
APPLIED GEOCHEMISTRY & LUMINESCENCE ON CULTURAL HERITAGE (GeoLuC)

Annual Activity Report 2013

UNIT: Chemical and Radiopharmaceutical Sciences

TEAM

Name	Category	R&D (%)
Maria Isabel Garrido Prudêncio	Principal Researcher (Habilitation), Group Leader	100
Maria Isabel Marques Dias	Invited Auxiliary Researcher	100
Christopher Ian Burbidge	Auxiliary Researcher (contract)	100
Rosa Maria Salgueiro Marques	Graduated Technician (MSc)	100
Guilherme de Jesus de Oliveira Cardoso	Graduated Technician (MSc)	100
Luís Manuel Ferreira Belot Fernandes	Graduated Technician	100
Dulce da Conceição Brejo Russo Franco	Technician (Assistant)	100
Maria José Ferreira Trindade	Post-Doc, FCT grant	100
Ana Luisa Sebastião Rodrigues	PhD, FCT grant	100
João Davide Neto Franco	MSc, FCT grant	100
Tiago Alexandre do Nascimento Ambaram	MSc Dissertation (DF-IST)	15 (March-Dec)
Telma da Piedade Silva	BIC, FCT grant (MSc)	100 (Jan-June)

OBJECTIVES

The mission of the GeoLuC research group is to perform research mainly in experimental and theoretical physics, chemistry, geochemistry and mineralogy and to apply nuclear and luminescence techniques and knowledge in earth sciences, environment and cultural heritage (CH), including the interaction of humans with the environment. The principal objectives for 2013 include:

- Nuclear methods development and optimization for the characterization, dating and preservation of cultural and natural heritage, and geoenvironments – from field work with in situ measurements, sampling, laboratorial procedures, and data analysis: INAA and TL-OSL.
- Characterization for provenance and production technologies determination, and absolute dating of CH objects, particularly pre-historic and historic ceramics, and glazed tiles.
- Neutron tomography and ionizing radiation studies – contribution for the establishment of conservation techniques and biological inactivation in ancient glazed tiles.
- Geochemistry, mineralogy, environmental dosimetry and absolute dating by luminescence of soils and sediments in surficial environments – differentiation of geogenic and anthropogenic origins.
- Luminescence-dosimetric processes in quartz; spatial variation of dose rate in superficial environments.
- Contribution to the construction of the Geochemical Atlas of Cape Verde (according to the IGCP 259 - “International Geochemical Mapping”) – Santiago, Fogo and Brava islands.
- The education and training courses and the organization of international conferences was also a major goal.

MAIN ACHIEVEMENTS

Nuclear methods and cultural heritage characterization

Chemical and mineralogical composition of CH and raw materials from several archaeological sites were performed. The chemical characterization of porcelain fragments collected during recent archaeological excavations from Portugal (Lisbon and Coimbra) was done for provenance issues:

identification/ differentiation of Chinese porcelain kilns used. The results point to the existence of three main chemical-based clusters. A general attribution of the porcelains studied to southern China kilns was found, and a few samples were specifically attributed to Jingdezhen and Zhangzhou kiln sites (Fig. 1). In a chronological point of view, for the studied samples we assist to an increasing improvement of the production procedure from late 15th till the 17th centuries of the Chinese porcelains sent to Portugal, especially enhanced by the association of late porcelains with refining processes of the original raw material, consistent with removal of more heavy minerals (Dias et al, 2013).

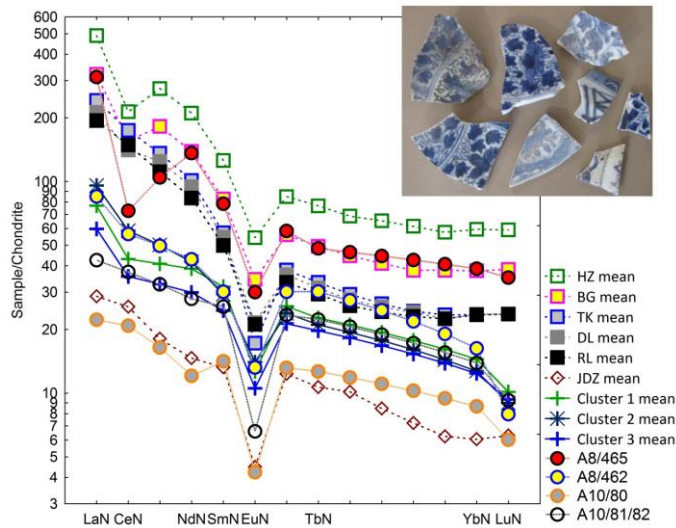


Fig. 1 – REE distribution curves of porcelains found in Portugal, and Chinese kilns (Zhangzhou and Jingdezhen).

Luminescence chronologies of archaeological and geological records

Sampling, in situ gamma spectrometry measurements, laboratory luminescence, AAN, and gamma spectrometry analyses, and publication of results relate to a range of archaeological and geological sites, funded through FCT and IAEA projects, and service analyses. Studies include investigation of the geomorphological development of the Troia penninsula, the transition to farming in the Alto Ribatejo, and the history of lead mining in the Mt Kosmaj region, Serbia (Fig. 2).

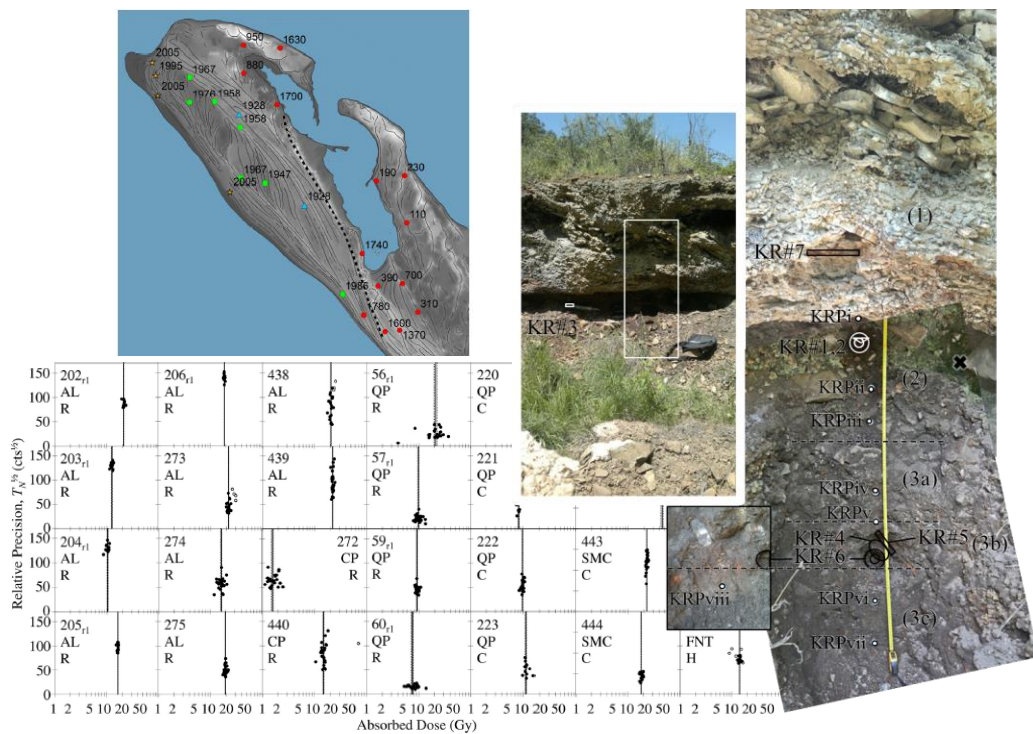


Fig 2. Dating results for dunes across the Troia peninsula (Rebêlo et al., 2013). Absorbed dose distributions in archaeological regolith and ceramics from the Alto Ribatejo (Burbidge et al., In Press). Sequence of metallurgical slags, soils and ceramics sampled at Mt Kosmaj, Serbia (IAEA/RER034).

Dose rate evaluation from natural radioisotopes

The VADOSE project has focussed on mineralogical, geochemical and radiometric analyses of different granulometric fractions prepared from the soil samples taken in 2012, and on enclosure dosimetry in bulk samples in the laboratory. Calibrations and tests of different systems used for dosimetry and radiometrics, as well as radiation transport studies, were continued. Research by students associated with the project is investigating relationships between luminescence dosimetric behaviour of minerals with environmental geochemistry, and dose rates from cosmic radiation at shallow depths. Implementation of high resolution gamma spectrometry analyses through the project has been applied to collaborative research on the radioactivity of geological materials used as topical applications (Fig. 3).

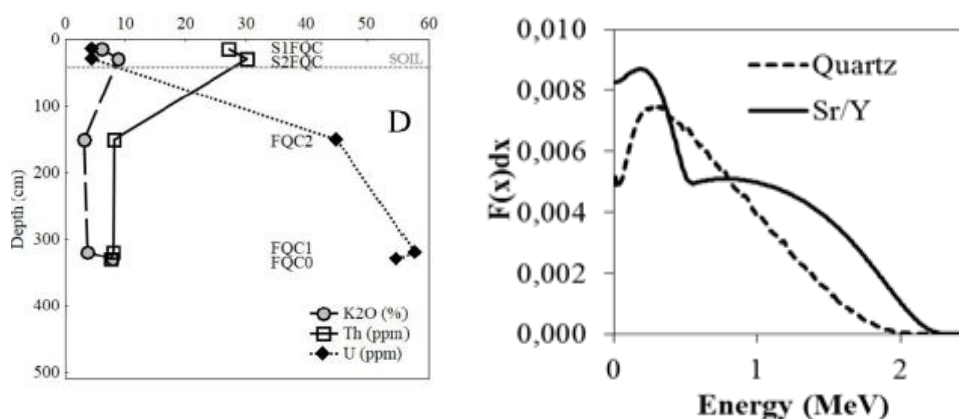


Fig. 3. Radionuclide concentrations through an aplite dyke, which locally exceeded minimum reference levels for gamma radiation despite release of up to 590 Bq. kg^{-1} of ^{220}Rn (Trindade et al., 2013). Energy distribution of beta radiation emitted from the sealed source of an automatic luminescence reader, and that absorbed in a quartz sample (Teles and Burbidge, SSD17 book of abstracts).

Nuclear methods applied to human-paleoenvironments interactions

Nuclear techniques, geochemistry, mineralogy and dating (optical stimulated luminescence and thermoluminescence) have been applied to geological and archaeological materials and contexts around Alqueva dam (FCT Doctoral Fellowship SFRH/BD/62396/2009); application of nuclear techniques on elemental characterization of naturally occurring radioactive materials (NORM); contribution for the knowledge of the environmental variability and human-environment interactions to reconstruct human impacts on ecosystems over the past 5000 years. Negative archaeological structures (Chalcolithic or Neolithic) in Baixo Alentejo (Portugal) are being dated by luminescence methods and characterized in a geochemical and mineralogical (bulk sample and clay fraction) point of view. The estimated ages for samples with the lowest calcite content were closest to archaeological expectations; in the calcitic contexts, the Quartz OSL sensitivity is in all cases high - responses appear activated in nature - suggesting geochemical effects of a high calcium environment, however, variations in sensitivity between samples and sites do not seem to show relationships with calcite content, but instead with the geological units from which the quartz is thought to originate or severity of physical weathering. The best reset luminescence signals for dating at these sites come from the layers with the lowest calcite content (Rodrigues et al., 2013). The anthropogenic and environmental influence in the studied materials can be observed by the higher amounts of Br and Sb in the archaeological samples relative to the geological ones, probably due to the human activity (Fig. 4).

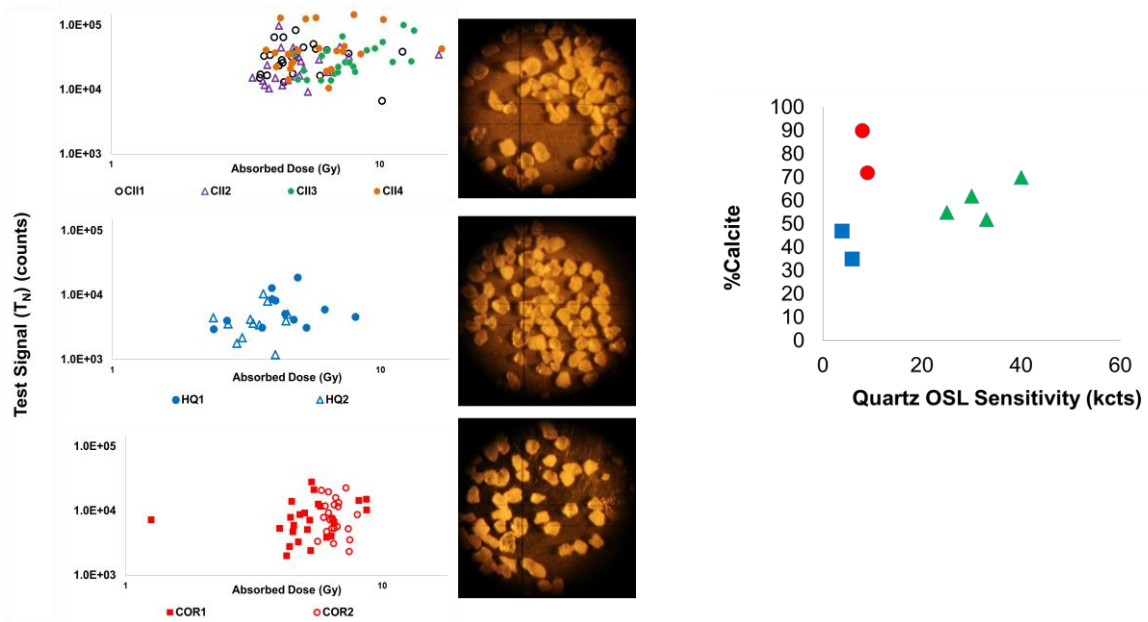


Fig. 4. Estimated absorbed dose and quartz OSL sensitivity in calcite rich samples from negative structures of archaeological sites from Baixo Alentejo.

Nuclear methods for Environmental analysis and Geochemical Mapping

The chemical characterization of volcanic soils was done by INAA contributing to the establishment of a geochemical atlas of the Fogo and Brava islands, in collaboration with Univ. of Aveiro. Sampling in Fogo and Brava during 2013 (Fig. 5) was done according to the recommendations of the IGCP 259 (“International Geochemical Mapping”). Biological samples (vines) were also collected in Fogo island (Fig. 6) in order to evaluate the uptake of trace elements by plants, including elements that can be a threat to health. Rare earth elements and other trace elements clearly differentiate soils from different geological formations and chronology of volcanic episodes. Iron speciation was done by Mossbauer spectroscopy to evaluate the role of iron forms in the semi-arid surficial environment of Cape Verde islands, particularly Fogo and Brava.



Fig. 5. Sampling of soil and vines in Fogo Island (Cape Verde).

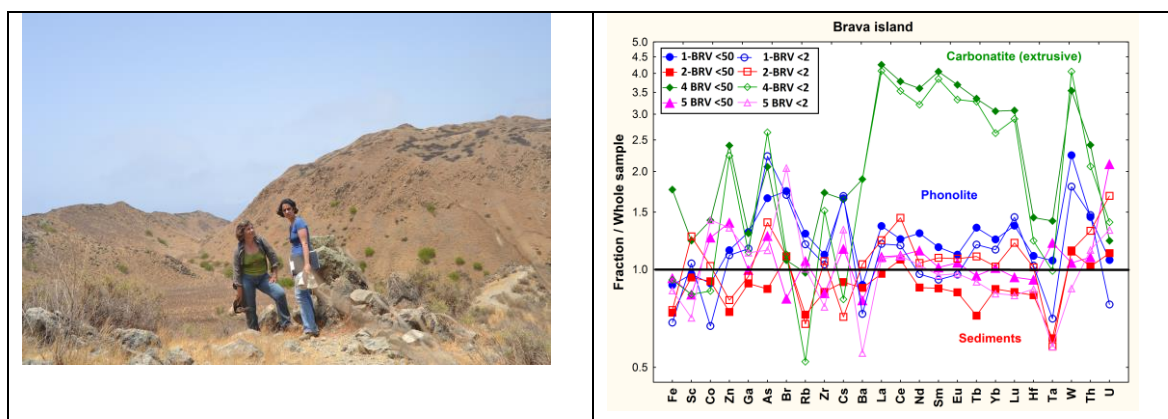


Fig. 6. Sampling campaign in Brava (Cape Verde) during 2013 (a), and geochemical patterns of soils developed in different geological formations (b).

RELEVANT PUBLICATIONS

- M.I. Dias, M.I., Prudêncio, M.A. Pinto de Matos, A. Luisa Rodrigues, Tracing the origin of blue and white Chinese Porcelain ordered for the Portuguese market during the Ming dynasty using INAA. *Journal of Archaeological Science* 40, 3046-3057 (2013). DOI: org/10.1016/j.jas.2013.03.007
- Rodrigues, A.L., Burbidge, C.I., Dias, M.I., Rocha, F., Valera, A., Prudêncio, M.I. 2013. Luminescence and mineralogy of profiling samples from negative archaeological features. *Mediterranean Archaeology and Archaeometry* 13.3, 37-47. ISSN: 1108-9628.
- L. Rebêlo, S. Costas, P. Brito, M. Ferraz, M.I. Prudêncio, C.I. Burbidge, Inprints of the 1755 tsunami in the Tróia Peninsula shoreline, Portugal. *Journal of Coastal Research*, Special Issue n° 65, 814-819 (2013), DOI: 10.2112/SI65-138.1, http://ics2013.org/papers/Paper4430_rev.pdf
- T.P. Silva, M.O. Figueiredo, M.I., Prudêncio, Ascertaining the degradation state of ceramic tiles: a preliminary non-destructive step in view of conservation treatments. *Applied Clay Science*, 82, 101–105 (2013), <http://dx.doi.org/10.1016/j.clay.2013.06.013>
- M.J. Trindade, F. Rocha, M.I. Dias, M.I. Prudêncio, Mineralogy and grain-size distribution of clay-rich rock units of the Algarve Basin (South Portugal). *Clay Minerals*, 48, 1, 59-83 (2013). DOI: 10.1180/claymin.2013.048.1.04.

FUNDS

Project/Service	Reference	Start/End	2013
The Della Robbia sculptures in Portugal: History, Art and Laboratory - ROBBIANA	PTDC/HIS-HEC/116742/2010	05-03-2012 to 04-03-2015	
RUPSCIENCE - Analysis of the operational chains, archaeometry and chronology of Rock Art Paintings. An approach to materials technology of Portugal, Spain and Colombia's contexts	PTDC/HIS-ARQ/101299/2008	01-06-2010 to 30-11-2013	
Diagnosis, decontamination and conservation of cultural heritage: neutrons and ionizing radiation in artwork (RADIART)	PTDC/HIS-HEC/101756/2008	01-01-2010 to 30-6-2013	
Spatial Variation of Dose Rate in Soils and Sediments - VADOSE	PTDC/AAC-AMB/121375/2010		
Evaluation of the Degradation State	CHARISMA: CHAR2012-		

of Ancient Portuguese Glazed Tiles Aiming the Establishment of Conservation Strategies”	BRR-345		
Death management in Recent Prehistory: funerary practices in Perdigoes enclosure (FUNPERD)	PTDC/CS-ANT/104333/2008	1-6-2010 to 30-9-2013	

INTERNATIONALIZATION

- Collaborations with University of Huelva, Spain for environmental studies.
- Collaborations with University of Seville, Spain for cultural heritage studies.
- Collaborations with University of Coruña, Spain for environmental and cultural heritage studies.
- Collaborations with SUERC, Scotland, UK for environmental dosimetry.
- Convénio Portugal (FCT) / Itália (CNR) 2011-2012. End March 2013.
- IAEA Scientific visits POR/13001V (Burbidge = visiting scientist) and SRB/13008V (Burbidge = host), between IST/C2TN and the National Museum of Serbia.
- Scientific visit to IRSN, Paris (Burbidge = visiting scientist). RENE B (FP7, EURATOM)/EURADOS OSL/TL Intercomparison (retrospective dosimetry using electronic components from mobile phones).
- EURADOS Annual Meeting 2013. Escola Tècnica Superior d’Enginyeria Industrial de Barcelona (ETSEIB), Barcelona (4-8/02/2013) including the 6th EURADOS Winter School "Status and Future Perspectives of Computational Micro- and Nanodosimetry". Secretary, EURADOS WG10 “Retrospective dosimetry”.
- Guest Editor, L.A.I.S. 2012 special issue. Mediterranean Archaeology and Archaeometry 13(3).
- Collaboration with United States Geological Survey (USGS) - “Reference Materials” for certification testing.
- Members of Scientific Committees of international conferences.
- Members of the Directive Board of the SAPaC.

TEAM RESEARCHERS

NAME: Maria Isabel Garrido Prudêncio

CATEGORIA: Principal Researcher (Habilitation)

IST-ID: 5349

ACTIVITIES

Nº	Activies Description	R&D (%)
1	Coordinator of Chemical and Radiopharmaceutical Research Unit (CRSU)	10
2	Coordinator of the research group “Applied Geochemistry & Luminescence on Cultural Heritage” (GeoLuC)	5
3	Responsible of the gamma spectrometry laboratories – neutron activation analysis and naturally occurring radioactive materials.	10
4	Services – compositional characterization of cultural objects.	5
5	Project: "Diagnosis, decontamination and conservation of cultural heritage: neutrons and ionizing radiation in artwork (RADIART)" (PTDC/HIS-HEC/101756/2008)	10
6	Project: Technical Cooperation Project - IAEA TC Project RER/0/034 “Enhancing the Characterization, Preservation and Protection of Cultural Heritage Artefacts" (2012-2013).	8
7	Project: RUPSCIENCE - Analysis of the operational chains, archaeometry and chronology of Rock Art Paintings. An approach to materials technology of Portugal, Spain and Colombia's contexts. (PTDC/HIS-ARQ/101299/2008)	5

8	Project: FUNPERD - Death management in Recent Prehistory: funerary practices in Perdigões enclosure (PTDC/CS-ANT/104333/2008)	5
9	Project: ROBBIANA - The Della Robbia sculptures in Portugal: History, Art and Laboratory (PTDC/HIS-HEC/116742/2010)	5
10	Project: Spatial Variation of Dose Rate in Soils and Sediments – VADOSE (PTDC/AAC-AMB/121375/2010)	5
11	Project: SIMPLE Dark Matter project; Coordinator: T.A. Girard (CFNUL)	5
12	Project: “Evaluation of the Degradation State of Ancient Portuguese Glazed Tiles Aiming the Establishment of Conservation Strategies” (CHAR2012-BRR-345) CHARISMA – Cultural Heritage Advance Research Infrastructures, FIXLAB PLATFORM B - BUDAPEST RESEARCH REACTOR. Coordinating person: M.I. Prudêncio. European Commission – transnational project.	5
13	Project: “Application of Ionizing Radiation for a Sustainable Environment” – ARIAS, FCT RECI/AAG-TEC/0400/2012.	2
14	Contribution to the construction of the Geochemical Atlas of Cape Verde (according to the IGCP 259 - “International Geochemical Mapping”) – Santiago, Fogo and Brava islands.	5
15	Supervision of post-docs and PhD	10
16	Referee of scientific magazines	5
Total		100

WORK SUMMARY

Nº	Work Summary and Main Achievements
1	Coordination of the combined activities of CRSU including the general management of expenses, and renewal and maintenance of equipment; elaboration of the 2012 report.
2	Coordination of the activities of GeoLuC research group, including the general management of human resources and laboratories, renewal and maintenance of equipment, elaboration of the 2011 report and the work plan for 2012. The promotion activities and the publications of the research group result on the expertise recognition of the international scientific community through the invitation for research collaboration at several levels, participation in research projects, conferences organization and scientific committees. Also several invitations were received for peer review of manuscripts on earth sciences, environment and health, and cultural heritage, particularly geochemistry (particularly REE) of the earth surface, environmental studies using inorganic and organic indicators, applied geochemistry and chronology, cultural heritage characterization and conservation, among other domains.
3	Coordination of the activities of the gamma spectrometry laboratories for instrumental neutron activation analysis (INAA) using the RPI as neutron source, and naturally occurring radioactive materials (NORM). Promotion of collaborative activities with the United States Geological Survey (USGS) in the frame of the project “Reference Materials Project”. As a result of the promotion of the INAA laboratory, editors of several international journals asked for peer review of manuscripts concerning nuclear methods and applications.
4	Chemical analysis of ancient ceramics and raw materials of Algarve region, by using neutron activation analysis (one report).
5	Project: "Diagnosis, decontamination and conservation of cultural heritage: neutrons and ionizing radiation in artwork (RADIART)" (PTDC/HIS-HEC/101756/2008) – coordination of the technical-scientific management structure, and responsible for the IST/ITN team. Synchronization of the teams of the participant institutions was done according with the main methodological approaches developed in each task of the project. As main results articles were submitted for publication and presentations were done in international conferences.
6	Project: Portuguese nuclear scientist nominated, designated Responsible Person from Counterpart Institute (IST) Technical Cooperation Project - IAEA TC Project RER/0/034. The main activities were: promotion of nuclear techniques on Cultural Heritage (mobile and immobile) in Portugal, participation in the Sumy (Ukraine) meeting, and elaboration of the

	report with the main activities in 2013.
7	Member of the project: RUPSCIENCE - (PTDC/HIS-ARQ/101299/2008) – coordination of the neutron activation analysis of different types of materials and participation in the integration studies of the results obtained by different methodologies of materials/contexts.
8	Member of the project: FUNPERD - (PTDC/CS-ANT/104333/2008) – coordination of the neutron activation analysis of different types of materials and participation in the integration studies of the results obtained by different methodologies of materials/contexts.
9	Member of the project: ROBBIANA - (PTDC/HIS-HEC/116742/2010) – coordination of the neutron activation analysis of different types of materials and participation in the integration studies of the results obtained by different methodologies of materials/contexts.
10	Member of the project: VADOSE (PTDC/AAC-AMB/121375/2010) – participation in the field work – geological contexts/sampling; coordination of the neutron activation analysis of geological materials.
11	Project: SIMPLE Dark Matter project; Coordinator: T.A. Girard (CFNUL) Belonging to the Core Team of the project, I was the responsible investigator on the precise and accurate determination of the uranium and thorium concentrations by instrumental neutron activation analysis (INAA) in different materials involved in the experiments such as polyethylene.
12	Chemical analyses of ceramics by PGAA and PIXE in BNC and Wigner Research Center in the frame of “Evaluation of the Degradation State of Ancient Portuguese Glazed Tiles Aiming the Establishment of Conservation Strategies” (CHAR2012-BRR-345) CHARISMA.
13	Member of the project: “Application of Ionizing Radiation for a Sustainable Environment” – ARIAS, FCT RECI/AAG-TEC/0400/2012 – contribution for equipment specifications.
14	Chemical characterization of topsoils of Santiago, Fogo and Brava islands (Cape Verde). Contribution to the construction of the Geochemical Atlas of Cape Verde (according to the IGCP 259 - “International Geochemical Mapping”); fieldwork in Fogo and Brava islands. Results were presented in international conferences and manuscripts were submitted for publication.
15	Supervision of post-docs and PhD on nuclear techniques/geochemistry/geomaterials – establishment of natural backgrounds of different environments (Portuguese territory and Cape Verde islands); differentiation of geogenic and anthropogenic origins; application of nuclear techniques on elemental characterization and naturally occurring radioactive materials (NORM). Manuscripts were submitted for publication (http://www.sciencedirect.com/science/article/pii/S0883292713002047).
16	Referee of several manuscripts submitted for publication in scientific magazines – nuclear methods, geochemistry, environment and cultural heritage.

PUBLICATIONS

- T.P. Silva, M.O. Figueiredo, M.I., Prudêncio, Ascertaining the degradation state of ceramic tiles: a preliminary non-destructive step in view of conservation treatments. *Applied Clay Science*, 82, 101–105 (2013), <http://dx.doi.org/10.1016/j.clay.2013.06.013>.
- L. Rebêlo, S. Costas, P. Brito, M. Ferraz, M.I. Prudêncio, C.I. Burbidge, Inprints of the 1755 tsunami in the Tróia Peninsula shoreline, Portugal. *Journal of Coastal Research*, Special Issue n° 65, 814-819 (2013), DOI: 10.2112/SI65-138.1, http://ics2013.org/papers/Paper4430_rev.pdf.
- J. Cruz, M.O. Silva, M.I. Dias, M.I. Prudêncio, Groundwater composition and pollution due to agricultural practices in Sete Cidades volcano (Azores, Portugal). *Applied Geochemistry*, 29, 162-173 (2013), <http://dx.doi.org/10.1016/j.apgeochem.2012.11.009>.
- Rodrigues, A.L., Burbidge, C.I., Dias, M.I., Rocha, F., Valera, A., Prudêncio, M.I. 2013. Luminescence and mineralogy of profiling samples from negative archaeological features. *Mediterranean Archaeology and Archaeometry* 13.3, 37-47. ISSN: 1108-9628. <http://www.maajournal.com/>.
- Stanojev Pereira, M.A., Marques, J.G., Santos, J.P., Burbidge, C.I. Prudêncio, M.I., Dias, M.I. 2013. Neutron imaging techniques applied in the study of the archaeological and cultural heritage

field. *Mediterranean Archaeology and Archaeometry* 13.3, 137-143. ISSN: 1108-9628. <http://www.maajournal.com/> .

- Trindade, M.J., Prudêncio, M.I., Burbidge, C.I., Dias, M.I., Cardoso, G., Marques, R., Rocha, F. 2013. Distribution of naturally occurring radionuclides (K, Th and U) in weathered rocks of various lithological types from the uranium bearing region of Fornos de Algodres, Portugal. *Mediterranean Archaeology and Archaeometry* 13.3, 71-79. ISSN: 1108-9628. <http://www.maajournal.com/>.
- T.P. Silva, M.O. Figueiredo, M.A. Barreiros, M.I. Prudêncio, Decorative 18th century blue-and-white Portuguese tile panels: a type-case of environmental degradation. *Journal of Materials*, Volume 2013, Article ID 972018, 6 pages (2013). <http://dx.doi.org/10.1155/2013/972018>.
- M.I. Dias, M.I., Prudêncio, M.A. Pinto de Matos, A. Luisa Rodrigues, Tracing the origin of blue and white Chinese Porcelain ordered for the Portuguese market during the Ming dynasty using INAA. *Journal of Archaeological Science* 40, 3046-3057 (2013). DOI: [org/10.1016/j.jas.2013.03.007](https://doi.org/10.1016/j.jas.2013.03.007).
- M.J. Trindade, F. Rocha, M.I. Dias, M.I. Prudêncio, Mineralogy and grain-size distribution of clay-rich rock units of the Algarve Basin (South Portugal). *Clay Minerals*, 48, 1, 59-83 (2013). DOI: [10.1180/claymin.2013.048.1.04](https://doi.org/10.1180/claymin.2013.048.1.04).
- M.J. Trindade, M.I. Prudêncio, J. Sanjurjo Sánchez, J.R. Vidal Romaní, T. Ferraz, D. Fernández Mosquera, M.I. Dias, Post-depositional processes of elemental enrichment inside dark nodular masses of an ancient aeolian dune from A Coruña, Northwest Spain. *Geologica Acta* , Vol. 11 , N ° 2, 231 – 244 (2013). DOI: [10.1344/105.000001838](https://doi.org/10.1344/105.000001838).
- M.I. Dias, M.I. Prudêncio, Recent studies on the application of nuclear methods for the construction of a temporality approach on Neolithic and archaeological contexts of Perdígões archaeological site, south Portugal, IAEA TC RER0034 Regional Project – Enhancing the characterization, conservation and protection of cultural heritage artefacts, *Science for Heritage Newsletter* n° 1, 4-5 (2013).

Book Chapters

- M. Pozo, M.I. Carretero, F., Ruiz, F., M. Olías, M., Abad, J. Rodríguez Vidal, L.M., Cáceres, M.I., Prudêncio, M.I., Dias, A.M. Muñoz, A. Toscano, Geochemistry of lower pliocene to holocene formations from the doñana national park (SW Spain). In: *Advances in Geochemistry Research*, chapter 1, Editor: Jorge Sanjurjo Sánchez, ISBN ISBN: 978-1-62618-245-5, 2013, Nova Science Publishers, Inc., p. 1-10. (Softcover).
- ebook: https://www.novapublishers.com/catalog/product_info.php?products_id=40076&osCsid=46545dbe18cc09f1fda02e3f88de5bec .
- M.I. Dias, A.C. Valera, M.I. Prudêncio, F. Rocha, Tecnologias de produção cerâmica e exploração de matérias-primas nos Povoados do Moinho de Valadares 1 e Monte do Tosco 1. In: *As Comunidades Agropastoris na margem esquerda do Guadiana, 2ª metade do IV aos inícios do II milénio AC* (A.C. Valera). *Estudos Arqueológicos do Alqueva*, eds. EDIA, DRCALEN, Memórias d’Odiana, 2ª série, p. 189- 202 (2013).

REPORTS

- Final report of FCT funded project: RADIART project (PTDC/HIS-HEC/101756/2008)

COMMUNICATIONS

Invited

- *Neutron Techniques on Cultural Heritage*. M.I. Prudêncio, Invited lecture, Budapest Neutron Center, Hungarian Academy of Sciences, Association of the KFKI Research Institutes EK – WIGNER, Budapest, Hungary, 2nd July 2013.
- *Matérias Primas e Tecnologias de Produção de Azulejos Portugueses (XVII-XX)*. M.I. Dias, M.I. Prudêncio, II Encontro Património Azulejar., Azulejo Hoje, 5-6 Dezembro de 2013, Lisboa, Portugal.

- *Caracterização composicional de esculturas della Robbia: o Medalhão Fé do Museu Gulbenkian. Resultados Preliminares.* M. Isabel Dias, Christopher Burbidge, M. Isabel Prudêncio. Colóquio DIGITILE E ROBBIANA. Projectos de investigação e disseminação em Azulejaria e Cerâmica. AUDITÓRIO III – FUNDAÇÃO CALOUSTE GULBENKIAN. 18 e 19 de Abril de 2013.

Oral

- *O Campaniforme na Beira-Alta e Alentejo (Portugal): contextos, proveniência e circulação,* M. I. Dias, M. I. Prudêncio. *X Congresso Ibérico de Arqueometria, Castellón, Spain, 16-18 October 2013*, Oral.
- *Esculturas Della Robbia em Portugal: análise da composição das pastas,* M.I. Dias, M.J. Trindade, M.I. Prudêncio, R. Marques, P. Flor. *X Congresso Ibérico de Arqueometria, Castellón, Spain, 16-18 October 2013*, Oral.
- *Raw materials and technology of 17th- 20th Portuguese glazed tiles,* M.I. Dias, M.J. Trindade, R. Marques, M.I. Prudêncio. *12th European Meeting on Ancient Ceramics, EMAC 2013, Padova, Italy, 19-21 September 2013*, Oral.
- *Della Robbia Sculptures in Portugal: neutron techniques applied to provenance issues,* M.I. Dias, M.I. Prudêncio. *1st International Conference on Neutron Imaging and Neutron Methods in Archaeology and Cultural Heritage Research, Garching, Germany, 9-12 September 2013*, Oral.
- *Indicadores geoquímicos de centros produtores de ânforas Lusitanas: Peniche, Tejo, Sado, Algarve.* M. Isabel Dias E M. Isabel Prudêncio. *Congresso Internacional “Anforas Lusitanas – Produção e Difusão. Troia. Portugal. 10-13 October 201*, Oral.
- *Authentication and dating of two sets of miniature terracotta high-reliefs by multi-analytical techniques.* Agnès Le Gac, Camila Remonato, Teresa I. Madeira, Stéphane Longelin, Isabel Nogueira, M. Isabel M. Dias, Christopher Burbidge, G. Cardoso, M. I. Prudêncio, Luís Piorro, Marta Manso, Anísio Franco, António Candeias, Maria Luísa Carvalho. *TECHNART 2013. Rijksmuseum, Amsterdam, from 23 - 27 September 2013*, Oral.
- *Exploring Luminescence Behaviour of Calcitic Archaeological Fill Materials in the Context of Chemical and Mineralogical Composition.* A.L. Rodrigues, C.I. Burbidge, M.I., Dias, F. Rocha, M.I. Prudêncio. *17th Solid State Dosimetry Conference. Recife, Brazil, 22-27 Set. 2013*, Oral.
- *Spatial variations of chemical patterns in fine fractions of surficial materials from Brava Island (Cape Verde) – correlation with mineralogy/parent rock.* R. Marques, M.I. Prudêncio, F. Rocha, E.F. Silva, M.I. Dias, J. Madeira. *XV International Clay Conference. Universidade Federal do Rio de Janeiro. Rio de Janeiro, RJ, Brasil. July 7-11t, 2013*, Oral.
- *Mineralogy and geochemistry of negative archaeological structures in carbonate contexts, Alentejo (Portugal).* A.L. Rodrigues, M.I. Dias, C.I. Burbidge, F. Rocha, M.I. Prudêncio, G. Cardoso, D. Franco, R. Marques. *XV International Clay Conference. Universidade Federal do Rio de Janeiro. Rio de Janeiro, RJ, Brazil. July 7-11t, 2013*, Oral.
- *Diagnostics of glaze pathologies in ancient (XVII-XVIII cents.) decorative blue-and-white ceramic tiles with the aim of implementing innovative conservation techniques,* T.P. Silva, M.O., Figueiredo, M.O., QA. Barreiros, M.I. Prudêncio. *E-MRS Spring Meeting 2013, Strasbourg/France, May 27th-31st 2013*, Oral.
- *A chemical study of Portuguese archaeological faience by INAA as a valid tool to investigate provenance,* M.I. Dias, M.I. Prudêncio, A. Pais, A.L. Rodrigues, R. Marques. *1º Congresso Internacional de Faiança Portuguesa. Museu Nacional de Arte Antiga, Lisbon, Portugal, 22-25 Maio 2013*, Oral.

Poster

- *Neutron techniques applied to better define conservation strategies of 16th – 18th centuries Portuguese glazed tile,* M.I. Prudêncio, M.I. Dias. *1st International Conference on Neutron Imaging and Neutron Methods in Archaeology and Cultural Heritage Research, Garching, Germany, 9-12 September 2013*, Poster.
- *Quinta do Torel glazed tile panel: chemical and mineralogical study of the ceramic body (Lisbon, Portugal).* M. Isabel Prudêncio, M. Isabel Dias, Susana Varela Flor, Leonel Ribeiro, M. J.

- Trindade, M. T. Bispo, Laura Trindade, Pedro Flor. *X Congreso Ibérico de Arqueometría. Museo de Bellas Artes de Castellón. 16-18 October 2013*, Poster.
- *The Della Robbia Sculptures of The National Museum of Ancient Art, Portugal.* M. Isabel Dias, M. José Trindade, M. Isabel Prudêncio, Rosa Marques, Pedro Flor, Anísio Franco. *EMAC 2013 - 12th European Meeting on Ancient Ceramics, 19-21 September 2013, Padova, Italy*, Poster.
 - *Neolithic Occupation and Mid-Holocene Pedogenetic Features at Palácio dos Lumiares Site (Lisbon, Portugal): Geochemical And Mineralogical Considerations.* M. I. Dias & M. I. Prudêncio. *XV International Clay Conference. Universidade Federal do Rio de Janeiro. Rio de Janeiro, RJ, Brasil. July 7-11th, 2013*, Poster.
 - *Alteration Materials of a Pyroclastic Succession in Cabeça Fundão, Fogo Island (Cape Verde) - Geochemical and Mineralogical Variations.* R. Marques, M. I. Prudêncio, F. Rocha, M. I. Dias, E. F. Silva, D. Franco. *XV International Clay Conference. Universidade Federal do Rio de Janeiro. Rio de Janeiro, RJ, Brazil. July 7-11th, 2013*, Poster.
 - *Distribution of Trace Elements in Schistous Weathered Materials from the Ordovician (Omz), Alentejo, Portugal.* A. L. Rodrigues, M. I. Dias, F. Rocha, M. I. Prudêncio. *XV International Clay Conference. Universidade Federal do Rio de Janeiro. Rio de Janeiro, RJ, Brazil. July 7-11th, 2013*, Poster.

EDUCATION

- *María José López Galindo. "Biometeorización de rocas ígneas (espeleotemas silíceos desde una perspectiva geobiológica)". Tese de Doutoramento, Universidade da Coruña, Doutoramento em Geologia, España, 12 de Novembro de 2013.*
- *R. Marques, "Rare earth elements and other trace elements in Cape Verde Island" (PhD, in course). Supervisors: Prof. Fernando Tavares Rocha of the University of Aveiro, and M.I. Prudêncio, IST.*

PROJECTS

Running

- *Evaluation of the Degradation State of Ancient Portuguese Glazed Tiles Aiming the Establishment of Conservation Strategies (CHAR2012-BRR-345) CHARISMA – Cultural Heritage Advance Research Infrastructures, FIXLAB PLATFORM B - BUDAPEST RESEARCH REACTOR. Coordinator: M.I. Prudêncio.*
- *Project "Diagnosis, decontamination and conservation of cultural heritage: neutrons and ionizing radiation in artwork (RADIART)" (PTDC/HIS-HEC/101756/2008) - 2010-2013, Leading Institution: IST/ITN; Coordinator: M.I. Prudêncio (25%).*
- *Technical Cooperation Project - IAEA TC Project RER/0/034 "Enhancing the Characterization, Preservation and Protection of Cultural Heritage Artefacts". M. Isabel Prudêncio: Portuguese nuclear scientist nominated, designated Responsible Person from Counterpart Institute (Instituto Superior Técnico) (2012-2013).*

SCIENTIFIC COMMITTEES

- Member of the Directive Board of the "Sociedad de Arqueometría Aplicada al Patrimonio Cultural".
- Member of the Scientific Committee of the X Conference on Iberian Archaeometry, Castellon, Spain. <https://sites.google.com/site/arqueometria2013/organizacion/comite-cientifico>.
- Member of the Scientific Committee of IST-ITN.

COLLABORATIONS

- Prof. Fernando Rocha and Prof. Eduardo Ferreira da Silva - University of Aveiro: Member, GeoBioTec Research Team, UA; collaboration in georesources and environmental studies – contribution for the construction of the "Geochemical Atlas of Cape Verde islands".

- Prof. Teresa Valente and Prof. M. Amália Sequeira Braga - University of Minho – geoenvironments, geological resources and tailings - environmental studies.
- Prof. Maria Ondina Figueiredo and Dra Teresa Silva – chemical characterization of glazes.
- Doctor Luis Rebêlo – LNEG - geochronology – absolute dating for the coastal reconstruction.
- Prof. Fernando Ruiz and Doctor Manuel Abad - University of Huelva, Spain – geoenvironments.
- Prof. Manuel Pozo - University of Madrid, Spain – geoenvironments.
- Doctor Zsolt Kasztovszky – BNC-Centre for Energy Research, Budapest, Hungary - collaboration in Nuclear Analysis (PGAA) and Radiography (NR).
- Professor Zoltan Szokefalvi-Nagy - BNC-Wigner Research Centre for Physics, Department of Biophysics, Budapest, Hungary - PIXE experiments.
- Doctor Imre Kovac - BNC-Wigner Research Centre for Physics, Department of Biophysics Budapest, Hungary - PIXE experiments.

NAME: Maria Isabel Marques Dias

CATEGORY: Auxiliary Researcher (invited)

IST-ID: 5449

ACTIVITIES

Nº	Activity Description	R&D (%)
1	Responsible of the Luminescence Dating Laboratory	10
2	Responsible at CTN of the Project: FUNPERD - Death management in Recent Prehistory: funerary practices in Perdigoês enclosure. PTDC/CS-ANT/104333/2008	9
3	Responsible at CTN of the Project: RUPSCIENCE - Analysis of the operational chains, archaeometry and chronology of Rock Art Paintings. An approach to materials technology of Portugal, Spain and Colombia's contexts. PTDC/HIS-ARQ/101299/2008	9
4	Responsible at CTN of the Project: ROBBIANA - The Della Robbia sculptures in Portugal: History, Art and Laboratory. PTDC/HIS-HEC/116742/2010	15
5	Member of the Project: RADIART - Diagnosis, decontamination and conservation of cultural heritage: neutrons and ionizing radiation in artwork. PTDC/HIS-HEC/101756/2008	5
6	Member of the CHARISMA Project: Evaluation of the degradation state of ancient Portuguese glazed tiles aiming the establishment of conservation strategies – TIGLAZE. BNC Proposal Nr. BRR-345.	5
7	Member of the Project: VADOSE – Spatial variation of Dose Rate in Soils and Sediments. (PTDC/AAC-AMB/121375/2010).	2
8	Organization of International Conference (X CIA, Castellon, Spain)	
9	Supervision of PhD and curricular units in masters degrees	10
10	Preparation and submission of 1 CHARISMA Project	2
11	Preparation and submission of 1 COST Project as coordinator	5
12	Preparation and submission of 1 COST Project as participant	2
13	President of the Iberian Society “Sociedade de Arqueometria Aplicada ao Património Cultural” (SAPaC)	2
14	Coordination of field-work and sampling activities in geological and archaeological contexts and in Museums.	10
15	Referee of scientific magazines	2
16	Coordination of Services – compositional and chronological issues of cultural heritage objects.	5
17	Contribution to the construction of the Geochemical Atlas of Cape Verde (according to the IGCP 259 - “International Geochemical Mapping”) – Santiago, Fogo and Brava islands.	5
18	Project: “Application of Ionizing Radiation for a Sustainable Environment” –	2

	ARIAS, FCT RECI/AAG-TEC/0400/2012.	
Total		100

WORK SUMMARY

Nº	Work Summary and Main Achievements
1	Coordination of the activities of the luminescence dating laboratory. Dissemination and promotion of the main valences of the laboratory to the scientific community, and to the community (private and public) that deals with objects of cultural heritage.
2	Responsible at IST/ITN of the FUNPERD project (PTDC/CS-ANT/104333/2008) – coordination of the scientific tasks of ITN team, comprising compositional characterization (of ceramics and potential raw materials of the region) and absolute dating of archaeological artefacts and contexts of Perdigões archaeological site (Reguengos Monsaraz), as well as fieldwork and sampling. In 2013 it was the last year of the project with a complete overview of the following tasks: (i) “Chemical characterization of pottery from the Perdigões site by instrumental neutron activation analyses (INAA)”; (ii) “Mineralogical characterization of pottery from the Perdigões site by X-ray diffraction (XRD)”; (iii) “Compositional data management – Statistics applied to geochemical and mineralogical data”; (iv) “Luminescence dating”. Presentation of results were at International Conferences. Overall coordination of integration studies of the results obtained by different methodologies of materials/contexts.
3	Responsible at IST/ITN of the RUPSCIENCE project PTDC/HIS-ARQ/101299/2008 – coordination of the scientific tasks of ITN team, comprising compositional characterization and absolute dating of archaeological contexts with rock art paintings. Special emphasis was done to the raw materials of rock paintings (inorganic) characterization. In 2013 it was the last year of the project with a complete overview of the following tasks: (i) chemical (INAA) and mineralogical (XRD) composition characterization, and iron forms detailed studies (Mossbauer) of “ocres”. Overall coordination of integration studies of the results obtained by different methodologies of materials/contexts.
4	Responsible at IST/ITN of the ROBBIANA project PTDC/HIS-HEC/116742/2010 – coordination of the scientific tasks of ITN team, comprising compositional characterization and absolute dating of artworks attributed to De La Robbia artist in the following museums: 1. Museu dos Jerónimos; 2. Museu Nacional de Arte Antiga; 3. Fundação Calouste Gulbenkian. In 2013 particular attention was paid to: (i) sampling campaigns at statues and sculptures of the artist in the above mentioned museums; (iii) chemical (INAA) and mineralogical (XRD) composition characterization of body samples of work of arts; (iv) in situ dosimetry. Overall coordination of integration studies of the results obtained by different methodologies of materials/contexts.
5	Member of the Project: RADIART (PTDC/HIS-HEC/101756/2008) – coordination of the luminescence activities; participation in the integration studies of the results obtained by different methodologies applied to tiles study and characterization.
6	Member of the CHARISMA Project: Evaluation of the degradation state of ancient Portuguese glazed tiles aiming the establishment of conservation strategies – TIGLAZE. BNC Proposal Nr. Is BRR-345. Participation in the PIXE and PGAA analysis at the Budapest Neutron Centre. Treatment of data and interpretation of results.
7	Member of the Project: VADOSE – Spatial variation of Dose Rate in Soils and Sediments. (PTDC/AAC-AMB/121375/2010). Participation in laboratory approaches.
8	Organization of International Conference (X CIA, Castellon, Spain). Meeting with organizers and spanish institutions.
9	Supervision of a PhD on nuclear techniques, geochemistry, mineralogy and luminescence applied to geological and archaeological materials and contexts (around Alqueva dam); application of nuclear techniques on elemental characterization and naturally occurring radioactive materials (NORM). Presentations at international conferences; One publication. Curricular units at Masters degrees in the NORM, geochemistry, archaeometry, clays, and nuclear and isotopic domains.
10	Coordination, preparation and submission of a CHARISMA 7 th FP. Cultural Heritage Advanced Research Infrastructures. Synergy for a multidisciplinary approach to

	conservation/restoration. Fixlab Plataform B – Budapest Research Reactor. Submission of research project “Stone idols from Chalcolithic Perdigões ditched enclosures (Southern Portugal): Funerary practices, raw materials and interaction networks”. BNC (Cudapest Neutron Centre). Approved to start in 2014 with code number BRR-376.
11	Coordination, preparation and submission of 1 COST Project: BACK TO THE SOURCE: PROVENANCE AND CIRCULATION OF BELL BEAKERS. COST Trans-Domain Proposal Open Call 2013-2. Proposal Reference oc-2013-2-17345. Evolving the participation at an European level of more 9 country partners (Austria, Swtizerland, Czech Republic, Spain, France, United Kingdom, Hungary, Italy, Netherlands)
12	Participant in the preparation and submission of 1 COST Project: EUROPEAN NETWORK ON TRACING HIDDEN ANCIENT FLAVOURS. COST Trans-Domain Proposal Open Call 2013-2. Proposal Reference oc-2013-2-17303. Evolving the participation at an European level of more 11 country partners (Austria, Cyprus, Germany, Spain, France, United Kingdom, Croatia, Italy, Romania, Sweden, Turkey)
13	Within the framework of President of the Iberian Society "Sociedade de Arqueometria Aplicada ao Património Cultural" (SAPaC) several promotion of the society was performed, namely at a national level, as Portuguese participants needed to be increased. Participation in meetings regarding the archaeometry at an Iberian level and promotion of Iberian scientific networks in this field. Preparation of the X Conference on Iberian Archaeometry held in Castellon, Spain.
14	Coordination of museum exhibition artwork sampling strategy (micro-invasive) more suitable to chemical and mineralogical compositional characterization and luminescence dating (Fundação Calouste Gulbenkian; Museu Nacional de Arte Antiga; Museu Nacional do Azulejo, Museu dos Jerónimos). In situ dosimetry for luminescence dating in geological and archaeological contexts (Reguengos de Monsaraz, Beja, Alqueva dam surrounds, and museums (Fundação Calouste Gulbenkian; Museu Nacional de Arte Antiga; Museu Nacional do Azulejo, Museu dos Jerónimos). Field work in the frame of services and contracts.
15	Referee of various works in the following scientific journals: Journal of European Ceramic Meeting; Special issue of the 2nd International Conference on Tiles;
16	Coordination of the service “Cronoestratigrafia em problemáticas arqueológicas identificadas na área de afectação da construção da barragem do Sabor”. EDP. Baixo Sabor – Bento Pedroso Construções e Lena Engenharia e Construções, ACE. 2013 – 2014.
17	Chemical and mineralogical characterization of topsoils of Santiago, Fogo and Brava islands (Cape Verde). Contribution to the construction of the Geochemical Atlas of Cape Verde (according to the IGCP 259 - “International Geochemical Mapping”). Results were presented in international conferences and manuscripts were submitted for publication.
18	Environment” – ARIAS, FCT RECI/AAG-TEC/0400/2012 – contribution for equipment specifications.

PUBLICATIONS

Book chapters

- Dias, M. I. (2013). Geochemistry of Clays of Surficial Materials from the Paleozoic and Cenozoic of Reguengos de Monsaraz Region, Ossa Morena Zone. In: Advances in Geochemical Research. Chapter 7. Editor: J. Sanjurjo. Series: Geology and Mineralogy Research Developments. Earth Sciences in the 21st Century. ISBN: 978-1-62618-245-5. Nova Science Publishers, Inc. p.139-154.
- Pozo, M., Carretero, M.I., Ruiz, F., Olías, M., Abad, M., Rodríguez Vidal, J., Cáceres, L.M., Prudêncio, M.I., Dias, M.I., Muñoz, A.M., Toscano, A. (2013). Geochemistry of lower Pliocene to Holocene formations from the Doñana National Park (SW Spain). In: Advances in Geochemistry Research, Chapter 1. Editor: Jorge Sanjurjo Sánchez. Series: Geology and Mineralogy Research Developments. Earth Sciences in the 21st Century. ISBN: 978-1-62618-245-5, Nova Science Publishers, Inc. p. 1-10.
- ebook: https://www.novapublishers.com/catalog/product_info.php?products_id=40076&osCsid=46545dbe18cc09f1fda02e3f88de5bec

- Dias, M.I., Valera, A.C., Prudêncio, M.I., Rocha, F. (2013). Tecnologias de produção cerâmica e exploração de matérias-primas nos Povoados do Moinho de Valadares 1 e Monte do Tosco 1. In António Valera coord. *As Sociedades Agro-pastoris na margem esquerda do Guadiana (2ª metade do IV aos inícios do II milénio AC)*. Memórias D'Odiana-2ª série. Volume 6. Cap. 8.2. EDIA. Estudos Arqueológicos do Alqueva. p. 189- 203.

PAPERS

International Scientific Magazines

- TRINDADE, M.J., PRUDÊNCIO, M.I., BURBIDGE, C.I., DIAS, M. I., CARDOSO, G., MARQUES, R., ROCHA, F. (2013). Study of an aplite dyke from the Beira uraniferous province in Fornos de Algodres area (Central Portugal): Trace elements distribution and evaluation of natural radionuclides. *Applied Geochemistry*, <http://dx.doi.org/10.1016/j.apgeochem.2013.07.024>
- JORGE, A., DIAS, M.I., DAY, P.M. (2013). Plain pottery and social landscapes: Reinterpreting the significance of ceramic provenance in the Neolithic. *Archaeometry* 55, 5 (2013) 825–851. doi: 10.1111/j.1475-4754.2012.00714.x.
- TRINDADE, M. J., ROCHA, F., DIAS, M. I., PRUDÊNCIO, M.I. (2013). Mineralogy and grain-size distribution of clay-rich rock units of the Algarve Basin (South Portugal). *Clay Minerals* 48 Issue: 1, p. 59-83; DOI: 10.1180/claymin.2013.048.1.04.
- Rodrigues, A.L., Burbidge, C.I., Dias, M.I., Rocha, F., Valera, A., Prudêncio, M.I. 2013. Luminescence and mineralogy of profiling samples from negative archaeological features. *Mediterranean Archaeology and Archaeometry* 13.3, 37-47. ISSN: 1108-9628.
- Trindade, M.J., Prudêncio, M.I., Burbidge, C.I., Dias, M.I., Cardoso, G., Marques, R., Rocha, F. 2013. Distribution of naturally occurring radionuclides (K, Th and U) in weathered rocks of various lithological types from the uranium bearing region of Fornos de Algodres, Portugal. *Mediterranean Archaeology and Archaeometry* 13.3, 71-79. ISSN: 1108-9628.
- Stanojev Pereira, M.A., Marques, J.G., Santos, J.P., Burbidge, C.I. Prudêncio, M.I., Dias, M.I. 2013. Neutron imaging techniques applied in the study of the archaeological and cultural heritage field. *Mediterranean Archaeology and Archaeometry* 13.3, 137-143. ISSN: 1108-9628.
- CRUZ, J. VIRGÍLIO, SILVA, M.O., DIAS, M. ISABEL, PRUDÊNCIO, M. ISABEL (2013). Groundwater composition and pollution due to agricultural practices at Sete Cidades volcano (Azores, Portugal), *Applied Geochemistry*, Volume 29, February 2013, p. 162-173, ISSN 0883-2927, <http://dx.doi.org/10.1016/j.apgeochem.2012.11.009>.
(<http://www.sciencedirect.com/science/article/pii/S0883292712003253>)
<http://dx.doi.org/10.1016/j.apgeochem.2012.11.009>
- DIAS, M.I., PRUDÊNCIO, M.I., MATOS, M.A., RODRIGUES, A.L. (2013). Tracing the origin of blue and white Chinese Porcelain ordered for the Portuguese market during the Ming dynasty using INAA, *Journal of Archaeological Science* 40. Issue 7. p. 3046 - 3057. <http://dx.doi.org/10.1016/j.jas.2013.03.007>
- TRINDADE, M.J., PRUDÊNCIO, M.I., SANJURJO SÁNCHEZ, J., VIDAL ROMANÍ, J.R., FERRAZ, T., FERNÁNDEZ MOSQUERA, D., DIAS, M.I. (2013). Post-depositional processes of elemental enrichment inside dark nodular masses of an ancient aeolian dune from A Coruña, Northwest Spain. *Geologica Acta*, vol. 11, nº 2, June 2013, p.231-244 (DOI: 10.1344/105.000001838).
- M.I. Dias, M.I. Prudêncio, Recent studies on the application of nuclear methods for the construction of a temporality approach on Neolithic and archaeological contexts of Perdígões archaeological site, south Portugal, IAEA TC RER0034 Regional Project – Enhancing the characterization, conservation and protection of cultural heritage artefacts, *Science for Heritage Newsletter* nº 1, 4-5 (2013).

REPORTS

Final reports of 2 FCT funded projects:

- FUNPERD project (PTDC/CS-ANT/104333/2008);

- RUPSCIENCE project PTDC/HIS-ARQ/101299/2008

COMMUNICATIONS

Oral Invited

- *Matérias-Primas e Tecnologias de Produção de azulejos Portugueses (XVII-XX)*, M. I. DIAS. *II Encontro de Património Azulejar: LISBOA HOJE*, Departamento de Património Cultural, Direcção Municipal de Cultura, Câmara Municipal de Lisboa, 6th Dec. 2013.
- *Instrumental Neutron Activation Analysis as a valuable tool to investigate ceramic provenance*. M. I. DIAS. *Budapest Neutron Centre, Hungarian Academy of Sciences, Association of the KFKI Research Institutes EK – WIGNER*, Budapest, Hungary, 2nd July 2013.
- *Matérias-primas e estudos de proveniência de artefactos arqueológicos*. M. I. DIAS. *Workshop 3: Arqueologia e outras ciências: que presente e que futuro? Secção de Arqueologia. Sociedade Portuguesa de Geografia*. 17th April 2013.
- *ROBBIANA – As Esculturas della Robbia em Portugal: estudo histórico, artístico e laboratorial*. M. ISABEL DIAS. *Colóquio DIGITILE E ROBBIANA. Projectos de investigação e disseminação em Azulejaria e Cerâmica. AUDITÓRIO III – FUNDAÇÃO CALOUSTE GULBENKIAN*. 18-19th April 2013.
- *Caracterização composicional de esculturas della Robbia: o Medalhão Fé do Museu Gulbenkian. Resultados Preliminares*. M. ISABEL DIAS, CHRISTOPHER BURBIDGE, M. ISABEL PRUDÊNCIO. *Colóquio DIGITILE E ROBBIANA. Projectos de investigação e disseminação em Azulejaria e Cerâmica. AUDITÓRIO III – FUNDAÇÃO CALOUSTE GULBENKIAN*. 18-19th April 2013.

Oral

- *Esculturas Della Robbia em Portugal: análise da composição das pastas*. DIAS M. ISABEL, TRINDADE M. JOSÉ, PRUDÊNCIO, M. ISABEL, MARQUES, ROSA, FLOR, PEDRO. *X Congreso Ibérico de Arqueometría. Museo de Bellas Artes de Castellón*. 16-18 Outubro 2013.
- *O Campaniforme na Beira-Alta e Alentejo (Portugal): contextos, proveniência e circulação*. DIAS, M. ISABEL & PRUDÊNCIO, M. ISABEL. *X Congreso Ibérico de Arqueometría. Museo de Bellas Artes de Castellón*. 16-18th October 2013.
- *Indicadores geoquímicos de centros produtores de ânforas Lusitanas: Peniche, Tejo, Sado, Algarve*. M. ISABEL DIAS E M. ISABEL PRUDÊNCIO. *Congresso Internacional “Anforas Lusitanas – Produção e Difusão. Troia. Portugal*. 10-13rd October 2013.
- *Authentication and dating of two sets of miniature terracotta high-reliefs by multi-analytical techniques*. Agnès LE GAC, Camila REMONATTO, Teresa I. MADEIRA, Stéphane LONGELIN, Isabel NOGUEIRA, M. Isabel M. DIAS, Christopher BURBIDGE, G. CARDOSO, M. I. PRUDÊNCIO, Luís PIORRO, Marta MANSO, Anísio FRANCO, António CANDEIAS and Maria Luísa CARVALHO. *Technart 2013. Rijksmuseum, Amsterdam, from 23 – 27th September 2013*.
- *Exploring Luminescence Behaviour of Calcitic Archaeological Fill Materials in the Context of Chemical and Mineralogical Composition*. RODRIGUES, A. L., BURBIDGE, C. I., DIAS, M. I., ROCHA, F., PRUDÊNCIO, M. I. *17th Solid State Dosimetry Conference. Recife, Brasil, 22-27th Set. 2013*
- *Raw materials and technology of 17th-20th Portuguese glazed tiles*. DIAS, M. ISABEL, TRINDADE M. JOSÉ, MARQUES, ROSA, PRUDÊNCIO, M. ISABEL. *EMAC 2013 - 12th European Meeting on Ancient Ceramics, 19-21st September 2013, Padova, Italy*.
- *Della Robbia Sculptures in Portugal: neutron techniques applied to provenance issues*. DIAS, M. ISABEL & PRUDÊNCIO, M. ISABEL. *1st International Conference on Neutron Imaging and Neutron Methods in Archaeology and Cultural Heritage Research. Technische Universität München, Garching, Germany In cooperation with the International Atomic Energy Agency (IAEA). September 9-12th, 2013*.
- *Spatial variations of chemical patterns in fine fractions of surficial materials from Brava Island (Cape Verde) – correlation with mineralogy/parent rock*. MARQUES, R., PRUDÊNCIO, M. I., ROCHA, F., SILVA, E. F., DIAS, M. I., MADEIRA, J. *XV International Clay Conference. Universidade Federal do Rio de Janeiro. Rio de Janeiro, RJ, Brazil. July 7-11th, 2013*.

- *Mineralogy and geochemistry of negative archaeological structures in carbonate contexts, Alentejo (Portugal)*. RODRIGUES, A. L., DIAS, M. I., BURBIDGE, C. I., ROCHA, F., PRUDÊNCIO, M. I., CARDOSO, G., FRANCO, D., MARQUES, R. *XV International Clay Conference. Universidade Federal do Rio de Janeiro. Rio de Janeiro, RJ, Brasil. July 7-11th, 2013.*
- *A chemical study of Portuguese archaeological faience by INAA as a valid tool to investigate provenance*. M. ISABEL DIAS, M. ISABEL PRUDÊNCIO, A. PAIS, A. L. RODRIGUES, R. MARQUES. *1º Congresso Internacional de Faiança Portuguesa. Museu Nacional de Arte Antiga, 22-25 May 2013.*

Posters

- *Quinta do Torel glazed tile panel: chemical and mineralogical study of the ceramic body (Lisbon, Portugal)*. M. ISABEL PRUDÊNCIO, M. ISABEL DIAS, SUSANA VARELA FLOR, LEONEL RIBEIRO, M. J. TRINDADE, M. T. BISPO, LAURA TRINDADE, PEDRO FLOR. *X Congresso Ibérico de Arqueometría. Museo de Bellas Artes de Castellón. 16-18th October 2013.*
- *The Della Robbia Sculptures of the National Museum of Ancient Art, Portugal*. M. ISABEL DIAS, M. JOSÉ TRINDADE, M. ISABEL PRUDÊNCIO, ROSA MARQUES, PEDRO FLOR, ANÍSIO FRANCO. *EMAC 2013 - 12th European Meeting on Ancient Ceramics, 19-21 September 2013, Padova, Italy.*
- *Neutron techniques applied to better define conservation strategies of 16th – 18th centuries Portuguese glazed tiles*. M. ISABEL PRUDÊNCIO, & M. ISABEL DIAS. *1st International Conference on Neutron Imaging and Neutron Methods in Archaeology and Cultural Heritage Research. Technische Universität München, Garching, Germany In cooperation with the International Atomic Energy Agency (IAEA). September 9-12th, 2013.*
- *Neolithic Occupation and Mid-Holocene Pedogenetic Features at Palácio Dos Lumiars Site (Lisbon, Portugal): Geochemical and Mineralogical Considerations*. M. I. DIAS & M. I. PRUDÊNCIO. *XV International Clay Conference. Universidade Federal do Rio de Janeiro. Rio de Janeiro, RJ, Brasil. July 7-11th, 2013.*
- *Archeometric Studies of Ceramic “Sugar Jars” From Aveiro, Lisbon and Madeira Regions (Portugal)*. F. ROCHA, P. MORGADO, A. QUINTELA, D. TERROSO, M. I. DIAS. *XV International Clay Conference. Universidade Federal do Rio de Janeiro. Rio de Janeiro, RJ, Brasil. July 7-11th, 2013.*
- *Alteration Materials of a Pyroclastic Succession in Cabeça Fundão, Fogo Island (Cape Verde) - Geochemical and Mineralogical Variations*. R. MARQUES, M. I. PRUDÊNCIO, F. ROCHA, M. I. DIAS, E. F. SILVA, D. FRANCO. *XV International Clay Conference. Universidade Federal do Rio de Janeiro. Rio de Janeiro, RJ, Brasil. July 7-11th, 2013.*
- *Distribution of Trace Elements in Schistous Weathered Materials from the Ordovician (Omz), Alentejo, Portugal*. A. L. RODRIGUES, M. I. DIAS, F. ROCHA, M. I. PRUDÊNCIO. *XV International Clay Conference. Universidade Federal do Rio de Janeiro. Rio de Janeiro, RJ, Brasil. July 7-11th, 2013.*

EDUCATION

- Supervisor, Ph. D. Thesis, *Geoquímica, mineralogia e luminescência de materiais geo-arqueológicos circundantes à barragem do Alqueva*, by Ana Luisa Rodrigues, Universidade de Aveiro, ongoing (2010-2014).
- Co-supervisor, Graduation Project, (FAD/UL–2012-2023/05) *Património escultórico em terracota policromada - dois conjuntos setecentistas de altos-relevos miniaturais do Museu Nacional de Arte Antiga*. Camila Mortari Remonato, Licenciatura em Ciências da Arte e do Património da Faculdade de Belas Artes da Universidade de Lisboa.
- Master degree in “*Teoria e Métodos da Arqueologia*”. Universidade do Algarve. Curricular Unit: “Arqueometria”. Thematic Unit: *Análises de proveniência de matérias-primas de materiais arqueológicos*.

PROJECTS

Running

- *The Della Robbia sculptures in Portugal: History, Art and Laboratory (ROBBIANA)*, PTDC/HIS-HEC/116742/2010. Coordenador of Project: FCSH/UNL (P. Flor). Outros parceiros: FL/UL; FCG; IGESPAR; MNAA; IHA/FCSH/UNL (2012-2015). IST/ITN Coordinator: M. I. Dias.
- *Death management in Recent Prehistory: funerary practices in Perdigões enclosure (FUNPERD)*, PTDC/CS-ANT/104333/2008. Coordenador of Project: FCT/UC (A. M. Silva). Outros parceiros: Era Arqueologia SA (2010-2012). IST/ITN Coordinator: M. I. Dias.
- *Analysis of the operational chains, archaeometry and chronology of Rock Art Paintings. An approach to materials technology of Portugal, Spain and Colombia's contexts (RUPSCIENCE)*, PTDC/HIS-ARQ/101299/2008. Coordenador of Project: IPT (L. Osterbeek). Outros parceiros: UTAD, UA. (2009-2011). IST/ITN Coordinator: M. Isabel Dias.

Submitted

- *“Stone idols from Chalcolithic Perdigões ditched enclosures (Southern Portugal): Funerary practices, raw materials and interaction networks”*. CHARISMA 7th FP. Cultural Heritage Advanced Research Infrastructures. Synergy for a multidisciplinary approach to conservation/restoration. Fixlab Plataforma B – Budapest Research Reactor. Submission of research project BNC (Cudapest Neutron Centre).
- *Back To The Source: Provenance And Circulation Of Bell Beakers*. COST Project: COST Trans-Domain Proposal Open Call 2013-2. Proposal Reference oc-2013-2-17345. Evolving the participation at a European level of more 9 country partners (Austria, Switzerland, Czech Republic, Spain, France, United Kingdom, Hungary, Italy, Netherlands). Main proposer: M. I. Dias
- *European Network On Tracing Hidden Ancient flavours*. COST Project: COST Trans-Domain Proposal Open Call 2013-2. Proposal Reference oc-2013-2-17303. Evolving the participation at a European level of more 12 country partners (Croatia, Romania, Sweden, Austria, Turkey, United Kingdom, France, Spain, Germany, Cyprus, Italy). Secondary proposer: M. I. Dias
- *Estudio de los elementos de adorno personal*. Convocatoria de Ayudas para proyectos arqueológicos en el exterior, 2013. Dirección General de Bellas Artes y Bienes Culturales y de Archivos y Bibliotecas (Ministerio de Educación, Cultura y Deporte), Spain. Coordinator: Carlos Odriozola, Universidad de Sevilla. Partners C2TN, U. Coimbra, U. Lisboa, U. Valladolid. Submitted. CTN responsible chemical and mineralogical issues. CTN responsible chronological issues: C. Burbidge
- *Nature, Society and Monumentality: High-Resolution Archaeological Research of the Antequera Megalithic Landscape- MEGA*. “Convocatoria de ayudas a Proyectos de I+D «EXCELENCIA» do Subprograma de Generación de Conocimiento, Subdirección General de Proyectos de Investigación do Ministerio de Economía y Competitividad, Spain, 2013; Coordinator: Leonardo Garcia Sanjuan da Universidade de Sevilha, Spain.

SCIENTIFIC COMMITTEES

- President of the Directive Board of the “Sociedad de Arqueometría Aplicada al Patrimonio Cultural”.
- Member of the Organization of the X Conference on Iberian Archaeometry, Castellon, Spain.

COLLABORATIONS

Collaboration with national and international scientists/Universities:

- Doctor Zsolt Kasztovszky – BNC-Centre for Energy Research. Collaboration in Nuclear Analysis (PGAA) and Radiography (NR).

- Professor Zoltan Szokefalvi-Nagy - BNC-Wigner Research Centre for Physics, Department of Biophysics. Collaboration in PIXE experiments.
- Doctor Imre Kovac - BNC-Wigner Research Centre for Physics, Department of Biophysics. Collaboration in PIXE experiments.
- Prof. Fernando Rocha - University of Aveiro: Member, GeoBioTec Research Team, UA; collaboration in clay science: Clays and biological systems interactions; NORM; Natural Nuclear risks and Harmful effects.
- Prof. Fernando Ruiz - University of Huelva: Geochemistry of clays and geoenvironments.
- Doctor Manuel Abad - University of Huelva: Geochemistry of clays and geoenvironments.
- Doctor C. Odriozola - Univ. Seville: Archaeometry: chemical and mineralogical composition of Bell Beakers from Chalcolithic archaeological sites of Guadiana basin.
- Doctor J. Sanjurjo – Univ. Corunha: Geochemistry and archaeometry: geochemistry of the earth surface and luminescence dating.
- Doctor L. Garcia - Univ. Seville: Archaeometry: chemical and mineralogical composition of pre-historic archaeological contexts and artefacts.
- As President of the Iberian Society "Sociedade de Arqueometria Aplicada ao Património Cultural" (SAPaC) – scientific activities were performed with directive board of the society, particularly with: Secretary and Treasurer Clodoaldo Roldán García (Universidad de Valencia), Vowels Josefina Perez-Arategui (Universidad de Zaragoza), Blanca Gómez Tubío (Universidad de Sevilla) and Yolanda Carrión Marco (CSIC).

NAME: Christopher Ian Burbidge

CATEGORY: Auxiliary Researcher (invited)

IST-ID: 5491

ACTIVITIES

Nº	Activity Description	R&D (%)
1	Principal Investigator. FCT project PTDC/AAC-AMB/121375/2010.	40
2	Coordinator and Investigator Responsible - Portugal. Convénio Portugal (FCT) / Itália (CNR) 2011-2012.	3
3	Co-investigator. IAEA Technical Cooperation Project RER/0/034	3
4	Co-investigator. FCT project PTDC/CS-ANT/104333/2008	5
5	Co-investigator. FCT project PTDC/HIS-HEC/101756/2008	10
6	Co-investigator. FCT project PTDC/HIS-ARQ/101299/2008	10
7	Collaborative research: GeoBioTeC(UA) and IST/CTN	2
8	Preparation and submission of proposals for research projects.	2
9	Supervision and Teaching	10
10	Review and Editorial	10
11	European Radiation Dosimetry Group	3
12	Preparation of publications in relation to previous services and projects	2
Total		100

WORK SUMMARY

Nº	Work Summary and Main Achievements
1	<p>Principal Investigator. Spatial Variation of Dose Rate in Soils and Sediments - VADOSE. PTDC/AAC-AMB/121375/2010. €198k. Coordinator of Project: ITN (C.I. Burbidge). Partners: U. Aveiro, GEOBIOTEC (Portugal), SUERC (U.K.).</p> <p>Work on this project in 2013 focussed on mineralogical, geochemical and radiometric analyses of different granulometric fractions prepared from the soil samples taken in 2012, and on enclosure dosimetry in bulk samples in the laboratory. Calibrations of and tests of different systems used for dosimetry and radiometrics, as well as radiation transport modelling studies, were continued. The laboratory of the project consultant was visited to conduct calibration of field gamma spectrometry systems. Research by students associated</p>

	<p>with the project is investigating relationships between luminescence dosimetric behaviour of minerals with environmental geochemistry, and dose rates from cosmic radiation at shallow depths. Implementation of high resolution gamma spectrometry analyses through the project has been applied to collaborative research on the radioactivity of geological materials used as topical applications.</p> <p>Work related to the project has been presented at the International Congress of Metrology 2013, the 1st International Conference on Neutron Imaging and Neutron Methods in Archaeology and Cultural Heritage Research, the 17th International Conference on Solid State Dosimetry, and at the WG10 sessions of the EURADOS annual meeting 2013. In addition to 1 publication listed in indicators, two publications are in press.</p>
2	<p><i>Project Coordinator and Investigator Responsible-Portugal. Processos Luminescentes-Dosimetricos no Quartz. italia128584682220330. Convénio Portugal (FCT) / Itália (CNR) 2011-2012. Investigator Responsible-Italy, Prof. M. Martini, CUDaM, UNIMIB. Extended: end march 2013.</i></p> <p>This project established a basis in international collaboration for the development of new understanding of trapping, transport and recombination of the electronic charges that produce dosimetric luminescence signals in quartz. The results indicate relationships between a variety of phenomena that are important for understanding the luminescence-dosimetric behaviour in quartz, and also directions for future analyses.</p> <p>Quartz grains were prepared from Portuguese granite and aplite-pegmatite samples, and measured using optically and thermally stimulated luminescence (OSL, TSL), radio-luminescence (RL) and ionoluminescence (IL), following activation and annealing up to 1100 °C/1hr. Higher temperature and longer wavelength emissions were more prominent from the aplite-pegmatitic quartz. An emission peak ca. 495 nm is absent or very weak in both quartzes: although the 365 nm peak still exhibits predose dependent activation, subsequent deactivation with irradiation is reduced compared to previously reported samples. Increases in sensitivity of up to 10⁵ times following annealing and activation occur in the Ultraviolet (UV) emission (365 nm) of both sample types, and in the Orange-Red emission from the aplite-pegmatitic quartz. Sensitivity and sensitization of the Orange-Red TSL emission was related to silanols. Lags in sensitization of the activated UV emission indicate that de-hydrogenation enables subsequent re-trapping of alkali ions. Annealing effects were stable over 18 months except for decreases in UV emissions, indicating reoccupation of Al related hole traps.</p>
3	<p><i>Co-investigator. Technical Cooperation Project - IAEA TC Project RER/0/034 "Enhancing the Characterization, Preservation and Protection of Cultural Heritage Artefacts". M. Isabel Prudêncio: Portuguese nuclear scientist nominated, designated Responsible Person from Counterpart Institute (Instituto Superior Técnico) (2012-2013).</i></p> <p>Two one week scientific visits were conducted in the scope of this project: IAEA Scientific visits POR/13001V (Burbidge = visiting scientist) and SRB13008V (Burbidge = host), between IST/C²TN and the National Museum of Serbia. Training in each host institution focussed on methods used in the characterization of archaeo-metallurgical sites and materials of the Mt Kosmaj region, Serbia, including the local raw materials (geology), history of technological development (history/archaeology) and preservation and environmental effects. Samples were taken of metallurgical waste (slags) and stratigraphically related archaeological materials (bricks / ceramics) and sediments, to generate a chrono-sequence of human-environment interaction using luminescence dating. Geochemical and in-situ radiometric analyses, and are complementing mineralogical and petrographic analyses. Knowledge exchange has lead to significant improvements in sample preparation and analysis protocols. Analyses are underway. Shared interests, established through the scientific visits and related meetings with scientists and local government representatives in each country, led to participation in one COST project proposal. Activities of 2012 in this project were presented at the WG10 sessions of the EURADOS annual meeting 2013.</p>

4	<p><i>Co-investigator. Gestão da morte na Pré-História Recente: práticas funerárias no recinto dos Perdigões. PTDC/CS-ANT/104333/2008. FCT, €142k. Coordinator of Project: UC, Centro de Investigação em Antropologia (Ana M. Silva). Partners: NIA-ERA Arqueologia S.A. ITN.</i></p> <p>Quantitative dating analysis was conducted on 17 ceramic sherds and 30 regolith samples, and semi-quantitative luminescence profiling analysis was made in the sedimentary sequences of 2 ditches. Results from fills of 2 ditches and a variety of pits were similar to or older than 14C results, which in turn were greater than archaeological expectations (early as opposed to late 3rd millennium in Chalcolithic contexts). Neolithic contexts yielded results of decreasing age with depth from the mid- 5th to late- 4th millennia BC. Stratigraphically related ceramic, regolith and profiling samples from the wide ditch encircling the site, indicated construction of the wide ditch encircling the site around the time the early Chalcolithic ceramics accumulated in its environs, and abandonment in the mid-late Chalcolithic. Other results, including from the underside of a fallen orthostat, indicate Chalcolithic fills and artefacts affected by landscape instability in the 17th century AD. The combination of luminescence dating of soils/sediments and ceramic sherds, with stratigraphically detailed profiling provided the most powerful combination for dating both archaeological assemblages and their contexts of accumulation, and interpreting any differences between these.</p>
5	<p><i>Co-investigator. Diagnóstico, descontaminação e conservação da herança cultural: neutrões e radiação ionizante em objectos de arte (RADIART). PTDC/HIS-HEC/101756/2008. FCT, €140k. Coordinator of Project: ITN (M. Isabel Prudêncio). Partners: IMC.</i></p> <p>Having evaluated and performed high-dose radiation treatment monitoring of historic tiles, and assisted in neutron tomography studies, luminescence dating analyses of ca. 30 untreated historic tiles are presently underway. Quartz grains ca. 11-40 micron have been prepared and are being evaluated for their luminescence-dosimetric behavioural characteristics.</p>
6	<p><i>Co-investigator. RUPSCIENCE - Analysis of the operational chains, archaeometry and chronology of Rock Art Paintings. An approach to materials technology of Portugal, Spain and Colombia's contexts. PTDC/HIS-ARQ/101299/2008. FCT, €84k. Coordinator of Project: IPT (Luiz Oosterbeek). Other partners: ITN; UTAD; GIPRI, Bogota; IRP-UPV, Valencia; MAE/USP, São Paulo.</i></p> <p>Shards of quartzite with traces of pigment on their surfaces, blocks of quartzite substrate and local soil were taken from sites in eastern Portugal and western Spain. Pieces of natural ochre (potential raw materials) from the locale of the Portuguese site were subjected to a firing experiment and their luminescence characteristics tested. A piece of ochre from the Spanish site was tested as-found. Evaluation of dose rates in these environments was made in situ by field gamma spectrometry. The ochres indicated the potential of quartz extracted from this material for dating of activities related to the production of rock art, and the ochre from the Spanish site yielded a date estimate consistent with late prehistory, though this remains subject to large uncertainties in its radiation environment and in radionuclide uptake or loss as a function of time. Insufficient ochre was obtained from the quartzite shards to enable similar analyses of the rock art itself, but the luminescence behaviour of the quartzite was found sufficiently different from the ochre to indicate potential approaches to the isolation of signals appropriate for dating.</p>
7	<p><i>Collaborative work as associated investigator of GeoBioTeC – GeoBioSciences, GeoTechnologies and GeoEngineering UA, and in the scope of ongoing research and service projects in IST/CTN.</i></p> <p>Work with GeoBioTeC has focussed on the application of high resolution gamma spectrometry for the evaluation of activity concentrations of K, Th, U in samples of geological materials relevant to topical application for skin therapy; and evaluation of indications of disequilibrium in the U series, with the aim of contributing to evaluation of this pathway for radiation exposure of clients and workers.</p> <p>Collaborative work on the project ROBIANA has included field gamma spectrometry</p>

	<p>survey of historic buildings, and micro-invasive sampling of the ceramic pastes of statues and medallions. Initial testing of the luminescence-dosimetric characteristics of this material has been conducted, and preparation of defined grain-size fractions has been made for the samples with more material.</p>
8	<p><i>Preparation and submission of proposals for research projects.</i> I have been involved in three project submissions in 2013:</p> <ul style="list-style-type: none"> • COST proposal for analytical investigation of the composition and chronology of historic Orthodox Art across Europe (responsible Portugal; listed in indicators). • Proposal to the Spanish Ministerio de Educación, Cultura y Deporte for the development and testing of luminescence dating methodology applied to ancient jewellery and megalithic monuments. • FP7 proposal related to the sustainable extraction and processing of rare earth elements. <p>In addition to proposals in which I have some responsibility, listed in indicators, I participated in the following proposal: <i>ENVIREE (ENVironmentally friendly and efficient methods for extraction of Rare Earth Elements from primary and secondary sources)</i> Submitted to the first ERA-MIN Joint Call on Sustainable and responsible supply of primary resources (2013). Coordinator Partners: CUT-Sweden (VINNOVA), UST and INCT-Poland (NCBR), AICU-Romania (UEFISCDI), IPFN-Portugal (FCT), AU-Finland (TEKES). Co-investigator. Submitted – not funded.</p>
9	<p><i>Supervision and Teaching.</i> Teaching activities focussed on the delivery of laboratory and practical classes in Mechanics and Waves to first year students of Chemical Engineering, in the Department of Physics of IST.</p> <ul style="list-style-type: none"> • The FCT Doctoral Fellowship SFRH/BD/62396/2009, co-supervised with U. Aveiro and associated with the VADOSE project, has continued. Experimental work on soil and rock samples in this study is now finishing; data analysis to establish luminescence based chronologies is at an advance stage. Presentations and publications have focussed on relating luminescence sensitivity of sand sized quartz grains to the geochemistry of their burial environments. One published paper and two presentations at international conferences are listed in indicators. • A Masters Dissertation Project, cosupervised with DF-IST and associated with the VADOSE project is investigating energy deposition by cosmic radiation in soils and sediments of different lithologies. Measurements have been made of background radioactivity, the cosmic radiation spectrum, and its attenuation by 100 kg soil samples in the laboratory, using NaI gamma spectrometers and TLDs. Field measurements of background above and in water have been conducted. Experimental configurations are being simulated using GEANT4. • An Undergraduate Dissertation Project, cosupervised with UNL, investigated the mineralogy, geochemistry and chronology of two sets of miniature terracotta high-reliefs from the Museu Nacional de Arte Antiga. The student was introduced to the preparation and analysis of samples for luminescence dating.
10	<p><i>Review and Editorial.</i></p> <ul style="list-style-type: none"> • Guest Editor, LAIS2012 Special issue, Mediterranean Archaeology and Archaeometry. • Evaluation of a project proposal to the Ministero dell’Istruzione, dell’Università e della Ricerca, Italy. • Reviewer of articles submitted to Radiation Measurements, Quaternary Geochronology, Spectroscopy Letters, Quaternary Research. • External Examiner, MSc thesis, Rhodes University, South Africa.
11	<p><i>European Radiation Dosimetry Group: Member and WG Secretary.</i> As a full member of EURADOS and Secretary of Working Group 10 “Retrospective dosimetry”, I attend each annual meeting, maintain contact details of WG members, prepare and collate minutes of group meetings etc. The annual meeting is a medium for establishing participation in international exercises, continuing professional development, and</p>

	<p>dissemination of C²TN research activities.</p> <p>EURADOS Annual Meeting 2013. EURADOS Annual Meeting 2013. Escola Tècnica Superior d'Enginyeria Industrial de Barcelona (ETSEIB), Barcelona (4-8/02/2013) including the 6th EURADOS Winter School "Status and Future Perspectives of Computational Micro- and Nanodosimetry".</p> <p>At the EURADOS AM2013 I made two oral presentations (listed below). During 2013 I participated in the RENEB/EURADOS OSL/TL Intercomparison (retrospective dosimetry using electronic components from mobile phones), including a scientific visit for training at IRSN, Paris. Results from the previous round of intercomparisons were presented at SSD17 (listed in indicators) and have been submitted for publication in Radiation Measurements.</p>
12	<p><i>Preparation of publications in relation to previous services and projects:</i></p> <p>In addition to 2 publications listed below, 1 book section and 2 articles have been submitted for publication:</p> <ul style="list-style-type: none"> • Costas, S., Rebêlo, L., Brito, P., Burbidge, C.I., Prudêncio, I., FitzGerald, D. Submitted. The joint history of Tróia peninsula and Sado ebb-delta. In. Sand and gravel spits. Coastal Research Library. Springer. • Odriozola, C.P., Burbidge, C.I., Dias, M.I., Hurtado, V. Accepted-In Press. Las Mesas walled enclosure (La Fuente, Spain). Trabajos de Arqueologia. • Richter, D., Angellucci, D.E., Dias, M.I., Gouveia, M.A., Prudêncio, M.I., Cardoso, G., Burbidge, C.I., Zilhão, J. 2014. Heated flint from Gruta de Oliveira (Portugal): comparison of TL-dating results with radiocarbon and U-series dating. <i>Journal of Archaeological Science</i> 41, 705-715. ISSN: 0305-4403.

PUBLICATIONS

- Rodrigues, A.L., Burbidge, C.I., Dias, M.I., Rocha, F., Valera, A., Prudêncio, M.I. 2013. Luminescence and mineralogy of profiling samples from negative archaeological features. *Mediterranean Archaeology and Archaeometry* 13.3, 37-47. ISSN: 1108-9628.
- Stanojev Pereira, M.A., Marques, J.G., Santos, J.P., Burbidge, C.I. Prudêncio, M.I., Dias, M.I. 2013. Neutron imaging techniques applied in the study of the archaeological and cultural heritage field. *Mediterranean Archaeology and Archaeometry* 13.3, 137-143. ISSN: 1108-9628.
- Trindade, M.J., Prudêncio, M.I., Burbidge, C.I., Dias, M.I., Cardoso, G., Marques, R., Rocha, F. 2013. Distribution of naturally occurring radionuclides (K, Th and U) in weathered rocks of various lithological types from the uranium bearing region of Fornos de Algodres, Portugal. *Mediterranean Archaeology and Archaeometry* 13.3, 71-79. ISSN: 1108-9628.
- Rebêlo, L., Costas, S., Brito, P., Ferraz, M., Prudêncio, I., Burbidge, C. 2013. Imprints of the 1755 tsunami in the Tróia Peninsula shoreline, Portugal. In: Conley, D.C., Masselink, G., Russell, P.E. and O'Hare, T.J. (eds.), Proceedings 12th International Coastal Symposium (Plymouth, England), *Journal of Coastal Research*, Special Issue No. 65, 814-819. ISSN: 0749-0208.
- Sanderson, D.C.W., Burbidge, C.I., Kinnaird, T.C. 2013. Appendix 2 Optically Stimulated Luminescence Dating. In. O'Connell, A. Harvesting the Stars. A pagan temple at Lismullin, Co Meath. Grogan, E. (ed.), NRA Scheme Monographs 11. Dublin, National Roads Authority, 146-149. ISBN: 978-0-9754380-0-2.

COMMUNICATIONS

- Authentication and dating of two sets of miniature terracotta high-reliefs by multi-analytical techniques. Le Gac, A., Remonatto, C., Madeira, T.I., Longelin, S., Nogueira, I., Dias, M.I., Burbidge, C.I., Cardoso, G., Prudêncio, M.I., Piorro, L., Manso, M., Franco, A., Candeia, A., Carvalho, M.L. Rijksmuseum, Amsterdam, 23 - 27 September 2013. Oral.

- Characterization of archaeological sites in carbonate contexts from Alentejo (Portugal) - mineralogy and geochemistry. Rodrigues, A.L., Dias, M.I., Burbidge, C.I., Rocha, F., Prudêncio, M.I., Cardoso, G., Franco, D., Marques R. International Clay Conference 07-11 July 2013 Rio de Janeiro – Brazil. Oral.
- TSL, OSL, RL and IL signals and emissions from HF etched grains of quartz from Portuguese granite and aplite-pegmatite. Burbidge, C.I., Martini, M., Fasoli, M., Alves, L., Cardoso, G., Villa, I. 17th International Conference on Solid State Dosimetry. 22-27 September, 2013, Recife, Brazil. Poster.
- Retrospective radiation dosimetry using OSL on electronic components: results of an inter-laboratory intercomparison. Bassinet, C., Woda, C., Bortolin, E., Della Monaca, S., Fattibene, P., Quattrini, M.C., Bulanek, B., Ekendahl, D., Burbidge, C., Cauwels, V., Correcher, V., Kouroukla, E., Geber-Bergstrand, T., Piaskowska, A., Marczevska, B., Bilski, P., Sholom, S., McKeever, S., Smith, R., Veronese, I., Galli, A., Panzeri, L., Martini, M. 17th International Conference on Solid State Dosimetry. 22-27 September, 2013, Recife, Brazil. Poster.
- Monte-carlo simulations of the irradiator on a Risø reader. Teles, P., Burbidge C.I. 17th International Conference on Solid State Dosimetry. 22-27 September, 2013, Recife, Brazil. Poster.
- Exploring luminescence behaviour of calcitic archaeological fill materials in the context of chemical and mineralogical composition. Rodrigues, A.L., Burbidge, C.I., Dias M.I., Rocha F., Prudêncio M.I. 17th International Conference on Solid State Dosimetry. 22-27 September, 2013, Recife, Brazil. Poster.
- EURADOS WG 10 activities on uncertainties in physical and biological dosimetry. Ainsbury, E.A., Bassinet, C., Bernhardsson, C., Burbidge, C., Chumak, V., Cauwels, V., Correcher, V., Della Monaca, S., Fattibene, P., Geber, T., Lund, E., Mattsson, S., Michalec, B., Rääf, C., Veronese, I., Christiansson, M., Vinnikov, V., Wieser, A., Woda, C., Trompier, F. EPR Biodose 2013, March 24-28, 2013. Leiden, The Netherlands. Poster.
- IAEA TC Project RER/0/034 Enhancing the Characterization, Preservation and Protection of Cultural Heritage Artefacts, Regional Training Course on Radiation Technology for Cultural Heritage Preservation. Instituto Superior Técnico/ Instituto Tecnológico e Nuclear, 5th - 9th November 2012. Director: M. Isabel Prudêncio. Burbidge, C.I., EURADOS Annual Meeting 2013. Escola Tècnica Superior d'Enginyeria Industrial de Barcelona (ETSEIB), Barcelona (4-8/02/2013). Oral.
- VADOSE, a new project to investigate spatial variations in dose rate in soils and sediments. Burbidge, C.I., Teles, P.M., Prudêncio, M.I., Trindade, M.J., Reis, M.J., Andrejkovicova, S., Sanderson, D.C.W., Rocha, F., Cardoso, J.V., Carvalho, G., Abrantes, J., Marques, R., Cardoso, G.J.O., Romanets, Y., Santos, L., Franco, D., Sequeira, M.C., Gouveia, M.A. EURADOS Annual Meeting 2013. Escola Tècnica Superior d'Enginyeria Industrial de Barcelona (ETSEIB), Barcelona (4-8/02/2013). Oral.

EDUCATION

- Co-supervisor. FCT Doctoral Fellowship SFRH/BD/62396/2009, *Geoquímica, mineralogia e cronologia absoluta de materiais geo-arqueológicos circundantes à barragem do Alqueva. Contribuição para o conhecimento e valorização do património cultural*, by A. L. Sebastião Rodrigues. Supervisor Prof. F. Rocha. Co-supervisors M. I. Dias (A. Valera). Partners: ITN, UA, NIA-ERA Arqueologia S.A. Ongoing.
- Cosupervisor Masters Dissertation Project “*Measurement and Modelling of the energy deposited from Cosmic Rays in soils and sediments of different lithologies*” Tiago Ambaram. Departamento de Física, IST, UL. Supervisor Patricia Gonçalves LIP. Ongoing.
- Co-supervisor, Graduation Project, (FAD/UL–2012-2023/05) *Património escultórico em terracota policromada - dois conjuntos setecentistas de altos-relevos miniaturais do Museu Nacional de Arte Antiga*. Camila Mortari Remonato, Licenciatura em Ciências da Arte e do Património da Faculdade de Belas Artes da Universidade de Lisboa.
- Invited Lecturer Team, Physics Department, Instituto Superior Técnico. Mechanics and Waves Practical and Laboratory Classes.
- External examiner, MSc Thesis, Thermoluminescence characteristics of synthetic quartz, Mr P. Niyonzima. Dept. Physics, Rhodes University, South Africa.

PROJECTS

- *Spatial Variation of Dose Rate in Soils and Sediments - VADOSE*. PTDC/AAC-AMB/121375/2010. €198k. Coordinator of Project: ITN (C.I. Burbidge). Partners: U. Aveiro, GEOBIOTEC (Portugal), SUERC (U.K.). Principal Investigator (40%).
- *Processos Luminescentes-Dosimetricos no Quartzzo*. italia128584682220330. Convénio Portugal (FCT) / Itália (CNR) 2011-2012 (extended to finish 31 March 2013). Investigator Responsible-Italy, Prof. M. Martini, CUDaM, UNIMIB. Project Coordinator and Investigator Responsible-Portugal.
- *Orthodox Art in the Ottoman Empire – Scientific and Technical Research and Revaluation*. COST TDP proposal oc-2013-2-16682. Main Proposer: Dr Magdalena Stoyanova (CISBI-Ca'Foscari, Venezia). Secondary Proposer (Responsible Portugal). Submitted.
- *Estudio de los elementos de adorno personal*. Convocatoria de Ayudas para proyectos arqueológicos en el exterior, 2013. Dirección General de Bellas Artes y Bienes Culturales y de Archivos y Bibliotecas (Ministerio de Educación, Cultura y Deporte), Spain. Coordinator: Carlos Odriozola, Universidad de Sevilla. Partners C2TN, U. Coimbra, U. Lisboa, U. Valladolid. Submitted. CTN responsible chemical and mineralogical issues: M. I. Dias. CTN responsible chronological issues: C. Burbidge

COLLABORATIONS

- IAEA Scientific visits POR/13001V (Burbidge = visiting scientist) and SRB/13008V (Burbidge = host), between IST/C²TN and the National Museum of Serbia. In the scope of IAEA Technical Cooperation Project RER/0/034 “Enhancing the Characterization, Preservation and Protection of Cultural Heritage Artefacts”. M. Isabel Prudêncio: Portuguese nuclear scientist nominated, designated Responsible Person from Counterpart Institute (Instituto Superior Técnico) (2012-2013).
- Scientific visit to IRSN, Paris (Burbidge = visiting scientist). For training as part of the RENEB (FP7, EURATOM)/EURADOS OSL/TL Intercomparison (retrospective dosimetry using electronic components from mobile phones).
- EURADOS Annual Meeting 2013. Escola Tècnica Superior d'Enginyeria Industrial de Barcelona (ETSEIB), Barcelona (4-8/02/2013) including the 6th EURADOS Winter School "Status and Future Perspectives of Computational Micro- and Nanodosimetry".
- Secretary, EURADOS WG10 “Retrospective dosimetry”.
- Guest Editor, L.A.I.S. 2012 special issue. Mediterranean Archaeology and Archaeometry 13(3).
- Review of project proposal to the Ministero dell'Istruzione, dell'Università e della Ricerca, Italy
- Reviewer of articles submitted to Radiation Measurements, Quaternary Geochronology, Spectroscopy Letters, Quaternary Research.
- Associated Member, GeoBioTec Research Team, Universidade de Aveiro.
- Member, Sociedad de Arqueometría Aplicada al Patrimonio Cultural.
- Member, Quaternary Research Association.