



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)



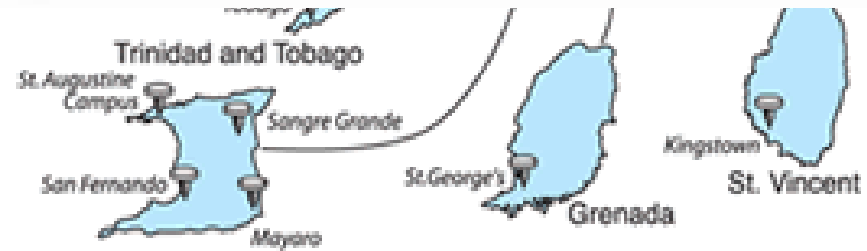
ICENS at UWI



Belize



Grand Cayman



CARIBBEAN ISLANDS

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

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)

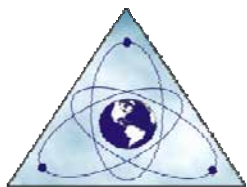
- Inorganic chemical analysis of Jamaican farmed food crops for 17-20 elements
- Stable isotope ratio analysis of potentially toxic elements in soils and speciation of isotope cycling and uptake in plants (metallophytes)
- Trace element geochemistry of Jamaican bedrock

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

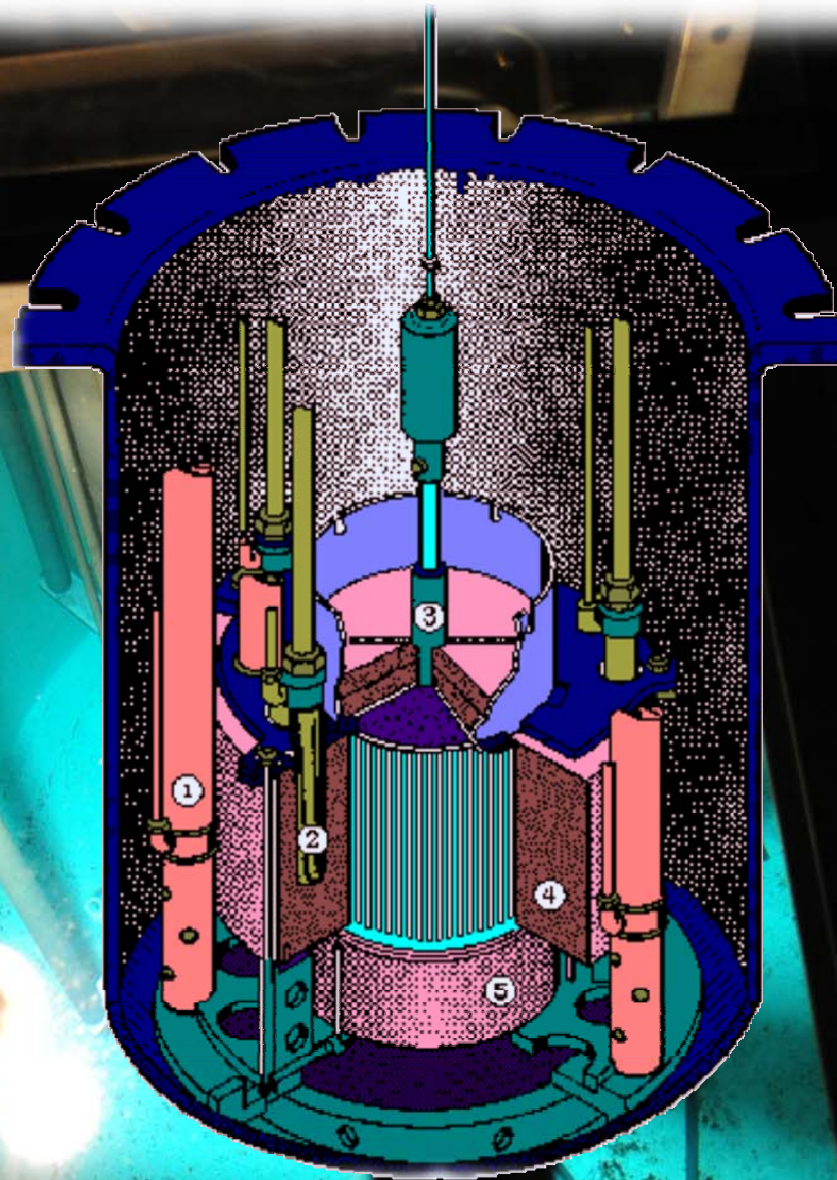
General Projects

- 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



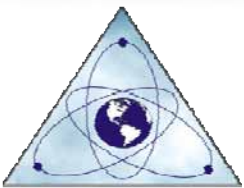
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Power :	20kW
Flux : n/cm ² /s	1 x 10 ¹²
Sites :	5+1+30
Operators :	4
Hours/ Week:	~20
Hours/Year :	~800



SLOWPOKE-II 20kW Reactor

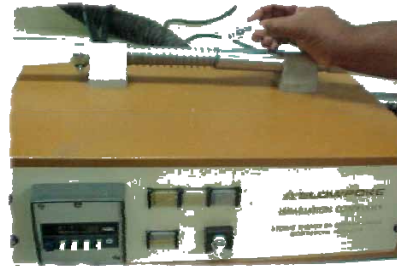
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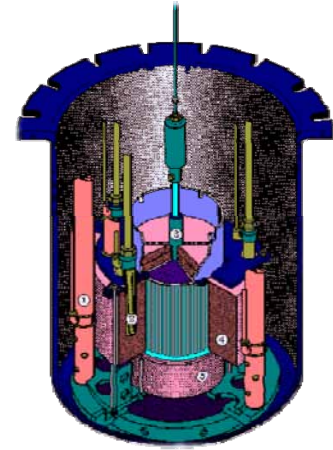
Neutron Activation Analysis



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



Sample entry by
fast rabbit



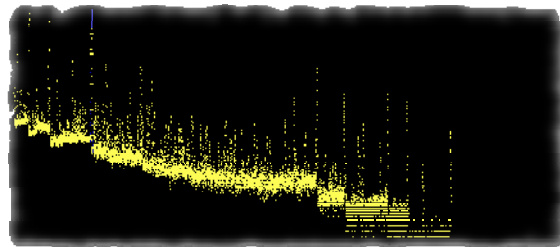
Irradiation
(flux, time, ...)



Sample retrieval

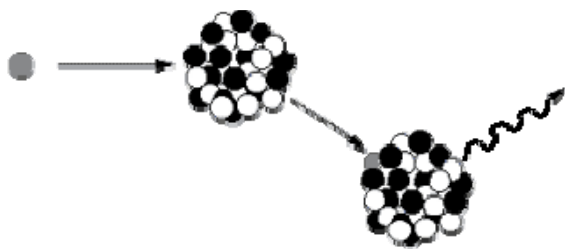


HPGe N detector with
sample changer



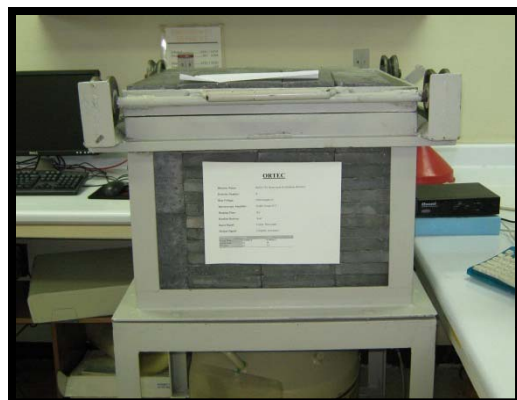
Counting
(decay time, count time, ...)





Analytical Facilities

Neutron Activation Analysis



15% HPGe N type



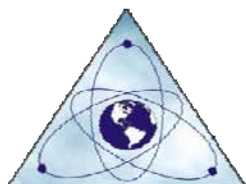
20% HPGe N detector
with sample changer



20% HPGe N type

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



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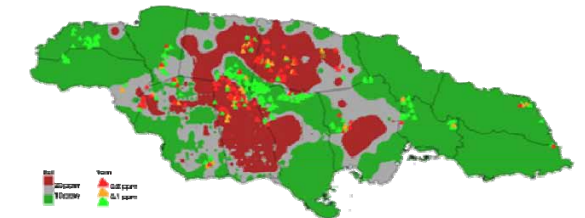
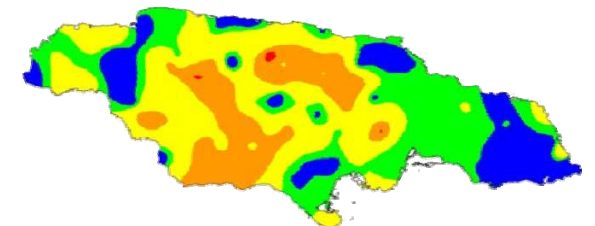


Applications of NAA

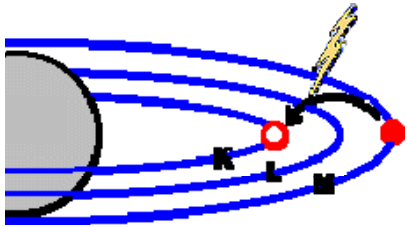


AV-N1-2003-03-22

PIC1 DISK2



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Analytical Facilities

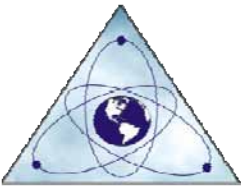
Energy Dispersive X-ray Fluorescence



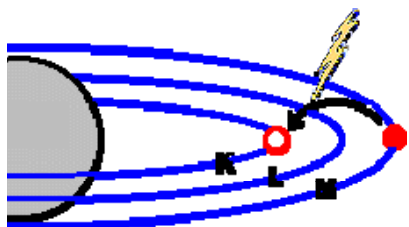
Kevex Spectrometer ED-771 XRF K,
Ca, Ti, Cr, Mn, Fe, Ni, Cu, Zn, Rb, Sr, Y, Zr,
Nb, Cd, Cs, Ba, La, Hg, Pb, Ce



**Portable NITON XRF
Spectrometer**



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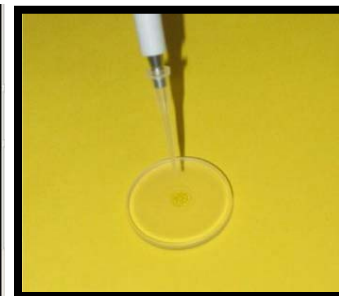
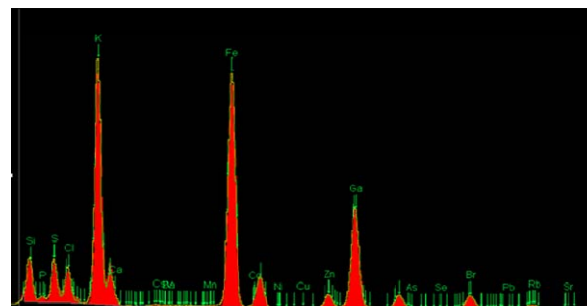


Analytical Facilities

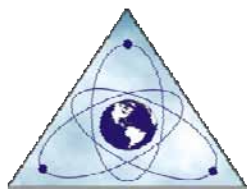
Total Reflection Energy Dispersive X-Ray Fluorescence



Wobistrax TXRF Spectrometer



Elements	Detection Limit
Ca, K, P, S	1 – 10 ppm
Cu, Fe, Mn, Zn	0.1 – 1 ppm
Rb, Se, Sr	10 – 100 ppb
Cr, Ni, Ti, V <i>expected</i>	*.1 – 1 ppm





Analytical Facilities

Solution Spectrometry

Analysis of biological, geological and clinical samples



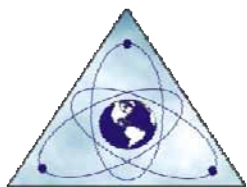
LaChat Quikchem 8000
Flow Injection Analyser



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.

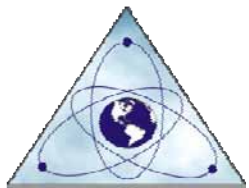
- ☐ **Sample collection information** (sample no, unique analytical ID, sampling details, sample location);
- ☐ **Sample preparation information** (prepared material code and treatment code)
- ☐ **Activation details** (irradiation, decay counting time, counting system details);
- ☐ **Spectrum analysis** (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);

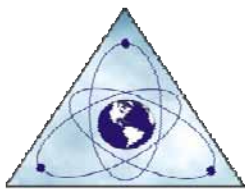
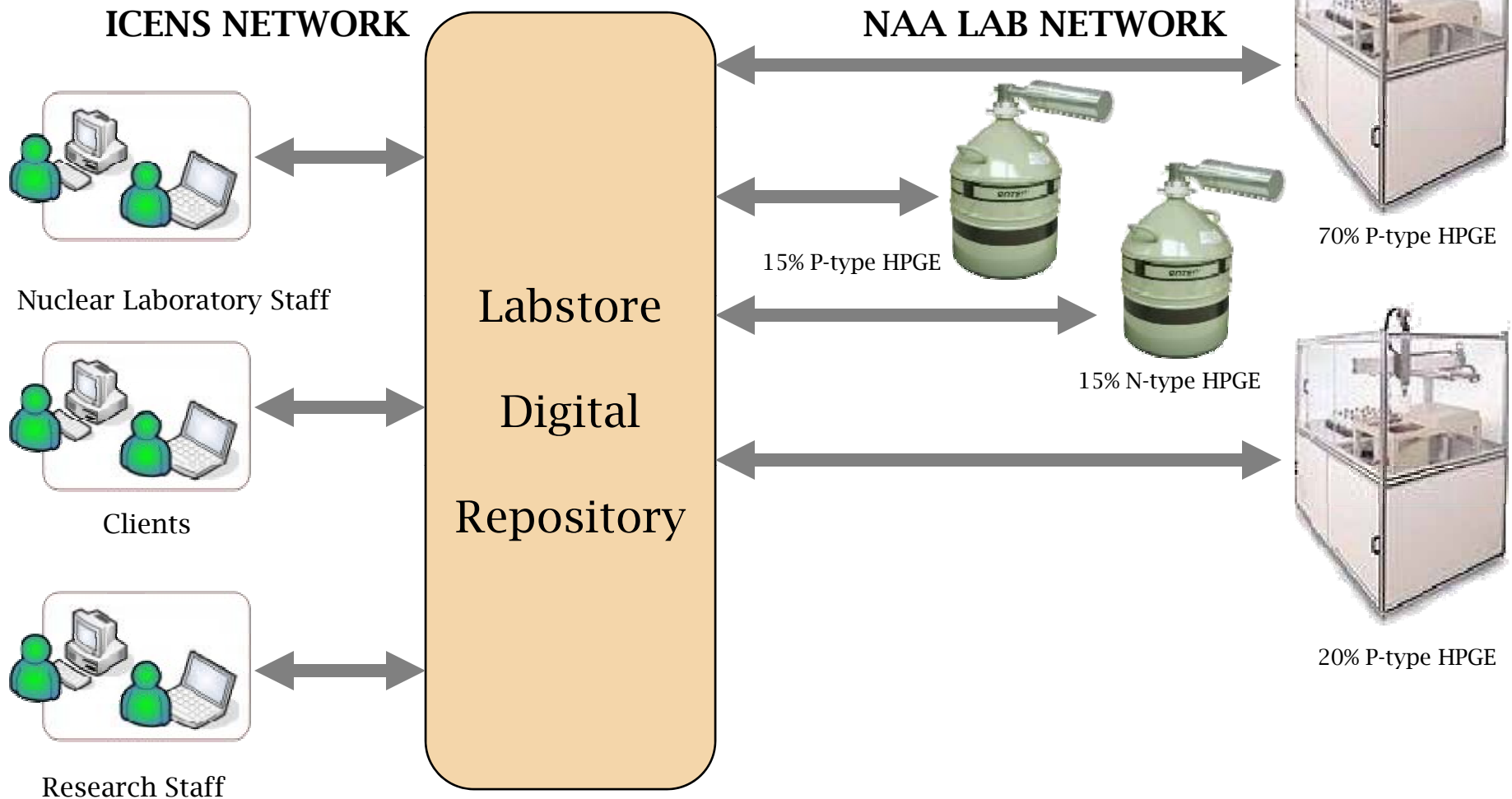


What else ?

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;





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Data Processing for Analytical Services



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- ◆ [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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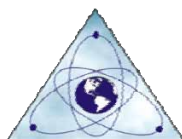
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[1547 Peach Leaves](#)

Analysis, Inter-laboratory (*National Institute of Standards and Technology*, 1993-01-23)

[1566a Oyster Tissue](#)

Analysis, Inter-laboratory (*National Institute of Standards and Technology*, 2007-10-08)

[1567a Wheat Flour](#)

Alvarez, R. (*National Institute of Standards and Technology*, 1988-09-08)

[1567 Wheat Flour](#)

Alvarez, R. (*National Institute of Standards and Technology*, 1978-01-03)

[1568a Rice Flour](#)

Alvares, R. (*National Institute of Standards and Technology*, 1988-01-20)

[1568 Rice Flour](#)

Alvares, R. (*National Institute of Standards and Technology*, 1978-01-03)

[1570a Trace Elements in Spinach Leaves](#)

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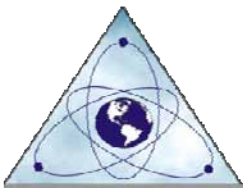
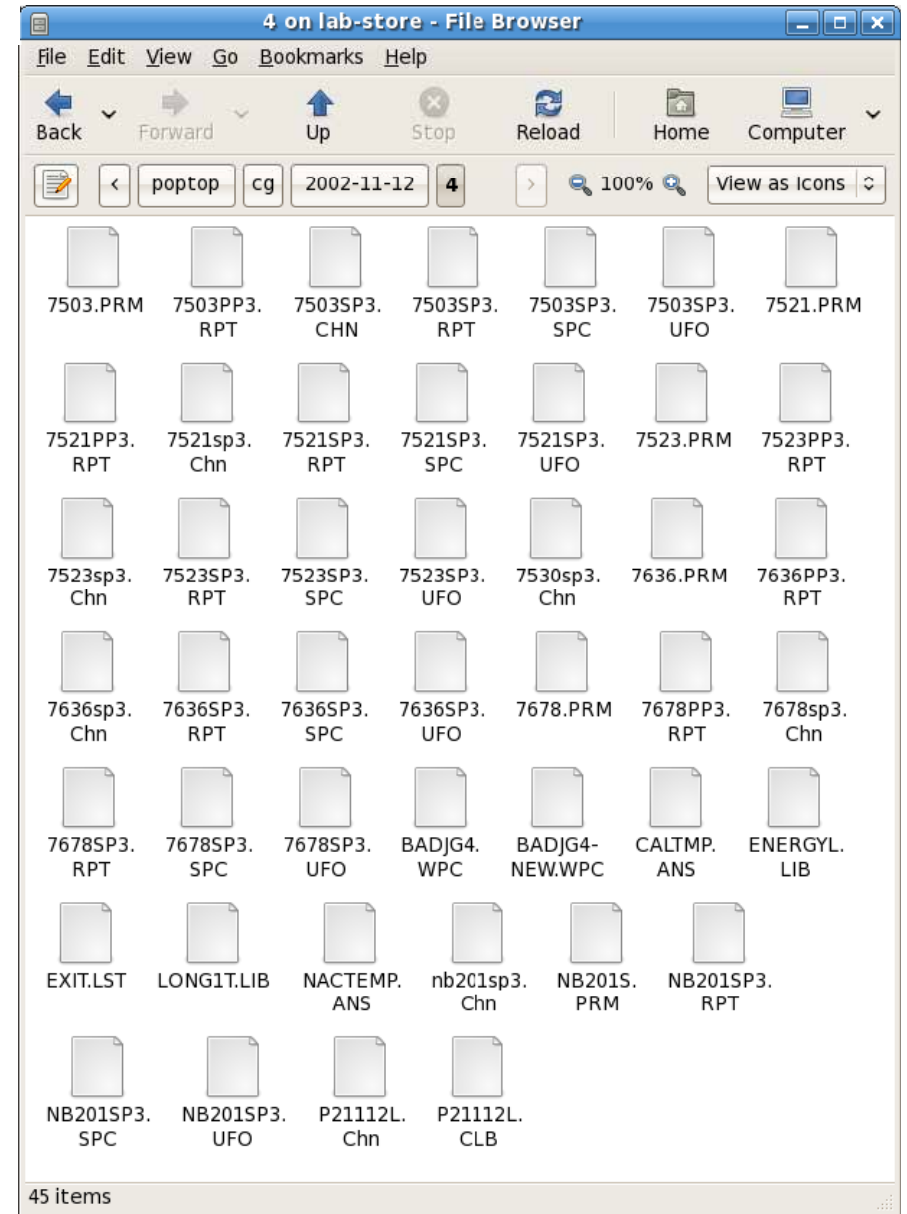
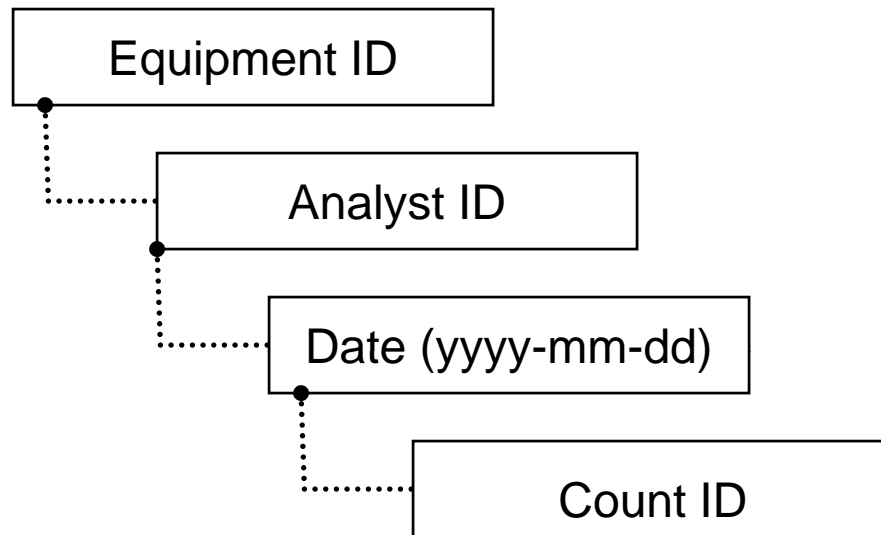
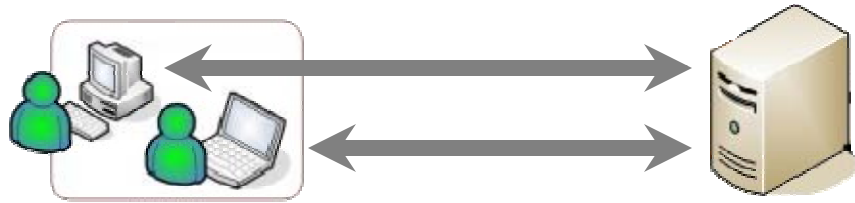
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Archive Browser



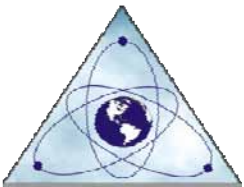
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Digital information repository

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

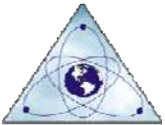
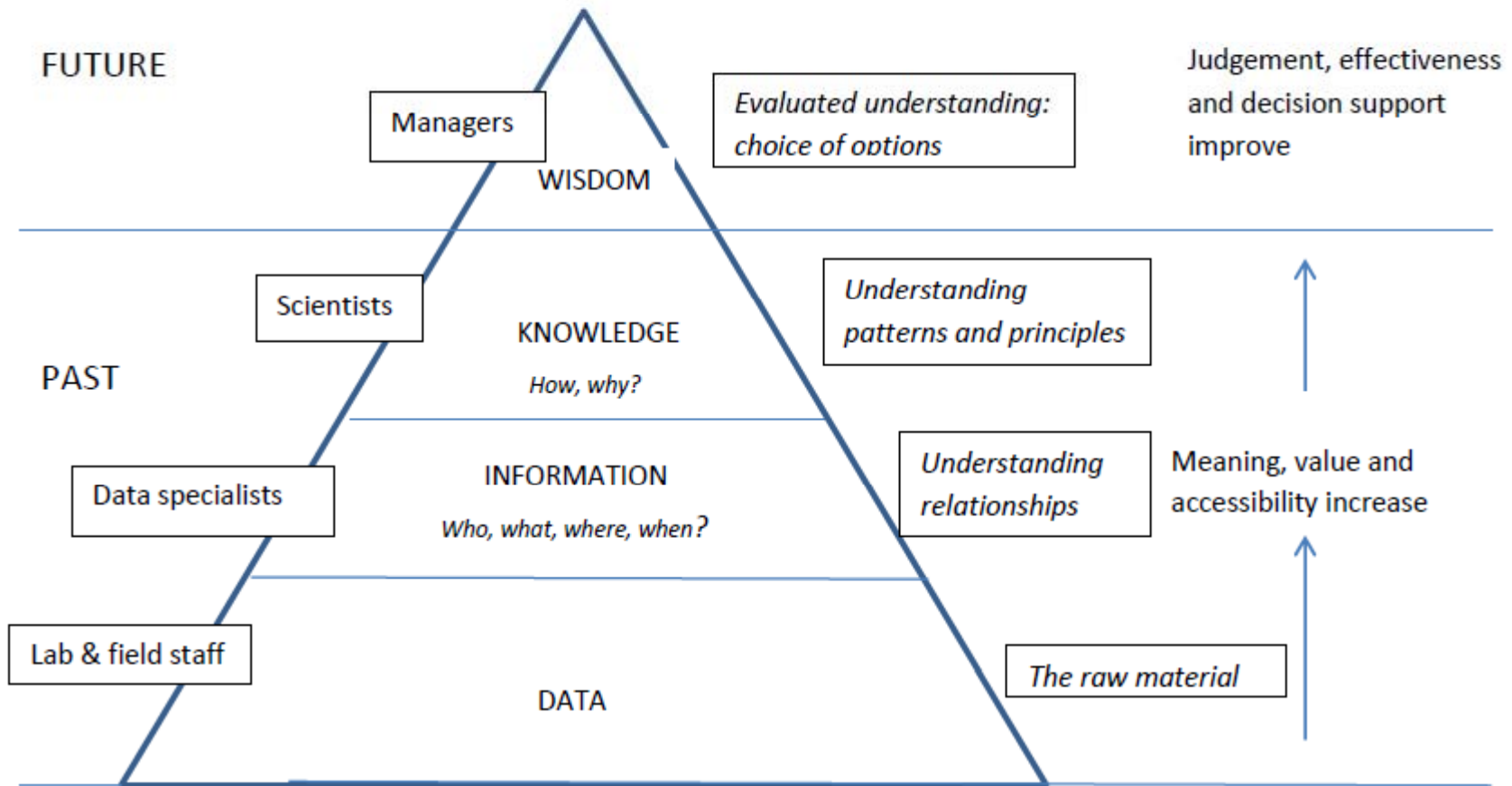
It helps to address such issues as:

- ✓ Sample throughput
- ✓ QA / ISO Accreditation
- ✓ Knowledge management
- ✓ New application development

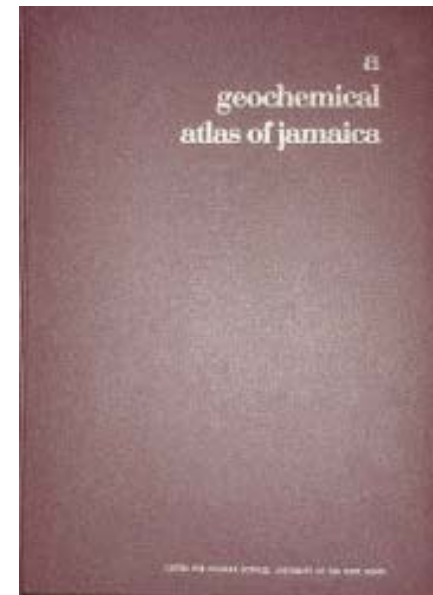
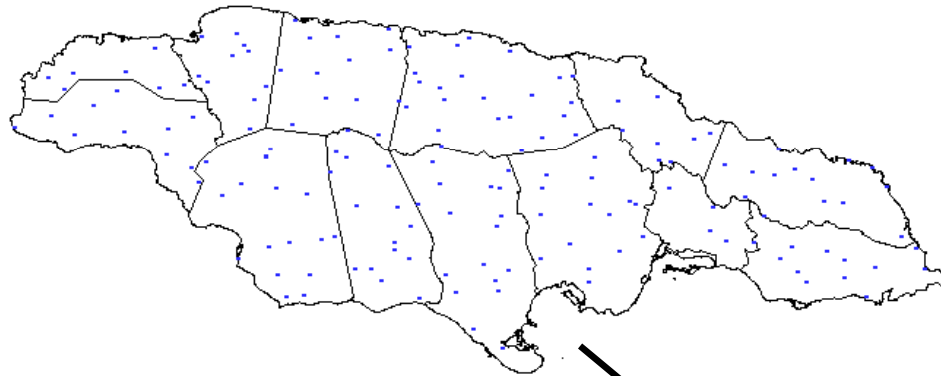


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The DIKW Hierarchy



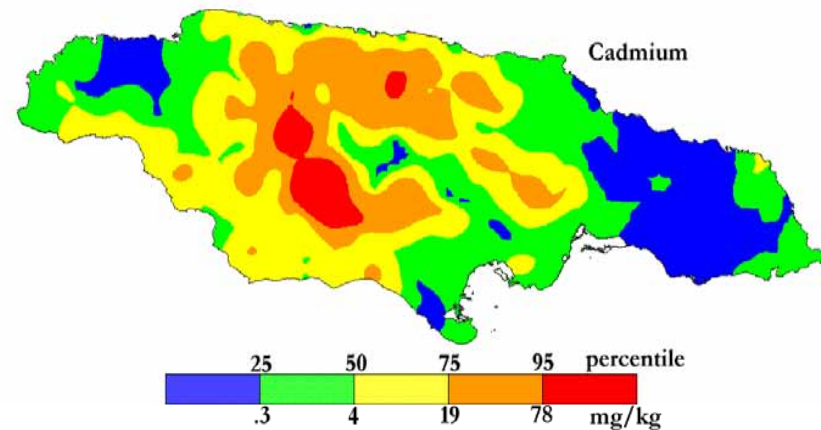
GIS applications of information



1995

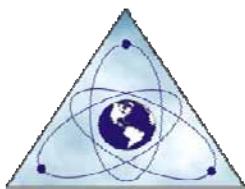
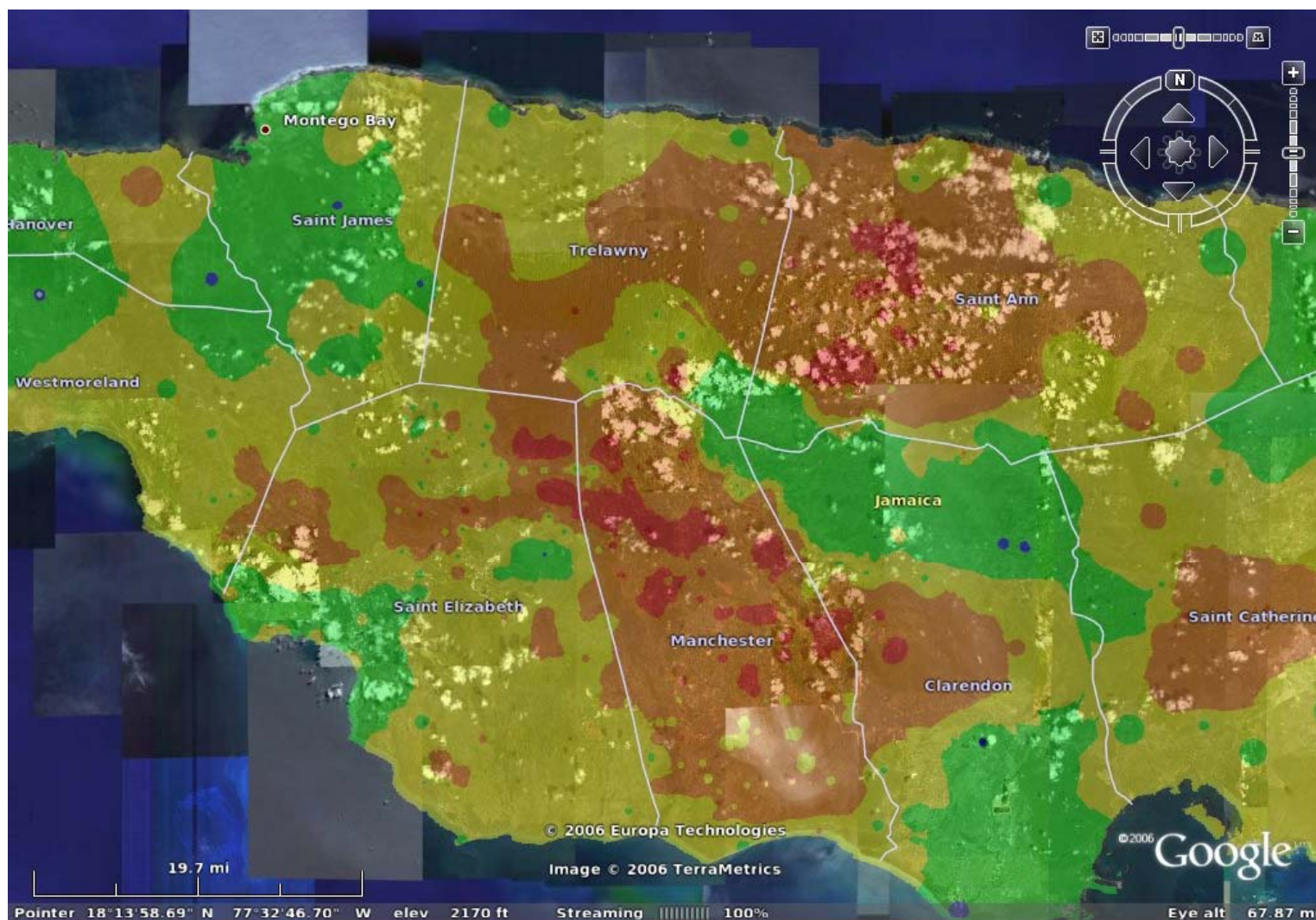
Elements of interest:

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



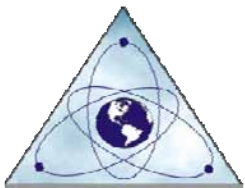
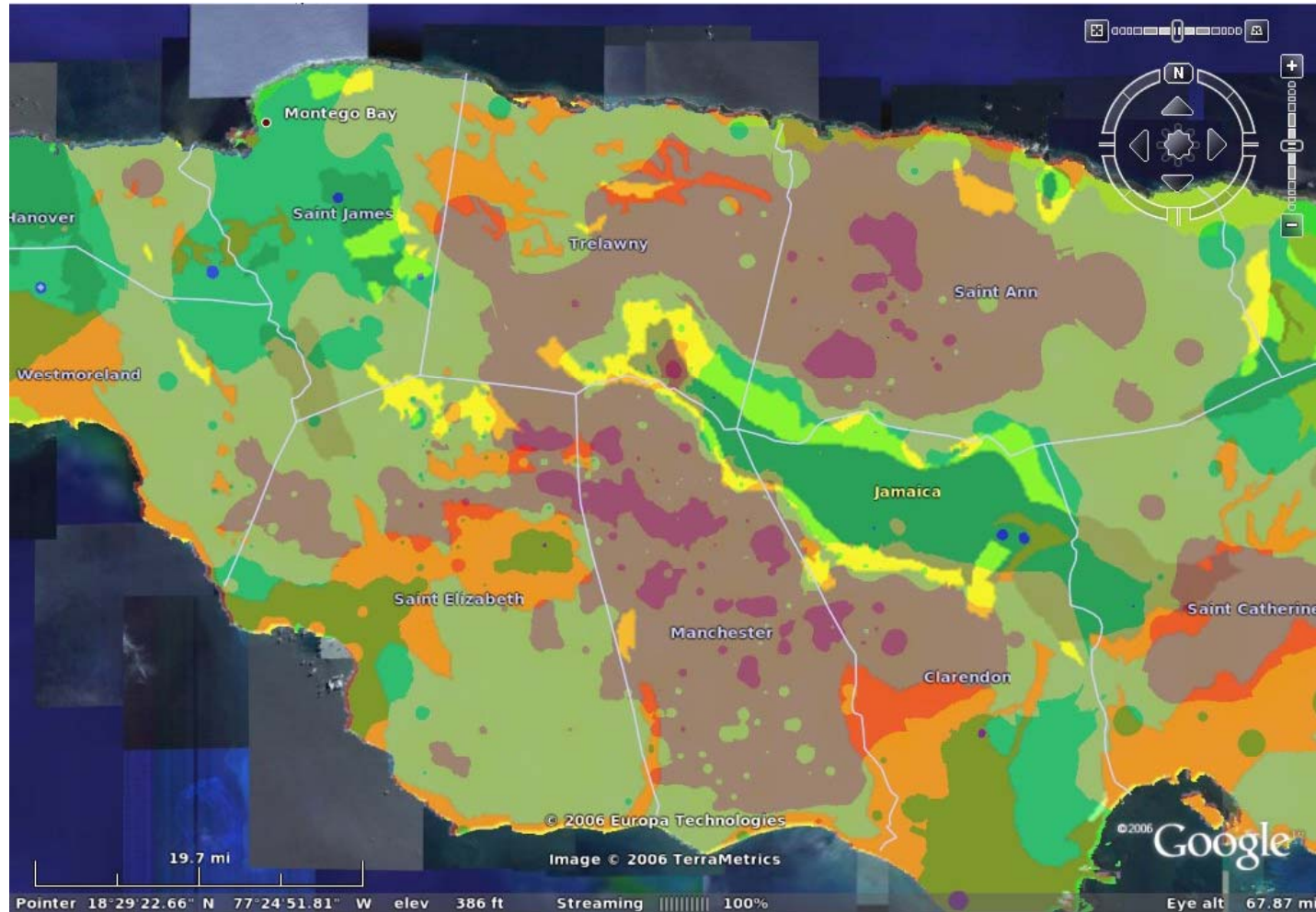
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Cadmium in Jamaican soils



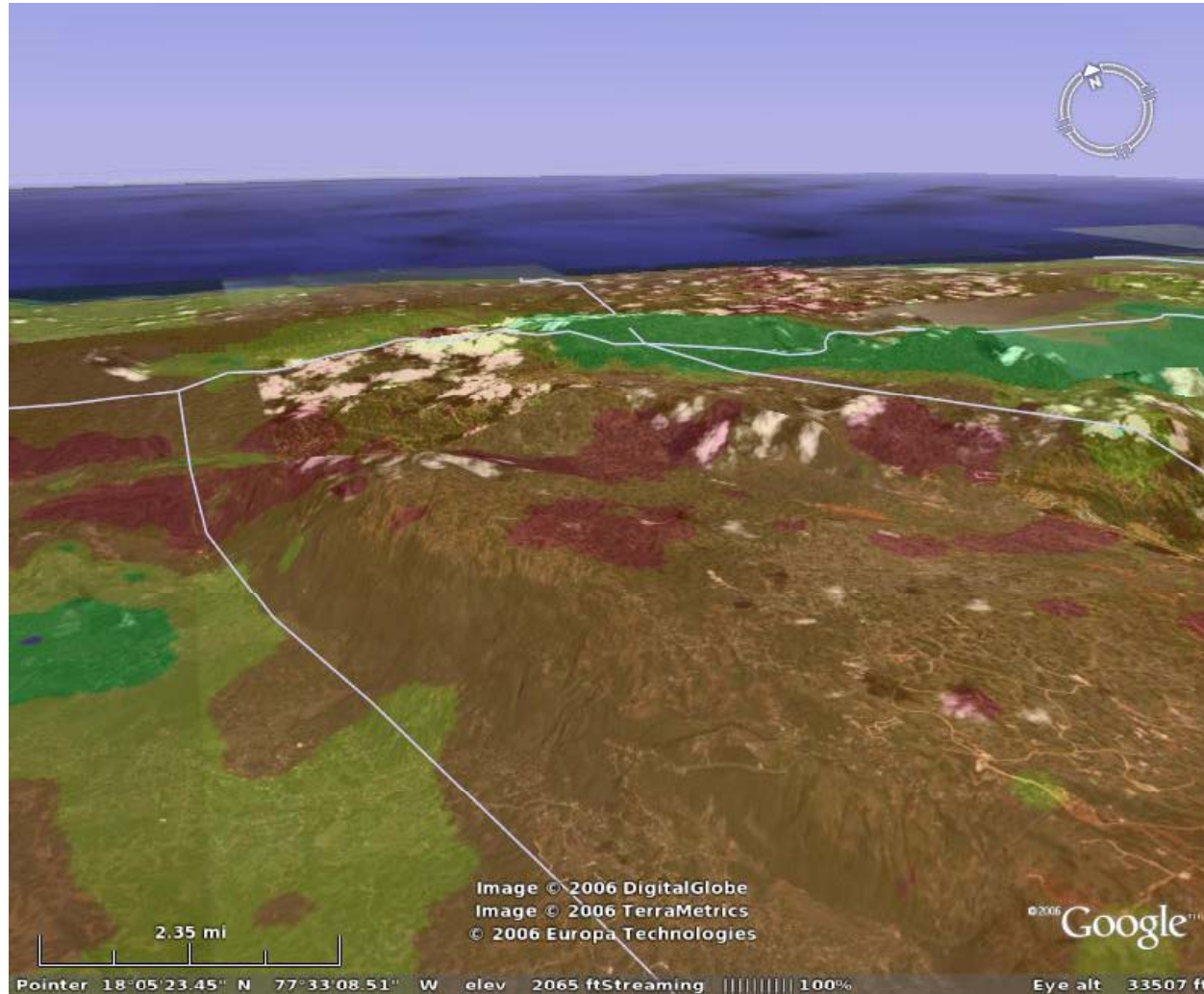
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Cadmium in Jamaican soils : with geology



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Cadmium in Jamaican soils : with relief



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A download with more information about ICENS is online at:

<http://eshare.uwimona.edu.jm/icens-20-year-report.pdf>



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