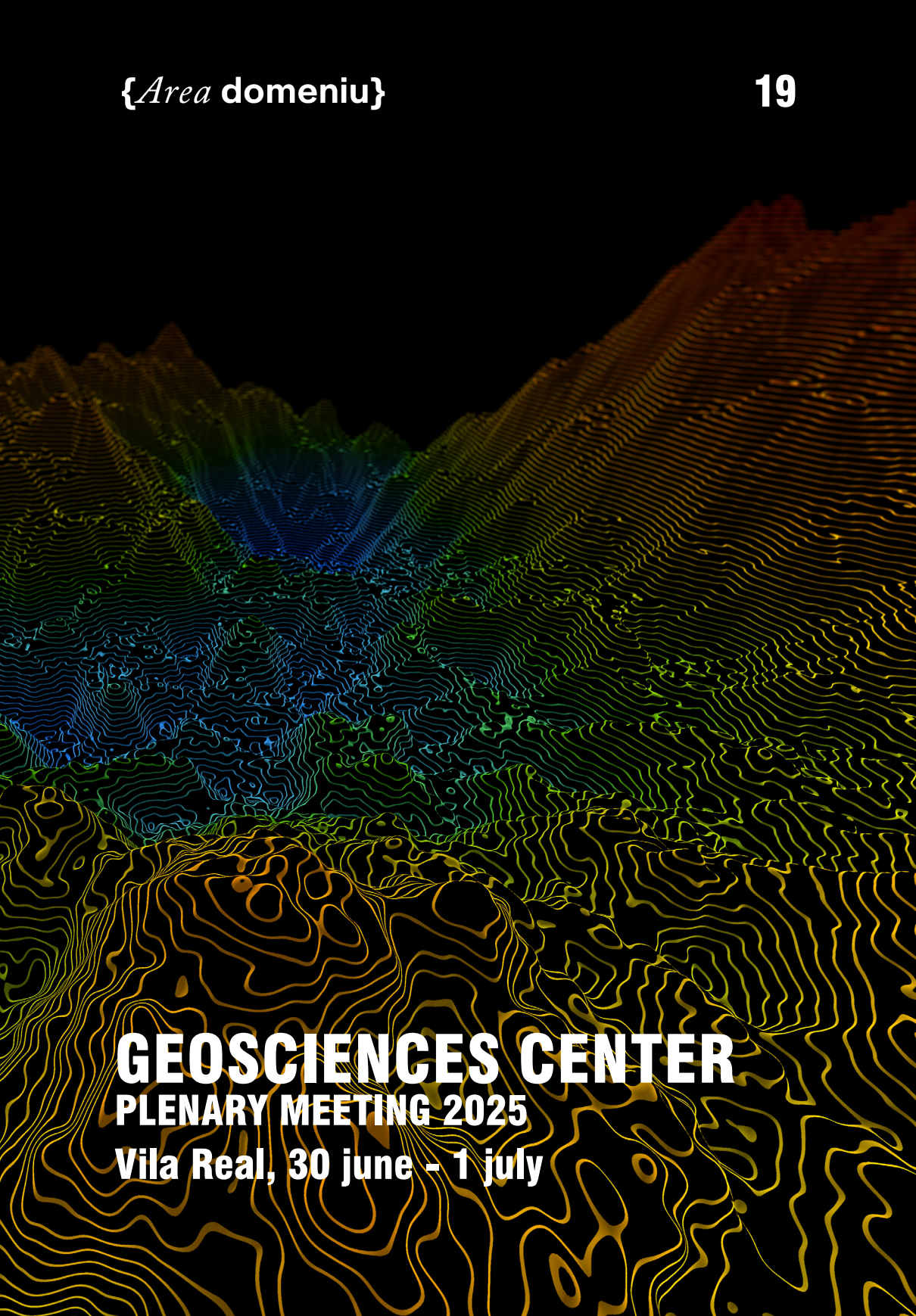




GEOSCIENCES CENTER
PLENARY MEETING 2025
Vila Real, 30 june - 1 july

$\{Area\}$ domeniu}

Geosciences center

PLENARY MEETING 2025

Vila Real, 30 june - 1 july, 2025

{*Area* domeniu}

FICHA TÉCNICA

{*Area domeniu*} 19

Propriedade: Instituto Terra e Memória e Centro de Geociências

Conselho Editorial: Sara Garcês, Inês Pereira, Luiz Oosterbeek, Maria Helena Henriques, Nuno Monteiro Vaz, Hugo Gomes, Ana Castilho, Adolfo Silveira, Patrícia João.

Título: Geosciences Center. PLENARY MEETING 2025, Vila Real, 30 june - 1 july.

© 2025, CGEO, UC, IPT, ITM, UTAD, UAL e autores

Projeto gráfico: Kenia de Aguiar Ribeiro

Montagem e paginação: Sara Garcês

Ilustração da Capa: Imagem de vecstock no Freepik

DEPÓSITO LEGAL: 177117 / 02

ISSN: 1645-6947

ISBN: 978-989-35056-8-7

Tiragem: edição eletrónica

Mação, 2025

Ref*: Geosciences Center. PLENARY MEETING 2025, Vila Real, 30 june - 1 july. Mação: Instituto Terra e Memória, série AREA DOMENIU, vol. 19, 96p.

Este estudo é financiado por Fundos portugueses da Fundação para a Ciência e a Tecnologia, I.P. (Portugal), no âmbito do projeto estratégico UIDB/00073/2025 e UIDP/00073/2025 da Unidade de I&D Centro de Geociências (Universidade de Coimbra – Portugal).

Solicitemos permuta | On prie l'échange | Exchange wanted | Tauschverkehr erwünscht | Sollicitiamo scambio

Contactar:

Instituto Terra e Memória

Largo dos Combatentes, 6120—750 Mação, Portugal

itm.macao@gmail.com

www.institutoterramemoria.org

Geosciences Center

PLENARY MEETING 2025 | 30th June – 01st July | University of Trás-os-Montes e Alto Douro, Vila Real, Portugal

CONSELHO EDITORIAL: SARA GARCÊS, INÊS PEREIRA, LUIZ OOSTERBEEK, MARIA HELENA HENRIQUES,
NUNO MONTEIRO VAZ, HUGO GOMES, ANA CASTILHO, ADOLFO SILVEIRA, PATRÍCIA JOÃO

Publicado por:



Com o apoio de:



Table of contents

INTRODUCTION	16
ABSTRACTS	18
Developing UNESCO World Geoparks in Iran: Lessons, obstacles and a scalable strategy for the Middle East and Central Asia Alireza Amrikazemi, Artur Sá, Nicolas Zouros	20
Contribution to the study of the aesthetics of pre-Hispanic societies: Notes on the rock art of the Ecuadorian tropics and the high Andes Carlos Augusto Rodríguez Martínez	22
Heritage: History, Narrative(s) and Community(ies) Celeste Afonso	24
A Multiscalar Study of Palaeolithic Zoomorphic Representations in Western Iberia using Geometric Morphometrics and Machine Learning Dionysios Danelatos, Sara Garcês, Hipólito Collado Giraldo, Sandra Jardim	26
The Takruktektek as cultural landscape Edileila Maria Leite Portes, Luiz Oosterbeek	28
Study of Soil Quality in the Surroundings of Cabo Mondego and the Impact of Past Industrial Activity Fernando Michels, Joana Ribeiro, Maria Helena Henriques	30
From collections to communities: mediation strategies and practices in museums for a people-oriented heritage Inês Bettencourt da Câmara	32
Using Maritime Archaeology to Understand the Dynamics and Mobilities of the Salt Port Complex on Igoronhon Island, Tutóia Jardel Stenio de Araujo Barbosa	34
Building Bridges: Intercultural Dialogue and Diversity within the Portuguese Network of Museums Joaquim Jorge	36
Tracing Prehistoric Lifeways in Central Portugal: A Multi-Isotope Study of Mobility and Diet in the Nabão Valley Mahym Amanova, Luiz Oosterbeek.....	38
Cultural heritage and territory management: analytical matrix and performance indicators for choices' options at small communities Maurizio Quagliuolo.....	40

Geological Contribution to Sustainable Rehabilitation Based on Natural Engineering and Engineering Geology Mónica Pratas-Silva ¹ , Pedro Andrade, Mário Quinta-Ferreira.....	42
Defining Pre-Schematic Art in the Iberian Peninsula: A Comparative Study Using Integrative and Machine Learning Methods Noelia Priego Cecilia, Sara Garcês, Hipólito Collado Giraldo, Sandra Jardim	44
Tracing subduction-type metamorphism using detrital minerals in stream sediments Nuno Grácio, Inês Pereira, Pedro Dinis.....	46
The monuments to the dead of the Great War in Portugal during the Estado Novo regime: the construction of memory and forgetfulness in the public space Ligia Mateus	49
Holocene Slope Deposits and Microstratigraphy in the Portuguese Middle Tagus Valley Opeyemi Adewumi, Luiz Oosterbeek, Josep Vallverdú, Mário Quinta- Ferreira	50
Territories and Human Occupation in the Last Glacial Maximum on the Western edge of Iberian Peninsula: a techno-functional approach of the lithic industries Pedro Peça, Telmo Pereira, Marina Igreja	52
Geological Heritage of the “Atlantic Geopark” Project (Central Portugal) Salomé C. Custódio, Maria Helena Henriques, Artur A. A. Sá	54
Mapping the change: protection, mitigation and adaptation strategies for cultural heritage in the face of climate change Sarah Martinville, Alexandra Figueiredo, Claudio Monteiro	56
Geotourism Development within UNESCO Global Geoparks through Local Community Engagement Soma Sayedyounesi, Artur A. Sá, Emmaline Rosado-González	58
Human ability to adapt to environmental changes during the Quaternary in the Iberian Peninsula through a geoarchaeological analysis Virginia Lattao, Maria Helena Henriques, Pierluigi Rosina	60
POSTERS	62
Mineralogical characterization of fine materials derived from granite quarries, northern Portugal Tomás Gomes, Anabela Reis, Rui Teixeira, Luís Sousa	64
Project GRAV3D - Multidimensional files: The 3D Revolution in Rock Art Interpretation Cláudio Monteiro, Alexandra Figueiredo, Fernando Coimbra	65

Zooarchaeology and taphonomy of early/middle holocene Mammals: the Rua do Papagaio Archaeological Site (SARP), coast of Santa Catarina, Brazil Diego Dias Pavei, Juliano Bitencourt Campos, Albérico N. de Queiroz, Luiz Miguel Oosterbeek, Nelson J. O. de Almeida	66
AI + Anticipatory Governance = Next-Gen Cultural Landscape Intelligence Erika Robrahn-González, Luiz Oosterbeek	67
Cultural Landscapes Community AI Hub Erika Robrahn-González, Luiz Oosterbeek	68
EUROMUSE: Sound and Music in Museums Fernando Coimbra, Luiz Oosterbeek, Anabela B. Pereira, Sandra Alexandre, Virginia Lattao, Margarida Pacheco, Isabel Afonso	69
Archaeological research at Vale do Junco (Mação) Fernando Coimbra, Davide Delfino	70
Herit-Aware Hugo Gomes, Luiz Oosterbeek, Sara Garcês, Pierluigi Rosina	71
TRANSFORMATIVE TERRITORIES: Performing transition through the arts Hugo Gomes, Luiz Oosterbeek	72
Geoconservation in Portugal: an overview Maria Helena Henriques, Salomé C. Custódio, Ismar de Souza Carvalho	73
FINGERprinting cold subduction and Plate Tectonics using key minerals (FINGER-PT) Inês Pereira, Nuno Grácio, Patrícia Amaro, André Cravinho & Patrícia João	74
Heritage Education as a Contribution to Sustainable Development in Caminhos dos Cânions do Sul UNESCO Global Geopark Juliano Bitencourt Campos, Annie Souza Marques, Suliano Ferrasso, Diego Dias Pavei, Luiz Miguel Guedi, Estefani de Oliveira Serafim, Luciano Miranda, Mikael Miziescki, Maria da Glória Tavares Demamann, Mônica Priscila Kravczik Guglielmi, Breno Ferreira Fontana, Alex Luciano Tavares Rollano, Tarcísio Roldão da Rosa, Pâmela Ribeiro Jaques, Lucas Fabricio de Souza Firmino, Carlos dos Passos Paulo Matias, José Gustavo S. da Silva	75
Understanding and segmenting the geotourist profile in Caminhos dos Cânions do Sul UNESCO Global Geopark based on motivations José Gustavo S. da Silva, Ricardo E. Fonseca Filho, Álvaro J. Back, Juliano B. Campos, Artur A. Sá	76
Geological heritage sites of the São Tomé Island (West Africa) Keynesménio Neto, Maria Helena Henriques	77
The paleo-spaces of the Massili watersheds (Burkina Faso) Lassané Touga, Hantissié Hervé Farma, Benjamin Sawadogo, Abdoulaye Daboné	78

Cultural Identity through Gastronomic Tourism in the Caminhos dos Cânions do Sul UNESCO Global Geopark: a Study in Santa Catarina Municipalities Lucas Fabricio de Souza Firmino, Juliano Bitencourt Campos	79
PORT-SALT: A introdução do sal nas dietas em território português antes da escrita Luís Jesus	80
Methodological proposal for classification and determination of tourist carrying capacity applied to trails in the Caminhos dos Cânions da Sul UNESCO Global Geopark Luciano Miranda, José Gustavo S. da Silva, Juliano Bitencourt Campos	81
APHELEIA and BRIDGES - Transdisciplinary Landscape management Luiz Oosterbeek	82
Geomorphological Restoration: Concept and Practical Applications Mónica Pratas-Silva, Jose F. Martín Duque, María Tejedor Palomino, Pedro Andrade, Mário Quinta-Ferreira	83
AVECASTA - PORTAL DO TEMPO José Mateus, Paula Queiroz	84
The Double-u Replay / CGeo Wetland Program Miguel Gerales, José Mateus, Paula Queiroz	85
FIRST-ART PROJECT - Evolution and development of a comprehensive methodology for the study of Rock Art Hipólito Collado, Sara Garcês, Hugo Gomes, Virginia Lattao, Pierluigi Rosina, George Nash	86
RA3I - ROCK ART ANALYSES WITH ARTIFICIAL INTELLIGENCE Sara Garcês, Luiz Oosterbeek, Sandra Jardim, Carlos Mora	87
Assessment of Rock Slope Stability Pedro Andrade, Mónica Pratas-Silva, Mário Quinta-Ferreira	88
Património arqueológico e turismo sustentável em Portugal: caracterização, tendências e estruturação de uma estratégia para a sua gestão integrada Rosa Linda Graziano, Adolfo Silveira, Fabio Carbone	89
Exploring archaeological contexts with Diversity and Similarity indices from the perspective of Zooarchaeology in coastal sites in Southern Brazil Suliano Ferrasso, Juliano Bitencourt Campos	90
Visitor guides to the municipality of Praia Grande, Santa Catarina, Brazil: Environmental interpreters of the canyons Tarcísio Roldão da Rosa, José Gustavo Santos da Silva, Juliano Bitencourt Campos	91

MODERNIZATION OF PREVENTIVE ARCHAEOLOGY: THE USE OF REMOTE SENSING IN ENVIRONMENTAL IMPACT STUDIES.	
Vanessa Antunes	92
Hydrocarbon Sub-Basalt Basin Potential in West India and Offshore Pakistan	
Yasir Shahzad, Ines Pereira, Ricardo Pereira, Rui Pena dos Reis	93
COASTLINE project - Integrated Management and Mitigation of Environmental Risks to Coastal Cultural Heritage	
Alexandra Figueiredo, Sarah Martinville, Cláudio Monteiro	94
MEDICE II- Scientific project for the study of communities from the recent Prehistory to the Classical Era in the central region of Portugal	
Alexandra Figueiredo, Cláudio Monteiro, Adolfo Silveira	95
Vale da Anta: index properties	
Mónica Pratas-Silva, Pedro Andrade, Mário Quinta-Ferreira	96

Introdução

Que bom é poder reencontrar colegas e amigos, membros do Centro de Geociências, em Vila Real. É também uma excelente oportunidade para conhecer os novos membros que foram chegando, sejam todos muito bem-vindos. Deixamos um agradecimento aos colegas da UTAD pela organização deste Encontro, esperando que seja profícuo para todos.

O Centro de Geociências em 2025 completa, pelo menos do ponto de vista formal perante as instituições públicas, 50 anos de existência. Apesar de não termos os primeiros registos da fundação da nossa unidade, em 1975 o Centro de Geociências – à época, da Universidade de Coimbra – começava a dar os primeiros passos como grupo de investigação. A nossa unidade já viu passar a Junta Nacional de Investigação Científica e Tecnológica (JNICT), o Instituto Nacional de Investigação Científica (INIC), voltando em 1992 à gestão da JNICT e desde 1997, a Fundação para a Ciência e Tecnologia (FCT), à qual prestamos contas anualmente. Desde então, e através das inúmeras reorganizações na atribuição de financiamento que a FCT tem sofrido, o Centro de Geociências tem sido alvo de avaliações periódicas, no âmbito do financiamento Plurianual das unidades de investigação. É com grande felicidade que no ano que celebramos 50 anos de investigação tenhamos alcançado a classificação de Excelente. Não sendo a primeira vez que o alcançamos, esta avaliação reflete uma subida no nosso desempenho, após o Muito Bom obtido no programa anterior, confirmando que o caminho que temos percorrido é louvável. Esta avaliação oferece-nos agora uma oportunidade e garantia de melhores condições para o desenvolvimento dos nossos projetos de investigação, dos nossos programas de pós-graduação e formação avançada e na criação de sinergias entre os nossos diferentes domínios científicos – geociências e humanidades.

Questões como a geoética, como o desenvolvimento territorial e valorização do património e do ambiente, a aplicação de inteligência artificial e tecnologias mais modernas para potenciar o estudo, a prospeção e exploração dos recursos naturais e patrimoniais e a compreensão da evolução da Terra, dos territórios e da vida são as grandes apostas para este novo ciclo

de financiamento. Conseguimos assim assegurar a continuidade e o lançamento de projetos nestas áreas e criar novas oportunidades para estudantes e investigadores em início de carreira. Será um grande desafio, o qual teremos de encarar com sentido de responsabilidade, criatividade e empenho.

É desta forma que chegamos ao nosso Encontro CGeo 2025, que se antevê como dois dias de grande partilha e uma oportunidade para começar a desenhar os próximos 5 anos. Juntos. Contamos com duas apresentações orais de projetos estratégicos para o CGeo, várias comunicações orais de estudantes de doutoramento e uma sessão de pósteres que contam com a contribuição de vários membros. Teremos ainda a oportunidade de nos conhecermos melhor – na sessão “speed dating” – e de discutir propostas de dinamização da nossa investigação para o próximo ano durante a reunião plenária. Bom Encontro.

Em nome da Direção,
Inês Pereira

Introduction

It is a pleasure to meet up with colleagues and friends from the Geosciences Centre in Vila Real. It is also a great chance to meet the new members who have arrived, and we would like to extend a warm welcome to them all. We would like to thank our UTAD colleagues for organising this meeting and hope that it will be fruitful for everyone.

The Geosciences Centre will celebrate its 50th anniversary in 2025, at least in terms of formal public institutions. While we do not have records of our unit's foundation, the Geosciences Centre — initially of the University of Coimbra — began operating as a research group in 1975. Since then, our unit has seen institutions such as the Junta Nacional de Investigação Científica e Tecnológica (JNICT) and the Instituto Nacional de Investigação Científica (INIC), before returning to JNICT management in 1992. Since 1997, we have reported annually to the Fundação para a Ciência e Tecnologia (FCT). Throughout the numerous reorganisations of funding allocations that the FCT has undergone since then, the Geoscience Centre has been subject to periodic evaluations as part of the multi-annual funding of research units.

We are delighted that, in the year we celebrate 50 years of research, we have achieved an 'Excellent' rating. While this is not the first time we have achieved this rating, it reflects an increase in our performance following the 'Very Good' rating obtained in the previous program. This confirms that our approach is commendable. This assessment offers us an opportunity to develop our research projects, postgraduate and advanced training programmes, and create synergies between our scientific fields of geosciences and humanities.

This new funding cycle will focus on issues such as geoethics, territorial development, the valorisation of heritage and the environment, and the application of artificial intelligence and other modern technologies to enhance the study, exploration and exploitation of natural and heritage resources, as well as our understanding of the evolution of the Earth, its territories and life.

This will ensure the continuity and launch of projects in these areas, creating new opportunities for

students and early career researchers. This will be a significant challenge that we must approach with responsibility, creativity and commitment.

This brings us to our CGeo 2025 meeting, which is expected to be two days of valuable networking and an opportunity to start designing the next five years. Together. There will be two oral presentations regarding strategic CGeo projects, several oral communications from PhD students, and a poster session with contributions from various members. There will also be an opportunity to get to know each other better during the 'speed dating' session, as well as to discuss proposals for boosting our research next year during the plenary meeting. Have a good meeting!

On behalf of the Executive Board,
Inês Pereira

ABSTRACTS





Developing UNESCO World Geoparks in Iran: Lessons, obstacles and a scalable strategy for the Middle East and Central Asia

Desenvolvimento dos Geoparques Mundiais da UNESCO no Irão: Lições, obstáculos e uma estratégia escalável para o Médio Oriente e Ásia Central

Alireza Amrikazemi^{1,2,3}, Artur A. Sá^{1,2,3} & Nickolas Zouros^{4,5}

¹Department of Geology, University of Trás-os-Montes e Alto Douro, Quinta de Prados, 5000-801 Vila Real, Portugal

²Geosciences Centre (CGeo), Pole of the University of Trás-os-Montes e Alto Douro, Quinta de Prados, 5000-801 Vila Real, Portugal;

³UNESCO Chair on 'Geoparks, Sustainable Regional Development and Healthy Lifestyles', University of Trás-os-Montes e Alto Douro, Quinta de Prados, 5000-801 Vila Real, Portugal

⁴Department of Geography, University of the Aegean, University Campus, GR-81100 Mytilene, Lesvos, Greece.

⁵UNESCO Chair on Geoparks and Sustainable Development of Insular and Coastal Areas, University of the Aegean, University Campus, GR-81100 Mytilene, Lesvos, Greece

ABSTRACT

In recent decades, UNESCO Global Geoparks (UGGps) have emerged as innovative platforms for integrating geoconservation, sustainable tourism, and community development. As the world grapples with environmental challenges and seeks inclusive development strategies, UGGps offer a unique model that blends natural heritage with cultural identity, education, and economic opportunity. Within this global movement, Iran holds significant untapped potential. Home to exceptional geo-cultural landscapes—from the Lut Desert to the Zagros Mountains—Iran was an early regional pioneer in UGGps initiatives. Nevertheless, despite identifying over thirty promising sites since 2000, only three—Qeshm Island, Aras, and Tabas—have achieved official UNESCO designation. This disconnects between potential and implementation underscores a need for strategic realignment.

This study examines the fundamental factors that have limited the development of Iran's UGGp and investigates how a more cohesive and context-aware approach can harness the country's extensive geoheritage potential. Utilizing a five-phase, mixed-methods framework, the research commences with a historical overview of Iran's UGGps initiatives and a comparative evaluation of international best practices. Subsequently, it identifies and assesses significant geo-cultural sites for their suitability, utilizing geospatial data and field observations. By conducting in-depth case studies of Iran's current UGGps, the research evaluates their effects on conservation, education, and socio-economic resilience. Surveys of stakeholders and policy analysis reveal institutional and operational challenges, culminating in the creation of a strategic roadmap informed by SWOT analysis and insights from successful global examples. In this context, this research seeks to elucidate how political, environmental, and economic factors influence the implementation of UGGps in Iran, as well as how these obstacles can be addressed through enhanced policy, strategic planning, and community involvement.

Anticipated results encompass a national GIS-based catalogue for UGGps locations, a pragmatic policy framework aimed at expanding the UGGp network, and actionable strategies to enhance funding, inter-agency collaboration, and

grassroots engagement. By integrating theoretical insights with practical applications, this study aspires not only to guide national policy but also to motivate a wider regional transition towards inclusive and sustainable heritage management. It positions Iran to take a leading role in re-envisioning UGGps as transformative environments, where geological features intersect with human communities, and local populations assume the role of guardians of a legacy of global significance.

Keywords: Local Empowerment; Policy Frameworks; Geo-cultural Assets; Sustainable Tourism Models; Stakeholder Collaboration.

RESUMO

Nas últimas décadas, os Geoparques Mundiais da UNESCO (UGGps) surgiram como plataformas inovadoras para a integração da geoconservação, do turismo sustentável e do desenvolvimento comunitário. À medida que o mundo se debate com os desafios ambientais e procura estratégias de desenvolvimento inclusivas, as iniciativas UGGps oferecem um modelo único que combina o património natural com a identidade cultural, a educação e a oportunidade económica. No âmbito deste movimento global, o Irão tem um potencial significativo por explorar. Lar de paisagens geoculturais excepcionais - desde o Deserto de Lut até às Montanhas Zagros - o Irão foi um dos pioneiros regionais nas iniciativas UGGps. No entanto, apesar de ter identificado mais de trinta sítios promissores desde 2000, apenas três - a Ilha de Queshm, Aras e Tabas - obtiveram a designação oficial da UNESCO. Este desfasamento entre o potencial e a implementação sublinha a necessidade de um realinhamento estratégico.

Este estudo analisa os factores fundamentais que limitaram o desenvolvimento do UGGp do Irão e investiga como uma abordagem mais coesa e consciente do contexto pode aproveitar o extenso potencial do geopatrimónio do país. Utilizando uma estrutura de métodos mistos de cinco fases, a investigação começa com uma visão histórica das iniciativas UGGps do Irão e uma avaliação comparativa das melhores práticas internacionais. Posteriormente, identifica e avalia a adequação de sítios geoculturais significativos, utilizando dados geoespaciais e observações no terreno. Ao realizar estudos de caso aprofundados dos actuais UGGps do Irão, a investigação avalia os seus efeitos na conservação, educação e resiliência socioeconómica. Os inquéritos às partes interessadas e a análise das políticas revelam desafios institucionais e operacionais, culminando na criação de um roteiro estratégico baseado na análise SWOT e em conhecimentos de exemplos globais de sucesso.

Neste contexto, esta investigação procura elucidar a forma como os factores políticos, ambientais e económicos influenciam a implementação de UGGps no Irão, bem como a forma como estes obstáculos podem ser abordados através de uma política melhorada, planeamento estratégico e envolvimento da comunidade.

Os resultados esperados incluem um catálogo nacional baseado em SIG para locais de UGGps, um quadro político pragmático destinado a expandir a rede UGGp e estratégias acionáveis para melhorar o financiamento, a colaboração entre agências e o envolvimento das bases. Ao integrar conhecimentos teóricos com aplicações práticas, este estudo pretende não só orientar a política nacional, mas também motivar uma transição regional mais ampla para uma gestão inclusiva e sustentável do património. O estudo posiciona o Irão para assumir um papel de liderança na reavaliação dos UGGps como ambientes transformadores, onde as características geológicas se cruzam com as comunidades humanas e as populações locais assumem o papel de guardiães de um legado de importância global.

Palavras-chave: Capacitação Local; Quadros Políticos; Activos Geoculturais; Modelos de Turismo Sustentável; Colaboração das Partes Interessadas.

Contribution to the study of the aesthetics of pre-Hispanic societies: Notes on the rock art of the Ecuadorian tropics and the high Andes

Contribuição ao estudo da estética das sociedades pré-hispânicas: Notas sobre arte rupestre dos trópicos equatoriais e dos altos Andes

Carlos Augusto Rodríguez Martínez¹

¹GIPRI Colombia; Instituto Terra e Memória - Centro de Geociências; Universidad Pedagógica Nacional / Universidad Distrital Francisco José de Caldas; Universidade Autónoma de Lisboa; Instituto Politécnico de Tomar

*carlosrupestre@hotmail.com | carlosrupestre@gmail.com

ABSTRACT

This paper acknowledges that the history of archaeological and rock art interpretations in Colombia has largely been shaped by theoretical frameworks and explanatory models not originally designed to address the specific conditions of the high and low Andean equatorial tropics. As a result, explanatory categories that consider the unique environmental and geographic features of the region have not been developed, leading to the repeated application of externally derived models. While there is no strict geographical or environmental determinism in the production of language, art, and social life, these do not emerge in a vacuum—they are deeply interwoven with the contexts in which thought is generated. This study seeks to conceptualize and propose categories suited to understanding aesthetic phenomena, particularly rock art, within the environmental contexts of the high Andean tropics—specifically the regions of Bojacá (pictographs) and San Antonio de Tequendama (petroglyphs) in Colombia's central highlands. The central focus is tropical rock art, a subject that raises three interrelated issues: spatial (internal and contextual), aesthetic (artistic expression), and documental (archival and interpretative). The core research questions include: What defines and influences the production of rock art in the high Andean equatorial tropics? How does this art reflect its specific human and environmental conditions? To what extent is it possible to construct context-sensitive categories that contribute to a long-term understanding of the equatorial highland rock art phenomenon? What aesthetic elements are shared with other material expressions, such as ceramics, textiles, and metallurgy? And finally, are there formal and substantive connections with rock art from other regions?. Bibliographic and field documentation is in progress, along with the drafting of the final document.

Keywords: Petroglyphs; Pictographs; Equatorial Tropics; Rock Art.

RESUMO

Este trabalho argumenta que os estudos arqueológicos e de arte rupestre na Colômbia têm sido historicamente moldados por estruturas teóricas pouco adequadas às especificidades ambientais dos trópicos equatoriais

andinos, tanto de altitude quanto de baixa altitude. Como consequência, modelos explicativos sensíveis ao contexto permanecem subdesenvolvidos, levando à aplicação contínua de paradigmas externos a essas regiões. Embora não haja um determinismo geográfico ou ambiental estrito na produção simbólica, essas manifestações tampouco emergem no vazio — são profundamente entrelaçadas com os contextos em que o pensamento se forma. Este estudo propõe repensar categorias conceituais para interpretar a arte rupestre em contextos tropicais de altitude, com foco nos pictogramas de Bojacá e nos petróglifos de San Antonio de Tequendama — ambos localizados no planalto central andino da Colômbia. O eixo central da pesquisa é a arte rupestre tropical, analisada a partir de três dimensões interligadas: espacial (interna e contextual), estética (expressão artística) e documental (registro e interpretação). As perguntas norteadoras incluem: Quais fatores contextuais moldam a criação da arte rupestre nos trópicos andinos equatoriais? Como essas obras expressam a inter-relação entre experiência humana e condições ecológicas? Até que ponto é possível construir categorias analíticas locais que contribuam para uma compreensão de longo prazo do fenômeno da arte rupestre equatorial? Que elementos estéticos são compartilhados com outras práticas materiais, como cerâmica, têxteis e metalurgia? E, por fim, existem continuidades formais ou simbólicas entre essa arte e expressões rupestres de outras regiões? A documentação bibliográfica e de campo está em andamento, juntamente com a elaboração do documento final.

Palavras-chave: Petróglifos; Pictogramas; Trópicos Equatoriais; Arte Rupestre.

Heritage: History, Narrative(s) and Community(ies)

Património: história, narrativa(s) e comunidade(s)

Celeste Afonso¹

¹Universidade Autónoma de Lisboa; Instituto Politécnico de Tomar; Instituto Terra e Memória - Centro de Geociências

*celesteafonso@gmail.com

ABSTRACT

This research critically examines cultural heritage as a social construct, exploring the links between history, narratives, and communities. It adopts a diachronic and transdisciplinary approach, grounded in contributions from the humanities, critical anthropology, political philosophy, and postcolonial critique. An in-depth analysis of guiding documents issued by UNESCO, ICOMOS, the Council of Europe and the European Union serves as the foundation for a broader methodological inquiry. The goal is to build an operative definition of community, rooted in territorial realities and capable of guiding more inclusive heritage processes.

The concept of rhizomatic communities — plural, contingent, and multispecies — emerges as a central theoretical proposition, developed through a dialogue with authors such as Gilles Deleuze, Bruno Latour, Isabelle Stengers, Donna Haraway, Anna Tsing, Arturo Escobar, Marisol de la Cadena, and Orlando Fals Borda, as well as with literary short stories by Kafka and Luiz Pacheco, which are used as critical devices.

In parallel, a case study is being conducted in the Serra do Caramulo, which accompanies the entire research as an action-research process. Grounded in intangible cultural markers, this study promotes an integrated cultural management of the territory, with strong community participation. The adopted methodology is inspired by Stengers' ecology of practices and is guided by principles of epistemic justice and cultural regeneration through active and situated listening.

The next stage of the research will focus on consolidating the methodological approach developed through the Caramulo case study, which has enabled the testing of hypotheses, experimentation with participatory methods, and the integration of local and more-than-human knowledge into heritage practice. Two to three international case studies will be selected to allow for a comparative analysis of community participation models, associated narratives, and management practices. This comparative analysis aims to test the transferability of the identified methodological principles and to further develop proposals for patrimonialisation in complex and shifting contexts.

Keywords: Cultural Heritage; Narratives; Rhizomatic Communities; Participation; Ecology of Practices.

RESUMO

A investigação em curso analisa criticamente o património cultural como construção social, explorando os vínculos entre história, narrativas e comunidades. Assume uma abordagem diacrónica e transdisciplinar, ancorada em contributos das humanidades, da antropologia crítica, da filosofia política e da crítica pós-colonial.

A análise aprofundada dos documentos orientadores da UNESCO, do ICOMOS, do CE e da EU serve de base à problematização metodológica. O objectivo é construir uma definição

operativa de comunidade, enraizada na realidade dos territórios e capaz de orientar processos patrimoniais mais inclusivos.

A noção de comunidades rizomáticas — plurais, contingentes, multiespécies — emerge como proposta conceptual, num diálogo entre autores como Gilles Deleuze, Bruno Latour, Isabelle Stengers, Donna Haraway, Anna Tsing, Arturo Escobar, Marisol de la Cadena e Orlando Fals Borda e contos literários de Kafka e de Luiz Pacheco, usados como dispositivos críticos.

Em paralelo, está em curso um estudo de caso na Serra do Caramulo, que acompanha toda a investigação como processo de investigação-ação. A partir de marcadores culturais, este estudo tem promovido uma gestão cultural integrada do território, com forte participação das comunidades. A metodologia adoptada inspira-se na ecologia das práticas (Stengers) e assume uma escuta activa e situada, orientada por princípios de justiça epistémica e regeneração cultural.

A próxima etapa da investigação será dedicada à consolidação da abordagem metodológica desenvolvida a partir do estudo de caso da Serra do Caramulo, que tem permitido testar hipóteses, experimentar metodologias participativas e integrar saberes locais e mais que humanos na prática patrimonial. Procurar-se-á seleccionar dois a três estudos de caso internacionais que permitam uma análise comparada dos modelos de participação comunitária, das narrativas associadas e das práticas de gestão. Esta análise procurará testar a transferibilidade dos princípios metodológicos identificados e consolidar propostas metodológicas para a patrimonialização em contextos complexos e mutáveis.

Palavras-chave: Património Cultural; Narrativas; Comunidades Rizomáticas; Participação; Ecologia das Práticas.

A Multiscalar Study of Palaeolithic Zoomorphic Representations in Western Iberia using Geometric Morphometrics and Machine Learning

Um Estudo Multiescalar das Representações Zoomórficas Paleolíticas na Península Ibérica Ocidental utilizando a Morfometria Geométrica e Machine Learning

Dionysios Danelatos^{1,2,3}, Sara Garcês^{2,3}, Hipólito Collado Giraldo^{2,3,6} & Sandra Jardim^{4,5}

¹Departamento de História, Artes e Humanidades, Universidade Autónoma de Lisboa, 1169-023, Lisboa, Portugal

²Departamento de Arqueologia, Conservação Restauro e Património, Instituto Politécnico de Tomar, Tomar 2300-313, Portugal

³Instituto Terra e Memória - Centro de Geociências, Mação, 6120-721, Portugal

⁴Centro de Investigação em Cidades Inteligentes, Instituto Politécnico de Tomar, Tomar, 2300-313, Portugal

⁵Unidade Departamental de Tecnologias de Informação e Comunicação, Instituto Politécnico de Tomar, Tomar, 2300-313, Portugal

⁶Junta de Extremadura, Sección de Arqueología, Mérida, 06800, Spain

*30014110@students.ual.pt

ABSTRACT

This project investigates zoomorphic figures (such as horses, bovinds, goats and deer) in Upper Palaeolithic rock art of Western Iberia Peninsula, focusing on their form, style, distribution and chronology. The proposal addresses two challenges: (1) the lack of robust chronological frameworks for regional art styles, and (2) the limited attention given to the role of zoomorphic iconography when analyzing cultural connectivity. By integrating machine learning (via the RA3I project's AI tools) with statistical applications, geometric morphometrics and spatial analysis, the aim is to analyze around 300 zoomorphic representations from 20 sites in order to establish a data-based stylistic chronology. This interdisciplinary approach - developed through collaborations with the Geosciences Centre and the Rock Art Laboratory of Instituto Terra e Memória - aims to contribute to debates on artistic evolution and migratory patterns in Late Pleistocene Europe. The selected figures come from the major clusters and sites of Western Iberia, including recently discovered panels from sites such as the Ocreza Valley and the Escoural cave. The project is currently in its initial phase. They will be presented the objectives, the state of the art, the methodological framework, and expected results.

Keywords: Rock art; Zoomorphic figures; Upper Palaeolithic; Geometric Morphometrics; Artificial Intelligence.

RESUMO

Este projeto investiga figuras zoomórficas (tais como cavalos, bovídeos, cabras e veados) na arte rupestre do Paleolítico Superior do Oeste da Península Ibérica, focando-se na sua forma, estilo, distribuição e cronologia.

A proposta aborda duas problemáticas: (1) a ausência de um enquadramento cronológico robusto para estilos regionais e (2) a pouca atenção dada à iconografia zoomórfica na análise da conectividade cultural. Ao integrar Machine Learning (através das ferramentas de IA do projecto RA3I) com aplicações estatísticas, morfometria geométrica e análise espacial, o objetivo passa por analisar cerca de 300 representações zoomórficas de 20 sítios arqueológicos para estabelecer uma cronologia estilística baseada em dados. Esta abordagem interdisciplinar - desenvolvida através de colaborações com o Centro de Geociências e o Laboratório de Arte Rupestre do Instituto Terra e Memória - tem como objetivo contribuir para os debates sobre a evolução artística e os padrões migratórios na Europa do Pleistoceno Final. As figuras seleccionadas provêm dos principais núcleos e sítios da Península Ibérica Ocidental, incluindo painéis recentemente descobertos em sítios como o vale do Ócreza e a gruta do Escoural. O projeto encontra-se atualmente na sua fase inicial. Serão apresentados os objetivos, o estado da arte, o enquadramento metodológico e os resultados esperados.

Palavras-chave: Arte rupestre; figuras zoomórficas; Paleolítico superior; Morfometria geométrica; Inteligência artificial.

Funding/Financiamento: This study is supported by the RA3I project – Rock Art Analysis with Artificial Intelligence (Techframe- Instituto Politécnico de Tomar - Instituto Terra e Memória funded by Portugal 2030).

The Takruktektek as cultural landscape

A Takruktektek como paisagem cultural

Edileila Maria Leite Portes^{1,2,4} Luiz Oosterbeek^{2,3,4}

¹Departamento de História, Artes e Humanidades, Universidade Autónoma de Lisboa, 1169-023, Lisboa, Portugal

² Instituto Politécnico de Tomar, Tomar, 2300-313, Portugal

³Instituto Terra e Memória, Mação, 6120-721, Portugal

⁴Centro de Geociências

*edileilaportes@gmail.com

ABSTRACT

This PhD project in “Heritage, Technologies and Territory”, focused on “Heritage, Technologies and Cultural Landscapes” draws from rock drawings collected during ethnographic research conducted in the Krenak Territory, located at the banks of the Doce river, Minas Gerais, Brazil, inhabited by the ethnic group Borum Krenak, linguistic group Macro-Jê, descendants of the Botocudos. The Masters’ study in Territory Management, in Brazil, sets the ground for analyzing Borum drawings – body art, handicrafts, rock art – for an understanding of the Krenak Territory. From Weber’s comprehensive theory (1864-1920), and Geertz’s (1978, 2001) interpretative/hermeneutic anthropology, these drawings, considered as actions prompted by the thought that guides the borum, allowed for a theoretical reflection connected to the values and meanings given by the borum. More than categories or concepts, it is possible to see senses that, when mixed, form a spiritual/symbolic territory or landscape, as well as an explanatory picture of the physical/material territory. The perception: these actions’ genesis lies in the rock drawings, found in Takruktektek, the “Rock of Paintings”. Not necessarily because that was its original meaning, but because they function that way, in the context of possible reinterpretations, in a process that is convergent with other societies. The plasticity revealed by these drawings allows for new research and interpretations, connecting them to the concepts of cultural landscape and heritage. Aiming to understand what has been presented, building on the ethnographic process, it is possible to use an ethnologic study as method. It would bring a comparison between traditional knowledge/cosmology that remains and the required “agency” required from borum to navigate the “krai” society, the one from the “civilized whites”. There is a dialogue with this multiplicity of meanings that is present in the post-industrial society and the varied landscapes that come from it, gathering new epistemologies that articulate disciplinary and transdisciplinary studies.

Keywords: Heritage; Territory; Cultural Landscape; Rock Drawings; Identities.

RESUMO

O doutoramento em “Patrimônio, Tecnologias e Território”, na especialidade “Patrimônio, Tecnologias e Paisagens Culturais”, tem como ponto de partida os desenhos rupestres coletados numa pesquisa etnográfica desenvolvida no Território Krenak, faixa de terra localizada às margens do rio Doce, Minas Gerais, Brasil, habitada pela etnia Borum Krenak, grupo linguístico macro gê, remanescentes dos Botocudos. Pesquisa que, no Mestrado em

Gestão do Território, realizado no Brasil, subsidiou o estudo dos desenhos Borum – corporais, desenhos no artesanato, rupestres – para compreensão do Território Krenak. A partir da teoria compreensiva de Weber (1864-1920) e da antropologia interpretativa/hermenêutica de Geertz (1978, 2001), esses desenhos, considerados como ações desencadeadas pelo pensamento que rege os borum, permitiram uma reflexão teórica vinculada aos valores, significados e sentidos dados pelos próprios borum. Neles, mais do que categorias ou conceitos, foram vislumbrados sentidos que se fundem formando um território espiritual/simbólico ou paisagem, e um quadro explicativo do território físico/material. A percepção é de que nos desenhos rupestres, encontrados na Takruktektek, a “Pedra da Pintura”, está a gênese dessas ações. Não necessariamente por ser esse o seu significado original, mas por funcionarem dessa forma num contexto de eventuais ressignificações, num processo convergente com outras sociedades. A plasticidade com que eles se apresentaram dão margem para propor novas pesquisas e interpretações vinculando-os aos conceitos de paisagem cultural e patrimônio. Objetivando compreender o proposto, a partir do trabalho etnográfico realizado, há a possibilidade de utilizar como método, no doutoramento, um estudo etnológico, comparativo entre os saberes tradicionais/cosmovisão, que são mantidos, e o “agenciamento” necessário que os borum fazem para transitarem na sociedade dos krai, os “brancos civilizados”. Dialoga-se, assim, com esse “desdobramento de significados” que se opera na sociedade pós-industrial e nas distintas paisagens que dela emergem, coadunando com novas epistemologias que propõem estudos disciplinares, se articulando e convergindo com estudos transdisciplinares.

Palavras-chave: Patrimônio; Território; Paisagem Cultural; Desenhos rupestres; Identidades.

Study of Soil Quality in the Surroundings of Cabo Mondego and the Impact of Past Industrial Activity

Estudo da qualidade do solo na envolvente do Cabo Mondego e impacte da atividade industrial do passado

Fernando Michels^{1,2}, Joana Ribeiro^{1,3} & Maria Helena Henriques^{1,2}

¹Universidade de Coimbra, Departamento de Ciências da Terra da Universidade de Coimbra, Rua Sílvio Lima, 3030-790, Coimbra, Portugal

²Universidade de Coimbra, Centro de Geociências da Universidade de Coimbra, Rua Sílvio Lima, 3030-790, Coimbra, Portugal

³Universidade de Coimbra, Instituto Dom Luiz - Polo da Universidade de Coimbra, Rua Sílvio Lima, 3030-790, Coimbra, Portugal

*fernandohmichels@gmail.com

ABSTRACT

The distribution of contaminants in soils from the Cabo Mondego area is addressed in this research project, offering a critical assessment of the long-term environmental legacy of historical industrial and mining activities active from the 19th century through the early 21st century in the area. Located on the central Atlantic coast of Portugal, Cabo Mondego is internationally recognized for its geodiversity, designation as a National Monument of Portugal, and inclusion in the ongoing Atlantic Geopark project, which highlights the concerns about the environmental quality of the study area. Surface soil samples are being analyzed through a multi-technique approach to detect both inorganic and organic contaminants, to identify their sources and their geochemical associations. The evaluation includes comparison with reference values for healthy soils, statistical analysis, assessment of contamination severity and geospatial mapping. The findings suggest that emissions from the industrial complex are the primary source of contamination in the surrounding soils, with critical levels of combustion-derived organic contaminants and potentially toxic inorganic elements, mainly associated with coal combustion used as fuel in the facilities. The presence of coal mining waste residues in specific areas highlights the long-term environmental impact of past industrial activities, which were active when environmental regulations were less stringent. The project is currently at the stage of ecological and human health risk assessment of soils, focusing on potentially toxic inorganic elements (e.g., As, Hg, Se) and priority polycyclic aromatic hydrocarbons, which are recognized pollutants harmful to human health and ecosystems. The results will allow the definition of detailed risk maps, which will be integrated with the region's categorized geosites to support targeted restoration and protection strategies. This work contributes to a deeper understanding of environmental vulnerabilities in Cabo Mondego and underscores the need for targeted conservation efforts.

Keywords: Cabo Mondego (Portugal); Soil quality; Coal mining, Cement industry; Coal Combustion.

Funding: The author acknowledges the financial support of Fundação para a Ciência e a Tecnologia (FCT) through the research grant with reference 2021.06231.BD. This work is part of the projects UIDB/00073/2025 and UIDP/00073/2025 of the I & D unit of Geosciences Center of the University of Coimbra (Portugal), funded by FCT, I.P. (Portugal).

RESUMO

A distribuição de contaminantes nos solos da área do Cabo Mondego é abordada neste projeto de investigação, oferecendo uma avaliação crítica do legado ambiental de longo prazo das atividades industriais e mineiras históricas, ativas desde o século XIX até o início do século XXI na região. Localizado na costa atlântica central de Portugal, o Cabo Mondego é reconhecido internacionalmente pela sua geodiversidade, classificado como Monumento Natural de Portugal e incluído no projeto em curso do Geoparque do Atlântico, o que evidencia as preocupações quanto à qualidade ambiental da área de estudo. Amostras de solo superficial estão sendo analisadas por meio de uma abordagem multitécnica, com o objetivo de detectar contaminantes orgânicos e inorgânicos, identificar as suas fontes e associações geoquímicas. A avaliação inclui a comparação com valores de referência para solos não contaminados, análise estatística, avaliação da severidade da contaminação e mapeamento geoespacial. Os resultados sugerem que as emissões do complexo industrial constituem a principal fonte de contaminação dos solos envolventes, com níveis críticos de contaminantes orgânicos derivados da combustão e elementos inorgânicos potencialmente tóxicos, principalmente associados à queima de carvão utilizada como combustível nas instalações. A presença de resíduos de exploração mineira de carvão em áreas específicas evidencia o impacto ambiental prolongado das atividades industriais do passado, desenvolvidas numa época em que a legislação ambiental era menos rigorosa. O projeto encontra-se atualmente na fase de avaliação do risco ecológico e para a saúde humana dos solos, com foco nos elementos inorgânicos potencialmente tóxicos (e.g., As, Hg, Se) e hidrocarbonetos policíclicos aromáticos prioritários, reconhecidos como poluentes prejudiciais à saúde humana e aos ecossistemas. Os resultados permitirão a definição de mapas de risco detalhados, os quais serão integrados com os geossítios categorizados da região, de forma a apoiar estratégias direcionadas de recuperação e proteção. Este trabalho contribui para um entendimento das vulnerabilidades ambientais do Cabo Mondego e reforça a necessidade de esforços de conservação específicos.

Palavras-chave: Cabo Mondego (Portugal); Qualidade do solo; Mineração de carvão, Indústria de cimento; Combustão de carvão.

Financiamento: O autor agradece o apoio financeiro da Fundação para a Ciência e a Tecnologia (FCT) através da bolsa de investigação com a referência 2021.06231.BD. Este trabalho faz parte dos projetos UIDB/00073/2025 e UIDP/00073/2025 da Unidade de I & D Centro de Geociências da Universidade de Coimbra (Portugal), financiados pela FCT, I.P. (Portugal).

From collections to communities: mediation strategies and practices in museums for a people-oriented heritage

Das coleções às comunidades: estratégias de mediação e práticas nos museus para um património orientado para as pessoas

Inês Bettencourt da Câmara^{1,2}

¹Instituto Politécnico de Tomar e Universidade Autónoma de Lisboa;

²Centro de Geociências, Portugal

*ines.camara@mapadasideias.pt

ABSTRACT

This dissertation investigates how mediation practices are integrated into Portuguese and European museums with scientific and historical collections, with the aim of fostering social relevance and sustainability. Employing a mixed-methods approach, the research is strongly based on case-studies, and explores how mediation intersects with marketing, exhibition design, events programming, audience development, and retail operations.

The study focuses on identifying effective, participatory strategies that enhance inclusion, accessibility, and social relevance. It argues that mediation should evolve from a supplementary educational niche to a transversal institutional strategy that shapes curatorial narratives, visitor services, and communication practices.

In addition to museum-specific insights, the research extends to related cultural fields—such as libraries and the performing arts—to uncover shared challenges and mediation models, reinforcing the value of a cross-sectoral and intersectional approach. Museums are framed as civic actors in an era of social transformation, political polarization, and cultural tension, and the dissertation proposes a shift toward participatory knowledge production and democratic engagement.

Ultimately, this work contributes to international debates on institutional innovation, cultural democracy, and mediation, offering a practical and theoretical framework that can inform museum practice and cultural policy. It positions mediation not as a discrete activity but as an integrated cultural strategy capable of supporting inclusive, resilient, and community-focused institutions.

Keywords: Museum Studies; Mediation Practices; Audience Development; Narrative-Based Strategies; Cultural Strategy; Marketing; Communities.

RESUMO

Esta investigação analisa a integração de práticas de mediação em museus portugueses e europeus com coleções científicas e históricas, visando a relevância e sustentabilidade social. Através de uma abordagem metodológica mista, baseada em estudos de caso, o trabalho examina como a mediação se articula com áreas como o marketing,

a programação expositiva, o design de exposições, o desenvolvimento de públicos, os eventos e as operações de retalho.

Seguindo o método indutivo, a investigação centra-se em práticas concretas e estratégias participativas, procurando identificar modelos e práticas de mediação. Argumenta-se que a mediação deve deixar de ser confinada a um nicho educativo para se tornar um eixo transversal à estrutura organizacional dos museus, influenciando narrativas curatoriais, serviços aos visitantes e estratégias de comunicação.

A investigação estende-se ainda a outros sectores culturais, como as bibliotecas e as artes performativas, para compreender dinâmicas comuns e ampliar a análise comparativa. O estudo posiciona os museus como agentes cívicos num contexto contemporâneo marcado por transformações sociais, polarizações políticas e tensões culturais, propondo um modelo institucional que privilegia o envolvimento ativo e a produção partilhada de conhecimento.

Esta dissertação pretende contribuir para o debate internacional sobre inovação institucional, democracia cultural e mediação, propondo um quadro analítico que possa informar a prática profissional e a formulação de políticas culturais mais inclusivas, sustentáveis e centradas nas pessoas.

Palavras-chave: Estudos de museus; Práticas de Mediação; Desenvolvimento de Audiências; Estratégias baseadas em Narrativas; Estratégia Cultural; Marketing; Comunidades.

Using Maritime Archaeology to Understand the Dynamics and Mobilities of the Salt Port Complex on Igoronhon Island, Tutóia

Utilização de Estudos de Arqueologia Marítima para compreensão das dinâmicas e mobilidades do Complexo Portuário Salineiro na Ilha de Igoronhon, Tutóia

Jardel Stenio de Araujo Barbosa^{1,2}

¹Universidade Autónoma de Lisboa; Instituto Politécnico de Tomar

²Centro de Geociências, Portugal

*jardelstenio@gmail.com

ABSTRACT

This doctoral project aims to analyze the evolution and decline of the salt port complex on Igoronhon Island, located in the municipality of Tutóia, State of Maranhão, Brazil, during the period from 1900 to 1990. The study addresses a gap in archaeological and historical research regarding the importance of the Igoronhon Island saltworks as part of the maritime cultural heritage of northeastern Brazil. Currently in the phase of developing the theoretical framework and methodological plan, the research adopts interdisciplinary approaches from Maritime Archaeology, supported by geotechnologies and documentary analysis, with the objective of identifying, mapping, and interpreting the salt-related material culture, port infrastructure, and community memories associated with this activity. The project is being prepared for fieldwork, which will use non-invasive methods, including surface surveys, photogrammetry, and interviews with remaining members of the local saltworking community. The aim is to articulate the material elements that constitute this maritime heritage, contributing to its recognition and cultural value. The study also seeks to offer critical reflections on the shutdown of the salt industry and the resulting socioeconomic impacts on the so-called “salt people,” promoting the integration of research, memory, and heritage management.

Keywords: Maritime Archaeology; Cultural Heritage; Saltworks; Tutóia; Brazil.

RESUMO

Este projeto de doutoramento tem como objetivo analisar a evolução e o declínio do complexo portuário salineiro na Ilha de Igoronhon, localizada no município de Tutóia, Estado do Maranhão, Brasil, no período de 1900 a 1990. O estudo parte de uma lacuna na investigação arqueológica e histórica sobre a importância das salinas da Ilha de Igoronhon como parte do patrimônio cultural marítimo para o nordeste do Brasil. Atualmente em fase de elaboração do referencial teórico e plano metodológico, a pesquisa mobiliza abordagens interdisciplinares da Arqueologia Marítima, com apoio de geotecnologias e análise documental, visando identificar, mapear e interpretar a cultura material salineira, portuária e memórias associados à atividade salineira. O projeto encontra-se em preparação para o trabalho de campo, que adotará métodos não interventivos, incluindo prospecção superficial, fotogrametria e entrevistas com remanescentes da comunidade salineira local. Busca-se, assim, articular os

elementos materiais que constituem este património marítimo, contribuindo para sua valorização e eventual reconhecimento institucional. O estudo visa ainda oferecer reflexões críticas sobre a desativação das atividades salineiras e os impactos socioeconômicos para os “povos do sal”, promovendo a integração entre pesquisa, memória e gestão do património.

Palavras-chave: Arqueologia Marítima; Património Cultural; Salinas; Tutóia; Brasil.

Building Bridges: Intercultural Dialogue and Diversity within the Portuguese Network of Museums

Pontes entre Culturas: Diálogo Intercultural e Diversidade nos Museus da RPM

Joaquim Jorge^{1,2,3}

¹Universidade Autónoma de Lisboa

²Instituto Politécnico de Tomar

³Centro de Geociências, Portugal

*joaquim.santos.jorge@gmail.com

ABSTRACT

The primary objective of this research is to understand how museums certified by the Portuguese Network of Museums (RPM) have been adapting to contemporary societal transformations, with particular focus on evolving curatorial and research practices concerning ethnic minority communities. The study examines how these methodological shifts manifest in diversified programming and inform strategic acquisition of material culture for museum collections.

This investigation assumes heightened significance in light of the revised museum definition adopted by ICOM in 2022, which repositions museums as inclusive, participatory institutions committed to social justice, accessibility, and the amplification of multiple voices within their research, exhibition, and mediation practices.

This research builds upon a continuum of scholarly work that conceptualizes museums as contact zones (Clifford, 1997), spaces of dialogue (Carbone, 2005), and intercultural communication platforms (Ivanova & Kistova, 2022) which enable dynamic interaction between museums and communities. This conceptual foundation underpins our work endeavour. In the initial phase, a survey will be administered to RPM museums, analyzing four dimensions of intercultural work: mission and strategy; programming and mediation; incorporation of objects into collections; and institutional relationships with ethnic community representatives. The collected data will be complemented by case studies comprising interviews with museum professionals and representatives from involved communities.

We have thus far identified two relevant examples within the RPM with significant practices: the Municipal Museum of Loures and the National Museum of Natural Science and History. Despite their specificities, both institutions have initiated critical and reflective revision processes of their practices and established collaborative networks with minority community members, involving them in research, exhibition, mediation, and programming processes, proposing new meaning-making approaches.

By November 2025, the systematic survey of public policies specifically related to ethnic minority inclusion will be completed. We believe that a cross-analysis of these two sets of findings may provide new perspectives on the quality of interactions between museums and different ethnic communities across the national territory within the RPM framework. By explicitly recognizing museums as democratic spaces dedicated to human dignity and sustainability, this definition underscores the urgency of critically rethinking how the cultures of ethnic minorities are collected and represented. The proposed research aligns with this contemporary paradigm by examining the

extent to which Portuguese museums are — or are not — translating these principles into concrete practices, contributing to the development of more open, pluralistic, and socially engaged institutions.

Keywords: Museum Studies; Contact Zones; Intercultural Dialogue; Exhibitions; Cultural Diversity Representation; Ethnic Minority Communities; Portuguese Network of Museums; Critical Museum.

RESUMO

Esta investigação visa compreender de que forma os museus integrados na Rede Portuguesa de Museus se têm adaptado às transformações sociais contemporâneas, focando-se na evolução das práticas curatoriais/expositivas e de investigação relativas às comunidades de minorias étnicas. Examinar como estas adaptações operaram transformações dentro dos museus, contribuindo informar de forma sensível a aquisição de cultura material destes grupos minoritários para as coleções dos museus.

Este estudo assume particular relevância à luz da nova definição de museu adotada pelo ICOM em 2022, que reconhece os museus como instituições inclusivas, participativas e orientadas para a justiça social, comprometidas com a acessibilidade e com a multiplicidade de vozes nas suas práticas de investigação, exposição e mediação. Assim, esta investigação insere-se numa continuidade de trabalhos académicos que conceptualizam os museus como zonas de contacto (Clifford, 1997), espaços de diálogo (Carbone, 2005) e plataformas de comunicação intercultural (Ivanova & Kistova, 2022) que possibilitam a interação dinâmica entre museus e comunidades. Este fundamento conceptual sustenta a nossa investigação.

Numa primeira fase será aplicado um inquérito aos museus da RPM, analisando quatro dimensões de trabalho intercultural: missão e estratégia; programação e mediação; incorporação de objetos nas coleções, e, relação institucional com os representantes das comunidades étnicas. Os dados recolhidos serão complementados com estudos de caso que compreendem entrevistas aos técnicos dos museus e aos representantes das comunidades envolvidas. Conseguimos, até agora, identificar dois exemplos da RPM com práticas relevantes: o Museu Municipal de Loures e o Museu Nacional de Ciência e História Natural. Apesar das suas especificidades, ambos encetaram um processo de revisão crítica e reflexiva das suas práticas e estenderam redes colaborativas com pessoas das comunidades minoritárias, envolvendo-as nos processos de investigação, exposição, mediação e programação, propondo novos processos de resinificação.

Até novembro de 2025 ficará concluído o levantamento sistémico das políticas públicas relacionadas especificamente com as questões da inclusão de minorias étnicas. Acreditamos que uma leitura cruzada dos dois resultados apurados poderá trazer novas perspetivas sobre a qualidade das interações entre os museus da RPM e as diferentes comunidades étnicas à escala da RPM no território nacional.

Ao reconhecer explicitamente o papel dos museus como espaços democráticos, comprometidos com a dignidade humana e com a sustentabilidade, esta definição reforça a urgência de repensar criticamente os modos como se incorporam e representam as culturas de minorias étnicas. A investigação aqui proposta alinha-se com este paradigma contemporâneo, ao procurar compreender de que forma os museus portugueses estão — ou não — a traduzir esses princípios em práticas concretas, contribuindo para a consolidação de instituições mais abertas, plurais e socialmente implicadas.

Palavras-chave: Estudos de Museus; Zonas de Contacto; Diálogo Intercultural; Exposições; Representação da Diversidade Cultural; Comunidades Étnicas Minoritárias; Rede Portuguesa de Museus; Museu Crítico.

Tracing Prehistoric Lifeways in Central Portugal: A Multi-Isotope Study of Mobility and Diet in the Nabão Valley

Traçando percursos de vida pré-históricos no Centro de Portugal: Um Estudo Multi-Isótopo da Mobilidade e Dieta no Vale do Nabão

Mahym Amanova^{1,2,3}, Luiz Oosterbeek^{2,3}

¹Universidade Autónoma de Lisboa; ²Instituto Politécnico de Tomar; ³Centro de Geociências, Portugal

*aluno25146@ipt.com

ABSTRACT

This project investigates prehistoric human mobility and dietary practices in Central Portugal through a multi-isotope analysis of skeletal remains from the Nabão valley in northern Ribatejo. Despite its archaeological richness, the region remains underexplored isotopically, limiting our understanding of Neolithic and Chalcolithic lifeways in this part of Iberia. Building on the regional synthesis and chronological data compiled in ARKEOS 51 (MTAS project), this study expands upon the archaeological baseline through isotopic methods. By analyzing strontium ($^{87}\text{Sr}/^{86}\text{Sr}$), oxygen ($\delta^{18}\text{O}$), carbon ($\delta^{13}\text{C}$), and nitrogen ($\delta^{15}\text{N}$) isotopes in bone and dental tissues, this study reconstructs individual life histories and explores mobility, subsistence, and social differentiation across the 6th–3rd millennia BCE. Samples are drawn from four burial caves (Gruta do Cadaval, Gruta dos Ossos, Gruta de Nossa Senhora das Lapas, and Gruta do Morgado Superior). A multi-tissue approach, incorporating enamel, dentine, and bone, enables reconstruction of both geographic origin and dietary changes over time. Local bioavailable strontium baselines will be established through environmental sampling to distinguish local from non-local individuals with greater resolution. By integrating isotopic data with archaeological context, this research contributes novel insights into population movement, resource use, and socio-economic organization during the Middle Holocene. The findings will enhance broader discussions of prehistoric mobility and adaptation in Western Iberia and provide valuable comparative data for broader European studies.

This study thus fills a significant regional gap and highlights the value of isotopic methods in understanding past human lifeways.

Keywords: Multi-Isotope Analysis; Strontium Isotope; Human Mobility; Centre of Portugal; Nabão Valley.

RESUMO

Este projeto investiga a mobilidade humana pré-histórica e as práticas alimentares no Centro de Portugal através de uma análise multi-isótopo de restos de esqueletos do vale do Nabão, no norte do Ribatejo. Apesar da sua riqueza arqueológica, a região continua a ser pouco explorada do ponto de vista isotópico, o que limita a nossa compreensão dos modos de vida neolíticos e calcolíticos nesta parte da Península Ibérica. Com base na síntese regional e nos dados cronológicos compilados no ARKEOS 51 (projeto MTAS), este estudo amplia a base

arqueológica através de métodos isotópicos. Através da análise de isótopos de estrôncio ($^{87}\text{Sr}/^{86}\text{Sr}$), oxigénio ($\delta^{18}\text{O}$), carbono ($\delta^{13}\text{C}$) e azoto ($\delta^{15}\text{N}$) em tecidos ósseos e dentários, este estudo reconstrói histórias de vida individuais e explora a mobilidade, subsistência e diferenciação social durante o sexto e terceiro milénios a.C..

As amostras foram recolhidas em quatro grutas funerárias (Gruta do Cadaval, Gruta dos Ossos, Gruta de Nossa Senhora das Lapas, e Gruta do Morgado Superior). Uma abordagem multi-tecido, incorporando esmalte, dentina e osso, permite a reconstrução tanto da origem geográfica como das alterações alimentares ao longo do tempo. Serão estabelecidas linhas de base locais de estrôncio biodisponível através de amostragem ambiental para distinguir com maior resolução os indivíduos locais dos não locais.

Ao integrar dados isotópicos com o contexto arqueológico, esta investigação contribui com novos conhecimentos sobre os movimentos populacionais, a utilização de recursos e a organização socioeconómica durante o Holoceno Médio. Os resultados contribuirão para uma discussão mais alargada da mobilidade e adaptação pré-históricas na Península Ibérica Ocidental e fornecerão dados comparativos valiosos para estudos europeus mais alargados. Este estudo preenche assim uma lacuna regional significativa e realça o valor dos métodos isotópicos na compreensão dos trajectos da vida humana no passado.

Palavras-chave: Análise Multi-Isótopo; Isótopo de Estrôncio; Mobilidade Humana; Centro de Portugal; Vale do Nabão.

Funding/Financiamento: This study is supported by the RA3I project – Rock Art Analysis with Artificial Intelligence (Techframe- Instituto Politécnico de Tomar - Instituto Terra e Memória funded by Portugal 2030).

Cultural heritage and territory management: analytical matrix and performance indicators for choices' options at small communities

Património cultural e gestão do território: matriz analítica e indicadores de performances para opções de escolha em pequenas comunidades

Maurizio Quagliuolo^{1,2,3}

¹Universidade Autónoma de Lisboa; ²Instituto Politécnico de Tomar; ³Centro de Geociências, Portugal

*maurizio.quagliuolo@gmail.com

ABSTRACT

This Research is aimed to demonstrate that it is possible to have individual and collective perceptions of material and immaterial contexts as a basis for an independent algorithm that let us measure and use its results in order to improve the available data and their interpretation for a more informed decision making.

The final goal is to produce and implement one 'Local Brand Index©', n. 5 Sub-indices and a 'Vocation guide' through a knowledge management model for decision support (not only for decision makers, also for everyone of us), aimed to be applied in different contexts to answer questions such as ...Where to live? On what to invest? How to react? What to visit? Which results from public investments?...

The originality of the research resides in the attempt to find constants in the mechanism of our perception and interaction with the context in which we live that can be declined in strategic areas of interest useful to improve a decision making shaped according to basic needs, aspirations, goals and achievements of individuals and communities, collecting data poorly or never collected before with an holistic approach and in a new way.

This study thus fills a significant regional gap and highlights the value of isotopic methods in understanding past human lifeways.

Keywords: Heritage; Territory; Villages; Indicators.

RESUMO

Esta pesquisa tem como objetivo demonstrar que é possível ter percepções individuais e coletivas de contextos materiais e imateriais como base para um algoritmo independente que nos permita mensurar e utilizar seus resultados para melhorar os dados disponíveis e sua interpretação, visando uma tomada de decisão mais informada. O objetivo final é produzir e implementar um 'Local Brand Index' com 5 subíndices e uma "Guia de Vocações", por meio de um modelo de gestão do conhecimento para apoio à decisão (não apenas para tomadores de decisão, mas também para todos nós), com o objetivo de ser aplicado em diferentes contextos para responder

a perguntas como... Onde morar? Em que investir? Como reagir? O que visitar? Quais os resultados dos investimentos públicos?...

A originalidade da pesquisa reside na tentativa de encontrar constantes no mecanismo de nossa percepção e interação com o contexto em que vivemos, que possam ser declinadas em áreas estratégicas de interesse, úteis para melhorar uma tomada de decisão amoldada de acordo com as necessidades básicas, aspirações, objetivos e realizações de indivíduos e comunidades, coletando dados mal coletados ou nunca coletados antes com uma abordagem holística e de uma nova maneira.

Palavras-chave: Património; Território; Aldeias; Indicadores.

Geological Contribution to Sustainable Rehabilitation Based on Natural Engineering and Engineering Geology

Contribuição da Geologia para Reabilitações Sustentáveis baseadas na Engenharia Natural e na Geologia de Engenharia

Mónica Pratas-Silva^{1*}, Pedro Andrade¹ & Mário Quinta-Ferreira¹

¹Universidade de Coimbra, Centro de Geociências, Portugal

*mpsilva@student.dct.uc.pt

ABSTRACT

The PhD project (UI/BD/150842/2021) focuses on the geological and geotechnical study of three quarries located along the coastal area of Cabo Mondego and one quarry in Penela. In all study areas, geological and geotechnical characterization was conducted to identify the main lithological and structural features, as well as the associated stability problems.

The methodology included a literature review, a geotechnical description of the study areas, and laboratory and field tests to determine the index properties of the geological materials. Rock masses were classified using geomechanical classification systems (e.g., RMR, SMR, GSI, and Q-slope). Additionally, slope stability assessments were performed using Rocscience software (e.g., Dips, Slide, and RocFall).

Based on the results obtained, the sectors most susceptible to instability were identified, and sustainable stabilization and rehabilitation solutions were proposed for the study areas, grounded in Geomorphological Restoration, Nature-Based Engineering and Engineering Geology. These solutions aim to protect the environment, promoting landscape integration and the recovery of flora and fauna after years of exploitation and abandonment. The project is currently at the stage of discussing results and consolidating technical and environmental proposals for rehabilitating the study areas.

Keywords: Environment; Nature-Based Engineering; Geology; Geotechnics; Geomorphological Restoration.

Funding/Financiamento: Mónica Pratas-Silva has been awarded a PhD Research Grant from the project (UI/BD/150842/2021) FCT - Fundação para a Ciência e Tecnologia (Foundation for Science and Technology) until 2025.

RESUMO

O projeto de doutoramento (UI/BD/150842/2021) consiste no estudo geológico e geotécnico de três pedreiras situadas na zona litoral do Cabo Mondego e de uma pedreira localizada em Penela. Em todas as áreas de investigação foi realizada uma caracterização geológica e geotécnica, com o objetivo de identificar as principais condicionantes litológicas e estruturais e os problemas de estabilidade associados.

A metodologia incluiu uma revisão bibliográfica, a descrição geotécnica das áreas de investigação, bem como a realização de ensaios laboratoriais e de campo para determinar as propriedades índice dos materiais geológicos. Os maciços rochosos foram caracterizados com base em sistemas de classificação geomecânica (p. ex. RMR, SMR, GSI e Q-slope) e, complementarmente, realizou-se a avaliação da estabilidade com recurso ao software da Rocscience (p.ex. Dips, Slide e RocFall).

Com base nos resultados obtidos, identificaram-se os setores com maior suscetibilidade à instabilidade, propondo-se soluções de estabilização e reabilitação sustentáveis das áreas de investigação, baseadas na Restauração Geomorfológica, na Engenharia Natural e na Geologia de Engenharia. Estas soluções procuram respeitar o meio ambiente, promovendo a integração paisagística e a recuperação da flora e fauna perdidas ao longo dos anos de exploração e de abandono. O projeto encontra-se atualmente na fase de discussão dos resultados e consolidação das propostas técnicas e ambientais para a reabilitação das áreas estudadas.

Palavras-chave: Ambiente; Engenharia baseada na Natureza; Geologia; Geotecnia; Restauração Geomorfológica.

Financiamento: Mónica Pratas-Silva recebeu uma bolsa de investigação de doutoramento do projeto (UI/BD/150842/2021) FCT - Fundação para a Ciência e Tecnologia até 2025.

Defining Pre-Schematic Art in the Iberian Peninsula: A Comparative Study Using Integrative and Machine Learning Methods

Definição de Arte Pré-esquemática na Península Ibérica: Um estudo comparativo utilizando métodos integrativos e Machine Learning

Noelia Priego Cecilla^{1,2,3}, Sara Garcês^{2,3}, Hipólito Collado Giraldo^{2,3,6}, & Sandra Jardim^{4,5}

¹Departamento de História, Artes e Humanidades, Universidade Autónoma de Lisboa, 1169-023, Lisboa, Portugal;

²Departamento de Arqueologia, Conservação Restauro e Património, Instituto Politécnico de Tomar, Tomar 2300-313, Portugal

³Instituto Terra e Memória - Centro de Geociências, Portugal, Mação, 6120-721,

⁴Centro de Investigação em Cidades Inteligentes, Instituto Politécnico de Tomar, Tomar, 2300-313, Portugal

⁵Unidade Departamental de Tecnologias de Informação e Comunicação, Instituto Politécnico de Tomar, Tomar, 2300-313, Portugal

⁶Junta de Extremadura, Sección de Arqueología, Mérida, 06800, Spain

*0016233@students.ual.pt

ABSTRACT

This research aims to analyse, classify, and compare the pre-schematic rock art of the Iberian Peninsula, with particular emphasis on its potential stylistic and chronological connections with Levantine art. Despite representing a crucial period in the transition between Upper Palaeolithic and Holocene graphic traditions, pre-schematic art has received limited systematic attention, hindering a comprehensive understanding of its function, evolution, and cultural context.

The project proposes a detailed study of the formal and stylistic characteristics of these graphic expressions, considering their geographic distribution and their integration within the broader sociocultural changes that accompanied the shift from hunter-gatherer societies to more sedentary lifeways. The research will focus on regions with significant concentrations of documented sites, including Andalusia, Aragón, Soria, and the river basins of the Douro, Tejo, and Guadiana.

Adopting an interdisciplinary approach, the study will combine traditional archaeological methods with advanced digital analysis tools, including machine learning techniques —particularly convolutional neural networks (CNNs)— applied to pattern recognition, morphological-stylistic classification, and cluster analysis. These tools will allow for the identification of formal similarities, regional variations, and possible symbolic networks across different geographic areas.

A key aspect of the research will be the critical reassessment of the current chronological framework attributed to pre-schematic art, aiming to determine whether these graphic expressions represent a continuity of Palaeolithic

symbolism or should be more appropriately contextualized within Epipalaeolithic or Early Neolithic settings. To this end, the application of absolute dating techniques —such as radiocarbon and uranium-series dating— will be considered for selected sites.

This thesis seeks to establish an updated interpretative framework that enhances our understanding of prehistoric symbolic expression in Iberia and contributes to the reevaluation of existing chrono-cultural sequences.

Keywords: Environment; Nature-Based Engineering; Geology; Geotechnics; Geomorphological Restoration.

RESUMO

Esta investigação tem como objetivo analisar, classificar e comparar a arte rupestre pré-esquemática da Península Ibérica, com especial enfoque em possíveis conexões estilísticas e cronológicas com a arte levantina. Apesar de representar um período crucial na transição entre as tradições gráficas do Paleolítico Superior e do Holoceno, a arte pré-esquemática tem sido pouco abordada de forma sistemática, o que tem limitado a compreensão da sua função, evolução e contexto cultural.

O projeto propõe um estudo pormenorizado das características formais e estilísticas destas manifestações gráficas, considerando a sua distribuição geográfica e a sua inserção nos processos de transformação sociocultural que acompanharam a transição das sociedades de caçadores-recolectores para formas de vida mais sedentárias. A investigação concentrar-se-á em regiões com elevada densidade de sítios documentados, como a Andaluzia, Aragão, Sória e as bacias dos rios Douro, Tejo e Guadiana.

Através de uma abordagem interdisciplinar, integrar-se-ão métodos arqueológicos tradicionais com técnicas avançadas de análise digital, incluindo ferramentas de aprendizagem automática —nomeadamente redes neuronais convolucionais (CNN)— aplicadas ao reconhecimento de padrões, classificação morfoestilística e análise de agrupamentos. Estas ferramentas permitirão identificar afinidades formais, variações regionais e possíveis redes de interação simbólica entre diferentes áreas geográficas.

Um dos eixos centrais do estudo será a revisão crítica do quadro cronológico atualmente atribuído à arte pré-esquemática, com o objetivo de determinar se estas expressões gráficas representam uma continuidade do simbolismo paleolítico ou se se inserem mais adequadamente em contextos Epipaleolíticos ou do início do Neolítico. Neste sentido, será considerada a aplicação de técnicas de datação absoluta, como o radiocarbono ou as séries de urânio, em sítios previamente selecionados.

Este trabalho visa estabelecer um quadro interpretativo atualizado que contribua para o conhecimento da expressão simbólica pré-histórica em contexto ibérico e para a reavaliação das sequências cronoculturais vigentes.

Palavras-chave: Arte rupestre; arte pré-esquemática; Península Ibérica; transição; últimos caçadores-recolectores.

Funding/Financiamento: This study is supported by the RA3I project – Rock Art Analysis with Artificial Intelligence (Techframe- Instituto Politécnico de Tomar - Instituto Terra e Memória funded by Portugal 2030).

Tracing subduction-type metamorphism using detrital minerals in stream sediments

Rastreamento de metamorfismo de zonas de subducção utilizando minerais detríticos em sedimentos de rio

Nuno Grácio^{1*}, Inês Pereira^{1} & Pedro Dinis^{2***}**

¹Universidade de Coimbra, Centro de Geociências, Portugal

²Universidade de Coimbra, MARE;

*nuno.gracio@dct.uc.pt; ** ines.pereira@dct.uc.pt; *** pdinis@dct.uc.pt

ABSTRACT

Subduction zones are critical settings for understanding plate tectonics, but their metamorphic record, especially high-pressure, low-temperature (HP–LT) rocks, becomes increasingly scarce deeper in geological time, likely due to erosion and preservation bias. Detrital heavy minerals in modern sediments provide an alternative archive for tracking such metamorphism when source rocks are no longer preserved. However, out of petrological context, many of the commonly employed thermobarometric tools cannot be applied, limiting the list of minerals that can be used. Additionally, many common metamorphic minerals do not have high resistance to weathering. This Ph.D project will thus focus on whether detrital titanite, rutile, and garnet, resistant minerals commonly found in HP-LT rocks, can preserve evidence of HP–LT metamorphism as they are sampled downstream and away from their source rocks.

The main study area to test this approach is the Western Alps, where sixteen stream sediment samples were collected from four rivers (Isère, Arc, Orco, and Po), that drain from external sedimentary domains into internal zones with exhumed HP metamorphic units (Fig. 1). These transects through an active orogen provide ideal conditions to test how provenance, transport, and grain-size affect mineral preservation, and if with the existing petrogeochemical tools we can track HP-LT metamorphism away from the source areas. An additional study area will be selected from another region where HP-LT rocks are exposed, enabling a comparison and more confidence in our findings. This project integrates GIS-based analysis, heavy mineral identification and separation, SEM-EDS, LA-ICP-MS, and Raman spectroscopy. Heavy minerals from the alpine stream sediments have been successfully separated, and initial microscopy and SEM-EDS screening confirm the presence of the target minerals. These results will guide the selection of grains for detailed chemical and isotopic analyses, paying particular attention to grains that exhibit well-preserved inclusions and zoning.

The present investigation will contribute to a broader understanding of how metamorphic signatures are preserved and transferred into the sedimentary record, providing new insights into provenance analysis in active orogens. This may be particularly useful to test the presence of HP-LT metamorphism prior to the Neoproterozoic, screening the detrital sedimentary record.

Keywords: Heavy minerals; Western Alps; HP-LT metamorphism.

RESUMO

As zonas de subducção são fundamentais para a compreensão da tectónica de placas, mas o seu registo metamórfico, especialmente as rochas de alta pressão e baixa temperatura (HP–LT), torna-se progressivamente mais escasso à medida que se recua no tempo geológico, provavelmente devido à erosão e ao viés de preservação. Os minerais pesados detríticos presentes em sedimentos de rio constituem um arquivo alternativo para rastrear este tipo de metamorfismo quando as rochas fonte já não se encontram preservadas. No entanto, fora de um contexto petrológico, muitas das ferramentas termobarométricas habitualmente utilizadas não podem ser aplicadas, limitando assim a lista de minerais que podem ser analisados. Além disso, muitos minerais metamórficos comuns apresentam baixa resistência à meteorização. Este projeto de doutoramento focar-se-á, em avaliar se minerais como a titanite, rútilo e granada, que são resistentes e frequentemente encontrados em rochas HP–LT, conseguem preservar evidências de metamorfismo HP–LT à medida que são transportados rio abaixo e afastados das suas rochas fonte.

A principal área de estudo para testar esta abordagem localiza-se nos Alpes Ocidentais, onde foram recolhidas dezasseis amostras de sedimentos provenientes de quatro rios (Isère, Arc, Orco e Po), que drenam desde domínios sedimentares externos até zonas internas com unidades metamórficas de alta-pressão exumadas (Fig. 1). Estes transeptos através de um orógeno ativo oferecem condições ideais para testar de que forma a proveniência, o transporte e o tamanho dos grãos afetam a preservação mineral, e se, com as ferramentas petrogeoquímicas atualmente disponíveis, é possível rastrear o metamorfismo HP–LT para além das áreas fonte. Será ainda selecionada uma área de estudo adicional noutra região onde afloram rochas HP–LT, permitindo uma comparação e uma maior robustez dos resultados obtidos.

Este projeto integra análise baseada em SIG, identificação e separação de minerais pesados, SEM-EDS, LA-ICP-MS e espectroscopia Raman. Os minerais pesados dos sedimentos alpinos foram separados com sucesso, e as análises iniciais por microscopia e SEM-EDS confirmam a presença dos minerais-alvo. Estes resultados irão orientar a seleção de grãos para análises químicas e isotópicas detalhadas, com especial atenção a grãos que apresentem inclusões bem preservadas e zonamentos.

A presente investigação contribuirá para uma compreensão mais abrangente de como as assinaturas metamórficas são preservadas e transferidas para o registo sedimentar, fornecendo novas perspetivas sobre a análise de proveniência em orógenos ativos. Isto poderá ser particularmente útil para testar a presença de metamorfismo HP–LT anterior ao Neoproterozoico, através da análise do registo sedimentar detrítico.

Palavras-chave: Minerais Pesados; Alpes Ocidentais; Metamorfismo HP-LT.

Funding/Financiamento: Ph.D Grant funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.

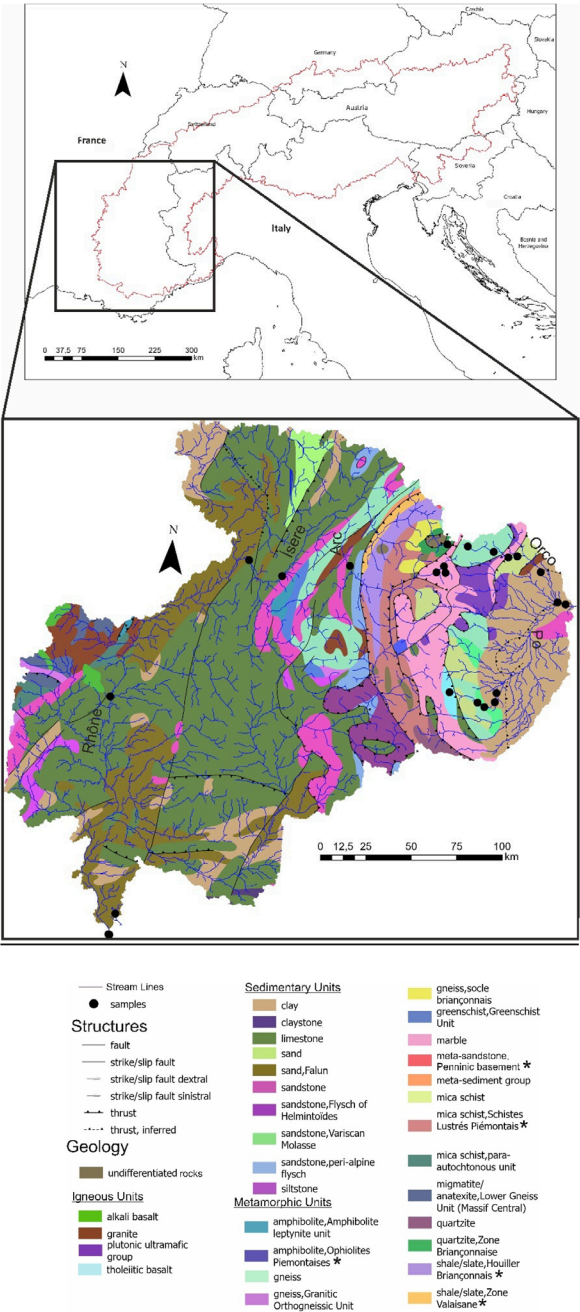


Fig. 1 – Location of the study area, its geological setting and sample locations (red outline – Alps). The geological map was adapted from Asch, K. (2005): IGME 5000: 1:5 000 000 International Geological Map of Europe and Adjacent Areas, BGR, Hannover. Units with HP-LT rocks are marked with an asterisk (*)

The monuments to the dead of the Great War in Portugal during the Estado Novo regime: the construction of memory and forgetfulness in the public space

Os monumentos aos mortos da Grande Guerra em Portugal durante o Estado Novo: a construção da memória e do esquecimento no espaço público

Lígia Mateus^{1,2}

¹Universidade Autónoma de Lisboa; Instituto Politécnico de Tomar

²Centro de Geociências, Portugal

*ligia.mateus@ipt.pt

ABSTRACT

This project will analyze the monuments to the dead of the First World War in Portugal during the Estado Novo regime to explore the relationship between their visibility in the public space and their impact on Portuguese collective memory. The project will examine how these monuments were constructed and reinterpreted between 1933 and 1974, exploring the ongoing tension between memory and forgetting. The project uses a diverse corpus of documents, including historical documents, photographs and other primary sources, and employs various observation and analysis methodologies. The monuments will be interpreted as sites of memory, exploring the tension between commemoration and oblivion, and contributing to the development of sustainable policies for preserving the heritage and memory of the First World War.

Keywords: monuments to the dead; sites of memory; re-signification; collective memory; forgetfulness; public space.

RESUMO

Este projeto analisará os monumentos aos mortos da Primeira Guerra Mundial em Portugal durante o Estado Novo para explorar a relação entre a sua visibilidade no espaço público e o seu impacto na memória coletiva portuguesa. Observar-se-á como a construção e ressignificação destes monumentos evoluiu entre 1933 e 1974, numa tensão permanente entre a construção da memória e a intenção de esquecimento. O projeto recorre a um corpus documental diverso, composto por documentos históricos, fotografias e outras fontes primárias, e adota diferentes metodologias de observação e análise. Os monumentos serão interpretados como “lugares de memória”, procurando descortinar a tensão entre memorialização e esquecimento e assim contribuir para a definição de políticas sustentáveis com vista à preservação do património e memória da Grande Guerra.

Palavras-chave: monumentos aos mortos; lugares de memória; ressignificação; memória coletiva; esquecimento; espaço público.

Holocene Slope Deposits and Microstratigraphy in the Portuguese Middle Tagus Valley

Depósitos de Vertente do Holocénico e Microestratigrafia no Vale Médio do Tejo, Portugal

Opeyemi Adewumi^{1,2,4*}, Luiz Oosterbeek^{1,3,4}, Josep Vallverdú^{5,6} & Mário Quinta-Ferreira¹

¹Geosciences Centre (CGEO), Portugal

University of Coimbra (Polo II), Faculty of Science and Technology, Department of Earth Sciences

³Polytechnic Institute of Tomar, Portugal

⁴Earth and Memory Institute, Mação, Portugal

⁵IPHES- The Catalan Institute of Human Paleocology and Social Evolution, Tarragona, Spain

⁶Àrea de Prehistoria, Universitat Rovira i Virgili (URV), Tarragona, Spain.; jvallverdu@iphes.cat

*adewumiopeyemi.ao@gmail.com

ABSTRACT

This doctoral research presents a completed comprehensive study of Holocene slope deposits and microstratigraphy from three archaeological sites in Portugal's Middle Tagus region: Anta 1 de Vale da Laje (Zêzere Valley), Gruta do Cadaval (Nabão Valley), and Amoreira (Tagus Valley). Situated in an ecotonal zone characterized by diverse geomorphological settings and rich archaeological records, the Middle Tagus provides a valuable context for investigating human-environment interactions during the Holocene.

Micromorphological analysis of thin sections was employed to examine soil formation processes, sedimentary environments, and anthropogenic impacts. Using the catena slope model, the sites were integrated into a broader geomorphological framework, classified as up-slope, mid-slope, and foot-slope positions.

Results indicate that sedimentation was shaped by both water-driven erosion and human activities at all sites. At Anta 1 de Vale da Laje, sheet wash and rainfall-induced erosion predominate, alongside evidence of soil development and post-depositional human influence. Gruta do Cadaval reveals high-energy events, including rockfalls and mudflows, along with signs of bioturbation and diagenesis. Amoreira records shallow flows and hyper-concentrated deposits associated with episodic rainfall and sustained anthropogenic activity.

The study identifies dominant soil types namely, Alfisols, Ultisols, and Spodosols, revealing their evolution about underlying substrates and human impact. Chronostratigraphic data align with key Holocene climatic phases: Greenlandian indicators in Amoreira and Gruta do Cadaval reflect early warming trends, expanded human activity during the Northgrippian, Meghalayan signals, though less frequent, illustrate continued human-environment interactions. A notable occupational hiatus after the 4.2 ka event, including the absence of Early Bronze Age evidence, suggests a significant regional shift in settlement reorganisation likely driven by population movement toward coastal areas in response to environmental change.

This research offers a comprehensive regional perspective on Holocene sedimentary dynamics and human adaptation in western Iberia.

Keywords: Microstratigraphy; Holocene; Slope Deposits; Middle Tagus; Soil formation.

RESUMO

Este doutoramento apresenta um estudo completo e abrangente sobre os depósitos de vertente e microestratigrafia do Holocénico em três sítios arqueológicos na região do Médio Tejo, em Portugal: Anta 1 de Vale da Laje (Vale do Zêzere), Gruta do Cadaval (Vale do Nabão) e Amoreira (Vale do Tejo). Localizada numa zona ecotonal marcada por contextos geomorfológicos diversos e um rico registo arqueológico. Esta região oferece um cenário valioso para o estudo das interações entre o ser humano e o ambiente ao longo do Holocénico.

A análise micromorfológica de lâminas delgadas foi utilizada para investigar os processos de formação de solos, os ambientes sedimentares e os impactos antropogénicos. Aplicando o modelo de vertente em catena, os sítios foram integrados num enquadramento geomorfológico mais amplo, sendo classificados como posições de topo, meia-encosta e sopé.

Os resultados indicam que a sedimentação foi moldada tanto por erosão hídrica como por atividades humanas em todos os depósitos. Na Anta 1 de Vale da Laje, predominam a escoamento laminar e a erosão induzida pela precipitação, com evidências de pedogénese e influência humana pós-deposicional. A Gruta do Cadaval revela eventos de elevada energia, como quedas de blocos e fluxos de lama, bem como sinais de bioturbação e diagénese. Em Amoreira, registam-se fluxos pouco profundos e depósitos hiperconcentrados associados a chuvas periódicas e atividade humana contínua.

Identificaram-se tipos de solos dominantes, Alfissolos, Ultissolos e Espodossolos, que evidenciam a sua evolução em função dos substratos e da ação humana. Os dados cronostratigráficos alinham-se com fases climáticas do Holocénico: os indicadores do Greenlandiano na Amoreira e na Gruta do Cadaval refletem tendências iniciais de aquecimento; a atividade humana expandida durante o Northgrippiano; e sinais do Meghalaiano, embora menos frequentes, ilustram a continuidade das interações entre o ser humano e o ambiente. Um notável hiato de ocupação após o evento 4.2 ka, que inclui a ausência de evidências do início da Idade do Bronze, que sugere uma reorganização significativa regional do povoamento rumo ao litoral devido às alterações ambientais.

Esta investigação oferece uma perspetiva regional abrangente sobre a dinâmica sedimentar holocénica e a adaptação humana no ocidente da Península Ibérica.

Palavras-chave: Microestratigrafia Holoceno; Depósitos de vertente; Médio Tejo; Formação do solo.

Funding/Financiamento: This study is funded by Portuguese funds from the Foundation for Science and Technology, I.P. (Portugal), with reference (UI/BD/150841/2021, <https://doi.org/10.54499/UI/BD/150841/2021>) under the strategic project UIDB/00073/2025 and UIDP/00073/2025 of the R&D Unit Geosciences Centre (University of Coimbra – Portugal).

Territories and Human Occupation in the Last Glacial Maximum on the Western edge of Iberian Peninsula: a techno-functional approach of the lithic industries

Territórios e ocupação humana no Último Máximo Glaciar na orla ocidental da Península Ibérica: uma abordagem tecno-funcional das indústrias líticas

Pedro Peça^{1,2,3}, Telmo Pereira^{1,2,3,5}, Marina Igreja^{4,5}

¹Universidade Autónoma de Lisboa

²Instituto Politécnico de Tomar,

³Centro de Geociências, Portugal

⁴Laboratório de Arqueociências (Património Cultural, IP.)

⁵Uniarq

*pedropeca@gmail.com

ABSTRACT

This research project aims to reconstruct the spectrum of activities carried out in contexts from the Last Glacial Maximum (beginning with the transition from the Gravettian to the Solutrean) located at the present-day central coastal region of Portugal, through the techno-typological and functional analysis of the lithic assemblages. From this, it seeks to infer the characterization and management strategies of the available natural resources, as well as the modes of territorial occupation, mobility patterns and site function. The techno-typological approach aims the characterization and quantification of the objects technologic stigmas, with the objective of insert them within the concept of chaine opératoire, where different reduction sequences can be individualized, analogous to technical and cultural variability of each assemblage/site. In addition, Use-wear analysis is a methodology that involves studying and defining the function and operating mode of lithic artifacts through macro- and microscopic analysis of the traces resulting from their contact with different materials (bone, wood, meat, hide, etc.), under various forms and intensities (scraping, cutting, etc.). The study will focus on chert artifacts from the Solutrean techno-complex from the sites of Abrigo do Poço and Abrigo da Buraca da Moira (located in the incised valleys of the Lis River Basin) and Lapa do Picareiro (a large cavity on the western slope of the Serra d'Aire). For the use-wear analysis, experimental archaeology is being used to replicate stone tools made of chert and use them to process a wide range of materials into various actions (drilling, cutting, scraping, etc.) in order to produce use-wear marks, that can be compared to the archaeological stone tools under analysis.

Keywords: Last Glacial Maximum; Upper Paleolithic; stone tools ; Use-wear; Experimental Archaeology; Human behavior

RESUMO

Este projeto de investigação tem como objetivo, restituir o espectro de atividades efetuadas em contextos do Último Máximo Glaciar (a partir da transição do Gravetense para o Solutrense) localizados na área Centro-litoral de Portugal, através da análise tecno-tipológica e funcional dos artefactos líticos. Pretende-se, a partir daqui, inferir sobre a caracterização e estratégia de gestão dos recursos naturais disponíveis, as formas de ocupação do território, padrões de mobilidade e funcionalidade dos sítios. A abordagem tecno-tipológica procura, através da caracterização e quantificação dos estigmas tecnológicos dos artefactos, inseri-los dentro do conceito de cadeia-operatória, onde podem ser individualizadas distintas sequências de redução, análogas à variabilidade tecnológica/cultural de cada colecção/sítio. Em complemento, a traceologia é uma metodologia de análise que consiste no estudo e definição da função e modo de funcionamento dos artefactos líticos, através da análise macro e microscópica dos vestígios resultantes do seu contacto com diferentes materiais (osso, madeira, carne, pele, etc.), sob diversas formas e intensidade (raspagem, corte...). Serão estudados artefactos em sílex do tecno-complexo Solutrense dos sítios Abrigo do Poço e do Abrigo da Buraca da Moira (situados em vales encaixados da Bacia Hidrográfica do Lis) e da Lapa do Picareiro (ampla cavidade na vertente poente da Serra d'Aire). Para a análise traceológica, tem-se recorrido à arqueologia experimental, replicando instrumentos de sílex, usando-os para processar uma variedade de materiais sob acções diversas (furar, cortar, raspar...) com o objectivo de criar marcas de uso passíveis de comparação com os artefactos em análise.

Palavras-chave: Último Máximo Glaciar, Paleolítico Superior, líticos, Traceologia, Arqueologia Experimental; Comportamento humano.

Funding/Financiamento: PhD scholarship FCT - Fundação para a Ciência e Tecnologia I.P (Portugal) under reference 2024.03402.BDANA.

Geological Heritage of the “Atlantic Geopark” Project (Central Portugal)

O Património Geológico do Projeto “Geoparque Atlântico” (Portugal Central)

Salomé C. Custódio^{1*}, Maria Helena Henriques^{1} & Artur A. A. Sá^{2***}**

¹Geosciences Center, Department of Earth Sciences, University of Coimbra, Rua Silvío Lima s/n, 3030-070 Coimbra, Portugal

²Department of Geology and Pole of the Geosciences Center, University of Trás-os-Montes e Alto Douro, Quinta de Prados, 5000-801 Vila Real, Portugal

* scmcustodio@student.uc.pt | ** hhenriq@dct.uc.pt | ***asa@utad.pt

ABSTRACT

This research work aims to inventory, characterize and evaluate the geoheritage of the territory composed by the municipalities of Cantanhede, Figueira da Foz, Mealhada, Mira, Montemor-o-Velho and Penacova, located in central Portugal, and has a connection and applicability in the context of territorial development under the “Atlantic Geopark” Project. The results obtained here will be incorporated into the application dossier of this project to the Global Geoparks Network.

During the course of this research work, the geological framework of the territory has already been characterized. The geological heritage is currently being inventoried through: the identification and characterization of sites of geological interest (SIG); the analysis of the geopatrimonial value of each SIG at the international, national and local (global) scales and in the scientific, educational and/or tourist dimensions; and the identification of the current state of conservation of each SIG and the current or potential threats that could put its conservation at risk.

As a first approach, it is estimated to be around half a hundred SISs with geoheritage value in the territory, of which the six most emblematic (one for each municipality) were published in 2024 in a special edition dedicated to geological heritage in the journal Geosciences: “Selected Geoheritage Resources of ‘Atlantic Geopark’ Project (Central Portugal)”. This document is a decisive step in validating the hypothesis that the territory covered by the above-mentioned municipalities has geological heritage of international importance, which allows for the implementation of a sustainable development strategy based on these natural values.

Thus, the main goal of this research work is to contribute to the production of scientific knowledge capable of promoting societies to be more sustainable at the environmental, political and economic levels, concomitantly with the safeguarding of geological heritage.

Keywords: “Atlantic Geopark” Project; Geological Heritage; Geoconservation; Geological History; Sustainable Development.

RESUMO

Este trabalho de investigação visa inventariar, caracterizar e avaliar o património geológico do território que engloba os municípios de Cantanhede, Figueira da Foz, Mealhada, Mira, Montemor-o-Velho e Penacova, localizados no centro de Portugal, e tem uma conexão e aplicabilidade no contexto do desenvolvimento territorial no âmbito do projeto “Geoparque Atlântico”. Os resultados aqui obtidos irão ser incorporados no dossiê de candidatura deste projeto à Rede Mundial de Geoparques da UNESCO.

No decorrer deste trabalho de investigação, já se procedeu à caracterização do enquadramento geológico do território, estando em curso a inventariação do património geológico através: da identificação e caracterização de sítios de interesse geológico (SIG); da análise do valor geopatrimonial de cada SIG às escalas (global) internacional, nacional, local e nas dimensões científica, educacional e/ou turística; e da identificação do estado de conservação atual de cada SIG e das atuais ou potenciais ameaças que possam pôr em risco a respetiva conservação.

Numa primeira abordagem, estimam-se cerca de meia centena de SIGs com valor patrimonial no território, dos quais os seis mais emblemáticos (um por cada município), foram em 2024 objeto de publicação em edição especial dedicada ao património geológico da revista Geosciences: “Selected Geoheritage Resources of “Atlantic Geopark” Project (Central Portugal)”. Este documento constitui um passo decisivo na validação da hipótese de que o território abrangido pelos municípios acima referidos detém património geológico de relevância internacional, o que permite a implementação de uma estratégia de desenvolvimento sustentável assente nesses valores naturais.

Assim, este trabalho de investigação pretende produzir conhecimento científico relevante para a promoção de sociedades mais sustentáveis nas dimensões ambiental, económica e política, concomitantemente com a salvaguarda do património geológico.

Palavras-chave: Projeto “Geoparque Atlântico”; Património Geológico; Geoconservação; História Geológica; Desenvolvimento Sustentável.

Funding/Financiamento: Bolsa de doutoramento FCT – Fundação para a Ciência e Tecnologia I.P (Portugal) com a referência 2024.03829.BD.

Mapping the change: protection, mitigation and adaptation strategies for cultural heritage in the face of climate change

Mapear a mudança: estratégias de proteção, atenuação e adaptação do património cultural face às alterações climáticas

Sarah Martinville^{1,2,3*}, Alexandra Figueiredo^{2,3}, Claudio Monteiro^{3,4***}**

¹Universidade Autónoma de Lisboa

²Instituto Politécnico de Tomar

³Centro de Geociências, Portugal

⁴TECNH&ART – Instituto politécnico de Tomar

* martinville_sj@hotmail.fr | ** alexfiga@ipt.com | ***cmonteiro@ipt.pt

ABSTRACT

This project, in collaboration with the Laboratory of Archaeology and Conservation of Underwater Heritage at the Polytechnic Institute of Tomar, addresses the urgent need to protect archaeological sites along the Portuguese coastline from the escalating impacts of climate change. With sea level rise, increased coastal erosion, and other environmental pressures now well-documented by the Intergovernmental Panel on Climate Change (IPCC), this project aims to identify and classify vulnerable heritage sites in areas at risk. By cross-referencing data from the Portuguese Environment Agency (APA) and the Cultural Heritage Institute (PC-IP), a map was created, showing that there are 486 archaeological sites within 100 meters of the coastline—220 of which are considered at risk. Excluding the Algarve region due to the lack of data from the APA, the study shows that 76.4% of coastal sites face potential damage within the next 50 years. Sites were categorized by risk level based on proximity to predicted hazard zones: high, medium, and low. The most affected periods include the Paleolithic and Mesolithic, with a predominance of open-air sites, which are particularly susceptible to degradation. This initial findings highlight the critical need for urgent action. In order to gather more accurate and extensive data, several steps need to be followed, including improved site verification, integration of broader climate models, inclusion of currently excluded regions, creation of a risk assesment grid. This project aims to help all decision-makers and cultural stake holders in prioritizing interventions and serves as a call to incorporate archaeological site preservation into national strategies for climate resilience. By promoting awareness and guiding more informed decision-making, this project contributes to the long-term safeguarding of Portugal's coastal heritage in the face of ongoing environmental change.

Keywords: coastal heritage; climate change; cultural management strategy.

RESUMO

Este projeto, em colaboração com o Laboratório de Arqueologia e Conservação do Património Subaquático do Instituto Politécnico de Tomar, aborda a necessidade urgente de proteger os sítios arqueológicos ao longo da costa portuguesa dos impactos crescentes das alterações climáticas. Com a subida do nível do mar, o aumento

da erosão costeira e outras pressões ambientais já bem documentadas pelo Painel Intergovernamental para as Alterações Climáticas (IPCC), este projeto visa identificar e classificar sítios patrimoniais vulneráveis em áreas de risco. Através do cruzamento de dados da Agência Portuguesa do Ambiente (APA) e do Instituto do Património Cultural (PC-IP), foi criado um mapa que mostra que existem 486 sítios arqueológicos a menos de 100 metros da linha de costa - 220 dos quais são considerados em risco. Excluindo a região do Algarve, devido à falta de dados da APA, o estudo mostra que 76,4% dos sítios costeiros enfrentam danos potenciais nos próximos 50 anos. Os sítios foram categorizados por nível de risco com base na proximidade das zonas de perigo previstas: alto, médio e baixo. Os períodos mais afectados incluem o Paleolítico e o Mesolítico, com uma predominância de sítios ao ar livre, que são particularmente susceptíveis à degradação. Estas primeiras constatações põem em evidência a necessidade crítica de uma ação urgente. Para reunir dados mais precisos e extensos, é necessário seguir várias etapas, incluindo uma melhor verificação dos sítios, a integração de modelos climáticos mais amplos, a inclusão de regiões atualmente excluídas, e a criação de um sistema de avaliação de riscos. Este projeto visa ajudar todos os decisores e intervenientes culturais a priorizar intervenções e serve como um apelo para incorporar a preservação de sítios arqueológicos nas estratégias nacionais de resiliência climática. Ao promover a sensibilização e orientar a tomada de decisões mais informadas, este projeto contribui para a salvaguarda a longo prazo do património costeiro de Portugal face às alterações ambientais em curso.

Palavras-chave: património costeiro; alterações climáticas; estratégia de gestão cultural.

Geotourism Development within UNESCO Global Geoparks through Local Community Engagement

Desenvolvimento do geoturismo nos geoparques mundiais da UNESCO através do envolvimento da comunidade local

Soma Sayedyounesi^{1,2,3}, Artur A. Sá^{1,2,3} & Emmaline Rosado-González^{2,3,4}

¹Departamento de Geologia, Universidade de Trás-os-Montes e Alto Douro, Quinta de Prados, 5000-801 Vila Real, Portugal

²Centro de Geociências (CGeo), Polo da UTAD, Universidade de Trás-os-Montes e Alto Douro, Quinta de Prados, 5000-801 Vila Real, Portugal

³Cátedra UNESCO de 'Geoparques, Desenvolvimento Regional Sustentado e Estilos de Vida Saudáveis', Universidade de Trás-os-Montes e Alto Douro, Quinta de Prados, 5000-801 Vila Real, Portugal

⁴Unidad Académica de Estudios Territoriales-Oaxaca, Instituto de Geografía, Universidad Nacional Autónoma de México (UNAM). Av. Universidad 3004, Copilco Universidad, Coyoacán, Ciudad de México 04510, México

ABSTRACT

In an era increasingly characterized by sustainability demands, UNESCO Global Geoparks (UGGPs) stand out as crucial environments where geotourism serves as a means for fostering environmental responsibility, empowering communities, and revitalizing economies. This doctoral research proposal examines the relationship between the development of geotourism and the involvement of local communities within geoparks, presenting a comprehensive framework designed to further the Sustainable Development Goals (SDGs). Rooted in a multidisciplinary perspective, the study investigates how community-driven strategies, participatory governance, and the enhancement of geoproducts and local cuisine can synergistically improve visitor experiences while safeguarding geological and cultural heritage.

At its essence, the project tackles the significant conflict between the expansion of tourism and the preservation of heritage. It asserts that the long-term viability of geoparks relies on genuine, grassroots participation from local communities, not just as recipients of benefits, but as active contributors to tourism narratives and guardians of their cultural and natural resources. Utilizing a mixed-methods research approach—which includes stakeholder interviews, community surveys, and comparative case studies from four distinct UGGPs—the research aims to create practical resources such as a Community Engagement Toolkit and a Visitor Experience Enhancement Model. These outcomes are intended to shape policy, direct local initiatives, and function as replicable frameworks within the Global Geoparks Network.

This proposal presents itself at a crucial juncture where global challenges meet local opportunities, providing not just an academic contribution but also practical insights for geopark managers, policymakers, and community leaders. By highlighting the importance of collaboration, resilience, and cultural authenticity, it reconceptualizes geotourism as a transformative practice—one that has the potential to promote sustainable livelihoods, enhance visitor experiences, and strengthen our shared connection to the Earth's vibrant heritage.

Keywords: Geotourism; UNESCO Global Geoparks; Community Engagement; Sustainable Development; Geoconservation.

RESUMO

Numa era cada vez mais caracterizada por exigências de sustentabilidade, os Geoparques Mundiais da UNESCO (UGGps) destacam-se como ambientes cruciais onde o geoturismo serve como um meio para promover a responsabilidade ambiental, capacitar as comunidades e revitalizar as economias. Esta proposta de investigação de doutoramento estuda a relação entre o desenvolvimento do geoturismo e o envolvimento das comunidades locais nos geoparques, apresentando um quadro abrangente concebido para promover os Objectivos de Desenvolvimento Sustentável (ODS). Enraizado numa perspetiva multidisciplinar, o estudo investiga de que forma as estratégias orientadas para a comunidade, a governação participativa e a valorização dos geoprodutos e da gastronomia local podem melhorar sinergicamente as experiências dos visitantes, salvaguardando simultaneamente o património geológico e cultural.

Na sua essência, o projeto aborda o conflito significativo entre a expansão do turismo e a preservação do património. Afirmar que a viabilidade a longo prazo dos geoparques depende da participação genuína das comunidades locais, não apenas como recetores de benefícios, mas como contribuintes activos para as narrativas turísticas e guardiões dos seus recursos culturais e naturais. Utilizando uma abordagem de investigação de métodos mistos - que inclui entrevistas às partes interessadas, inquéritos à comunidade e estudos de caso comparativos de quatro UGGps distintos - a investigação tem como objetivo criar recursos práticos, tais como um Kit de Ferramentas para o Envolvimento da Comunidade e um Modelo de Melhoria da Experiência do Visitante. Estes resultados pretendem moldar políticas, direcionar iniciativas locais e funcionar como estruturas replicáveis dentro da Rede Global de Geoparques.

Esta proposta apresenta-se numa conjuntura crucial em que os desafios globais se encontram com as oportunidades locais, fornecendo não só uma contribuição académica, mas também conhecimentos práticos para gestores de geoparques, decisores políticos e líderes comunitários. Ao destacar a importância da colaboração, da resiliência e da autenticidade cultural, reconceptualiza o geoturismo como uma prática transformadora - uma prática que tem o potencial de promover meios de subsistência sustentáveis, melhorar as experiências dos visitantes e reforçar a nossa ligação comum ao património vibrante da Terra.

Palavras-chave: Geoturismo; Geoparques Mundiais da UNESCO; Envolvimento da Comunidade; Desenvolvimento Sustentável; Geoconservação.

Human ability to adapt to environmental changes during the Quaternary in the Iberian Peninsula through a geoarchaeological analysis

A capacidade humana de adaptação às alterações ambientais durante o Quaternário na Península Ibérica através de uma análise geoarqueológica

Virginia Lattao^{1,2*}, Maria Helena Henriques^{1} & Pierluigi Rosina^{2,3***}**

¹Geosciences Centre, University of Coimbra, Rua Sílvio Lima, Pólo II, 3030-790 Coimbra, Portugal; University of Coimbra (Polo II), Faculty of Sciences and Technology, Department of Earth Sciences and Geosciences Centre, Coimbra, Portugal

²Earth and Memory Institute, Mação, Portugal

³Polytechnic Institute of Tomar, Estrada da Serra, 2300-313 Tomar, Portugal; Geosciences Centre, University of Coimbra, Rua Sílvio Lima, Pólo II, 3030-790 Coimbra, Portugal

* virginia.lattao@gmail.com | ** hhenriq@dct.uc.pt | *** prosina@ipt.pt

ABSTRACT

The relationship between man and the environment has always been the subject of study in many disciplines, such as geoarchaeology. In particular, the geochemical approach was used to reconstruct environmental changes in continental sediments using isotopic analysis, specifically of carbon ($\delta^{13}\text{C}$). This study uses a multi-proxy approach in archaeological sediments from the Iberian Peninsula, with techniques such as X-ray fluorescence (XRF), loss on ignition (LOI) and stable carbon isotope analysis ($\delta^{13}\text{C}$), to investigate the composition of soils and vegetation present in the past. The sediments analysed come from fluvial, colluvial and cave deposits and show different stages of human occupation, both by Neanderthals and Sapiens.

Carbon ($\delta^{13}\text{C}$), being a volatile element, reflects environmental conditions on a regional scale. Isotopic analysis of $\delta^{13}\text{C}$ in inorganic sediments has proved effective in reconstructing vegetation and climatic variations, especially between the Pleistocene and the Holocene.

Vegetation is classified according to the photosynthetic cycle (C3, C4, CAM), which is influenced by climate and human activity. The results show that in the Pleistocene the environment responded to natural fluctuations, while in the Holocene human impact became more significant. The variations in $\delta^{13}\text{C}$ in the sediments are consistent with those observed in other organic materials, confirming the effectiveness of this method for studying environmental dynamics and the evolution of human-occupied landscapes over time.

Keywords: Isotopes; Palaeoenvironment; Quaternary; Iberian Peninsula; Geochemistry.

RESUMO

A relação entre o Homem e o ambiente foi, desde sempre, objeto de estudo em muitas disciplinas, tais como a geoarqueologia. Em particular, a abordagem geoquímica foi utilizada na reconstituição das alterações ambientais em sedimentos continentais utilizando a análise isotópica, especificamente do carbono ($\delta^{13}\text{C}$). O presente estudo utiliza uma abordagem multi-proxy em sedimentos arqueológicos da Península Ibérica, com técnicas como a fluorescência de raios X (XRF), a perda por ignição (LOI) e a análise de isótopos estáveis de carbono ($\delta^{13}\text{C}$), para investigar a composição dos solos e da vegetação do passado. Os sedimentos analisados provêm de depósitos fluviais, coluviais e de grutas, e mostram diferentes fases de ocupação humana, tanto por Neandertais como por Sapiens.

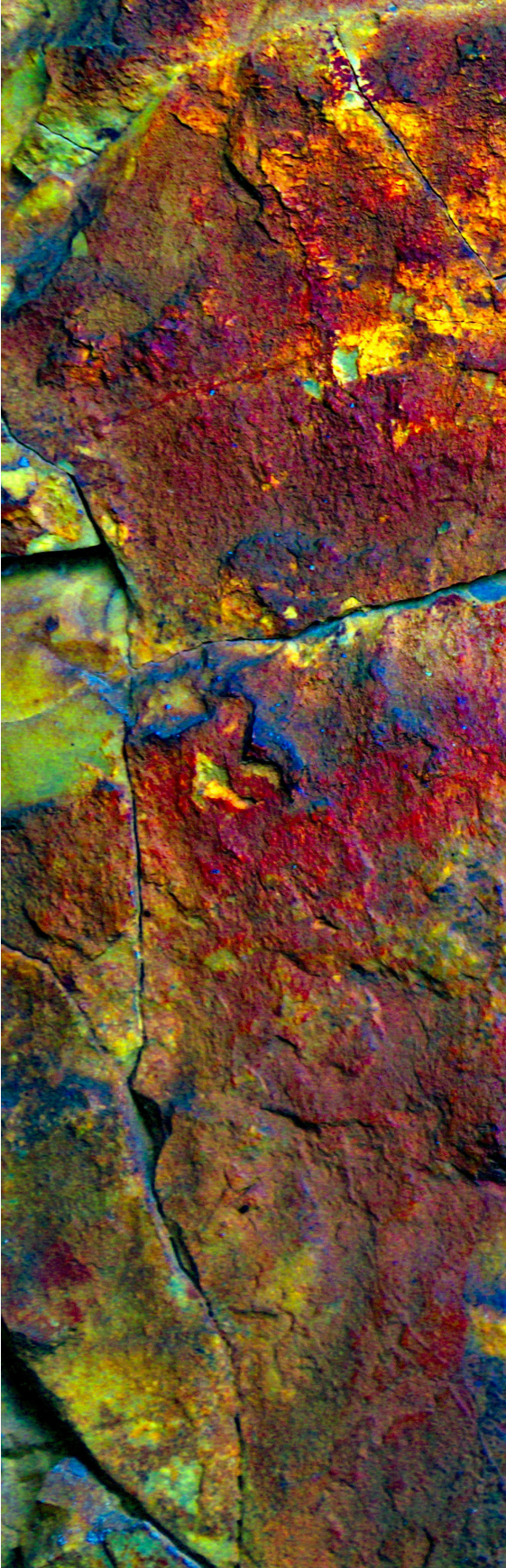
O carbono ($\delta^{13}\text{C}$), sendo um elemento volátil, reflete as condições ambientais a uma escala regional. A análise isotópica do $\delta^{13}\text{C}$ em sedimentos inorgânicos tem-se revelado eficaz na reconstituição da vegetação e das variações climáticas, especialmente entre o Pleistoceno e o Holoceno.

A vegetação é classificada de acordo com o ciclo fotossintético (C3, C4, CAM), que é influenciado pelo clima e pela atividade humana. Os resultados mostram que, no Pleistoceno, o ambiente respondeu a flutuações naturais, enquanto no Holoceno o impacto humano se tornou mais significativo. As variações de $\delta^{13}\text{C}$ nos sedimentos são consistentes com as observadas noutros materiais orgânicos, confirmando a eficácia deste método para estudar a dinâmica ambiental e a evolução das paisagens ocupadas pelo homem ao longo do tempo.

Palavras-chave: Geoturismo; Geoparques Mundiais da UNESCO; Envolvimento da Comunidade; Desenvolvimento Sustentável; Geoconservação.

Funding/Financiamento: Virginia Lattao has been awarded a PhD Research Grant from the project (UI/BD/150848/2021) FCT - Fundação para a Ciência e Tecnologia (Foundation for Science and Technology) until November 30, 2024.

POSTERS





Mineralogical characterization of fine materials derived from granite quarries, northern Portugal

Tomás Gomes ¹, Anabela Reis ², Rui Teixeira ² & Luís Sousa ²

¹ University of Trás-os-Montes e Alto Douro, UTAD, Quinta de Prados, 5000-801 Vila Real, Portugal, al202411111@alunos.utad.pt

² University of Trás-os-Montes e Alto Douro, UTAD, Quinta de Prados, 5000-801 Vila Real, Portugal, anarreis@utad.pt, rteixeir@utad.pt, lsousa@utad.pt, www.utad.pt; Geosciences Center, University of Coimbra

Introduction

The exploitation of granite in the Vila Real region, particularly in the Pedras Salgadas and Serra da Falperra quarries, is of significant economic and environmental importance. This study aimed to characterize the fine materials resulting from the aforementioned quarries' extractive activities from a mineralogical perspective, for posterior analysis of possible reuse. Samples were collected from a fine tailing dam and a dismantling front, respectively, to enable a comparative analysis of their composition (Gomes, 2024).

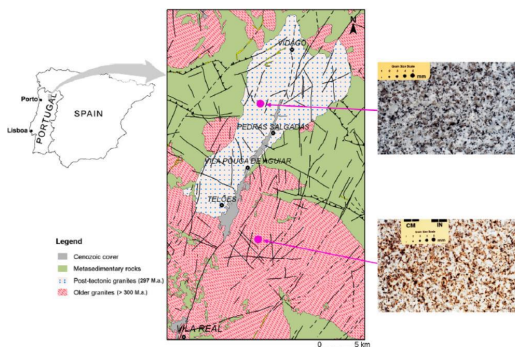


Figure 1 - Location of the quarries in which the samples of granite mining waste were collected, and their geological setting (adapted from Sousa et al., 2017). a) Pedras Salgadas, b) Serra da Falperra.

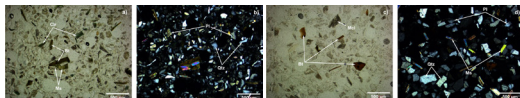


Figure 2 - Microscopic aspect of the fine materials collected from the fine tailing dam (Pedras Salgadas - a and b) and dismantling front (Serra da Falperra - c and d). Qtz: Quartz; Pl: Plagioclase; Mch: Microcline; Ms: Muscovite; Bt: Biotite; Ch: Chlorite (a and c - parallel nicols; b and d - crossed nicols) (Gomes, 2024).

Geological setting and petrography

The Pedras Salgadas biotite granite is intrusive in parautochthonous metasedimentary successions of Silurian age of the Galicia – Trás-os-Montes Zone (Martins et al., 2008), whereas the Serra da Falperra two-mica granite is installed in the autochthonous segment of the Central Iberian Zone of the Iberian Massif that is dominated by a thick sequence of Precambrian to Lower Paleozoic metasediments, known as Dúrcio-Beirão (Sousa et al., 2017; Figure 1).

The petrographic analysis revealed that the fine materials are mainly composed of quartz, feldspars (microcline and plagioclase), and micas (biotite and muscovite). The angular shape of the fragments present in the samples is a direct result of the exploitation and crushing processes (Figure 2).

XRD analysis

X-ray diffraction (XRD) was used to confirm the identification of the mineral phases and carry out quantitative analysis using the Rietveld refinement method (Figure 3). The results indicated that the samples mainly consist of quartz, albite and muscovite, with variations in percentage composition between samples collected at different locations. The XRD analysis revealed a higher relative percentage of quartz and albite in the Amarelo Real granite sample from Serra da Falperra and a higher relative percentage of muscovite, as well as the presence of kaolinite, in the Cinzento Claro granite sample from Pedras Salgadas.

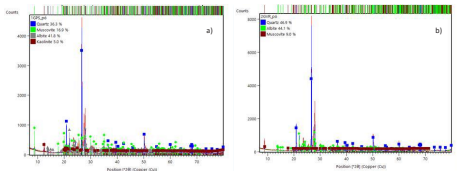


Figure 3 - Results of the XRD analysis of samples from the Pedras Salgadas (a) and Serra da Falperra (b) quarries, with a grain size of less than 0.300 mm (Gomes, 2024).

Conclusions

The reuse of this waste can be discussed within the context of a circular economy, highlighting its potential applications in construction, ceramic and glass production, and degraded soil recovery. This study emphasizes the importance of mineralogical characterization for the sustainable management of granite waste, which contributes to reducing environmental impact and conserving natural resources.

References:

- Martins, H.C.B., Sant'Óvala, H., & Noronha, F. (2009). Genesis and emplacement of felsic Variscan plutons within a deep crustal lineation, the Penacova-Régua-Verín fault: An integrated geophysics and geochemical study (NW Iberian Peninsula). *Lithos* 111 (3–4), 142–155. <https://doi.org/10.1016/j.lithos.2008.10.018>
- Gomes, T. H. C. (2024). Caracterização mineralógica dos materiais finos derivados de explorações de granitos [Unpublished Geology Internship report - Biology and Geology course]. University of Trás-os-Montes e Alto Douro
- Sousa, L.M.O., Barabach, J., Stein, K.-J. B., Siegesmund, S. (2017). Characterization and quality assessment of granitic building stone deposits: A case study of two different Portuguese granites. *Engineering Geology*, 221, 29–40. <https://doi.org/10.1016/j.enggeo.2017.01.030>



PLENARY MEETING 2025

30th June – 01st July
University of Trás-os-Montes e Alto Douro

Project GRAV3D - Multidimensional files: The 3D Revolution in Rock Art Interpretation

Cláudio Monteiro¹, Alexandra Figueiredo² Fernando Coimbra³

¹ CAAPortugal, TECN&ART, IPT – Centro de Investigação em Ciências Históricas, UAL; cmonteiro@ipt.pt

² CGEO – Instituto Politécnico de Tomar; alexfiga@ipt.com

³ Instituto de Terra e Memória - GEO - Universidade de Coimbra; coimbra.rockart@yahoo.com

ABSTRACT

The GRAV3D project has been developed over the past few years with the goal of creating scientific support tools that enhance and optimize archaeological research. It aims to generate multidimensional files that can be explored entirely virtually. These multidimensional files have shown great potential not only as scientific tools but also as a method for recording and safeguarding endangered heritage. They are capable of storing visual characteristics as well as scientific data, which can be analyzed and explored even after the destruction of the site or object.

Introduction

Three-dimensional modeling has undergone significant development over the past two decades. Its democratization and adoption by archaeology have enabled the creation of new approaches to heritage exploration. Its use has been particularly important in field recording, allowing the production of high-quality maps and orthophotos that facilitate the creation of accurate technical drawings much more quickly and comfortably than traditional drawing techniques.

In dissemination, conservation, and musealization, 3D reconstruction has enriched and enhanced content presentation. However, its potential as a scientific tool is still in an early stage. In the study of rock art, several projects have attempted to document and analyze this type of heritage through high-resolution mapping, which is later studied using the collected digital data.

A notable example is the work carried out in the Lascaux cave, which not only enabled detailed recording of the cavity but also supported complex climatological studies, revealing information about the past and future of the site and its conservation (Lacanette & Malaurent, 2014). More recently, high-resolution orthophotos of the Cõa Valley engravings were created for documentation and study, using photogrammetry combined with GIS systems (Botica & Bernardes, 2023).

Another example is the use of photogrammetry combined with multispectral imaging to analyze rock art in Gua Tambun, Malaysia (Zainuddin et al., 2019), which allowed researchers to perceive details that would be beyond the reach of traditional methods. Digital optical analysis is an analytical technique that enables the object of study to be observed entirely digitally, in multiple dimensions and with great detail—particularly its morphology, capturing features that are often concealed by texture or significant wear.

Case Study

The archaeological site of *Canto do Nadadoura Paiva Sousa 1* is located at the Foz do Arelhio, in the municipality of Caldas da Rainha. This site falls within the scope of our project as it is situated in an at-risk area undergoing rapid degradation due to both natural and anthropogenic factors.

The location includes a cavity containing human bones, the ruins of a structure—possibly a small former chapel—and a set of engravings spanning a broad chronological range. Among these, the engraving known as “A Boneca” (“The Doll”) (Fig. 1 A) stands out. It depicts an apparently female anthropomorphic figure with a voluminous body. The work involved ultra-high-resolution 3D modeling of the engraving using photogrammetry in Agisoft Metashape software. The resulting multidimensional file was then analyzed and studied using Rhinoceros 7 software.

Conclusions

Digital optical analysis has proven to be an effective method for recording engravings, showing clear advantages over traditional recording techniques. It is a non-invasive process capable of reaching layers not visible to the naked eye, allowing observers to visualize hidden details and elements (Fig. 1, 2 and 3). Furthermore, it enables the correlation of data and the development of experimental studies.

References

- Botica, N., Luk, L., & Bernardes, P. (2023). Use of photogrammetry to survey Iron Age rock art motifs in the Cõa Valley: The Vermelhosa Rock 3 case study (Vila Nova de Foz Côa, Portugal). *Virtual Archaeology Review*, 25(36), 97–109. <https://doi.org/10.4995/var.2024.37223>
- Lacanette, D., & Malaurent, F. (2014). Prévision climatique 3D dans la grotte de Lascaux. *Revue d'Archéologie*, 62, 49–57. Recuperado de https://www.persee.fr/doc/hant_0751-7688_2014_num_63_1_3042
- Zainuddin, K., Majid, Z., Ahril, M. F. M., Idris, K. M., Abbas, M. A., & Darwin, N. (2019). 3D modeling for rock art documentation using lightweight multispectral camera. *International Archives of Photogrammetry, Remote Sensing & Spatial Information Sciences*, 48(2-5/9), 787–793. <https://doi.org/10.5194/isprs-archives-XII-2-787-2019>

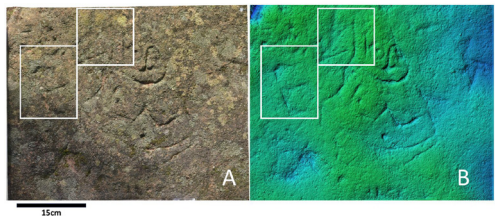


Figure 1 – (A) High-resolution image of the engraving “A Boneca” and (B) Digital elevation model revealing hidden details.

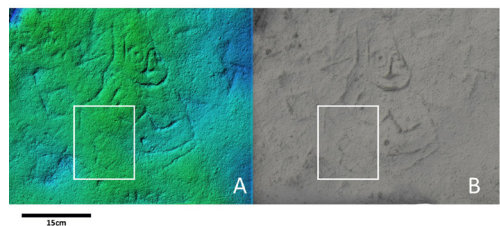


Figure 2 – Digital elevation model (A) and digital optical analysis with transmitted light (B). In image (B), the visual enhancement of the anthropomorphic figure's silhouette is clearly visible.

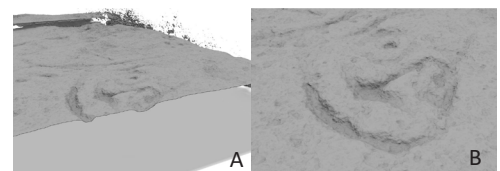


Figure 3 – Morphological analysis: (A) cross-sectional profile; (B) analysis through digital magnification.



PLENARY MEETING 2025

30th June – 01st July
University of Trás-os-Montes e Alto Douro

Zooarchaeology and taphonomy of early/middle holocene Mammals: the Rua do Papagaio Archaeological Site (SARP), coast of Santa Catarina, Brazil

Diego Dias Pavei¹, Juliano Bitencourt Campos², Albérico Nogueira de Queiroz³, Luiz Miguel Oosterbeek⁴ & Nelson José Oliveira de Almeida⁵

¹University of Southern Santa Catarina, Criciúma, Brazil; PhD student in the Postgraduate Program in Environmental Sciences; diego.pavei@unesc.net

²University of Southern Santa Catarina, Criciúma, Brazil; Postgraduate in Environmental Sciences; Earth and Memory Institute, Geosciences Center of University of Coimbra (CGeo), Portugal; jbi@unesc.net

³Federal University of Sergipe - UFS, Brazil; anqueiroz@hotmail.com

⁴Polytechnic Institute of Tomar - IPT, Portugal; Geosciences Center of University of Coimbra (CGeo); loost@ipt.pt

⁵University of Évora - UEVORA, Portugal; nelson.almeida@uevora.pt

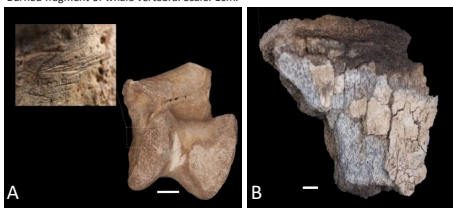
Introduction and Objective

This research is part of a PhD in Environmental Sciences, integrating archaeological and zooarchaeological approaches to the study of faunal remains. This study aims to investigate how taphonomic processes recorded in faunal remains can reveal distinct patterns of mammal carcass handling, deposition, and disposal. These findings enable inferences about subsistence strategies, ritual practices, and occupational dynamics of the populations that inhabited the site over time.

Preliminary Results

Zooarchaeological analysis identified 155 specimens, with Artiodactyla predominating (92.26%, n=143), particularly Tayassuidae (7.1%) and Delphinidae (71.61%). Other taxa (Cetacea, Carnivora, Rodentia, etc.) each represented less than 5%. Cut mark analysis (n=31) revealed incision marks as most frequent (n=23, 74.2%), followed by scraping marks (n=6, 19.4%) and chop marks (n=1, 3.2%). Long bone fracture patterns (n=8) showed prevalent smooth fractures, suggesting anthropogenic processing for marrow extraction, while irregular fractures indicate post-depositional taphonomic activity. Thermal alteration analysis (n=133) demonstrated higher frequency of intermediate burning degrees (Grade 2=35.3%; Grade 4=30.8%), associated with moderate fire exposure, whereas extreme degrees (3 and 5; <11%) suggest occasional intense combustion. These integrated results reflect diversified subsistence practices—from butchering (evidenced by cut marks) and marrow processing to hearth disposal—highlighting complex human-environment interactions at the site. The combined data contribute to reconstructing behavioral patterns and archeofaunal assemblage formation processes.

Figure 2: A) *Astragalus* of *Tapirus terrestris* (tapir) with cut marks on the lateral side; B) Burned fragment of whale vertebra. Scale: 1cm.



References:

- Behrensmeyer, A. K. (1978). Taphonomic and ecologic information from bone weathering. *Paleobiology*, 4(2), 150–162. <https://doi.org/10.1017/S0094837300005820>
- Birford, L. R. (1981). Bones: Ancient men and modern myths. Orlando, FL: Academic Press.
- Stiner, M. C., Kuhn, S. L., Weiner, S., & Bar-Yosef, O. (1995). Differential burning, recrystallization, and fragmentation of archaeological bone. *Journal of Archaeological Science*, 22, 223–237. <https://doi.org/10.1006/jasc.1995.0022>
- Villa, P., & Mahieu, E. (1991). Breakage patterns of human long bones. *Journal of Human Evolution*, 21, 27–48. [https://doi.org/10.1016/0047-2484\(92\)90034-3](https://doi.org/10.1016/0047-2484(92)90034-3)

Funding:

This study was financed in part by the "Coordenação de Aperfeiçoamento de Pessoal de Nível Superior" - (BRASIL) - Finance Code 001, it also receives partial support from the PDSE Program (Doctoral Sandwich Program Abroad) - the Polytechnic Institute of Tomar (IPT) in Mação, Portugal.

Metodology

The archaeological site Rua do Papagaio (SARP) is located on the central-northern coast of Santa Catarina, Brazil. Radiocarbon dating conducted on bone collagen indicates an occupation between 8,600 and 5,469 years BP (Before Present). The remains are curated by the Laboratório de Arqueologia Pedro Ignácio Schmitz (LAPIS) at the University of southern Santa Catarina (UNESC) in Criciúma, southern Santa Catarina. The research employs macro- and microscopic taxonomic and taphonomic analyses of faunal remains. The primary methods focus on identifying taphonomic processes (including cut marks analyzed according to Binford (1981), fracture patterns classified following Villa and Mahieu (1991), and burning patterns using the classification system by Stiner *et al.* (1995) and biostratigraphic/diagenetic alterations (Behrensmeyer, 1978). These analyses enable inferences about subsistence practices (butchering and food processing patterns) and ritual behaviors (selective treatment of bones) at the site.

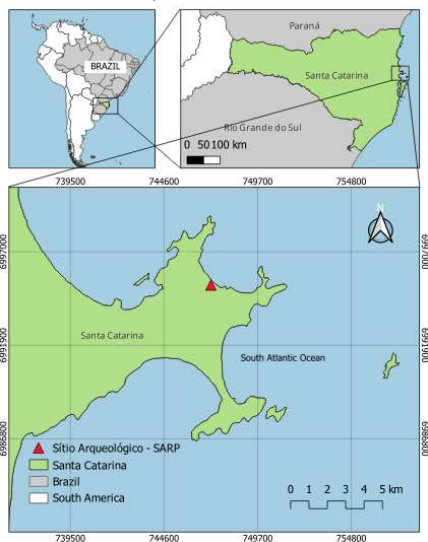


Fig. 1 - Location of the Rua do Papagaio Archaeological Site - SARP



PLENARY MEETING 2025

30th june – 01st july
University of Trás-os-Montes e Alto Douro

AI + Anticipatory Governance = Next-Gen Cultural Landscape Intelligence

Erika Robrahn-González¹ & Luiz Oosterbeek²

¹ITM, CGEO; erika@documentocultural.net

²IPT, CGEO; loost@ipt.pt

Territory as Physical, Digital and Cognitive Space

Historically, territory was shaped by material practices such as war, migration and agriculture. Today, however, **territories are also being shaped on a symbolic and digital level**. Networks, images, algorithms and simulations are emerging as new forms of occupation and dispute. In this context, AI enables us to **model potential futures visually**, thereby transforming territory into a field of cognitive dispute. The project proposes a **new territorial ontology where memory and projection are intertwined in the creation of collective futures**.

Anticipatory Governance with Artificial Intelligence

In the face of climatic, social and cultural uncertainties, there is an **urgent need for governance that can predict, simulate and adapt**. Anticipatory governance with AI enables the **construction of multiple scenarios, the anticipation of risks, and the support of data- and value-driven decision-making**. Through predictive modelling, generative simulations and early warning systems, the project provides practical tools for planning that is both **resilient and sensitive to context in cultural territories**.

The 'AI + Anticipatory Governance = Next-Gen Cultural Landscape Intelligence' project explores **theoretical and methodological innovations at the intersection of artificial intelligence and anticipatory governance**. The project aims to inform decision-making in the adaptive management of cultural landscapes. The project recognises these **landscapes as complex socio-ecological systems that are increasingly vulnerable to climate change**. This requires governance models that can anticipate risks, simulate public policies, and promote resilient long-term planning.

An integrated ecosystem: From Theory to Practice

The ethics of artificial intelligence must look beyond the present. They must be forward-looking, **capable of anticipating the potential impact of general AI (AGI) on lifestyles, institutions, and ecosystems**. This project adopts an ethic of foresight based on intergenerational justice, transparency, and inclusion. While innovating in its methods, the project **reaffirms the need to build a future in which technology serves equity and human dignity**.

Ethics and Foresight in the Era of AI and AGI

This project is directly linked to the **Cultural Landscape Community AI Hub** project, acting as its **theoretical and methodological framework**. While the Hub operates as a living laboratory in which communities can experiment with different development paths, anticipatory governance provides the necessary tools for analysing risks, comparing paths, and supporting the conscious selection of desirable futures. **Together, they form an ecosystem that connects science, participation and action**.

Cultural landscapes as portals to desirable futures

Cultural landscapes are interfaces between the lived and the possible; they are more than **just legacies of the past**. In this project, these landscapes are treated as complex living systems that are constantly evolving and capable of creativity. Through the use of AI and anticipatory governance, they become **platforms for envisioning and constructing equitable, regenerative futures that are grounded in cultural diversity**. By combining data science, traditional knowledge, and citizen participation, we propose a **new form of territorial intelligence that is ethical, inclusive, and transformative**.



References:

- OOSTERBEEK, L. - Co-transforming landscapes. Transdisciplinary contributions for cultural integrated landscape management. Mação, Portugal: Instituto Terra e Memória, (2023).
OOSTERBEEK L.M. - Cultural Integrated Landscape Management: a humanities perspective. Instituto Terra e Memória, Mação, (2017).
ROBRAHN-GONZÁLEZ, E.M. - Cultural Heritage in Landscape Management: overcoming the challenges of Sustainable Development Goals. *Bulletin du Musée d'Anthropologie Préhistorique de Monaco*, n° 63 (2024), 37-54.
ROBRAHN-GONZÁLEZ, E.M. - Culture as a vector for Social Innovation and Creative Economy: application cases with Brazilian communities. In: Campina, A.; Rodrigues, C. (eds.) "International Capital Conference on Multidisciplinary Scientific Research. Proceeding Book". Universidade Fernando Pessoa, Lisbon, (2023), 356-364.



PLENARY MEETING 2025

30th June – 01st July
University of Trás-os-Montes e Alto Douro

Cultural Landscapes Community AI Hub

Erika M. Robrahn-González¹ & Luiz Oosterbeek²

¹ITM/CGEO; erika@documentocultural.net

²IPT/CGEO; loost@ipt.pt

Project Overview

The **Cultural Landscapes Community AI Hub** project is a scientific and social initiative that aims to create a **participatory governance space based on data by integrating artificial intelligence with scientific and traditional knowledge**. The project is structured as a **Living Lab** and its mission is to strengthen the links between communities, researchers and public managers, with a focus on territories that have historically been marked by cultural diversity and social vulnerability.

Contributions to Social Cohesion

- We strengthen the sense of belonging by **celebrating cultural landscapes and collective memories**.
- Creating platforms for **dialogue between science and the community**.
- Encouraging collaborative governance and **territorial co-responsibility**.
- We actively resist what we call the **Social Winter**: the retreat of rights, community fragmentation, and the erosion of the common good.



Social Innovation and the Community as Protagonist

- The project acts as a **catalyst for social innovation** by bringing together emerging technologies and traditional practices.
- It promotes **local solutions to global challenges** such as sustainability, well-being, and inclusion.
- As **opposed to the dominant AI First logic**, which often disregards cultural contexts and localised knowledge, it promotes a **Community First model**.



Case study: community of the middle Tagus River

- The Hub is being implemented in rural areas with high asset density and regional development challenges.
- Data collection and curation **involving citizens**.
- Using AI as a **participatory planning tool** to simulate possible futures.
- Mobilising local networks for **cultural and economic landscape regeneration**.



Education as the ethical foundation of AI

- **Accessible and critical education** is a prerequisite for informed decision-making in community contexts.
- The collective construction of territorial intelligence should be guided by the principles of **justice, transparency and equity**.
- **Training local actors** to use and understand AI technologies.
- Education, in this context, is not just a means, but an **ethical end to the very use of AI**.



Conclusion: Culture, Community and Network Regeneration



The **Cultural Landscapes – Community AI Hub** project is more than just a technological platform; it is an **ecology of care and community reconstruction**. In the face of the advance of **Social Winter**, it offers a way to **reconnect people, territories and knowledge**. By integrating artificial intelligence with local knowledge, the project introduces new ways of **thinking about and experiencing the common good**.

It also recognises the **territory as a repository of accumulated knowledge, expressed through cultural landscapes, archaeological layers, and the living memory of communities**. This deep temporality, connecting the past, present, and potential futures, informs the development of AI tools that honour and amplify local significance. In this process, **archaeology acts as a valuable ally in interpreting the traces of time, while the community takes the lead in shaping future paths**.

References:

OOSTERBEEK, L. - Co-transforming landscapes. Transdisciplinary contributions for cultural integrated landscape management. Mação, Portugal: Instituto Terra e Memória, (2023).

OOSTERBEEK L.M. - Cultural Integrated Landscape Management: a Humanities perspective. Instituto Terra e Memória, Mação, (2023).

ROBRAHN-GONZÁLEZ, E.M. - Cultural Heritage in Landscape Management: overcoming the challenges of Sustainable Development Goals. *Bollettín do Museu d'Antropologia, Etnologia e História*, n.º 63 (2024), 37-54.

ROBRAHN-GONZÁLEZ, E.M. - Culture as a vector for Social Innovation and Creative Economy: application cases with Brazilian communities. In: Campina, A., Rodrigues, C. (eds.) *International Capital Conference on Multidisciplinary Scientific Research*. Proceeding Book³. Universidade Fernando Pessoa, Lisbon, (2022), 356-364.



PLENARY MEETING 2025

30th June – 01st July
University of Trás-os-Montes e Alto Douro

EUROMUSE: Sound and Music in Museums

Fernando Coimbra,¹ Luiz Oosterbeek ²

Team: Anabela B. Pereira,⁴ Sandra Alexandre,⁴ Virginia Lattao,³ Margarida Pacheco,⁴ Isabel Afonso ⁴

¹ Earth and Memory Institute/ Polytechnic Institute of Tomar, Geosciences Centre f-coimbra@ipt.pt

² Polytechnic Institute of Tomar, Earth and Memory Institute, Geosciences Centre loost@ipt.pt

³ Earth and Memory Institute

⁴ Museum of Prehistoric Art (Mação)

Psychological effects of applied music in museums (oral presentation in the 11th Apeleia International Seminar)



Examples of drums used in a percussion workshop (11th Apeleia International Seminar)



End of the Euromuse training at Mação



Meeting of composers with the Community Muse Board



Brief project description

EUROMUSE is an International project co-funded by the Creative Europe Programme of the European Union, lead by Serbia, with partners in Portugal, Italy and Greece. In the 10th of April an event of this project took place in Mação, during the 11th Apeleia International Seminar, which was constituted by oral presentations, an interactive percussion workshop (using several types of percussion instruments) and two video documentaries. On the following day, a training session for museum staffs took place at the Museum of Mação. One of the aims of this project is to have two young composers by museum, which will create, each one a musical track that will pass in the participant museums. In that sense, the composers had a meeting with a Community Muse Board where they had the chance to hear traditional chanting accompanied by *adufe* playing, a traditional Portuguese square drum. The composers themselves had the opportunity of experimenting the mentioned drums.

References:

Coimbra, F. A. (In press). Rhythms and percussion since Prehistory till the present times: Notes of an interactive workshop. 11th Apeleia International Seminar Proceedings.

Jokic, B., Lukewic, L. (In press). Psychological effects of applied music in museums. 11th Apeleia International Seminar Proceedings.

Oosterbeek, L. (2014). Changing the gestures of the eyes to invent new landscapes. In: Cultural heritage and local development. Local communities through heritage awareness and global understanding. Territori della Cultura, 18. Ravello: 108-117.

Archaeological research at Vale do Junco (Mação)

Fernando Coimbra¹, Davide Delfino²

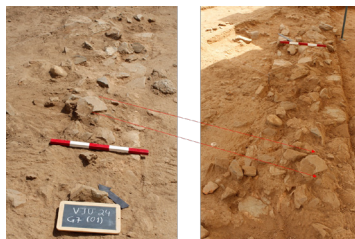
¹ Earth and Memory Institute/ Polytechnic Institute of Tomar, Geosciences Centre f-coimbra@ipt.pt

² Earth and Memory Institute/ Geosciences Centre/ Ministero della Cultura – DRM Molise, Italy

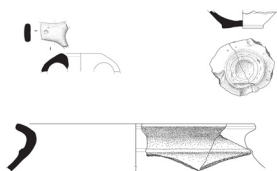
Aerial view of the archaeological site
(White canvases are protecting the excavated structures)



Discovery of new structures
(Left, June 2024; right, October 2024)



Roman pottery



Drawings by: Fernanda Sousa

Stratigraphy



Plan of the excavated area



Brief project description

This is a four years project that started in 2022 with a geoelectrical prospection, which indicated the presence of buried structures. The first excavation took place in the Spring of 2023, identifying the Roman walls reported by the mentioned prospection. In 2024 there were organized two more excavations (Spring and Autumn), revealing the first one a Visigothic structure and Islamic pottery, which demonstrated that the site had an occupation till much later than was previously known. The fieldwork of the Autumn of 2024 brought to day light more Roman walls that must correspond to a large building. The findings are constituted mostly by pottery of several characteristics and chronologies (Roman, Visigothic, Islamic), but there were found also remains of iron and bronze artefacts, fragments of glass vessels and residues of local glass production, which is another important information in the sequence of the project, since those production centres are only a few in Portugal. Remains of fauna such as wild boar, bovinds and sheep are certainly related to nourishment. Pre Roman materials were also unearthed, such as two flint bladelets and debitage residues.

References:

- Coimbra, F. A. (2022a) (Coord.). *Vale do Junco e o passado romano no território de Mação*. Catálogo da exposição. Câmara Municipal de Mação: 102p.
Coimbra, F. A. (2022b). *Investigação arqueológica no sítio romano de Vale do Junco (Ortiga, Mação)*. *Antropo*, 25: 33-52.
Encarnação, J. de (2022). *A reabilitação do sítio romano de Vale do Junco e o passado romano no território de Mação*. Catálogo da exposição. Politécnico de Tomar: 14-17.
Encarnação, J. de; Coimbra, F. A. (2022). *Estatueta Romana de Vale do Junco (Ortiga, Mação)*. *Antropo*, 24: 177-190.
Oosterbeek, L. (2022). *Dinâmicas de povoamento: nas origens da relação entre espaços urbanos e o mundo rural*. In: Coimbra (Coord.), *Vale do Junco e o passado romano no território de Mação*. Câmara Municipal de Mação: 10-12.



PLENARY MEETING 2025

30th June – 01st July
University of Trás-os-Montes e Alto Douro









Hugo Gomes^{1,2,3}, Luiz Oosterbeek^{1,2,3}, Sara Garcês^{1,2,3}, Pierluigi Rosina^{1,2,3}

1. Tomar Polytechnic University; h-gomes@ipt.pt, loost@ipt.pt
2. Geosciences Center
3. Earth and Memory Institute (Mação)

SERIOUS GAME - HERITAGE AWARE

GENERAL IDEAS BEHIND THE GAME

TIMELINE

- Two prototypes developed between 2021 and 2023
- Creation of the European consortium
- Production of a final version between September 2023 and September 2026

SERIOUS GAME

- Real-time exploration game
- Multiplayer/Online (WebGL, Mac, Windows)

ADAPTABLE

- Adjustable game duration
- 5 world zones and 24 challenges
- Administrator/Autonomous mode

ACADEMIC CONTENT

- Educational documents
- Real-world challenges
- Integrated management plan in the game

INCLUSIVE

- Dyslexia-Friendly (OpenDyslexic font)
- Adaptability for color blindness
- Audio description

HERITWARE'S GAMEPLAY

EXPLORATION

- Discovering an area
- Collecting information about the environment

TEAMWORK

- Management of the shared budget
- Communication via the in-game chat

ACQUISITION OF KNOWLEDGE

- Completion of missions
- Obtaining educational content

PROTECTION OF HERITAGE

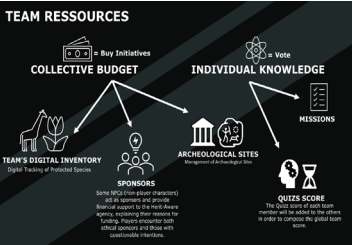
- Collaboration for choosing initiatives
- Solving cultural and environmental challenges



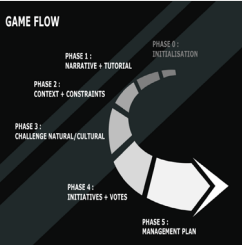
PLAY SERIOUS GAME – HERIT-AWARE



TEAM RESSOURCES



GAME FLOW



SAVING HERITAGE IN MIDDLE TAGUS, PORTUGAL

The player, accompanied by his faithful companion, a Deer, faces dangerous challenges and explores the secret caves in the hope of finding lost artefacts revealing ancient knowledge.



Engraving On The Rocks

Oh, this little scratch is not what it looks like! It's an engraving made by the prehistoric communities, more than 5000 years ago! There are many others in the Tagus Valley in Portugal, but you can find them almost nowhere in the world. They are really tricky to see!

HINT 1



Burnt Tree

This used to be an *Quercus*. Although in these species, xylematic accounts for a quarter of through-trunk tissue and is composed almost 100% of the secondary xylem, which is not dead, and this is suitable for the economy. They are used to produce paper and other forest commodities, however, engravings on the bark cause a reduction in through and represent a danger to the cultural heritage of the area.

HINT 2



Winter on the Rock

Winter on the Rock due to the dams

GAME OVER

Finally, after countless explorations and discoveries, the player reaches the goal. With courage and determination, he draws up a plan to safeguard the Middle Tagus heritage.

The explorer becomes a legend in the region, remembered for his bravery and devotion to preserving cultural heritage. By reflecting on past actions, he will also inspire others to protect the beauty and history for future generations.

Website <https://herit-aware.eu>







This study was supported by Portuguese funds from Fundação para a Ciência e a Tecnologia, I.P. (Portugal) in the frame of UIDB/00073/2025 and the UIDP/00073/2025 projects of the I & D unit of Geosciences Center (University of Coimbra, Portugal).





PLENARY MEETING 2025

30th June – 01st July
University of Trás-os-Montes e Alto Douro

TRANSFORMATIVE TERRITORIES Performing transition through the arts

Hugo Gomes^{1,2,3}, Luiz Oosterbeek^{1,2,3}

1. Tomar Polytechnic University, h-gomes@ipt.pt, loost@ipt.pt
2. Geosciences Center
3. Earth and Memory Institute (Mação)

A new European cooperation program led by COAL with five European partners focusing on Transformative Artistic Practices.

Performing Transition through the Arts explores the role of collective, participatory, and transdisciplinary artistic practices in supporting ecological and social transitions at the territorial level. The project brings together six pioneering partners-Campo Adentro, Art Mill, Tavros, ITM, and Zone Sensible-each operating as a laboratory for experimentation, learning, and the invention of resilient and inclusive cultural models. These organizations function as new places of transmission and co-creation, contributing to the development of what we define as Transformative Artistic Practices.

Research-Creation Work

Collective Research and Knowledge Exchange:

Partners have engaged in ongoing transnational exchanges, sharing methodologies and artistic processes that address ecological transition and social innovation. Regular online and in-person meetings have facilitated dialogue and peer learning, reinforcing the network's collaborative ethos.

Development of Methodological Tools:

Work is underway to co-create and document methodological tools that support transformative artistic practices. These include participatory frameworks, pedagogical models, and evaluation instruments designed to be adaptable across diverse regional contexts¹.

Artistic Residencies and Community Engagement:

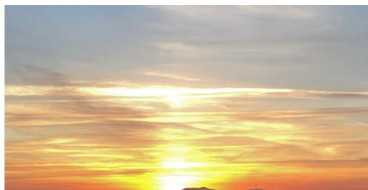
ITM has hosted and prepared artistic residency, workshops, and public events. These activities emphasize collective creation, stakeholder engagement, and the co-production of knowledge, with a focus on addressing local ecological and social challenges through art-based approaches.

Dissemination and Platform Building:

Efforts are ongoing to build a robust platform for exchange and mutual support among partners, as well as to disseminate project outcomes to the wider cultural sector and to stakeholders involved in sustainability transitions. This includes the development of a project website, publication of reports and toolkits, and participation in international seminars and conferences.



Creative Assembly – Earth and Memory Institute (Mação)



START OF PROJECT – Research creation project by the Instituto Terra e Memoria: Utopia photo competition

As part of the Transformative Territories project, artist Maria de Aguiar Ribeiro has been leading a territorial photography residency at the Instituto Terra e Memoria (ITM) since October 2024. Her challenge is to establish a connection between the photographic territory of sacred sites and the reality of the residents that have shaped the history of Mação.

On the first stage of the project involved a photographic inventory of sites considered sacred in the eight parishes that make up the municipality of Mação. This survey was carried out in collaboration with researchers from the Instituto Terra e Memoria (ITM).

Based on this mapping, the artist-in-residence began her fieldwork, documenting sites with spiritual and cultural significance for local communities. Among the photographed locations are chapels, wells, altars, rock engravings, megalithic monuments, ancient castles, water crosses, consecrated forests, as well as natural reserves such as streams and vineyards.

The ultimate goal of this collection of images is to create a photographic narrative linking the sacredness of these sites to the residence and regeneration of the territory after the wildfires.

The artistic intervention by the artist and those of local community members will come together in a quest of contemplation, generating an collaborative project during the APHELEIA seminar, a major international event to be held in April in Mação.



Artistic Residence and Community Engagement

Driven by a new generation of artists, these practices mobilize diverse modes of attention and engagement, involving communities and other entities in reimagining ways of inhabiting the Earth. The project positions art as a catalyst for ecological transition, offering culture-based solutions that foster sustainable transformation of territories and ways of living. Through transnational research-creation, the project aims to strengthen the circulation of artists, works, and methodologies, and to disseminate innovative pedagogies and tools across the cultural sector and beyond.

References:

1. COAL <https://projectcoal.org/en/hurting/european-cooperation/IT-seminar-art-food-and-transformation-of-european-territories/>
2. TRANSFORMATIVE TERRITORIES: Performing transition through the arts.
3. A new European cooperation program led by COAL with five European partners focusing on Transformative Artistic Practices.
4. Performing Arts in Transition: Moving between Media Routledge & CRC Press. - 1st Edition. Artists, especially dance and performance art as well as opera are involved to an increasing degree in the transfer between different media, not only in their productions but also the events, materials, and documents that surround them. At the same time, the focus on that which remains has become central to any discussion of performance. Performing Arts in Transition explores what takes place in the moments of transition from one medium to another, and from the live performance to that which
5. Modes of Production – Performing Arts in Transition is a Research & Development project that interconnects the field of artistic studies.
6. Performative Arts and Social Transformation - Focus on theater pedagogical-artistic mediation, didactic-artistic procedures with "disturbances" in teaching-learning relationships.
7. Performing Arts and the Ecological Transition - Research Catalogue, analyses the modes of production and management models of arts and cultural projects and organizations.
8. Report EU H2020 Research Project Art4formation: Mobilising the Arts for an Inclusive Digital Transformation Culturalisation.



PLENARY MEETING 2025

30th June – 01st July
University of Trás-os-Montes e Alto Douro

Geoconservation in Portugal: an overview

Maria Helena Henriques¹, Salomé C. Custódio¹ & Ismar de Souza Carvalho^{1,2}

¹University of Coimbra, Geosciences Center, Department of Earth Sciences, Rua Sílvio Lima 3030-790, Coimbra, Portugal; hhenriq@uct.uc.pt; salomec14@gmail.com

²Federal University of Rio de Janeiro, Department of Geology, Cidade Universitária - Ilha do Fundão, CCMN/IGEO 21.949-900, Rio de Janeiro, Brazil; ismar@geologia.ufrrj.br

Introduction

Protecting and valuing the geological heritage of Portugal is an important asset in promoting sustainable, non-seasonal tourism which is reflected in the well-being of the residents. It is the responsibility of political leaders to enact public policies that ensure the effective geoconservation of these areas, while other societal sectors should engage more actively in protecting their geohat.

There is no specific legislation on geoconservation in Portugal. The national legislation aimed at conserving natural areas (Decree-Law n.º19/93 dated 3rd July) establishes various categories primarily for biological reasons, with a single category set aside for geological sites that require protection of their physical integrity (Henriques, 2004). Among them is the Cabo Mondego Natural Monument, located on the west coast of the country, with a particularly significant record of the Middle and Upper Jurassic (Fig. 1), and which is part of the territory related to the ongoing 'Atlantic Geopark Project', aimed at a future application to the Global Geoparks Network (Custódio et al., 2024).

This top-down approach to nature conservation has shown itself to be completely unsuitable and has failed to foster a harmonious relationship between communities and nature. In parallel with the Portuguese state's disinvestment in the conservation of the country's geodiversity, several local initiatives have sprung up for this purpose. Among them are projects aimed at integrating territories into the UNESCO World Geoparks Network.



Figure 1. The extraordinary Middle Jurassic stratigraphic record of Cabo Mondego Natural Monument, where the Bajocian GSSP (A) and the Bathonian ASSP (B) were defined. The Upper Jurassic record includes dinosaur footprints on the surface bedding plane (C) (Carvalho et al., 2022).

The bottom up approach

The first Portuguese Geopark to join the UNESCO World Geoparks Network was Naturtejo in 2006, followed by Arouca, the Azores, Terras de Cavaleiros, Estrela and Oeste (CNI, 2025; Table 1; Fig. 2). Rather than emerging from a nationwide political decision, UNESCO Global Geoparks (UGGp) are established through a bottom-up process involving all relevant local and regional stakeholders and authorities in the area, deeply committed to the exploration, development and celebration of the links between the geological heritage and all other aspects of the area's natural, cultural and intangible heritage (UNESCO, 2025).

UGGp proved to be a sustainable strategy for protecting the geological heritage of Portugal. This may have inspired the Portuguese political authorities to change the legislation on the protection of geological heritage, allowing the creation of Local Natural Monuments. Proposals for their creation come from the local authority, as well as their management, once the classification has been approved by the national authority. The last two Natural Monuments to be classified by the Portuguese State have this status.

Table 1. UNESCO Global Geoparks in Portugal.

Nome	Official Website	Designation Date
Naturtejo	https://www.naturtejo.pt/	2006
Arouca	https://arouca.pt/	2009
Azores	https://www.geoparkazores.pt/	2013
Terras de Cavaleiros	https://www.geoparkterrasdecavaleiros.pt/pt/en/	2014
Estrela	https://www.geoparkestrela.pt/	2020
Oeste	https://www.geoparkoeste.pt/	2024



Figure 2. UNESCO Global and Aspiring Geoparks in Portugal (modified after AG, 2025).

The relevance of community involvement in geoconservation

Nature conservation in Portugal was initially governed by top-down approaches, based on centralized classification initiatives that resulted in difficulties in the management of protected areas. The geological heritage classified as Natural Monuments covers around 1500 ha, of which around 1000 ha correspond to the Portas do Ródão Natural Monument (ICNF, 2025), a territory included in the Naturtejo Geopark and therefore subject to the geoconservation requirements of UNESCO's Global Geoparks Network (GGN, 2025). But the rest of the area, although classified, has not been valued and, in some cases, is at risk of destruction due to lack of monitoring. The likelihood of utilizing these locations of acknowledged scientific and educational value is virtually non-existent, as they do not have the facilities to accommodate visitors or the information necessary to grasp how the geological site record aids in comprehending Earth's history. The Natural Monuments are briefly described on the official ICNF website, which is the only information available to anyone wishing to visit them (Fig. 3).

The creation of geoparks, which emerge from local initiatives, with extensive community involvement in all stages of geoconservation, has proved to be the most effective way of guaranteeing the integrity of geological objects with heritage value, as well as their enjoyment by society. They demonstrated to be a viable approach to the development of areas with remarkable geological heritage which can be adapted to various social and economic contexts as well as cultural ones (Henriques and Brilha, 2017).

Portuguese authorities recognized the relevance of community involvement, and the last two Natural Monuments to be classified in Portugal are already local in scope, and their geoconservation is expected to be more effective.

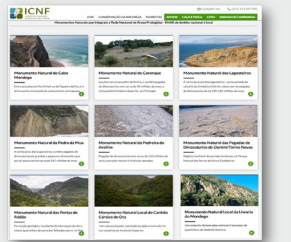


Figure 3. The Natural Monuments of national rank which are managed by a national, centralized entity, the Institute for Nature Conservation and Forests (ICNF, 2025).

Additionally, the structure of nature conservation at the state level was modified to incorporate the National Network of Protected Areas (a government initiative and responsibility) along with areas classified through alternative management systems like those integrated into the Natura 2000 Network, as well as other areas recognized under international obligations undertaken by the Portuguese State, including Ramsar Sites, Geoparks, and Biosphere Reserves (SNAC, 2025; Fig. 4). Nevertheless, preserving national natural monuments without enhancements for educational and/or geotourism use is a squander of an economic, social, and environmental resource.

Figure 4. The current organization of nature protection at state level in Portugal (SNAC, 2025).



Conclusions

Geocheritage and geotourism contribute to fostering inclusive and sustainable economic progress, comprehensive and fruitful employment, and decent work for everyone, aligning with the Sustainable Development Goals outlined in the 2030 Agenda (Gill, 2017). This is an especially crucial matter for peri-Mediterranean nations, whose economy relies significantly on tourism, primarily seasonal and focused on coastal areas. Regarding geoconservation in Portugal, there is a state entity that aggregates information on the inventory of the country's geological heritage, in close collaboration with the academic community – the Laboratório Nacional de Energia e Geologia, which is a state laboratory of the Ministry of the Environment and Energy (LNEG, 2025). Within the same Ministry, the Nature Conservation Institute oversees the National Network of Protected Areas, which aims to ensure the protection of the geological heritage and the integrity of its characteristics, in the territorial context in which they are located (ICNF, 2025). However, all the other steps that make it possible to guarantee the physical integrity of geological sites (classification, monitoring), as well as their enjoyment for educational and geotourism purposes (valuation) depend fundamentally on local and/or private initiative.

References

- Algarveiros Geopark. (2025). Algarveiros Geopark. <https://geoparkalgarveiros.pt/unesco/index-portuguesa-dos-geoparks-mundiais> (retrieved 17.05.2025).
- Carvalho, S., Cunha, P. P., Figueiredo, S. D. (2022). Discontinuation in Upper Jurassic siliclastic levels at Cabo Mondego (Lusitanian Basin, Portugal): evidences in a fluvial-dominated deltaic succession. *Paleoworld*, 31(3), 455-477. <https://doi.org/10.1016/j.palworld.2021.09.001>.
- Comissão Nacional da UNESCO. (2025). Geoparks Mundiais da UNESCO. <https://unescoportugal.mne.gov.pt/redes-unesco/geoparks-mundiais-da-unesco> (retrieved 17.05.2025).
- Custódio, S. C., Henriques, M. H., Rosado-González, E. M., Vas, H. M., & Sá, A. A. (2024). Selected Geopark Resources of 'Atlantic Geopark' Project (Central Portugal). *Geosciences*, 14(3), 81. <https://doi.org/10.3390/geosciences1403081>.
- Global Geoparks Network. (2025). Global Geoparks Network, International Association of Geoparks. <https://www.globalgeoparksnetwork.org/> (retrieved 17.05.2025).
- Gill, J. C. (2017). Geology and the Sustainable Development Goals. *Episodes*, 40(1), 70-76. <https://doi.org/10.18814/epiqrj/2017/40.1/017010>.
- Henriques, M. H. (2004). Jurassic heritage of Portugal: state of the art and open problems. *Rivista Italiana di Paleontologia e Stratigrafia*, 110(1), 389-392. DOI: <https://doi.org/10.13130/2039-4942/6317>.
- Instituto da Conservação da Natureza e das Florestas. (2025). Instituto da Conservação da Natureza e das Florestas. <https://www.icnf.pt/conservacao/ordenamentoterritorial/tnac> (retrieved 17.05.2025).
- Henriques, M. H., Brilha, J. (2017). UNESCO Global Geoparks: a strategy towards global understanding and sustainability. *Episodes*, 40(4), 349-355. DOI: <https://doi.org/10.18814/epiqrj/2017/40.4/017036>.
- Laboratório Nacional de Energia e Geologia. (2025). Geoparkalgarveiros. <https://geoparkalgarveiros.pt/en/databases/geoparks/en/> (retrieved 17.05.2025).
- Sistema Nacional de Áreas Classificadas. (2025). Sistema Nacional de Áreas Classificadas - SNAC. em resumo. <https://www.icnf.pt/conservacao/ordenamentoterritorial/tnac> (retrieved 17.05.2025).
- UNESCO. (2025). UNESCO Global Geoparks. <https://www.unesco.org/en/igpp/geoparks/about> (retrieved 17.05.2025).



PLENARY MEETING 2025

30th June – 01st July
University of Trás-os-Montes e Alto Douro

FINGERprinting cold subduction and Plate Tectonics using key minerals (FINGER-PT)

Inês Pereira^{1,2}, Nuno Grácio^{1,2}, Patrícia Amaro¹, André Cravinho & Patrícia João^{1,2}

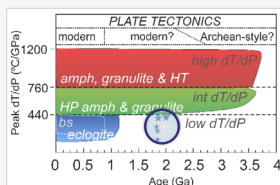
¹Geoscience Center

²Department of Earth Sciences – University of Coimbra
ines.pereira@dct.uc.pt



Rationale

Low-temperature eclogite and blueschist rocks, indicative of low crustal geothermal gradients and formed at subduction zones, occur widespread in the Cenozoic and Mesozoic record, and become progressively less common as we go back in time, until the Neoproterozoic (ca. 850 Ma)¹. Scarce occurrences of these rocks have been found with Paleoproterozoic age (1.9 – 2.1 Ga), typically retroeclogites reequilibrated at amphibolite conditions², but no evidence of these conditions either during the Mesoproterozoic or the Archean have been found.



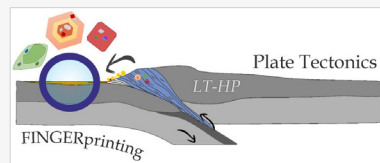
(1) Was the Earth able to sustain cold subduction before the Neoproterozoic?

(2) Was plate tectonics, prior to the Neoproterozoic, similar to nowadays?

To address these questions, we propose to use **detrital heavy minerals**, namely garnet, rutile and titanite to track metamorphic conditions through time using an alternative archive to the existing metamorphic record: sedimentary rocks.

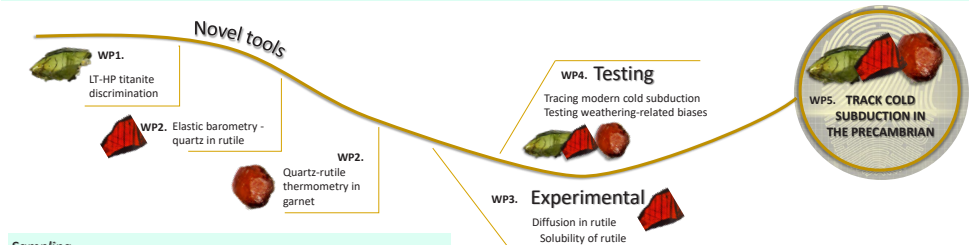
Why garnet, rutile and titanite?

These are commonly found in blueschist and low-temperature eclogite rocks, they incorporate trace elements that can be used to test their petrogenesis, and they survive weathering and thus are also found in detrital sedimentary rocks³.

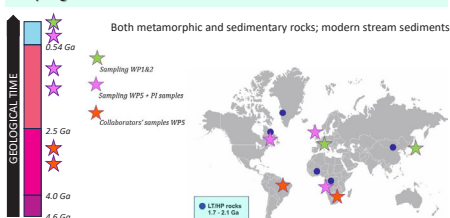


MAIN CHALLENGE: To retrieve pressure, temperature and age information from single detrital grains, out of petrological context, and infer both the metamorphic conditions and tectonic settings – namely the presence of cold subduction zones – through time.

Work Packages



Sampling



References: 1. Brown, M. & Johnson, T. E. (2019). Global age, temperature and pressure data for secular change in metamorphism. Version 1.0. Interdisciplinary Earth Data Alliance (IEDA). 2. François, C.; Debaile, V.; Paquette, J. L.; Baudet, D. & Javaux, E. J. (2018). The earliest evidence for modern-style plate tectonics recorded by HP-LT metamorphism in the Paleoproterozoic of the Democratic Republic of the Congo. Scientific Reports, 8(1):1-10. 3. Pereira, I.; van Schijndel, V.; Todeschi, M.; Cutts, K. & Guitreau, M. (2024). A review of detrital heavy mineral contributions to furthering our understanding of continental crust formation and evolution. Geol Soc. Spec. Publ., 533(1):9-55.

Methodologies and Labs

- EDS and WDS mineral analyses
- Single crystal X-ray diffraction using synchrotron radiation
- High resolution chemical and isotopic analyses by SIMS
- Piston-cylinder and solubility reactors

IN SITU

In situ trace element compositions U-Pb and Lu-Hf dating

EDS, CL, HR BSE, Raman
Electron microscopy

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.





PLENARY MEETING 2025

30th June – 01st July
University of Trás-os-Montes e Alto Douro

Heritage Education as a Contribution to Sustainable Development in Caminhos dos Cânions do Sul UNESCO Global Geopark

Juliano Bitencourt Campos^{1,2}; Annie Souza Marques²; Suliano Ferrasso²; Diego Dias Pavei²; Luiz Miguel Guedin²; Estefani de Oliveira Serafim²; Luciano Miranda²; Mikael Mizieski²; Maria da Glória Tavares Demamann²; Mônica Priscila Kravczik Guglielmi²; Breno Ferreira Fontana²; Alex Luciano Tavares Rollano²; Tarcísio Roldão da Rosa²; Pâmela Ribeiro Jaques²; Lucas Fabricio de Souza Firmino²; Carlos dos Passos Paulo Matias²; José Gustavo S. da Silva^{2,3}

¹ University of Southern Santa Catarina, Criciúma, Brazil; Postgraduate in Environmental Sciences; Earth and Memory Institute, Geosciences Center of University of Coimbra (CGeo), Portugal; jbi@unesoc.net

² University of Southern Santa Catarina, Criciúma, Brazil; Pedro Ignácio Schmitz Archaeology Laboratory (LAPIS); Lapis@unesoc.net

³ University of Southern Santa Catarina, Criciúma, Brazil; Ph.D student of Geosciences Center of University of Coimbra (CGeo), Portugal; gustasantos92@gmail.com

Introduction

Creating a dialogue among history, culture, heritage, and science within the communities of the Southern of Santa Catarina has been a primary goal of the research, extension, and dissemination initiatives undertaken by the Pedro Ignácio Schmitz Archaeology Laboratory (LAPIS) at the University of Southern of Santa Catarina (UNESC). The Research Group on Archaeology and Integrated Territorial Management (GPAGIT) has been engaged in examining regional archaeological studies through various methodologies and is dedicated to promoting their findings. Through various research methodologies and outreach initiatives, GPAGIT has played a significant role in the exploration and dissemination of knowledge regarding the archaeological cultures of the region within local communities and educational institutions, primarily via Heritage Education (HE). Building on these foundations, the LAPIS team has been engaged in developing HE projects targeted at the community for more than ten years. Since 2019, the research group has shifted its focus to a newly designated area in the region, known as Caminhos dos Cânions do Sul UNESCO Global Geopark (CCSUGGP), situated between the states of Rio Grande do Sul (RS) and Santa Catarina (SC), Brazil (Fig. 1).

Study area

UNESCO Global Geoparks (UGGP) serve as venues for education and communication aimed at promoting territories (Sá *et al.*, 2024). They function as authentic living laboratories, offering insights that trace back to the Earth's history and the evolution of human cultures. Additionally, they encompass the narratives of the local communities in which they are situated. At present, the CCSUGGP encompasses seven municipalities within its jurisdiction, with four situated in the state of Santa Catarina and three located in the state of Rio Grande do Sul. The geographical region encompassing the seven municipalities that constitute the CCSUGGP stretches from the coastal zone in Torres/RS, traversing through canyons and cliffs to reach the Serra Geral plateau.

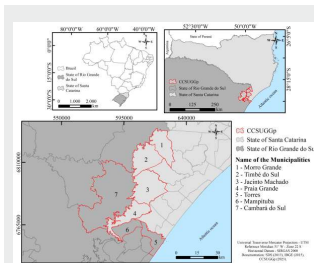


Fig. 1 - CCSUGGP location.

Project development

The initiative commenced in 2020 and received a renewal in 2023, concluding in April 2025, with over 50 schools engaged, encompassing more than 2,000 students. It is important to highlight that the participation of schools, along with their educators and students, enhances awareness about the identification, appreciation, and dedication to the conservation of heritage. The project is executed through activities specifically designed for the students and teachers within the regional educational community, facilitated by themed workshops, employing engaging pedagogical techniques.

Results

The initiatives undertaken in the project fostered the recognition of local archaeological and cultural heritage, particularly that of indigenous communities, challenging colonial stigmas and narratives while aiding in adherence to Laws 10.639/2003 and 11.645/2008. The project utilized various tools, including themed exhibitions, workshops on ceramics and rock art, simulated excavations, and the ARISE app (augmented reality), thereby rendering education more engaging, interactive, and accessible. Heritage Education was successfully aligned with the goals of the 2030 Agenda, particularly SDGs 4 (quality education) and 11 (sustainable cities and communities), thereby enhancing critical awareness, cultural citizenship, and a sense of belonging. The extension practice was established as a conduit between the university and the community, facilitating the democratization of knowledge and the appreciation of memory and cultural diversity. The activities encouraged a sense of identity and belonging among children and adolescents in relation to their territory.



Fig. 2. Visit by elementary school students

References: Sá, A. A., Rosado-González, E., Vaz, N. M., Lourenço, I. M., Silva, E., & Marner-Mann, I. E. (2024). A comunicação e a educação como pilares do desenvolvimento sustentável em geoparques mundiais da UNESCO. In E. Lubbeck, F. F. Lisboa Filho, & L. de Carvalho (Orgs.), *Comunicação & desenvolvimento* (pp. 27-37). Facos - UFPM.

Funding: This initiative is supported by Notice N.º 514/2022 - Pro-Rector of Research, Postgraduate Studies, Innovation and Extension (PROPIEX) along with the Directorate of Extension, Culture, and Community Actions at the University of Extremo Sul Catarinense. The objective of the project is to create a cartography of the archaeological heritage within the Caminhos dos Cânions do Sul UNESCO Global Geopark, engaging municipal and state schools from the municipalities that comprise the territory through Heritage Education.



PLENARY MEETING 2025

30th June – 01st July
University of Trás-os-Montes e Alto Douro

Understanding and segmenting the geotourist profile in Caminhos dos Cânions do Sul UNESCO Global Geopark based on motivations

José Gustavo S. da Silva¹, Ricardo E. Fonseca Filho², Álvaro J. Back³, Juliano B. Campos⁴ & Artur A. Sá⁵

¹ University of Southern Santa Catarina, Criciúma, Brazil; Ph.D student of Geosciences Center of University of Coimbra (CGeo), Portugal; gustasantos92@gmail.com

² Federal University of Delta do Parnaíba, Parnaíba, Piauí, Brazil; ricardo.fonseca@ufdp.edu.br

³ University of Southern Santa Catarina, Criciúma, Brazil; ajb@unesoc.net

⁴ University of Southern Santa Catarina, Criciúma, Brazil; Earth and Memory Institute, Geosciences Center of University of Coimbra (CGeo), Portugal; jbi@unesoc.net

⁵ University of Trás-os-Montes e Alto Douro, Vila Real, Portugal and UNESCO Chair on Geoparks, Sustainable Regional Development and Healthy Lifestyles, Department of Geology, Geosciences Center of University of Coimbra; asa@utad.pt

Introduction

New tourist destinations are emerging in Brazil due to the consolidation and expansion of UNESCO Global Geoparks (UGGP) (Silva *et al.*, 2024). These areas possess considerable potential for diversifying tourism itineraries within a region, directing their development towards the economic utilization of geodiversity. This utilization is primarily realized through various tourism practices. The findings discussed in this document are derived from the broader doctoral research conducted by the first author, which aims to explore the evolution of regional tourism within the Caminhos dos Cânions do Sul UNESCO Global Geopark (CCSUGGP). This segment of the research focuses on analyzing and categorizing the characteristics of geotourists, specifically in relation to the motivations driving visitors to Sites of Geological Interest (SGI).

Methodology

The semi-structured interview method was employed. The research tool is organized into two sections; the first section focuses on socioeconomic and tourism aspects, aiming to delineate the socioeconomic profile of the visitor or tourist. The second part of the questionnaire is designed to evaluate the respondents' understanding of the concepts of geopark and geotourism, as well as their motivations for visiting the area. Responses for this second part are gathered using a 5-point Likert scale. The data collected from these responses were analyzed using statistical software. This study examines the SGIs situated within the municipalities that constitute the state of Santa Catarina (Fig. 2): i) Malacara Canyon, Rio do Boi, and Pedra Branca (municipality of Praia Grande); ii) Paleoburrow Portal do Palmiro (municipality of Timbó do Sul); and iii) Paleoburrow of Três Barras and Queda do Risco Waterfall (municipality of Morro Grande).

Study area

At present, the CCSUGGP (Fig. 1) encompasses seven municipalities within its jurisdiction, with four situated in the state of Santa Catarina and three located in the state of Rio Grande do Sul. The geographical region encompassing the seven municipalities that constitute the CCSUGGP stretches from the coastal zone in Torres/RS, traversing through canyons and cliffs to reach the Serra Geral plateau. Consequently, the CCSUGGP showcases a variety of landscape scenarios within a single territory, which can be leveraged to enhance the range of services available in the area, thereby creating a landscape of opportunities for activities "between the mountains and the sea" (Valdati *et al.*, 2024).

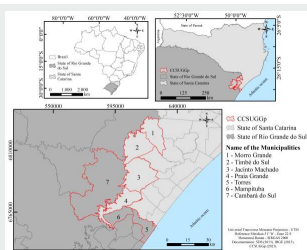


Fig. 1 - CCSUGGP location.

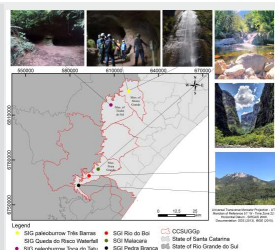


Fig. 2 - Location of the interview sites

Results

The categorization of geotourists enables a deeper comprehension of the various profiles that visit a UGGP, aiding in the development of destination strategies. The socioeconomic characteristics of the interviewees can be described as predominantly female, aged between 30 and 49 years, white, belonging to the middle class, and possessing higher education qualifications. This demographic exhibits a considerable capacity for consumption and the potential to participate in conscious and sustainable tourism practices. In terms of the tourist profile, the interviewees primarily hail from the southern regions of Brazil (RS and SC), typically travel in groups consisting of friends or family, utilize their personal vehicles for transportation, and generally remain in the area for a minimum of two nights. Social media serves as the principal influence on their destination selection. The analysis of motivational factors uncovered eight unique profiles of geotourists. These profiles illustrate the varied interests and expectations of visitors, indicating that geotourism in the CCSUGGP is a complex activity. Furthermore, the findings highlight elevated levels of satisfaction regarding the tourist experience, along with a significant intention to revisit and recommend the destination.

References: Silva, J. G. S. d., Fonseca Filho, R. E., Nascimento, M. A. L. d., Campos, J. B., Ladwig, N. I., & Back, Á. J. (2024). Geoparks mundiais da UNESCO no Brasil: Novas formas de gestão integrada dos territórios. *Caminhos de Geografia*, 25(100).

<https://doi.org/10.14398/CG2510070178>

Valdati, J., Bechtel, A. P., Gomes, M. C. V., dos Santos, Y. R. F., Ricetti, J. H. Z., & Weinschütz, L. C. (2024). More than fossils: Paleoburrows as geoheritage and paleoenvironmental archives in the caminhos dos cânions do sul unesco global geopark, southern Brazil. *Journal of South American Earth Sciences*, 105205. <https://doi.org/10.1016/j.jsames.2024.105205>

Funding: This study was financed in part by the "Coordenação de Aperfeiçoamento de Pessoal de Nível Superior" - Brazil (CAPES) - Finance Code 003, through a visiting Ph.D Scholarship (PDS) - Programa de Doutorado Sanduíche no Exterior, process number: 88881.515852/2024-01, with the University of Trás-os-Montes e Alto Douro, Vila Real, Portugal and the UNESCO Chair on "Geoparks, Sustainable Regional Development and Healthy Lifestyles". Additionally, it is supported by the Fundação de Amparo à Pesquisa e Inovação do Estado de Santa Catarina (FAPESC) for the Ph.D Scholarship in Brazil (CPN48/2023).





PLENARY MEETING 2025

30th June – 01st July
University of Trás-os-Montes e Alto Douro

Geological heritage sites of the São Tomé Island (West Africa)

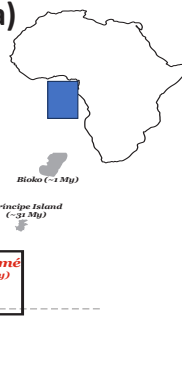
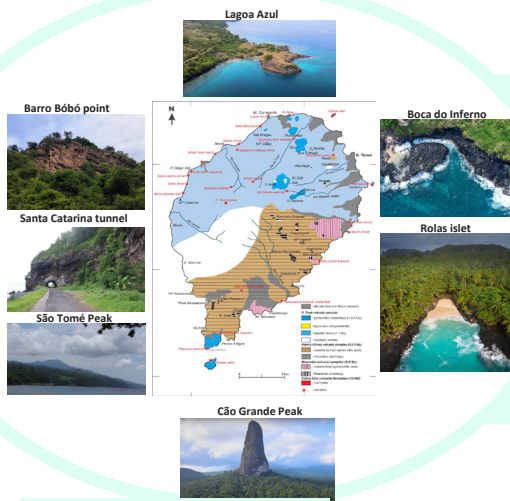
Keynesménio Neto^{1,2} & Maria Helena Henriques¹

- 1 Department of Earth Sciences, Geoscience Center, University of Coimbra, Rua Sílvio Lima, Coimbra 3030-790, Portugal;
- 2 University of São Tomé e Príncipe, Quinta de Santo António, C.P. 546 - São Tomé, São Tomé, São Tomé and Príncipe; keynesmenio@gmail.com

Introduction

São Tomé is a small Atlantic Island located in the Gulf of Guinea (West Africa) that integrates the set of volcanic islands located at the Cameroon Volcanic Line (CVL). Besides the aesthetic appeal of volcanic landscapes provided by these remote islands (Carrón-Mero et al. 2024), they also represent a privileged area for the comparative study of oceanic volcanism and continental alkaline volcanism (Henriques and Neto, 2019), and to understand important concepts and ideas about Darwin's Coral Reef Theory (Henriques and Neto, 2023).

Geology of the Study Area



Geosites Inventorying and Assessment

The inventory was meticulously designed to identify geological heritage of scientific value and national relevance, employing international methodologies as a framework. The are no specific legislation on geoscientific heritage and the incipient state of public awareness of local geological is incipient. But some of the recognized geosites display intense social use once they have facilitated access, an essential condition for becoming a tourist attraction and an educational resource. Scenic content prevails over other types of geoscientific contents, an important asset when analyzing the island's potential for geotourism purposes. São Tomé Peak, Lagoa Azul, Cão Grande Peak, Rolas Islet, Santa Catarina Tunnel, Barro Bóbo Point, and Boca do Inferno geosites display the highest rank in terms of geoscientific qualitative assessment and should be the focus of priority geoscientific measures. All these geosites require valuation measures (in terms of accessibility and the installation of information panels, for example).

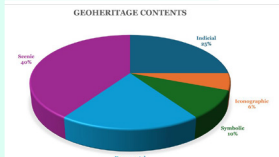
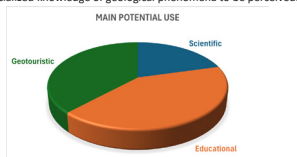


Conclusion

The geological heritage of São Tomé Island comprises 28 geosites, underscoring its geodiversity and geohistory. Notable geosites, including Cão Grande Peak and Lagoa Azul, possess international significance, as they exemplify the geological history associated with the opening of the South Atlantic. A considerable number of geosites are utilized by society; this utilization enhances their potential as tourist attractions and educational resources. Notable geosites, including São Tomé Peak and Rolas Islet, have been identified as top performers in geoscientific assessments, thus meriting priority designation for geoscientific initiatives. Accessibility improvements and informative installations are imperative, particularly for Lagoa Azul, which experiences high levels of visitation, to ensure the preservation of its physical integrity and ecological balance.

Geosites Inventorying and Assessment

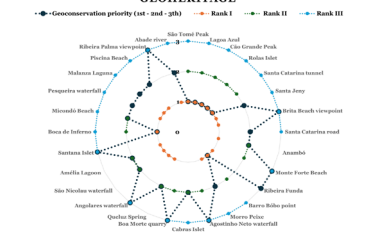
Most of the recognized geosites display intense social use once they have facilitated access, an essential condition for becoming a tourist attraction. This is an issue of the utmost importance in territories covered by intense vegetation, which prevents the observation of a large part of the island's geological record. For the same reasons, the same geosites may also have educational potential, while the scientific potential is limited to geosites that are relevant in the frame of the island's location in the CVL, i.e., geosites requiring specialized knowledge of geological phenomena to be perceived.



References:

- Carrón-Mero P, Sánchez-Zambrano E, Mata-Perelló J et al (2024) Geosites assessment in a volcanic hotspot environment and its impact on geotourism, Santa Cruz-Galapagos Islands, Ecuador. *Int J Geohazard Parks* 12(1):147-167. <https://doi.org/10.1016/j.ijgeop.2024.01.006>
- Henriques MH, Neto K (2019) Geosites at the Equator: Revisiting Selected Geosites of São Tomé Island (Cameroon Line, Central Africa). www.videleaf.com
- Neto K, Henriques MH (2023) Geosites of the Principe UNESCO world biosphere reserve (West Africa). *Sel Geosites. Geosites* 15(4):1-13. <https://doi.org/10.1007/s12371-023-00887-W/TABLES/1>

QUALITATIVE ASSESSMENT OF THE SÃO TOMÉ ISLAND GEOHERITAGE



This study was supported by Portuguese funds from Fundação para a Ciência e a Tecnologia, I.P. (Portugal) in the frame of UIDB/00073/2025 and the UIDP/00073/2025 projects of the I & D unit of Geosciences Center (University of Coimbra, Portugal)

fct Fundação para a Ciência e a Tecnologia

The palaeo-spaces of the Massili watersheds (Burkina Faso)

Lassané Toubga^{1,2,3}, Hantissié Hervé Farma¹, Benjamin Sawadogo^{4,5} & Abdoulaye Daboné¹

¹Laboratoire d'Archéologie, d'Histoire des Arts et des Techniques, Université Joseph Ki-Zerbo 1; lassanetoubga@hotmail.fr

²Instituto Terra e Memória, Portugal

³Centro de Geociências, Universidade de Coimbra, Portugal

⁴Laboratoire Géosciences Environnement, Université Joseph Ki-Zerbo, Burkina Faso

⁵IRD, Ouagadougou, Burkina Faso

Geophysical framework of the study

The Massili is one of the most important tributaries of the Nakambé river, which is the second largest river in Burkina Faso after the Mouhoun. It is 516 km long in Burkina Faso, rises in the Sahel at an altitude of 335 m and flows into the Atlantic Ocean after crossing Ghana (Fig. 1).

The Massili catchment area is located in the centre of Burkina Faso, in the Sudano-Sahelian climate zone. Ouagadougou, the country's capital, is located in this basin.

In this area, the subsoil is largely occupied by immense granite massifs stretching for hundreds of kilometers, which are visible in some places due to erosion (Fig.2).

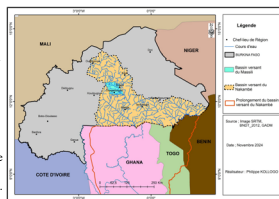


Figure 1: Map of the Massili and Nakambé basins

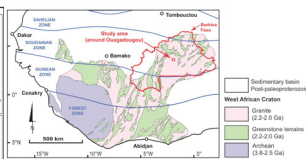


Figure 2: Location of the study area on a West African regional geological map (modified from 3)

Current state of research and objectives

The study area has already been the subject of several archaeological investigations (Simpore 2005). These investigations were carried out with a view to deepening local ethnohistory, particularly that of the rise of the Mossi kingdoms. For this reason, the approach consisted, on the one hand, of identifying the authors of the archaeological sites among the various peoples who have occupied this area over the ages. On the other hand, they took place within the framework of the inventory of archaeological heritage as a support for historical knowledge (Farma & al.2023).

However, this research has enabled us to appreciate the typological diversity of the archaeological remains in the area and to draw up the first maps of ancient human occupation. Radiocarbon dates obtained during archaeological excavations indicate a temporal hiatus characterized by a significant anteriority between these sites and the chronologies proposed by historiography, which rarely exceed the 15th century (Iboudo-Thiombiano 2023, Ouédraogo 2020). The incoherence of the archaeological and historical data derived from oral traditions is an indication of the complex dynamics of the occupation of the area in question, the understanding of which is the aim of this multidisciplinary research project.

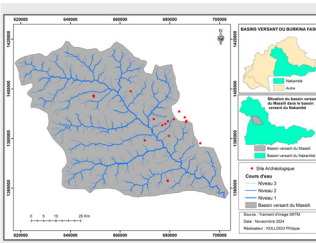


Figure 3: Map of prehistoric sites in the Massili basin

The main objective is to determine the human and environmental dynamics in the Massili basin from prehistoric times to the 15th century, the period corresponding to the arrival of the Moaga aristocracy in the region.

The Secondary objectives are:

- to understand the role played by this transitional area during periods of flooding and ebbing of the Sahara;
- to characterize the different prehistoric cultures in the study area;
- to determine the end of prehistory in the area under study, both chronologically and in terms of material culture;
- to characterize the various cultural manifestations of the Iron Age period in the study area up to the 15th century;
- to study the heritage issues facing the area, in particular the impact of infrastructure development and uncontrolled urbanization on archaeological sites.

Preliminary results and perspectives

Archaeological surveys currently focused on the Massili basin, the main tributary of the Nakambé, have identified over a thousand archaeological sites to date. These include lithic industry sites, ancient iron metallurgy sites, anthropic (habitat) mounds, ecropolises, etc. Lithic industry sites are surface sites located precisely on granite outcrops. Preliminary analysis of the surface material reveals Early, Middle and Late Stone Age features (Fig.3). Initial excavations focused on five sites, uncovering a variety of archaeological remains, including ceramic sherds, paved and flagstone floors and human remains. Radiocarbon dating places the occupation in the period between 4000 BC to 13 AD.

All these sites are located in the metropolis-village of Ouagadougou, where urban pressure is increasingly eroding the integrity of the aforementioned sites.

We intend to continue investigations into the two main periods. In prehistory, the work will consist of undertaking excavations with a view to carrying out OSL and/or ESR dating on the one hand, and characterizing material cultures from stratigraphic contexts on the other.

For the Iron Age period, research will initially consist of characterizing the archaeological material uncovered in order to establish an initial chrono-cultural framework. The second phase will involve continuing archaeological excavations on other types of site

Farma H.H., Toubga L. et Daboné A. (2023), Résilience scientifique : une « archéologie déplacée Interne » en zones urbaine et péri-urbaine de Ouagadougou (région du Centre, Burkina Faso). Nyame Akuma (99), pp.12-20;

Iboudo-Thiombiano F.E. (2023), Données sur la métallurgie ancienne du fer dans la périphérie est de Ouagadougou au Burkina Faso : résultats de recherche des sites de production ancienne du fer à Gonsé. Azania : pp.1-20;

Ouédraogo S.H. (2020), Traditions céramiques et histoire du peuplement dans la province d'Ouhitenga (Burkina Faso) : données archéologiques du site de Wargandga. Thèse de doctorat unique, Université Joseph Ki-Zerbo : 387 p.

Simpore L.7 (2005), Éléments du patrimoine culturel physique du riungu de Wogdogo (Burkina Faso) : approche archéologique et historique. Thèse de doctorat, Université de Ouagadougou, 742p.

Cultural Identity through Gastronomic Tourism in the Caminhos dos Cânions do Sul UNESCO Global Geopark: a Study in Santa Catarina Municipalities

Lucas Fabricio de Souza Firmino¹, Juliano Bitencourt Campos²

¹ University of Southern Santa Catarina, Criciúma, Brazil, PhD student in the Postgraduate Program in Environmental Sciences; firmino@unesc.net

² University of Southern Santa Catarina, Criciúma, Brazil, Postgraduate in Environmental Sciences; Earth and Memory Institute, Geosciences Center of University of Coimbra (CGeo), Portugal; jbit@unesc.net

Introduction

Gastronomic tourism highlights local food heritage, promoting cultural identity and sustainable development. The Caminhos dos Cânions do Sul UNESCO Global Geopark, recognized for its significant geodiversity and diverse intangible and tangible cultural heritage (Santos *et al.*, 2024), represents a unique context for examining the interplay between gastronomy, culture, and regional development. Food heritage serves not only as a marker of cultural identity but also as an essential vector for regional economic and tourism growth (Gimenes-Minasse, 2023). Notably, the GEOfood initiative, already implemented in several UNESCO Global Geoparks (UGGP) worldwide (Fig. 1), demonstrates the potential of connecting gastronomy, sustainability, and geodiversity to strengthen both local identity and tourism attractiveness.

Methodology

This research employs a qualitative methodology with a focus on narrative analysis and a review of secondary and primary data sources, including local gastronomic practices, community interviews, and cultural tourism documentation. The methodological framework aligns with sustainable regional development goals, considering community-based tourism principles, as well as the concepts of gastronomic tourism and GEOfood, with an emphasis on cultural aspects, local resources, authenticity and sustainability criteria.

Study area

The Caminhos dos Cânions do Sul UNESCO Global Geopark (CCSUGGP) extends across seven municipalities in southern Brazil (Fig. 2), with four located in the state of Santa Catarina: Jacinto Machado, Morro Grande, Praia Grande, and Timbé do Sul. These Santa Catarina municipalities, which are the focus of this study, feature remarkable natural environments, such as dramatic canyons, waterfalls, and archaeological sites, combined with a diverse cultural heritage. The region's identity has been shaped by indigenous peoples, waves of European immigration, “tropiceros” (Brazilian muleteers or drovers) and longstanding rural traditions. Cultural expressions in these communities include historic buildings, traditional festivals, crafts, and distinctive local gastronomy. Together, these assets are essential to local identity and serve as drivers for sustainable tourism and regional development (Santos *et al.*, 2024).



Fig. 1 - Examples of GEOfood (Source: GEOfood, 2024).

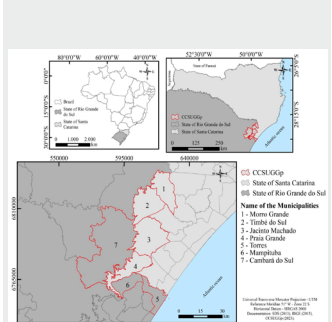


Fig. 2 - CCSUGGP location

Results

Preliminary findings reveal a significant gastronomic heritage within the geopark area, highlighting the potential of culinary practices to strengthen regional identity. Local food heritage can be actively promoted through initiatives such as Geofood, which value gastronomic authenticity, sustainable production practices, and community involvement. Local products and culinary traditions, aligned with sustainability practices, gastronomic tourism, and community-based tourism, significantly enhance tourists' experiences and local economic growth. The main initiatives identified include local restaurants and dishes, as well as traditional food products that meet the sustainability criteria required by the GEOfood brand, promoting authenticity and sustainability in local food consumption and production.

References: GEOfood. (2024). Geoparque Naturtejo. GEOfood. In: <https://geofood.no/geoparques/naturtejo-geopark-2/>
Gimenes-Minasse, M. H. S. G. (2023). Food tourism: concepts & features. *Revista Brasileira de Pesquisa em Turismo*, 17, e 2793. <https://doi.org/10.7784/rbptur.v17.2791>
Santos, A. L., Bandeira, D. R., Cavali, M. N., Campos, J. B., Santos da Silva, J. G., & Wołosz, M. (2024). Cultural heritage in the cities of Santa Catarina that are part of the UNESCO Global Geopark Southern Canyons Pathway. *Desenvolvimento Socioeconômico em Debate*, 10(1), 86-98. <https://doi.org/10.18616/deb.v10i1.8553>
Funding: This study was financed in part by the "Coordenação de Aperfeiçoamento de Pessoal de Nível Superior" - Brazil (CAPES) - Finance Code 001.



PLENARY MEETING 2025

30th June – 01st July
University of Trás-os-Montes e Alto Douro

PORT-SALT: A introdução do sal nas dietas em território português antes da escrita.

Luís Jesus¹

1 UAL/IPT, Geoscience Center (CGeo)

luisfcjesus@gmail.com

Objective

The project seeks to understand how salt was introduced, exploited, used, and transported into the diet, economy, and life of Proto- and Prehistoric populations from western Iberia. Through a multidisciplinary approach based on bibliographic, archaeological experimental and geomorphological data, this paper aims to identify potential zones of salt exploitation in Portugal, whether by briquetage or saltern techniques.

Methods

Ceramic fragments from various archaeological sites, dated chronologically between the Early Neolithic and the Iron Age, are being used. This study encompasses three main components: experimental archaeology with ceramics, geochemical analysis of both prehistoric and experimental ceramics, and geochemical analysis of the deposits from which these ceramics originate.

Subtitle

From an evolutionary point of view, the importance of salt can be traced back to the early stages of human evolution, when the first humans were primarily focused on securing food. Since sodium is not synthesized in the body, obtaining it from dietary sources was essential for survival. Despite sodium intake through meat and fish, salt was likely sought for taste enhancement and food processing, contributing to its large-scale production and distribution in ancient communities. This demand implies deliberate and organized efforts to secure and manage salt resources. Archaeological interest in salt has grown in recent decades due to advances in archaeosciences and new discoveries. Evidence from the Upper Paleolithic mainly suggests proximity to saline sources, though this remains speculative. From the Neolithic onward, indirect traces such as burned clay structures and ceramic accumulations begin to suggest systematic exploitation.

Fig. 1: various archaeological evidences for salt production.*

Fig. 2 – 4: XRF analysis to Neolithic Pena d'Água ceramics



Conclusion

The study of salt production in prehistoric contexts, particularly within the structure of the Iberian Peninsula, has broader implications that resonate beyond archaeological discourse, influencing contemporary environmental and cultural studies. The analysis of old techniques such as, salt pans and briquetage, provides a vital view of human adaptation and early manipulation of their environments. These ideas are essential to understanding how old societies have been involved with their natural environment, which in turn can inform modern approaches to sustainable practices and resource management. Despite the technical limitations encountered, the project has made significant progress in recognizing the importance of salt in Portuguese prehistory. The lack of direct analytical evidence should not be mistaken for an absence of evidence, highlighting the need to continue research with adapted methodologies. The connection between shell middens—often located at altitudes exceeding 100 meters—and the presence of brackish water sources inland opens a new interpretative framework. These findings question long-held assumptions that marine transgression alone explains the inland distribution of marine bivalves. Instead, they suggest a deliberate and sustained exploitation of local saline environments by prehistoric communities. Such adaptive strategies point to a sophisticated understanding of resource management and environmental conditions well before the advent of writing. The proposed approach thus aims to consolidate new pathways in the study of early salt production in Portugal.

References:

- Harding, A. 2013. The prehistoric exploitation of salt in Europe. *Geological Quarterly* 2014, 58 (3): 591–596.
Tencati, F. A., et al. (2015). Briquetage and salt cakes: An experimental approach of a prehistoric technique. *Journal of Archaeological Science*, 59, 118–131.
Valera, A. C. (2017). Salt in the 4th and 3rd Millennia BC in Portugal: specialization, distribution, and consumption. *Cuaternario y Geomorfología*, 31.
Weller, O., 2015. First salt making in Europe: an overview from Neolithic times. *Documenta Praehistorica XLII*, 185–196, 2015.



PLENARY MEETING 2025

30th June – 01st July

University of Trás-os-Montes e Alto Douro

Methodological proposal for classification and determination of tourist carrying capacity applied to trails in the Caminhos dos Cânions da Sul UNESCO Global Geopark

Luciano Miranda¹, José Gustavo S. da Silva² & Juliano Bitencourt Campos³

¹ University of Southern Santa Catarina, Criciúma, Brazil; PhD student in the Postgraduate in Environmental Sciences; lucianomda@hotmail.com

² University of Southern Santa Catarina, Criciúma, Brazil; Ph.D student of Geosciences Center of University of Coimbra (CGeo), Portugal; gустasantos92@gmail.com

³ University of Southern Santa Catarina, Criciúma, Brazil, Postgraduate in Environmental Sciences; Earth and Memory Institute, Geosciences Center of University of Coimbra (CGeo), Portugal; jbi@unesp.net

Introduction

UNESCO Global Geoparks (UGGp) represent distinctive geographic regions that safeguard and maintain landscapes of geological significance, managed with a focus on conservation, education, and sustainable development. The southern part of Brazil has emerged prominently on the national stage as the area boasting the highest number of UGGp. In particular, the territory between the states of Rio Grande do Sul and Santa Catarina that has been gaining attention is the Caminhos dos Cânions do Sul UNESCO Global Geopark (CCSUGGp). There has been a notable rise in the number of visitors to the geological sites that constitute the CCSUGGp. This increase in foot traffic along the trails leading to various tourist attractions may pose potential risks for visitors. Consequently, there is a growing concern regarding the sustainability of this destination, particularly in relation to the Tourist Carrying Capacity (CCT) of the trails, as tourism activities can inevitably affect the sites.

Research Question

Visitor safety and the protection of resources are critical components in ensuring the sustainability of any tourist destination. Consequently, as indicated in the master's thesis authored by the proposer of this document, a deficiency was identified concerning the methodologies utilized to establish the Carrying Capacity of Trails (CCT), particularly within the territory of the CCSUGGp (Miranda, 2024). The objective of this project is to develop a methodological framework for classifying and assessing the CCT applicable to trails that provide access to tourist attractions within the CCSUGGp. The pertinent literature highlights that the predominant method for determining the CCT in Latin America is that proposed by Cifuentes (1992), which employs a quantitative approach aimed at ascertaining the maximum daily visitor capacity of a protected area.

General objective

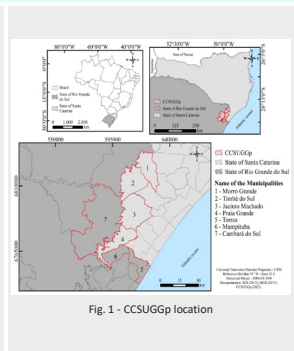
Develop a methodological framework for the classification and assessment of the Tourist Carrying Capacity (CCT) relevant to trails that provide access to tourist attractions in CCSUGGp.

Specific Objectives

- Organize and categorize the trail based on the level of severity in accordance with ABNT NBR 15505-2, 2019;
- Establish the physical and functional load capacity of the trail;
- Establish the management capabilities of the organization;
- Suggest modifications to the methodology based on the level, categorization, and quantity of factors in relation to the Degree of Severity of the Environment.

Study area

At present, the CCSUGGp (Fig. 1) encompasses seven municipalities within its jurisdiction, with four situated in the state of Santa Catarina and three located in the state of Rio Grande do Sul. The geographical region encompassing the seven municipalities that constitute the CCSUGGp stretches from the coastal zone in Torres/RS, traversing through canyons and cliffs to reach the Serra Geral plateau. Consequently, the CCSUGGp showcases a variety of landscape scenarios within a single territory, which can be leveraged to enhance the range of services available in the area, thereby creating a landscape of opportunities for activities "between the mountains and the sea" (Valdati *et al.*, 2024). The region is notable for its intricate geodiversity, characterized by lithological formations and geomorphological features that are a result of the significant volcanic activity.



Research Problem and Questions

This study seeks to establish the Tourist Carrying Capacity (CCT) to facilitate the management of visitor numbers that support both conservation and tourism, as disarray may lead to a situation of irreversible environmental damage.

Several inquiries emerge concerning the objectives of this initiative:

- Could tourist attractions pose potential risks, given the circumstances they may create for visitors? Furthermore, does the influx of visitors disrupt the conservation of these attractions?
- Is it feasible to adapt and modify methodologies, and should these adjustments be implemented variably based on the unique characteristics of each trail?
- Would the addition of informational signs regarding local geodiversity and biodiversity represent a meaningful improvement for both environmental education and emergency preparedness?

References:

- Associação Brasileira de Normas Técnicas. (2019). NBR 15505-2: Turismo de aventura – Caminhada – Parte 2: Classificação de percursos. ABNT.
- Cifuentes, M. (1992). Determinación de capacidad de carga turística en áreas protegidas. Serie Técnica, Informe Técnico nº 134, Curitiba: CATIE.
- Miranda, L. (2024). Capacidade de carga turística aplicada à Trilha Portal da Pedra, Timbó do Sul, SC: Caminhos dos Cânions do Sul UNESCO (Dissertação de Mestrado, Universidade do Extremo Sul Catarinense).
- Valdati, J., Bechtel, A. P., Gomes, M. C. V., dos Santos, Y. R. F., Rietz, J. H. Z., & Weinschütz, L. C. (2024). More than fossils: Paleoenvironmental archives in the canyons of the canyons do sul unesco global geopark, southern brazil. *Journal of South American Earth Sciences*, 105020. <https://doi.org/10.1016/j.jsames.2024.105020>
- Funding: This study was financed in part by the "Coordenação de Aperfeiçoamento de Pessoal de Nível Superior" - Brazil (CAPES) - Finance Code 003 (Ph.D Scholarship in Brazil).



PLENARY MEETING 2025

30th June – 01st July
University of Trás-os-Montes e Alto Douro

APHELEIA and BRIDGES Transdisciplinary Landscape management

Luiz Oosterbeek¹

¹Instituto Politécnico de Tomar, Instituto Terra e Memória, CGeo; loost@ipt.pt

Apheleia



APHELEIA – a global interdisciplinary academic network

Apheleia aims at structuring a convergent set of strategies based in the methodologies of the Humanities that will foster the need for a properly Cultural (i.e. human and diverse) Integrated (as opposed to dispersed) Landscape (not limited to places) Management (rooted in human understandings and leading towards governance through awareness and critical thinking) for Local and Global Sustainability (addressing global dilemmas but also focused on individual concerns and needs).

Established in 2014, it now engages researchers and projects in Europe, Southern America, Africa and Asia.

BRIDGES – a new UNESCO tool for sustainability

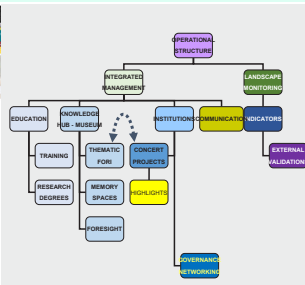
BRIDGES' Humanities-driven sustainability science is a novel transdisciplinary method that integrates conventionally undervalued knowledge systems into established approaches to deliver innovative solutions to the most pressing social and environmental challenges tackled by the United Nations' Sustainable Development Goals (SDG 2015). It acknowledges non-academic expertise and champions meaningful co-production that combines the methods and expertise of the humanities and the arts with STEM subjects.

Established by UNESCO at the initiative of the International Council for Philosophy and Human Sciences and APHELEIA, BRIDGES is a major tool that offers a new understanding of sustainability, overcoming the shortcomings of the traditional triple-bottom-line model.

APHELEIA snapshots



Mação, Portugal



Mato Grosso do Sul et al., Brazil

AIMS OF APHELEIA

- To **promote** the Humanities and Social Sciences at a global level, focusing their relevance for landscape management, well-being and sustainability.
- To **consolidate a solid international consortium**, involving academic and non-academic partners, focusing in developing (multi-) (inter-) (trans-) disciplinary research to address societal problems and questions related to a properly integrated cultural landscape management for both local and global sustainability.
- To promote and support the **creation of different (multi-) (inter-) (trans-) disciplinary research groups** – according to the concerns, interests, resources and capabilities of each partner – to address particular problems and questions related to cultural integrated landscape management
- To foster the co-design and co-development between partners of **education tools**.
- To organize **research and training seminars and workshops** on the complex use of convergent (multi-) (inter-) (trans-) disciplinary tools for cultural integrated landscape management.
- To coordinate efforts for **collecting, consolidating, and disseminating knowledge** advancements in the Humanities and Social Sciences in the domain of Landscape studies.
- To **collect, analyse and synthesize the rich teaching and research field experiences** gathered by the partner members on diverse **case studies** to be distributed worldwide.
- To involve in both teaching and research activities **basic disciplinary core required competences** (archaeology, history, anthropology, philology, communication, geography, technology, economy, law, sociology, urban planning, etc.), permanently integrated through transversal competences, engaging earth and life sciences as well as community based practices.
- To encourage **knowledge dissemination** and applied initiatives not only among Apheleia members but also involving external stakeholders, namely representatives of regional and local communities.
- To **collaborate with other international research and education organisations**, namely UNESCO and the International Council for the Philosophy and Human Sciences (CIPSH).

References:

- www.apheleia-project.org
<https://bridges-eu.eu/>
 Oosterbeek, Luiz, Caron, L.; Quaglini, M. "Introduction." In SustainabilityDilemmas. Transdisciplinary contributions to integrated cultural landscape management. - série ARKEOS, 38-39. Portugal: ITM, 2016.
 Oosterbeek, Luiz. "Landscapes transformations: understanding culturechange". In Co-Transforming Landscapes, Transdisciplinary Contributions for Cultural Integrated Landscape Management, 11-16. Mação: Instituto Terra e Memória, 2023

fct Fundação
para a Ciência
e a Tecnologia



PLENARY MEETING 2025

30th June – 01st July
University of Trás-os-Montes e Alto Douro

AVECASTA - PORTAL DO TEMPO

José Mateus^{1,2,a)}, Paula Queiroz^{2,b)}

¹ Double-u Replay

² CGeo - Centro de Geociências

a) jedumateus@gmail.com

b) paulafernandaqueiroz@gmail.com

Introdução

AVECASTA - PORTAL DO TEMPO

A Gruta da Avecasta preserva uma longa série de horizontes de ocupação, muitos dos quais preservados sob a forma de chãos cobertos por lama fina. Para além do Paleolítico ainda inacessível, temos povoados (em continuidade desde o Neolítico ao Bronze Médio) e importantes instalações artesanais (da Idade do Ferro à Idade Média). Prevalece uma actividade metáurgica contínua que faz da Gruta da Avecasta um sítio de relevância científica mundial. A escavação, muito prejudicada por dois eventos destrutivos (em 1990 e 2011), embora iniciada em 1980, é ainda muito limitada e circunscrita.

Quatro fases de trabalho de campo:

- A - Escavações dos anos oitenta
- B - Primeiras campanhas de salvamento (entre 1996 e 2002)
- C - Segundas campanhas de salvamento (entre 2017 e 2019)
- D - PIPAAVE (programa em curso desde 2022)

O programa desenvolve-se sob coordenação de José Mateus e Paula Queiroz sob a forma de uma parceria envolvendo a Double-u Replay Associação (WR), o Município de Ferreira do Zêzere (CMFZ), o Instituto Politécnico de Tomar (IPT) e o Laboratório Hércules (LHUE), integrando-se agora no Centro de Geociências.

A Gruta da Avecasta foi classificada como imóvel de interesse público.

Equipa envolvida:

Ana Martins (AM), Artur Mateus (Am), Carlos Pinheiro (CP), Cláudia Relvado (CR), Cristina Barroca Dias (CD), Denise Silva (DS), Fernando Coimbra (FC), João Paulo Esteves Pereira (JP), José Mateus (JM), Máximo Beltrame (MB), Miguel Geraldes (MG), Obisdom Ganyiv (OG), Paula Queiroz (PQ), Ricardo Trilles (RT), Rui Patrício (RP), Teresa Bray (TB)



Gruta da Avecasta (foto de 1980)

SUB-PROGRAMAS EM CURSO

(No âmbito do Programa De Investigação Pluri-anual de Arqueologia PIPAAVE, coordenado por José Mateus e Paula Queiroz)

1 - Escavação, salvamento e materiais arqueológicos

1) - Um sub-programa de escavação metódica de desmontagem minuciosa, presentemente focado nos níveis medievais (Torres do Forno Feneiro¹), quer na sondagem (sectores A e C) quer na 'Ramina W'. [JM,PQ][14,27]
Privilegia a escavação de superfícies de desmontagem, procurando local entidades estratigráficas de sentido deposicional e tafonómicamente homogêneas. Pretende-se um registo exaustivo das condições e padrões de distúrbios

2) Um sub-programa de salvamento para a re-contextualização dos achados arcaicos e das suas matizes estratigráficas e ocupacionais originais. [JM,PQ][14,27]
Procura-se escavar os entulhos do vandalismo paralelamente à desmontagem das vizinhas estratigráficas preservadas que os explicam

3) Um sub-programa de estudo (e catalogação) dos materiais arqueológicos (focalizado presentemente na cerâmica). [JM,Am,DS,TB][14]
Para além do inventário das achadas, desenvolve-se a sua catalogação tipológica, parametrizada sob o conceito de 'layer analysis' (nível único e seus estigmas preservados)

4) Um sub-programa de traçologia (sobre materiais líticos e ósseos) [JP,JM][14]
Em fase preliminar, dando suporte e sentido ao sub-programa 3

5) Um sub-programa de leitura de grãos, graffiti e pintura das paredes (em fase preliminar) [FC,JM,TB]
Com base num novo registo fotográfico (e fotografométrico) de detalhe, sob condições diferenciadas de luz



Um dos sectores das paredes do curso: uma palmeira múltipla de estigmas de habitação humana e ambiental

3D e Virtualização

6) Um sub-programa de registo 3D detalhado das estruturas arqueológicas (AVE-3D+ - Sistema de Informação Arqueológica), das paredes do curso e dos objectos (prefabricados e recursos) [JM,PQ,TB,RP,DS,AM][26,19]

Notas e a experiência da AVE-3D+ e a incorporação na Estrutura Total



7) Um sub-programa de virtualização arqueológica interactiva com base no UNREAL (da EPIC), projectando achados à realidade, investigando a história da investigação e interpretação num palco diversificado de actores naturais, artificiais e humanos [JM,PQ,TB,RP,DS,AM][26,26,26,26]

Desenvolve-se um novo conceito de Arqueologia Cénica com base na ideia operatória da Réplica Realista Regional Visual do passado

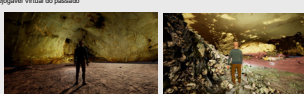


Imagem do protótipo de realidade virtual interactiva (videogame) Avecasta - O Portal Espaço do Tempo

Bio-Arqueologia e (Paleo)ecologia

8) Um sub-programa de arqueozoologia com duas frentes: macro e micro-vertebrados (anda numa base preliminar) [CP][17]
Tem como base o risco ecológico osteológico recolhido (que resulta em parte da utilização de um sistema de crivagem a água com malhas até um milímetro)

9) Um sub-programa de Antropologia [CR][17]
Os vestígios humanos na Gruta são ainda escassos, associados a episódios de destruição. Está ainda por identificar os contextos funerários associados aos níveis povoados

10) Flora e Vegetação do Cabeço da Avecasta [PQ,JM][25]
O cabeço, onde persiste um elenco de habitats naturais ecologicamente maduros, ricos de diversidade biológica. A visão paleoecológica sobre a evolução do território envolvente, permitida pelo estudo da longa sequência de argilas fossilíferas, referencia estas estruturas, hoje vivas

11) Um sub-programa sobre madeiras e sementes carbonizadas [PQ][18,21]
Estudo potenciado pela sistemática recolha de resíduos de colares (1 milímetro de malha) e pelo tratamento pontual de colunas de crivagem defloculante até 0,25 milímetros

12) Um sub-programa de Palinologia [PQ,JM][15]
Estudo potenciado pela boa conservação do pólen e das esporas na argila fina



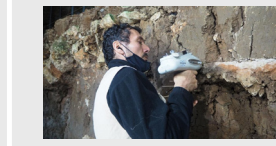
Imagem SEM do pólen de *Cistus tataricus*

Arqueometria

13) Um sub-programa de Análise de Resíduos orgânicos em cerâmicas [AM,CD][13]
Iniciado sobre cerâmicas do Calcolítico, envolvendo cooperação com o Laboratório Hércules (LHUE)

14) Um sub-programa de estudo das pastas de cerâmica [MB,OG,JM,Am][10,12]
Atualmente com foco na série pré-númica de ocupações, envolvendo cooperação com o Laboratório Hércules (LHUE), e utilizando análise petrográfica-mineralógica com lâminas finas e análise micro-estrutural a microscópio e difração de Raios-X

15) Um sub-programa de geocronologia e sedimentologia [MB,JM][11]
Envolvendo o recolha de dados através da Fluorescência de Raios-X ao longo de toda a coluna sedimentar holocénica



Recolha de uma série estratigráfica de dados geo-químicos por análise de fluorescência de Raios-X (na imagem Massimo Beltrame)

Museografia, Divulgação e Extensão Cultural

16) Um sub-programa de conservação e restauro de materiais arqueológicos (anda em fase preliminar). [RT][17]
Anda numa fase esboçada, em cooperação com o Departamento de Conservação e Restauro do IPT

17) Um sub-programa para a proposta de classificação como Monumento Natural, envolvendo uma parceria entre o Município de Ferreira do Zêzere e a Double-u Replay [MQ][45]
Processo em curso

18) Um sub-programa de adequação logístico-museográfica do sítio na óptica do acesso de públicos [JM,PQ][1]
Prevê-se a repositão da topografia original (com cobertura arbórea da montanha verde e solo) através de uma estrutura metálica que facilitará o acesso e a segurança dos visitantes e a preservação das áreas em escavação

19) Um sub-programa de divulgação
Assente na criação de painéis, paredes expositivas e conteúdos da WEB, na realização das 'Cursas Avecasta' e nas 'Jornadas da Primavera' (entre muitos outros eventos de conferência e exposição)

20) Extensão cultural e artística
Promovendo a Grande Sala como palco de concertos, Promovendo visitas guiadas



Gruta da Avecasta - Jornadas da Primavera

Referências: ALMEIDA, L. (2004). Avaliação do potencial da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2004. 120 p. ALMEIDA, L. (2005). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2005. 120 p. ALMEIDA, L. (2006). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2006. 120 p. ALMEIDA, L. (2007). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2007. 120 p. ALMEIDA, L. (2008). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2008. 120 p. ALMEIDA, L. (2009). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2009. 120 p. ALMEIDA, L. (2010). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2010. 120 p. ALMEIDA, L. (2011). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2011. 120 p. ALMEIDA, L. (2012). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2012. 120 p. ALMEIDA, L. (2013). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2013. 120 p. ALMEIDA, L. (2014). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2014. 120 p. ALMEIDA, L. (2015). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2015. 120 p. ALMEIDA, L. (2016). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2016. 120 p. ALMEIDA, L. (2017). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2017. 120 p. ALMEIDA, L. (2018). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2018. 120 p. ALMEIDA, L. (2019). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2019. 120 p. ALMEIDA, L. (2020). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2020. 120 p. ALMEIDA, L. (2021). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2021. 120 p. ALMEIDA, L. (2022). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2022. 120 p. ALMEIDA, L. (2023). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2023. 120 p. ALMEIDA, L. (2024). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2024. 120 p. ALMEIDA, L. (2025). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2025. 120 p. ALMEIDA, L. (2026). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2026. 120 p. ALMEIDA, L. (2027). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2027. 120 p. ALMEIDA, L. (2028). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2028. 120 p. ALMEIDA, L. (2029). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2029. 120 p. ALMEIDA, L. (2030). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2030. 120 p. ALMEIDA, L. (2031). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2031. 120 p. ALMEIDA, L. (2032). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2032. 120 p. ALMEIDA, L. (2033). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2033. 120 p. ALMEIDA, L. (2034). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2034. 120 p. ALMEIDA, L. (2035). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2035. 120 p. ALMEIDA, L. (2036). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2036. 120 p. ALMEIDA, L. (2037). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2037. 120 p. ALMEIDA, L. (2038). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2038. 120 p. ALMEIDA, L. (2039). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2039. 120 p. ALMEIDA, L. (2040). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2040. 120 p. ALMEIDA, L. (2041). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2041. 120 p. ALMEIDA, L. (2042). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2042. 120 p. ALMEIDA, L. (2043). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2043. 120 p. ALMEIDA, L. (2044). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2044. 120 p. ALMEIDA, L. (2045). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2045. 120 p. ALMEIDA, L. (2046). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2046. 120 p. ALMEIDA, L. (2047). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2047. 120 p. ALMEIDA, L. (2048). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2048. 120 p. ALMEIDA, L. (2049). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2049. 120 p. ALMEIDA, L. (2050). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2050. 120 p. ALMEIDA, L. (2051). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2051. 120 p. ALMEIDA, L. (2052). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2052. 120 p. ALMEIDA, L. (2053). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2053. 120 p. ALMEIDA, L. (2054). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2054. 120 p. ALMEIDA, L. (2055). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2055. 120 p. ALMEIDA, L. (2056). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2056. 120 p. ALMEIDA, L. (2057). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2057. 120 p. ALMEIDA, L. (2058). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2058. 120 p. ALMEIDA, L. (2059). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2059. 120 p. ALMEIDA, L. (2060). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2060. 120 p. ALMEIDA, L. (2061). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2061. 120 p. ALMEIDA, L. (2062). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2062. 120 p. ALMEIDA, L. (2063). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2063. 120 p. ALMEIDA, L. (2064). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2064. 120 p. ALMEIDA, L. (2065). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2065. 120 p. ALMEIDA, L. (2066). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2066. 120 p. ALMEIDA, L. (2067). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2067. 120 p. ALMEIDA, L. (2068). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2068. 120 p. ALMEIDA, L. (2069). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2069. 120 p. ALMEIDA, L. (2070). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2070. 120 p. ALMEIDA, L. (2071). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2071. 120 p. ALMEIDA, L. (2072). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2072. 120 p. ALMEIDA, L. (2073). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2073. 120 p. ALMEIDA, L. (2074). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2074. 120 p. ALMEIDA, L. (2075). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2075. 120 p. ALMEIDA, L. (2076). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2076. 120 p. ALMEIDA, L. (2077). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2077. 120 p. ALMEIDA, L. (2078). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2078. 120 p. ALMEIDA, L. (2079). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2079. 120 p. ALMEIDA, L. (2080). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2080. 120 p. ALMEIDA, L. (2081). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2081. 120 p. ALMEIDA, L. (2082). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2082. 120 p. ALMEIDA, L. (2083). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2083. 120 p. ALMEIDA, L. (2084). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2084. 120 p. ALMEIDA, L. (2085). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2085. 120 p. ALMEIDA, L. (2086). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2086. 120 p. ALMEIDA, L. (2087). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2087. 120 p. ALMEIDA, L. (2088). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2088. 120 p. ALMEIDA, L. (2089). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2089. 120 p. ALMEIDA, L. (2090). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2090. 120 p. ALMEIDA, L. (2091). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2091. 120 p. ALMEIDA, L. (2092). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2092. 120 p. ALMEIDA, L. (2093). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2093. 120 p. ALMEIDA, L. (2094). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2094. 120 p. ALMEIDA, L. (2095). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2095. 120 p. ALMEIDA, L. (2096). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2096. 120 p. ALMEIDA, L. (2097). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2097. 120 p. ALMEIDA, L. (2098). Avaliação da Gruta da Avecasta para a criação de um museu de história natural e de geologia para a Gruta da Avecasta. Relatório de Trabalho de Conclusão de Curso, Universidade de Trás-os-Montes e Alto Douro, Vila Real, 2098. 120 p



PLENARY MEETING 2025

30th June – 01st July
University of Trás-os-Montes e Alto Douro

The Double-u Replay / CGeo Wetland Program

Double-u Replay (WR) is an association concerned with archaeological, ecological and art-historical research which (still informally) integrates the CGeo

Miguel Gerales^{1,2,3,4}, Paula Queiroz^{3,4} & José Mateus^{3,4}

¹Centro de Estudos Geográficos, Instituto de Geografia e Ordenamento do Território, Universidade de Lisboa, Laboratório Associado TERRA, Portugal; mgeraldes@edu.ulisboa.pt

²IBLE University of Greifswald, Partner in the Greifswald Mire Centre

³Double-u Replay (WR)

⁴CGeo (Centro de Geociências)

Consultant in the PEATMAP project

PEATMAP - A prototype model for the study of peatland distribution, ecology and carbon dynamics in the Iberian Peninsula landscape mosaic

Start and end date
01.01.2024 - 15.05.2025

Financing
MIT Portugal Program
(Ref. 2022.15748.MIT; <http://doi.org/10.54499/2022.15748.MIT>)

Laboratory of Palaeoecology - Double-u Replay (Mateus & Queiroz), IPT & Torres Vedras, Portugal

Double-u Replay Wetland Program - apart from the Avecasta Cave Program (considered in another CGeo Plenary poster) WR's main concern is the mapping, conservation and study of mires, peatlands, swobs, and their microstratigraphical profiles.

- Laboratorial unit..... |
- Part of the technical library | Instituto Politécnico de Tomar (M build.)
- Reference collections and mire |
- stratigraphic frozen archives
- Computational unit Torres Vedras headquarters

This research program concerns the vast archives of ecological and territorial memory, preserved (film by film) in the stratigraphy of peat, mud, and clay in certain organic-rich wetlands (mires and peatlands, marshes, swamps, and lagoons, dams, weirs, and wells) and in caves and karst shelters.

Results & Future Output for Double-u Replay as a member of the CGeo – Centro de Geociências

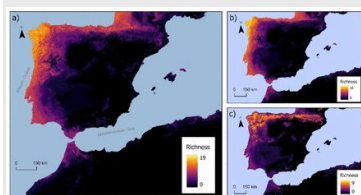


Figure 1.

Predicted richness of plant taxa associated with mires, peatlands and other potential organic soil-forming environments in the Western Mediterranean Realm. Richness maps are presented for all taxa (a), for taxa found in lower-altitude environments (b), and for taxa found in higher-altitude environments (c)

Results & Future Output for Double-u Replay:

Fig. 2 Many more tiny mires, peatlands and swobs

- effectiveness of combination of bioindicator-based cross-taxa richness modelling with a comprehensive set of environmental predictors in predicting the distribution of peatland and organic soil-forming environments in the Western Mediterranean (> 700 discovered peatlands in Portugal)
- New significant areas of high richness, including overlooked regions such as southern Portugal and northern Morocco, northeastern Algeria, and northern Tunisia, providing a critical baseline for conservation planning, demonstrating the potential of SDMs for advancing peatland mapping in underrepresented regions

West Mediterranean/Iberian Realm

North	Pyrenees and Basque Mires	Mapping accuracy
Central	Galician-Moroccan-Cantabrican	good
Central	Cantabrican	good
Central	North-Western Iberian	good
Central	South-Western Iberian	good
East	Levantine coast	good
West	Portuguese Mire	good
West	Portuguese Central and Tagus-Guadiana Basins	good
Central	Talud-Moroccan and Algarve-Southern Iberian	good
Southwest	Portuguese Atlantic and Algarve coasts	good
Southwest	Galician, Cantabric and Iberian Mires	good
South	Tagus-Guadiana and Iberian Mires	good
South	Galician and Iberian Mires	good
South	Galician and Iberian Mires	good



- To map new spots in order to survey, identify, sample and study the Late Pleistocene and Holocene peat and mud microstratified deposits of Western-Central Portugal
- To sample pollen, spores, other micro-fossils and plant macro-remains (such as seeds and wood)
- To investigate in long time-series to provide a sound reconstruction of palaeo-vegetation development and change due to coastal change, climate and human impact and territorial land-use establishment

Contribution to a National Wetlands Inventory effort, to enrich the pollen and NPP national record, to soil organic carbon mapping

Double-u Replay's work aims to play a decisive role in identifying and filling critical data gaps that hinder effective sampling of palaeoecological information as well as restoration and conservation efforts in organic-rich wetlands, such as peatlands, in mainland Portugal, in the context of implementing the Nature Restoration Law. The combination of decades of work on these palaeoecological archives with innovative modeling and remote sensing methodologies, sampling stratification, and ground-truthing has produced new data, redrawing the map of these wetland ecosystems in mainland Portugal:

- extension and condition of mires, peatlands and swobs
- further development of regional classification of peatlands
- greenhouse gas emissions
- substrate organic carbon models
- record of peat, peat depth and type
- soil traits
- restoration and conservation practices
- long-term monitoring
- biodiversity
- hydrology
- paludiculture potential evaluation
- other ecosystem services

References:

Gerales M, Fernandes R, Santos M, Barthelme A, Joosten H & Capinha C (2025) Bioindicator-based mapping of peatland potential in the Western Mediterranean-Atlantic Realm. Preprint available.
Gerales M, Theunert M, Couwenberg J, Joosten H, Capinha C, Queiroz P & Mateus J (in prep.) Reconstruction model of palaeogeographic landscapes with mires, peatlands and swobs in the West Iberian Peninsula
Mateus J, Queiroz P, & Joosten H. (2017). Portugal. In: H. Joosten, F. Tanneberger, & A. Moen (Eds.), *Mires and peatlands of Europe: Status, Distribution and Conservation* (pp. 572–579).



This study was supported by Portuguese funds from Fundação para a Ciência e a Tecnologia, I.P. (Portugal) in the frame of UIDB/00073/2025 and the UIDP/00073/2025 projects of the I & D unit of Geosciences Center (University of Coimbra, Portugal).





PLENARY MEETING 2025

30th June – 01st July
University of Trás-os-Montes e Alto Douro

FIRST-ART PROJECT

Evolution and development of a comprehensive methodology for the study of Rock Art

Hipólito Collado^{2,3}, Sara Garcês^{1,2,3*}, Hugo Gomes^{1,2,3}, Virginia Lattao^{2,3,4}, Pierluigi Rosina^{1,2,3}, George Nash^{2,3}

¹Instituto Politécnico de Tomar; saragarcês@ipt.pt

²Instituto Terra e Memória, Mação, Portugal

³Centro de Geociências, Portugal

⁴Universidade de Coimbra, Coimbra, Portugal



Objective

From its inception, the FIRST ART project was conceived in response to the need for collaborative efforts to expand and update knowledge of the early prehistoric rock art in the caves of Escoural in Portugal and Maltravieso in Spain. The goal was to increase tourist appeal by promoting the artistic value of both cave systems together. Having successfully completed the project's initial phase, we have developed an innovative, highly specialised scientific working methodology focused on researching rock art. This approach was made possible by a team of experts specialising in documenting, dating, and contextualising the graphic assemblages in both caves. The team is supported by a network of laboratories that provide essential analytical processes, facilitating an intrinsic understanding of prehistoric iconography related to the chronological period in which it was created.



Research and Functional Objectives

The FIRST ART project is a research initiative focused on supporting the study and conservation of rock art in all its forms. Like all projects, FIRST ART has evolved from being exclusively linked to the research, conservation and dissemination needs of the Maltravieso (Cáceres, Spain) and Escoural (Montemor-o-Novo, Portugal) caves. Thanks to the participation of a significant number of researchers and support laboratories, a novel methodological proposal has been developed that aims to analyse rock art manifestations in an integrated manner, regardless of their chronology, technique, location (in caves or open air) or geographical location. To this end, a team of researchers specialising in four key areas related to prehistoric representations has been established: **2D/3D graphic documentation** of prehistoric rock art; **analysis and characterisation of the pigments** and supports inherent in the creation process; **chronological determination** of figurative ensembles; and **the link between graphic manifestations and the human groups** that produced them. This has led the FIRST ART project to a new stage, with the main objective of establishing collaborative strategies with other research groups focused on studying any type of rock art manifestation. This involves setting up joint working frameworks through which the technical and analytical capacities of the laboratories and specialists integrated into FIRST ART can be made available to these groups, creating a synergy that will undoubtedly improve the quality and diversification of rock art studies. Currently, the FIRST-ART project is working in more than 30 caves in Iberian Peninsula (Portugal, Andalusia, Asturias and Cantabria) as well as participating in rock art projects in the UK, Italy, Colombia, Brazil, Croatia, Turkey, Angola and South Africa.





PLENARY MEETING 2025

30th June – 01st July
University of Trás-os-Montes e Alto Douro

RA3I - ROCK ART ANALYSES WITH ARTIFICIAL INTELLIGENCE

Sara Garcês^{1,2,3}, Luiz Oosterbeek^{1,2,3}, Sandra Jardim^{1,4,5}, Carlos Mora¹

¹Instituto Politécnico de Tomar; saragarc@ipt.pt

²Instituto Terra e Memória, Mação, Portugal

³Centro de Geociências, Portugal

⁴Centro de Investigação em Cidades Inteligentes, Instituto Politécnico de Tomar, Tomar, 2300-313, Portugal

⁵Unidade Departamental de Tecnologias de Informação e Comunicação, Instituto Politécnico de Tomar, Tomar, 2300-313, Portugal



Objective

The primary goal of RA3I is to develop AI-powered tools to interpret and catalog prehistoric rock art automatically. The project seeks to provide solutions for automatically converting images into scalable formats, identifying and classifying individual images, and applying data mining techniques to uncover patterns in the rock art data.



Research and Functional Objectives

RFO1: Conversion of Photographs into Models Typically, rock art images are collected using photographs of the panels, and it is difficult to convert them to more manageable media from an archaeological point of view, typically scale drawings, without the manual means of an archaeologist. Therefore, the first objective is to automatically convert the existing images into decals without human intervention, ignoring/excluding characteristics of the medium (cracks, splits, natural stains, etc.). In addition, the aim is to detect the external limits of the panel in question, and its orientation (top-bottom), without prejudice to the possibility that different elements with different orientations may exist on the same panel. Each panel is also characterized within formation on location, typology, dating, etc.

RFO2: Identification and Classification of Individual Elements Based on the support obtained in RFO1, the second objective is to individually identify and semantically classify the individual elements that make up the engraving, complementing the characterization of each one with information such as size and relative position in the engraving, as well as recurring associations and classification into styles. In addition, the aim is to add information, as automatically as possible, regarding the techniques and technology used, geographic location and time.

RFO3: Cross-Sectional Analysis of Classified Elements With the results of the two previous objectives being saved in a specific database, and standardized by semantic concepts and characteristics of each individual element, the third objective is to use advanced Data Mining (DM) methods to explore the information collected, with a view to identifying recurring patterns, correlations between components or relationships between images from different locations, thus extrapolating possible complex interpretations or other information impossible to obtain up to now, given the lack of information that this project will compile, such as migratory flows of primitive populations.

Research and Market Highlights

Market Potential: There is currently no product on the international market that offers the kind of automated interpretation and classification system for rock art that RA3I aims to develop. This presents an untapped market opportunity, especially for museums, universities, and archaeological institutions worldwide. **Innovation in Archaeology:** Archaeology has seen limited application of AI, particularly in rock art studies. By employing machine learning and data mining, the project is expected to bridge a gap in the digital transformation of archaeological research.

Technical Aspects: The project employs state-of-the-art computer vision techniques and ML algorithms to process images and detect meaningful patterns. For instance, it integrates deep learning frameworks for the identification and classification of pictograms, with the potential to expand to millions of images globally. **Challenges and Solutions:** One of the key technical challenges is the poor quality of many rock art images, which are often affected by environmental conditions. RA3I addresses this by developing robust image processing algorithms capable of working with such images. Another challenge is ensuring that the AI models can interpret complex and overlapping symbols. The project uses explainable AI (XAI) techniques to ensure that the automated systems remain transparent and adjustable by researchers. A third challenge is related to the irregular shape of many surfaces. The project will be able to deal with non-orthogonal perspectives, processing images appropriately to avoid interpretations and/or classifications influenced by this factor.

RA3I REPRESENTS A GROUNDBREAKING EFFORT IN COMBINING AI WITH ARCHAEOLOGY. ITS SUCCESS COULD REDEFINE HOW PREHISTORIC ART IS STUDIED AND UNDERSTOOD, OFFERING UNPRECEDENTED OPPORTUNITIES FOR DATA-DRIVEN RESEARCH IN THE FIELD.

Assessment of Rock Slope Stability

Pedro Andrade^{1*}, Mónica Pratas-Silva¹ & Mário Quinta-Ferreira²

1 University of Coimbra, Geosciences Center, Department of Earth Sciences, Coimbra, Portugal

2 University of Coimbra, Geosciences Center, Coimbra, Portugal

* Corresponding Author: pandrade@dct.ucp.pt

Introduction

The study of slope stability is very important in urban areas and along roads infrastructures. The studied areas are located in Central Portugal (Fig. 1a), Santiago Island (Cape Verde) (Fig. 1b), Western and Southwestern Angola (Figs. 1c and 1d), and East Timor (Fig. 1e). The studied slopes are composed of various rock types including limestone, marly limestone, metagreywackes and phyllites (Central Portugal); volcanic rocks (Cape Verde); limestone, marly limestone, marls, quartz-sandstones and granites (Western and Southwestern Angola); and schists and metagreywackes (East Timor). The most common types of slope movements observed include rock fall, rotational, translational slides (planar, wedge), and toppling.

Methodology

Field surveys are carried out focusing on the potential development of slope failures. Parameters such as orientation, discontinuity characteristics, rock block dimension, and rock material properties are defined. The testing methods used to determine the intact rock material strength included point load tests and Schmidt hammer tests.

The classifications systems applied include the Rock Mass Rating (RMR), Slope Mass Rating (SMR), Geological Strength Index (GSI), Q-Slope, and the Rockfall Hazard Rating System (RHRS).

Software programs from the Rocscience (2025), such as Dips, RocFall, Swedge, RocPlane, Slide, RocTopple, are used to more accurately assess slope movements, allowing for the definition of safety factors, remediation techniques, and protection measures.

Some of the areas under study are affected by rock falls. The slope cross-sections are characterized by rock fall trajectories that may reach or come close to roads and even pedestrian areas.

Results

The most common characteristics of discontinuities such as spacing, persistence, roughness (at both small and large scales), aperture, infilling material and weathering degree, observed in slopes from Central Portugal slopes are shown in Table 1.

The RocFall software permits to determine the velocity and bounce height along rock fall trajectories, as well as their final resting locations (Fig. 2). The studies can provide decision-recommendations on whether slope instability is tolerable, and whether existing measures are suitable and may also define the adoption of alternative prevention, control or mitigation measures. As an example, mention is made of a slope located in Central Portugal, composed of phyllites and metagreywackes, which presents several potential wedge failure scenarios, illustrated in Fig. 3. In this case, the application of wire mesh combined with rock bolting was recommended as a stabilization measure (Fig. 4).

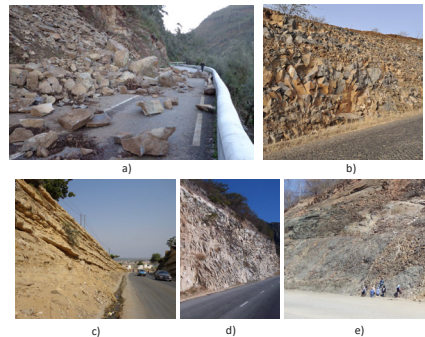


Figure 1 – Studied slopes in a) Penacova (Central Portugal), b) Santiago Island (Cape Verde), c) Benguela (Western Angola), d) Leba (Southwestern Angola), e) Liquiçá (East Timor).

Table 1 - Discontinuities characteristics of Central Portugal slopes.

Discontinuity Characteristics	Model Values
Spacing (m)	0.2 – 0.6
Persistence (m)	1 – 3, 3 – 10
Roughness - small scale	Smooth and undulating (Phyllites and Schists) Slightly rough and rough (Quartzites) Slightly rough (Metagreywackes, Dolomites and Limestones)
Roughness - large scale	Slightly curved to straight (Phyllites and Schists) Slightly curved (Dolomites and Limestones; Metagreywackes) Mostly curved (Quartzites)
Aperture (mm)	0.1 – 1.0, 1.0 – 5.0
Infilling material	Absent (Phyllites and Schists; Quartzites; Metagreywackes) Absent to clay (Dolomites and Limestones)
Weathering	Moderately to highly (Phyllites and Schists; Quartzites; Metagreywackes; Dolomites and Limestones) Slightly to moderately (Quartzites)

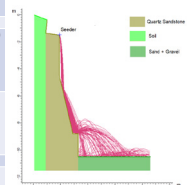


Figure 2 - Possible rockfall trajectories on a slope section near Lubango (Southwestern Angola).

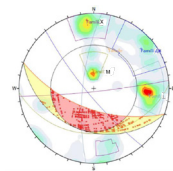


Figure 3 - Representation of the potential wedge failure in a slope composed of phyllites and metagreywackes near Coimbra (Central Portugal), generated using Dips software (Rocscience, 2025).



Figure 4 - Implementation of wire mesh and rock bolts on a slope composed of phyllites and metagreywackes near Coimbra (Central Portugal).

Production resulting from this project:

Andrade, P.S. (2021). Application of Rock Mass Rating and Slope Mass Rating in Slopes of Central Portugal. In: Hydrogeology, Engineering Geology and Geotechnics. ISBN: 978-619-7603-20-0. SGEM, Varna: 165-170. DOI: 10.5593/sgem2021/1.1a/02021

Andrade, P.S., Kaidia, E. (2024). Rock Fall Study in Different Areas of Southwest Angola. Hydrogeology, Engineering Geology and Geotechnics. SGEM 2024, Albena, Bulgaria.

Duarte, J., Coelho, N., Figueiredo, F., Andrade, P.S. (2023). Application of Photogrammetry for Geotechnical and Structural Characterization of Carbonated Rock Mass. In: Chamini, H.J., Fernandes, J.A. (eds). Advances in Geoengineering, Geotechnologies, and Geoenvironment for Earth Systems and Sustainable Georesources Management. Advances in Science, Technology & Innovation. 141-145. Springer, Cham. https://doi.org/10.1007/978-3-031-25988-9_24

Neto, B., Andrade, P.S., Tróia, A.N. (2024). Instability Characterization of the Geological Formation "Áreas e Agilias de Taveiro" in the Cordeira e Coimbra areas (Central-Western Portugal). Hydrogeology, Engineering Geology and Geotechnics. SGEM 2024, Albena, Bulgaria.

Pratas-Silva, M., Quinta-Ferreira, M., Andrade, P.S. (2025). Caracterização Geológica do Talude Norte no Vale da Ania, Cabo Mondego. Comunicados Geológicos, 112, Especial I. 299-303. <https://doi.org/10.34873/cg25.1a/02025>

Pratas-Silva, M., Quinta-Ferreira, M., Andrade, P.S. (2021). Contribution of Geology For Natural Engineering Works. Study Case Cape Mondego (Aspiring Atlantic Geopark). Encontro Ciências '21, 28 a 30 Junho 2021.



PLENARY MEETING 2025

30th June – 01st July
University of Trás-os-Montes e Alto Douro

Património arqueológico e turismo sustentável em Portugal: caracterização, tendências e estruturação de uma estratégia para a sua gestão integrada

Rosa Linda Graziano¹, Adolfo Silveira² & Fabio Carbone³

¹ UAL-IPT, Centro de Geociências; rosalinga.graziano@gmail.com

² UAL-IPT, Centro de Geociências; aasilveira@autonoma.pt

³ Universidade Northampton, IPT, Centro de Geociências; Fabio.Carbone@northampton.ac.uk

Resumo

Esta pesquisa tem como objetivo geral investigar a interação entre a preservação dos sítios arqueológicos nacionais e o turismo, passando pela compreensão dos modelos de gestão turística aplicados em sítios arqueológicos em Portugal e analisando as suas práticas e os impactos na conservação do património e na experiência do visitante. O estudo será fundamentado em referenciais teóricos da gestão patrimonial e do turismo sustentável, dialogando com conceitos de interpretação do património e do turismo cultural.

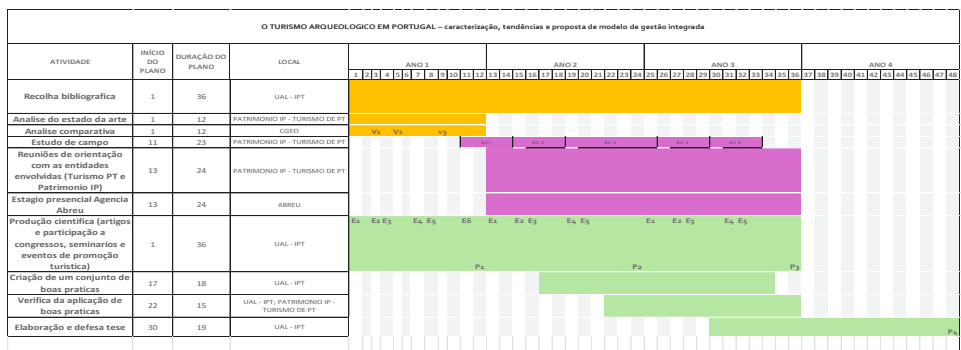
Objectivos Específicos

Seleção dos sítios arqueológicos visitáveis e acessíveis aos turistas. Nesta fase será fundamental complementar a recolha através das cartas arqueológicas regionais para conseguir distinguir e selecionar os sítios arqueológicos merecedores de atenção coletiva. Esta fase irá efetuar-se consultando os dados fornecidos pelo Património Cultural I.P e pelo Turismo de Portugal.

Propor-se há um modelo de gestão patrimonial que integre sustentabilidade ambiental, participação comunitária e inovação digital, colmatando a separação existente entre valorização académica e acessibilidade turística eficaz. A implementação da promoção do património arqueológico de Portugal, através da elaboração deste normativo, tem como elemento fulcral o objetivo primário, ou seja, a análise do impacto que o turismo está a criar na gestão dos sítios arqueológicos portugueses e da resposta que a arqueologia é capaz de fornecer ao crescente interesse turístico.

Com base nos dados recolhidos e na aplicação das boas práticas, vão ser formuladas diretrizes para a valorização do património arqueológico nacional e a sustentabilidade do turismo cultural.

Cronograma





PLENARY MEETING 2025

30th June – 01st July
University of Trás-os-Montes e Alto Douro

Exploring archaeological contexts with Diversity and Similarity indices from the perspective of Zooarchaeology in coastal sites in Southern Brazil

Suliano Ferrasso¹ & Juliano Bitencourt Campos²

¹ University of Southern Santa Catarina, Criciúma, Brazil, PhD student in the Postgraduate Program in Environmental Sciences; suliano.ferrasso@gmail.com

² University of Southern Santa Catarina, Criciúma, Brazil, Postgraduate in Environmental Sciences; Earth and Memory Institute, Geosciences Center of University of Coimbra (CGeo), Portugal; jbi@unesoc.net

Introduction

The study of archaeological contexts interfaces with various fields of knowledge, which can vary depending on the type of remains and the premises of each study, within the perspective of archaeology, which seeks to understand aspects of human behavior. An example is zooarchaeology. Zooarchaeological research adopts a much more cultural than zoological or ecological perspective, focusing on the cultural importance of fauna for human behavior (Olsen and Olsen, 1981; Terreros, 2013). The diversity of species involves aspects of organisms and has been the subject of extensive debate. One definition is that it can be understood as the richness and relative abundance of species in time and space. Diversity indices allow comparison of different areas, provided that the sampling methodology is consistent across them (Magurran, 2013). In the use of similarity indices, these work with descriptive coefficients, mainly two types: binary and quantitative (Pinto-Coelho, 2000). Binary indices (Jaccard Index) are used in cases with presence or absence data, and the similarity is evaluated based on contingency tables (cluster analysis) (Pinto-Coelho, 2000; Hammer et al., 2001). From the taxa of the archaeofaunas at each site, Shannon Diversity indices and Jaccard Similarity will be used to characterize and compare the different cultural contexts.

Methodology

The spatial layout of the study takes place within the coastal plain, from the southernmost tip of Santa Catarina (SC) to the central coast of Rio Grande do Sul (RS), Brazil. It is characterized by a wide plain with a straight coastline, and throughout its extent there is a strong influence and predominance of typical Atlantic Forest vegetation. A bibliographic review of sites with the presence of archaeofaunas, within standardized methodologies, will be conducted. Samples of archaeological faunas, already published, that were counted according to the criteria of NISP (Number of Identified Specimens) and MNI (Minimum Number of Individuals) will be considered as basic elements for their inclusion in this work's sample. The spaces of the Archaeology Laboratory (LAPIS) at UNESC will be used for the development of the research. For each archaeological site, a set of information will be organized, creating a database in spreadsheet format within the PAST[®] software so that it is possible to apply routines for estimating values related to the Biological Diversity of each sample, as well as to conduct statistical modeling of Similarity.

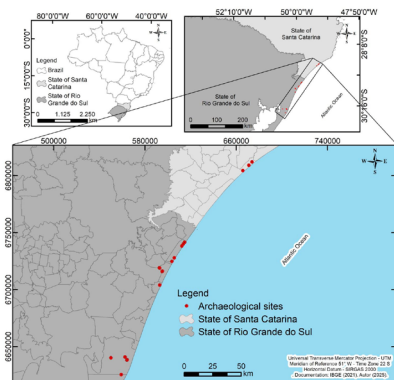


Figure 1. Archaeological sites distributed along the Coastal Plain of Rio Grande do Sul and Santa Catarina, both selected for the analyses proposed in the development of this project.

Results

In a preliminary review of archaeological sites within the proposed scope, there are sites representing the southernmost tip of Santa Catarina (SC), including sites SC-IC-01, SC-IC-06, and SC-ARA-030; the northern coast of Rio Grande do Sul (RS), with sites RS-LN-279, RS-LN-312, RS-LN-285, and RS-LN-316; and along the central coast of Rio Grande do Sul, with sites RS-LC-80, RS-LC-82, RS-LC-83, RS-LC-94, RS-LC-96, and RS-LC-97. The analysis of archaeofaunas is part of the project proposal, serving as sources for publication, generating new data, and contributing to the understanding of occupation in the area. Archaeofaunas from sites RS-LN-19 and RS-LN-319 have been analyzed, and the analysis of sites VF-01, VF-02, TRO-01, and TRO-02 is ongoing. It should be noted that this research is in its initial phase and aims to progress further with the results.

References:

- HAMMER, B., HARPER, D.A.T., & RYAN, P. D. (2001). PAST: Paleontological Statistics Software Package for Education and Data Analysis (v.1.7). Paleontologia Electronica In <https://www.nhm.uio.no/english/research/resources/past/>. Disponível em <https://www.nhm.uio.no/english/research/resources/past/download/pastManual.pdf>
- Magurran, Anne E. (2013). *Medida da diversidade biológica*. Curitiba: Editora da UFPR.
- OLSEN, S. L. (1981). A comment of nomenclature in faunal studies. *American Antiquity*, 46, n. 1, 192-194.
- Pinto-Coelho, Ricardo Motta (2000). *Fundamentos em ecologia*. Porto Alegre: Artmed.
- Terreros, José Wladimir Sainz de los (2013). *Tafonomia Aplicada a Zooarqueologia*. Madrid: Uned.

Funding: I thank the Support "Fundação de Amparo à Pesquisa e Inovação do Estado de Santa Catarina (FAPESC), Call n.º 19/2024, for granting the Doctorate Scholarship.



PLENARY MEETING 2025

30th June – 01st July
University of Trás-os-Montes e Alto Douro

Visitor guides to the municipality of Praia Grande, Santa Catarina, Brazil: Environmental interpreters of the canyons

Tarcísio Roldão da Rosa¹, José Gustavo Santos da Silva² & Juliano Bitencourt Campos³

¹ University of Southern Santa Catarina, Criciúma, Brazil; PhD student in the Postgraduate Program in Environmental Sciences; tarcisioanyons@gmail.com

² University of Southern Santa Catarina, Criciúma, Brazil; Postgraduate in Environmental Sciences; Ph.D student of Geosciences Center of University of Coimbra (CGeo), Portugal; gustasantos92@gmail.com

³ University of Southern Santa Catarina, Criciúma, Brazil; Postgraduate in Environmental Sciences; Earth and Memory Institute, Geosciences Center of University of Coimbra (CGeo), Portugal; jbi@unesoc.net

Introduction

This research focuses on the effectiveness of visitor guides who utilize environmental interpretation as a management strategy within Conservation Units (CUs). It concurrently fosters collaborations with educational institutions and schools to advance the goals of environmental education (Layrargues & Lima, 2014) both within and adjacent to national parks. Furthermore, it emphasizes the features of two ecotourism trails: the Rio do Boi trail (Fig. 1a) located in the Aparados da Serra National Park (PNAS) and the Piscinas do Malacara trail found in the Serra Geral National Park (PNSG) (Fig. 1b). The analysis of this study will be concentrated in the municipality of Praia Grande/SC (Fig. 2). The visitor guides referenced in this article are affiliated with the Praiagrandense Association of Ecotourism Guides (APCE).

Methodology

The methodology employed in this study will adopt a descriptive and explanatory framework, utilizing a qualitative approach grounded in the case study strategy, with the research being exploratory in nature. This case study centers on the visitor guide associated with APCE, a non-profit organization. A literature review is conducted on several key terms within this domain, including visitor guides, ecotourism, and environmental interpretation, with the latter being of utmost significance, followed by concepts such as conservation units and national parks. In addition to this literature review, the Caminhos dos Cânions do Sul UNESCO Global Geopark (CCSUGGp) within the study area and neighboring municipalities, has garnered international attention, prompting visitor guides to enhance their expertise in various fields such as history, archaeology, paleontology, geology, geomorphology, and biological sciences, thereby facilitating new avenues for scientific inquiry.

Study area

The municipality of Praia Grande is situated in the microregion of southern part of Santa Catarina, an area recognized for tourism as the "Caminho dos Canyons". This municipality is positioned at the base and slope of the Serra Geral, adjacent to the state of Rio Grande do Sul. In the realm of ecotourism, the Itaimbezinho and Malacara canyons are particularly notable, both located within Praia Grande (SC). Its borders include: to the north, Jacinto Machado and Santa Rosa do Sul; to the south and west, the state of Rio Grande do Sul; and to the east, the municipality of São João do Sul (SC). Within this region, the Aparados da Serra Integrated Management Center and the CCSUGGp (Rosa *et al.*, 2022).

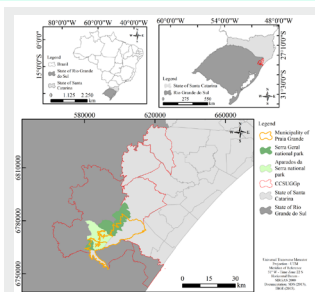


Fig. 2 – Location of study area

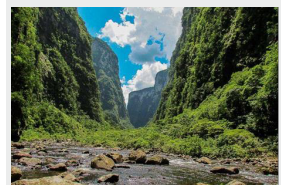


Fig. 1a - The Rio do Boi trail



Fig. 2b - The Malacara trail

Results

The role of visitor guides enables tourists to innovate, engage, and realize their potential within natural settings. From this analytical perspective, several outcomes can be identified: it is grounded in the Guidelines for a National Ecotourism Policy; it integrates geotourism into the operational framework of National Parks; it advocates for environmental justice and sustainability; it fosters sustainable collaborative practices with tourism businesses; it engages in public management and governance; it seeks to utilize the significance of natural and cultural resources to foster personal connections between visitors and the protected heritage; environmental interpretation offers transient visitors the chance to acquire meaningful insights about the environment they explore; the visitor guide facilitates environmental education primarily through school initiatives; it aids ICMBio's mission in safeguarding natural heritage and promoting socio-environmental awareness in national parks and their adjacent areas.

Referências: Layrargues, P. P., & Lima, G. F. D. C. (2014). As macroestratégias político-pedagógicas da educação ambiental brasileira. *Ambiente & sociedade*, 17, 23-40.

Rosa, T. R., Campos, J. B., da Silva, J. G. S., Miranda, L. B., & Zucchi, J. J. (2022). Núcleo de gestão integrada apoiado da Serra Geral e a sua indissociabilidade com o ecoturismo. In *OPEN SCIENCE RESEARCH VIII* (Vol. 8, pp. 1014-1024). Editora Científica Digital.

Funding: This study was financed in part by the "Coordenação de Aperfeiçoamento de Pessoal de Nível Superior" - Brazil (CAPES) - Finance Code 001.

12



This study was supported by Portuguese funds from Fundação para a Ciência e a Tecnologia, I.P. (Portugal) in the frame of UIDB/00073/2025 and the UIDP/00073/2025 projects of the I & D unit of Geosciences Center (University of Coimbra, Portugal).



MODERNIZATION OF PREVENTIVE ARCHAEOLOGY: THE USE OF REMOTE SENSING IN ENVIRONMENTAL IMPACT STUDIES.

Vanessa Antunes¹

¹ Centro de Geociências, Universidade Autónoma de Lisboa, Instituto Politécnico de Tomar, Património Cultural IP & ERA Arqueologia; vancantunes@gmail.com

INTRODUCTION

Environmental policy, regulated by specific legislation, has promoted understanding of archaeological heritage in Portugal, mainly through professional action. Actions carried out in impact minimization processes allow contextual data to be obtained on remains that would otherwise remain hidden or be destroyed by construction works.

However, the widely adopted model for managing archaeological heritage in Portugal has proven ineffective in identifying remains in advance, which often suffer impacts during construction work. Archaeologists agree that the description of heritage in Environmental Impact Assessments (EIA) is limited, resulting in the late identification of heritage impediments after the start of licensed projects.

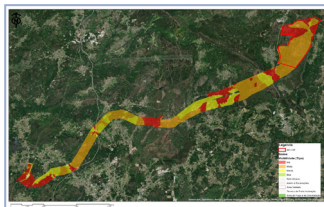


Figure 01: Example of a visibility map from a Portuguese environmental impact assessment of Vila Nova de Paiva (Pereira & Arrais, 2022). Be aware of poor visibility conditions.

In other countries, such as the United Kingdom, advanced remote sensing technologies have been used for years, allowing detailed data to be obtained without direct contact with the remains. Recently, in Portugal, these technologies have gained prominence, driven by the support of the Cultural Heritage Institute (IP) through official documents. This trend represents a paradigm shift, with the potential to transform the management of archaeological heritage in EIAs.

RESEARCH PROBLEM

Inadequate Diagnoses: The heritage descriptor in EIAs often fails to identify archaeological remains before works begin.

Irreversible Impacts: Traces are discovered late, resulting in partial/total damage or destruction.

Field Challenges: Dense vegetation, terrain morphology and limited access make effective archaeological prospecting difficult.

STRATEGIES FOR THE IMPLEMENTATION AND INTEGRATION OF REMOTE SENSING TECHNIQUES IN PORTUGAL

Strategic Investment	Multidisciplinary Training	Innovative Technologies
Allocate financial resources for research and development of remote sensing technologies adapted to the Portuguese context.	Promote continuous training and collaboration between a multidisciplinary team.	Implement advanced techniques such as LIDAR, drones and satellites to map and monitor coastal archaeological sites.



Figure 02: Efficiency in using data to identify shelters, MDT Galeria do Carvalho, Abrigo da Ponte da Moira, and Abrigo da Ribeira, Leiria (ERA, 2023).

CONCLUSION

Remote sensing offers an effective solution to overcome the limitations of EIAs, improving the identification of archaeological remains and promoting heritage preservation. Its integration, combined with innovative practices, scientific rigor, and public policies, ensures a balance between development and conservation.

REMOTE SENSING: AN OVERVIEW

Remote sensing offers mechanisms that enable more effective mapping and monitoring of archaeological sites.

Detailed Mapping

Creation of accurate archaeological maps. Identification of archaeological sites.

Continuous Monitoring

Monitoring erosion and human impact. Early warning of imminent threats.

Strategic Planning

Development of preservation plans. Implementation of effective protection measures.

PROJECT OPTIMIZATION OF ARCHAEOLOGICAL MAPPING IN THE CONTEXT OF ENVIRONMENTAL IMPACT STUDIES THROUGH REMOTE SENSING IN PORTUGAL.

The doctoral project began in July 2023. In September 2024, it received support from FCT (grant 2024.04475.BDANA) and has the collaboration of Património Cultural IP, ERA Arqueologia, Universidade Autónoma de Lisboa, and Instituto Politécnico de Tomar.

It covers the entire Portuguese territory and focuses on the application of non-intrusive methodologies, with the aim of creating a guide of good practices for the integration of these technologies in Environmental Impact Studies. The project seeks to reconcile scientific application and business practice.

References:

- ERA Arqueologia, S.A. (2023). Relatório dos Trabalhos Arqueológicos - Levantamento LIDAR Ribeiras das Chitas, Mortórios e Leão. 21p.
PEREIRA, G., ARRAYS, A. J. (2022) – Descritor de Património – Central Fotovoltaica de Vila Nova de Paiva – 220 MVA (Queiriga /Vila Nova de Paiva) – Relatório Final dos Trabalhos Arqueológicos. NEXIO – Património Cultural Rel. polic. Esmor. 227p.



PLENARY MEETING 2025

30th June – 01st July
University of Trás-os-Montes e Alto Douro

Hydrocarbon Sub-Basalt Basin Potential in West India and Offshore Pakistan

Yasir Shahzad¹, Ines Pereira¹, Ricardo Pereira^{2,3}, & Rui Pena dos Reis¹

¹ Universidade de Coimbra, Centro de Geociências

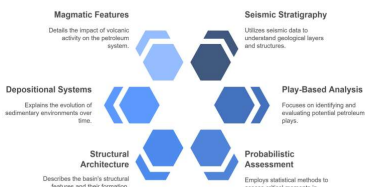
² GeoBioTec, Dep. Ciências da Terra, FCT-UNL, Monte de Caparica, Portugal

³ Universidade de Lisboa, Faculdade de Ciências, Instituto Dom Luiz, Lisboa

Introduction

The Offshore Indus Basin of Pakistan, a region with significant hydrocarbon potential, remains under-explored due to challenges posed by the K-Pg Deccan flood basalts [1]. This research provides a detailed assessment of the Sembar-Goru petroleum system (?), utilizing advanced methodologies to overcome exploration challenges. By integrating seismic stratigraphy, depositional analysis, play-based analysis, and probabilistic critical moment assessment, the study delineates viable exploration targets, aiming to unlock untapped oil and gas resources. The findings suggest that strategic exploration, particularly in the northeastern fairway, could redefine approaches to sub-basalt hydrocarbon systems globally.

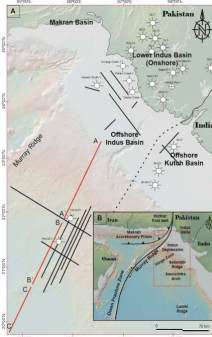
Understanding the Sembar-Goru Petroleum System (?)



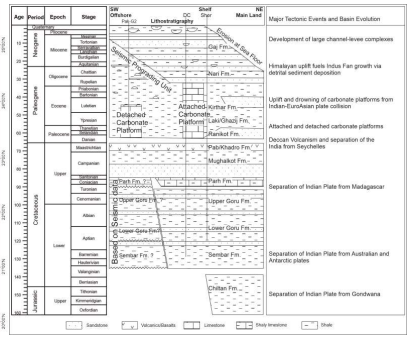
Background and Geological Settings

- The Offshore Indus Basin is a rifted passive margin basin system [1].
- Structural trend shifts from shallow shelf to deep trough.
- Syn-rift subsidence shaped during the India-Seychelles breakup phase [2].
- Cretaceous sequences reflect marine, volcanic, and tectonic evolution [3].
- Sills and vents modified heat flow and aided trap formation.

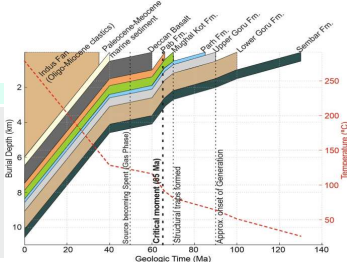
Location map



Lithostratigraphic cross-section



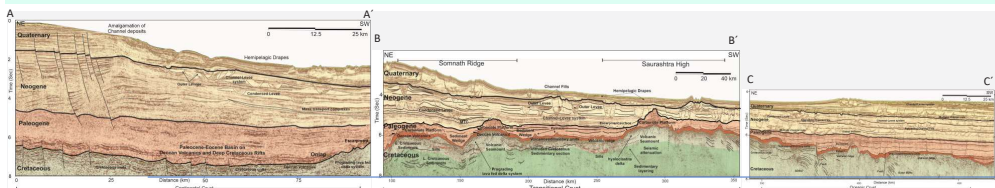
Burial and thermal evolution: Highlighting Critical Moment



Results and Conclusion

- Sembar Formation identified as primary source rock with high TOC values.
- Lower Goru and Pab sandstones serve as principal reservoir units.
- Two fairways mapped: moderate-risk northeast and high-risk southwest zone.
- Northeastern traps sealed by Upper Goru shale and Deccan basalts.
- Critical moment at 65 ± 5 Ma from volcanism and rifting.
- Advanced seismic methods are recommended to improve sub-basalt imaging success.

Interpreted Seismic Profiles A-A', B-B', and C-C' (red lines on the location map)



- References:
- [1] Cornschat, S. M., Akhtar, S., Bennett, J. K., Fatimi, M. A., Hosain, K., Jones, R. W., Longacre, M. R., Osborne, M. J., & Tozer, R. S. (2009). Geology and hydrocarbon potential of the offshore Indus Basin, Pakistan. *Petroleum Geoscience*, 15(2), 387–116.
 - [2] Daley, T., & Alam, Z. (2002). Seismic stratigraphy of the offshore Indus Basin. *Geological Society*.
 - [3] Muhammad Baloch, S., & Quirk, G. D. (1999). Tectonic subsidence and HC generation in the offshore Indus Basin of Pakistan. *Pakistan Journal of Hydrocarbon Research*, 11, 1–14.

PLENARY MEETING 2025

30th june – 01st july

University of Trás-os-Montes e Alto Douro

COASTLINE project - Integrated Management and Mitigation of Environmental Risks to Coastal Cultural Heritage

Alexandra Figueiredo¹, Sarah Martinville² & Cláudio Monteiro³

¹CGEO – Instituto Politécnico de Tomar: alexfiga@ipt.com

²CGEO – colaboradora/doutoranda; martinville_sj@hotmail.fr

³TECNH&ART – Instituto Politécnico de Tomar; cmonteiro@ipt.pt

ABSTRACT

This project aims to develop an integrated approach to cultural management, risk analysis, and the minimization of environmental impacts in Portugal's coastal interface zones. Through a detailed study of the interactions between cultural heritage and environmental risks, the project seeks to create conditions for raising public awareness about the threats affecting coastal cultural heritage, including erosion, climate change, and other environmental dynamics. Additionally, it aims to promote effective mitigation strategies, preserving local cultural assets and ensuring their long-term sustainability. The project plays a key role in educating and raising awareness among communities, while contributing to integrated cultural management aligned with contemporary challenges and the valorization of the territory.

Contributions

Based on climate data provided by the Portuguese Environment Agency (APA) and the database of heritage sites of the Public Institute of Cultural Heritage (PCIP), the project aims to cross-reference both sources to create a map of sites at risk due to climate change and a map of the urgency of action to minimize impacts on these sites. The aim is to assist in the management of these sites and minimize the associated risks. Direct contributions of the project to the protection of coastal archaeological heritage:

Risk Mapping and Assessment: The project aims to carry out analyses to determine the relevance and extent of the problems caused by climate change along the Portuguese coast, identifying areas of high risk and the urgent need to implement effective preservation and management strategies.

Multidisciplinary Data Integration: By combining information from the Portuguese Environment Agency with archaeological site records from the Endovélico database, the project provides a comprehensive overview of the risks faced by coastal archaeological heritage, site typology and chronologies, giving an overview of the archaeological heritage at risk present in the coastal interface area.

Awareness and Strategic Planning: COASTLINE highlights the urgency of implementing effective preservation and management strategies, contributing to more informed decisions by competent authorities and the community.

IMPACTES

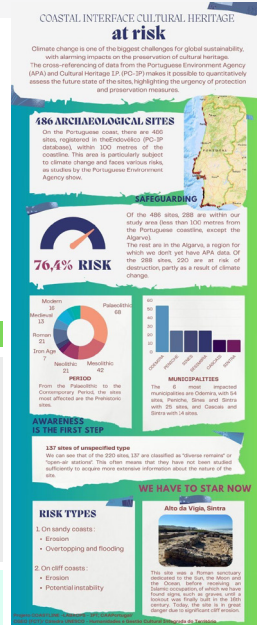
The COASTLINE project has clear objectives of innovation and impact, which have been effectively achieved. In terms of innovation, it stands out for the integration of environmental and archaeological data (notably those provided by the APA and the Endovélico database), applying a geospatial approach with risk buffers that allow for the precise quantification of the degree of threat to coastal archaeological sites. This methodology will allow for a multi-scale territorial reading that is unprecedented in Portugal for coastal archaeology in the context of climate change.

In terms of impact, the project has already produced concrete and alarming data, such as the identification of 246 sites at risk, of which 214 are at high risk, which has the potential to influence policy makers and land management authorities. Furthermore, by demonstrating that the periods most affected are Prehistory and that most of the sites are open-air and poorly studied, it reinforces the urgency of preventive actions, safeguard plans, and the valorization of archaeological heritage as an integral part of the response to the climate crisis. The project, therefore, not only innovates methodologically, but also promotes a new public and institutional perception of the risks faced by heritage.

References:

Figueiredo, A., & Martinville, S. (2024). O Património Arqueológico Costeiro em áreas de Galgamento e Erosão sedimentar em Portugal: Impacto Ambiental na Preservação do Património. *Finisterra*, 59(127), e36569. <https://doi.org/10.18055/Finis36569>

Figueiredo, A., Agueda, & Martinville, S. (2024). Impacto Ambiental e das Mudanças Climáticas na preservação do Património Arqueológico Costeiro em zonas de Arriba, (Portugal): um estudo abrangente e urgente. *Quaternary and Environmental Geosciences*, 15. <https://doi.org/10.5380/qeg.v15i0.95356>





PLENARY MEETING 2025

30th June – 01st July
University of Trás-os-Montes e Alto Douro

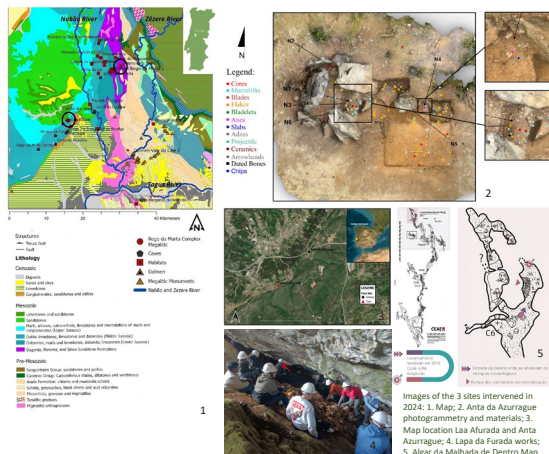
MEDICE II - Scientific project for the study of communities from the recent Prehistory to the Classical Era in the central region of Portugal

Alexandra Figueiredo¹, Cláudio Monteiro² & Adolfo Silveira³

¹CGEO - Instituto Politécnico de Tomar; alexfiga@ipt.pt

²TECHN&ART e CGEO – Univ. Autónoma de Lisboa; cmonteiro@ipt.pt

³CGEO – Univ. Autónoma de Lisboa; asilveira@autonoma.pt



Abstract

From 2024 to 2028, the research study the cults and rituals, exploring their evolution a will focus on understanding the sociocultural evolution from Prehistory to the Classical Era in the Alto Médio Tejo. The project aims to nd the functional and symbolic relationship between megalithic orthostatic architectures and burial practices in caves. It builds on the continuity of previous projects, such as TEMPOAR, SIPOSU-MG, ANTROPE, and PIPA MEDICE.

The studied region, characterized by the confluence of three major geomorphological units and the rivers Nabão, Zêzere, and Tejo, provides a unique space to understand environmental adaptation processes and cultural exchange. Variations in the archaeological records, often interpreted as "styles" (Figueiredo, 2007; 2021), suggest intense dynamics of trade and cultural exchange.

The project also includes biomolecular, genetic, and chemical analyses to investigate kinship relations and cultural differentiation among individuals buried in different contexts. The ultimate goal is to consolidate 25 years of research results and discuss the role of megalithism in the Nabão region, linking it to practices in caves and megalithic sites in the Baixo Zêzere and Tejo valleys.

Community Objective:

Aiming to be close to the community, A close relationship between scientific studies and the community is fundamental in the process of knowledge construction and raising awareness regarding the preservation and safeguarding of heritage and cultural identity itself.



Archaeological Context and Scientific Objective:

The 21st century marked the beginning of a new phase of intense archaeological work in Alvaizere. Among the notable projects is MEDICE I, which investigated human occupation from Prehistory to the Classical period, with a focus on the Algar da Água site, Gruta do Bacelinho, Povoados do Castelo da Loureira, and the Megalithic Complex of Rego da Murta. This research found evidence of prehistoric burials, rock art, and human activities extending into the Classical era.

In 2019 and 2021, a monograph was published on the Megalithic Complex of Rego da Murta and the work done at Algar da Água, consolidating decades of research.

Currently:

To the southwest of Alvaizere, the municipality of Ourém contains significant prehistoric sites, such as the Povoados do Agroal, studied by Katina Lillios. Many of these sites remain underexplored, and recent discoveries suggest great untapped archaeological potential. In 2023, the PIA project, led by the same researchers, made new discoveries, including prehistoric rock shelters, burial sites, and about 30 new archaeological sites. These findings highlight the region's importance for understanding prehistoric and protohistoric occupation in central Portugal. The year 2024 marked the beginning of the MEDICE II project, with excavations at Algar da Malhada de Dentro, Anta da Azurruque, and Lapa da Furada.

Results:

The excavation at the *Anta da Azurruque* revealed a diverse set of lithic artifacts, including flakes, flint cores, some arrowheads, blades, and undecorated ceramic fragments of spherical and truncated-conical shapes. A considerable number of polished artifacts and two rectangular mica-schist plates, possibly used for sharpening polished tools, were also found. Additionally, human and faunal osteological remains were discovered. Inside the chamber, a large number of macrooliths artifacts were recorded.

At *Lapa da Furada*, excavation efforts have focused on clearing debris. Some macrooliths of quartzite were found.

Regarding radiocarbon dating, six dates were performed for *Anta da Azurruque* and one for *Lapa da Furada*. The dating results show that the *Anta da Azurruque* (AZ24.D01/2024N1) and *Lapa da Furada* (FTMC-P168-2/MEDICE23) occurred contemporaneously.

The excavation of Algar da Malhada de Dentro located nearly 100 meters deep, it demonstrated the continuity of cults and funerary rituals in the cave up until the Roman period.



Events held in relation to the community

References:

- Figueiredo, A. (2003). Rituals and death cults in recent prehistory in central Portugal (Alto Ribatejo). In *Documenta Praehistorica XXXIII*, University of Liège, Faculty of Arts, Department of Archaeology (pp. 85-94). <https://www.researchgate.net/publication/311111111>
- Figueiredo, A. (2012). Os megalitos do Complexo Megalítico do Rego da Murta (Alvaizere). *Revista do Museu de Évora*, 15, 1-13. <https://www.researchgate.net/publication/311111111>
- Figueiredo, A. (2021). *As primeiras ANDALUSIAS EM PORTUGAL: O CASO DO COMPLEXO MEGALÍTICO DE REGO DA MURTA*. Alvaizere: Museu Municipal Alvaizere, CNA/Portugal, Instituto Politécnico de Tomar. ISBN 978-989-8840-52-3
- Figueiredo, A., & Monteiro, C. (2019). *Notas de trabalho de investigação da área arqueológica do Alto do Castelo e do Rego da Murta (Alvaizere). Projeto PIPA/2018 - Memórias, Dinâmicas e Contextos da Pré-História e do Período Clássico*. Processos 5-27920.
- Figueiredo, A., & Monteiro, C. (2019). *Notas de trabalho de investigação da área arqueológica do Alto do Castelo e do Rego da Murta (Alvaizere). Projeto PIPA/2018 - Memórias, Dinâmicas e Contextos da Pré-História e do Período Clássico*. Processos 5-27920.
- Figueiredo, A., & Monteiro, C. (2019). *Notas de trabalho de investigação da área arqueológica do Alto do Castelo e do Rego da Murta (Alvaizere). Projeto PIPA/2018 - Memórias, Dinâmicas e Contextos da Pré-História e do Período Clássico*. Processos 5-27920.





PLENARY MEETING 2025

30th June – 01st July
University of Trás-os-Montes e Alto Douro

Vale da Anta: index properties

Mónica Pratas-Silva ^{1*}, Pedro Andrade ¹ & Mário Quinta-Ferreira ²

¹University of Coimbra, Geociences Center, Department of Earth Sciences, Coimbra, Portugal

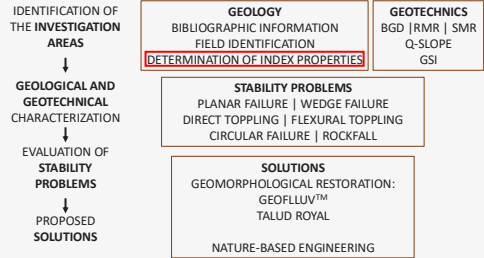
²University of Coimbra, Geociences Center, Coimbra, Portugal

*Corresponding Author: mpsilva@student.dct.uc.pt

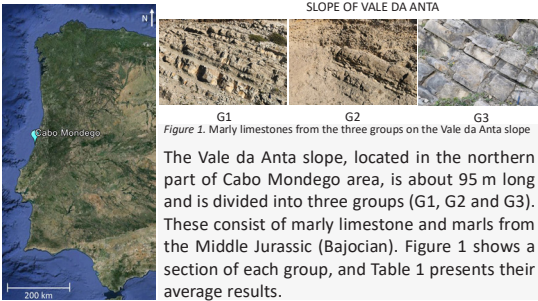
Introduction

The study of rock mass stability requires appropriate **geological and geotechnical** characterization. On the slope of Vale da Anta, tests were carried out to determine its physical properties — Water Content (ω), Density (ρ), Porosity (η), Rapid Absorption and Water Absorption (Abs), and the Slake Durability Test (I_d) — as well as mechanical properties, such as Point Load Strength ($I_{s(50)}$) and the estimated Uniaxial Compressive Strength (UCS) obtained using the Schmidt Hammer, in accordance with ISRM (2007) recommendations. These data allowed the determination of the index properties of the materials, forming a basis for the slope stability assessment.

Metodology



Study Area



Results

Table 1. Average index property values for the groups of the Vale da Anta slope (SD – Standard Deviation)

	ω (%)		ρ (g/cm ³)	SD	η (%)		Abs (%) 1h 48h	SD	I_p (%)		UCS (MPa)	SD	$I_{s(50)}$	SD
G1	0.4	0.13	2.59	0.02	3.68	0.73	0.5 1.0	0.14 0.35	C_r : 99.6 C_c : 99.5	53	0.53	4.17	1.13	
G2	0.5	0.18	2.61	0.02	3.15	0.64	0.9 1.6	0.35 0.48	C_r : 99.7 C_c : 99.5	66	1.28	3.46	0.87	
G3	0.4	0.12	2.57	0.03	4.02	1.38	0.6 1.4	0.28 0.53	C_r : 99.6 C_c : 99.4	75	11.9	3.57	1.28	

Group G2 presents the highest average values for water content and density; Group G3 stands out for porosity and estimated uniaxial compressive strength (Schmidt Hammer); while Group G1 records the highest point load strength.

Discussion

Based on the results obtained, the geological materials of the Vale da Anta slope were classified. Groups G1, G2, and G3 showed intermediate bulk density values, and the marly limestone presented low porosity across all groups, according to IAEG (1979). In the Slake Durability test, durability was classified as very high after the second cycle (Gamble, 1971), ranging from very high (Gamble, 1971) to extremely high (Franklin and Chandra, 1972) after the first cycle. According to Bieniawski (1979), UCS results defined the marly limestone as medium-strength rocks in all groups, and the point load test indicated very high strength for G1 and high strength for G2 and G3. Despite some variability, the index property values remain consistent across samples from different groups. These results reinforce the importance of detailed material characterization in stability studies. The data obtained contributes to greater reliability in geotechnical analyses and in defining sustainable rehabilitation solutions tailored to the actual conditions of the rock mass.

Acknowledgments: The authors express their gratitude to FCT for funding the project through the grant 10/00130840/2021

References:

- ISRM (2007). The complete ISRM suggested methods for rock characterization, testing and monitoring: 1974–2006. Ulusay, R., & Hudson, J. A. (Eds.). Turkish National Group of ISRM.
Bieniawski, Z.T. (1979). The Geomechanics Classification in Rock Engineering Applications. Proceedings of the 4th International Conference on Rock Mechanics, Montreal, vol. 2, pp. 45–48.
Franklin, J.A., Indraratna, S., & Chandra, S. (1972). Suggested methods for determining water content, porosity, density, absorption, and related properties and swelling and slake-durability index properties. In R. Ulusay & J.A. Hudson (Eds.), The Complete ISRM Suggested Methods for Rock Characterization, Testing and Monitoring: 1974–2006 (pp. 83–88).
Gamble, J.C. (1971). Slake-durability Classification of Shales and Other Argillaceous Rocks. PhD Thesis, University of Illinois at Urbana-Champaign, USA.
IAEG Commission on Engineering Geological Mapping. (1979). Recommended nomenclature for engineering geological mapping. Bulletin of the International Association of Engineering Geology, 10, 235–274.



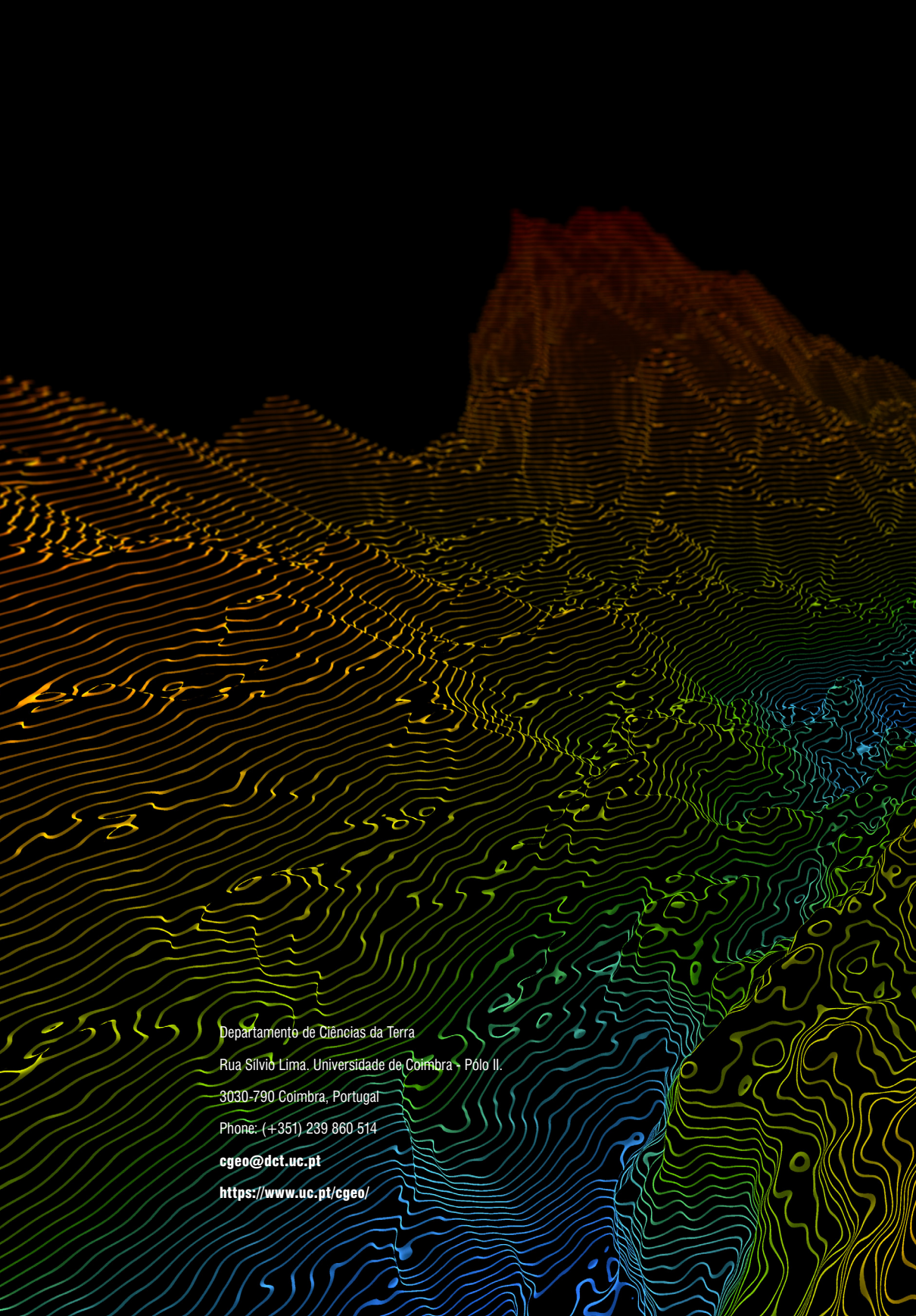
This study was supported by Portuguese funds from Fundação para a Ciência e a Tecnologia, L.P. (Portugal) in the frame of UIDB/00076/2023 and the UIDP/00075/2023 projects of the I & D unit of Geosciences Center (University of Coimbra, Portugal).



Geosciences center

2025 CGEO Day

Vila Real, 30 june - 1 july, 2025



Departamento de Ciências da Terra
Rua Silvio Lima, Universidade de Coimbra - Pólo II.
3030-790 Coimbra, Portugal
Phone: (+351) 239 860 514
cgeo@dct.uc.pt
<https://www.uc.pt/cgeo/>