



# PIXE

MEXICO  
2007

**PROCEEDINGS OF THE  
XI INTERNATIONAL CONFERENCE ON  
PARTICLE INDUCED X-RAY EMISSION  
AND ITS ANALYTICAL APPLICATIONS**

**Editors:**

**J. Miranda, J. L. Ruvalcaba-Sil,  
O. G. de Lucio**

**ORGANIZED BY  
UNIVERSIDAD NACIONAL AUTÓNOMA DE MÉXICO  
BENEMÉRITA UNIVERSIDAD AUTÓNOMA DE PUEBLA  
INSTITUTO NACIONAL DE INVESTIGACIONES NUCLEARES**

**IN COLLABORATION WITH  
INTERNATIONAL ATOMIC ENERGY AGENCY  
CENTRO LATINOAMERICANO DE FÍSICA  
SOCIEDAD MEXICANA DE FÍSICA**



# PROCEEDINGS OF THE XI INTERNATIONAL CONFERENCE ON PIXE AND ITS ANALYTICAL APPLICATIONS

## Editors:

J. Miranda, J.L. Ruvalcaba-Sil, O.G. de Lucio.

## PIXE 2007 logo

J. Manuel Martínez Trens  
Luis G. Miranda

## Cover Picture

Mosaic at the *Santuario de Nuestra Señora de Guadalupe*, Puebla.  
J.L. Ruvalcaba-Sil

## Printed by

Instituto de Física, Universidad Nacional Autónoma de México.

© Universidad Nacional Autónoma de México, 2007  
ISBN 978-970-32-5115-5

*Mexico City, November 2007.*

## Disclaimer

The contents of papers published in this book are the responsibility of the authors. Organizers are not responsible for facts published and the technical accuracy of data presented. The editors also apologize for any possible error caused by electronic transmission and processing of materials.

## PIXE 2007 Sponsors



## COMMITTEES

### INTERNATIONAL ADVISORY COMMITTEE

---

|                    |                |
|--------------------|----------------|
| G.W. Grime (Chair) | United Kingdom |
| J.L. Campbell      | Canada         |
| D.D. Cohen         | Australia      |
| A. Denker          | Germany        |
| B.L. Doyle         | USA            |
| K. Ishii           | Japan          |
| Erh Kang Lin       | Taiwan         |
| J. Knox            | USA            |
| W. Maenhaut        | Belgium        |
| K.G. Malmqvist     | Sweden         |
| P.A. Mandò         | Italy          |
| J. Miranda         | Mexico         |
| W. Przybylowicz    | South Africa   |
| C. Ryan            | Australia      |
| Z. Smit            | Slovenia       |
| Z. Szökefalvi-Nagy | Hungary        |
| M. Uda             | Japan          |
| Sha Yin            | China          |

### CONFERENCE PROGRAM COMMITTEE

---

|              |           |
|--------------|-----------|
| L. Beck      | France    |
| B.L. Doyle   | USA       |
| F. Lucarelli | Italy     |
| T. Osipowicz | Singapore |
| M.A. Reis    | Portugal  |
| Z. Smit      | Slovenia  |

### LOCAL ORGANIZING COMMITTEE

---

|                          |                                   |
|--------------------------|-----------------------------------|
| J. Miranda<br>(Chairman) | J.L. Ruvalcaba-Sil<br>(Secretary) |
| J. Rickards              | A. Oliver                         |
| L. Rodríguez             | J.C. Cheang-Wong                  |
| A. Crespo-Sosa           | C. Solís                          |
| V. Rodríguez-Lugo        | E. Andrade                        |
| M. Lugo-Licona           | J.A. Aspiazu                      |
| G. Murillo               | N.R. Rebollo                      |

# Foreword

The analytical technique X-ray spectrometric method Particle Induced X-ray Emission, (PIXE) is currently applied in many fields of knowledge, enhancing the understanding of the Physics underlying the interaction of ion beams with matter, related to the processes that originate PIXE, as well as the improvements in the instrumentation. For example, the development of the nuclear microprobe was strongly linked to PIXE. The wide capacities of this technique allowed its spreading around the world, so in 1976, the First International Conference on PIXE and its Analytical Applications took place in Lund, Sweden.

After this first encounter, an outstanding tradition was initiated with subsequent PIXE conferences (Lund 1980, Heidelberg 1983, Tallahassee 1986, Amsterdam 1989, Tokyo 1992, Padua 1995, Lund 1998, Guelph 2001, and Portoroz 2004). These meetings shared a common high scientific standard, while they also encouraged the social and cultural exchange among attendants.

The past PIXE Conferences showed the advances in the area. Examples of recent research include the use of high energy proton beams for materials characterization, the study of biological tissues *in vivo*, analysis of extraterrestrial materials, development and application of micro- and nano-beams for PIXE and related techniques, improvements in the X-ray detection systems, and investigations about the basic physical phenomena involved in the application of PIXE. Nonetheless, this research is still posing unanswered questions.

PIXE has been applied in Mexico for almost 30 years. Mexican scientists have participated continuously in the PIXE conferences since Tokyo 1992, so the International Advisory Committee (IAC) accepted the bid of the Mexican groups, presented in Portoroz, Slovenia, in 2004, to organize the Eleventh International Conference on PIXE and its Analytical Applications. This event was held in the city of Puebla, Mexico, from May 25 to May 29, 2007.

The city of Puebla offered a historical environment (both colonial and prehispanic), that enhanced the friendly interaction of more than 110 participants from 27 countries. There were 44 oral presentations in 12 sessions, while a total of 92 posters were displayed in two sessions. Furthermore, two round tables with Archaeometry and Environmental applications as main topics took place, as well as a workshop for the explanation of the new quantitative analysis software GUPIXWIN. The subjects of the sessions were classified as Basic Physical Principles, Advances in Experimental Devices, Biology and Biomedical Sciences, Arts and Archaeology, Environmental Sciences, Materials Science, and Complementary Analytical Methods. The concluding remarks of the Conference were presented by Dr. Geoff W. Grime, Chair of the IAC.

As this was the first time this conference was awarded to a developing country, it was pleasant to have a strong participation of scientists from other emergent nations, especially (but not limited to) countries in Africa and Latin America. This way, the conference allowed the interaction of young scientists and students from these geographical areas with the most prestigious PIXE scientists.

Furthermore, an accompanying persons program, with more than 15 participants, was scheduled, including visits to several interesting places in the surroundings of Puebla. The traditional excursion in the PIXE conferences had to be adjusted in the last minute due to damage produced by a storm to the prehispanic site of Cacaxtla, so the colonial sites of Huejotzingo, Cholula, and San Francisco Acatepec were visited.

As in the case of PIXE 2004 in Slovenia, proceedings for many presented works in PIXE 2007 are published in this volume, electronic format. There was a rigorous refereeing process, in order to maintain or improve the scientific level of other PIXE conferences. Furthermore, the International Advisory Committee selected a limited number of papers for publication in this special issue of *X-ray Spectrometry* (XRS), following the strict refereeing process established by XRS. The publication of these works in this prestigious journal will also benefit those users of PIXE, worldwide, that could not attend the Conference, as well as future scientists.

Although it was not possible to have an exhibit of companies related to the ion beam analysis area, National Electrostatics Corp., High Voltage Engineering, Oxford Microprobes, and John Wiley & Sons supported the Conference. Additionally, the International Atomic Energy Agency and the Centro Latinoamericano de Física sponsored the participation of Latin-American scientists and students.

The proposal presented by the group from the University of Surrey, United Kingdom, led by Dr. Geoff W. Grime, to host the 12<sup>th</sup> International Conference on PIXE and its Analytical Applications, was accepted by the IAC, in June 2010. We hope this will be an even more successful event than the previous PIXE Conferences.

Only with the support of many people the PIXE 2007 Conference could take place. In particular, it is necessary to mention Dr. Pedro Hugo Hernández-Tejeda and Dr. Ventura Rodríguez-Lugo (Benemérita Universidad Autónoma de Puebla), and their team, especially María del Carmen Herrera; the collaboration of Leonor Báez and Patricia Carranza (Sociedad Mexicana de Física), as well as the hard work of Valter Barrera, Alberto Espinosa and Juan Reyes-Herrera. Finally, the editions of these proceedings and the book of abstracts were mostly due to the invaluable work of Marcelo Lugo-Licona, Raquel Noria, Grisell Reyes and Óscar de Lucio. The support of Dr. Ana Maria Cetto (International Atomic Energy Agency) was always encouraging. Certainly, the group at Instituto de Física, UNAM (José Luis Ruvalcaba-Sil, Corina Solís, Alejandro Crespo-Sosa, Luis Rodríguez-Fernández, Juan Carlos Cheang-Wong, and Alejandra López-Suárez) had a fundamental role in this Conference. Thanks to all of them.

*Javier Miranda*

Chair, PIXE 2007 Organizing Committee

# PIXE

MEXICO

2007



# PIXIE

MEXICO

2007



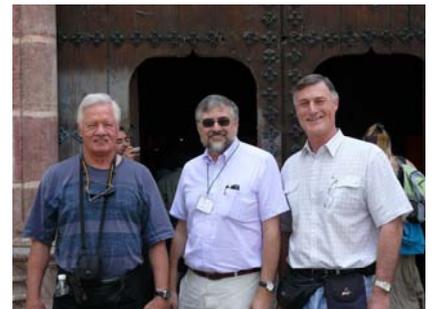
# PIXICO 2007



# PIXE

MEXICO

2007





- |                           |                             |                           |                            |
|---------------------------|-----------------------------|---------------------------|----------------------------|
| 1 Juan Reyes-Herrera      | 33 Brian Perley             | 60 Graciela Perez         | 86 Karim Butalag           |
| 2 Robert G. Flocchini     | 34 Aya Ishii                | 61 David Watt             | 87 Zoltan Szókefalvi-Nagy  |
| 3 Paul Wakabayashi        | 35 Klas Malmqvist           | 62 Belinda Colston        | 88 Rainer Siegele          |
| 4 Nicholas Boyd           | 36 Gianluca Quarta          | 63 Pedro A. Miranda       | 89 Héctor Somacal          |
| 5 Allison Lattner         | 37 Daniele Ceccato          | 64 Carin Lapicki          | 90 Miguel A. Respaldiza    |
| 6 Sheryl Flocchini        | 38 Ari Ide Ektessabi        | 65 Vladimir Havranek      | 91 Giuseppe Calvi          |
| 8 Melanie Webb            | 39 Américo Sansigolo Kerr   | 66 Hiromi Nakazawa        | 93 Andrés J. Kreiner       |
| 10 Carlos M. R. Kröger    | 40 Geoff W. Grime           | 67 Isabelle Henry         | 94 José Luis Ruvalcaba-Sil |
| 11 Alessandro Borghi      | 41 Chis Jeynes              | 69 James Turner           | 95 Juan Carlos Cheang-Wong |
| 12 Katsumi Saitoh         | 42 Miguel Domínguez         | 70 Willy Maenhaut         | 96 Giuseppe Pappalardo     |
| 13 Johnny Ferraz Dias     | 44 Nidia Majerowicz         | 71 Gregory Lapicki        | 97 Thomas A. Cahill        |
| 14 Zsófia Kertész         | 45 Andreas-Germanos Karydas | 72 Estela Romero          | 98 Keiko Terakawa          |
| 17 Guirec Querré          | 46 Pier A. Mandó            | 73 Rafael Correa Devés    | 99 Stjepko Fazinic         |
| 18 Koichiro Sera          | 47 Erick Dobos              | 74 Magda Klaeys           | 100 Guy Demortier          |
| 19 Lila S. Rojo           | 48 Kenya Días de Cunha      | 75 A. de la Torre Saucedo | 101 Katsumi Saitoh         |
| 21 Floyd D. McDaniel      | 49 Moni Behar               | 76 Paula Cristina Chaves  | 102 Satoshi Harada         |
| 22 Carolina Gutiérrez     | 50 Brian Jones              | 77 Eduardo Andrade        | 103 Carlos A. Pineda V.    |
| 23 Lucile Beck            | 51 Javier García-López      | 78 Franco Lucarelli       | 104 Novella Grassi         |
| 24 Michiko Sera           | 52 Adriana E. Perez         | 79 Fin Folkmann           | 105 Federico González      |
| 26 Valter Armando Barrera | 53 Dimosthenis Sokaras      | 80 Priscila Santos        | 106 David D. Cohen         |
| 27 Thomas Calligaro       | 54 Victoria Purewal         | 81 Alexandra Rodrigues    | 107 Jan Olof Lill          |
| 28 Rebecca Vinson         | 56 Gloria Vaggelli          | 82 Corina Solís           | 108 Miguel A. Reis         |
| 29 Keizo Ishii            | 57 Helena Calvo             | 83 Ziga Smit              |                            |
| 30 Barney Doyle           | 58 Patricia Carranza        | 84 Mateja Kos             |                            |
| 31 Jorge Rickards         | 59 Javier Miranda           | 85 Frederico Figueiredo   |                            |

## ORAL SESSIONS

### **Session B. Basic physical principles & Advances in experimental devices**

*Chairperson: F.D. McDaniel*

- B-1. Invited Talk. **Theory of atomic bremsstrahlung based on Binary Encounter Approximation.** *K. Ishii.*
- B-2. **PIXE-PAGE analysis by scanning proton microprobe.** *A. Kocsonya, I. Kovács, Z. Szőkefalvi-Nagy, S. Lüthje, D. Hopff and M. Niecke.*
- B-3. **Silicon detector deadlayer thickness estimates using proton bremsstrahlung from low atomic number targets.** *D.D. Cohen, E. Stelcer, R. Siegele, M. Ionescu.*
- B-4. **Elemental concentrations in aerosol samples determined by Artificial Neural Networks from PIXE spectrum.** *M.I. Dinator, R. Correa, I. Requena and J.R. Morales.*

### **Session C. Biology and biomedical sciences**

*Chairperson: Z. Szőkefalvi-Nagy*

- C-2. **The characterisation of a contaminant-free support film for microPIXE analysis of biological samples.** *R.J. Southworth-Davies, A. Scothern, K. Leath, G.W. Grime and E.F. Garman.*
- C-3. **Micro-PIXE studies of elemental distribution in mycorrhizal and nonmycorrhizal roots of Ni-hyperaccumulator *Berkheya coddii*.** *E. Orłowska, J. Mesjasz-Przybyłowicz, W. Przybyłowicz, and K. Turnau.*
- C-4. **Localisation of trace metals in hyper-accumulating plants using  $\mu$  PIXE.** *R. Siegele, N. Bhatia, M. Ionescu and D.D. Cohen.*

### **Session D. Biology and biomedical sciences**

*Chairperson: F. Folkmann*

- D-2. **Micro-PIXE analysis of bioconductive hydroxyapatite coatings on titanium alloy.** *C.A. Pineda-Vargas, M. Topić, T. Ntsoane and W.J. Przybyłowicz.*
- D-3. **The identification of historic biocide residues on herbarium material at the National Museum Wales.** *V. Purewal, B. Colston, S. Roehrs.*
- D-4. **Nuclear microprobe studies of grasshopper feeding on nickel hyperaccumulating plants.** *M. Augustyniak, W. Przybyłowicz, J. Mesjasz-Przybyłowicz, M. Tarnawska, P. Migula, E. Głowacka, A. Babczyńska.*
- D-5. **Daily changes of elemental concentration in a human body over 218 days obtained by quantitative analyses of beard samples.** *K. Sera, J. Itoh, Y. Saitoh and S. Futatsugawa.*

### **Session E. Complementary analytical techniques and other topics**

*Chairperson: B.L. Doyle*

- E-2. **Micro-PIXE determination of Zr in rutile: an application to geothermometry of high-P rocks from the Western Alps (Italy).** *G. Vaggelli, A. Borghi, S. Calusi, R. Cossio, L. Giuntini, B. Lombardo, M. Massi.*

### **Session F. Arts and archaeology**

*Chairperson: J.L. Ruvalcaba-Sil*

- F-1. Invited Talk. **PIXE in the study of archaeological and historical glass.** *T. Calligaro*
- F-3. **Characterization of white pigments and paint layers by simultaneous PIXE and RBS.** *L. Beck, P. C. Gutiérrez, J. Salomon, Ph. Walter, M. Menu.*



## **Session G. Complementary analytical techniques & Arts and archaeology**

*Chairperson: F. Lucarelli*

- G-1. Invited Talk. **Benefits of combined PIXE and AMS with new accelerators.** G. Demortier and L. Calcagnile
- G-4. **The contribution of the LNS portable PIXE system for the examination of gold preparations in the miniatures of the 492 code (Pontificale) preserved at the Museo Diocesano in Salerno.** L. Pappalardo, M. Bicchieri, M. Nardone, G. Pappalardo, F.P. Romano, P.A. Russo, A. Sodo.

## **Session H. Environmental sciences**

*Chairperson: M.A. Respaldiza*

- H-2. **Application of PIXE technique for identification of occupational exposure to Tantalum.** K.C. Dália, R. Jean, C.M. Lima, L. Barros, C.V. Santos Nascimento, G.E. Medeiros, L. Carneiro, K. Dias da Cunha.

## **Session I. Environmental sciences**

*Chairperson: W. Przybyłowicz*

- I-1. **Detection of atmospheric aerosol sources at São Paulo City by PIXE analysis.** A. A. F. S. Kerr, T. G. Veríssimo, S. Gioia, M. Babinski.
- I-2. **Chemical composition and mass closure for PM<sub>2.5</sub> and PM<sub>10</sub> aerosols at K-pusztá, Hungary, in summer 2006.** W. Maenhaut, N. Raes, X. Chi, J. Cafmeyer and W. Wang

## **Session K. Materials science & Advances in experimental devices**

*Chairperson: L. Beck*

- K-3. **Particulate screening using micro-PIXE and multivariate statistical analysis.** B.L. Doyle, J.C. Banks, P.G. Kotula and A.J. Antolak.

## **POSTER SESSION I**

### **Basic physical principles**

- PI-2. **Empirical approximation for  $L_{\alpha}$  production cross-sections.** *Ž. Šmit and A. Tancek.*
- PI-3. **Mo L X-rays relative yield ion energy dependence.** *P. C. Chaves, M. Kavčič, M.A. Reis.*
- PI-4. **Measurement of K–L radiative vacancy transfer probabilities in rare earth elements bombarded with 3 MeV–4 MeV protons.** *J. Reyes-Herrera and J. Miranda.*
- PI-6. **Comparison of Gd-K and L X-rays RYIED and proton-NMRD.** *M.A. Reis, P.C. Chaves, A. Tabora, A. Carvalho.*

### **Advances in experimental devices**

- PI-8. **A new target chamber for simultaneous Ion Beam Analysis at the University of Chile.** *P. A. Miranda, J. Wachter, and J. R. Morales.*
- PI-12. **Development of an ion microprobe setup for complex elemental analysis of individual microparticles.** *Zs. Kertész, A. Simon, Z. Szikszai, E. Dobos, G. Á. Sziki, I. Uzonyi.*

### **Biology and biomedical sciences**

- PI-13. **Microbeam analysis of yellow sand dust particles.** *S. Matsuyama, K. Ishii, H. Yamazaki, Y. Kikuchi, Y. Kawamura, R. Oyama, T. Yamamoto, A. Ishizaki and M. Genki.*
- PI-15. **Improved radiosensitive liquid core microcapsules for the targeting of chemotherapeutic agents.** *S. Haradat, S. Ehara, K. Ishii, H. Yamazaki, S. Matsuyama, T. Sato, S. Oikawa, T. Kamiya, K. Arakawa, K. Sera, J. Ito.*
- PI-19. **PIXE analysis of some medicinal plants usually extracted and drunk as tea, beverage, or used as spice or flavor in Nigeria.** *S.O. Olabanji, S.K. Adesina, D. Ceccato, M.C. Buoso, and G. Moschini.*

### **Environmental sciences**

- PI-21. **Elemental mapping of plants using submilli-PIXE camera.** *H. Yamazaki, K. Ishii, S. Matsuyama, Y. Kikuchi, Y. Takahashi, Y. Kawamura, R. Watanabe, K. Tashiro and C. Inoue.*
- PI-22. **The use of biomonitors and PIXE analysis in the study of air pollution in Mexico City.** *L. Cervantes, O. Avila, J.L. Ruvalcaba, J. Miranda, R. Muñoz.*
- PI-23. **PIXE and  $\mu$ -PIXE analysis of biological records in environmental studies.** *L. Calcagnile, K. Butalag, G. Quarta, L. Maruccio.*
- PI-24. **Effects on the elemental concentration in growth tree ring due to Popocatepetl volcano exhalations.** *A. R. Cruz-Muñoz, L. Rodríguez Fernández, G. Calva-Vázquez, and J. L. Ruvalcaba-Sil.*
- PI-25. **Relationship between soil composition and the distribution of three *Manfreda* (*Agavaceae*) in Mexico.** *N. Martínez-Nava, R. Ríos-Gómez, E. Solano-Camacho, M. Ayala, L. Rodríguez Fernández, J. Reyes-Herrera and L. Caballero-Pagaza.*
- PI-26. **Uncertainty evaluation in quantities obtained from PIXE elemental analysis of atmospheric aerosols.** *A. Espinosa, J. Miranda, and J.C. Pineda.*



- PI-28. **Atmospheric levels and elemental composition of fine and coarse aerosols during wet and dry season campaigns at two sites in Tanzania.** *W. Maenhaut, N. Raes, and S. Mkomu.*
- PI-32. **Intercomparison of aeolian dust elemental concentrations via PIXE and ICP-AES.** *L. Rojo, T. Gill, and M. Barnes.*

### **Earth sciences**

- PI-33. **Identification of Saharian sand storms by PIXE from 1995 to 2006.** *M.A. Reis, G. Dias, A. Quaresma, P.C. Chaves.*
- PI-34. **Composition of mineral aerosols generated in the Salt Basin of Far West Texas (USA) using PIXE and complementary techniques.** *A. E. Perez and Th. E. Gill.*
- PI-36. **The Aznalcollar disaster: An in-depth PIXE study of the pirite mine spill of 1998.** *H. Calvo del Castillo, J.L. Ruvalcaba, M.A. Álvarez, T. Calderón.*

### **Arts and archaeology**

- PI-41. **PIXE analysis of artefacts from radiocarbon dated archaeological contexts.** *G. Quarta, L. Calcagnile, K. Butalag, L. Maruccio and M.D'Elia.*
- PI-42. **Analysis of 19th century Mexican postage stamps by PIXE.** *Th. E. Gill.*
- PI-47. **Non destructive study of gilded tumbaga artifacts from the Chichén-Itza cenote.** *J. Contreras, J.L. Ruvalcaba Sil, J. Arenas Alatorre.*
- PI-48. **PIXE and Ionoluminescence for Mesoamerican jadeite characterization.** *J.L. Ruvalcaba Sil, L. Manzanilla, E. Melgar, R. Lozano Santa Cruz.*
- PI-50. **PIXE analysis of obsidians from Teotihuacan.** *J. Gazzola, M. Sánchez del Río, C. Solís and T. Calligaro.*

## **POSTER SESSION II**

### **Advances in experimental devices**

- PII-1. **DT2 a PIXE spectra simulation and fitting program.** *M.A. Reis, P.C. Chaves, C. Pascual-Izarra, L.C. Alves, N. P. Barradas.*
- PII-2. **New high energy and high resolution Lisbon PIXE set-up.** *P.C. Chaves, M.A. Reis, E. Alves.*
- PII-3. **Status report of Sasaki Taro memorial PIXE Center.** *A. Terakawa, T. Sasaki, K. Ishii, U. Kawamura, K. Sera, H. Sasaki.*
- PII-5. **Radiographic technique for densitometric studies using heavy ion microbeams.** *J. Muscio, H. Somacal, A.A. Burlon, M. E. Debray, A. J. Kreiner, J. M. Kesque, D. M. Minsky and A.A. Valda.*

### **Complementary analytical techniques**

- PII-7. **Characterization of natural and synthetic zeolites using ion beam analysis techniques.** *E. Andrade, J.M. Aceves, R. Miranda, C. Solis, J. Cruz, M.F. Rocha and E.P. Zavala.*
- PII-8. **Cleaning wastewater from ammonium with the mineral vermiculite –Using PIGE for nitrogen monitoring.** *J-O. Lill, J. Rajander, , L. Harju, K-E. Saarela, A. Lindroos and S-J. Heselius.*

### **Biology and biomedical sciences**

- PII-11. **Application of micro-PIXE and dynamic analysis for the characterization of human hard tissues.** *M.E.M Eisa, C.A. Pineda-Vargas, U.M.E. Chikte, A.L. Rodgers, S. Naidoo, J.L. Conradie.*
- PII-13. **An elemental analysis of Periphyton: A natural source of phosphorus in the wetlands of the Mayan region of Quintana Roo, Mexico.** *S. Palacios-Mayorga, A. López-Suárez, L. Huerta, and A. Gómez-Pompa.*
- PII-14. **PIXE analysis of some Nigerian pharmacological plants.** *S.O. Olabanji, O.R. Omobuwajo, D. Ceccato, M.C. Buoso, and G. Moschini.*

### **Environmental sciences**

- PII-17. **Trace metals in the sea grass *Thalassia Testudinum* from Mexican Caribbean coasts.** *C. Solís, K Isaac-Olivé, A. Martínez, E. Lavoisier, Z. Ruiz, LM Rivera.*
- PII-19. **Zinc profiles in archaeological and modern teeth.** *A.-M. M. Williams and R. Siegele.*
- PII-22. **High airborne Chlorine in micro or sub-micrometer particles.** *M.A. Reis, G. Dias, A. Quaresma, P.C. Chaves, N. Franco, N. P. Barradas, L.C. Alves.*
- PII-23. **Seasonal variability in atmospheric aerosol levels and elemental composition during 2006 at Uccle, Belgium.** *W. Maenhaut, N. Raes, H. De Backer, and A. Cheymol.*
- PII-24. **Detailed aerosol and elemental mass size distributions during winter and summer campaigns in Ghent, Belgium.** *N. Raes and W. Maenhaut.*
- PII-25. **Comparison of Debrecen fine fraction aerosol data with others collected in some European collaboration.** *E. Dobos, I. Borbély-Kiss, Zs. Kertész, Gy. Szabó and E. Koltay.*
- PII-26. **Time resolved elemental component study of urban aerosol in Debrecen, Hungary.** *Zs. Kertész, E. Dobos, B. Fenyő, R. Kéki, and I. Borbély-Kiss*



- PII-27. **Elementary composition of particles PM<sub>2.5</sub> present in urban areas of Baja California, Mexico.** M.C.Castañón Bautista, G.C.Diaz Trujillo, F. Wakida, J. Miranda.
- PII-28. **PIXE technique used for characterization of human exposure to mineral sand dust particles.** K Dias da Cunha, C.V. Barros Leite.
- PII-29. **Analysis by PIXE of underground water from Ixtaxochitla, Puebla.** F. González, E. Romero, J. Vargas, C. Solís, and J. Miranda.
- PII-31. **Development of sample preparation method for engine lubricating oil analysis using in-air PIXE.** K. Saitoh, T. Ishikawa, H. Iso, S. Hasegawa, A. Fushimi, S. Kobayashi, K. Tanabe, T. Konishi and H. Imaseki.

### **Earth sciences**

- PII-32. **Particle size/composition relationships of wind-eroding sediments, Owens Lake, California, USA.** L. Rojo, Th. Gill and D. Gillette.
- PII-33. **PIXE Based Geochemical Characterization of the Pluvial Lake Palomas – Samalayuca Dunes Corridor System, Chihuahua, México.** M. Domínguez-Acosta, and T.E. Gill.

### **Arts and archaeology**

- PII-38. **Long distance transport of Neolithic variscite ornaments along the European Atlantic arc demonstrated by PIXE analysis.** G. Querré, F. Herbault and T. Calligaro.
- PII-43. **The Grolier Codex: A PIXE & RBS study of the possible Maya document,** H. Calvo del Castillo, J.L. Ruvalcaba, T. Calderón, M. Van der Meeren and L. Sotelo
- PII-44. **Study of damage induced by ion beam in white pigments.** P. C. Gutiérrez, L. Beck
- PII-46. **Proton Beam Characterization of Bone Remains from the Middle Mesoamerican Formative.** L. Couoh, J.L. Ruvalcaba Sil.



*XI International Conference on PIXE and its Analytical Applications*  
*Puebla, Mexico, May 25-29, 2007*

## **AUTHOR INDEX**

## Oral sessions

---

### A

Antolak A.J., K-3  
Augustyniak M., D-4

### B

Babczyńska A., D-4  
Babinski M., I-1  
Banks J.C., K-3  
Barros L., H-2  
Beck L., F-3  
Bhatia N., C-4  
Bicchieri M., G-4  
Borghi A., E-2

### C

Cafmeyer J., I-2  
Calcagnile L., G-1  
Calusi S., E-2  
Calligaro T., F-1  
Carneiro L., H-2  
Chi X., I-2  
Cohen D.D., B-3, C-4  
Colston B., D-3  
Correa R., B-4  
Cossio R., E-2

### D

Dália K.C., H-2  
Demortier G., G-1  
Dias da Cunha K., H-2  
Dinator M.I., B-4  
Doyle B.L., K-3

### F

Futatsugawa S., D-5

### G

Głowacka E., D-4  
Garman E.F., C-2  
Gioia S., I-1  
Giuntini L., E-2  
Grime G.W., C-2  
Gutiérrez P. C., F-3

### I

Ionescu M., B-3, C-4  
Ishii K., B-1  
Itoh J., D-5

### J

Jean R., H-2

### K

Kanngießer B., B-2  
Karydas A.G., B-2  
Kerr A.A. F. S., I-1  
Kotula P.G., K-3

### L

Leath K., C-2  
Lima C.M., H-2  
Lombardo B., E-2

### M

Maenhaut W., I-2  
Malzer W., B-2  
Massi M., E-2  
Medeiros G.E., H-2  
Menu M., F-3  
Mesjasz-Przybyłowicz J., C-3,  
D-4  
Migula P., D-4  
Morales J.R., B-4

### N

Nardone M., G-4  
Ntsoane T., D-2

### O

Orłowska E., C-3

### P

Pappalardo G., G-4  
Pappalardo L., G-4  
Pineda-Vargas C.A., D-2  
Przybyłowicz W., C-3, D-4  
Przybyłowicz W.J., D-2  
Purewal V., D-3

### R

Raes N., I-2  
Requena I., B-4  
Roehrs S., D-3  
Romano F.P., G-4  
Russo P.A., G-4

### S

Saito Y., D-5  
Salomon J., F-3  
Santos Nascimento C.V., H-2  
Scothern A., C-2  
Sera K., D-5  
Siegele R., B-3, C-4  
Sodo A., G-4  
Sokaras D., B-2  
Southworth-Davies R.J., C-2  
Stelcer E., B-3  
Szökefalvi-Nagy Z., B-2

### T

Tarnawska M., D-4  
Topić M., D-2  
Turnau K., C-3

### V

Vaggelli G., E-2  
Veríssimo T. G., I-1

### W

Walter Ph., F-3  
Wang W., I-2

## Posters

---

### A

Aceves J.M., PII-7  
Adesina S.K., PI-19  
Álvarez M.A., PI-36  
Alves E., PII-2  
Alves L.C., PII-1, PII-22  
Andrade E., PII-7  
Arakawa K., PI-15  
Arenas Alatorre J., PI-47  
Avila O., PI-22  
Ayala M., PI-25

### B

Barnes M., PI-32  
Barradas N.P., PII-1, PII-22  
Barros Leite C.V., PII-28  
Beck L., PII-44  
Borbély-Kiss I., PII-25, PII-26  
Buoso M.C., PI-19, PII-14  
Burlon A.A., PII-5  
Butalag K., PI-23, PI-41

### C

Caballero-Pagaza L., PI-25  
Calcagnile L., PI-23, PI-41  
Calderón T., PI-36, PII-43  
Calva-Vázquez G., PI-24  
Calvo del Castillo H., PI-36, PII-43  
Calligaro T., PI-50, PII-38  
Carvalho A., PI-6  
Castañón Bautista M.C., PII-27  
Ceccato D., PI-19, PII-14  
Cervantes L., PI-22  
Chaves P.C., PI-3, PI-6, PI-33, PII-1, PII-2, PII-22  
Cheymol A., PII-23  
Chikte U.M.E., PII-11  
Conradie J.L., PII-11  
Contreras J., PI-47  
Couoh L., PII-46  
Cruz J., PII-7  
Cruz-Muñoz A.R., PI-24

### D

De Backer H., PII-23  
Debray M.E., PII-5  
D'Elia M., PI-41  
Dias G., PII-22, PI-33  
Dias da Cunha K., PII-28  
Diaz Trujillo G.C., PII-27

Dobos E., PI-12, PII-25, PII-26  
Domínguez-Acosta M., PII-33

### E

Eisa M.E.M., PII-11  
Espinosa A., PI-26

### F

Fenyős B., PII-26  
Franco N., PII-22  
Fushimi A., PII-31

### G

Gazzola J., PI-50  
Gill T. E., PI-32, PI-34, PI-42, PII-32, PII-33  
Gillette D., PII-32  
Gómez-Pompa A., PII-13  
González F., PII-29  
Gutiérrez P.C., PII-44

### H

Haradat S., PI-15  
Harju L., PII-8  
Hasegawa S., PII-31  
Herbault F., PII-38  
Heselius. S-J., PII-8  
Huerta L., PII-13

### I

Imaseki H., PII-31  
Inoue C., PI-13  
Isaac-Olivé K., PII-17  
Ishii K., PI-13, PI-15, PI-21, PII-3  
Ishikawa T., PII-31  
Ishizaki A., PI-21  
Iso H., PII-31  
Ito J., PI-15

### K

Kamiya T., PI-15  
Kavčič M., PI-3  
Kawamura Y., PI-13, PI-21  
Kawamura U., PII-3  
Kéki R., PII-26  
Kertész Zs., PI-12, PII-25, PII-26  
Kesque J.M., PII-5  
Kikuchi Y., PI-13, PI-21  
Kobayashi S., PII-31  
Koltay E., PII-25  
Konishi T., PII-31

Kreiner A.J., PII-5

### L

Lavoisier E., PII-17  
Lill J-O., PII-8  
Lindroos A., PII-8  
López-Suárez A., PII-13

### M

Maenhaut W., PI-28, PII-23, PII-24  
Martínez A., PII-17  
Martínez-Nava N., PI-25  
Maruccio L., PI-23, PI-41  
Matsuyama S., PI-13, PI-15, PI-21  
Melgar E., PI-48  
Minsky D.M., PII-5  
Miranda P.A., PI-8  
Miranda J., PI-4, PI-22, PI-26, PII-27, PII-29  
Miranda R., PII-7  
Mkoma. S., PI-28  
Morales. J.R., PI-8  
Moschini G., PII-14, PI-19  
Muñoz. R., PI-22  
Muscio J., PII-5

### N

Naidoo S., PII-11

### O

Oikawa S., PI-15  
Olabanji S.O., PI-19, PII-14  
Omobuwajo O.R., PII-14  
Oyama R., PI-21

### P

Palacios-Mayorga S., PII-13  
Pascual-Izarra C., PII-1  
Perez A.E., PI-34  
Pineda J.C., PI-26  
Pineda-Vargas C.A., PII-11

### Q

Quaresma A., PI-33, PII-22  
Quarta G., PI-23, PI-41  
Querré G., PII-38

## Posters

---

### R

Raes N., PI-28, PII-23, PII-24  
Rajander J., PII-8  
Reis M.A., PI-3, PI-6, PI-33,  
PII-1, PII-2, PII-22  
Reyes-Herrera J., PI-4, PI-25  
Ríos-Gómez R., PI-25  
Rivera LM, PII-17  
Rocha M.F., PII-7  
Rodgers A.L., PII-11  
Rodríguez Fernández L., PI-24,  
PII-25  
Rojo L., PI-32, PII-32  
Romero E., PII-29  
Ruiz Z., PII-17  
Ruvalcaba-Sil J.L., PI-22, PI-24,  
PI-36, PI-47, PI-48, PII-43,  
PII-46

### S

Saarela K-E., PII-8  
Saitoh K., PII-31  
Sánchez del Río M., PI-50  
Sasaki T., PII-3

Sasaki H., PII-3  
Sato T., PI-15  
Sera K., PI-15, PII-3  
Siegele R., PII-19  
Simon A., PI-12  
Šmit Ž., PI-2  
Solano-Camacho E., PI-25  
Solis C., PI-50, PII-7, PII-17,  
PII-29  
Somacal H., PII-5  
Sotelo L., PII-43  
Szabó Gy., PII-25  
Sziki G.A., PI-12  
Szikszai Z., PI-12

### T

Taborda A., PI-6  
Takahashi Y., PI-13  
Tanabe K., PII-31  
Tancek A., PI-2  
Tashiro K., PI-13  
Terakawa A., PII-3

### U

Uzonyi I., PI-12

### V

Valda A. A., PII-5  
Van der Meeren M., PII-43  
Vargas J., PII-29

### W

Wachter J., PI-8  
Wakida F., PII-27  
Watanabe R., PI-13  
Williams A.-M. M., PII-19

### Y

Yamamoto T., PI-21  
Yamazaki H., PI-13, PI-15, PI-  
21,

### Z

Zavala E.P., PII-7

Esta obra se concluyó  
en el mes de Noviembre de 2007  
en el Instituto de Física,  
Universidad Nacional Autónoma de México  
Cto. de la Investigación Científica s/n  
México, D.F., 04510 MÉXICO

La edición consta de 150 ejemplares

# PIXE

MEXICO

2007

© Universidad Nacional Autónoma de México, 2007

ISBN 978-970-32-5115-5



9 789703 251155