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Chairmen
Prof. Dr. habil. Eng. Mihai Emilian Popa
Prof. Dr. Eng. Cristian Mărunțeanu
Dr. Marin Palcu

PROGRAMME

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Raluca Dinescu, Mircea Radulian, Ioan Munteanu	Seismic network of Romania: from past to present	12.30 – 12.50
Gabriela Mariana Dragomir	Geotechnical characterization of marly clay and marl from the Suceava area: an empirical approach-case of study	12.50 – 13.10
Constantin Lazăr, Gabriel Ion, Mihaela Carmen Melinte-Dobrinescu	Quaternary geological evolution of the NW Black Sea continental shelf: palaeogeographical and palaeoecological implications	13.10 – 13.30
Oliver Livanov	2023 magnetometry field campaign results	13.30 – 13.50
Mihalcea Cristian, Mihaela Melinte-Dobrinescu, Ioan Munteanu	Architecture of folds and thrust belt of the Eastern Carpathians: case study Moineşti area	13.50 – 14.10
Valentin Nistor, Ernst Willingshofer, Ioan Munteanu, Liviu Mațenco	Analogue modelling of break-thrust folding kinematics in strata with contrasting rheological layering: preliminary inferences for understanding the evolution of the marginal folds nappe in the East Carpathians	14.10 – 14.30
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Scrădeanu	hydrogeological conditions in the Zarqa main hydrographic Basin (Dead Sea)	14.50
Maria Pârlea	U-Pb-Th geochronology on zircon and titanite at the University of Bucharest's new isotope laboratory	14.50 – 15.10
Adrian Popa, Mihai Emilian Popa	Naval mines detection using geophysical methods and remote operated vehicles (rovs)	13.10 – 13.30
Adriana Stoica, Gheorghe Popescu	Preliminary results on the mineralogical study of garnet phenocrysts from South Apuseni Neogene magmas	13.30 – 13.50
Alexandru Verioti	Measures to reduce the pollution risk of medium-high depth groundwater sources in metropolitan Constanța area	14.30 – 14.40
Adrian Talmaciu, Bogdan Mihai Niculescu	Geoelectrical identification of tectonic features related to geothermal water occurences in Mangalia area (South Dobrogea)	14.40 – 15.00
Mihai Emilian Popa, Cristian Mărunțeanu, Marin Palcu	Concluding remarks	15.00-15-10

ABSTRACTS

MID-CRETACEOUS ANOXIC EVENTS IN THE EASTERN CARPATHIANS

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Keywords: Cretaceous, anoxic, isotope, biostratigraphy.

This study is focused on the Oceanic Anoxic Events (OAEs) that occur within the Albian-Turonian interval in the outer Eastern Carpathians (Vrancea Nappe), aiming to evaluate the sedimentological processes along with the biostratigraphy. Furthermore, the chemostratigraphy ($\delta^{13}C_{org}$ isotope) was investigated to highlight the possible anoxic events.

Our work focuses on the Lepsa section, which is situated in the Vrancea Nappe (Outer Moldavides). This section shows a typical lithology for discovering anoxic events. The main challenge was to discriminate between the regional and the global control of the black shale sedimentation.
Two lithological units are cropping out in the studied area: (i)The Lower Cretaceous Streiu Formation (300-350m in thickness) that consists of alternating black and dark-grey shales, grey marls, and convolute calcareous sandstones; (ii) The Upper Cretaceous Tisaru Formation (100-110m in thickness) which is divided in two members: the Lower Member, dominated by couplets of greenish-black shales and radiolarites, and the Upper Member, composed mainly of variegated (greenish and red) shales. Based on calcareous nannofossil investigations, the age of the whole studied succession is late Albian - early Turonian (UC0 up to UC7 biozones).

The investigated succession contains OAEs which were pointed out based on their lithological overprint (black shales), chemostratigraphy ($\delta^{13}C$ isotope fluctuation), and based on calcareous nannofossils assemblages. The Albian-Cenomanian interval has been thoroughly sampled (4 samples/m) for geochemistry and biostratigraphy analysis.

Beside the fluctuations of total organic carbon (TOC), two positive excursions of $\delta^{13}C_{org}$ have been identified. The first is placed in the upper Albian, probably corresponding to the OAE1d, below the LO (last occurrence) of the nannofossil *Hayesites albiensis*. The second positive excursion of $\delta^{13}C_{org}$ is situated in the mid-Cenomanian, slightly above the FO (first occurrence) of the nannofossil *Lithraphidites acutus*, and might be assigned to the mid-Cenomanian Event (MCE).

For the further validation and investigations of these statements and for being able to distinguish between global versus regional influences, additional biostratigraphic analyses are required for more rigorous age control, along with the $\delta^{13}C_{org}$ multiplication analysis in order to investigate the Albian/Cenomanian and Cenomanian/Turonian stratigraphic limits.

SEISMIC NETWORK OF ROMANIA: FROM PAST TO PRESENT

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Keywords: seismic monitoring, seismographs, seismograms, analogue instrumentation.

Natural events such as earthquakes may occur suddenly and without warning. To get information about earthquakes and their seismic impacts we are using continuous monitoring with seismic stations that record the arrival times of the waves. Romania is one of the first countries in the world involved in earthquake monitoring, due to its high seismic activity at the crustal and intermediate depth levels. Seismic monitoring has been established there since the 19th century. Over 35,000 seismic events located in Romania (magnitude ranging from 0 to 7.7) have been detected and registered in Romania since 1900.

The first seismic station was installed in 1894 in Filaret-Bucharest meteorological observatory and had two components: a microseismoscop Guzzantu and a seismograph Tacchini pendulum. In 1902, two Bosch type seismographs with smocked paper were installed in the same location. This equipment ensured the seismic monitoring for Bucharest until 1958.

In 1977, after the major earthquake from the 4th of March 1977, the Centre for Earth Physics and Seismology was created under the State Committee for Nuclear Energy authority to offer better monitoring of the Vrancea region. During the 1980-1982 years, 18 telemetered seismic stations were installed in Vrancea area, with 4 stations in the inner (western) Carpathians and 14 stations located in the outer (eastern) part of the Carpathians.

The development of the seismic network of Romania continues today with more than 200 short-period and broadband permanent and temporary seismic stations installed and a real-time monitoring. The scope of the present work is to describe and discuss the evolution of the seismic monitoring in Romania and its increased capability to detect, locate and evaluate the earthquake effects.

GEOTECHNICAL CHARACTERIZATION OF MARLY CLAY AND MARL FROM THE SUCEAVA AREA: AN EMPIRICAL APPROACH-CASE OF STUDY

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Keywords: marl, Suceava, clay, permeability.

This research investigates the geotechnical properties of marly formations in the Suceava area by integrating granulometry, limits, index value, and free swelling analysis. The study aims to establish a comprehensive understanding of the physical behavior of these formations by exploring the relationships between carbonate content, clay minerals, and key geotechnical parameters, including permeability, consolidation coefficient, and characteristic values. In addition to traditional geotechnical parameters, the research emphasizes the influence of carbonate content and clay minerals on the physical behavior of marly formations. The relationships between these mineralogical aspects and geotechnical properties such as permeability, consolidation coefficient, and characteristic values are explored. This integrated approach enhances the understanding of the material's behavior, allowing for a more accurate assessment of its engineering properties.

The results of this study contribute to the advancement of geotechnical knowledge specific to marly formations in the Suceava area. The incorporation of mineralogical analysis alongside traditional geotechnical testing provides a more nuanced understanding of the factors influencing the physical behavior of these formations. The outcomes of this research have implications for engineering practices in similar geological contexts, aiding in the development of informed and effective strategies for construction and infrastructure projects in marly terrains.

QUATERNARY GEOLOGICAL EVOLUTION OF THE NW BLACK SEA CONTINENTAL SHELF: PALAEOGEOGRAPHICAL AND PALAEOECOLOGICAL IMPLICATIONS

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Keywords: Quaternary, Palaeogeography, Palaeoecology, Black Sea.

The Black Sea is an elliptical basin with an area of 423,000 Km2 and a volume of 534,000 Km3 and a maximum depth of 2,212 m. Since the only connection of the Black Sea with the global ocean is through the Bosporus Strait, which is less than 50 m water-depth, this marine basin represents a semi-isolated marginal sea, which sensitively reacts to environmental changes.

Back to the Last Glacial Maximum (LGM), 21,000 years ago, the Black Sea was probably a giant freshwater to semi–brackish-water lake, or at least a brackish enclosed basin. During the Early Holocene, around 7,000 years ago, an outstanding event took place in the Black Sea basin, i.e., the reconnection with Mediterranean, which marked the end of the lacustrine phase of this basin and the onset of a marine anoxic regime, similar to the present day one.

Since LGM regressions and transgressions produced by the successive sea level variations have controlled the formation and destruction of the paleo-shorelines and corresponding hydrographic networks.

The aim of the study is to refine the Black Sea paleosetting and the geological evolution corresponding to the Pleistocene to Holocene interval. An integration of the lithological data, fossil records, absolute dating, geochemistry along with high-resolution geophysics (seismics and bathymetry) will be performed.

2023 MAGNETOMETRY FIELD CAMPAIGN RESULTS

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Noviodunum held significance as a Roman and later Byzantine settlement due to its strategic location, cultural exchange, and its role in facilitating trade and connectivity within the empire provinces. The archaeological diggings in the area have revealed remains of necropoleis, kilns, public baths, and other structures, providing valuable insights into Roman/Byzantine urban planning and daily life during that era.

It's important to note that archaeological sites often attract multidisciplinary research efforts, and geomagnetic surveys are among the various methods used in archaeological investigations to understand subsurface structures without excavation.

In recent years, a series of geomagnetic measurements have been undertaken in the extramural area of the Noviodunum fortress. Between 2021-2022, a perimeter located SW of the fortress was surveyed. In 2023, geomagnetic investigations continued in this area, along with another perimeter in the SE part of the fortress. Of course, the 2023 research also revealed new magnetic anomalies with possible archaeological implications.

In the context of Noviodunum or other archaeological sites, magnetometry surveys could provide valuable insights into the layout, organization, and potential hidden structures of the ancient settlement, aiding archaeologists in their research and understanding of the site's history and significance.

ARCHITECTURE OF FOLDS AND THRUST BELT OF THE EASTERN CARPATHIANS: CASE STUDY MOINEŞTI AREA

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From a geostructural perspective, within the Eastern Carpathians fold and thrust belt, several structural styles can be distinguished, corresponding to well-defined structural stages during the evolution of this belt. These zones are aligned along the mountain range in nappes or systems of nappes, which are generally much younger in the East. From the West towards East, some areas are delineated as follows: the metamorphic core zone and the fold and thrust belt; the later one was classically separated into internal flysch, median flysch, and external flysch (in which area included Tarcău, Vrancea and Subcarpathian nappes).

The studied area Moinești is located within Bacău County and, geologically, it is in the Paleogene-Miocene folds and thrust belt of the Subcarpathian Nappe, representing the most external part of the Eastern Carpathian nappes, covered by thrusted sediments of the inner (western) Tarcău Nappe.

Using the modern geological and geophysical investigation methods we have revealed the internal architecture of these area and constrain a new geological models and structures using 3D seismic methods, tomography in boreholes, "walk away" and "walk above" seismic methods in boreholes, as well as modern borehole geophysics tools such as, QuantaGeo, Formation Micro-Imager, Ultrasonic Borehole Imager (UBI) and Dipolsonic.

Different from the classical interpretations where the fault zones are presented as a characteristic feature of the Tarcău nappes, developing to the North of Moinești and in Târgu Ocna region, our interpretation reveals that the structure resembles a duplex stack of the marginal fold units. Seismic correlation and borehole data have enabled a much more precise structural interpretation, leading to the development of a new geological model, confirmed by new wells. From seismic and borehole geophysical data, it can be concluded that the Moinești area is composed of a series thrust nappes. This area represents a distinct structural zone, and the structural elements are separated by faults. These findings lead to the conclusion that typical duplex structures are present in the area. Upon studying the seismic and borehole geophysical data within the studied area, it has been observed the typical mechanical characteristics of a "duplex stack". This led to the conclusion that the studied area follows a new and interesting geological and structural model.

ANALOGUE MODELLING OF BREAK-THRUST FOLDING KINEMATICS IN STRATA WITH CONTRASTING RHEOLOGICAL LAYERING: PRELIMINARY INFERENCES FOR UNDERSTANDING THE EVOLUTION OF THE MARGINAL FOLDS NAPPE IN THE EAST CARPATHIANS

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Keywords: analogue modelling, decollement, sand, glass beads, PDMS, strain rate.

Analogue modelling is a useful tool to understand the kinematics of deformation, particularly useful to derive the mechanical behavior of contrasting rheologies during the formation and evolution of fold and thrust belts. One interesting place where the analogue modelling is particularly well suited is the external part of the East Carpathians, where the alternance of rheologically contrasting lithologies of the Marginal Folds nappe has created a structural style locally known as “scale folds”, which is a variation of break-thrust folding whose mechanics of deformation is not yet understood. Understanding the mechanics of this deformation is fundamentally important for accurate predictions of the geometry of buried reservoirs, relevant for both the conventional and sustainable georesources exploration.

The analogue modelling approach is characterized by a simplified layer-cake brittle-ductile stratigraphy grouped in four mechanical groups and a scaled-to nature reference model (in respect to geometrical, kinematics, strain-rate and dynamic similarities) built by and alternance between two ductile and two brittle layers. The reference model is complemented by a parametrical study, where the

variability of the strain rate, decollement material (e.g., PDMS or glass beads), thickness and the number of ductile layers is gradually studied in subsequent modelling runs. The models were studied by surface scanning during deformation and cross-sections at the end of the modelling time, complemented by CT scanning of the internal deformation for studying in detail the kinematic evolution.

The results show that the model made only of feldspar sand is too brittle and the amount of the forethrusts is relatively proportional with the amount of backthrusts, with no break-thrust geometries observed. The model were glass beads were used as a bottom decollement the dominant structures are first order thrusts with large displacement, no backthrusts or overturned flanks. The model with two decollement layers made of PDMS shows that the uppermost one accommodates most of the displacement. The most similar geometries to break-thrust folding were observed in the model with two layers of decollement, low strain rate (5cm/h) and a 50% shortening. These preliminary results are promising in the further research of understanding the scale-folds of the East Carpathians, which will be further pursued by the means of additional analogue modelling.

THE IMPACT OF CLIMATE CHANGES ON THE HYDROLOGICAL AND HYDROGEOLOGICAL CONDITIONS IN THE ZARQA MAIN HYDROGRAPHIC BASIN (DEAD SEA)

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Introduction and study objectives

The issue of global climate change has begun to play an increasing role in scientific and policy debates over effective water management. The article describes and discusses the concerning of the geological and hydrogeological conditions in the Zarqa Ma'in basin (ZMB), directly conditioned by the geomorphology of the land due to the climate regime.

In recent years, the evidence that global climate change will have significant effects on water resources in Jordan and particularly in Zarqa Ma'in basin (ZMB) has continued to accumulate.

This study aims to reduce the effects of flash flood risks that occur in the study area due to climatic regime that change the physical characteristics of the hydrological system in the Middle East and the impact already appearing worldwide.

The Zarqa Ma'in region has a moderate to high relief with elevations ranging from -348 m below sea level to 924 m above sea level. Due to the high relief of the study area, especially in the southwestern part, the risk of damage from a flash flood is very high. Zarqa Ma'in area is very hilly with steep slopes without soil. Soil erosion and runoff rate are directly proportional to slope.

Methodology

The proposed methodology based on the analysis over 20 years data of the precipitation, slope, infiltration and temperatures where the DIGITAL ELEVATION MODEL (DEM) was extracted to analyze the catchment area, flow accumulation, channel network and the flow path.

The conceptual approach of the physical base with available data has been adopted, which allows a better understanding of the physical nature of the basin (land use and topography) and the meteorological (precipitation and runoff). Satellite imagery was used to map land use and morphological features. The geological data used in the current study will help to understand the different rock units and map the different soil units. Hydrological data, including historical records from the precipitation dataset, are used for precipitation analysis and statistical distributions, also evaporation and climatological data such as (temperature, relative humidity and wind speed) are considered for flood calculations. The hydrological data set was collected by the Ministry of Water and Irrigation (MWI) and the Jordan Meteorological Department (JMD) and the Ministry of Energy and

Mineral Resources (MEMR) and the Ministry of Municipals Affairs (MMA) and Energy and Minerals Regulatory Commission (EMRC).

Results and conclusions

Analysis of climate data and insights show that an increase in precipitation is associated with an increase in temperature and a decrease in relative humidity over time. This could be attributed to climate change. In addition, as the air temperature rises, the air can contain more water particles, and its relative humidity decreases. However, in arid areas, relative humidity increases at night and during temperature drops, increasing the likelihood of precipitation. Climate change leads to flash floods. This is due to several factors, including increased rainfall. Going forward, heavy precipitation (along with temperatures) is forecast to increase due to climate change. These include extreme weather events known as atmospheric fluxes, which are water-laden air currents from the tropics.

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I would also be happy to extend my thanks and appreciation to Eng. Alexandra Megahed and my friends from Jordan, who have helped with collecting the data for this research, and I also extend my thanks and gratitude to the university administration, which has played the greatest role in providing facilities and services to all of the students.

U-Pb-Th GEOCHRONOLOGY ON ZIRCON AND TITANITE AT THE UNIVERSITY OF BUCHAREST'S NEW ISOTOPE LABORATORY

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Key words: zircon, titanite, geochronology, U-Pb dating.

Tests on the new laser ablation ICP-MS laboratory of the University of Bucharest started in August 2023 for geochronology. Concentrated zircon and/or sphene are separated from while rocks via routine techniques involving crushing, sieving, magnetic separation and optical picking at the new Prep laboratory of the University of Bucharest. Crystals are then mounted in epoxy, although thin sections, or small rock chips can also be used. We use a new gen 193 nm excimer laser made by Teledyne PhotoMachine called Iridia. Samples are introduced in a sample exchange cell where it is ablated. For a standard U-Pb age determination on zircons and titanites we use a fluence (power of laser, that can be increased for harder materials) of 3,6 J/cm^2 for zircons and 3,8 J/cm^2 for titanite with at a rep rate of 10Hz, with a spot size of 35 microns for both. Spot seizes can be decreased to less than 15 microns when needed. The ablation time is 40 s with 10 seconds pre-ablation for background measurement and 10 seconds after for the signal to clear up. The samples are usually measured with a standard (SLF for zircons and BLR for titanites) that follow the pattern: 3 standard points at the beginning and end, and 2 standard points for every 5 unknown points. For this laser the inert gas used is Nitrogen and the carrier gas is high purity Helium.

The ablated aerosol is then carried into the ICP-MS which is an iCap quadrupole ICP-MS with a plasma torch that uses argon. We use a proprietary spray chamber optimized for geochronology. The sample is ionized and then the intensity of the signal is measured as cps. Dwell times are optimized for the particular instrument-laser ablation combo and they are (^{206}Pb – 0.0384, s ^{207}Pb – 0.6115 s, ^{208}Pb –

0.1314 s, ^{232}Th – 0.0034 s, ^{235}U – 0.3373 s, ^{238}U – 0.0025 s). We reduce raw intensities with the Teledyne proprietary software HDIP or the commercially available IOLITE (Paton et al., 2010).

Early runs or both magmatic and detrital zircon suites as well as various magmatic titanites were able to reproduce ages of all measured standards as unknowns with precisions and accuracies similar to or better than ages reported on higher resolution ICP-MS instruments elsewhere. The caveat of using a quadrupole ICP-MS is that one cannot measure 204Pb and perform fine tune common lead corrections such as Stacey-Kramers.

As is, the experimental runs can measure ages of zircons and titanites with high precision spanning age ranges from a few Million years to Archean. Ongoing efforts are targeted at measuring ages and trace elements of zircons and titanites simultaneously.

NAVAL MINES DETECTION USING GEOPHYSICAL METHODS AND REMOTE OPERATED VEHICLES (ROVS)

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Keywords: Black Sea, Romanian Waters, Naval Mines.

In World War Two (WW2) as well as in recent times (Russian invasion of Ukraine), thousands of naval mines were used in Black Sea either to protect national water, to restrict shipping or access the enemy waters. Other types of ordnance were sunken with the ships transporting them. Most of the naval mines were destroyed in wartime or decommissioned after, while some were caught in fishermen's nets. Still, many naval mines and unexploded ordnance still exist and pose a danger for coastal as well as for deep waters, for all naval activity including shipping and fishing, tourism and research. Finding these items may be done in a safe manner with the help of geophysical methods employing a multibeam echosounder (MBES), a sidescan sonar (SS), a magnetometer or by a remote operated vehicle (ROV). The best approach is to use all, integrated geophysical methods to acquire the best data possible. Employing only geophysical methods does not imply the certainty that a possible target is a real naval mine or an unexploded ordnance, a ROV or divers must be employed to verify the geophysical data. For practical reasons, as well as for safety concerns, deploying a ROV is preferable. In November 2023, a cruise aimed to discover naval mines from WW2 took place in Romanian waters of the Black Sea. The research conducted by NIRD GeoEcoMar took place onboard RV Mare Nigrum, and the main tools employed were a Norbit iWBMSh MBES, a Kongsberg SAR 6100 sidescan sonar and a Vector 500 ROV. The very good spatial resolution, 20 cm/pixel for MBES and 10 cm/pixel for sidescan sonar, allowed us to detect many potential targets for the ROV search. Some of the targets discovered may be related to naval mines, while others may belong to ships that were sunken nearby. The research was carried out in the framework of the project EROVMUS, Reference Number: MarTERA-2020_109, funded by the European Union under the Grant Agreement no. 101102316.

PRELIMINARY RESULTS ON THE MINERALOGICAL STUDY OF GARNET PHENOCRYSTS FROM SOUTH APUSENI NEOGENE MAGMAS

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Keywords: igneous garnet, almandine, South Apuseni, Neogene magmatism.

We report preliminary results regarding the mineral characterisation of garnets and their mineral inclusions, on five occurrences of Neogene garnet-bearing andesites and dacites from South Apuseni, Romania, with a purpose of determining their ultimate origin (as pre-anatectic, peritectic or cotectic phase). In all five localities (two from Brad area, and three from Stănija - Almașul Mare), garnets occur as rare 3-5 mm anhedral phenocrysts, and exhibit concave resorption margins and reaction coronas consisting of plagioclase feldspar, chlorite, Fe-Ti oxides and apatite. Their major element chemistry shows that garnets in all studied areas are almandine-rich, with a mineral formula $Alm_{59-63}Pyr_{12-20}Gros_{12-15}Spes_{5-13}$, and generally display a homogeneous or slightly zoned composition from core to rim. The mineral phase assemblage included in garnets consists of rounded blebs of Fe-Ti oxides, patches of anhedral plagioclase aggregates, euhedral apatites and zircons, and rare rutile needles and sulphides. Applied oxithermometry on magnetite - ilmenite pairs yielded crystallisation temperatures of 715-730°C for Brad samples, and 780-830°C for Stănija - Almașul Mare samples. Oxygen fugacity ranges between QFM+0.4 - QFM+1.4 in Brad samples, and slightly lower QFM+0.2 - QFM+0.75 in Stănija - Almașul Mare samples. *In-situ* U/Pb dataset obtained on garnet-shielded zircons from Brad area yielded a Miocene age (11-12 Ma ± 3 Ma) which precludes any inherited provenance for their mineral host and demonstrate the magmatic origin of the studied garnets. Based on their major element composition, mineral inclusion assemblage, U/Pb data on included zircons, and their mode of occurrence, we propose that the garnet phenocrysts studied here are ortho- or antecrysts, resulted from the cotectic crystallisation, along with their included mineral cargo, in a cooling silicic, slightly oxidised magma at depth.

GEOELECTRICAL IDENTIFICATION OF TECTONIC FEATURES RELATED TO GEOTHERMAL WATER OCCURENCES IN MANGALIA AREA (SOUTH DOBROGEA)

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Keywords: geophysical, geoelectric, thermal mineral waters, GIS.

In August 2023, together with a team of geophysicists from IGR and a group of students from the Faculty of Geology and Geophysics, under the leadership of Professor Bogdan Niculescu, geophysical investigations were conducted in the form of geoelectric measurements in the Balta Mangalia area and east of Costinesti. These investigations follow measurements made a year ago, in the company of the same team of geophysicists.

The main objective is to extend geophysical measurements mainly in the resort area of Mangalia, where multiple occurrences/springs of thermal mineral waters are documented, in order to clearly highlight the tectonic alignments that favor the circulation of these waters.

The recorded geoelectrical data were processed with RES2DINV software, placed on coordinates in AutoCAD and subsequently placed in GIS format in the Global Mapper program.

MEASURES TO REDUCE THE POLLUTION RISK OF MEDIUM-HIGH DEPTH GROUNDWATER SOURCES IN METROPOLITAN CONSTANȚA AREA

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Keywords: hydrogeological, piezometric, groundwater.

Introduction

This study proposes an analysis of risks that may occur and may cause alteration of groundwater quantity and quality in the metropolitan area of Constanta, and the measures that we have taken to reduce or eliminate these risks.

Given the vital importance of groundwater's quality in providing the county's residents, the water company RAJA S.A. has implemented a quality management system that ensures the optimal quality and quantity of water provided to its clients. Therefore, for tracking groundwater quality we take in consideration a permanent monitoring of hydrogeological parameters, physical and chemical indicators of aquifers.

Constanta metropolitan area is mainly supplied with water from four groundwater sources located in the south and southwest of Lake Siutghiol. Water sources account 75 water wells whose installed capacity is about 4.0 m3/sec. During summer when the consumption reaches its peak, these groundwater sources supply water to over 500,000 people, including Mamaia resort.

Results and Discussion

We analyzed the evolution of aquifer piezometric head in area located close to Lake Siutghiol, for the period 1988-2023. We studied and observed if is a visible connection between the aquifer piezometric head level evolution and lake head. This helped us to understand the hydraulic connection between this water bodies, and where are this connections located.

In terms of water chemistry of the lake and the aquifer, as reflected in the variation diagrams of chemical parameters of water (Ca, NO3, Chlorides) shows the following:
We see a poor correlation between water chemistry of the aquifer and of the lake (for parameters Ca and NO3).

As a result we conclude that between lake and aquifer a hydraulic connection exists, the low volumes of water drained from each does not significantly affect the groundwater water quality. For Chlorides we didn't find any significant variations in the two environments. Therefore there is no risk of pollution with chlorine, much less from Black Sea, located around 1 km away from the abstractions of groundwater. As long as we keep the average head of the groundwater aquifer above the average lake head, we consider a very low risk for any pollution.

Also, we analyzed other parameters, like NO3, fix residue and specific waste water parameters to analyses if any leaks from surface and from upper aquifer can occurs in lower aquifer.

Main Conclusions

The hydraulic relationship between the aquifer and surface water existing in the studied area is relatively weak. Independent relative evolution levels of groundwater and lake water and insignificant correlations between the chemistry of this two sources of water, draw us to these conclusions, using other arguments:

Geological argument – the Cretaceous and Jurassic limestones and dolomites layer which store the aquifer is protected by a superficial layers of compact Senonian chalk (thiknes ~40m), which extends into the Black Sea shelf. This layer of chalk presents a certain small areas of cracks and fissures (including along the major fault Capidava-Ovidiu) that allow poor hydraulic connection between aquifer and lake

Hydraulic argument - filter coefficient below 0.5 m / day of chalky rocks, the compact nature of this rocks and lack of high developed system of faults and cracks makes the water drainage difficult between this two aquatic environments and with a long reaction (2-3 years). Thus chalky rock meets the optimum conditions for water filtration in any eventually pronounced drain surface water.

The measures we have taken in terms of investments in the infrastructure of household sewage networks with EU founds and RAJA SA own founds and extended hydrogeological protections area and sanitary areas for grownd water sources have led to a significant reduction of the risk factors that can pollute the water source.

Almost all developed urbane areas that surrounding the source have been covered with unitary wastewater pipes networks to collect the waste waters from buildings. Also, pump stations have been modernized to eliminate the waste water from this area and avoid any accidental leaks or discharges.