# IRPS BULLETIN

Newsletter of the International Radiation Physics Society

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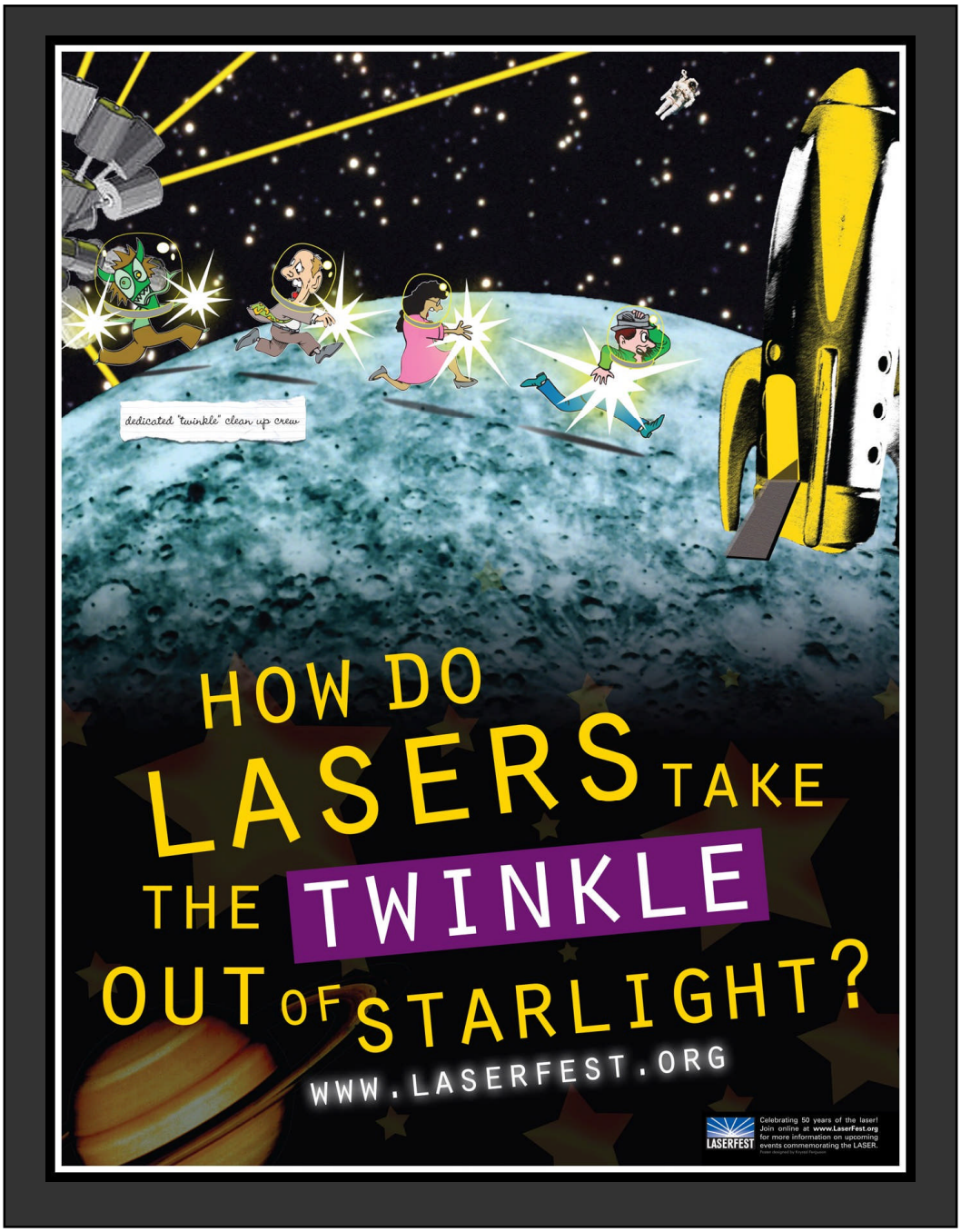


We take our cover this issue (with permission) from the LaserFest.org website, a rich source of material celebrating the 50th anniversary of the invention of the laser

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**MEMBERSHIP PAYMENT INFORMATION ON PAGE 23**

# From the Editors

The mid-year issue of IRPS Bulletin is finally here, and, with contributions from near and far – Canada, UK, France, Czech Republic, Egypt, Australia, India and the US – we hope you'll find much of interest in its pages. As noted, the cover page is adapted from a poster available at www.laserfest.org, where you'll find information related to the 50th anniversary of the laser, including suggestions for how to conduct your own observance of the anniversary. In fact, Larry Hudson documents just such an event in a short report contained herein, in a new Bulletin section entitled About People and Places, to which Society members are encouraged to submit interesting tidbits of general interest, personal profiles and the like. Larry's report is featured here along with personal profiles of three Society members: Alana Treasure, Shirley McKeown and David Bradley. We are grateful to our former President Dudley Creagh for initiating this new section, and we direct your attention to the short announcement he has provided.

In place of a President's Column, we have a Report from IRPS Secretary Mic Farquharson that alludes to exciting developments at the recent Council meeting, in which our new Membership Secretary Elaine Ryan presented ideas for growing Society membership.

We are also pleased to present a couple of technical contributions: 1) the second installment of our two-part series of reports resulting from the x-ray Fundamental Parameters Initiative meeting in Berlin in May 2009, from Pierre Caussin (Bruker-AXS), and 2) a report describing an interesting nuclear geophysics application, by Dr. Hima Bindu Pitta and Professor A.S. Nageswara Rao (Kakatiya Unversity, Warangal, India). Along with these we have an announcement regarding publication of proceedings of IRRMA-7, provided by Ladislav Musilek; a regional report from Africa and the Middle East, by M.A. Gomaa; and numerous conference announcements. As always, we are grateful for your attention and encourage your continued contributions.

*Ron Tosh and Larry Hudson*

# About People and Places

This section of the IRPS Bulletin is devoted to increasing interaction between members. On pages 4 - 7 are the first contributions.

Do you have something of interest you would like to communicate to other members of the society? Have you participated in some community or professional event which may be of interest to others? Have you recently been promoted in your institution? Is there something you have accomplished, such as the publication of a significant paper or some significant research you are conducting?

If so: take the time to send to me your contributions. Contributions must be no longer than 300 words. A high resolution photograph may accompany the text.

*Dudley Creagh*

# Report from the Secretary


## Michael Farquharson

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So, here we start with a new item for the Bulletin. Where is the President's Column? I hear you asking, and I ask the same thing. Don't get me wrong I think each member of the Council contributing something to the Bulletin is a great idea, but in my opinion, it should supplement the President's piece, not replace it.

We have recently had a Council meeting at McMaster University in Canada, and it was one of the most positive meetings I have had the pleasure of attending. Let me explain. I have been involved with the IRPS since the Jaipur meeting in 1997. I became Membership Secretary at the following meeting in Prague in 2000 and remained in that position until 2009. During that time I have tried to push the Council to consider ways of increasing enrolment numbers and holding on to members we recruit. I have always felt that we needed to grow and offer the membership a little more, and I feel that the best way to do this is through investing in the modernisation of our existing web site. There are plenty of examples out there to look at. Members have a log on identity, memberships can be renewed on line, there are communications networks and all the things we come to take for granted in this age of the WWW. However, this idea has been consistently rejected by the Council on the grounds of expense, but now it seems the winds ofchange may have begun to stir if the ideas at the McMaster meeting follow through.

We have a new Membership Secretary, Elaine Ryan. Now, although new to the post, she has knowledge of goings on of the IRPS as she was my graduate student and my post doc researcher for a total of 5 years, and she had to listen to my ranting when I returned from a Council meeting uttering words like resistance to change, no vision and Luddites. So it came as no surprise to me that Elaine was going to suggest some substantial changes at her first Council meeting, and she did just that. While I was preparing to hide under the table to save my embarrassment for her when the members of the Council politely explained it was a good idea but not possible, etc. etc., imagine my surprise when it was treated as the best idea and the most important issue of our time.

In all seriousness this really is great news. There is a feeling now among the Council, voiced particularly well by Bill Dunn, that the time is now right for such changes to be seriously considered in order to see growth in our Society, even the survival of our Society, and I truly welcome these initiatives. However, my message to you, the membership, is that the Society should be for its members, so send us your thoughts, contribute to the Bulletin and get involved.

*Michael Farquharson*

# LaserFest 2010: Tripping the Light Fantastic

**Larry Hudson, Josh & Sandy Hall**

**NIST, Gaithersburg, MD U.S.A.**

Fifty years ago, on May 16, 1960, Theodore Maiman's lab at Hughes Research Laboratories in Malibu, California USA produced the first terrestrial source of laser light. Since that time, the laser has become a ubiquitous scientific tool, with countless commercial, industrial and medical applications. APS (The American Physical Society), OSA (The Optical Society of America), SPIE (Society of Photographic Instrumentation Engineers) and IEEE-Photonics (Institute of Electrical and Electronics Engineers) have joined in a yearlong, worldwide celebration of the anniversary, dubbing it LaserFest 2010. As professional and laser-hobby enthusiasts, we organized an outreach event in LaPorte, the seat of Sullivan County, Pennsylvania USA. According to the official and resource-laden web site, www.laserfest.org, on the day of our celebration, May 15, there were also celebrations in Spalding, Lincolnshire UK; Burnaby, British Columbia Canada; Idaho Falls, Idaho USA; and São Paulo, Brazil.

About 50 townspeople participated on this Saturday night beginning with a barbeque chicken cookout (in exchange for donations to the local food pantry). As illustrated in the accompanying photo, there were demonstrations of laser components, and optical pumping (fluorescence of lead glass and tonic water with a blue-violet laser), leading into discussions of population inversion and the special characteristics of laser light. As the sun began to set, the kids crafted reflecting membranes using knitting hoops, Saran, double-sticky tape, and mirrors. These were deployed after dark in front of pulsating loud speakers and used to reflect red, green, and blue-violet lasers onto the side of a barn. Due to retinal retention, the resulting patterns ranged from Lissajous figures (K. D. Lang) to the more stochastic (Lady GaGa), while children of all ages tripped the light fantastic!


*../About People and Places (continued)*

# Rocks and Radiation !

**Shirley McKeown**

**University of Canberra, Canberra, Australia**

When I left school I studied secretarial/administration courses (girls were not encouraged to undertake university courses in those days ) but I have always had a deep interest in the "how it works" of nature. I can remember as a child (long ago!!) asking "Why is sunshine so hot?" Some years later I found the answer in a book ! A fascination with the variations in rocks also started early, and led to an interest in tectonics - to such an extent that in 1990 my two children persuaded me to enrol at the University of New England (part time). At that time I was working in the Department of Physics at ADFA (UNSW), and the help and information I gained from the staff (which included Dudley Creagh) during my years of study was absolutely great. This help increased enormously when Dudley involved me with IRPS, to handle the layout of the Bulletin and the website. Reading the papers from members was (and still is) absorbing, and John Hubbell also provided me with papers about the relationship between radiation and earthquakes. In 2001 I graduated with an Honours degree in Geology and Physical Geography (the theme for my Honours thesis was earthquakes in the Canberra region !).

When Dudley moved to the University of Canberra, I became his Research Associate. He organised support from the University for the IRPS Bulletin and website, and I have been Associate Editor of the IRPS Bulletin and webmaster since then.

Although my studies were too late in life for me to work in geology, my interest in rocks, tectonics and radiation continues to be fed through membership with the Geological Society of Australia and my continuing involvement with IRPS. Interest in the composition of extra-terrestrial rocks has led me to involvement in astronomy (I am on the Committee of the Canberra Astronomical Society). In fact - I first met John Hubbell at a solar eclipse occurrence in Australia.

A very special thanks to everyone who has helped me with my studies, with the IRPS Bulletin and website, for the hard work that the editors put into the Bulletin, and to the members of IRPS for the helpful emails and great papers !

*Another* rock for my collection...!!

*../About People and Places (continued)*

# Degradation of Iron Gall Inks on Parchment

**Alana Treasure and Carolyn Whitley**

**Infrared Beamline, Australian Synchrotron**

Alana Treasure and Carolyn Whitley have continued their experiments into the degradation of iron-gall inks on parchment at the Infrared Beamline at the Australian Synchrotron. This research is important because many of the books and official documents produced in Europe from Roman times to the 19th Century were written using iron-gall inks on parchment, vellum, or paper.

Until recently many special documents such as treaties and constitutions have been written using iron-gall inks. Examples are the Canadian Treaties with the Indian tribes and the Australian Constitution.

The ink is extracted from the galls formed in oak trees by infestations of wasps. The inks contain significant amounts of iron complexes, which both react with the substrate and degrade with exposure to light, air, and moisture.

The research seeks to discover the nature of the ink-parchment interaction, and to understand the chemical degradation pathways. IR spectra (at 10μm spatial resolution) are taken by scanning across letters in the text and by scanning the cross sections taken from the parchment, underneath the letter.

Alana Treasure showing the 19th Century Indenture from which samples have been taken for IR analysis

*../About People and Places (continued)*

# Professor of Physics

**David Bradley**

**University of Surrey, Guildford, Surrey, U.K.**

1st April (April Fools Day) 2010 saw the elevation of this writer to the status of Professor of Physics, rather late in one's career IMHO, but then, as one is so often told, gratitude should be shown for small mercies. Talking of small mercies, I daily find it a source of amazement that I am paid for an activity that I am so totally absorbed in, namely applied nuclear physics. In seeking to progress my interests I find myself constantly fighting to reduce my personal level of ignorance, a humbling experience that can also be a source of fulfilment, which I guess is why one does any of this at all (occasional though any realisation of novelty might be, if even ever). To work in an invigorating environment (I am talking about working with fellow academics and not the administration sent to exasperate us) is a blessing. To work with young people is yet another, entrusted as we are with guiding the thoughts of those who seek to follow on from us, hopefully with the outcome that in due course they can go on to demonstrate that our understanding of issues has been incomplete, immaterial or even plain wrong.

As I continue to seek academic development, I constantly revisit the question of whether I am working on things that are worth working on. Linked to this is the truism that those with good ideas are rather rare. I do not claim to have been gifted in either of these matters. No, the truth is that it has been my fortune to have been associated with IRPS for close to three decades and through this to have met some rather special people. My eyes have been opened to new vistas and even sometimes to means for tackling a number of the associated issues. In my opinion, my achieving the level of Professor has been manifestly influenced by a number of such associations, the focal of which are imprinted on my mind. If I can claim anything at all, it is an ability to observe and listen. I recommend both attributes to you as do I long-term membership of IRPS, not least to those who share aspirations to Professorship. I just hope you will not be left embittered by the duration of the journey.

# *Vice President's Report, Africa and the Middle East*

**M.A. Gomaa**

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# Africa and Middle East Activities

## March - April 2010

Several workshops and conferences on diverse topics within radiation physics took place within the region comprising Africa and the Middle East. The following report summarizes the content of a few of these and includes information about other significant events of interest to the international radiation physics community.

### I. NORM VI – Symposium on Naturally Occurring Radioactive Materials

22-26 March 2010 Marrakech, Morrocco

While NORM I through NORM V were held in Europe, NORM VI was held in Marrakech, Morocco. (The NORM VII International Symposium will be held in India in 2013.) NORM VI was well attended by people throughout both Africa and the Middle East, as is evident in the group photo below:


NORM VI featured the following main topics:

- Operational Radiation Protection
- Regulatory Aspects
- Transport of NORM

../Continued

- Management of NORM Residues
- Use of NORM Products and Residues
- Focus on the Uranium Industry

The following information, taken from NORM VI presentations, illustrates the breadth of industries impacted by regulations governing the handling of naturally occurring radioactive materials:

**NORM Industries**

- List of NORM industries which will require regulatory consideration :
  - Extraction of rare earth from monazite
  - Production of thorium compounds and thorium containing products
  - Processing of niobium/tantalum ore
  - Oil and gas production
  - Geothermal energy production
  - $TiO_2$ pigment production
  - Thermal phosphorus production
  - Zircon and zirconia industry
  - Production of phosphate fertilisers
  - Cement production, maintenance of clinker ovens
  - Coal-fired power plants, maintenance of boilers
  - Phosphoric acid production
  - Primary iron production
  - Tin/lead/copper smelting
  - Ground water filtration facilities
  - Mining of ores other than uranium ore
- including relevant secondary processes

NORM VI allied activities included the following:

- Workshop on Phosphogypsum (PG) Management & Uses
- Technical visit to the Benguerir phosphate mining deposits (70 km north of the city of Marrakech). See photo below:

*../Continued*

## II. UNSCEAR – United Nations Scientific Committee on the Effects of Atomic Radiation

57th Session, 19-23 April 2010 Vienna, Austria

The 57th session of UNSCEAR was postponed until the 3rd quarter of 2010 because the Vienna airport was closed due to ash from the volcanic eruption in Iceland.

## III. ICRSA – International Conference on Radiation Sciences and Applications

28-31 April, 2010 Marsa Alam, Egypt

The second conference was held in Marsa Alam, at the Dreams Beach Resort along the Red Sea. Marsa Alam is located 300 km south of Hurghada and 700 km from Cairo. The conference was attended by 100 participants and was supported by the Arab Atomic Energy Agency. Conference sessions featured talks on a diverse range of applications in chemistry, entomology, safety, food sciences and biotechnology, microbiology, waste management, biology and physics.

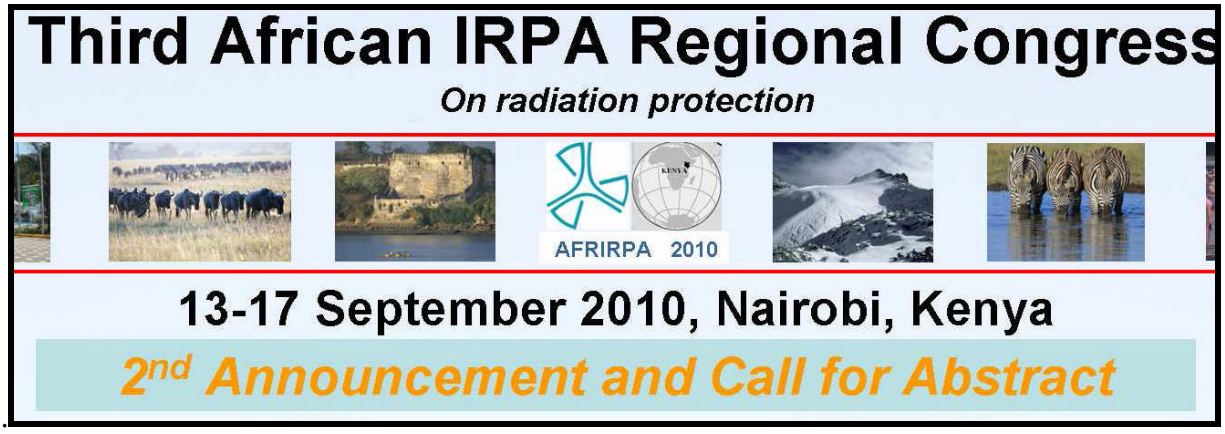
## IV. Regional and Local Activities

A. Legislation – a new Egyptian ionizing radiation law, no. 7 (2010) was issued on 29 March, 2010, which is intended to regulate nuclear and radiation activities. Executive regulations to be completed within 6 months.

B. Training Programs
1. Radiation Protection , Egyptian Atomic Energy Authority, March –April 2010,
2. Radiation Protection , Middle East Regional Center for Arab Countries, April –May 2010
3. Fallout , Atomic Energy Authority, April 2010 , Egypt

## V. Forthcoming events

A.




B. 10th Radiation Physics and Protection Conference, 26-30 November 2010
Conference selected topic is the new Egyptian ionizing radiation Law issued in March 2010 (regulating nuclear and radiation activities).

Registration and Abstract submission is on line at www.rphysp.com

# The IRRMA-7 Proceedings Have Now Been Published

Ladislav Musilek

**The International Topical Meeting on Industrial Radiation and Radioisotope Measurement Application (IRRMA)** is a triennial event aimed at bringing together scientists and engineers from around the world who share an interest in applications of radiation and radioisotope measurements. The first meeting in this series took place in Pinehurst, North Carolina, USA in 1988, and the most recent one (IRRMA-7) was in Prague, Czech Republic, in 2008. Although IRRMA retains its traditional name, it no longer covers only industrial applications, but extends to the whole field of applications of ionising radiation and radioisotopes, including medicine, the environment, and cultural heritage.

At IRRMA-7, about 200 papers in the following 8 topic areas were presented by 163 participants from all continents (with the exception of Antarctica):

A. Ionizing radiation sources and measurement
B. Industrial applications and radiation technologies
C. Radiation in physical and material sciences
D. Biological and medical applications of radiation
E. Radiation in environmental sciences and research
F. Applications to archaeometry and cultural heritage
G. Contraband and threat material detection
H. Monte Carlo Modelling

Senior researchers from universities, research institutes and companies, and also early-stage researchers, including PhD students, participated in discussions on the state-of-the-art in this rapidly developing branch of applied science. 111 selected papers from this interesting event were included in the proceedings, which have now been published by Elsevier as a special issue of the journal Applied Radiation and Isotopes, vol. 68, 4-5, April/May 2010. Four invited lectures open the issue:

G.A. Johansen, U. Hampel and B.T.Hjertaker: Flow imaging by high speed transmission tomography.

R. Cesareo et al.: Pre-Columbian alloys from the royal tombs of Sipán; energy dispersive X-ray fluorescence analysis with portable equipment.

J. Kluson: In-situ gamma spectrometry in environmental monitoring.

P. Vaz: Monte Carlo methods and techniques: status and prospects for future evolution.

They are followed by contributed oral and poster papers (without differentiation, they are taken as equally valuable), divided into the eight sessions summarized above.

The editors of the proceedings, Ladislav Musílek and William L. Dunn, believe that this publication will be a valuable reference source for everybody interested in applied radiation physics and the use of ionising radiation in various branches of human activities.

IRRMA-8 will be held in Kansas City, Missouri, USA, from June 26$^{th}$ – July 1$^{st}$, 2011. There is good reason to hope that the programme will be interesting, both scientifically and socially, and will continue in the tradition of IRRMA as a topical meeting on applications of ionising radiation.

**See you in Kansas City in 2011**

# Technical Content from "Fundamental Parameters" Meeting, May 2009

***Editors' Note:*** Jorge Fernandez (U. of Bologna), our IRPS Vice President for Western Europe, recommended that we capture some of the technical content of the May 2009 "Fundamental Parameters" meeting. It was thought that of particular interest to Society members were a couple of reports from their Working Group 4. In the previous issue of the Bulletin, J. L. Campbell of the University of Guelph, Ontario, Canada presented his "Report on X-Ray Energies, Transition Probabilities, Fluorescence and Coster-Kronig Probabilities." In this issue of the Bulletin, Pierre Caussin of Bruker-AXS reports on "A Comparison of Five Available X-ray Absorption Tables."

By way of background, the International Initiative on X-ray Fundamental Parameters is a collaborative effort of the Laboratoire National Henri Becquerel (Paris), the Physikalisch-Technische Bundesanstalt (Berlin), and the Technical University of Vienna. Its objective is to improve the quality of the database which underlies the fundamental parameters approach to X-ray fluorescence analysis of materials. At present it has seven working groups studying different issues.

# A Comparison of Five Available X ray Absorption Tables

A report prepared for the International Initiative on X-ray Fundamental Parameters [1]


## Pierre Caussin

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**77447 Marne la Vallée Cedex 2**



### Abstract

A specific tool has been developed to graphically compare absorption tables. This technique had previously been used by D De Boer in 1988, and maybe others; the tool adds some interactivity to help diagnose the reasons for discrepancies. From the observed pattern in the Z - energy plane it is possible to sort the discrepancies in classes and make some recommendations for future improvements.


*…/Introduction*

[1] This is one of two reports prepared by members of Working Group 4 within the FP Initiative. It is the basis of a presentation made by the author at the second FPI meeting in Berlin in 2009. The purpose of the report was to help initiate discussion of concerted efforts towards improvements to the database for X-ray fluorescence analysis.

## Introduction

The work is deliberately oriented towards XRF spectroscopy, and the studied energy range has been restricted to 100 to 60,000 eV although this range could easily be extended. The study is purely empirical and does not attempt to link the data to theory; one major limitation of this approach is that good agreement among several authors is not proof that the data are valid since the origin of the data is hard to retrieve: many authors have extensively relied on older data which may be direct from experience or interpolated between experimental values.

**Comparison tool:** A specifically designed Windows program calculates the absorption for Z = 1 to 94 at 100 arbitrarily selected energies from 100 to 60,000 eV using a square root scale so that the absorption edges more or less align on oblique lines. Each database is implemented as a DLL which has two major entry points: Name of author and Absorption as a function of Z and energy in keV. The code automatically locates all such DLLs, lists them, making it possible to select a subset for comparison. Expanding the tool to another data source is very straightforward, since it is enough to place the DLL for the new data source in the same directory as the comparison tool. The plane is divided in 94 x 100 rectangles; for those 9400 points the absorption (Z, energy) is calculated from the selected data sources, and the rectangle is coloured according to the maximum *relative* deviation between one individual source and the average according to the following code:

Grey = no data
Black = less than 1%
Dark blue = 1% to less than 2%
Lighter blue = 2% to less than 5%
Green = 5% to less than 10%
Yellow = 10% to less than 20%
Red = 20% to less than 50%
Purple = 50% to less than 100%
White = above 100%

Available data sources, first author, by descending order of date of publication:

H Ebel 2003 [1000 to 100,000eV]
T Elam V1.2 2001 [100 to 100,000eV]
D De Boer 1988 [100 to 100,000eV]
BL Henke 1982 [30 to 10,000eV]
J Leroux 1977 [1000 to 40,000eV]

All authors acknowledge the approximately linear relationship

$$log(\mu[E]) = log(\mu[E_{ab}]) - K * log(E/E_{ab})$$

between absorption edges. Ebel uses a 5th degree polynomial fit and Elam uses a 3rd degree spline fit to improve the accuracy, whereas Leroux further assumes

$$\mu = C*E_{ab} / E^{k};$$

in other words

$$\mu[E_{ab}] = C * E_{ab}^{(1-k)}$$

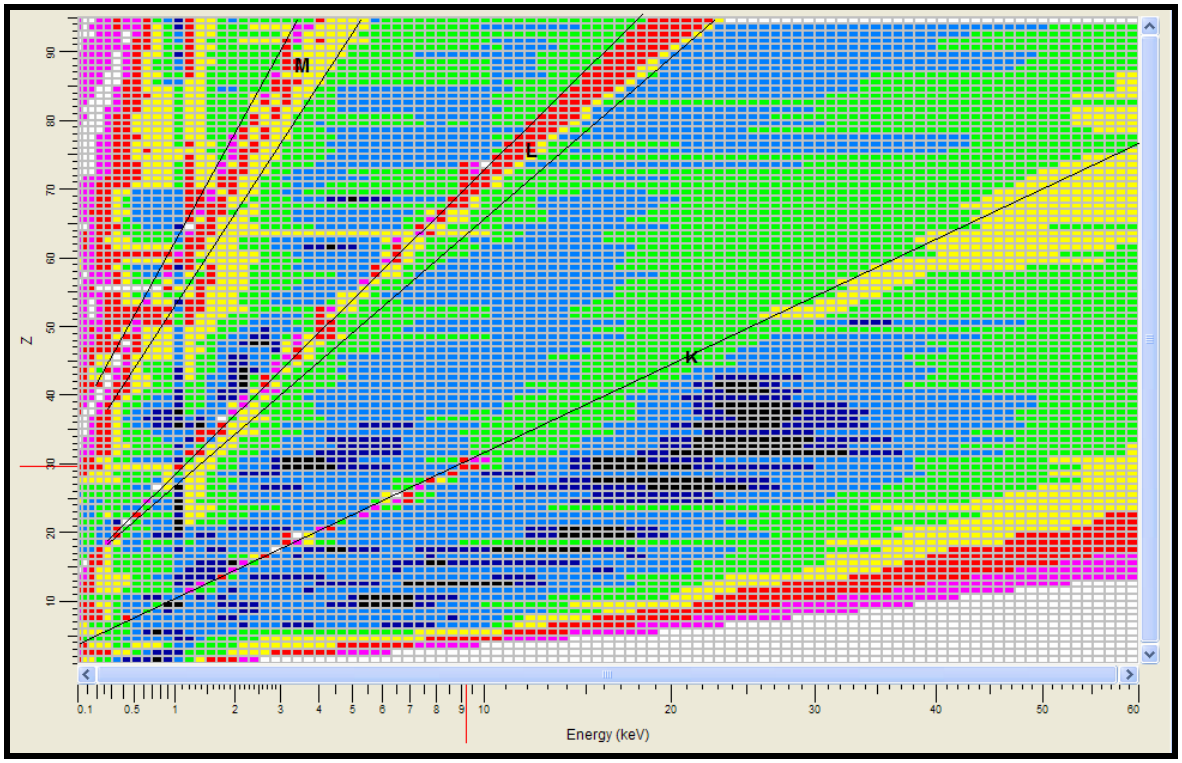
where C is fixed for a given element.

De Boer and Ebel accurately describe all the absorption edges in the range, there are omissions in the Elam table. Henke does not list the absorption near the edges, so the evaluation is not usable in the vicinity of edges.

*../Comparisons*

# Comparison

***Comparison of five tables:***




5 regions can be distinguished on the above graphics, from the bottom right to the top left:

1) Very large discrepancies at low Z and high energy. This is caused by very low cross sections, the relative uncertainty is high, but this region is irrelevant *in the field of quantitative XRF spectroscopy*.

2) Relatively good agreement between the discontinuities (lines have been drawn on the graphic to show the approximate location of the K, L and M discontinuities).

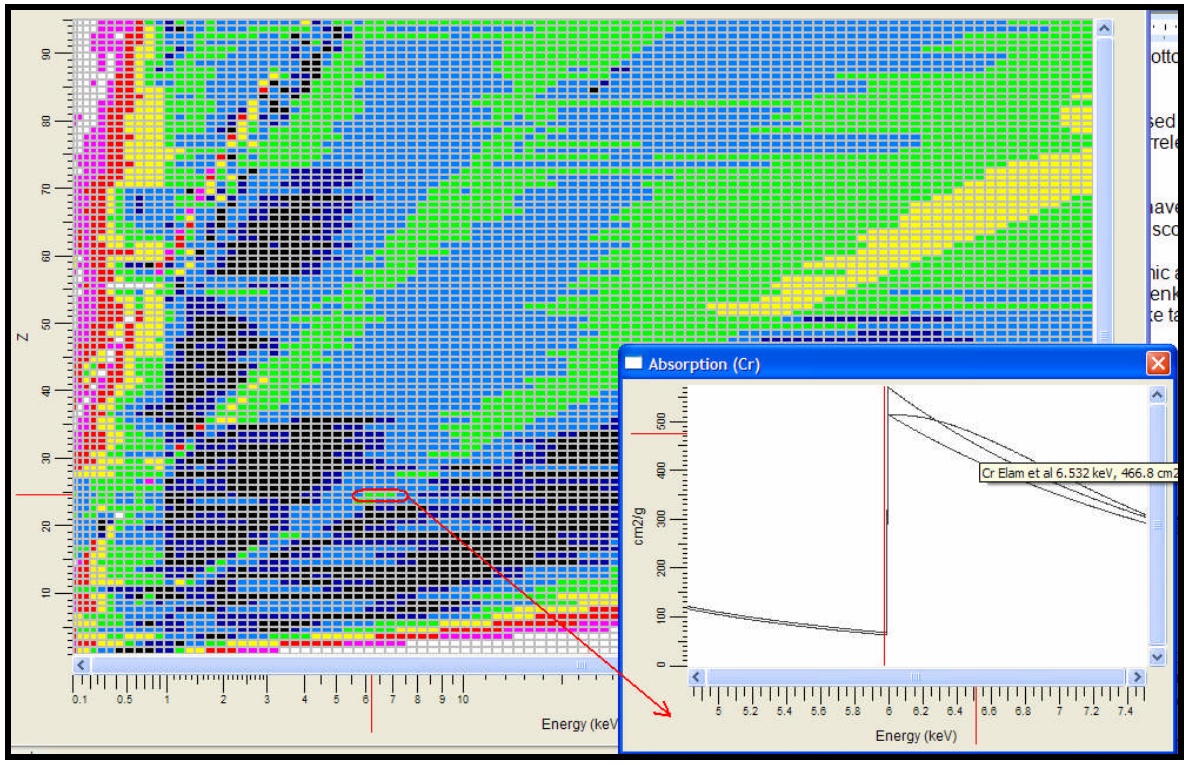
3) Poor agreement around the L and M discontinuities. The graphic also shows poor agreement in the K region for E < 10 keV, but this is due to the Henke table using straight interpolation around the discontinuity; removing the Henke table from the comparison suppresses most of those K-related discrepancies.

4) Very poor agreement below 1 keV. The 1.0 keV vertical is a point of good agreement, probably just showing that a lot of experimental data around this very value was available; whereas, the world below 1keV is more or less terra incognita.

5) Randomly distributed single point discrepancies, which generally can be traced to errors in individual databases, a systematic review of those errors is still underway.

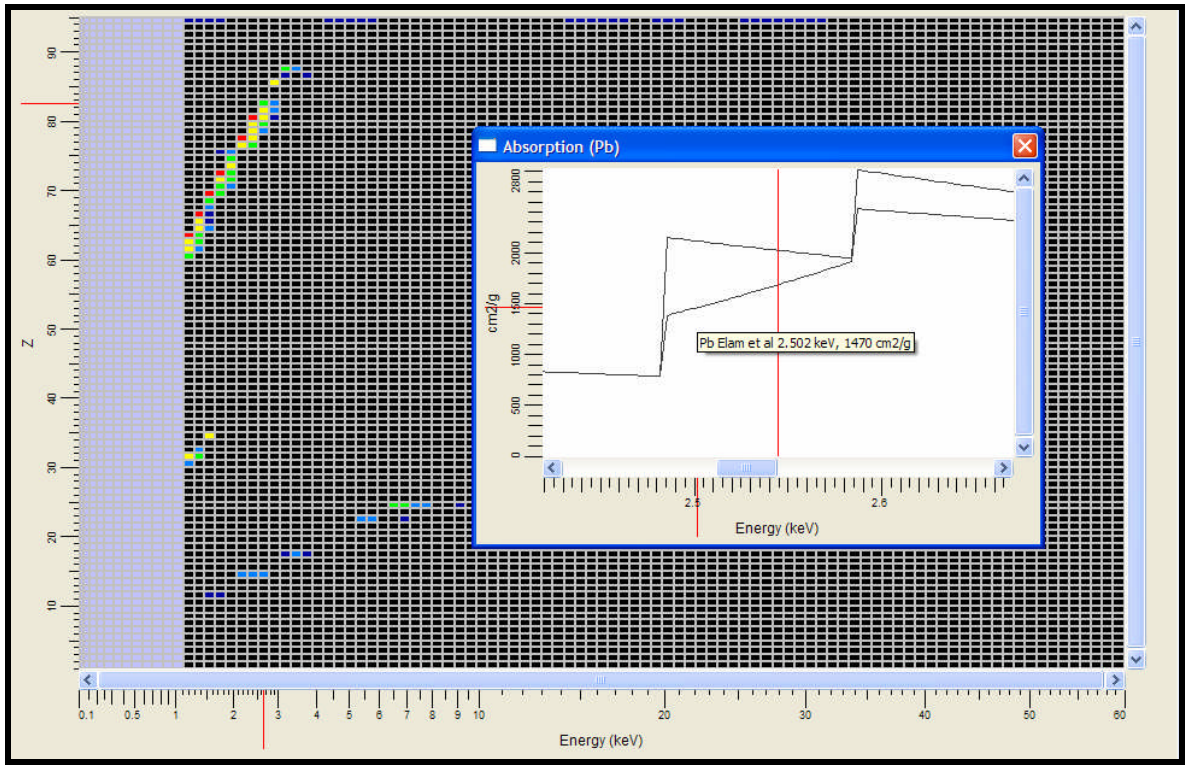
*../Comparisons (continued)*

***Example of random error found by this application: (Comparison of Ebel, Elam and De Boer)***




*Above:* a rare case of interpolation error in the Elam table.

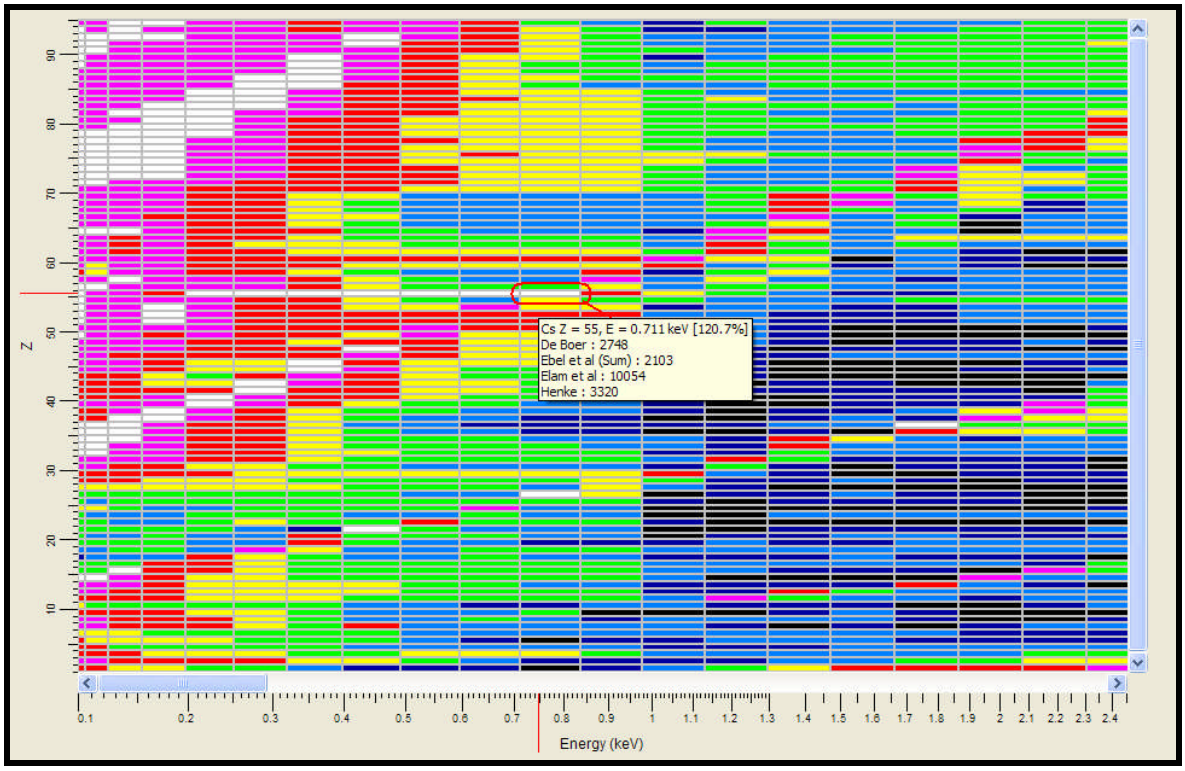
***Example of interpolation error near the M edges of lead (Elam / Ebel)***




*Above:* The comparison of Ebel and Elam tables showing some discrepancies around the K and M edges, whereas the tables generally are in broad agreement.

*../Comparisons (continued)*

***Example of discrepancy at low energy (comparison of Ebel, Elam, De Boer, Henke)***




Enlarged 100 to 2500 eV region

In the above example (Z = 55, Cs, 711eV), the Elam table gives ca 5 times higher result than the other authors, whereas there is much less dispersion for adjacent elements at the same energy. Note that the Ebel table was displayed below 1keV in the above example, against the advice of the author who explicitly states that the values below 1keV are not reliable.

## Intermediate Conclusion

The comparison tool makes it possible to single out some errors that could be corrected (if they have not already been in newer releases of the tables we were not aware of), and shows the need for improving the data in the low energy range and around the absorption edges. It is known that the fundamental parameters programs do not give good results in the low energy range; the inaccuracy of absorption tables is probably not the only factor, but significant progress in the theory can probably not be made without better photo electric absorption tables.

## Literature


1. Ebel et al X-RAY SPECTROMETRY 2003; 32 442-451: Numerical description of photoelectric absorption for fundamental parameter programs.
2. Elam et al // File Version 1.2 Wed Jan 31 10:34:50 2001 NIST.
3. De Boer Philips Research lab publication, 1988.
4. Henke et al. Atomic Data and Nuclear Data tables 27, 1, January 1982.
5. Leroux et al Table révisée des coefficients d'atténuation massique des Rayons X, corporation scientifique Claisse, 1977.
6. M$^{c}$Master et al Compilation of X-RAY cross sections, 1969.

# Computed Total Gamma Ray Values of Well Cores of Shales

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## Abstract

Natural gamma ray spectroscopy measurements for determining the radioactive concentrations of potassium ($^{40}K$), uranium ($^{238}U$) and thorium ($^{232}Th$) of the exploratory wells of the Pacific Margins basin were carried out. The measurements were done using a NaI(Tl) detector and also a HP-Ge detector connected to a multichannel analyzer (MCA) along with a linear amplifier coupled to a PC-based data acquisition and analysis system. The data analyses of 68 samples of the same shale formation for the depths 1522m to 3483m were done. The total gamma ray values of the well cores were calculated from the K, U and Th concentrations and were compared with the total gamma ray values obtained from the well log data.

***Key words***:
Natural gamma ray spectroscopy, well cores, potassium, uranium and thorium concentration, HP-Ge detector system, lithology.

## Introduction

A natural gamma ray spectroscopy (NGS) log is a borehole log indicating the concentration of thorium (Th), uranium (U), and potassium (K) in the rocks surrounding a borehole and is a measurement of the natural radioactivity of the formation (sample log is shown in figure 1). All rocks contain some natural radioactivity - Th, U, and K, for example - that emit gamma-rays which can penetrate 15-60 cm of the rock and possibly enter the borehole. The energy of the gamma-rays (photons) differs for Th, U, and K. Potassium emits only gamma photons of energy 1.46 MeV. Thorium emits gamma photons of a number of different energies, the highest of which is 2.62 MeV. Uranium similarly emits gamma photons of a number of different energies with 1.76 MeV as the highest energy that can be detected in a borehole.

Developed commercially more than 70 years ago,the gamma ray log is a technique for continuous measurement of natural or introduced radioactivity as a function of well depth (e.g. when radiation sources are deliberately placed to mark depth in a well, then the gamma ray log may be used for monitoring depth). Relevant here is its use for logging naturally occurring radioactivity in geological structures of interest, where it can provide valuable information regarding composition of rock formations. For example, it is of considerable value for locating certain minerals, such as uranium, or for ascertaining shale volume in a particular geologic zone [1].

../continued

[1] Abbreviations and description of the log can be found on web at http://www.slb.org

Different types of rocks often contain differing concentrations of radioelements, thus it can provide clues to relative composition (e.g. differences in potassium content detected via gamma-ray logs are used to distinguish sandstone from shale in sedimentary rocks [2,3,4].

If a NGS log should be recorded, one needs a gamma detector system that is able to perform an energy sorting of the detected gamma photons. By analyzing the energy distribution of the detected photons, termed a gamma spectrum, one may calculate the amount of Th, U, and K that has generated the spectrum [5]. In sedimentary formations the log normally reflects the shale content of the formations. This is because the radioactive elements tend to concentrate in clays and shales. As most of the wells in the world have been drilled in sedimentary rocks, the interpretation methods applied to natural gamma ray (NGR) logs are based on the radiogenic properties of sedimentary rocks (like determination of lithology with the help of Th, K crossplots).

There are several factors which affect the accuracy log data while logging. As NGS data of core samples has been found to be more accurate than log data [4], cores from the 5 wells (namely A, B, C, D and P) of Pacific margin basins have been studied. These are exploratory wells (i.e. randomly drilled without any geological reference or new in the area). The high gamma – high resistivity Raghavapuram shale [6] formation is the source of well cores studied for all the 5 wells.

## Experimental details

***Multichannel analyser***

Inbuilt amplifier (DSA 2000) with high voltage supply and multichannel analyser was used for spectrum analysis. It consists of 64K channels and its maximum operating voltage is 5000V. The software for spectrum analysis was GENEI$^{2000}$ , provided by Canberra Inc., USA.

## Sample preparation

Core samples weighing about 250 grams were ground into fine powder. The powder was then placed in cylindrical boxes made of transparent plastic which have low attenuation to gamma rays.

## Methodology

The natural gamma ray spectroscopy (NGS) study on the core samples was carried out using the Multi-Detector Facility belonging to the Logging Group, Keshava Deva Malaviya Institute of Petroleum Exploration (KDMIPE), Dehradun, Uttarakhand, India. The integrated NGS setup is a software-controlled, PC-based operating system (GENIE 2000) compatible with Windows-98 and utilizing hyper-pure germanium (HP-Ge) gamma ray detectors. The detector assembly is encased in a specially designed thick lead shield in order to minimize the effect of environmental gamma ray activity.

../continued

[2] Elemental concentration is given in ppm's for U and Th, whereas in % for K in the standard rock sample by the Physical Research Laboratory, Ahmedabad and NGS international standards by the American Petroleum Institute.

The first step of our NGS study involved energy calibration of the detectors, using a multi-energy gamma ray source. This provided calibration of detectors in terms of gamma ray energies versus the MCA channel number under which gamma counts are recorded. The next step was the recording of background gamma ray spectrum for each of the detectors. Since background gamma ray activity is very weak, the spectrum was recorded for an extended time duration of 48 hours.

Subsequently, gamma ray spectra of the core samples, crushed into powdered form and sealed in air-tight plastic containers was recorded. The recording time of the spectra was optimized to 24 hours for each sample.

The background corrected gamma ray counts within the respective energy peaks of K (1.46MeV), U (1.76 MeV) and Th (2.62 MeV) were obtained from the spectra of standard rock sample and of the core samples. The elemental concentrations of U, Th and K were determined from the spectral data (gamma ray count rate) corresponding to signature energy peaks using following relations:

$$U\,(ppm) = [S_U \times (R\_1.76/W)] \quad (1)$$

$$Th\,(ppm) = [S_{Th} \times (R\_2.62/W)] \quad (2)$$

$$K\,(\%) = [S_K \times (R\_1.46/W)] \quad (3)$$

Where,

S = [elemental concentration[1] × (sample weight/gamma ray count rate)] for standard rock sample.

R_ = gamma ray count rate corresponding to signature peaks (1.46MeV, 1.76 MeV and 2.62 MeV) for core samples.

W = weight of core sample (grams)

The gamma ray count rate is recorded as counts per minute per gram (cpmg)

As described above, the concentrations of thorium, uranium and potassium in different core samples of WELL-A, WELL-B, WELL-C, WELL-D and WELL-P comprised of Raghavapuram shale are measured and the total gamma ray values of cores are computed using the following standard equation:

$$GR_{Tot} = aTh + bU + cK \quad (4)$$

Where, a, b and c are constants of summation with the values, 4.0, 8.0 and 16.0 respectively [7]. The values of Th, U and K concentrations measured for core samples from different wells are shown in Fig 2.
Taking the values into consideration, the total gamma ray values of cores are computed using equation (4).

Gamma ray log data were provided by the logging group, ONGC, Rajahmundry, India. This was obtained with the help of a logging tool consisting of a NaI(Tl) detector and a PC-based data acquisition system (logging operations were done by M/S. Schlumberger Ltd.).

## Conclusions

Plots of the values of the total gamma ray response during logging and the computed

../continued

total gamma ray values of well cores for the same intervals are compared in Fig 3. The values of U, Th and K concentration of core samples of WELL-A, WELL-B, WELL-C, WELL-D and WELL-P, obtained by experimental method in the lab, are expected to be more accurate because of tighter control of experimental parameters during measurement.

The distribution pattern of total gamma ray values of cores from the above mentioned wells indicates their relatively higher concentration in lower unit as compared to upper unit of Raghavapuram shale in the wells of study area.

Total gamma-ray API (American Petroleum Institute) values of cores of Raghavapuram shale formation of Wells -A, B, C, D and P are in good correlation with the log data. Corrections in the log data have to be made accordingly with the measured gamma ray values of the core samples. As the gamma ray log acts as a base for other logging parameters in the evaluation of a well, accurate values of total gamma activity help in the better estimation of well parameters and formation evaluation.

## Acknowledgements

Acknowledgements are due to M/S. Schlumberger Ltd, Logging group, ONGC, Rajahmundry and Logging group, KDMIPE, Dehradun. HBP* would like to thank University Grants Commission (RGNFS) for its financial support during the research work.

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*../Figures 1, 2, 3*

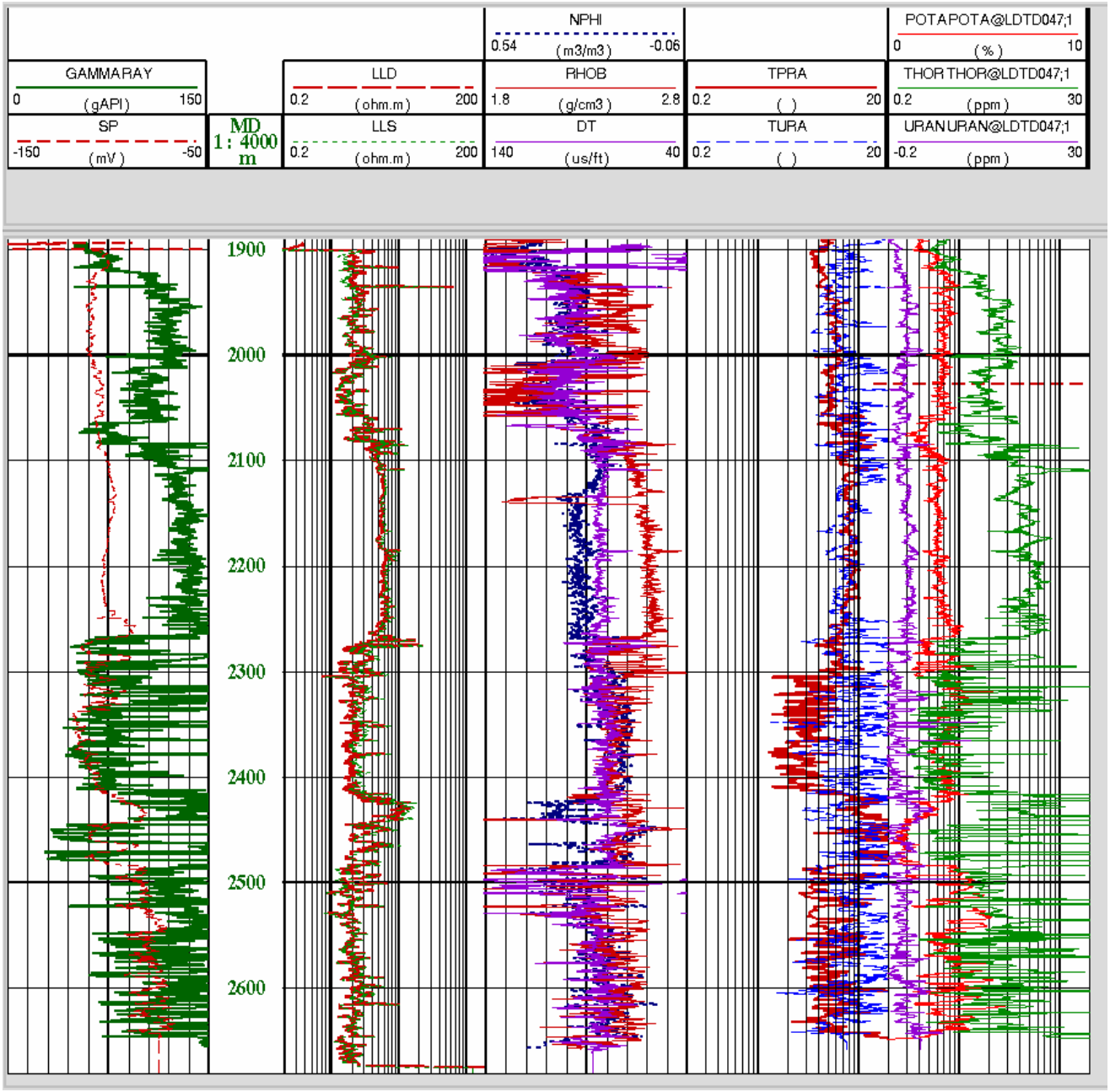


*Fig 1.* Sample gamma ray log of WELL-X (Courtesy, ONGC, India Ltd)

Log indicating total gamma ray (API), Th to K ratio, Th to U ratio, K,Th,U concentration

**SP**- Spontaneous Potential;

**NPHI** -Thermal neutron porosity;

**LLD**- Laterlog deep resistivity;

**LLS**- Laterlog shallow resistivity;

**DT**- Delta time (Fixed interval transit time)

*../Figures 2, 3*

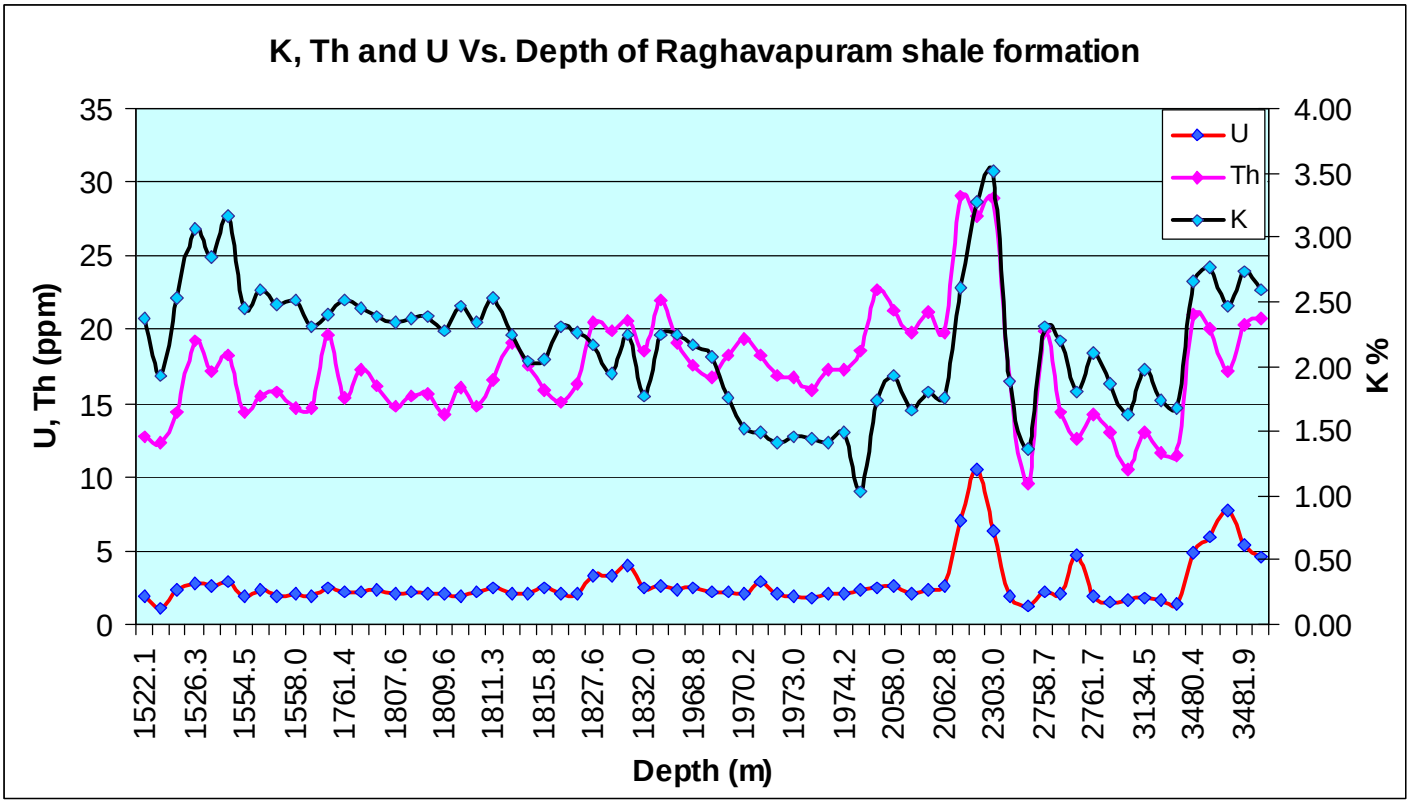


*Fig 2.* Potassium, Thorium and Uranium concentrations of wells- A,B,C,D and P with reference to depth in metres

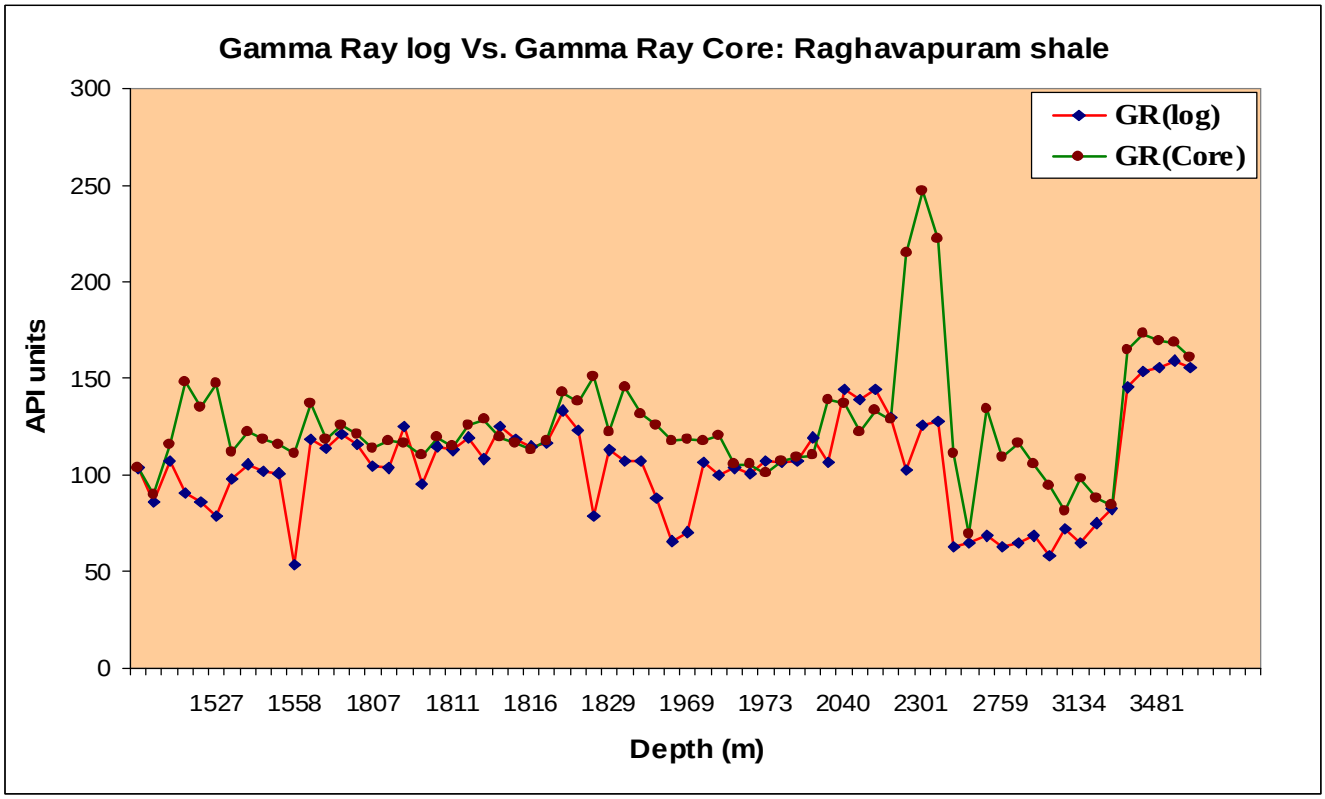


*Fig 3.* Gamma ray log correlation curve with gamma ray core data of Raghavapuram shale region of wells - A,B,C,D and P

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The poster, which originally was designed by Dan Jones, is now the responsibility of Leif Gerward. Suggestions for improving the promotional material are most welcome. Please, send your comments to the e-mail address :

gerward@fysik.dtu.dk

# 6th International Conference on Protection Against Radon at Home and at Work

**13th - 17th September, 2010**

:

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Czech Technical University in Prague

The main topic of the conference – Radon as information carrier

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National programs and projects
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www.radon2010.cz

or contact the organisers at the conference address
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http://www.uow.edu.au/conferences/SSD16

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# 4th Solid State Dosimetry Summer School "Concepts and Trends in Medical Dosimetry" and SSD 16 Conferences.

**4th SSD Summer School "Concepts and Trends in Medical Dosimetry" will be held 15 - 18 September, 2010**

at Innovation Campus University Wollongong (iC UoW) , Australia, located near a nice Pacific beach, 1 hour drive from Sydney Airport. The outstanding Summer School Program and Faculty are described at: http://www.uow.edu.au/conferences/SSD16/summerschool.html

During the Summer School, continuous training and consulting on GEANT 4 radiation transport code will be conducted by several internationally recognized experts from the USA, Australia and Japan and supported by the CMRP cluster. Participation at the Summer School by young researchers, practitioners and medical and health physics students will be valuable.

Summer School dinner will be held on 16th September at a fantastic seafood restaurant situated in Wollongong Harbour. Lectures will be followed by informal discussions on the beach with Australian beer every day.

*../continued*

**Solid State Dosimetry** (SSD 16) conference follows the SSD Summer School and will be held on 19-24 September, 2010 in Sydney http://www.uow.edu.au/conferences/SSD16/ at Sofitel Wentworth Hotel near the Opera House. It is a beautiful location at a nice time of the year in Sydney.

Satellite half-day Workshops on **"Radiation Dosimetry for Space and Avionics"** and **"Radiation Doses and Risk in Medicine"** will be part of the SSD 16 conference on 23rd September.

Extensive industrial exhibitions at SSD 16 will present numerous opportunities for discussions between academia and industry on technology transfer. Two cocktails sessions at the industrial exhibitions will also be featured at SSD 16.

We are expecting an interesting conference with a special focus on Medical Dosimetry for Modern Radiation Therapy and Diagnostic Radiology, Risk of Medical Radiation, Simulational Dosimetry (GEANT 4, MCNP, FLUKA, PENELOPE) and Instrumentation for Dosimetry.

A limited number of **Young Scientist Awards** will be available to support participation at the SSD Summer School and SSD 16 conference, which are kindly supported by ISSDO and CMRP.

Participants of the SSD16 Conference and SSD Summer School will have access to an outstanding social program. You will have the chance to experience Sydney's beautiful weather, stunning beaches and wineries in the country. Conference gala dinner with guest speaker NASA Astronaut Dr. Leroy Chiao will be a special feature of the SSD 16. Leroy will be speaking about his experiences in outer space and will be showing and discussing footage he acquired on one of his space missions.

http://www.uow.edu.au/conferences/SSD16/news.html

September is the best time to visit Far North Queensland to experience the stunning Great Barrier Reef, where we are going to continue discussion about future directions in dosimetry research after the conference.

To book your travel, including airfares, please contact the SSD16 travel consultant. At the same time you can also book pre-and post-SSD 16 Conference discounted tours.

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The homepage of the SSD16 Conference is constantly being updated. Please check the website.

The Local Organising Committee is working hard to make an outstanding Summer School and SSD 16 conference and your pleasant and enjoyable stay in Sydney. We have received for SSD 16 more then 400 abstracts!

Please do not hesitate to contact SSD 16 Secretariat Mrs Karen Ford kford@uow.edu.au or directly Anatoly Rosenfeld anatoly@uow.edu.au

We look forward to seeing you in Sydney, and to having an interesting and productive Summer School and SSD16 conference.

# Calendar

## 2010

**September, 2010** **13th - 17th**

### Third African IRPA Regional Congress on Radiation Protection

**Nairobi, Kenya**

**Further information : M.A. Gomaa**

***Email :*** **radmedphys@yahoo.com**

**September, 2010** **13th - 17th**

### 16th International Conference on Protection Against Radon at Home and at Work

**Faculty of Nuclear Sciences and Physical Engineering,**
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**Topics for the conference are shown on page 24**

*For further information :*

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**September, 2010** **15th - 18th**

### 4th SSD Summer School

### "Concepts and Trends in Medical Dosimetry"

**Innovation Campus**
**University of Wollongong (iC UoW), Australia**

**Details of the conference are shown on page 25**

*Contacts :* SSD 16 Secretariat Mrs Karen Ford **kford@uow.edu.au**

Anatoly Rosenfeld **anatoly@uow.edu.au**

***Conference Website :*** **http://www.uow.edu.au/conferences/SSD16/summerschool.html**

*../2010 continued and 2011*

# 2010

**November, 2010** **26th - 30th**

## 10th Radiation and Physics Protection Conference

**Al-Menia University, Al-Menia, Egypt**

**Early Announcement**

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**Conference Scientific Secretary**
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# 2011

**February, 2011** **6th - 11th**

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## Australian X-ray Analytical Association
### Schools, Advanced Workshops, Conference and Exhibition

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**June - July, 2011** **26th June - 1st July**

## IRRMA - 8

**8th International Topical Meeting on**

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**Kansas City, Missouri, U.S.A.**

Further information on page 17 of the December 2009 Bulletin, and also visit the website

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The primary objective of the International Radiation Physics Society (IRPS) is to promote the global exchange and integration of scientific information pertaining to the interdisciplinary subject of radiation physics, including the promotion of (i) theoretical and experimental research in radiation physics, (ii) investigation of physical aspects of interactions of radiations with living systems, (iii) education in radiation physics, and (iv) utilization of radiations for peaceful purposes.

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The **IRPS Bulletin** is published quarterly and sent to all IRPS members.

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