Profile of Activities:

International Centre for Environmental and Nuclear Sciences (ICENS)  
Jamaica

Richard Annells
Director General, ICENS

15th Meeting of the Coordinating Council of COMSATS  
TÜBİTAK – MRC, Gebze Kocaeli, Turkey, 24th - 25th May 2012
ICENS was inaugurated in 1984 by the Government of Jamaica and the University of the West Indies (UWI) as a node of the COMSATS global network of Centres of Excellence for research and training in selected areas of science and technology of critical importance for sustainable socio-economic development in the Developing World.

ICENS is affiliated to the Ministry of Science, Technology, Energy and Mining and the University of The West Indies (Mona)
Core Purposes of ICENS

ICENS is an enabler and catalyst for multidisciplinary research and progressive science and technology innovation (STI) to improve the environment, natural resource base and socio-economic advancement of Jamaica.

ICENS investigates the chain:

bedrock ► soil ► plants and animals ► humans

by:

• Geochemical analysis of rocks, soils, plants, animals and pollution and their effects on agriculture, foodstuffs and human health, using applied nuclear sciences and advanced laboratory instrumentation

• Converting the resulting data and storing it for conversion into multidimensional information and visualisations such as GIS

• Transforming the information into knowledge which it shares through online networks to provide high-level decision makers with options for policy and actions

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ICENS Personnel and Equipment

- 18 scientists and engineers
- 8 administration and support staff
- 3 laboratories

- SLOWPOKE research reactor (20kW) and NAA
- EDXRF and TXRF
- ICP-OES and AAS
- Computer systems for:
  - Data banks, information banks
  - Converting analytical data to information
  - GIS visualisation of information

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Long-Term Strategic Initiatives of ICENS

Multi-use geochemical mapping of the Jamaican environment
To support mineral exploration, land use and natural hazard assessment, food safety and health, new materials research, water resources, coastal zone management, education, training and tourism

Data, information and knowledge production and dissemination
Well-structured, sustainably curated digital databases and information systems to make scientific and technical information and know-how available online in formats including GIS images for end-users including the public

Peaceful uses of nuclear energy in Jamaica
Use of the SLOWPOKE research reactor as a neutron source for neutron activation analysis (NAA) and for scoping the future uses of nuclear energy and peripheral technologies

Specialised Services
Provision of national radiation monitoring services to hospitals, clinics and the Port Authority

Collaborations and strategic partnerships
Research collaborations and partnerships with other specialist members of the national and international research and stakeholder communities, including TWAS, the Developing World Academy of Sciences, which has 90 member countries

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ICENS Current Research Fields

Carried out by:

**Reactor & Neutron Activation Analysis (NAA) Laboratory**
- Analysis of 51 elements in soils, foods and human tissues related to age and gender in the Jamaican population
- Use of unstable isotopes of Se, Be to trace land degradation (IAEA-ARCAL RLA5062)

**Spectrometer Laboratory (ICP-OES and AAS)**
- Inorganic chemical analysis of Jamaican farmed food crops for 17-20 elements
- Stable isotope ratio analysis of potentially toxic elements in soils and speciation of isotope cycling and uptake in plants (metallophytes)
- Trace element geochemistry of Jamaican bedrock

**Computer Laboratory**
- Developing/maintaining data repositories for all samples and analytical results
- Transforming data into georeferenced information and knowledge (GIS maps)
- Sharing information through online and broadband networks e.g. C@ribNET

**General Projects**
- Collaboration with Department of Geology and Mines and UWI Geology to compile a new online Jamaica Geological and Mineral Occurrence Map to guide future development
- Devising new uses for industrial and agricultural waste products to substitute imports and create new jobs: e.g. low-cost pozzolanic cements

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<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power</td>
<td>20kW</td>
</tr>
<tr>
<td>Flux</td>
<td>$1 \times 10^{12}$ n/cm$^2$/s</td>
</tr>
<tr>
<td>Sites</td>
<td>5+1+30</td>
</tr>
<tr>
<td>Operators</td>
<td>4</td>
</tr>
<tr>
<td>Hours/Week</td>
<td>~20</td>
</tr>
<tr>
<td>Hours/Year</td>
<td>~800</td>
</tr>
</tbody>
</table>

SLOWPOKE-II 20kW Reactor

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Neutron Activation Analysis

Sample preparation
(sample treatment, sample weight, sample type, ...)

Sample entry by fast rabbit

Irradiation (flux, time, ...)

Counting (decay time, count time, ...)

HPGe N detector with sample changer

Sample retrieval

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Analytical Facilities
Neutron Activation Analysis

70% HPGE N detector with sample changer
K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Rb, Si, Mo, Ag, Cd, In, Sn, Cs, Ba, La, Hf, Ta, W, Au, Ce, Nd, Sm, Eu, Tb, Dy, Ho, Th, U

20% HPGe N detector with sample changer
Applications of NAA

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Analytical Facilities

Energy Dispersive X-ray Fluorescence

Kevex Spectrometer ED-771 XRF
K, Ca, Ti, Cr, Mn, Fe, Ni, Cu, Zn, Rb, Sr, Y, Zr, Nb, Cd, Cs, Ba, La, Hg, Pb, Ce

Portable NITON XRF Spectrometer

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Analytical Facilities

Total Reflection Energy Dispersive X-Ray Fluorescence

<table>
<thead>
<tr>
<th>Elements</th>
<th>Detection Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca, K, P, S</td>
<td>1 – 10 ppm</td>
</tr>
<tr>
<td>Cu, Fe, Mn, Zn</td>
<td>0.1 – 1 ppm</td>
</tr>
<tr>
<td>Rb, Se, Sr</td>
<td>10 – 100 ppb</td>
</tr>
<tr>
<td>Cr, Ni, Ti, V</td>
<td>*.1 – 1 ppm</td>
</tr>
</tbody>
</table>

Wobistrax TXRF Spectrometer

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Analytical Facilities

Solution Spectrometry

Analysis of biological, geological and clinical samples

LaChat Quikchem 8000 Flow Injection Analyser

Perkin Elmer 5100 AA

Perkin Elmer Optima 7000 ICP-OES.

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Data Management

ICENS has developed flexible data management capabilities that enable capture of all the data in the sample analysis chain so that investigations can be completed faster and more accurately.

- Sample collection information (sample no, unique analytical ID, sampling details, sample location);
- Sample preparation information (prepared material code and treatment code);
- Activation details (irradiation, decay counting time, counting system details);
- Spectrum analysis (spectrum files, calibration data files, intermediate files);
- QA sample analysis results (certified reference materials analysis);
- Final analysis result report (identified elements, elemental concentration, uncertainty, detection limits);
ICENS data management systems also enable us to:

- Verify analyses across batches;
- Optimise the irradiation decay counting scheme for various sample matrices;
- Data mine spectral library;
- Data mine sample results;
- Tools to assist researchers;

What else?
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Data Processing for Analytical Services
Collections in this community

- Canada Centre for Mineral and Energy Technology
- CPI International
- Domtar
- European Commission
- Institute of Nuclear Chemistry and Technology
- International Atomic Energy Agency
- Micro-Matter Company
- National Institute of Standards and Technology
- National Research Council of Canada
- Perkin Elmer
- South African Bureau of Standards
- Spex
- United States Geological Survey

Recent Submissions

3136 Nickel Spectrometric Standard Solution
MacDonald, B.S. (National Institute of Standards and Technology, 1995-10-16)

SD-N-2 Sediment
Analysis, Inter-laboratory (International Atomic Energy Agency, 1985-01-01)

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Archive Browser

Equipment ID

Analyst ID

Date (yyyy-mm-dd)

Count ID

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Digital information repository

Storing all information in a digital repository is an important tool in the effort to maximize the returns on time effort and money invested in analysing the samples.

It helps to address such issues as:

- ✔ Sample throughput
- ✔ QA / ISO Accreditation
- ✔ Knowledge management
- ✔ New application development
GIS applications of information

Elements of interest:

Al, Sb, As, Br, Cd, Ca, Cr, Co, Cu, Hf, I, Fe, Pb, Mg, Mn, Hg, Mo, REEs, Sc, Na, Sr, Th, Ti, U, V, Zn

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Cadmium in Jamaican soils

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Cadmium in Jamaican soils: with geology

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Cadmium in Jamaican soils: with relief
A download with more information about ICENS is online at: