GeoResources and Geomaterials

GeoResources and Geomaterials (G3)

Report 2021

Unidade de I&D ICT

Instituto de Ciências da Terra - ICT

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U.PORTO FACULDADE DE CIÊNCIAS UNIVERSIDADE DO PORTO

Instituto de Ciências da Terra
Institute of Earth Sciences

The GeoResources and Geomaterials – Group 3 is included in ICT structure, a multidisciplinary institution, organized into six research groups covering major areas of Earth Sciences and comprising a wide range of scientific expertise. The main objective of **GeoResources and Geomaterials Group** is aligned with the ICT mission which is to develop exceptional-quality research, promote technological development and support public policies in the area of Earth Sciences.

This report presents the main achievements produced by **GeoResources and Geomaterials - Group 3**, including publications, organization of events, outreach activities, and other outcomes.

The composition of the **Group 3 team** can be consulted at:

https://www.icterra.pt/g3/index.php/team/

The main goals of the **Group 3 team** can be consulted at:

https://www.icterra.pt/g3/index.php/about-us/

The **most significant publications,** presented below, were selected based on the criteria that they were published in peer-review journals (ISI and Scopus) and that their first author was a PhD student.

Cardoso-Fernandes, J., *Silva, J., Perrotta, M., Lima, A., Teodoro, A.C., Ribeiro, M.A., Dias, F., Barrès, O., Cauzid,J., Roda-Robles;E., 2021. Interpretation of the Reflectance Spectra of Lithium (Li) Minerals and Pegmatites: A Case Study for Mineralogical and Lithological Identification in the Fregeneda-Almendra Area. Remote Sens. 2021, 13, 3688.*

Leal, S., *Lima, A., Noronha, F. 2021. Characterization of heavy mineral concentrates and detrital gold particles from the Bigorne granite-hosted gold deposit in the Iberian Variscan Belt. In: Recent Advances in Understanding Gold Deposits: from Orogeny to Alluvium. Edited by T. Torvela, R.J. Chapman and J. Lambert-Smith. Geological Society, London, Special Publications, 516, 26 May 2021.*

Oliveira, A.J.T., *Martins, H.C.B., Sant'Ovaia, H.M., 2021. Petrogenetic constraints on the felsic vein magmatism in northern Portugal based on petrological and geochemical data. Comptes Rendus Géoscience, 353 (1), pp. 377-398.*

Pereira, S.G., *Guedes, A., Abreu, I., Ribeiro, H. 2021.Testing the Raman parameters of pollen spectra in automatic identification. Aerobiologia 37(1), 15–28.*

I take this opportunity to thank you all for the effort made in the implementation of our Group's strategic plan during another atypical year.

Best regards!

An excellent and peaceful 2022!

Helena Sant'Ovaia

GeoResources and Geomaterials Group Coordinator

Porto, 3rd February 2021

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1. Main Achievements

Within the **GeoResources and Geomaterials** Group (G3) the research focuses on two main areas:

(i) LCT pegmatites and hydrothermal deposits of Critical Raw Materials (CRMs) associated with acid magmatism for the identification of genesis, age and mode of occurrence to improve exploration programs and processing technologies, and to improve and develop methods of evaluation of industrial wastes to promote recycling;

and,

(ii) Characterization of natural and anthropogenic geomaterials for the promotion of critical metals recovery, in the scope of geoarchaeological and architectural and civil engineering purposes, and in studies of soils and sediments for forensic applications.

The following are the results obtained throughout 2021 in these two major themes.

(i) LCT pegmatites and deposits of rare elements associated with granites

The exponential increase of the world population requires the increasing demand for search new ore deposits able to answer present and future needs. The development of innovative indirect and non-invasive tools for prospecting new ore deposits of Critical Raw Materials (CRMs) are vital. Considering this, the understanding of the variscan granite's role in the occurrence of high rare metal anomalies is fundamental.

Therefore, during 2021, multidisciplinary approaches, including fieldwork, mineralogy, magnetic fabrics, geochemistry, geochronology, radiometric, and gravimetry studies, were applied to several Portuguese variscan granites and to variscan felsic and mafic veins, of Galiza Trás os Montes Zone, Central Iberian Zone and Ossa Morena Zone, to highlight the typical signatures of granites with metallogenic potential for Sn, W, Mo and Au mineralizations. Also important was the establishing of 3D geological models and emplacement kinematic for granitic bodies.

New structural analyzes and K-Ar and $^{40}Ar/^{39}Ar$ in muscovite, biotite and K-feldspar, and ages of available U-Pb, and magnetic fabrics, allowed the history constraining of intrusion, cooling and exhumation of granitic batholiths, namely in areas of the Iberian Variscan Belt where the mineralizations associated with granites are found. Mineralogical studies were carried out on melt/fluid evolution associated with strategic metals such as Li, Be, W and Sn.

The metasedimentary rocks were also targeted namely volcanic Cambro-Ordovician rocks of Valongo Anticline allowing the reinterpretation of the stratigraphic succession.

Was also goal of G3 the construction of spectral libraries concerning lithium exploration, with an emphasis on the interpretation of reflectance spectra and its implications to satellite-based approaches. Complementary geochemical exploration, cartographic, lithological/ mineralogical and petrographic characterization tools were used for mapping mineral resources exploration and successfully used for delineating high lithium potential areas.

(ii) Characterization of natural and anthropogenic geomaterials

Research work was developed in the scope of soils characterization, mainly associate with coal mining and industrial activities using combustion of fossil fuels in the past (thermal power plant, cement industry), aiming the identification of contamination problems. In the studies of coal combustion ashes, studies aimed to assess the potential as raw material (e.g., rare earth elements) or to be applied as value added material (e.g., catalyst in reduction reaction and wastewater treatment). These studies used several approaches namely organic petrology, geochemistry studies, lithological and soil mapping, and remote sensing remote sensing using unmanned aerial vehicles.

Moreover, soils and plant leaves characterization associated to older mining areas or in urban influence were assessed with the aim of monitoring and identification the related environmental impacts.

Characterization of the organic matter present in black shales through petrographic and geochemical methodologies, the paleodepositional environments, and ore deposits genesis studies were carried out.

Geoarchaeologic studies pointed out to the relationship between rock engravings and types of granites or schists and the potential sources of geological resources related to Megalithism and Bronze Age.

Concrete deterioration was studied considered the identification of minerals phases, namely Mg silicate hydrates and Ca sulphate phases, resulting from sea water attack on concrete.

Data have been collected from oceanographic cruises organized within the scope of international collaboration including ICT researchers.

Advanced remote sensing methods for the detection of high turbidity waters off the Iberian Peninsula were established, in particular under the effects of swell waves, namely thar river plumes such as the Douro River plume may generate internal waves, even in subcritical flow conditions.

Particular attention was given to waste management, namely in the characterization of cork dust ashes and in the evaluation of the best valorization procedure for this waste that is currently disposed of in landfills.

Also important was the development of GIS applications in open source software. In 2021, 4 applications were developed in the areas of precision agriculture, soil erosion, archeology and in health area. A web GIS was also developed that implements a method to assess the vulnerability of groundwater to pollution.

GeoResources and Geomaterials studies are linked with other ICT groups to reinforce the strategy framed in the **goal nº 12 UN SGD** (https://sdgs.un.org/goals) **,** mainly connected with G5 with research in the Iberian Variscan Belt and the G1 and G6 providing the geomaterials characterization to assess air, soil and water pollution and exposure to toxic chemicals.

2. Publications

A. Books, chapters in books, and articles

A1. Books and chapters in books

Couto, H., 2021. À volta dos meteoritos: extinção versus origem da Vida. Cristina Ferreira, Manuel Silva, José Alberto Pinto & Teresa Seixas Eds, pag 31. DOI 10.24840/978-989-33-1878-2

Bettencourt, A.M.S., Luz, S., **Simões, P.P.,** Alves, M.I.C., Abad-Vidal. E., 2021.Bronze Age sea salt production in Northwest Iberian Peninsula. In C. Marcigny, C. Mordant (Ed.), Bronze 2019: 20 ans de recherches (Suppléments nº 7 au Bulletin de l'Association pour la Promotion des Recherches sur l'Âge du ookhyBronze - l'APRAB), Nonant: OREP, 409-420" http://hdl.handle.net/1822/74685

Guimarães, V., **Bobos, I.,** 2021. Role of clay barrier systems in the disposal of radioactive waste, pg. 513-541. In Sorbents Materials for Controlling Environmental Pollution Current State and Trends. Elsevier. https://doi.org/10.1016/B978-0-12-820042-1.00011-0.

Hein, J., **Madureira, P.,** Colaço, A., Pinheiro, L., Roth, R., Pradeep S., 2021. Changes in Seabed Mining. Chapter 19 of the Second World Ocean Assessment (WOA II) under the Regular Process for Global Reporting and Assessment of the State of the Marine Environment, including Socioeconomic Aspects, established after the 2002 World Summit on Sustainable Development. United Nations.

Leal, S., Lima, A., Noronha, F. 2021. Characterization of heavy mineral concentrates and detrital gold particles from the Bigorne granite-hosted gold deposit in the Iberian Variscan Belt. In: Recent Advances in Understanding Gold Deposits: from Orogeny to Alluvium. Edited by T. Torvela, R.J. Chapman and J. Lambert-Smith. Geological Society, London, Special Publications, 516, 26 May 2021. https://doi.org/10.1144/SP516-2020-217.

Meunier, E., **Dias, F., Lima, A.,** Silva, R., Mirao, J., Figueiredo, E., 2021. A mina de estanho antiga de Vale do Mouro (Coriscada, Mêda, Guarda). Estudo preliminar. In Estudos em Homenagem ao Doutor António do Nascimento Sá Coixão, editado por Sandra Naldinho; Tony Silvino, 103-117. Vila Nova de Foz Côa, Portugal: Museu da Casa Grande de Freixo de Numão. ISBN: 978-972-99799-7-2

A2. Articles in peer-review Journals (ISI and Scopus)

Almeida, C.R.d., **Teodoro, A.C.,** Gonçalves, A., 2021. Study of the Urban Heat Island (UHI) Using Remote Sensing Data/Techniques: A Systematic Review. Environments, 8.
https://doi.org/10.3390/environments8100105

Amorim, P., **Couto, H.**, 2021. Geological Mapping of Rates and São Félix of Laúndos Region (Northern Portugal). IOP Conf. Ser.: Earth Environ. Sci. 906 012120.
https://iopscience.iop.org/article/10.1088/1755-1315/906/1/012120/meta

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Bobos, I., Gomes, C., 2021. Mineralogy and Geochemistry (HFSE and REE) of the Present-Day Acid-Sulfate Types Alteration from the Active Hydrothermal System of Furnas Volcano, São Miguel Island, The Azores Archipelago. In: Special Issue Hydrothermal Alteration and Associated Phenomena in Active Volcanoes: Mineralogy, Texture and Isotope Geochemistry. Minerals, 11(4), 335; https://doi.org/10.3390/min11040335

Bobos, I., Madruga, M., Reis, M., Guimarães, V., 2021. Clay mineralogy insights and assessment of the natural (228Ra, 226Ra, 210Pb, 40K) and anthropogenic (137Cs) radionuclides dispersion in the estuarine and lagoon systems along the Atlantic coast of Portugal. Catena, 206, https://doi.org/10.1016/j.catena.2021.105532

Brookfield, M., **Couto, H.,** Catlos, E., Schmitt, A., 2021. U-Pb SIMS zircon ages for Cambro-Ordovician rocks, Valongo Anticline, northwestern Portugal. Journal of Mediterranean Earth Sciences 13 (2021), 19-30. doi: 10.13133/2280-6148/17274
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Cardoso-Fernandes, J., Silva, J., Perrotta, M., **Lima, A., Teodoro, A.C., Ribeiro, M.A., Dias, F.,** Barrès, O., Cauzid,J., Roda-Robles;E., 2021. Interpretation of the Reflectance Spectra of Lithium (Li) Minerals and Pegmatites: A Case Study for Mineralogical and Lithological Identification in the Fregeneda-Almendra Area. Remote Sens. 2021, 13, 3688. https://doi.org/10.3390/rs13183688

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Schito, A., **Guedes, A.**, **Valentim, B.,** Sassarini, A.V., Corrado, S. 2021. A predictive model for maceral discrimination by means of raman spectra on dispersed organic matter: A case study from the carpathian fold-and-thrust belt (Ukraine). Geosciences 11(5), 213.

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C. Reports

Elias, M., Tereso, V., **Maia, M., Nogueira, P.,** 2021. Relatório de Atividades: Técnicas de prospeção aplicadas às mineralizações de ouro de Santiago do Escoural (Montemor-o-Novo): Caracterização de partículas de ouro enquanto indicadores de potenciais áreas de prospeção mineral. Universidade de Évora, 2021.

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Lopes, L., 2021. GD/19700/2021 - Contract and Provision of Services with the company Mármores Galrão, S.A. Technical Training in Ornamental Stones

Lopes, L., 2021. GD/25236/2021 - Provision of services with the company FrontWave, analysis and petrographic description in 3 lithotypes

Lopes, L., 2021. GD/36708/2021/P1 - Provision of Services with the Municipality of Vidigueira within the scope of the geological and geotechnical study of the interested land for the implementation of the Green Urban Park.

Ramos, V., Andersen, J., Rollinson, G., Crane, R., Littler, K., Coggan, J., Bailey, I., 2021. WP T2: Mineralogical and microstructural characterization of Rockpools. Deliverable T2.2.1 of the project Marineff, June 2021, 38 pp.

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Valentim, B. 2021. Progress Report nº 2. Novel Circular Economic Approaches for Efficient Extraction of Valuables from Spend Li-Ion Batteries – NEXT-LIB (ERA-MIN/0003/2018). Faculdade de Ciências da Universidade do Porto. Reporting period: November 2020 to October 2021. 42 pages.

D. Field trip guides

Araújo, A., **Pedro, J., Maia, M., Nogueira, P.,** Dias, R., 2021. Guia de Campo – Do Magma ao Minério, Universidade de Évora.

E. Others

Cardoso-Fernandes, J., Silva, J., **Dias, F., Lima, A., Teodoro, A. C.,** Barrès, O., Cauzid, J., Perrotta, M., Roda-Robles, E., **Ribeiro, M. A.**, 2021. Tools for remote exploration: a Lithium (Li) dedicated spectral library of the Fregeneda-Almendra aplite-pegmatite field [Data set]. Zenodo. https://doi.org/10.5281/zenodo.4575375

Sant'Ovaia, H., 2021. E se o Norte mudar? pp 43-43. In PARALAXE. Observações em torno do Tempo, da Terra e do Ar. ISBN 978-989-332370

F. Models

José da Silva: Several numerical applications and simulations of the model MITgcm (Massachusetts Institute of Technology general circulation Model) were implemented in NASA supercomputers, making use of fully nonlinear and nonhydrostatic modes. These were simulations in the Indian and Indonesian Oceans.

G. Computational applications

José da Silva: Implementation of a computational application to retrieve fraction of wave breaking in the deep ocean by means of satellite remote sensing data in the visible wavelengths.

3. Completed PhD Thesis

Cardoso-Fernandes, J., 2021. Remote sensing applied to lithium mineralizations: insights for lithium exploration. Geosciences PhD. Cotutelle PhD program UP/UA (Supervisors **A. Lima, A. Teodoro**).

Gemusse, U., 2021. Prospeção de Lítio em Moçambique. Geosciences PhD. Cotutelle PhD program UP/UA ((Supervisors **A. Lima, A. Teodoro).**

Gonçalves, A., 2021. Role of the late-Variscan structures in the emplacement of late-orogenic granitoids in NW Iberian Peninsula. Metallogenic implications in the occurrence of W (Sn) mineralizations. Geosciences PhD. Cotutelle PhD program UP/UA (Supervisors **H. Sant'Ovaia**, **F. Noronha**).

Leal, S. 2021. Assessment of the gold exploration potential of northern Portugal: a new research approach. Geosciences PhD. Cotutelle PhD program UP/UA (Supervisors **A. Lima**, **F. Noronha**).

4. Completed MSc Thesis

Barbosa, M., 2021. Caracterização mineralógica e geoquímica de depósitos de Mn da Faixa Piritosa Ibérica. Mestrado em Geomateriais e Recursos Geológicos. Faculdade de Ciências da Universidade do Porto. Universidade de Aveiro. (Supervisor: **Iuliu Bobos**).

Costa, M.I.M., 2021. Assinatura Geoquímica das Metantracites da Bacia Carbonífera do Douro: Efeitos Geológicos e Influências Ambientais. Mestrado em Geologia, Faculdade de Ciências da Universidade do Porto. (Supervisors: **Deolinda Flores**, Ary Delmar Pinto Jesus).

Dias, A.F.A., 2021. Contributos da Geologia em Instrumentos de Gestão e Avaliação Ambiental. Mestrado em Geociências. Universidade de Coimbra. (Supervisor: **Joana Ribeiro**).

Gonçalves, C.A., 2021. Avaliação do património geológico e económico do concelho de Bragança. Mestrado em Geomateriais e Recursos Geológicos. Faculdade de Ciências da Universidade do Porto. Universidade de Aveiro. (Supervisor: **Iuliu Bobos**).

Lautert, M.K., 2021. Estudo petrogeoquímico das rochas filonianas intrusivas no Complexo Xisto Grauváquico - Sector de Alto do Sobrido/Ribeiro da Serra. Mestrado em Geologia, Faculdade de Ciências da Universidade do Porto. (Supervisors: **Maria dos Anjos Ribeiro**, **Helena Sant'Ovaia**).

Maia, G. 2021. Petrografia das escoadas basálticas da formação Apoterí em Roraima-Extremo Norte do Brasil. Mestrado em Geologia, Faculdade de Ciências da Universidade do Porto (Supervisors: **Helena Brites Martins**, T. Ferreira).

Martins, I., 2021. Elementos químicos leves nos minerais de granitos Variscos de Portugal – Implicações Metalogénicas. Mestrado em Geomateriais e Recursos Geológicos. Faculdade de Ciências da Universidade do Porto. Universidade de Aveiro. (Supervisor: **Iuliu Bobos**).

Miranda, A.R., 2021. Vulnerabilidade e Risco do Sistema Aquífero das Aluviões do Mondego no Setor Coimbra - Montemor-o-Velho. Mestrado em Geociências. Universidade de Coimbra. (Supervisors: **Joana Ribeiro**, J J.M. Azevedo).

Renato, R., 2021. Geofísica Aplicada à Prospeção Geológica: Estudo gravimétrico de carácter exploratório em zonas com potencial geotérmico (região de Braga). Mestrado em Geologia, Faculdade de Ciências da Universidade do Porto. (Supervisors: **Helena Sant'Ovaia, Cláudia Cruz**, Bruno Sameiro).

Ribeiro, J. P., 2021. Caracterização e cartografia de instabilidade de taludes nas margens do Rio Douro em Vila Nova de Gaia e Porto. Avaliação de Perigosidade. Mestrado em Geologia, Faculdade de Ciências da Universidade do Porto (Supervisors: **Helena Sant'Ovaia, Joana Ribeiro, Patrícia Santos).**

Rocha, F., 2021. Deteção Remota aplicada à monitorização da cobertura rochosa da praia da Aguda. Mestrado em Ecologia e Ambiente, Faculdade de Ciências da Universidade do Porto. (Supervisors: **Ana Teodoro,** Neftali Sillero, Mike Weber (ICBAS)).

Rodrigues, C., 2021. Remote Sensing Image-Based Analysis of the Urban Heat Island Effect in Bragança, Portugal. Mestrado em Deteção Remota, Faculdade de Ciências da Universidade do Porto. (Supervisors: **Ana Teodoro**, Artur Gonçalves (IPB)).

Rodrigues M.C. 2021. Resistividade elétrica para a avaliação ambiental do subsolo da pedreira de Alijó, Barroso Mestrado em Geomateriais e Recursos Geológicos. Faculdade de Ciências da Universidade do Porto. Universidade de Aveiro. (Supervisors Rui Moura**, Alexandre Lima**).

Santos, D., 2021. Remote sensing techniques for the identification of NYF pegmatites in Tysfjord, Norway. Mestrado em Sistemas de Informação Geográfica e Ordenamento do Território, Faculdade de Letras da Universidade do Porto. (Supervisors: **Ana Teodoro, Alexandre Lima**).

Silva, R.F.R., 2021. Digitalização e integração de informação geológico-geotécnica no GeoPro: estudo de caso do descarregador de cheias complementar da barragem de Caniçada. Mestrado em Geologia, Faculdade de Ciências da Universidade do Porto da Universidade do Porto. (Supervisors: **Maria dos Anjos Ribeiro, Lia Duarte**).

Yakovenko, A., 2021. Estudo de inclusões fluidas dos filões pegmatíticos litiníferos de Segura. Mestrado em Geologia, Faculdade de Ciências da Universidade do Porto (Supervisor: **Alexandra Guedes**).

Vasques, J.T., 2021. Lithogeochemistry and prospection of Lithium-bearing pegmatites and their host-rocks. Mestrado em Geologia, Faculdade de Ciências da Universidade do Porto da Universidade do Porto. (Supervisors **Alexandre Lima, Maria dos Anjos Ribeiro**).

5. PhD, research, post-doc fellowships, and researcher contracts signed in 2021

Alina Yakovenko: Master grant in the project ERA-MIN/0003/2019 (Supervisor: **Alexandra Guedes**).

Carla Carvalho: FCT PhD scholarship 2020.09729.BD (Supervisors, **Iuliu Bobos, Fernando Noronha**).

Cláudia Cruz: Contracted Researcher under the research project UIDP/04683/2020, financed by the FCT in the FCUP/ ICT-Porto.

Filipa Dias: FCT PhD scholarship 2020.05534.BD (Supervisor: **Alexandre Lima**).

Sara Costa e Silva: FCT PhD scholarship 2021.05376.BD (Supervisors: **Alexandra Guedes, Fernando Noronha**).

Sónia Pereira: PhD scholarship under the research project UIDP/04683/2020, financed by the FCT in the FCUP/ ICT-Porto (Supervisors: **Alexandra Guedes,** Helena Ribeiro).

6. Postgraduate courses

Alexandre Araújo, **Miguel Maia, Pedro Nogueira** and Rui Dias: Trainers in a field course that took place under the orientation of ICT-Évora Pole researchers and had the goal of transmitting the general view of the geodynamic evolution of Ossa-Morena Zone and its relation to the formation of ore deposits. This field course intlited "Do magma ao minério" was directed to high-school professors and was promoted by by the Centro de Formação da Associação de Escolas Bragança Norte (11-13 june 2021) (Figure 1).

Figure 1 – Group of field course participants in the margins of the Almansor stream.

Helena Sant'Ovaia: (i) Lecture online intitled "O que aprender no século XXI: tendências e perspectivas abertas pelo Perfil dos Alunos (para a área das Ciências Naturais)", presented in the scope of the X Congresso APPBG, and was directed to Middle and Secondary Schools Biology and Geology Teachers. 17th e 24th April 2021. (ii) Two webinars – "Saídas de campo virtuais em ambiente Google Earth: Sintra, Mafra e Litoral da Arrábida" and "Saídas de campo virtuais em ambiente Google Earth: Serra da Freita (Arouca)" promoted by Areal Editores, directed to Secoundary School Teachers (March 2021).

Luís Lopes: (i) XL Teacher Update Course of the Portuguese Association of Geologists: "Por Terras do Jurássico", in coordination with Aspiring Geoparque Oeste, May 28 – 30, 2021. (ii) XLI Updating Course for Teachers of the Portuguese Association of Geologists: "A Geodiversidade no Aspiring Geopark Algarvensis", in coordination with the Aspiring Geopark Algarvensis, September 11th, 18th and October 1st to 4th. (iii) Professional training courses (CPD): "Copernicus for Raw Materials". April 13th, 15th, 20th, 22nd (E@D); Co-organization: APG, EIT RawMatCopAcademy, ICOG and FEG. (iv) Professional training courses (CPD): "Application of Explosives in Rocky Mass blasting". June 16th, 25th (4 sessions; E@D); Co-organization: APG/AP3E. (v) Professional training courses (CPD): "Topographic and Geotechnical Monitoring". July 8th, 23rd (E@D and field trip); Co-organization: APG/CÊGÊ. (vi) 01/28/2021 - Virtual Day Event @ Inovstone 4.0 Advanced Technologies and Software for Natural Stone. CONSORTIUM INOVSTONE 4.0, Association Cluster Portugal Mineral Resources. (vii) 21th and 22nd January - Webinar - Soil and Water Contamination in Mining Areas. Part I and II. LNEC. (viii) 20th January - Webinar - Seminar on Explosives and Dismantling Operations. AP3E and FEUP.

7. Scientific Events participation, Field trips participation, Conferences organization

Alexandre Lima, Ana Cláudia Teodoro and **Joana Cardoso-Fernandes** participated as speakers at the "LIGHTS - Final Symposium: The Future of Lithium Exploration in Europe", an event to disseminate the results obtain in the scope of the LIGHTS project, held at Beak Consultants GmbH, Freiberg, Germany, on November 15th 2021.

Alexandre Lima and **Joana Cardoso-Fernandes** were invited speakers at the Scientific Journeys of the "Minerales estratégicos para la industria gallega", a dissemination event to highlight the need to exploit Galicia's own resources in the face of the global raw materials crisis, held between 20th and 22th September at Santiago de Compostela, Spain (Figure 2).

Figure 2 -Scientific Journeys of the "Minerales estratégicos para la industria gallega".

Alexandre Lima: Fieldwork Barroso – 31st March 2021: A radiometric campaign was carried out in the Alijó pegmatite area. A small profile perpendicular to the Alijó pegmatite was made. In total, 13 individual stations were covered with measurements. This data will be used in the GREENPEG, a European research project (Figure 3). Field work in Almendra for the LIGHTS project 29th - 30th May.

Figure 3 - Pegmatite Li-rich vein, being measured with spectroradiometer in the Barroso-Alvão aplite-pegmatite field.

Ana Marta Gonçalves: Participation in Workshop "Copernicus for Raw Materials", RawMatCop Academy – 13rd, 15th, 20th and 2nd April 2021. In the workshop the following topics were covered: (1) basics of remote sensing and its applications (Sentinel-1 & Sentinel-2); (2) water and vegetation detection using Sentinel-2; (3) mineral mapping and land use classification using Sentinel-2; (4) water detection and change detection suing Sentinel-1; and (5) added value from combined Sentinel-1 and Sentinel-2 scenes.

Ana Marta Gonçalves, Helena Sant'Ovaia and **Fernando Noronha**: Several fieldtrips were achieved throughout the 2021 year to collect samples for petrophysical and geochemical purposes. During the sampling campaigns, geological and structural data from the studied areas were also gathered (Figure 4).

Figure 4 - Sampling for petrophysical and geochemical purposes.

António Oliveira and **Cláudia Cruz:** Fieldwork in the Lamas de Olo pluton was made to obtain radiometric data (26th and 27th June 2021). Fieldwork in Labruge and Castelo do Queijo was also made, in order to obtain hand samples for geochemical analyses and magnetic susceptibility data using a portatil equipament (27th August 2021).

António Oliveira, Cláudia Cruz, Luís Lima, Sara Leal and **Miguel Maia**: Organization of "Jornadas do Instituto de Ciências da Terra 2021" (online), Porto, 11st - 12nd February 2021 (Figure 5).

Figure 5 - Print screen of Jornadas do ICT meeting.

Cláudia Cruz and **Helena Sant'Ovaia**: Fieldwork in the Ossa-Morena Zone for recognition of the granites of Fronteira and Ervedal; sampling for geochemincal analyses and petrographic studies were performed, and acquisition of radiometric data (21st and 22nd September 2021) was also made (Figure 6A). Fieldwork to obtain XRF and radiometric data (Figure 6B) in the Braga area (collaboration with Sinergeo Lda) (16th September 2021).

Figure 6 - Fieldwork campaigns: (A) Acquisition of radiometric data in Ervedal; (B) Acquisition of XRF and radiometric data in Braga region.

Cláudia Cruz, Filipa Dias, Guilherme Ínsua, Helena Sant'Ovaia and **Marcela Rodrigues:** Participation in "XI Congresso de Jovens Investigadores em Geociências (XI CJIG)" held in Aljezur between 27th and 30th November 2021. This event consisted of 4 days of fieldwork, combined with presentations and lectures, strengthening the proximity between the ICT poles of Évora and Porto (Figure 7).

Figure 7 –Fieldwork and geological mapping campaign in Aljezur.

Filipa Dias and **Alexandre Lima:** Fieldwork in the Aldeia Li-rich vein from the Barroso-Alvão aplite-pegmatite field with spodumene sampling (19-20th April) (Figure 8) and fieldwork in the Alijó Li-rich vein from the Barroso-Alvão aplite-pegmatite field with spodumene sampling (22th July).

Figure 8 - Aldeia Li-rich vein, from the Barroso-Alvão aplite-pegmatite field where a spodumene crystal can be seen in the left side of the picture.

Filipa Dias, Ricardo Ribeiro and **Alexandre Lima:** Field trip to Santiago de Compostela to participate in the scientific workshop "Minerales estratégicos para la industria gallega" promoted by the European project iTarg3T: Innovative Targeting & processing of Tin, Tungsten and Tantalum ores. During this field trip, we had the opportunity to visit the San Finx mines. The deposit's mineralization consists of quartz veins with cassiterite (tin) and wolframite (tungsten).

Guilhermo Ínsua: Participation in an online workshop dedicated to low-temperature geochemical modeling using PHREEQC (EMC 2020), lead by Prof. Mark Tyrer, Prof. Andy Watson and Dr. Andy West (Collegium Basilea). Also assisted to Workshop organized by Doctoral Program in Geosciences (FCUP). Participated to Congresso Jovens Investigadores em Geociências 2021 – CJIG 2021 consisted in four days of fieldwork in the Aljezur region, SW Portugal, lead by Prof. Rui Dias (Évora University).

Guilhermo Ínsua: Field campaign carried out in the vicinities of the Conlelas, Alimonde and Carrazedo localities, and Bragança, for samples collection in the frame of PhD project. Field campaign carried out in the western sector of the Bragança Complex in the frame of PhD project, including structural data and sample collection near the Vinhais, Sobreiró de Baixo, Tuizelo, and Zido localities. Cartography fieldtrip and samples collection (four-days) in the Conlelas, Alimonde and Carrazedo regions, Bragança (Figure 9).

Figure 9 - Outcrop on the side of the road between Alimonde and Carrazedo villages, showing a hornblendite body, visible on the left side of the picture, which seems to be interlayered with serpentinized dunites (on the right side of the picture) and pyroxenites.

Helena Couto: Lecture intitled “Stages in the evolution of life on Earth", in the scope of EUGLOH invited lectures "Communicating biology and geology in English" from Université Paris-Saclay. International Project (University of Porto/University of Saclay). 7th October 2021.

Joana Cardoso-Fernandes: Conference Chair of the IEEE/IGARSS International Geoscience and Remote Sensing Symposium (IGARSS), 2021. Keynote speaker at two editions of the RawMatCop Academy 2021, which took place on13-22 April 2021 and 1-9 June 2021, with the presentation entitled "Sentinel-2 data in lithium pegmatite exploration: the case study of the Fregeneda-Almendra pegmatite field".

Luís Lima: Participation in a course of explosives application in quarrying which was given by the Portuguese Geologist Association together with Portuguese Association of Explosives Engineering and Studies. This course focused on the safety measures, applied legislation, explosives operation and monitoring the secondary effects of blasting (Figure 10).

Figure 10 - Application of explosives in quarries.

Marcela Rodrigues: a) Completion of the “Fluid and Melt Inclusions: Applications to Geologic Processes” virtual Short Course organized by the University of Alberta for the GAC-MAC 2021 conference, on October 30-31, 2021. b) Completion of the “Introduction to Data Analytics and Machine Learning for Geologists” virtual Workshop organized by CSIRO Mineral Resources and Goldspot Discoveries for the GAC-MAC 2021 conference, on November 1-2, 2021.

Marcelo Silva: Organization of “Seminário Segurança Rodoviária”, Évora, 6 de Outubro de 2021. MOPREVIS project, in Évora.

Paula Alexandra Gonçalves: Fieldwork between 8th- 9th November 2021, in Castro Marin region (Algarve): charcoal samples resulting from forest fires in the summer of 2021 were collected for research purposes (Figure 11).

Figure 11 - Charcoal sampling in Castro Marim

Pedro Nogueira: Participation in the Madeira-Tore21 oceanographic campaign. The main objectives of the campaign Madeira-Tore Ridge (MTR) corresponded to the acquisition of oceanographic, biological and geological data for the characterization of the environmental baseline of the Madeira-Tore Ridge and inventory of marine debris potentially existing on the bottom and in the water column and the characterization of natural resources that occur along this geomorphological unit. The mapping of the substrate type and the distribution of mineral resources were also objectives to be achieved through the collection of rock and sediment samples. The campaign took place between 20 November and 4 December 2021, with 17 scientists/researchers and 19 members of the team of technicians and sailors (Figure 12).

Figure 12 - Madeira-Tore Ridge (MTR) team.

Invited by the research team, Pedro Nogueira was part of the Geology team that carried out all the geological surveys, namely rock and mineral analysis and rock geochemistry; and also gave support to the geophysics team. Pedro Nogueira was also the scientist responsible for one of the ROV dives. The mineralogy and geochemistry studies were carried out using the cycle presented in figure 13.

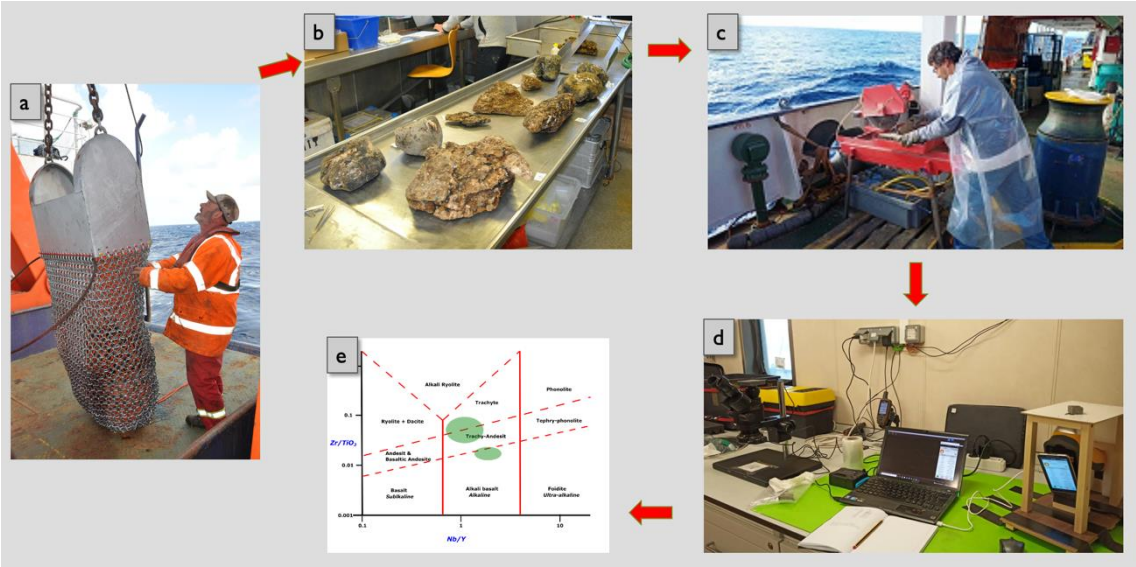


Figure 13 - Cycle of tasks carried out in the studies of mineralogy and geochemistry of rocks.

Ricardo Ribeiro: a) Fieldwork in Barroso – 31st March 2021: A radiometric campaign was carried out in the Alijó pegmatite area. A small profile perpendicular to the Alijó pegmatite was made. In total, 13 individual stations were covered with measurements. This data will be used in the GREENPEG, a European research project. b) Fieldwork in Argemela, Fundão – 15th April to 16th April 2021: Field trip to Argemela to collect gravimetric and radiometric (gamma-ray spectroscopy) data. In this first trip, a survey of the terrain was made to create a survey grid in the study area. The data were treated using the Oasis Montaj software. c) Fieldwork Argemela, Fundão – 10th June to 12th June 2021: Field trip to Argemela to collect gravimetric and radiometric (gamma-ray spectroscopy) data. We collected a big part of the geophysical data needed to perform the first Bouguer anomaly maps and the radiometric maps on this second trip. The data were treated using the Oasis Montaj software (Figure 14).

Figure 14 - Fieldwork in Argemela.

Sónia Pereira: Attendance at the 15th EAS Basic Course in Aerobiology, with a grant conceded by ESA – European Society of Aerobiology.

8. Nacional and International Projects

 # Project NORTE-01-0145-FEDER-00007- "Development of Sustainable Materials for Water Splitting: an integrated study from cradle to grave". NORTE-45-2020-75 - Sistema de Apoio à Investigação Científica e Tecnológica (SAICT) -Projetos Estruturados de I&D&I- Horizonte Europa. 2021-2023

This project aims to evaluate the national mineral resources, to develop national competences for fabrication of water splitting materials, and to assess the environmental safety of the fabricated materials, in that way contributing to the neutral climate impact of Smart Cities and to the national hydrogen strategy (EN-H2).
The sustainability of Smart Cities and their contribution for the goal of Neutral Climate Impact requires the development of greener energy sources with reduced climate impact. Hydrogen is envisaged by Portugal and the European Union as one step forward in the direction of Neutral Climate Impact. To achieve this, a scientific and technological effort is still required in the development of new materials that can improve the energetic efficiency of Hydrogen generation and use. Furthermore we cannot forget to look at the extraction of the mineral resources and at the environmental safety of the materials and production methods. Therefore, the H2Innovate project aims at, congregating the complementary expertise existing in four UPorto research centers (CIQUP, GreenUPorto, ICT and IFIMUT), contributing to assess and harmonize the existing data on national relevant mineral resources, to develop new oxide nanomaterials that can be used in the electrochemical and photoelectrochemical water splitting for hydrogen production, to issue recommendations on the safe environmental production and management of the raw materials and final products and to disseminate for the community the findings generated in the project.
The objectives are structured in five tasks aiming at the development of:
i) updated evaluation of the available mineral resources of non-precious metals that can be used in the fabrication of water splitting materials;
ii) new metal oxide materials for improved water splitting;
iii) new metal oxide nanomaterial devices with improved water splitting properties;
iv) recommendations on the safe environmental use of the metal oxide nanomaterial devices;
v) a prototype to demonstrate the achievements of the project.
The graphical abstract attached give a general picture of the contribution and integration of the different Work Packages to the project objectives.

Principal Investigator: Carlos Pereira (FCUP). Participants ICT/FCUP: **Alexandra Guedes, Alexandre Lima, Fernando Noronha, Helena Martins, Helena Sant'Ovaia, Maria dos Anjos Ribeiro.**

 # Project NORTE-01-0145-FEDER-000056 - "Soil health surrounding former mining areas: chracterization, risk analysis and intervention". NORTE-45-2020-75 - Sistema de Apoio à Investigação Científica e Tecnológica (SAICT) -Projetos Estruturados de I&D&I- Horizonte Europa. 2021-2023.

The North of Portugal is particularly rich in metallic and non-metallic mineral resources, whose exploitation dates back to the 19th century. The high-volume of mining wastes resulting from the exploration and processing of the ores that have been deposited in tailings close to the mines, in most cases without any recovery or maintenance. It is well documented

that improper mining waste disposal will result in air, soil, and water pollution. This environmental legacy, and the contamination caused by the mining waste disposal, is far from being properly assessed, namely the impact on the soils and groundwater of the surrounding areas. Furthermore, in the North of Portugal, the traditional and subsistence-like based agriculture is common, and the soils and groundwater are used without any knowledge about the risk management approach to the potential contamination caused by the mining waste disposal. In this framework, a project entitled Soil health surrounding former mining areas: characterization, risk analysis, and intervention is proposed within the Mission Area "Soil Health & Food", taking advantage of the longtime expertise of a consortium composed by five R&D Institutions from different and complementary areas, namely: Earth Sciences (ICT and CERENA), Chemistry (CIQUP), Sociology (IS-UP) and Art, Design and Society (i2ADS). This project will allow the assessment of the hydropedological impacts associated with mining and industrialization, and their contribute to the mitigation and/or remediation of these impacts, promoting soil protection and health. For this purpose, former areas where coal, Sb-Au and W mines operated, and where mining processing residues were deposited nearby, were selected.

The methodologies for remote detection and geostatistical analysis of the results will allow the development of observation and data collection systems that will lead to the development of models and applications, in a GIS environment, for the temporal and spatial monitoring of the soils under study. In the studied sites, in addition to the characterization, an environmental risk analysis will be carried out, and the most appropriate intervention techniques will be inventoried. During the project, awareness actions will be carried out with the population of the studied areas in order to understand the sociological impact associated with the exploitation of geological resources and the population hazard and risk perception. An artistic engagement and dialogue with local communities/researchers will be accomplished.

Principal Investigator: **Deolinda Flores.** Participants ICT/FCUP: **Alexandra Guedes, Alexandre Lima, Ana Cláudia Teodoro, Bruno Valentim, Fernando Noronha, Helena Martins, Helena Sant'Ovaia, Joana Ribeiro, Lia Duarte, Maria dos Anjos Ribeiro.**

Project ERA-MIN/0005/2018 – AUREOLE

tArgeting eU cRitical mEtals (Sb, W) and predictibility of Sb-As-Hg envirOnmentaL issuEs - Project Fundação para a Ciência e a Tecnologia (Lisboa) 2019-10 to 2022-09.

Antimony (Sb), a critical metal for Europe strategic for the European (EU) aircraft industry & battery manufacturing plants, is widely used in industrial operations. Its most promising use may be for rechargeable Li- & Na-ion batteries. The project is based on disruptive concepts: i) new 3D large-scale metallogenic model integrating deep-seated processes to determine the spatial distribution of ore deposits; ii) the use of mineral prospectivity data weighted by surface data to determine the probability of environmental risk over large areas. Despite a high EU potential, the knowledge on Sb remains poorly constrained. EU remains under the threat of the Chinese supply. In parallel, metalloids (Sb, As, Hg) of geogenic origin are recognised as a global threat for human health. Then, a large-scale identification of these areas should be a priority. In this 3 years project, it will produce i) a new 3D metallogenic model that will contribute to the understanding of the mineralizing processes; ii) a new understanding of surface processes that control the mobilisation & transport of metalloids; iii) a new large-scale mineral prospectivity and iv) a new large-scale environmental risk assessment by weighting mineral prospectivity with earth surface properties.

AUREOLE

Targeting European Critical Metals (Sb, W) & predictibility of Sb-As-Hg environmental issues

Participants ICT/FCUP: **Alexandre Lima, Maria dos Anjos Ribeiro, Lia Duarte, Helena Sant'Ovaia.**

Project EXCITE - Electron and X-ray microscopy Community for structural and chemical Imaging Techniques for Earth materials, H2020-INFRAIA-2020-1 (Integrating and opening research infrastructures of European interest), Topic: INFRAIA-02-2020, Type of action: RIA (Research and Innovation action), Project number: 101005611, 2021-2024.

Excite Network

EXCITE aims developing a community-driven technological imaging advancements that will strengthen and extend the current implementation of leading-edge microscopy for earth-materials research. In particular, the EXCITE strategy is to integrate joint research programmes with networking, training, and trans-national access activities, to enable both academia and industry to answer critical questions in earth-materials science and technology.

Principal Investigator FCUP: **Alexandra Guedes.** Participants ICT/FCUP **Violeta Ramos**.

 # ERA-MIN Joint Call 2019: Project MOSTMEG - Predictive models for strategic metal rich, granite-related ore systems based on mineral and geochemical fingerprints and footprints. 2020-2023.

The main goal of MOSTMEG project is to develop and validate predictive models for strategic metal-rich, granite-related ore systems by refining available concepts and exploration strategies, using mineral and geochemical criteria as pathfinders or vectors to mineralized systems. Such systems may range from quartz-lodes, breccia pipes and skarns enriched in W-Sn-F(-P-Bi-Sb-Cu)-bearing mineral associations, greisenized granite cupolas and aplite-pegmatite-hosted mineral assemblages incorporating Sn-Ta-Y-F(-W-Nb) or Li-Cs-Be-Ta(-P-Rb).

Principal Investigator FCUP: **Alexandra Guedes**. Participants ICT/FCUP: **Violeta Ramos and Bruno Valentim**.

 # CoalMine - POCI- 01-0145-FEDER-030138

Projeto "Resíduos de exploração de carvão: avaliação, monitorização e recuperação de impactos ambientais através de deteção remota e analise geoestatística" - CoalMine - POCI-01-0145-FEDER-030138. (www.fc.up.pt/coalmine/).

CoalMine is a project financed by FCT (AAC no 02/SAICT/2017) developed by a consortium consisting of ICT (Porto and Évora Poles) and Requimte. This project aims: (i) to identify and characterize the environmental impacts caused by the São Pedro da Cova coal mine waste pile (self-burning since 2005) in surrounding soils and waters; and, (ii) to monitor the combustion temperature and mass movements through remote sensing using unmanned aerial vehicles.

Leader: **Deolinda Flores**. Participants ICT/FCUP: **Ana Cláudia Teodoro, Joana Ribeiro, Lia Duarte,** Jorge Espinha**.**

ERA-MIN/0001/2017 – LIGHTS

Solução integrada de dados hiper espetrais obtidos in situ e com recurso a plataformas aéreas para prospeção de lítio - Project Fundação para a Ciência e a Tecnologia (Lisboa)2018-05 to 2021-04.

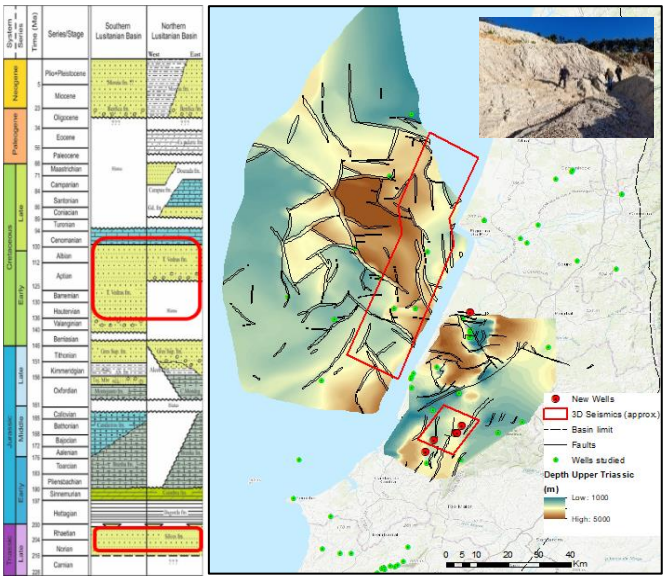
The LIGHTS project brings together world-leading industrial and research organizations to develop new methods and tools for drone-based lithium exploration. Has two main goals: to develop a software for easy and fast detection of lithium-host minerals combining drone-borne remote sensing data and field observations, and to understand how pegmatitic Li-deposits are formed. This is critical to establish how remote sensing and field observations can be used to unveil lithium deposits.

Participants ICT/FCUP: **Ana Claudia Teodoro, Alexandre Lima, Maria dos Anjos Ribeiro.**

PilotSTRATEGY

CO2 Geological Pilots in Strategic Territories (H2020-LC-SC3-2020-NZE-RES-CC)

The PilotSTRATEGY project focuses on advancing understanding of resources for geological CO_2 storage, and it will investigate in detail in three regions of Southern Europe: Paris Basin (France), Lusitanian Basin (Portugal) and Ebro Basin (Spain). This will include acquisition of new data, detailed geo-characterisation, feasibility studies and preliminary design or pre-front end engineering and design studies. At the end of the project, the level of site characterisation in these three regions will be sufficient to allow a final investment decision to be made and for geological CO_2 storage.



Participants ICT: **Jorge Pedro.**

ALT20-08-2114-FEDER-000216) – CIMarvão

Interpretive Centre and Gates of the Natural Park of Serra de São Mamede.

The CIMarvão project intends to build an interpretive centre in order to preserve and disseminate the geodiversity, biodiversity and cultural heritage of the Natural Park of Serra de São Mamede.

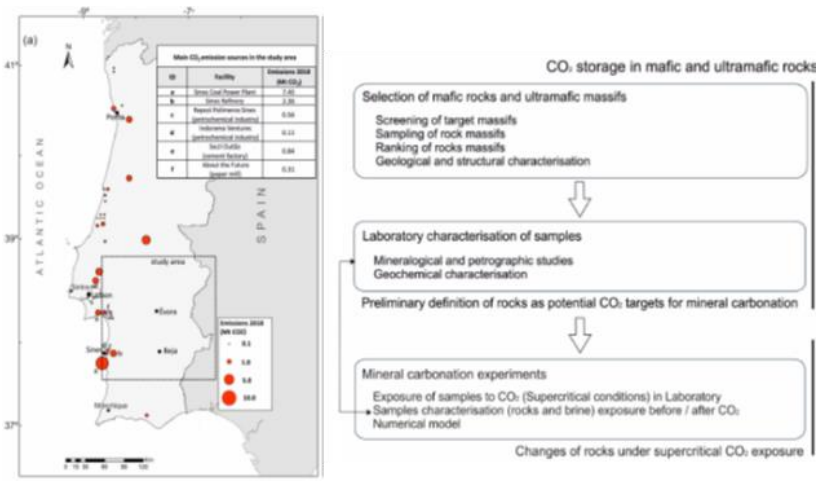
Participant ICT: **Jorge Pedro.**

PTDC/CTA-GEO/31853/2017 – InCarbon

In situ carbonation for reduction of CO2 emissions from Power and industrial sources in Alentejo.

The InCarbon project based on the principles of CO2 capture and storage technologies, aims to study the potential of in situ mineral carbonation in mafic and ultramafic rocks in Alentejo. It fits into climate change and mitigation technologies by studying a process that allows the industrial and power sectors to reduce their greenhouse gas emissions.

Participant ICT: **Jorge Pedro, Luís Lopes.**



 # Project MARINEFF (MARine INfrastructures EFFects) – VA INTERREG France (Channel)-England co-financed by the European Regional Development Fund

The Marineff project is a collaboration between France and the UK with the goal of developing coastal infrastructure to enhance and protect the ecological status of cross-channel coastal waters. The project aims to produce new ecological enhancement units to improve the ecological status of coastal and transitional watercourses, as well as professionals and stakeholders in the process.

Participant ICT: **Violeta Ramos**

 # Cost Action: OC-2016-1-20419- MULTI-modal Imaging of FOREnsic SciEnce Evidence tools for Forensic Science". 2017/2021.

The main objective of this Action, entitled 'MULTI-MODAL IMAGING OF FORENSIC SCIENCE EVIDENCE (MULTI-FORESEE)- TOOLS FOR Forensic Science', is to promote innovative, multi-informative, operationally deployable and commercially exploitable imaging solutions/technology to analyse forensic evidence. Forensic evidence includes, but not limited to, fingermarks, hair, paint, biofluids, digital evidence, fibers, documents and living individuals.

Participant ICT/FCUP: **Alexandra Guedes.**

 # Project POCI-01-0145-FEDER-022151- C4G-Colaboratório para as Geociências, Roteiro Nacional de Infraestruturas de Investigação de Interesse Estratégico.

The Collaboratory for Geosciences (C4G) is a distributed research infrastructure of the Portuguese Roadmap, the only one dedicated to Solid Earth Sciences, with the objective of sharing scientific resources in order to optimize the creation and diffusion of scientific knowledge in Portugal and internationally.

Participant ICT/FCUP: **Alexandra Guedes.**

ERA-MIN/0002/2017 project: DEASPHOR-Design of a product for SUBSTITUTION of phosphate rocks. ERA-MIN2 Join Call 2017.

The main objective of this project is the recycling of phosphorus from aviary litter ash as a substituting material of phosphate rocks. However, aviary litter ash is not economically attractive to substitute phosphate rocks, and also composed by materials that are impurities of the P2O5 extraction process. Therefore, novel solution is proposed to produce P-rich concentrates from aviary litter ash.

Project Coordinated: **Bruno Valentim**. Participant ICT/FCUP: **Alexandra Guedes.**

ERA-MIN/0003/2018 project: NEXT-LiB - Novel Circular Economic Approaches for Efficient Extraction of Valuables from Spend Li-ion Batteries. ERA-MIN Joint Call 2018.

The project aims to develop and demonstrate efficient processes and innovative techniques for the extraction of metals and separation of graphite from spent LIBs and to overcome the barrier and obstacles which limit the recovery efficiency.

Principal Investigator FCUP: B**runo Valentim**. Participants ICT/FCUP: **Alexandra Guedes.**

International Geological Correlation Project 653 (2016-2021)

The onset of the Great Ordovician Biodiversification Event do IGCP (International Geoscience Programme) – Project co-lead by Thomas Servais, David Harper, Olga T. Obut, Cristian Rasmussen, Alycia Stigali and Zhang Yuandong, IUGS/UNESCO International Geoscience.

Helena Couto is member.

Project PIPA - GUIFARQ II - Projeto de Investigação Arqueológica de Guifões

Helena Couto is scientific consultant for the area of Geology and Geological Characterization of Materials, project from Universidade de Letras da Universidade do Porto (2019 - 2022).

Project "Funerary and ceremonial practices between the Neothic to the Bronze Age by Archaeometry – ARQUEOM (ARQUE Project Lab2PTSept2014)".

Coordinator: Ana M. S. Bettencourt (University of Minho; CITCEM/UM; Participant ICT: **Pedro Pimenta Simões.**

Northwest Rock Art Route project. A Cultural Tourism Project (RAR Project - Oct2014)"

Coordinator: Ana M. S. Bettencourt (University of Minho; CITCEM/UM; Participant ICT: **Pedro Pimenta Simões.**

CLIMATE@COA - Climate and human adaptation during the Last Glacial Period in the Côa Valley region (Portugal). FCT - Ref: COA/CAC/0031/2019, 2021-2023.

Participant ICT: **Joana Ribeiro.**

ERASMUS+ CBHE " SUGERE - Sustainable Sustainability and Wise Use of Geological Resources". Ref: 598477-EPP-1-2018-1-PT-EPPKA2-CBHE-JP, 2019-2022.

Participant ICT: **Joana Ribeiro.**

SURGE CPLP - Sustentabilidade dos Recursos Geológicos na CPLP".

Financed by Instituto Camões through Programas Estratégico de Cooperação com Angola, Moçambique e Timor, 2019-2021.

Participant ICT: **Joana Ribeiro.**

Project DORIS funded by FCT

This project is now in concluding phase, and the ASV (Automated Surface Vehicle) that was built to sample surface films in a fully autonomous manner has proved to be successfull in the field. It was tested in Aveiro Lagoon, counting with collaboration from three institutons: University of Aveiro, Faculty of Engineering of the University of Porto and FCUP.

Participant ICT: **José da Silva.**

MontObEO - Observatório da biodiversidade de Montesinho

Uma ferramenta de Observação da Terra para a conservação da biodiversidade. FCT.

Co-Principal Investigator: **Ana Claudia Teodoro.** Participant FCUP/ICT: **Lia Duarte.**

 # Project "INOVMINERAL 4.0, TECNOLOGIAS AVANÇADAS E SOFTWARE PARA OS RECURSOS MINERAIS" 2020-07 to 2022- 12.

Incentive system for research and technological development mobilisation programmes, competitiveness clusters and other collective dynamics. Circular Economy; Process Digitization;Collaborative Processes 4.0 and Empowerment and Skills Creation.


Participants ICT/FCUP: **Alexandre Lima, Maria dos Anjos Ribeiro, Ana Claudia Teodoro, Lia Duarte.**

 # Project I4Stone: ALT20-03-0247-FEDER-072231 – Development of digital 4D registration systems and predictability of geological resources.

Participant ICT: **Luís Lopes.**

 # Project CALCINATA: ALT20-03-0247-ERDF-072239 – Production of lime-based mortar from the calcination of carbonated sludges from the ornamental rock industry (marble and limestone).

Participant ICT: **Luís Lopes.**

 # Project ANTECIPA: ALT20-03-0246-FEDER-000070 – Models of predictability of Ornamental Rocks on site and in operation.

Participant ICT: **Luís Lopes.**

 # Project LITHOS: ALT20-03-0246-FEDER-000036 - Laboratory for Innovation and Technological Hub for Ornamental Stone, financiamento Portugal 2020.

Participant ICT: **Luís Lopes.**

 # Project BRO-CQ: ALT20-03-0247-FEDER-017659 – Quality Control of blocks in Ornamental Rocks.

Participant ICT: **Luís Lopes.**

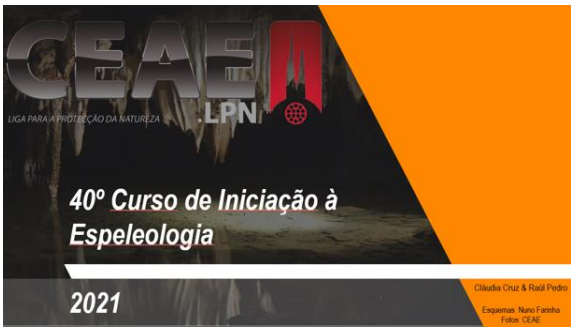
 # Verão com Ciência 2021 – "Técnicas de prospeção aplicadas às mineralizações de ouro de Santiago do Escoural (Montemor-o-Novo)".

Caracterização de partículas de ouro tendo em vista a identificação de potenciais áreas de prospeção. Description: This work had the main gold of initializing the study and characterization of gold particles obtained throughout a systematic sampling campaign that focused on stream sediments (from the Santiago do Escoural area. This work will allow to identify areas prone for the occurrence of primary gold mineralization which will benefit future mineral exploration in the area.

Project leader: Pedro Nogueira **Scientific supervision:** Miguel Maia

9. Scientific dissemination

Cláudia Cruz: Lecture intitled "Geologia Cársica" in the 40th Speleology Initiation Course (18th September to 16th October 2021). This course was promoted by the *Centro de Estudos e Atividades Especiais*.



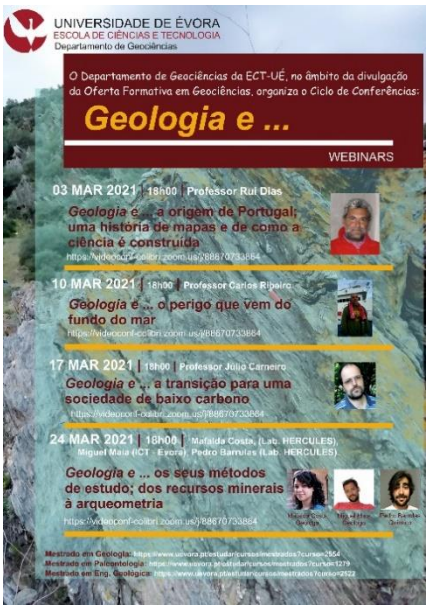
Helena Brites Martins: Presentation of the course of Geology 1st degree, through a virtual platform in 18ª MOSTRA DE ENSINO 2021" and FCUP "Dias Abertos".

Helena Couto collaborated as a scientific adviser with the Canelas Geological Interpretation Center (CIGC), **Arouca Geopark.**

Helena Sant'Ovaia: i) Lecture online intitled "Atividade sísmica e risco sísmico em Portugal", presented in Escola Secundária de Gondomar", and was directed to secondary school students. January 2021. ii) Lecture online intitled "Da Deriva de Continentes à Tectónica de Placas", presented in Colégio de Ermesinde, and was directed to middle school students. 26th February 2021. ii) Lecture online intitled "Recursos e sustentabilidade de recursos: Desafios do século XXI", presented in Escola Secundária de S. João do Estoril", and was directed to secondary school students. 12th May 2021. (iii) Lecture online intitled "Recursos e sustentabilidade de recursos: Desafios do século XXI", presented in Escola Secundária de Filipa de Vilhena", and was directed to secondary school students. 28th May 2021. (iv) SkypeTalks with middle school students. November 2021. (v) Fieldwork training for secondary school students in Complexo metamórfico da Foz do Douro (8 th June 2021) and in Lavadores (October 2021).

Joana Cardoso-Fernandes: Lecture entitled "Aplicações da deteção remota às Geociências " in the frame of the Earth Observation School 2021 held in Cidade da Beira, Mozambique.

Jorge Pedro: Lecture intitled “Geologia e …”. Webinar: Conferences cycle of scientific dissemination, on the 3rd, 10th, 17th and 24th of March with around 800 participants.



Miguel Maia: Lecture intitled “A Geologia … e os seus métodos de estudo aplicados aos recursos minerais”. Presentation on the scope of promoting the Geology Master degree which is offered by the Departamento de Geociências da Escola de Ciências e Tecnologias da Universidade de Évora.

Lia Duarte: (i) Presentation of “Tecnologias da Informação Geográfica – desenvolvimento de aplicações” and collaboration in the chat for students' questions through a virtual platform in 18ª MOSTRA DE ENSINO 2021 (May 2021). (ii) Collaboration in the chat for students' questions through a virtual platform in FCUP “Dias Abertos” (February 2021). (iii) Lecture intitled “Terra Digital: perspetivas em sistemas de informação geográfica”, promoted by U.Porto in Semana da Ciência e da Tecnologia 2021 (November 2021).

Luís Lopes: (i) Lecture intitled “Geologia da Zona de Ossa-Morena – Anticlinal de Estremoz. Pedreiras da Zona dos Mármores: 2000 anos de exploração e agora”. Presentation on the scope of “Mestrado em Ciências e Tecnologias do Ambiente” Universidade do Minho, Escola de Ciências, 9th March. (ii) Lecture intitled “Geologia da Zona de Ossa-Morena – Anticlinal de Estremoz. Pedreiras da Zona dos Mármores: 2000 anos de exploração e agora”. Presentation on the scope of “Mestrado em Engenharia de Minas e Geoambiente” Faculdade de Engenharia, Universidade do Porto, 25th March.

Sara Leal: Organization and promotion of the activity “Uma Aventura em Lavadores: bio e geodiversidade”. Natural History and Science Museum of the University of Porto (MHNC-UP) - Hall of Biodiversity- Ciência Viva Center. 2021.

10. Awards and Distinctions

Cláudia Cruz: PhD award. Awards and Distinctions Ceremony, 3rd December 2021 at FCUP.

Joana Cardoso-Fernandes: Distinction Diploma: "Scholarship by Merit" attributed by University of Porto in 2021 due to exceptional scholar achievements in the academic year of 2017/2018.

Marcela Rodrigues: "Award Prof. Doutor António Ribeiro" - Distinction attributed to the scientific research work "Estudo de inclusões de melt em Litiofilite-Trifilite da Mesquitela (Mangualde)" presented at the "XI Congresso de Jovens Investigadores em Geociências", which took place between the 27th and 30th of November 2021, at Aljezur.

Marcelo Silva: Best oral communication in Jornadas do ICT, Porto. 11st and 12nd February 2021, Porto (online), Portugal.