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Earth and Space Sciences PhD Seminar I, II & III
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Section 1 - Moderator: Md Ashiqur Rahman

Presentation P1/S1

**Vegetation indices monitoring for water resources management:
Preliminary results**

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Abstract:

In developing countries like Angola, water resources management has become a challenging problem. Earth Observation (EO) data and remote sensing technology has been used in African countries to map land cover of large and often inaccessible areas, providing useful information on qualitative and quantitative land cover changes. The lack of information on land cover monitoring has a huge impact on the water resources management. Knowledge of land cover such as different vegetation characteristics can therefore be related to water table fluctuations and groundwater dynamics. Furthermore, information about vegetation dynamics can be linked with groundwater flow patterns and recharge zones [2]. The normalized difference vegetation index (NDVI) is a critical parameter for identifying vegetation, and it has an obvious correlation with vegetation cover. Vegetation changes spatially and seasonally, therefore areas that have the same vegetation exhibit similar temporal variations. Therefore, the NDVI time-series information derived from long-term remote-sensing imagery is a crucial source of information for land cover analysis and classification [1]. The purpose of this study is to present a preliminary study aiming at finding a feasible methodology for identification of ground flow patterns using MODIS (Moderate Resolution Imaging Spectroradiometer) NDVI time series product.

Keywords: Land cover, NDVI, water resources.

References:

[1] Long Zhao, Pan Zhang, Xiaoyi Ma, Zhuokun Pan. (2017). Land Cover Information Extraction Based on Daily NDVI Time Series and Multiclassifier Combination. *Mathematical Problems in Engineering*, vol. 2017, Article ID 6824051, 13 pages. <https://doi.org/10.1155/2017/6824051>.

[2] Phiri, Margaret & Shiferaw, Yegnanew & Tesfamichael, Solomon. (2018). Modelling the relationship between groundwater depth and NDVI using time series regression with Distributed Lag M. *South African Journal of Geomatics*. 7. 147. 10.4314/sajg.v7i2.4.



Section 1 - Moderator: Md Ashiqur Rahman

Presentation P2/S1

Tracing raw materials and technological choices for pottery manufacture: an archaeometric approach

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Abstract:

The focus of this presentation is the importance of the integration of raw materials investigation into ceramic studies. Ceramic studies aim to provide a better understanding about past societies through the social, economic and technological conceptual framework of pottery production. A geological survey in a specific area and the geochemical and mineralogical characterization of the collected raw materials allows the assessment of the geochemical diversity of the area and consequently the establishment of a chemical pattern for each of the various ceramic traditions. The technological choices followed in pottery production have a great impact on the ceramic signature. Under the concept of experimental archaeology and through the application of a multi-analytical methodology on raw materials and archaeological ceramics, it is attempted to reconstruct pottery recipes and, thus, to offer important insights into past cultures.

Keywords: Archaeometry; Geophysical Sciences; Geology; Pottery

References:

1. Albero Santacreu, D. Materiality, Techniques and Society in Pottery Production: The Technological Study of Archaeological Ceramics through Paste Analysis (De Gruyter Open Ltd, 2014).
2. Day, P., Relaki, M. & Todaro, S. Living from pots? Ceramic perspectives on the economies of Prepalatial Crete in Political Economies of the Bronze Age Aegean, Proceedings of the Langford Conference (ed. D. J. Pullen) 205-229 (Oxbow, 2010).
3. Hein, A. & Kilikoglou, V. Ceramic raw materials: how to recognize them and locate the supply basins: chemistry. Archaeological and Anthropological Sciences 12, (2020).
4. Maniatis, Y. The Emergence of Ceramic Technology and its Evolution as Revealed with the use of Scientific Techniques. From Mine to Microscope: Advances in the Study of Ancient Technology in From Mine to Microscope: Advances in the Study of Ancient Technology (eds. Shortland A. J., Freestone I. &Rehren T.) (Oxbow, 2009).
5. Rice, P. M. Pottery Analysis: A Sourcebook (The University of Chicago Press,1987).



Section 1 - Moderator: Md Ashiqur Rahman

Presentation P3/S1

Anthropogenic Pressures and Physicochemical Characterization in the waters of the Catumbela Benguela river – Angola

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Abstract:

The commune of Catumbela is located in the Benguela province, Angola and is crossed by the River Catumbela. The region has a hot semi-arid climate and its geomorphology is characterized by several plateaus roughly parallel to the coast line and with increasing altitudes to the east. In the city of Lobito and Catumbela, the maximum precipitations are recorded from November to March and the minimum from May to September whose annual averages vary, being < 350mm and < 395, respectively. The average annual temperature is around 23-24°C, the average annual minimum ranges from 18-20°C, the warmest average is 29°C, with a 7-8°C annual temperature range.

The Catumbela River has a route of almost 250 km and originates in the mountains of Cassoco, located in the province of Huíla and flows into the Atlantic Ocean, not in the municipality of Catumbela. During its journey its main tributaries are the Cuiva River, on the right bank, and the Cubal River, on the left bank.

The outcropping carbonate rocks are from Cretaceous. The River Catumbela has a very high amount of suspended load, a big flux and a big caudal, especially during the raining season.

Keywords: Catumbela river, water, anthropogenic contamination

References:

Tchikuala, E.F. (2010)- Caracterização físico-química e avaliação de impactes antrópicos na água do Rio Catumbela, Benguela-Angola. Tese de Mestrado não publicada. Universidade de Coimbra, 42 pp.



Section 1 - Moderator: Md Ashiqur Rahman

Presentation P4/S1

Bibliography and Index of Portuguese conodonts (1963-2020)

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Abstract:

A summary of the bibliography concerning Portuguese conodont fossil occurrences, as well as a list of all identified taxa, are presented in this paper. A total of 18 articles and conference papers were found to have descriptions or references to Portuguese conodonts, starting with the work of Boogaard (1963). The discoveries were made in calcareous outcrops from Central Iberian Zone (Buçaco Syncline, Moncorvo Syncline), Ossa-Morena Zone (Cabrela Basin, Odivelas Limestone, Ferrarias Anticline, Ficalho-Moura Anticline) and South Portuguese Terrain (Phylito-Quartzite Group), ranging from the Upper Ordovician to the early Carboniferous. As for the species list, 189 taxa are identified, belonging to 44 different genera, although only 126 are based on P or coniform elements (required for a confident identification). From those 126 identifications, the most commonly identified genera are *Icriodus* (8 ids.), *Palmatolepis* (28 ids.), *Polygnathus* (36 ids.) and *Spathognathodus* (16 ids.). A systematic revision of this material is yet to be done.

Keywords: Conodonts; micropaleontology; Paleozoic; Portugal

References:

Boogaard, M. van den, 1963. Conodonts of Upper Devonian and Lower Carboniferous age from Southern Portugal. *Geologie en Mijnbouw*, 42: 248-259.



Section 1 - Moderator: Md Ashiqur Rahman

Presentation P5/S1

Geochemical and geophysical surveys applicate in the VHMS exploration in the Portuguese sector of Iberian Pyrite Belt

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Abstract:

The application of geochemical and geophysical techniques to massive sulphide deposits exploration (VHMS) has proven to be a success in the Iberian Pyrite Belt (IPB) metallogenetic province, both in Portugal and in Spain (Matos et al., 2020; Morais et al., 2020). Together, these techniques led to the discovery of a large number of blind deposits (Feitais and Cerro da Carrasca in Aljustrel and Lagoa Salgada). The methodology used by Portuguese state (ex Serviço de Fomento Mineiro) is easy: Application of a large number of techniques for the study of a particular geological object. In this way and for a given area, geological survey (sometimes at 1:5000 scale) was elaborate and applied a set of geophysical techniques (gravimetry, magnetometry, induced polarization, etc) and soils and stream sediments were collected. Currently, exploration activities are mainly carried out by mining companies with research contracts with Portuguese State. The Laboratório Nacional de Energia e Geologia (LNEG) is current the repository of a vast geological, geophysical and geochemical information. The LNEG databases are frequently requested by exploration companies and universities for the study of strategic sectors in the IPB, significantly increasing the geological knowledge of the belt.

Keywords: Iberian Pyrite Belt, geochemical, geophysical, databases

References:

Matos, J. X., Carvalho, J., Represas, P., Batista, M. J., Sousa, P., Ramalho, E. C., Marques, F., Morais, I., Albardeiro, L., Gonçalves, P., Dias, P. (2020) - Geophysical surveys in the Portuguese sector of the Iberian Pyrite Belt: a global overview focused on the massive sulphide exploration and geologic interpretation, *Comunicações Geológicas* 107, Especial III (Volume Especial Explora), 41-78.

Morais, I., Albardeiro, L., Batista, M. J., Matos, J. X., Solá, R., de Oliveira, D., Salgueiro, R., Araújo, V., Pacheco, N. (2020) – Geochemistry of Iberian Pyrite Belt Portuguese sector massive sulfide deposits-related volcanic rocks. Considerations on hydrothermal alteration, petrology and tectonic evolution, *Comunicações Geológicas* 107, Especial III (Volume Especial Explora), 133-149.



Section 2 - Moderator: Anna Tsoupra

Presentation P6/S1

Did ore-forming systems developed during alkaline magmatism in SW Iberia?

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Abstract:

Alkaline igneous rocks are known to host a large number of mineral raw materials, some of them considered critical in face of the envisaged risks of supply disruption, such as rare-earths and niobium [1]. Recently, many alkaline igneous rocks have been the subject of fundamental studies to establish robust models of emplacement and genesis of critical raw materials, improving ore-forming models and hence, optimize exploration methods [2]. The types of ore-bearing mineral assemblages in these rocks is thought to be dependent on the source composition, melting rates, and subsequent liquid immiscibility or fractional crystallization mechanisms that segregate halogen and metal enriched melts from residual, less differentiated fractions. A NW-SE trend of alkaline igneous rocks emplaced in SW Iberia (namely the northern Alentejo and Badajoz regions) during the latest stage of the Cambro-Ordovician rift-related magmatic event of northern Gondwana (ca. 480 Ma) have previously shown anomalous concentrations on mentioned metals [3]. To access the ore-bearing potential of these rocks, an interplay of structural, mineralogical and geochemical studies is proposed to track the likely source and time-span of the different alkaline varieties, and check whether any attributes can be used to predict the presence of concealed mineralization and infer on ore grades.

Keywords: Alkaline magmatism; SW Iberia; Metallogenesis; Critical Raw Materials

References:

- [1] Goodenough et al. (2016). Europe's rare earth element resource potential: An overview of REE metallogenetic provinces and their geodynamic setting. *Ore Geology Reviews*, 72, 838-856. doi: 10.1016/j.oregeorev.2015.09.019.
- [2] Marks & Markl (2017). A global review on agpaitic rocks. *Earth-Science Reviews*, 173, 229-258. doi: 10.1016/j.earscirev.2017.06.002
- [3] Carrilho Lopes, J. (2020). *Magmatismo Intrusivo no Ciclo Varisco (Alentejo NE, Portugal)*. Escola de Ciências e Tecnologias, Universidade de Évora, 566p. ISBN: 978-972-778-131-7



Section 2 - Moderator: Anna Tsoupra

Presentation P7/S1

Photogrammetry and multispectral imagery acquisition and processing for scene classification - A preliminary case-study of Mociços mine

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Abstract:

The objective of this work is to present and discuss the workflow needed for acquiring and processing of aerial photography and multispectral imagery taken by drone using a regular camera and a NDVI (Normalized Difference Vegetation Index) multispectral camera, using Mociços Mine as a case-study.

From the overlapping images, it is produced a digital elevation model (DEM), an orthophotograph, and point classification that allows the separation of soil, vegetation, and man-made structures. A combination of the orthophotography and the NDVI imagery will be used for spectral classification. After the classification, separating soil and vegetation, a test will be done to show how multispectral camera can be used to calculate the vegetation index, giving information about the vegetation health during Spring months, and will later be compared to one obtained near the end of August, after the flora has been affected by Summer.

A tentative classification of the bare soil and mine dumps will be done using all the bands available, i.e., 3 from the RGB camera and 3 from the multispectral camera.

Keywords: Unmanned Aerial Vehicles (UAS); DEM; Soil classification; Vegetation Index.



Section 2 - Moderator: Anna Tsoupra

Presentation P8/S1

**Morphogenetic Processes on the Continental Slope
of the Galicia Bank (West Iberia Margin)**

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Abstract:

Continental margins that border the continents are vital regions that provide food, energy, transport, mineral and genetic resources, communications and protection, on which the humankind depends today and in the future. Within the continental margins, the continental slopes are key areas due to their economic and geopolitical importance like the establishment of the outer limits of the legal continental shelf of a coastal state, in accordance with the United Nations Convention on the Law of the Sea. The main focus of this work is to describe and characterize the physiographic, morphological features, and understand the geomorphologic processes and respective interactions that shaped the seafloor of the Galicia Bank Region (West Iberia Margin). The dataset used is composed of multibeam bathymetry, echo-sounder profiles and multichannel seismic reflection profiles. Landmark and Geocap software's were used for seismic interpretation and geomorphological analyses respectively. Through the analysis of 48 bathymetric profiles, five continental margin physiographic provinces were identified: Shelf (0m-200m); Upper Slope (200m-3500m); Middle Slope (3500m-4500/5000m); Lower Slope (4500/5000m-5300m); and, Abyssal Plain (>5300m). The joint analysis of multibeam bathymetry and interpretation of seismic reflection profiles allowed the identification of features shaped by depositional (Contourite), erosive (Moat), gravitational (Mass Transport Deposits (MTD)) and tectonic processes (Peridotite Ridge). Considering both analyses it seems that the present-day morphology displayed by the Galicia Bank results from a complex interplay between different morphogenetic processes.

Keywords: Geomorphology, continental slope, Galicia Bank, West Iberia margin

References: Boillot, G., Winterer, A.L., Meyer, A.W., et al., 1987. Proc. Init. Rep. ODP103(A)663p. Harris, P., 2012. "Seafloor Geomorphology-Coast, Shelf, and Abyss."



Section 2 - Moderator: Anna Tsoupra

Presentation P9/S1

The influence of climate change on air quality in agricultural areas

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Abstract:

Climate change represents one of today's biggest environmental, social, and economic challenges, these transformations will change and affect the world and its social foundations as we know them. Global warming increases the frequency and severity of pests and diseases associated with plants leading to a decrease in quality and quantity. Climate change affects not only food quality and safety, but also human nutrition and diets and consequently human health as it limits access to diverse and high-quality diets. Climate change contributes to the increased exposure of food, and consequently humans, to certain toxic compounds, as well as chemical contaminants and compounds, including metals, dioxins, pesticide residues and other chemical contaminants. The trending use of these chemicals in food production, namely pesticides, is related to the attempt to improve the production and nutritional quality of food due to impediments resulting from climate change. The intensive use of pesticides such as herbicides, insecticides and fungicides has led to ubiquitous contamination, which may be present not only in soils, water bodies and / or crops, but also in the atmosphere. Therefore, air quality monitorization is an important tool for evaluate the effects of pesticides on the environment and human health.

Keywords: Climate Change; Agriculture; Pesticides; Health; Air quality; Water quality;

References:

- Agrimonti, C., Lauro, M., & Visioli, G. (2021). Smart agriculture for food quality: facing climate change in the 21st century. *Critical Reviews in Food Science and Nutrition*, 61(6), 971–981. <https://doi.org/10.1080/10408398.2020.1749555>
- Fanzo, J., Davis, C., McLaren, R., & Choufani, J. (2018). The effect of climate change across food systems: Implications for nutrition outcomes. *Global Food Security*, 18(January), 12–19. <https://doi.org/10.1016/j.gfs.2018.06.001>



Section 2 - Moderator: Anna Tsoupra

Presentation P10/S1

Unconventional Isotope Systems in Earth Sciences and Cultural Heritage Studies: A Review.

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Abstract:

Until relatively recently, isotope ratio research has focused on light stable isotopes of the most common major elements in living organisms (C, H, N, O, S) to trace metabolic processes as a means to reconstruct dietary patterns, trophic structures, migration and paleoenvironmental conditions in the fields of archaeology, ecology and palaeoecology, to name a few. However, the development of multi-collector ICP-MS (MC-ICP-MS) and its increasing use in the past two decades has allowed for the precise measurement of isotope ratios even at low concentrations. This means that heavier, non-traditional isotopes which show smaller fractionation, such as Ca, Cu, Fe, Mg, Hg, Sr (stable) and Zn can be investigated in biological tissues even when they exist in low abundances. This presentation will review the evolution of isotope ratio research and analysis techniques in recent years, as well as the expanding range of applications. Some case studies will be presented to illustrate innovative approaches to unconventional isotopes, and the potential for future multidisciplinary research in the fields of Earth Sciences, paleoecology and archaeology/cultural heritage studies will be briefly discussed.

Keywords: Stable Isotope ratios; MC-ICP-MS; Archaeology; Earth Sciences; Geochemistry



Section 2 - Moderator: Anna Tsoupra

Presentation P1/S2

Volcanic Seismology

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Abstract:

The Azores archipelago comprises nine islands. Since the 15th century, occurred in São Miguel seven eruptions inland and one onshore. The island is seismically active and mostly located in the center, associated with the Fogo, Congro, and Furnas volcanoes. Additionally, past volcanic history has demonstrated the intense seismicity and explosive volcanic activity of the island that aroused the curiosity of scientists around the world.

In our study, we will discuss a seismic swarm that occurred on February 12, 2018, associated with the Congro volcano in São Miguel Island. We use REDPy (Repeating Earthquake Detector) to identify clusters and organize them into families. This methodology will enable us to understand the present seismicity and analyze clustering in time.

To train our eyes to detect volcanic signals, we began by analyzing events that occurred around the Kilauea volcano after the recent eruption of the 20th of December 2020. This step is crucial to identify volcanic signals during the seismic swarm. Finally, clustering events occurring in Congro and Fogo regions will lead to an understanding of the type of source generating these types of events to better constrain the processes behind the observed seismicity.

Keywords: Template waveform matching, volcanic seismology, São Miguel island, volcanic signal, seismic activity.



Section 3 - Moderator: José Roseiro

Presentation P2/S2

An Overview on The Contribution of Geological Storage for The Hydrogen Strategy in Europe

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Abstract:

Renewable energy will be the leading source of power on the upcoming days. If we evaluate the global temperature trend from the past 130 years- we found that the global temperature is increasing continuously due to different human activities and it will continue in the same manner which is really alarming for the whole world. The trend of increasing temperature is mostly visible in Europe and South Asia/Middle East region. This paper describes the strategy for storing hydrogen in geological form in the European countries. The strategy includes hydrogen roadmap, sources of hydrogen, impact analysis, process for storing hydrogen in geological form and the efficiency of the existing system. So far green hydrogen is considered as the best alternative using Solid Oxide Electrolysis Cell (SOEC) electrolyser to achieve the maximum efficiency, with Power capacities of electrolysers of up to 40 GW by 2030, able to produce 10 million ton of green hydrogen. The only possibility to store such a large volumes of hydrogen is to utilize the underground storage in geological formations. A recent estimation indicates that there is a need of at least 125 to 250 salt caverns for hydrogen storage. More emphasize on research should be given to check the possibilities of storing hydrogen in saline aquifers and depleted hydrocarbons fields as well.

Keywords: Renewable Energy; Hydrogen Storage; Electrolyser; Hydrogen Fuel Cell; Geological Storage

References:

- Fuel Cells and Hydrogen Joint Undertaking (FCH), Hydrogen Roadmap Europe. 2019.
- N. Heinemann, M. G. Booth, R. S. Haszeldine, M. Wilkinson, J. Scafidi, and K. Edlmann, "Hydrogen storage in porous geological formations – onshore play opportunities in the midland valley (Scotland, UK)," *Int. J. Hydrogen Energy*, vol. 43, no. 45, pp. 20861–20874, 2018.
- D. P. C. C. L. E. Y. N. to K. in 20 Weeks, "A hydrogen strategy for a climate-neutral Europe," *Dk*, vol. 53, no. 9, pp. 1689–1699, 2015.



Section 3 - Moderator: José Roseiro

Presentation P3/S2

**Application of geophysics to assess subsurface contaminations:
preliminary results**

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Abstract:

Nowadays, one of the biggest problems and challenges faced by expanding cities is related to the generation, collection and destination of solid waste. When waste is disposed of in landfills or dumps over areas with permeable soil (gravel, sand or fractured rocks) the migration of the leachate can, after some time, cause the contamination of areas much larger than those where the waste is disposed.

In the environmental assessment of contaminated areas, conducting geophysical surveys has the basic objective identification of the presence of soil contamination and the definition of the geological features of the investigated sites. The characteristics of the geological environment, and the nature of the contamination, can determine the behavior of contaminants in the subsurface [1].

The use of geophysical techniques combined with the direct measurement techniques (such as soil and groundwater analysis) can be useful adopted as an integrated approach for a rapid pollution detection and assessment [2].

In this work, soil samples collected in abandoned dump area located in Luanda city were submitted to chemical analyses (ICP-MS) and geoelectrical experiments whose results were used to evaluate the contamination of the soil in the area of direct influence of the dump.

Keywords: Electrical method, soil sample, contamination.

References:

[1] De Carlo, Lorenzo & Ancona, Valeria & Caputo, Maria Clementina & Campanale, Claudia & Calabrese, Angelantonio & Uricchio, Vito. (2016). Geophysical Investigations to Support Soil Organic Contamination Assessment in a PCB Historically Contaminated Area. 10.3997/2214-4609.201601992.

[2] Nwankwo, Cyril & Emujakporue, Godwin. (2012). Geophysical Method of Investigating Groundwater and Sub-Soil Contamination – A Case Study. American Journal of Environmental Engineering. 2. 49-53. 10.5923/j.ajee.20120203.02.



Section 3 - Moderator: José Roseiro

Presentation P4/S2

Study on receiver functions analysis and its development

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Abstract:

Calculation of receiver functions is common to understand the near-surface structure beneath a seismometer. Basically, when P-waves found a subsurface boundary at a particular angle of incidence will result in refracted and reflected P- and S- waves. The generated waves of interest results from the local structure underneath the seismic station, and by correlational or deconvolutional combinations of vertical and horizontal components, local effects can be isolated in a receiver function. We downloaded teleseismic events of M6 till M9 at a distance that varies from 30° to 90° from II.CMLA (Chã da Macela, São Miguel Azores) seismic station. Initially, we filter events to keep the ones with good signal noise ratio. Then, we need prepare data in SAC (Seismic Analysis Code) to compute receiver functions using a Python Library. To reduce the difficulty of compute receiver functions, we create a Jupyter Notebook that performs the different steps inherent to the calculation.



Section 3 - Moderator: José Roseiro

Presentation P5/S2

Ground Penetrating Radar to reveal subterrain built heritage structure: The case study of the national palace of Queluz botanical garden, Portugal

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Abstract:

Historically significant built heritages are an integral part of the traditional architectonic part of a country. These earliest structures necessitate special attention on analysis for revealing their structure is essential, specifically using methods that won't alter the historical charm of the structure. This research work summarizes the findings from investigations evaluating the successful use of ground penetrating radar (GPR) to reveal the 17th-century's built residual structure of the botanical garden of national palace of Queluz, Portugal. GPR surveys were carried out mainly in the context – (i) to prospect the buried paths and beds structure in the geometric shapes of rhombuses that had been built according to the initial garden construction plans of the time, and (ii) to restore the garden including the lake with masonry edges and a fountain in the center, as new life brought everything old to modernity. Based on the GPR findings, the study demonstrates the presence of the original garden structure, confirmed by the three-dimensional reflectivity model with the various indications of the presence of structures, their location and volume. The main results obtained will be presented and discussed in an attempt to assess the effectiveness and reliability of GPR, as the non-invasive prospection of built heritage hidden in the subterrain from three most significant facts of view: historical, structural and geophysical.

Keywords: ground penetrating radar (GPR); non-destructive testing (NDT); three-dimensional analysis; botanical garden; Queluz;



Section 3 - Moderator: José Roseiro

Presentation P6/S2

A review of the Earthquake Early Warning Strategies

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Abstract:

Earthquake early warning (EEW) is a strategy for reducing disaster risk and increasing resilience to seismic hazard in urban settings. EEW systems provide real-time information about ongoing earthquakes, deliver the alerts to clients to help reducing the harm loss before the ground shaking arrives. This review paper introduces many aspects in this strategy: existing methods, instrumentation, and various algorithms developed for the rapid calculation of seismic-source parameters, ground shaking, and potential consequences in the wake of an event. A method that can simulate time dependent P-wave amplitudes is presented, which attempts to estimate the final magnitude (M) for in the location and target region. Messaging is also critical for the warning system, appropriate communication channels and training people to understand and properly respond are essential. In the end, limitation of existing EEW strategies is discussed. In the future, engineering-based and application-specific models/tools are proposed for more effective risk communication and reduces the blind zone for EEW.

Keywords: Seminar; Workshop 2021; Earthquake early warning; algorithm; simulation

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Section 3 - Moderator: José Roseiro

Presentation P1/S3

Applied geology in long term performance assessment of ornamental stones. A multianalytical approach dedicated to Portuguese industry

Preliminary results

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Abstract:

Natural stones are the most resilient building materials and for that widely used in ancient and contemporary architecture. Despite this, according to the mineralogical composition and by the presence of impurities, building stones can show aesthetical and technical defects after precipitations, under high UV radiation exposure, in high relative humidity context and because of weathering agents. The topic of this research is the compatibility assessment and long-term prediction of protective coatings efficacy applied on a Portuguese limestone, in order to limit or stop the pathologies associated to moisture circulation. The goal is to predict the performance both of the stone and coatings durability during time. To reach that purpose, aggravated weathering conditions in climatic chamber are reproduced. This means that several techniques will be associated before during and after the artificial ageing to monitor the chemical interaction occurring at the stone-coating interface: optical and electron microscopy for investigating the microstructure, the petrographic and geochemical composition; mineralogical analysis, detection of organic and inorganic compounds, hardness value measurement and colour variation. This multianalytical approach to diagnostics is essential for defining the causes of pathological phenomena and it's suitable for companies to support them in preventing controversial with client related to stone defects.

Keywords: Building stones; Building Pathology; Ageing tests; Coating's durability; Gypsum



Section 4 - Moderator: Gonçalo Silvério

Presentation P2/S3

Mantle Plumes

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Abstract:

Plate tectonic theory has evolved through the past 50 years. Continent movement are described by plate tectonic, a theory which has been accepted. However, if the plate tectonics is a well-established scientific fact, the convection mechanisms that induce the movement of the plates are highly debatable at the moment.

One of the important questions is the interaction/interference between the convection cells and the mantle plumes. Moreover, if mantle plumes seem to be a reality, a most important question is the existence or not of convection in the lower mantle. If for most of the researchers the all mantle convection is a reality, for others it only exists in the upper mantle, because the huge pressure in the deeper mantle prevent the convective processes. Thus, several recent studies have been developed and have generated opposite point of views that made these topics controversial.

Morgan's theory stipulates that deep mantle plumes create non-plate boundary volcanism called "hotspots" while Anderson one thinks that this well-known postulate can be disapproved. He believes that non-plate boundary volcanism is explained by shallow plate related stresses generated by convection in the upper-mantle. Thus, in our study these theories will be discussed and exposed.

Keywords: Mantle plumes, mantle convection, plate tectonics, hotspots.

Acknowledgement: This work was conducted with the support and guidance of Prof. Rui Dias.



Section 4 - Moderator: Gonçalo Silvério

Presentation P3/S3

An Overview on The Contribution of Geological Storage for The Hydrogen Strategy in Europe

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Abstract:

Renewable energy will be the leading source of power on the upcoming days. If we evaluate the global temperature trend from the past 130 years- we found that the temperature is increasing continuously due to different human activities and it will continue in the same manner which is really alarming for the whole world. The trend of increasing temperature is mostly visible in Europe and South Asia/Middle East region. This paper describes the strategy for storing hydrogen in geological form in the European countries. The strategy includes hydrogen roadmap, sources of hydrogen, impact analysis, process for storing hydrogen in geological form and the efficiency of the existing system. So far green hydrogen is considered as the best alternative using Solid Oxide Electrolysis Cell (SOEC) electrolyzer to achieve the maximum efficiency of 90% on the coming days. It is already evident that hydrogen will be ultimate source of clean fuel on the coming days in Europe.

Keywords: Renewable Energy; Hydrogen Storage; Electrolyzer; Hydrogen Fuel Cell; Geological Storage

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Section 4 - Moderator: Gonçalo Silvério

Presentation P4/S3

Geological processes and lithostratigraphic and structural units in the Cubango Basin, SE Angola: contribution to build a hydrogeological conceptual model

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Abstract:

Cubango is a transboundary basin of South Angola with great importance for biodiversity of the South of Africa, mainly due to the inland Okavango river delta and its wildlife and ecosystems. Okavango delta is highly dependent on the water recharged on the Cubango Basin, Angola. This work intends to contribute to the geologic knowledge of the basin.

The geological dynamics of the Cubango-Okavango basin is dominated by four major geological periods ranging in age from the Pre-Cambrian to the Pleistocene[1].

The oldest (Archaean) rocks form part of the Angola/Congo Craton, in the north, and part of the Kalahari Craton in the south, and comprise metasedimentary and volcanic rocks, and variably metamorphosed igneous rocks. These two terranes are separated by NE-SW trending Proterozoic orogenic belts. Thin Cretaceous sediments locally separate Kalahari Group sediments from the underlying rocks. The depositional history of the Kalahari Group is complex, but the sources of sediment are predominantly erosion products of crystalline basement rocks forming the Angolan Highlands and the Congo-Zambezi watershed[1]. Fault structures appear to control the alignment of the main rivers, and a major NE/SW or ENE/WSW structure has been postulated to exist, marking the NW margin of the pre-Karoo basement in southern Angola.

Keywords: Geological processes, Lithologies, Cubango basin.

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Section 4 - Moderator: Gonçalo Silvério

Presentation P5/S3

Characterization of the trace elements of soil and sediment in the reservoirs of Dominican Republic

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Abstract:

Investigation on the behavior of elements in the sediment and soil is important in geological processes studies. This work aims to investigate the relationship of these elements with one another. 10-14 sample values of sediment and soil elements (Ba, Co, Cr, Sr, V, Ni, Pb, and Zn) are obtained from Sabana Yegua (SY) and Tavera reservoirs in Dominican Republic. Sediment elements are collected for two periods (rainy and dry). Soil elements have no worth notice differences between the seasons. Elements distribution nature and the relationships between the elements are investigated by statistical method such as descriptive analysis and correlation coefficient. It is observed that sediment trace elements are seasonally driven, and this is more likely in SY reservoir. In case of soil elements, except Pb and Zn, other elements are observed to show the same correlation with Ba in both reservoirs. Results of this analysis could be considered in future environmental assessments.



Section 4 - Moderator: Gonçalo Silvério

Presentation P6/S3

**New wavelength-dependent femtosecond pulsed LASER cleaning:
A case study with stones of different provenance locality, Portugal**

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Abstract:

Laser cleaning techniques have been considered amongst the most impactful contributions of Physics towards the restoration of stonework. Contamination and deterioration products in stones eliminated by laser-assisted techniques is a new and promising development that may highlight the use of laser cleaning methodology in this sector. This research work reports on studies aimed to evaluate the use of ultrafast femtosecond (fs) pulsed lasers for the removal of contaminants on significant stone surfaces with different locality from Portugal. A series of studies have been carried out to assess the controlled laser cleaning parameters using two different laser systems: a 238 fs pulsed UV laser with emission at 343 nm and a 228 fs pulsed n-IR laser with emission at 1030 nm. In both cases, line scan pulse mode was employed to explore contaminant removal efficiency while, at the time, assessing the degree of damage produced to the underlying original substrate surface. Adequate repetition-rate generation, wavelength-dependent absorption and materials thermal properties are amongst the parameters considered, and the main results obtained will be presented and discussed in an effort to evaluate the potential that these new types of lasers offer towards an increased cleaning efficiency of stones with deteriorated surfaces.

Keywords: femtosecond laser; short pulse; stone; cleaning; restoration;



Section 4 - Moderator: Gonçalo Silvério

Presentation P7/S3

Provenance study of the limestone used in the construction and restoration of the Batalha Monastery (Portugal)

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Abstract:

To assess the provenance of the limestones used in the construction and restoration of the Batalha Monastery in central Portugal, stone samples collected from the monument and from five limestone quarries in the region surrounding the building were investigated by energy-dispersive X-ray fluorescence spectroscopy (ED-XRF), powder X-ray diffractometry (PXRD) and thermogravimetric analysis (TGA). Ca-Sr binary diagrams from the ED-XRF result indicated the source of the samples collected from different parts of the monastery. Thin-section observation supplemented the petrographic evidence for this identification, providing information of the the period and area these oolitic limestones were formed. PXRD and TGA were also used to acquire information on the mineral and chemical composition of the stones. Preliminary results suggest that the monastery baluster was made of stone from the Valinho do Rei or Reguengo do Fetal quarries, whereas part of the church railing, the north-aisle eaves arch and Royal Cloister were made with stone from the Pidiogo or Cabeço do Roxo quarries.

Keywords: Provenance study; Limestone; Batalha Monastery, Petrography

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