

WATER & ENVIRONMENT NEWS

A Newsletter of the Isotope Hydrology Section

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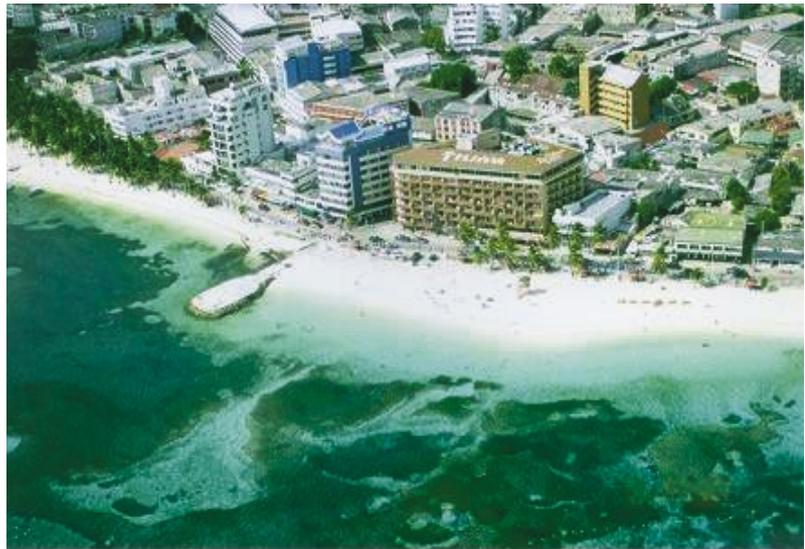
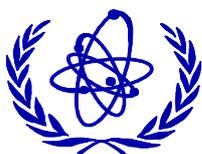


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San Andres Beach



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FROM THE SECTION HEAD....

Management of water resources to sustain the present and future development needs of the world will require joint efforts by international governmental and non-governmental organisations. Two recent activities highlight the efforts being made by the Isotope Hydrology Section to increase awareness of the role of isotope techniques in water resources management.

A poster outlining the Agency's activities in water resources was displayed in a joint pavilion of UN Agencies (IAEA, FAO, UNESCO, UNEP, HABITAT, UN-DESA, WHO, UNICEF, World Bank) at the 2nd World Water Forum and Ministerial Conference held at The Hague during 17-22 March 2000.

The Forum provided an opportunity for about 4500 participants to exchange ideas and experiences that may influence the process for making water decisions and policy. Many parallel sessions were run on national, regional, and international issues of concern in water resources development and management. Discussions in these sessions provided overviews on the various national and regional approaches to improve the availability of water for sustainable development. The development and financing institutions are emphasizing privatization of water supply infrastructure, atleast in large cities. NGOs increasingly emphasize community participation in resource management and in reviving traditional, local-scale approaches to watershed management. Regardless of the approach being adopted, there is a greater need



for using advanced technologies to improve the knowledge base for effective water resources management decisions.

The Conference issued a declaration in which it agreed that water is a basic human need. The UN system was asked to coordinate its programmes with more efficacy so that its role in fostering sustainable water resources management was more prominent.

Pursuant to the resolutions of the Agency's General Conference calling for increased collaboration with UNESCO and other UN Agencies, a joint programme initiatives of the IAEA, UNESCO, and WMO are being developed to integrate isotope techniques in hydrologic practices. A concept paper was prepared at an IAEA-UNESCO working group meeting to launch a new programme called JIIHP – Joint International Isotopes in Hydrology Programme involving the IAEA and UNESCO's International Hydrological Programme (IHP). The IHP is a mature progra-

me now running for about 30 years and is implemented with the help of national committees consisting of research and practicing hydrologists in the participating countries.

The concept paper for JIIHP was presented to the Inter-Governmental Council of the IHP at its meeting in June 2000. The Council approved the paper and adopted a resolution calling on the governing bodies of UNESCO and IAEA to launch the programme. Additionally, the resolution encourages the Member States to expand the national committees of IHP to also include experts in isotope hydrology. These expanded IHP committees will facilitate a greater dialogue and mainstreaming of isotope hydrology in Member States.

Pradeep AGGARWAL

MITIGATION STRATEGIES FOR ARSENIC CONTAMINATION

Groundwater with high arsenic concentrations from naturally occurring sources is the primary source of drinking water for millions of people in Bangladesh resulting in a major public health crisis of recent times. Efforts are being made by various national and international agencies to assist the Government of Bangladesh in mitigating the adverse impacts of arsenic in drinking water. One of the mitigation options is to exploit arsenic-free deep aquifers as an alternative source of safe drinking water. However, reliable criteria are not available to evaluate the long-term consequences of this mitigation option. As the full extent of the problem is being characterized and mitigation options are developed, it is necessary to answer the following questions:

- When existing deep wells are found to be contaminated, do they indicate the contamination of deep aquifer?
- If deep aquifers are free from arsenic now, would they remain so when developed as alternative sources of drinking water?
- What are the mechanisms of arsenic mobilization that explain its irregular distribution in mostly shallow aquifers?

The Agency in co-operation with the Bangladesh Atomic Energy Centre, the Bangladesh Water Development Board and University of Rochester, NY has launched a field study to provide a scientific basis for developing mitigation strategies by characterizing the mechanism of arsenic mobilization in groundwater and the present and future status of



Arsenic removal plant - one of the mitigation alternatives.

arsenic contamination in deeper aquifers.

About 55 shallow and deep groundwater samples ranging in depth from 10 to 335 m were collected and analyzed for their chemical and isotopic compositions. Distinct patterns of isotope compositions are found in shallow and deep groundwaters. Arsenic contamination is found to be present mostly in shallow groundwater to depths of less than 70 m. Groundwater samples from deep wells containing elevated arsenic concentrations are found to contain water mostly from shallow aquifers and do not indicate arsenic contamination of deeper aquifers. However, depth in itself is not a criterion that can be reliably or easily used to find arsenic-free, safe drinking water. Water with high arsenic concentrations sampled from "deep" wells may not be representative of deep aquifers, and presently uncontaminated water from somewhat deeper wells (~100 m) may not remain

so over a long period of time. Increased exploitation of deep groundwater (~300 m) such as in the Barisal area appears to be possible without fear of arsenic contamination from shallow aquifers. However, the potential for groundwater mining is clearly evident and the sustainability of this resource needs to be evaluated.

Isotope data from 1979 and 1999 indicate that the exponential increase in groundwater exploitation during over two decades has not affected the overall hydrodynamics of shallow and deep aquifers and, by implication, the arsenic mobilization processes. Currently favored mechanisms of arsenic mobilization are found to be inconsistent with isotope data. The most likely process of arsenic mobilization may involve desorption from the sediments as a result of the relatively rapid and continuing (natural) renewal of shallow aquifers with arsenic-free water.

SALINITY AND ITS IMPACT ON FRESH GROUNDWATER RESOURCES

A new coordinated research project, "Origins of salinity and impacts on fresh groundwater resources: Optimisation of Isotopic techniques" was recently approved by the Agency. This project is, to a large extent, based on the recommendations of the Consultants' Meetings held in December 1999 on "Palaeowaters as drinking water reserve and palaeo-climatic

archive" and "Isotope studies for groundwater salinization in water scarce areas".

The CRP aims to understand the mechanisms by which natural salinization of groundwater takes place and the impact of salinity on freshwater resources exploitation by using new tools (e.g. $\delta^{37}\text{Cl}$, ^{226}Ra , $\delta^{11}\text{B}$) in addition to the existing tools. It is planned to integrate the

efforts of an international group of researchers to investigate the origins and processes of groundwater salinisation at a single site.

Two sites, namely the coastal aquifer of Karachi, Pakistan and the Kurnob aquifer system of Israel, have been identified as possible pilot sites representative of coastal areas and inland basins respectively for concerted action.

CLIMATE AND ISOTOPIC COMPOSITION OF PRECIPITATION

A new coordinated research project on "Isotopic composition of precipitation in the Mediterranean Basin in relation to air circulation patterns and climate" was recently initiated.

The project aims to identify and define the interactions between climatic conditions and isotopic composition of precipitation in the Mediterranean Basin, in order to assess contribution of climatic parameters to the overall climatic change experienced in the region, including decreasing precipitation.

The specific objectives of the CRP will be the assessment of the variation of the isotopic values along the directions west-east and south-north, their correlation with climatic and meteorological parameters, comparison between isotopic composition of the precipitation, the shallow groundwater and the surface waters, determination of physical phenomena at a compliant place, and the refinement of a process-based understanding to fully realise the value of isotopic data in hydrological and climate studies.

Precipitation will be sampled around the Mediterranean Basin on a monthly and on event-based frequency, whereas water vapour sampling will be carried out for a limited period of time.

Both climatologists and hydrogeologists should benefit from the study. A significant number of Mediterranean countries will participate and a good coverage of the region is thus expected.

ISOTOPES IN SURFACE WATER POLLUTION STUDIES

The 2nd research coordination meeting of the CRP on the Use of Tracers and Stable Isotopes in Surface Water Pollution Studies was held in Vienna from 13 to 17 March 2000. The participants reported on their progress in the individual research contracts. The studies are well advanced and it is expected that this CRP will be concluded at the beginning of 2001. The subjects covered in this CRP are:

- Comparative study on the use of tritiated water and Rhodamine WT as artificial tracers to measure detention

time in domestic sewage treatment ponds. Aspects such as the loss of tritium through isotopic exchange with the atmospheric humidity and the stability of the fluorescent tracer after weeks of contact with sewage, are considered in this study.

- The use of Tc-99m as tracer in short-term hydrological studies. Stability of the tracer in natural and polluted streams.
- The use of Tc-99m in a chemically reduced form, to label fine sediments for short-term dispersion studies. The label-

ling methodology has been developed and is being optimised.

- Isotopic analysis of dissolved oxygen, as a tool to identify the relative contribution of atmospheric oxygen and photosynthetic oxygen to the oxygen pool dissolved in surface waters.
- Use of radioactive and fluorescent tracers in coastal water pollution. Sewage dispersion from submarine fallouts and in-situ bacterial die-off measurement.

WORKSHOP ON DAM LEAKAGE AND DAM SAFETY

A regional training workshop on dam leakage and dam safety was held in Yogyakarta, Indonesia, from 22 November to 3 December 1999, as one of the initial steps to start a Regional (RCA) programme on this subject under the Technical Co-operation Programme in 2001.

Nineteen participants from 10 countries in Asia and the Pacific region attended the workshop. Almost half of the participants were from institutions dealing with dam management and the others from the nuclear

applications area. Most of the participants from the dam management sector had no previous knowledge on the use of isotopic techniques in dam leakage studies. The status of dam leakage studies in each of the countries was discussed with the participants.

In addition to lectures covering nuclear and conventional techniques to study dam leakage, practical exercises on data processing and interpretation were also conducted. The participants were provided

with field and laboratory data of a real dam case study to process, evaluate and provide a diagnosis of the observed problem. The practical approach given to this training workshop was appreciated by the participants.

The information obtained in this workshop, combined with the answers provided by the participating countries to a specific technical questionnaire, was very useful for the project proposal, which is now being evaluated.



Tracer experiments in progress at the workshop held in Indonesia, November 22-December 3, 1999.

NUMERICAL MODELLING FOR WATER RESOURCES MANAGEMENT

A Regional training course on numerical modelling was held within the framework of the ongoing RCA project "Access to Clean Drinking Water" (RAS/8/084) in Bangkok, Thailand, from 14-18 February, 2000. The course, hosted by the Groundwater Division of the Department of Mineral Resources, had the main objective of providing in-depth training on development of site-specific groundwater flow and transport models for the study

areas where detailed isotope field investigations are being conducted.

The course was attended by 25 participants from 11 countries. Lectures and hands-on computer simulation sessions for flow and transport model development and calibration were carried out under the guidance of experts. The training course provided in-depth training on all aspects of development and calibration of

groundwater flow and transport models using the main software VISUAL MODFLOW and MT3D along with related software "Surfer", "Aquifer Test" and "Visual Help". Site-specific models on groundwater flow for 12 study sites involved in the project from different countries were developed and initial calibration runs were performed. Aspects related to constraining/verifying these models with isotope data were also covered.

DEVELOPMENT OF TECHNICAL CO-OPERATION PROJECTS ON GROUNDWATER RESOURCES IN CHINA



Participants of the meeting (from left): PANG Zhonghe; WANG Zhiming; Jeffrey TURNER; Edmundo GARCIA-AGUDO; WANG Jiyang; QIU Xinfei; M.N. RAZLEY; WANG Deqian; WEN Dongguang

- To exchange information on the status of national capacity, infrastructure and capability in isotope hydrology.
- To discuss problems, needs and future trends in isotope hydrology techniques in China.
- To identify study sites, institutions and persons involved in future projects.

The main outcome from the meeting was the initiation of a 2-year plan for co-operation between the IAEA and the Chinese counterparts on the application of isotope techniques to the groundwater resource development in Guangzhong and Erdos basins located in NW China.

Between 9 and 11 May 2000, a working meeting was convened jointly by the East Asia and Pacific Section and the Isotope Hydrology Section.

The meeting was held to develop opportunities for technical co-operation between

the IAEA and China on groundwater development and management, with special attention given to a national strategic priority for groundwater development in the NW of China. The main purpose of the meeting was:

A REGIONAL MEETING FOR WATER RESOURCES MANAGERS

A regional meeting entitled "Executive meeting for water resources managers on breakthrough in isotope applications in water resources management in Asia", was organized within the framework of the Regional project on "Access To Clean Drinking Water" (RAS/8/084). It was hosted by the Korean Atomic Energy Research Institute (KAERI) at Tejeon during 10-13 April, 2000. The purpose of the meeting was to inform senior

management staff in national water institutions of the activities, progress and achievements of the project, and to solicit their views with regard to the priority issues related to water resources assessment/management in the region as a means of designing future activities concerning isotope hydrology applications. The meeting was attended by 27 participants from 11 countries involved in the Regional project. The majority of the participants

were senior management staff from national institutions that have direct responsibility of water resources development and management.

The meeting, which brought together senior level managers from water institutions and isotope specialists, was very useful for information exchange as well as providing a forum to inform senior managers of the potential contributions of isotope hydrology.

ISOTOPE TECHNIQUES AND ENVIRONMENTAL CHANGE

An International Conference on the Study of Environmental Change using Isotope Techniques will be held at the Agency's Headquarters in Vienna during 23-27 April 2001. Papers are solicited on the following topics:

- Isotopes in the atmosphere and the hydrosphere
- Interaction between the atmosphere and the hydrosphere

- Isotope indicators of past climatic and environmental changes

- Advances in isotope and other analytical techniques.

The deadline for registration is 10 November 2000 (through the competent official authority), and the full papers must be received by the Agency not later than 10 March 2001.

Limited funds are available to

help meet the cost of attendance of selected specialist from developing countries with low economic resources. The deadline for applications for grants is 10 November 2000.

Detailed information on the Conference is available on the internet.

URL-<http://www.iaea.org/worldatom/Meetings/Planned/2001/index.html>

WATER RESOURCES OF COASTAL AREAS AND SMALL ISLANDS

The problems associated with sea water intrusion into coastal aquifers are well known. A closely related process is submarine groundwater discharge. An advisory Group Meeting (AGM) will be organized in September in Vienna to discuss problems and research needs on this topic. The main theme of the meeting will be isotope methods in assessment of submarine groundwater discharge (SGD) and coastal zone management.

The meeting outline will include the following:

- The scope and application of potential isotope tracers in SGD
- The role of isotopic tracer techniques in characterisation of submarine groundwater discharge: detection and flux estimation
- Novel isotopic methodologies and approaches as well as possible technical developments
- Intercomparison of isotope

methods and comparisons with other tracers and physical methods

- Case studies of isotopic applications
- New directions for the application of isotope methods in SGD
- Implications for coastal zone and onshore groundwater environmental and water resource management.

APPLICATION OF ISOTOPE TECHNIQUES TO SOIL EROSION AND SEDIMENTATION REMEDIATION

As part of an ongoing commitment to promoting the development and application of nuclear techniques in the evaluation of soil erosion and sedimentation processes, the IAEA Isotope Hydrology Section is proposing to hold an Advisory Group Meeting (AGM) in October 2000 on the application of nuclear techniques to sediment fingerprinting and its use in the evaluation of erosion and sedimentation control practices. It is intended that the meeting

will focus consciously on the application of isotope methods in the evaluation of erosion and sedimentation control practices. Thus the meeting is a means of advancing the use of these techniques from their use in characterisation of soil erosion problems to that in the evaluation of erosion and sedimentation remediation solutions. This will be an exciting scientific challenge for the AGM.

Editor's Note

To Receive a free copy of Water & Environment News regularly, please write to:

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Alternatively it is also available on the following website:

<http://www.iaea.org/programmes/ripc/ih>

STABLE ISOTOPE REFERENCE MATERIALS AND LABORATORY QUALITY ASSURANCE

The 8th IAEA Advisory Group Meeting on Stable Isotope Reference Materials will be conducted from 18-22 September 2000.

The topics of the meeting will include status reports and discussions on necessary changes for recommended values of stable isotope reference materials for the elements sulfur, nitrogen and carbon. The future replacement of VSMOW and SLAP will be discussed as well as possible new organic reference materials suitable for modern analytical techniques.

Further information will be made available on the homepage of the Isotope Hydrology Laboratory <http://www.iaea.org/programmes/rial/pci/isotopehydrology/> and in the ISOGEOCHEM newsgroup.

THE 6th IAEA INTER-LABORATORY COMPARISON ON TRITIUM

An interlaboratory comparison exercise (IC) for low level tritium activity in water samples will be initiated shortly. A set of untreated water samples with known tritium activities ranging from zero to greater than a hundred TU will be distributed in aliquots of 500 mL each. The IC exercise is open for up to 120 laboratories engaged in low level tritium measurements.

Interested laboratories may send an email with the subject "TRIC2000" and their complete address (contact name, laboratory, tel, fax, email) to the following email address:

Isotope.Hydrology.Lab@iaea.org

or to Manfred Groening, Fax +43 1 26007.

BORON STABLE ISOTOPE INTER-LABORATORY COMPARISON

Early this year, an inter-laboratory comparison (IC) on stable isotopes of Boron was initiated by the *Istituto di Geocronologia e Geochimica Isotopica (IGGI), Pisa, Italy*, in co-operation with the IAEA. Eight different samples (water, rock, mineral samples) have been distributed to the participating laboratories. The IC exercise will end in September 2000. Participation is still possible for interested laboratories. For further details please contact:

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Alternatively check the home
page of the Isotope Hydrology
Laboratory at -
[http://www.iaea.org/programmes/
rial/pci/isotopehydrology/](http://www.iaea.org/programmes/rial/pci/isotopehydrology/)

MEETINGS AT A GLANCE

AGMs

AGM-1088: Applications of Isotope Methods to Water Resources Assessment and Management of Coastal Areas and Small Islands

Vienna, 22-25 August 2000

AGM-1091: Preparation of a Technical Document on Future Trends in Stable Isotopes Reference Materials and Laboratory Quality Assurance

Vienna, 18-22 September 2000

AGM-1090: Sediment tracing (fingerprinting) by nuclear techniques and their application to the assessment of the effectiveness of erosion and sedimentation remediation strategies with emphasis on dam sustainability

Vienna, 10-13 October 2000

RCMs

RCM 687.2 - Application of Isotope Techniques to the Assessment of Aquifer Systems in Major Urban Areas

Vienna, 11-13 September 2000

RCM 688.2 - The Use of Isotope Techniques in Problems related to Geothermal Exploitation

Vienna, 11-13 September 2000

SYM

International Conference on the Study of Environmental Change Using Isotope Techniques

Vienna, 23 - 27 April 2001

IAEA Meeting Categories

AGM - Advisory group meeting
RCM - Research Co-ordination Meeting
CS - Consultant Service
CM - Consultants Meeting
SYM - International Symposium