in the Slovenian Quaternary stratigraphy by formalising allostratigraphy units in the Slovenj Gradec, Nazarje, Celje, Velenje, Drava-Ptuj and Medgorje basins by using morphometric, geomorphological, sedimentological and chronological methods. The project represented the first quantitative chronological study in most of the basins under consideration. The results allow for a correlation of the Pliocene-Quaternary sequence not only in Slovenia, but also around the area of the Alpine foothills. The sedimentation rate and surface uplift calculations have contributed to the field of active tectonics and therefore seismic hazard assessment. In addition, the project results have allowed for the placement of the Slovenian Quaternary stratigraphy within the framework of the entire Alpine orogeny.

GWMicroPlast – Improved methods for determining microplastic transport processes in groundwater
led by Dr. Nina Mali, 10/2023 6/2026

Among modern pollutants, microplastics (MP), are among the most challenging materials to understand in terms of their circulation in the geosphere and their transport through individual geological mediums. The purpose of this research is to improve methods for determining the occurrence, transport processes, and origins of MP in groundwater (GW) sources. Part of the research focuses on innovations in sampling and analysing MP in GW. Special attention is given to the study of the dynamic processes of MP in the unsaturated zone (USZ) of a sand aquifer, with experimental work in a lysimeter. The entire MP pathway is investigated through the aquifer, starting from the source and transport in the NC, and continuing to its detection in GW. The new findings will enable comparisons with available global data and help fill knowledge gaps regarding the MP transport in aquifers. The project introduces several innovations that will stimulate further research into the optimisation and development of new approaches in the pollution of aquifers with MP.

RegTPV v Alpah – Dynamics of regional groundwater flow in Alpine carbonate aquifers: mechanisms, boundary conditions and the impact of climate change
led by Dr. Luka Serianz, 10/2023 9/2025

This postdoctoral project focused on studying the dynamics of gravity-induced regional groundwater flow in Karst–Alpine regions, using western Slovenia as a case study. The aim was to improve understanding of regional groundwater flow dynamics through field investigations, laboratory analyses, and mathematical modelling. The activities centred on developing an innovative methodology for analysing diverse hydrogeological environments and large-scale flow systems, while also considering the potential impacts of climate change on regional groundwater regimes and dynamics. The results contribute to the long-term protection, sustainable management, and improvement of the quantity and quality of groundwater resources in the Alpine region.

Young Researchers

- Miha Marinšek – **Miocene ostracod fauna in eastern Slovenia,** 1/2020–9/2025, mentor Dr. Tea Kolar Jurkovšek

  The main aim of the doctoral dissertation was to determine the structure of ostracod formations in the Sarmatian and Pannonian sediments around Kozjansko, the Krško Valley and Prekmurje. Ostracods are microscopic crustaceans living in various environments, both in water and on land. Ostracods are not only studied by biologists, but also by geologists because their fossils were also found in the late Cambrian period. Previous studies of ostracods in these sediments are rare and partly unpublished. By comparing the sequence of biotic changes, we identified connections between different sedimentation spaces and the wider area.

- Janja Svetina – **Determining the origin points of point and multi-point pollution in a high-volume intergranular aquifer,** 10/2021–9/2024, mentor Dr. Mihael Brenčič

  This doctoral study examined the spread of pollutants in extensive and highly productive, hydrodynamically open aquifers in urban areas, with a focus on transport mechanisms in saturated areas. The thesis focused on groundwater pollution with hexavalent chromium in the Ljubljana Field area. The main objectives of the doctoral dissertation are to research and interpret the extent of contamination in 3D space, to study the main mechanisms of chromium transport in the studied aquifer, and to determine the possible sources of contamination using advanced geostatic methods and modelling.

- Elvira Colmenajero – **The presence and transport of microplastics in groundwater,** 10/2022–9/2026, mentors Dr. Nina Mali, Dr. Manca Kovač Viršek

  The aim of the doctoral thesis is to study the presence and transport of microplastics in groundwater in Slovenia, with a focus on intergranular and Karst aquifers. The research aims to assess the occurrence of microplastics in groundwater and analyse their transport through a unsaturated zone using innovative monitoring and tracking methods. The results will contribute to a better understanding of groundwater pollution with microplastics and to the development of standardised methods for its detection and monitoring.

- Katja Oselj – **Paleobiology of the Middle Triassic conodont species Pseudofurnishius murcianus,** 10/2022–9/2027, mentor Dr. Tea Kolar Jurkovšek

  The aim of the doctoral dissertation is to research how the morphology and functionality of the main element of the fossil conodont food chain and the diet of the conodont species Pseudofurnishius murcianus changed in space and time. The dissertation is focused on defining the morphological differences between elements of this species and on finding connections between these differences and palaeoecological parameters. In addition, it includes an interpretation of the function of this element or its role in the conodont apparatus, as well as the analysis of any changes in the diet of conodont animals through various ontogenetic phases.

- Ivana Perović – **Numerical modelling of groundwater dynamics and transport of modern pollutants in light of climate change,** 8/2024–9/2028, mentor Dr. Anja Koroša

  The aim of this doctoral research is to develop a numerical model for simulating groundwater flows and the transfer of modern pollutants in a granular aquifer under the influence of climate change. The focus is on studying the impact of climate change on groundwater remediation and on the behaviour of pollutants in extreme conditions such as droughts and floods. The results will contribute to a better understanding of these processes and to developing measures for the sustainable management of water sources.

- Lara Mencinger – **Properties of Oligocene and Miocene volcaniclastic rocks and determination of the source magma,** 10/2024–9/2028, mentor Dr. Kristina Ivančič

  Research of volcaniclastic rocks is crucial for understanding geological processes, paleoenvironments and paleogeographic changes. Its properties serve as the basis for further research in hydrogeology, geothermal energy, construction and agriculture. The aim of the doctoral dissertation is to determine similarities between Paleogene and Neogene volcaniclastic rocks, compare them with similar rocks in the broader region (Austria, Croatia, Hungary and Italy) and connect them to the original volcanic activity.

- Barbara Čeplak – **Distribution of the main and trace elements in the sediments of the Mura river with a focus on technologically critical elements,** 10/2021–9/2025, mentor Doc. Dr. Gorazd Žibret

  The central aim of this doctoral thesis was to research the connection between the rock layer, human activities, and the structure of sediments in the fluvial system of the Mura river. Special emphasis is placed on the presence of conventional and technologically critical metals. The sampling of alluvial, suspended and riverbed sediments covered the entire river flow, from its source in Austria to the Slovenian-Croatian border. The study will define the geochemical background and spatial distribution of elements with a focus on technologically critical metals, assess the impact of anthropogenic activities, and examine changes in the structure of suspended sediments under different water regimes. The results will contribute to a better understanding of the impact of modern technology on the environment.

Internally supported research projects

- **MANCA – Microplastics in the geosphere,** Dr. Nina Mali, 1/2024–12/2026

  The project focuses on the development of research into microplastics (MP) in the geological environment and the establishment of a microplastics laboratory at GeoZS. With Dr. Manca Kovač Viršek, working part-time, the project brings together researchers to develop methods for determining the occurrence, transport and origin of MP, with a particular focus on the aquatic environment. The work includes laboratory design, equipment procurement, the development of sampling methods and sample preparation methods, use of a Raman spectrometer, and conducting a tracer experiment in an unsaturated zone. Special focus is given to the prevention of contamination, one of the biggest challenges in MP research, while the introduction of modern technologies contributes to the development of approaches that will also be important in shaping future standards.

- **GEL** – **Development of a laboratory for performing geoelectric measurements,** Dr. Edmundo Gomez, 1/2024–12/2024

  The purpose of the project is to establish the first laboratory for geoelectric measurements in Slovenia, which will allow the use of its results in applied research in various fields (environmental engineering, agriculture, hydrogeology and natural resource management). In the initial phase, research will focus on the interpretation of complex electrical signatures of agricultural soil and in mining waste in order to better understand their petrophysical and hydrological properties.

- **PeatLand (SLO-FIN)** – **Quantification and evaluation of water and nutrient transfer in peatlands,** Dr. Anja Koroša, 3/2024–12/2024

  As part of the project, researcher Dr. Anja Koroša spent a month on a research visit to the Natural Resources Institute Finland in Helsinki and the Joensuu Institute. The aim of the research visit was to visit selected field sites in Finland, become familiar with experimental set up for monitoring nutrient transport and leaching processes at individual pilot locations, and participate in laboratory work. The work provided deeper insight into the complexity and multidimensionality of wetlands, as well as the fundamental hydrological processes within them.

- **PROPERock** – **Comprehensive study of the properties of sedimentary rocks,** Dr. Kristina Ivančič, 3/2024–6/2026

  The PROPERocK project studies the petrographic, palaeontological and geophysical properties of sedimentary rocks in northeastern Slovenia within the Pannonian Basin, considered to be an area with important geothermal and mineral resource potential. Due to the rapid changes in the sedimentary environment during the Neogene, lithological units are unevenly distributed, which makes it difficult to correlate them and understand the geology. The project focuses on determining the geophysical properties of various Neogene aquifer rocks, such as sandstone and limestone, using multidisciplinary methods (sedimentology, geophysics, palaeontology, geochemistry, mineralogy and thermogeology). The analysis of properties such as the mineral composition, texture, porosity, permeability, thermal conductivity and diffusivity, will allow their connection with the sedimentary environment and age of the rocks, and improve understanding of the hydrogeological and geothermal potential in the area.

- **RAVS** – **Development of an automatic water and precipitation sampling system,** Nejc Bizjak, 8/2024–12/2025

  As part of the RAVS project, we are developing an automated sampling system for reliable and systematic water sampling in the field, which will also enable isotopic analyses of the samples taken. The device will be easy to use, robust and adaptable, which will enable widespread use in various fields of hydrogeology. The sampler is intended for sampling ground- surface or precipitation water for all research and projects carried out at GeoZS.

- **ENLIL** – **The dynamics of geochemical processes under the influence of extreme weather events,** Dr. Martin Gaberšek, 6/2024–5/2026

  This project studies the effects of extreme precipitation on the redistribution of pollutants, especially potentially toxic elements, and on changes in their physical and chemical properties and the resulting effect on human health. The test area is the Upper Mežica Valley, which is contaminated with lead, zinc and cadmium and was severely affected during the floods in August 2023. The collected data will be aggregated in a joint database, which will serve as the basis for further geochemical research.

GeoZS as project partner in national research projects

- **HaČloRi – Research activities for the identification and prevention of pollution in the Jelševniščica and Otovec catchment area with a special emphasis on the black olm (Proteus anguinus parkelj) habitat,** Dr. Nina Mali, 10/2021–3/2024

- **Assessment of the potential incineration and co-incineration of waste on human health: a model study using the case of the Salonit Anhovo cement factory,** Dr. Mateja Gosar, 10/2022–2/2025

- **The origin of wine: geoclimatic, microbiological or human construct? The case of Slovenian Modra Frankinja wines,** Dr. Rok Brajkovič, 10/2023–9/2026
- **Digitalisation of Slovenian vineyard terroirs (DigiTerroirSLO),** Dr. Rok Brajkovič, 9/2024–8/2027
- **NaKaVo – Assessment of the impact of farmland irrigation on water quality and the status of water bodies in Slovenia,** Dr. Anja Koroša, 9/2024–8/2026
- **Prevention of environmental pollution due to the release of hazardous substances in facilities that pose a risk to the environment by increasing the resilience of supply chains,** Mag. Joerg Prestor, 10/2024–9/2025

GeoZS as project partner in international research projects

- **PARC – Partnership for the Assessment of Risks from Chemicals, Horizon Europe**
  led by Dr. Špela Bavec, project partner, 5/2022–4/2029

  PARC is a European partnership that combines 200 organisations from 28 European countries and numerous experts working in the fields of environmental and public health research from around the world. A total of EUR 400 million has been allocated for the functioning of the partnership for the next seven years, with half financed by the EU and half by member states. The leading organisation is the French Agency for Food, Environmental and Occupational Health & Safety. (Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail – ANSES). Fourteen Slovenian partners have joined the participating European institutions in the partnership, including state authorities and agencies, health and research organisations, and three external stakeholders, all active in the field of analysing the risk of chemicals. The risk analysis is a combination of risk assessment, risk management and risk communication. At the national level, coordination takes place in the framework of the PARC national hub, coordinated by the National Institute of Public Health. GeoZS, as an associate partner, provides expertise in exposure and risk analysis assessments for certain metals in various mediums such as the ground, dust (house, attic and road dust), and airborne particles in urban environments and former active mining areas.

- **iNNOSED – Innovative sediment management in the Danube River catchment, Horizon Europe**
  led by Dr. Jasminka Alijagić, project partner, 9/2024–8/2029

  iNNOSED is a project within the Horizon Europe programme, with partners from across the Danube region. The project focuses on researching innovative, sustainable and scientifically sound solutions for managing sediments in the Danube River basin. Sediments are often an overlooked part of river systems, but they have a significant impact on living environments and act as socio-economic, environmental and geomorphological resources. They are a source and sink of pollutants and fertile soil, while the material brought forward by torrential floods can destroy affected areas. The iNNOSED project comprises an international consortium of 46 partners and associate partners, including key partners from the DanubeSediment and SIMONA projects; scientists, water managers, innovators and stakeholders from 15 European countries, representing approximately 95% of the Danube river basin, enabling a transnational, cross-sectoral and multidisciplinary approach.

Geohazard – Geological Hazards

The key strategic directions of GeoZS in the coming years include strengthening research and development to identify important spatial and temporal factors influencing the occurrence and development of geologically induced hazards. Activities will be focused on the development of probability models, characterisation, monitoring, analysis, and the central collection of data on geologically induced hazards. We will continue to work for regulations that enable the risks of geologically induced hazard risks to be taken into account in spatial planning and development in Slovenia. Through our research projects, we collaborate with various domestic and international stakeholders, improving research methodology, strengthening internationally harmonised responses to geologically induced events, and introducing new research methods and observations, particularly remote sensing.

Presentation of projects in the field of geohazards – geologically induced hazards

GeoZS as the leading partner in national research projects

ROCKSENSE – Deciphering the sensitivity of rock walls to climate change and freeze-thaw cycles in areas without permafrost
led by Doc. Dr. Mateja Jemec Auflič, 10/2021–9/2025

In this project, we focused on studying the impact of climate change on freeze-thaw cycles as long-term factors influencing rockfall and rockslides in regions without permafrost. We introduced an approach using various methods, including experimental field measurements, observations, and monitoring of rock conditions. These data will form the basis for numerical modelling and simulations using the finite element method, which will help us determine temperature changes during the freezing and thawing cycles. The project results will provide a foundation for developing methodologies to manage risks associated with rockfalls and defining measures to reduce danger and provide early warning of rockfalls. The project has yielded new scientific insights into the effects of climate change in permafrost-free areas, which are rarely the subject of scientific research.

Young Researchers

- Lovro Rupar – **High-resolution geophysical research for the seismotectonic characterisation of active fault structures using ground-penetrating radar and electrical tomography,** 10/2022–9/2026, mentor Doc. Dr. Marjana Zajc

  High-resolution geophysical and tectonic-geomorphological research is being conducted on three important active faults with diverse

tectonic regimes, low deformation rates, and varying compositions and thicknesses of younger sediments, which requires an adaptation of methods and the development of new approaches. The aim is to detect deformations of Quaternary sediments, define the complexity and position of the fault zone, and evaluate the potential for paleoseismological excavations. The results will provide insights into the applicability of individual geophysical methods in different geological environments and their transferability to other faults. The integration of data will help to identify the influence of deformation mechanisms on sedimentation, and the defined seismotectonic parameters will contribute to updating the map of active faults in Slovenia, which is a key source for calculating earthquake hazards – maximum possible magnitude, return period, and probability of surface rupture.

- Aleša Uršič Arko – **Tectonic characteristics of the contact between the Adriatic foreland and the Dinarides in southwestern Slovenia,** 9/2024–09/2028, mentor Dr. Jernej Jež

The Karst edge comprises repeating sequences of Paleogene limestone and flysch rocks where limestones were thrust over softer flysch lates during the structural phases of Dinaric formation. Despite numerous research projects, key questions remain open regarding the temporal and spatial dynamics of the Cenozoic development, the quantification of deformations, and the structural and geological structure of the area. Further research is important to understand the contact between the external Dinarides and the Adriatic plate, and for the appropriate spatial placement of infrastructure in a geologically challenging environment. A focus of the dissertation is the identification and parameterisation of active faults, the connection of fault structures with deformation zones and understanding the dynamics of the area. The study will be based on a rich collection of data obtained during infrastructure construction, geological mapping and recent projects and will build on existing research, including ARSO tasks related to active tectonics and earthquake hazard modelling.

Internally supported research projects

- **ACTIVIST2CRO – Research into active faults in the Žumberak, Vukomeričke gorice and Hrastovica mountains in central Croatia,** Doc. Dr. Petra Jamšek Rupnik, 1/2024–12/2024

  As part of the ACTIVIST2CRO project, Doc. Dr. Petra Jamšek Rupnik conducted a month-long research project at the Croatian Geological Institute in Zagreb. Together with her Croatian colleagues, she researched active faults in the area of Žumberak, Vukomerički goric and Hrastovica Mountain in central Croatia. This research visit is part of extensive joint research projects following the earthquake in Petrinja at the end of 2020. The results of tectonic-geomorphological and shallow geophysical research will contribute to a better understanding of the activities of faults that may pose an earthquake risk to both neighbouring countries.

- **UjMA – Updating the state warning system for landslides after the floods in 2023,** Dr. Tina Peternel, 3/2024–2/2026

  Based on new insights gained from the floods in 2023, the UjMA project aims to update the landslide early warning system (MAPSREM). The update includes upgrading the trigger precipitation volumes to take in the effects of climate change, the inclusion of a new variant (weathering thickness) in the landslide probability map, and adjusting the weighting factors of engineering-geological units, which improves the accuracy and reliability of landslide probability predictions..

GeoZS as project partner in national research projects

- **SLOKIN – Geokinematic model of the territory of Slovenia,** Doc. Dr. Petra Jamšek Rupnik, 9/2020–8/2024

- **Evaluation of hybrid infrastructure for reducing vulnerability to climate change,** Doc. Dr. Mateja Jemec Auflič, 11/2022–10/2025

Energy Transition and Use of Carbon-Free Sources

Through cutting-edge scientific research, we aim to achieve a breakthrough in understanding the potential and use of geothermal energy as an important strategic source for the country's green energy transition and decarbonisation. We seek to expand the use of shallow geothermal energy and higher-temperature geothermal resources, which will replace fossil fuels in heating and cooling to the greatest extent possible. We constantly strive to integrate and transfer scientific findings into applied projects, and thus to test innovative solutions.

With our experience, credibility and knowledge, we are the central driver of a comprehensive assessment of the potential and optimal use of geological energy in Slovenia. We will focus our activities on developing a long-term national strategic vision for the green energy transition and the use of carbon-free sources.

Presentation of projects in the field of Energy Transition and the Use of Carbon-Free Sources

GeoZS as the leading partner in national research projects

GeoCOOL FOOD – Cold food storage using shallow geothermal energy, financed by ARIS and MKGP
led by Doc. Dr. Nina Rman, 10/2022–9/2025

The overarching objective of GeoCOOL FOOD is to develop, through an interdisciplinary approach combining geology, biology, technology, energy and management, a methodology for assessing the potential of shallow geothermal energy (SGE) in constructing new or redesigning existing cold storage facilities for vegetable farming. By designing SGE systems that are best suited to local natural conditions, and selecting the most appropriate technology, we can provide economically viable solutions to increase energy and food self-sufficiency. This could translate into lower prices of local products for the end consumer. To achieve this, we identified existing cold storage facilities operated by farms, cooperatives and interest groups, focused on measuring the energy needs of those that store cabbage or lettuce, and drilled and tested a geothermal probe at a selected pilot site to determine typical geothermal parameters. In this way we were able to identify the most suitable areas for the development of SGE-based cold storage facilities in Slovenia and to validate them with measurements and numerical models in the selected pilot area. These simulations form the basis for optimising technological solutions for operating agricultural cold storage facilities that are energy-efficient, cost-effective and environmentally sustainable. The project is a

collaborative effort between GeoZS, the Biotechnical Faculty, the University of Ljubljana and the Jožef Stefan Institute.

GeoterMORS – Assessment of the potential for using geothermal energy for Ministry of Defence facilities, financed by ARIS and MORS
led by Dr. Mitja Janža, 10/2024-9/2025

The main objective of the GeoterMORS project is to determine the geological, hydrogeological, and temperature conditions at selected military infrastructure locations and to use this information to assess the geothermal potential or feasibility of using geothermal energy for heating, cooling, and heat storage, to ensure greater energy autonomy for military facilities. The evaluation includes the potential for using both high-temperature (deep) and low-temperature (shallow) geothermal energy resources. For each selected area, we provided an assessment of the appropriateness of the approach to the use of geothermal energy and a proposal for the method (technology) and conditions for the use of geothermal energy.

Young Researchers

- Karlo Borko – **Impact of hydrogeological and geothermal factors on the potential for underground heat storage,** 6/2023–9/2027, mentor Doc. Dr. Nina Rman

  As part of his doctoral studies, Karlo is researching the influence of hydrogeological and geothermal factors on the potential for underground heat storage, with a focus on underground heat storage systems in aquifers (ATES) and geothermal probes (BTES). The use of optical fibres for continuous geothermal measurements is being investigated in order to develop a methodology for evaluating heat storage capacity in different geological and hydrogeological conditions. The dissertation contributes to the better utilisation of geothermal sources and more efficient storage of renewable energy sources.

Internally supported research projects

- **INTRIGeoTeam – Interdisciplinary research into reinjection to strengthen GeoZS's geothermal activity,** Doc. Dr. Nina Rman, 11/2023–12/2025

  The INTRIGeoTeam project studies the processes that affect the reinjection of thermally used groundwater to heterogeneous and anisotropic intergranular aquifers in the Pannonian Basin, and evaluates the regional hydraulic and thermal impacts of this process. It focuses on understanding the geological, physical, chemical, and biological factors that may reduce injectivity, as well as on developing approaches for efficient reinjection by considering the petrophysical, physical, and chemical properties of rocks and by identifying key risks.

GeoZS project partner in national research projects

- **InnoGeoPot – Innovative research methods to assess geothermal potential,** Dr. Mitja Janža, 3/2024–2/2028

Sustainable Use of Mineral and Energy Sources

The key strategic direction of GeoZS is to research the potential and evaluate the sources and reserves of mineral and energy raw materials, manage records of reserves and production, publish research results in reports, studies, expert reports, articles and monographs, and continuously maintain relationships with stakeholders in this field. After a slight slowdown in recent decades, we have begun to strengthen research into mineral and energy resources throughout their entire value chain, including secondary raw materials. We will also focus on critical and strategic mineral resources that are essential for the green and digital transition, and on the sustainable management of mineral resources in line with European directives and legislation (Critical Raw Materials Act) to achieve Sustainable Development Goals.

Presentation of projects in the Sustainable Use of Mineral and Energy Sources

Internally supported research projects

- **RSF – Antimony – Renaissance of metal deposit exploration in Slovenia – the case of antimony,** Dr. Klemen Teran, 11/2023–4/2025

  The Antimony project explores antimony deposits near Trojane. Antimony, which is on the EU's list of critical raw materials, has significant potential in the Posavje region. Minimal and incomplete data is available on the location, thickness, and quality of the ore veins, which was already mined in the early 20th century. Due to the re-evaluation of the deposit's prospects, the ore deposits need to be inspected using modern research methods. The project follows modern trends in the exploration of mineral deposits in Europe.

GeoZS project partner in national research projects

- **Geological and lithogeochemical characterisation of Slovenian dolomites with a trial extraction of magnesium,** Doc. Dr. Gorazd Žibret, 10/2023–9/2026

GeoZS as project partner in international research projects

- **GSEU – Geological Service for Europe, Horizon Europe CSA**
  led by Jasna Šinigoj, project partner, 9/2022–8/2027

  As part of the GSEU project, which aims to establish the Geological Service for Europe and foster cooperation among European geological surveys, GeoZS is leading the task of establishing the European International Centre of Excellence for Sustainable Resource Management (ICE-SRM EU). In 2024, ICE-SRM EU's activities focused primarily on organising training workshops on the use of the United Nations Framework Classification for Resources (UNFC). Through these workshops, GeoZS provided experts from European geological institutes with knowledge and support in implementing the European Regulation on establishing a framework to ensure a secure and sustainable supply of critical raw materials, which entered into force on 23 May 2024, particularly in reporting on national research programmes that EU member states are required to prepare in accordance with the Regulation. Forty-four experts from twenty European countries participated in three two-day workshops, structured in three stages with advanced content and held at GeoZS between April and June, enabling participants to be able to transfer knowledge on the use of the UNFC classification to the national level. GeoZS also contributed to the creation of the European map of critical mineral deposits.

- **FutuRaM – Future availability of secondary raw materials, Horizon Europe**
  led by Doc. Dr. Gorazd Žibret, project partner, 6/2022–5/2026

  This project addresses the future availability of secondary raw materials, with an emphasis on testing and promoting the use of the UNFC classification, which could be applied to both primary and secondary raw materials. GeoZS is part of a consortium comprising 28 partners from 11 European countries. The project will develop a knowledge base on secondary resources in terms of their availability and potential for re-use, with particular emphasis on critical raw materials (CRM) within the European Union. A methodology, reporting structure, and guidelines for improving the database will also be developed by 2050.

- **SCRREEN 3 – Solutions for critical materials – European expert network 3, Horizon Europe**
  led by Dr. Klemen Teran, project partner, 1/2024–12/2026

  Building on the experience of the previous SCRREEN and SCRREEN2 projects, SCRREEN3 continues to develop a European network of mineral resource experts to support decision-making processes at the EU level. It focuses on improving official statistics and knowledge of raw material process paths from extraction to recycling, strengthening the expert community for all materials assessed as critical in 2023, and supporting the European Commission in legislative processes, resource supply and demand analyses, and the identification of legislative and technological gaps in value chains.

Digital Transformation with the Goal of a Digital Twin

The key strategic directions for GeoZS in digital transformation include the continuous monitoring of new technologies and the introduction of artificial intelligence, taking into account cybersecurity and systematic management of the institute's data to ensure their quality. GeoZS aims to adopt a new law on geological data that aligns with the principles of open science, enabling open access to interpreted data and defining the institute as the central controller of all geological data in Slovenia.

Presentation of projects related to digital transformation with the goal of a digital twin

Internally supported research projects

- **VzorSIS – Establishment of an information system for recording sample storage,** Dr. Petra Gostinčar, 5/2024–6/2026

  The VzorSIS project aims to establish a comprehensive system for the organisation, storage, and management of rock and soil samples collected by GeoZS in basic and applied research. The current state of the storage facility makes it difficult to identify and use samples, so the project team, by adopting best practice, has prepared a conceptual model and a plan for managing the database. An information system will be established to facilitate the input, search, and management of data, thereby laying the foundations for an advanced geological repository that will enable the long-term and efficient use of samples in future research projects.

GeoZS as project partner in international research projects

- **GSEU – Geological Service for Europe, Horizon Europe CSA**
  led by Jasna Šinigoj, project partner, 9/2022–8/2027

  As part of the GSEU project, aimed at establishing a Geological Service for Europe through cooperation among European geological institutes, GeoZS is leading a task focused on the maintenance and management of the existing European Geological Data Infrastructure (EGDI). GeoZS is also leading the transition from data to a knowledge infrastructure, having successfully established a knowledge database and two pilot knowledge hubs in 2024. This new knowledge infrastructure ensures that the wealth of expert knowledge and expertise are no longer fragments and disconnected, and can now be presented in an organised and accessible manner. The EGDI is now entering its next development phase, no longer serving solely as a data platform but becoming a key component of the Geological Service for Europe, enabling effective support for policy formation and other strategic decisions at the European level.

Research Programmes

Regional Geology

The Regional Geology research programme pursues its core mission to create fundamental and thematic geological maps and models in the broadest sense. This is achieved through a combination of our state-of-the-art research at national and international level with interdisciplinary cooperation, which is a key principle of the group's operations and guides our core activites.

The quality of our results is achieved through a multidisciplinary approach, the introduction of modern analytical methods, and the integration of closely related research areas: fundamental geological research, the study of active tectonics, and the investigation of slope mass movements. Through fundamental research (palaeontological, stratigraphical, sedimentological, and structural), we are obtaining data for the basic 4D model of geological structures. Research in active tectonics (tectonic geomorphology and geophysical methods) allows us to better understand the geological structure at depth and recent geodynamics. Members of the programme group have been, and will continue to be, fully involved in national and European research, development, and applied projects.

In 2024, fundamental geological research included the completion of systematic biostratigraphic analyses of Late Palaeozoic strata of Slovenia, with a focus on reviewing Fusulinid zonation, researching Triassic layers with conodonts, and conducting (bio) stratigraphic and sedimentological studies of Middle Triassic basins and platforms in the Southern Alps and Dinarides. The research programme was supplemented and expanded to include studies of the structure of nanofossil formations, essential for palaeoecological interpretations, and biostratigraphic dating of Paleogene and Neogene marine sediments and rocks. Given the significant importance of understanding Pliocene and Quaternary formations in the study of active tectonics and slope mass movements, research also focused on Pliocene Quaternary formations, their genesis, geomorphology, and the provenence and age of the sediment.

In the field of active tectonics, we continued our field-based structural-geological investigations of active faults in Slovenia by further researching the Raša Fault. Geophysical research focused on creating a 3D model and mapping the distribution of P and S seismic wave velocities in the NW Dinarides area using seismic tomography. This research will contribute to a better understanding of the structure of the Earth's crust between the Alps, the Dinarides, and the Pannonian Basin.

Programme Leader
Dr. Matevž Novak

»Using the scientific research approach to new concepts in understanding the geological structure and geodynamics of Slovenia, the main objective of the Regional Geology research programme remains the integration and interpretation of all available results from other geological research in Slovenia into a coherent system, as well as their incorporation into the broader international context. The 4D geological model of Slovenia (three spatial dimensions and a temporal dimension) forms the basis for planning all interventions in the environment and assessing their impact on the environment, for researching water sources, planning the sustainable use of mineral resources, groundwater and energy sources, and for assessing geologically induced hazards. Advanced 3D models will enable significantly improved localisation of earthquake epicentres, leading to better seismotectonic characterisation of active faults and more reliable earthquake hazard assessments, while also contributing to the preservation of natural and cultural heritage.«

Groundwater and Geochemistry

The Groundwater and Geochemistry research programme brings together researchers from various branches of geology and other natural sciences, as complex processes in the geological environment require in-depth interdisciplinary research.

In the field of environmental geochemistry, we investigate potentially harmful substances. The central theme is research into the impact of anthropogenic activities on the environment, in relation to natural geological conditions and extreme weather events. The methods we use to evaluate the extent of anthropogenic impact on the environment include defining geochemical background levels and natural variation thresholds, calculating enrichment ratios, geoaccumulation indices, pollution indices, and producing geochemical atlases (including the GeoZS-produced geochemical atlas of Maribor). The use of geochemical background levels is essential for distinguishing between natural and anthropogenic contributions to pollution. We model the content of potentially harmful substances in the environment at various levels and propose increasingly efficient risk management measures. In cooperation with other research institutions, we are developing advanced assessments of human exposure to potentially harmful substances in environments that include known sources and transport paths of pollutants from the internal and external living environment. It is important to understand the carriers of potentially toxic elements, their physical and chemical properties and sources, and the processes that influence the release, transport and uptake of pollutants, as well to assess their harmfulness. We therefore research mining waste disposal sites, which can be a significant source of metals in the environment, as well as environmental mechanisms in areas with mining and industrial activity. We also conduct research on gas emissions and solid particles originating from ore processing or the activities of cement plants and co-incinerators. We also study possible anthropogenic impacts in pristine environments. An example of such an environment is wetlands, which have recently been used frequently in geochemical, environmental, and palaeoclimate studies.

We use various research techniques to analyse individual particles, such as scanning electron microanalysis and microspectroscopy. We determine the elemental composition, morphology, and mineralogy of solid carriers of potentially toxic elements at the micron level. This enables us to assess their sources, modes of occurrence, and impact on the environment. We are introducing a confocal Raman microscope into our research, which is valuable for studying the occurrence and transport processes of anthropogenic pollutants, including microplastics in groundwater, intergranular, karst, and fractured aquifers. The transport parameters of microplastics in the unsaturated zone of an alluvial aquifer are investigated through experimental research in the natural environment. This approach allows us to simulate real hydrological and geochemical conditions, which significantly contributes to the reliability and usefulness of the results obtained.

In the light of climate change, we are investigating the impacts of agriculture and the urban environment on groundwater, using simulations of various scenarios of nitrate and organic pollutant contamination in groundwater. Through ongoing isotopic analyses and monitoring of pollutant concentrations in groundwater, we determine the effects of seasonal and long-term changes on its quantity and quality.

In the field of shallow geothermal energy, we are investigating the geothermal and hydrogeological properties of the subsurface and developing methods to assess shallow geothermal potential and the potential for underground heat and cold storage. We are introducing new techniques using optical fibres and studying the potential effects on the chemical composition of groundwater, and the risks of conflict with other uses of underground water or space. We determine the extent of the impact of anthropogenic use and natural climate cycles on subsurface temperatures at various depths, particularly in urban areas and agricultural land. The results form the basis for research into the potential and planning of sustainable geothermal energy use.

We are searching for geothermal aquifers with high-temperature sources suitable for geothermal power plants. Using hydrogeochemical, hydrogeological, and geothermal methods, as well as numerical simulations, we are researching the regional flow of thermal and mineral waters in deep aquifers and the possibilities for reinjecting thermally exploited thermal water into these aquifers.

Programme Leader
Dr. Mateja Gosar

»GeoZS research makes an important contribution to improving the quality of life and health. Groundwater in Slovenia is almost the only source of safe drinking water and is an important technological raw material, which is why the research programme potentially has long-term effects on society in the form of better protection for our environment, especially soil and groundwater as natural resources.

We aim to strengthen our international scientific cooperation and establish partnerships with domestic and foreign universities and research institutions, improving research standards, demonstrating technological advancements, and promoting regional centres of excellence.«

Mineral Resources

The aim of the Mineral Resources research programme in Slovenia and beyond is to preserve existing knowledge and acquire new knowledge on deposits of mineral resources (metal, non-metal, and energy) throughout their entire life cycle. This includes geological knowledge of lithological formations and structures in which deposits and mineral occurrences are found, understanding the genesis of minerals and energy resources, planning their extraction using various operations and techniques, assessing the potential for processing mineral resources, managing mineral resources, studying the environmental impacts of past and current mining activities, the rehabilitation and recultivation of mining areas, managing mining waste, and identifying secondary resources.

European industry is largely dependent on mineral resources, many of which are imported. Due to the global geopolitical situation, the supply of some resources may be disrupted or terminated, having a drastic impact on the living standards of EU citizens. Without a steady supply of mineral resources, the EU's green transition objectives of becoming the first climate-neutral continent are also at risk. With the Regulation establishing a framework to ensure a secure and sustainable supply of critical raw materials, the EU aims to guarantee access to a safe and sustainable supply of critical raw materials, increase the production of raw materials within the EU – particularly critical raw materials – enhance processing and recycling, and diversify imports. To achieve these objectives, each member state must maintain and increase its knowledge of geological structures and mineral resource deposits in order to identify new potentially exploitable ore deposits.

The territory of Slovenia lies at the junction of the Alps, the Dinarides, and the Pannonian Plain. Although Slovenia is a small country, it possesses a diverse range of mineral resources and deposits. In the past, deposits of copper, mercury, antimony, lead, zinc, molybdenum, manganese, iron, bauxite, silver, and barite were exploited. There are 215 registered deposits and occurrences of metal mineral resources in Slovenia, including critical mineral resources such as bauxite, dolomite, antimony, barite, gallium, and germanium, and there remains potential for the discovery of other critical raw materials, particularly at greater depths.

Various deposits of industrial minerals, such as bentonite, gypsum, calcite, dolomite, clay, silica sand, tuff, and many others, are still being exploited today. Slovenia also has various energy sources, including lignite, brown coal, natural gas, oil, and uranium. Important construction materials include technical stone, sand and gravel, natural (decorative) stone, clay for the brick and ceramic tile industries, fire-resistant materials, and raw materials for the cement industry.

The Mineral Resources research programme is the only research programme in Slovenia focused on research in the field of mineral and energy natural resources, and is uniquely positioned to address key challenges posed by their sustainable supply.

The main activities undertaken within the Mineral Resources research programme in 2024 were: research into the occurrence of antimony in the Trojane region; lithogeochemical characterisation of dolomite formations; geochemical analysis of bauxite occurrences in Slovenia with a focus on REE content; using moss, soil, and sediments as indicators of metal pollution resulting from mining and smelting; geochemical research of sediments, soil, and soil profiles to track natural enrichments; research into the bioavailability of metals in dust polluted by smelting activities; research into secondary raw materials, particularly flotation tailings, mineral ashes, and cinders (as alternative sources of primary raw materials); research into Neogene rocks and Plio- and Pleistocene sediments; petrological and organic-chemical research of coal, oil, and gas; studying the potential for storing CO_2 in deep geological formations in Slovenia; determining the provenance of archaeological artefacts (mainly stone); preparation of the National Programme for the Research of Critical Raw Materials and Carrier Minerals; and other research concerning mineral raw materials.

Programme Leader Doc. Dr. Gorazd Žibret

»The activities of the Mineral Resources research programme cover a broad spectrum, ranging from basic science to applied research. The programme aims to supplement, review, verify, report, publish, and transfer the results of our research and expert insights to other scientists, industry stakeholders, policymakers, and the interested public. We provide reliable answers to open questions in the field of mineral resources and respond to various external initiatives that require prompt, expertly formulated answers. Our primary areas of expertise are the supply of metal and non-metal mineral resources, with an emphasis on critical mineral resources, and ensuring a sustainable and clean energy supply.«

Dynamic Earth

The Dynamic Earth research programme focuses primarily on understanding the dynamic processes on and beneath the Earth's surface, linking these processes to deformations and the development of life throughout the Earth's history and the present day.

As a comprehensive global geoscience, the field of Tectonics provides a framework that links processes occurring on and within the Earth to those in the hydrosphere, atmosphere, and biosphere. The territory of Slovenia lies within an active region at the junction of the Alps, Dinarides, and the Pannonian Plain, forming part of the broader collision zone between the Eurasian and African lithospheric plates. Due to the counterclockwise rotation of the Adriatic microplate and its northward movement, a series of active geological structures have developed, including numerous active faults and fault systems. Tectonic activity is accompanied by moderate seismic activity, with occasional destructive earthquakes. Active tectonic processes, particularly in relation to ongoing climate change, also influence increased activity of Earth surface processes, the most frequent of which in Slovenia are earthquakes and landslides.

Within the Dynamic Earth research programme, we focus on identifying and describing active fault systems, particularly the Dinaric fault system, Periadriatic fault system, Vodiška fault, and the seismic source at Petrinja. We use geophysical, geomorphological, and geochronological data to improve tectonic models and fault activity rates. This will improve seismic hazard assessment, particularly in populated areas where active faults pose a significant risk of earthquakes and ground deformation. The current understanding of tectonic activity will be advanced through the development of accurate slip rate models for key active faults, using advanced GNSS data, geodetic surveys and InSAR techniques to track horizontal and vertical displacements. These efforts contribute to seismic source modelling and assist in the preparation and analysis of fault displacement hazards, which is crucial for the security of critical infrastructure. We will also focus on the dynamics of slope mass movements, including landslides and rockfalls, using innovative monitoring techniques such as unmanned aerial vehicle (drone) photogrammetry, GNSS, LiDAR, and real-time geotechnical sensors.

We will research the impact of triggering factors, such as extreme precipitation and seismic events, on slope instability, which will form the basis for improved decision-making regarding landslides in both spatial and temporal contexts, as well as strategies for hazard mitigation. We aim to update and enhance our understanding of Quaternary sediments in Slovenia, with a focus on glaciogenic sediments, which are crucial for studying climate and environmental changes. The existing geological maps are outdated, and recent Quaternary studies have not yet been critically evaluated, leading to inconsistencies. We will collect and assess all relevant glacier and non-glacier data and create a publicly available GIS database.

New geomorphological, sedimentological and geochronological evidence will be collected to investigate glacier fluctuations and past climate conditions, and to improve our understanding of how processes on the Earth's surface have shaped the landscape under the influence of climate change. In parallel, we aim to establish a multidisciplinary workgroup focused on improving the understanding of dynamic processes on Earth, particularly the interactions between surface processes and tectonics. The group will lay the foundations for assessing geologically induced hazards and their impact on societal sustainability. The main aim is to provide excellent research results that, in accordance with open access principles, achieve international recognition. The research will promote international cooperation, enhance the research reputation of Slovenia and contribute to global projects in active tectonics and geohazards. In addition, we will transfer knowledge to future generations and contribute to the development of guidelines for improving society's resilience to geological hazards and climate change.

Programme Leader Doc. Dr. Mateja Jemec Auflič

»Improvements in the evaluation of seismic hazards have a direct impact on the construction sector and infrastructure impact assessments, such as energy and logistics. Better data on fault locations in urban areas will accelerate the seismic retrofitting of buildings. Improved seismic hazard assessment could form the basis for obtaining certificates for earthquake-resilient buildings. New findings in the field of hazard assessments due to slope mass movements could have a direct impact on the spatial planning of transport infrastructure outside the affected areas.

Results in the form of overview maps, plans, and models will serve as tools to provide efficient support for civil protection services in the event of landslides or destructive earthquakes, in developing or upgrading the existing landslide warning system, and the development of contingency plans for unpredictable events. The results of the research programme will enable the preparation of suitable legislation regarding preventive measures for improved earthquake and landslide safety.«

Infrastructure Programme: Geological Information Centre

At the Geological Information Centre, we adhere to the principles of open science, open data, and the FAIR principles, as the GeoZS guidelines for data handling dictate the provision of complete and open data free of charge. As part of the GeoZS infrastructure programme, we have established the “eGeologija” web portal for the widest possible range of users, providing quick access to an extensive set of high-quality geological data via a single entry point on the World Wide Web. We have also established a workflow that enables us to publish all new data generated by GeoZS research and projects on the portal. The eGeologija portal currently contains 1,060 data sources, services, and maps.

One of the main goals of the IP GIC is the standardisation of data obtained from various research programmes and projects, which must be compliant with the EU INSPIRE directive and other standards (OpenAir, OGC, ISO, BIM, etc.). The implementation of the INSPIRE directive is led and coordinated by GeoZS within the framework of the infrastructure programme, and GeoZS is also a member of the project group for implementing the INSPIRE directive under the Ministry of the Environment and Spatial Planning. GeoZS is the administrator of databases within the framework of the INSPIRE directive. We have established the “eTeren” infrastructure, to which data is submitted directly, unified, and continuously from all the measuring sensors GeoZS has installed in the field, thus ensuring the accessibility and archiving of measurement data, and an overview of the type, quantity, and locations of sensors in the field. As part of various projects, we have established six geology research laboratories, and all research equipment in these laboratories is regularly maintained through the IP GIC. The research geology laboratories enable long-term monitoring and collection of data related to geological processes in the Earth's crust, and contribute to a better understanding of natural phenomena and their interactions. The “eTeren” infrastructure currently includes 261 devices and sensors in the field.

The infrastructure programme maintains 29 web applications and more than 180 WMS, WFS, and WMTS web services for data transfer. We established the “eVrtine” infrastructure, which comprises a borehole database, public and internal viewers, and an application for entering and reviewing data in the borehole database. We also maintain the Revija Geologija portal, the leading Slovenian geological science journal with an international editorial board.

As part of the IP GIC, we have developed various GIS applications for the needs of ministries to support decision-making. For the Mining Division, we have developed a web GIS application for reviewing and querying administrative data on mineral resource deposits (public mining book). For the Administration of the Republic of Slovenia for Civil Protection and Disaster Relief, we developed an early warning system for landslides (MASPREM), which alerts the population twice daily via an online application that the risk of landslides will be/is increased in certain areas due to excessive predicted rainfall. We also developed the “ePlaz” application as part of the MASPREM project. We developed a spatial database of geologically induced hazards due to slope movement processes, erosion maps, and snow avalanche maps for the Ministry of Natural Resources and Spatial Planning, and developed an IT solution for interpreting and integrating landslide and erosion data into the “eVode” information system.

We have defined a process for submitting reports on completed research and the corresponding data. All reports produced within the various research programmes at GeoZS, as well as all work results, are stored, archived, and accessible for re-use through the “eGeologija” portal. We actively participate in the European Research Infrastructure on Earthquakes, Volcanoes, Surface Dynamics and Tectonics programme, in the establishment of the European Geological Data Infrastructure (EGDI), and in the European Marine Observation and Data Network (EMODnet). Together with members of the EPOS-SI consortium, we are developing the Slovenian research infrastructure RI-SI-EPOS. Data that form part of the Geological Information System comply with national and European standards and are included in various information systems, repositories, and platforms at both national and European levels.

The GeoZS research infrastructure is maintained as part of the infrastructure programme, which includes research equipment and knowledge-based resources (databases, archives, and scientific data) as well as e-infrastructure (database and computer systems and networks).

Programme Leader Jasna Šinigoj

»The Geological Information Centre Infrastructure Programme (GIC IP) serves as a central support platform for GeoZS research activities. Its purpose is to provide high-quality, open, and interoperable geological data for scientific research, the public sector, the business sector, and European legislative requirements.

We respect the global technological guidelines and continually improve and upgrade the GeoZS information infrastructure, applications, services, and above all, knowledge. We successfully share our experience and acquired knowledge in the field of spatial informatics with the wider European community and Africa. We lead two international associations: the Geoscience Information Consortium (https://www.g-i-c.org/), which brings together experts from 36 global organisations, and the IUGS Commission for the Management and Application of Geoscience Information (CGI-IUGS) (https://cgi-iugs.org/). We are also very active in the EuroGeoSurveys expert group for spatial information (SIEG).«

Public Services and Other State-Funded Projects

Ministry of Natural Resources and Spatial Planning (MNVP)

- Implementation of public mining services and geological expert services within the framework of JRZ GeoZS, led by Dr. Duška Rokavec
- Expert support to DRSV in decision-making processes in spatial and environmental documentation, opinions and water permits, led by Mag. Joerg Prestor
- Expert assessments in the field of erosion in the scope of the Green Location Framework project, led by Dr. Jernej Jež
- Creation of data layers in the field of landslide-prone areas in the scope of the Green Location Framework project, led by Dr. Jernej Jež
- Expert tasks in the field of water protection areas – work programme for 2024, led by Dr. Nina Mali
- Determination and presentation of contributing areas for drinking water catchments for 2024, led by Dr. Sonja Cerar

Slovenian Water Agency (DRSV)

- Technical support for the enforcement of records in the water cadastre, particularly in water protection areas, led by Lidija Levičnik
- Preparation of expert opinions for the needs of regional sectors, led by Mag. Joerg Prestor
- Expert support for decision-making in spatial and environmental documentation assessment procedures for the Department for Spatial and Environmental Documentation Assessment, led by Mag. Joerg Prestor
- Expert support for operational groundwater monitoring in the field of water permits, led by Mag. Andrej Lapanje
- Analysis of the monitoring of geological phenomena acquired via the reports of groundwater exploration permits, led by Mag. Andrej Lapanje

Ministry of the Environment, Climate and Energy (MOPE)

- Monitoring the conditions of closed mining waste disposal sites and providing expert support for the planning of four mining waste disposal sites at the former mine in Mežica, led by Dr. Mateja Gosar
- Implementation of expert tasks for the Ministry of the Environment, Climate and Energy in 2024: 3 sets; (1) preparation of a geochemical atlas of Slovenia, led by Dr. Robert Šajn, (2) monitoring the situation of closed mining waste disposal sites at the former mine in Mežica, led by Dr. Mateja Gosar, (3) analysis of groundwater pollution monitoring programmes in the field of landfills and baseline reports in the area of entities subject to the IED, led by Dr. Sonja Cerar
- Expert support in the field of geothermal energy for the Ministry of the Environment, Climate and Energy, led by Doc. Dr. Nina Rman

Slovenian Environment Agency (ARSO)

- Hydrogeological mathematical model of heat transfer in the deep geothermal groundwater body of northeastern Slovenia – model updated in 2024, led by Doc. Dr. Nina Rman
- Review and analysis of measurement sites for national groundwater quality monitoring and preparation for sampling in 2023 and 2024, led by Marko Hoetzl
- Seismotectonic mapping in 2024, led by Doc. Dr. Petra Jamšek Rupnik
- Preparation and commencement of simultaneous groundwater monitoring in the area of water body 4016 Mura Basin without the Apače field, led by Mag. Andrej Lapanje
- Review of submitted annual monitoring reports on groundwater at landfill areas for 2023, led by Dr. Sonja Cerar
- Expert groundwork for the national monitoring of deep boreholes in northeastern Slovenia, led by Doc. Dr. Nina Rman

Ministry of Agriculture, Forestry and Food (MKGP)

- Climate report in agriculture, led by Mag. Dušan Rajver

Ministry of Defence (MORS)

- Upgrading the research and development project MASPREM 6, led by Dr. Tina Peternel

Ministry of Higher Education, Science and Innovation (MVZI)

- SKUPP – Cooperation for strengthening the effectiveness of project offices (Recovery and Resilience Plan), led by Mag. Brigita Žepič Praprotnik
- SPOZNAJ – Support in implementing open science principles in Slovenia (Recovery and Resilience Plan), led by Dr. Petra Gostinčar
- KTO3 – Activities of the office for transferring knowledge, led by Nenad Damjanovič

Commercial Projects

Mineral Resources

- Implementation of geological research and drafting of geological documentation for mineral resource locations for various clients
- Reports on the classification and categorisation of calculated deposits and mineral resources for various clients

Structural Geology Research

- Structural geology and hydrogeology mapping in various areas and for clients
- Geophysical research for various clients
- Processing and interpretation of georadar data for various purposes and clients

Geohazards, Engineering Geology and Geotechnical Investigations

- Maintenance of existing monitoring, implementation and maintenance of electronic geotechnical monitoring and interpretation of monitoring data and reporting for the Urbas and Čikla landslide (Koroška Bela hinterland)
- Review of slope mass movements in certain areas for various clients

Hydrogeological Research

- Preparation of annual reports on operational monitoring of groundwater for various clients
- Preparation of annual reports on the operational monitoring of thermal water extraction and monitoring programmes for various clients
- Development of hydrogeological content for the preparation of a proposal for an operational groundwater pollution monitoring programme and a programme of measures for landfills for various clients
- The development of hydrogeological content for the preparation of a proposal for groundwater pollution monitoring programmes for IED facilities for various clients
- Video inspection and core measurements in boreholes for various clients
- Review of water reservoirs and performance of pumping tests to obtain water permits for the public drinking water supply for various clients
- Risk analysis of water source contamination due to infrastructure developments for various clients
- Review of groundwater level data at desired locations for various clients

Geothermal Research

- Determination of the thermal properties of rocks (thermal response test – TRT) for the for the potential for heat storage in various areas for various clients

International Projects

GeoZS as lead partner

- **INFO-GEOTHERMAL – Supporting the efficient cascading use of geothermal energy through access to official and public information, Norwegian Financial Mechanism**
  led by Doc. Dr. Nina Rman, lead partner, 9/2022–3/2024
- **EO4MASRISK – Ground Deformation and Risk Detection Information Service, European Space Agency – ESA**
  led by Doc. Dr. Mateja Jemec Auflič, lead partner, 10/2022–6/2025
- **SLO7001 – Improving Water Resource Capacity, International Atomic Energy Agency (IAEA)**
  led by Doc. Dr. Nina Rman, lead partner, 1/2024–12/2025
- **EIT RawMaterials RIS Adria Centre, EIT RawMaterials**
  led by Urša Šolc, lead partner, 3/2023–12/2025

GeoZS as project partner

- **EMODnet 5 – Operation, development and maintenance of the European Marine Observation and Data Network, EASME**
  led by Dr. Ana Novak, project partner, 9/2021–9/2025
- **NOCMOC22 – "Noč ima svojo moč", Horizon Europe MSCA**
  led by Dr. Meta Dobnikar, project partner, 5/2022–2/2024
- **HEI4S3-RM – Building Ecosystem Integration Labs at HEI to foster Smart Specialisation and Innovation in the field of Raw Materials, EIT Higher Education Initiative**
  led by Urša Šolc, project partner, 7/2022–6/2024
- **GEORIS – Innovative technologies for waste processing in the ESEE region, EIT RawMaterials**
  led by Doc. Dr. Gorazd Žibret, project partner, 9/2022–12/2024
- **TIMREX –Masters Programme in Innovative Mineral Resource Exploration, EIT RawMaterials**
  led by Urša Šolc, project partner, 1/2022–12/2024
- **EPOS ERIC – European Plate Observing System, European Research Infrastructure Consortium**
  led by Jasna Šinigoj, project partner, 5/2022–
- **PanAfGeo-2 – Support for Geological Sciences and Technology in Africa – EU Partnership, EU DG-INTPA**
  led by Špela Kumelj, project partner, 6/2021–3/2025
- **LIFE IP RESTART – Boosting waste recycling into useful products by creating an environment for a circular economy in Slovenia, Life 2020**
  led by Dr. Špela Bavec, project partner, 1/2022–12/2030
- **PhD BalticTeach – Doctoral schools on sustainable materials for the RIS region, EIT RawMaterials**
  led by Urša Šolc, project partner, 1/2023–6/2025
- **KRAS-CARSO II – Joint management and sustainable development of the Classical Karst area, Interreg Italy-Slovenia 2023–2025**
  led by Dr. Matevž Novak, project partner, 1/2023–12/2025
- **MAURI-CE – Management of urban water resources in Central Europe in the face of climate change, Interreg Central Europe 2021–2027**
  led by Mag. Joerg Prestor, project partner, 4/2023–3/2026
- **Danube GeoHeCo – Promoting the use of shallow geothermal hybrid heating and cooling systems in the Danube area, Interreg Danube 2021–2027**
  led by Dr. Mitja Janža, project partner, 1/2024–6/2026
- **Danube Sediment_Q2 – Sediment balance in the Danube river – sustainable, integrated and transnational management of the quantity and quality of sediments in the Danube river basin, Interreg Danube 2021–2027**
  led by Dr. Jasminka Alijagić, project partner, 1/2024–6/2026
- **GeoNetSee – A GEOsensor network system based on artificial intelligence and internet of things technology for real-time monitoring of unstable terrain and built structures, Interreg Danube 2021–2027**
  led by Dr. Ela Šegina, project partner, 1/2024–6/2026
- **AIMS – The development and testing of a joint forecasting AI-based model for the harmonised use of big data and the establishment of a joint landslide risk management system in the Adriatic-Ionian region, IPA Adriatic-Ionian programme 2021–2027**
  led by Dr. Klemen Teran, project partner, 6/2024–2/2027
- **WATERWISE – Co-creating sustainable management solutions for resilient Alpine headwaters, Interreg Alpine Space 2021–2027**
  led by Doc. Dr. Nina Rman, project partner, 9/2024–8/2027
- **MARGIN – Sustainable groundwater management in urban areas: vulnerability assessment of groundwater quality and quantity to climate change and urbanisation and the development of adaptation measures in cities, Interreg Alpine Space 2021–2027**
  led by Dr. Mitja Janža, project partner, 9/2024–8/2027
- **KaraMon – Improving resilience to natural disasters in the Karavanke Geopark by developing a common digital network for monitoring, communication and measures for prevention and mediation, Interreg Slovenia-Austria 2021–2027**
  led by Doc. Dr. Mateja Jemec Auflič, project partner, 11/2024–10/2027
- **SI-Geo-Electricity – Pilot geothermal power plant at the existing Pg-8 gas well, pilot project, Norwegian Financial Mechanism**
  led by Doc. Dr. Nina Rman, project partner, 5/2022–4/2024

07

Scientific Publications in 2024

Through excellence in scientific research, we strengthen our position as a leading institution in geosciences.

Original Scientific Articles

Leading author from GeoZS

1. ADRINEK, Simona, JANŽA, Mitja, SINGH, Rao Martand. Influence of geology, hydrogeology, and climate on ground source heat pump distribution in Slovenia and selected European countries. Resources. 2024, vol. 13, no. 3, p. 17. ISSN 2079-9276. DOI: 10.3390/resources13030039. [COBISS.SI-ID 189061635]
2. BAVEC, Špela, CERAR, Sonja, GABERŠEK, Martin, POGAČNIK, Željko. Geokemična porazdelitev elementov v okoljskih medijih iz okolice degradiranih območij površinskih kopov = Geochemical distribution of elements in the environmental media from the surroundings of open pit areas. Geologija. 2024, vol. 67, no. 2, p. 317-332. ISSN 0016-7789. DOI: 10.5474/geologija.2024.016. [COBISS.SI-ID 220292355]
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9. JAMŠEK RUPNIK, Petra, ATANACKOV, Jure, HORN, Barbara, MUSIC, Branko, ZAJC, Marjana, GRÜTZNER, Christoph, USTASZEWSKI, Kamil, TSUKAMOTO, Sumiko, NOVAK, Matevž, MILANIČ, Blaž, MARKELJ, Anže, IVANČIČ, Kristina, NOVAK, Ana, JEŽ, Jernej, ŽEBRE, Manja, BAVEC, Miloš, VRABEC, Marko. Revealing subtle active tectonic deformation: integrating lidar, photogrammetry, field mapping, and geophysical surveys to assess the Late Quaternary activity of the Sava Fault (Southern Alps, Slovenia). Remote sensing. 2024, vol. 16, no. 9, p. 33. ISSN 2072-4292. DOI: 10.3390/rs16091490. [COBISS.SI-ID 193873923]
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Reviewed Scientific Publications

Leading author from GeoZS

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53. IVANČIČ, Kristina, BARTOL, Miloš, MARINŠEK, Miha, KRALJ, Polona, MENCIN GALE, Eva, ATANACKOV, Jure, HORVAT, Aleksander. A review of the Neogene formations and beds in Slovenia, Western Central Paratethys = Pregled neogenskih formacij in plasti v Sloveniji, zahodna Centralna Paratetida. Geologija. 2024, vol. 67, no. 2, p. 193-215. ISSN 0016-7789. DOI: 10.5474/geologija.2024.009. [COBISS.SI-ID 220210179]

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54. STAFILOV, Trajče, ŠAJN, Robert, ALIJAGIĆ, Jasminka. Investigations of chemical element distributions in soil, North Macedonia—a review. Minerals. 2024, vol. 14, no. 3, p. 27. ISSN 2075-163X. DOI: 10.3390/min14030325. [COBISS.SI-ID 190006275]

Other Scientific Publications

Leading author from GeoZS

55. MENCIN GALE, Eva, KRALJ, Polona, TRAJANOVA, Mirka, GALE, Luka, SKABERNE, Dragomir. Petrology dataset of Pliocene-Pleistocene sediments in northeastern Slovenia = Podatki o petrologiji pliocensko-pleistocenskih sedimentov severovzhodne Slovenije. Geologija. 2024, vol. 67, no. 1, p. 157-160. ISSN 0016-7789. DOI: 10.5474/geologija.2024.008. [COBISS.SI-ID 200244739]

Leading author from other organisations

56. CORMIO, Carlo, FERNÁNDEZ-ALONSO, Marta, CLEALL, Peter, HEUSS-ASSBICHLER, Soraya, GUGLIETTA, Daniela, SINNETT, Danielle, SZABÓ, Katalin, ŽIBRET, Gorazd, CARVALHO, Maria Teresa, KRAL, Ulrich, WERNER, Tim T., LEMIERE, Bruno. Site-specific dataset of mining and metallurgical residues for resource management. Data in brief. 2024, vol. 54, p. 12. ISSN 2352-3409. DOI: 10.1016/j.dib.2024.110348. [COBISS.SI-ID 189965315]

08

Stakeholder Relations and Sharing Knowledge

We build systematic relationships with stakeholders, understand their expectations and needs, and ensure transparent communication with various publics.

GeoZS understands stakeholder relations as a continuous process and a systematic approach to involving stakeholders in our work and understanding their interests and values. Through consistent and clear communication, we establish lasting relationships and mutual understanding, thereby increasing the visibility of GeoZS operations in the broader social context. Openness and consistency in relations with stakeholders are key to building trust in our work and in geoscience.

Notwithstanding the individual stakeholders and the public, GeoZS's overarching messages are focused on consistent communication of the following GeoZS values:

- GeoZS is primarily a scientific research organisation committed to the principles of scientific excellence
- GeoZS plays a significant role in international associations and organisations operating in geoscience; through its expertise, it makes an important contribution to the development of European policies and programmes related to geoscience
- GeoZS provides expert support to national policymakers while fully maintaining its professional integrity

To manage relations with its stakeholders, GeoZS has outlined a map of its main stakeholder groups, comprising various subgroups.

Political and Decision-Making Community

- Ministry of Higher Education, Science and Innovation
- Ministry of the Environment, Climate and Energy
  - Slovenian Environment Agency
- Ministry of Natural Resources and Spatial Planning
  - Slovenian Water Agency
- Ministry of the Economy, Tourism and Sport
- Ministry of Infrastructure
- Ministry of Defence
- Ministry of Agriculture, Forestry and Food
- Slovenian Research and Innovation Agency
- GeoZS Management Board

Internal Community

- Employees
- Scientific Council
- Representatives of the Education, Science and Culture Trade Union of Slovenia (SVIZ) at GeoZS

Scientific Research Community

- University of Ljubljana
- Faculty of Natural Sciences and Engineering, Geology Department
- Other faculties (recruiting staff, cooperation)
- SAZU
- Other scientific research institutes
- Museum of Natural History and other technical museums and museums of natural sciences
- Expert institutions/organisations/companies working in the field of geology
- Slovenian Geological Society

Business Partners

- Commercial project clients – companies
- GeoZS suppliers (equipment, materials)

Local Communities

- Municipalities (leadership of municipalities)
- Local population

Media

- Printed and electronic (general media) – national level
- Printed and electronic (general media) regional and local level
- Specialised media

Non-governmental Organisations

International Community

- EuroGeoSurveys
- Geological Service for Europe (GSEU)
- Bodies of the European Commission
- International partners in projects

Citizens of Slovenia

- Adult population
- Teachers and professors in the primary and secondary school programme
- Younger population in schools

Communication Tools

Public/Stakeholders	One-way Tools	Two-Way Tools
Employees	GeoNovice	Conversations with superiors
	Internal portal	E-mail
	GeoZS Website	Measuring employee satisfaction
	GeoZS annual report	Workshops
	GeoZS brochures	Meetings by individual groups
		Organisation of events for employees
		Social media
Media	Media relations	Press conference
	GeoNovice	Invited talks/events/interviews
	Letters from readers/replies to a published article	Social media
	Publication of articles/cooperation in electronic media	
	GeoZS Website	
	GeoZS annual report	
Political Decision-makers	GeoZS Website	Meetings
	Official letters of GeoZS, reports on public service operations	Events: lectures, conferences, expert meetings and the participation of GeoZS at events organised by others
	GeoZS annual report	Webinars and online discussions
	GeoNovice	Lobbying
Scientific Research Public and Educational Institutes	GeoZS Website	Joint events and participation of GeoZS at events organised by other institutes
	GeoNovice	Meetings
	GeoZS annual report	Expert consultations and excursions
	Articles in expert media	Building alliances (joint actions)
		Educational and awareness campaigns (for teachers, students and high school students)
		Development of educational materials and participation in formal educational processes
		GeoZS Open Day
		Social media
Business Partners	GeoZS Website	Meetings and interviews
	GeoNovice	Project presentations
	GeoZS annual report	Presentation of project results
	Written communication	Social media
Local Communities	Preparation of explanatory materials, brochures	Written communication, meetings and interviews
		Presentations/panel discussions/workshops (involvement of the public)
		Social media
Non-governmental Organisations	Written communication	Meetings, interviews
	GeoZS Website	Participation at events
		Social media
		GeoZS Open Day
Citizens of Slovenia	Media appearances	Interested/engaged public: written answers or communication via e-mail
	GeoZS Website	Social media
	Monographies and other publications of GeoZS	GeoZS Open Day
International Community	GeoZS Website	Participation in international projects
	Written communication	Participation at international expert events and conferences
		Membership in international organisations
		Social media
		Lobbying

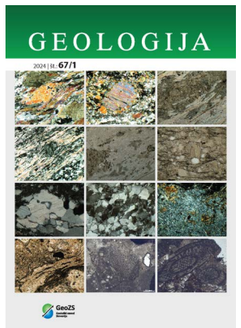
Processes of Sharing Knowledge with Society

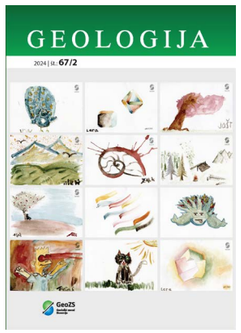
Through the efficient communication of scientific insights and by promoting geology to the general public, we are bridging gaps between scientific research and the benefits it brings to society, while increasing the recognition and importance of geoscience in addressing global and national challenges. Our efforts are directed towards promoting geoscience through publications, awareness activities, and the inclusion of the wider community.

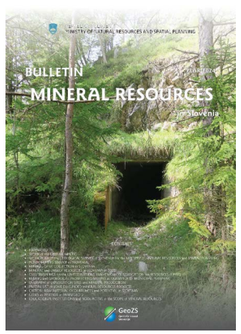
We transform scientific knowledge into value for society.

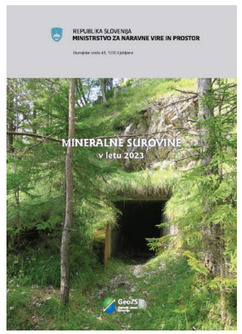
Publishing Activities

The magazine "Geologija", which we publish as part of our long-term publishing activity, is the central Slovenian periodical in the field of Earth sciences. The magazine is issued twice per year. We strive to increase its international recognition and to improve its reputation in the international scientific community in the categories of geology, geophysics, geochemistry, hydrogeology, and palaeontology. In 2024, we also published the following materials: the bulletin Mineralne surovine v letu 2023, the abbreviated English version Bulletin of Mineral Resources in Slovenia, the Booklet on energy efficient use of geothermal resources and their development, and a reprint of the book "70 geoloških zanimivosti Slovenije", thus contributing to the broader dissemination of geological knowledge.









Publications issued in 2024

Geologija. Ljubljana: Geological Survey of Slovenia, 1953–. ISSN 0016-7789. https://www.geologija-revija.si/index.php/geologija/issue/archive
Vol. 67, no. 1, 2, 2024.

Mineral resources in Slovenia 2024. Ljubljana: Geological Survey of Slovenia, 2008–. ISSN 1855-4725. https://www.geo-zs.si/publikacije/bulletin-mineral-resources-in-slovenia/

Mineralne surovine v letu 2023. Ljubljana: Geological Survey of Slovenia, 2005–. ISSN 1854-3995. https://www.geo-zs.si/publikacije/bilten-mineralne-surovine/

Letno poročilo 2023. Ljubljana: Geological Survey of Slovenia, 2005–. ISSN 1854-3995. https://www.geo-zs.si/wp-content/uploads/2025/02/Letno_porocilo_2023_SLO.pdf.

Annual report 2023 - Summary. Ljubljana: Geological Survey of Slovenia, 2005–. ISSN 1854-3995. https://www.geo-zs.si/wp-content/uploads/2025/02/Letno_porocilo_2023_ANG_summary.pdf.

GeoNovice – Novice Geološkega zavoda Slovenije, May 2024, June 2024, October 2024 and December 2024

GeoZS Strategy Summary 2030

- In Slovenian – https://www.geo-zs.si/wp-content/uploads/2025/03/Strategija-GeoZS-brosura_SI_splet.pdf
- In English – https://www.geo-zs.si/wp-content/uploads/2025/03/Strategy-GeoZS-brochure_ENG_web.pdf

Booklet on energy efficient use of geothermal resources and their development, Ljubljana: Geological Survey of Slovenia, 2024, ISBN 978-961-6498-81-4. https://www.geo-zs.si/publikacije/knjizica-o-energetsko-ucinkoviti-rabi-geotermalnih-virov-in-njihovem-razvoju/

70 geoloških zanimivosti Slovenije, Ljubljana, Geological Survey of Slovenia, 2016, 2. amended issue, 1. reprint, 2024, ISBN 978-961-6498-47-0. https://www.geo-zs.si/publikacije/70-geoloskih-zanimivosti-slovenije/.

Public Engagement

GeoZS is committed to actively involving the public in organising popular scientific lectures, workshops, and field excursions. These activities are designed to promote curiosity and provide accessible, scientifically justified insights into geology for various target groups, including both young and old. To improve the inclusion of geological content in the curricula of primary and secondary schools, we have strengthened our cooperation with decision-makers to ensure the fundamentals of geoscience knowledge for future generations.

Awareness-Raising and the Education of Young People

Geological educational - creative workshop Od kamna do slike at the 50th MINFOS in Tržič, 11-12 May 2024

Sulphide minerals are important ore minerals (e.g. cinnabar, galena, and pyrite), and some were previously used as colouring pigments in paintings. Why are they no longer used today, which colours can be prepared from minerals and rocks in Slovenia, and whether colours can also be made from charred plants – all this was presented to visitors at the educational and creative workshop at the 50th MINFOS in Tržič. Both young and old created art with natural pigments and painted motifs of sulphide minerals and carbon flora.

15th Znanstival Science Festival, 1 and 2 June 2024

GeoZS participated in the 15th Znanstival Science Festival, organised annually by the House of Experiments to promote curiosity, creativity, and science. We presented aspects of our research to visitors at the Experiment Garden. We also showcased some of the resources required for smartphone production. Together with participants, we identified the locations of critical mineral resource deposits used in modern technology on the critical mineral resources map. We demonstrated the properties of groundwater, the main source of drinking water in Slovenia, using an aquifer model, and emphasised the importance of protecting it from pollution and over-extraction.

Savinja Day 2024, 18 June 2024

GeoZS participated in the Savinja Day event, organised by the Institute of the Republic of Slovenia for Nature Conservation. GeoZS employees presented the KamenCheck application to more than 160 pupils, as well as the basic division of rocks and the rock circle. Also, using the story Od kamnin do računalnika (From stone to computer), they emphasised the importance of mineral resources in our everyday lives.

GeoZS Open Day, 27 September 2024

The GeoZS Open Day event was held as part of the European Researchers' Night and Science Month 2024, continuing the project Noč ima svojo moč. Together with students from Livada Primary School, we explored the importance of mineral resources and toured laboratories, where the highlight was examining rock samples under a microscope. We held live and online lectures on critical mineral resources, health risk assessment related to metal exposure, the geothermal potential of Slovenia, and the PanAfGeo project.

Hokus Pokus Science and Art Festival, 17-18 October 2024

GeoZS participated in the Hokus Pokus Science and Art Festival, organised by Pionirski dom. The focus was on the world of material properties, and we gave a presentation to students on the properties of stones, minerals, and other geological elements.

Lectures and events for adults

Opening of the exhibition From Ljubljana to Trieste – Od Ljubljane do Trsta – Aurisina, Karst, and Istria stone in Italy and around the world, in Trieste, 18 May 2024

More than 500 photographs and models were displayed at the exhibition, showing quarries, the use of natural stone, and buildings through history. Dr. Matevž Novak from GeoZS took part in the preparations within the framework of the project Carso crea(t)tivo.

International Geodiversity Day

On 6 October every year, we celebrate International Geodiversity Day, which we marked in 2024 with a round table entitled "Geology in Schools and Teaching Geodiversity." With the support of the Slovene National Commission for UNESCO and GeoZS, the event took place at the Faculty of Natural Sciences and Engineering, University of Ljubljana. Rok Brajkovič participated as the discussion moderator.

At the local event during Geodiversity Day in Tržič, Dr. Klemen Teran presented the new landslide warning maps for the Tržič area.

Education on mofetas and mineral water for educators and teachers

Doc. Dr Nina Rman participated in the workshop WATER: Bio- and geodiversity from the depths and surfaces, organised by the Institute of the Republic of Slovenia for Nature Conservation. Participants, teachers and educators tested the properties of mineral waters and free CO_2 at Ivanjševska slatina, and became familiar with the geological properties of the Ščavnica Valley at Negova Castle during the Breathing Earth lecture.

Cooperation with the Scientific Research Public

Cooperation within the scope of a formal education process

In 2024, a total of 11 GeoZS researchers took part in the pedagogical process of higher education institutions. Many GeoZS researchers also took part in individual student activities (mentorships, occasional lectures, field work, etc.) at the University of Ljubljana and University of Nova Gorica.

At the end of 2024, eight young researchers/ PhD students were employed at GeoZS on a fixed-term basis.

Hosting of foreign students at GeoZS

As part of the RIS-Internship programme EIT RawMaterials, three foreign Master's students completed their traineeships at GeoZS in July, August and September. Smith Jallah Saywaye (University of Debrecen) conducted field and laboratory work under the mentorship of Dr. Meta Dobnikar. Kashif Shamsher (TIMREX Master's programme, University of Miskolc) became familiar with advanced laboratory equipment and fieldwork with the assistance of Dr. Meta Dobnikar and Dr. Klemen Teran. Abdussalam Auwal Muhammad (University of Miskolc) participated in sampling projects and groundwater monitoring processes with Dr. Luka Serianz.

During the last week of September, GeoZS hosted geology students from the University of Åbo Akademi and the University of Turku in Finland. We prepared lectures for them on the geology of Slovenia and on GeoZS research work, with Prof. Dr. Boštjan Rožič and researchers Dr. Jernej Jež, Doc. Dr. Gorazd Žibret, Janja Svetina, Dr. Ela Šegina and Mag. Dušan Rajver participating.

Hosting foreign researchers at GeoZS

As part of a research exchange, we hosted Ella Busuttil, an expert on groundwater quality from the Malta Energy and Water Agency, for 14 days. We presented

the work of the Hydrogeology Department and shared our experience in researching chemical and isotope properties in groundwater, as well as our preparations for the third Slovenian Water Management Plan.

Expert Lectures

Online presentation of the eGeologija portal – Infrastructure of spatial data of the Geological Survey of Slovenia, 16 May 2024

As part of the SPOZNAJ project, we prepared an online presentation of the eGeologija portal, led by Jasna Šinigoj, Head of the Geological Information Centre at GeoZS. The portal provides quick access to high-quality geological information through modern e-services. It is based on the infrastructure of GeoZS spatial data and adheres to the principles of INSPIRE and FAIR. A recording of the lecture is available via the ARNES web platform..

Lecture: Geothermal energy – seeking warm water or something else?

Doc. Dr. Nina Rman presented geothermal energy at the Slovenian society, noting that it is no longer limited to spas and public baths, but may be used for heating, cooling, underground energy storage, the use of old oil wells, and obtaining critical raw materials, thereby contributing to the restructuring of the energy sector.

Media Outreach

We recognise the importance of media presence and digital communications in modern science communication. To increase public awareness of geology, GeoZS actively participates in national, regional and local print and electronic media, ensuring that geological research and its significance to society are accessible to the wider public.

In 2024, we contributed to the preparation of various popular science and expert content in newspapers, general and specialised magazines, and participated in interviews on television and radio programmes. We regularly responded to media inquiries, providing statements on current events in our field both domestically and internationally. GeoZS researchers took part in several interviews on television, in print media, and in various radio programmes and podcasts, such as Frekvenca X, Aktualna tema on Val 202, Hevreka on Radio Rai, the Firbcologi show, and Slovenski magazin on TV Slovenia. Throughout 2024, we regularly published news in the ESG (Environmental, Social and Governance) magazine, which also featured an interview with Doc. Dr. Nina Rman on the opportunities for geothermal energy in Slovenia.

In 2024, we strengthened the institution's presence on social media platforms such as Facebook, LinkedIn and YouTube, which enabled us to interact directly with the public, share research findings and promote geoscientific initiatives.

09

Financial report

In the field of financial management, we achieved the planned objectives.

Revenue

The total revenue in 2024 was EUR 8,030,616, of which 75.5 percent came from the state budget, 11.2 percent from the sale of goods and services on the market, 11.6 percent from the co-financing of European projects, and the remainder from other revenue. Total revenue was 8.8 percent higher than in the previous year. Revenue from the sale of products and services was EUR 902,744, financial revenue was EUR 70,210, other revenue was EUR 6,233, and revaluation operating revenue was EUR 18,952.

The excess of revenue over expenses was EUR 121,169.

Total revenue (in EUR)	**8,030,616**
Revenue from the sale of products and services	**7,935,221**
ARIS revenue	4,497,667
Other appropriations	1,525,334
Other revenue from public finances	40,955
Revenue market	902,744
Rental income	26,237
Revenue – EU projects	932,194
Other revenue	10,090
Financial revenue (public funds/market)	**70,210**
Other revenue (public funds/market)	**6,233**
Revaluation operating revenues (PF/market)	**18,952**

Expenses

In 2024, GeoZS's total expenditure was EUR 7,909,447, an increase of 8.2 percent compared to the previous year. This rise was mainly due to higher labour costs resulting from new hires, employee promotions, increased bonuses for length of service and meals allowance, as well as salary increases in accordance with the Collective Agreement for Research Activities, the new Public Sector Salary System Act (ZSPJS-AA), and the Decree on the Classification of Job Positions in Public Agencies, Public Funds, and Public Institutes into Salary Grades as of 1 April 2023.

The cost of materials and services increased by 1.3 percent compared to the previous year due to the higher volume of business. The cost of materials and services, representing 27 percent of all expenses, totalled EUR 2,132,212.

Labour costs, which accounted for 66.9 percent of total expenditure in 2024, were EUR 5,291,518, representing a 10.5 percent increase compared to the previous year. The average labour cost per employee was EUR 41,996, 3.5 percent higher than the previous year. Total revenue per employee was 1.9 percent higher than the previous year, at EUR 63,735, while total expenditure per employee was 1.3 percent higher than the previous year, at EUR 62,773.

Total expenses (in EUR)	**7,909,447**
Material and service costs	2,132,212
Labour costs	5,291,518
Depreciation costs	430,598
Other costs	47,913
Expenses	1,216
Other expenses	4,460
Revaluation operating expenses	1,530

Financial performance in 2024 compared to the plan (in EUR)

	Realisation 2024	Plan 2024	Index Realisation/ Plan
TOTAL REVENUE	**8,030,616**	**8,507,058**	**94.4**
Operating revenue	7,935,221	8,427,006	94.2
Financial revenue	70,210	65,000	108.0
Other revenue	6,233	0	/
Revaluation operating revenues	18,952	15,052	125.9
TOTAL EXPENSES	**7,909,447**	**7,936,008**	**99.7**
Material and service costs	2,132,212	2,247,940	94.9
Labour costs	5,291,518	5,169,068	102.4
Depreciation costs	430,598	450,000	95.7
Other costs	47,913	69,000	69.4
Expenses	1,216	0	/
Other expenses	4,460	0	/
Revaluation operating expenses	1,530	0	/
Excess of revenue/expenses	**121,169**	**571,049**	**21.2**

Comparison by activity – realisation and plan for 2024 (in EUR)

	Realisation 2024 Public Funds	Realisation 2024 Market	Plan 2024 Public Funds	Plan 2024 Market	Index Realisation PF/Plan	Index Realisation M/Plan
TOTAL REVENUE	**7,127,494**	**903,122**	**7,662,351**	**844,707**	**93.0**	**106.9**
Operating revenue	7,032,476	902,744	7,582,299	844,707	92.7	106.9
Financial revenue	70,205	5	65,000	0	108.0	/
Other revenue	5,861	373	0	0	/	/
Revaluation operating revenues	18,952	0	15,052	0	125.9	/
TOTAL EXPENSES	**7,069,061**	**840,386**	**7,131,192**	**804,816**	**99.1**	**104.4**
Material and service costs	1,791,093	341,119	1,929,847	318,093	92.8	107.2
Labour costs	4,819,243	472,275	4,704,165	464,903	102.4	101.6
Depreciation costs	404,566	26,032	429,180	20,820	94.3	125.0
Other costs	47,005	908	68,000	1,000	69.1	90.8
Expenses	1,167	49	0	0	/	/
Other expenses	4,457	3	0	0	/	/
Revaluation operating expenses	1,530	0	0	0	/	/
Excess of revenue/ expenses	**58,433**	**62,736**	**531,159**	**39,891**	**11.0**	**157.3**

10

Compliance with *the GRI Guidelines*

GRI indicators standardise the reporting of the economic, environmental, social, and governance impacts and performance of GeoZS.

Content Index According to GRI Standards

General Standard Disclosures

Indicator	Disclosure	Chapter / Subchapter
GRI 101: Foundation 2016		
GRI 102: General Disclosures 2016		
Organisation Presentation		
102–1	Name of the organisation	Cover of the Annual Report 2024
102–2	Primary activities and services	Summary of the Annual Report, Presentation of GeoZS, Non-financial indicators, Financial indicators, Strategic orientations and goals for 2024 and their achievement, Presentation of activities in 2024, Research programmes, Scientific publications in 2024
102–3	Headquarters of the organisation	Cover of the Annual Report 2024
102–4	Countries in which the organisation operates	Highlights of GeoZS activities in 2024, Membership in international organisations and associations, Strategic research areas, Research programmes, Stakeholder relations
102–5	Ownership and legal form	Governance and organisational structure
102–7	Size of the organisation (number of employees, number of activities, sales revenue, liabilities/equity, number of products or services)	Summary of the Annual Report 2024, Financial indicators, Non-financial indicators, Employees
102–8	Employees by type of employment, type of contract, region, and gender	Employees
102–13	Membership of organisations	Membership of international organisations and associations
Strategy and Analysis		
Ethics and Integrity		
102–16	Description of values, principles, standards, and norms of behaviour such as codes of conduct and ethics, corporate integrity	Mission, Vision, Ethics and integrity in science
Governance		
102–18	Governance structure of the organisation	Governance and organisational structure
Stakeholder Relations		
102–40	List of stakeholder groups with which the organisation cooperates	Stakeholder relations and knowledge sharing, Stakeholder network
102–42	Basis for identifying and selecting stakeholders with whom the organisation cooperates or engages	Stakeholder relations and knowledge sharing
102–43	Approaches to stakeholder engagement, including frequency of engagement by stakeholder groups	Stakeholder relations, Communication tools
Report Data		
102–50	Reporting period	Summary of the Annual Report 2024
102–52	Reporting cycle	Summary of the Annual Report 2024
102–54	Reference to reporting in accordance with GRI	Compliance with GRI Guidelines
102–55	GRI Content Index	Compliance with GRI Guidelines

Specific Standard Disclosures

Management Approaches and Disclosures	Material Topics	Chapter / Subchapter
ECONOMIC IMPACT		
GRI 201: Economic Performance		
103–1, 103–2, 103–3	Explanation of the material topic and its boundaries	Summary of the Annual Report 2024, Financial capital
201–1	Directly created and distributed economic value (revenues, operating costs, employee wages and benefits, taxes, donations, and other community investments)	Summary of the Annual Report 2024, Value chain creation, Financial report
ENVIRONMENTAL IMPACT		
GRI 307: Compliance		
103–1, 103–2, 103–3	Explanation of the material topic and its boundaries	Summary of the Annual Report 2024, Non-financial indicators, Strategic research areas, Research programmes
SOCIAL IMPACT		
GRI 401: Employment		
103–1, 103–2, 103–3	Explanation of the material topic and its boundaries	Employees
401–1	Number and rate of new employee hires and employee turnover	Employees
GRI 404: Training and Education		
103–1, 103–2, 103–3	Explanation of the material topic and its boundaries	Human capital, Employees
404–1	Education and training	Employees
GRI 405: Diversity and Equal Opportunity		
103–1, 103–2, 103–3	Explanation of the material topic and its boundaries	Ensuring gender equality
405–1	Composition of governance bodies and employee structure by employee category (by gender, age – under 30, 30–50, over 50, minorities, and other relevant diversity indicators)	Governance and organisation, Employees

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Geološki zavod Slovenije
Dimičeva ulica 14, 1000 Ljubljana
Tel: 01 2809-700 / Fax: 01 2809-753
info@geo-zs.si / www.geo-zs.si