Protection of our environment is becoming a more and more important issue as the world's population continues to increase along with levels of industrial activity. Industrial activity includes a wide range of manufacturing industries that use a wide variety of chemicals, many of which are spilled during the manufacturing processes. Historically a wide variety and massive amounts of chemicals and products have been spilled into the subsurface, water and soil and vented into the atmosphere. In addition the impact of oil and gas exploration also has to be investigated particularly with the recent developments in shale gas and shale oil production with associated hydrofracking operations.

There are two major approaches to environmental geochemistry. The first is the rather straightforward monitoring programs. In other words are certain compounds present in the environment above levels controlled by the government. In the US there are many methods put in place by the EPA that determine concentrations of a wide range of target compounds.

The second and far more challenging approach is that of environmental forensics. The goal of this work is directed towards a number of issues. First what has been spilled; second where was the point of release; third is it degrading; and fourth who is responsible and will pay to clean it up?

The major part of this course will be concerned with environmental forensics since this is the most important issue at the present time. The EPA methods will also be discussed in an introductory section. Most of the emphasis in the environmental forensics section will be related to problems involving petroleum hydrocarbons both during exploration, production and refining. In addition emphasis will also be placed on a wide array of chlorinated compounds widely used in many different areas.

The following is an outline of the topics it is proposed to cover in a four day short course:

1. Analytical techniques for characterization of crude oils and refined products. Not only will this include a discussion of conventional techniques such as gas chromatography (GC) and gas chromatography-mass spectrometry (GCMS) but it will also include discussion of new technology such as gas chromatography-isotope ratio mass spectrometry (GCIRMS) which is a particularly powerful tool for characterizing refined products from different suppliers.

2. Characterization of crude oils and refined products-topics to be covered in this section included discussion of the major compositional differences between crude oils and various types of refined products. Critical to such a discussion is the nature of the compounds which can be used to possible distinguish samples from different suppliers or different feedstocks. Are there compounds in refined products which permit them to be differentiated from naturally occurring crude oils or condensates?
3. Additives in refined products—a discussion of these compounds is important since such compounds, such as MTBE, can in many cases cause more environmental damage than the hydrocarbons themselves. Additives are also important for age dating times of product release.

4. Fate of hydrocarbons in the environment—once a spill or leak happens changes will occur to the composition of the spilled product. An understanding of the processes driving these changes is essential to being able to correlate the spilled product with its source.

5. EPA methods for characterizing hydrocarbons in the groundwater. Which method to use and what sort of information is obtained from each method. Getting the maximum amount of information from each method and ensuring you are interpret the data correctly.

6. Correlation of spilled sample with potential sources—what to look for and how the weathering process may confuse the issue. For example how do you distinguish gasoline from natural condensate? How can you correlate heavily weathered samples with non-degraded samples?

7. Age dating spills in ground water—what methods work and which ones are misleading—again essential for litigation purposes?

8. Remediation of groundwater contaminated by hydrocarbons. What methods are commonly used and which are most successful. How do you monitor the rate of clean-up?

9. Natural remediation—clean it up or let it degrade naturally—what options are available?

10. Unconventional hydrocarbon exploration and hydrofracking. What are the environmental issues associated with this and are they as significant as has been proposed by certain groups?

10. Examples of environmental cases where forensic geochemistry has played a major role in the litigation process.

ABOUT THE INSTRUCTOR
Prof. R. Paul Philp

Education
D.Sc. 1998 University of Sydney, Australia
Ph.D. 1972 University of Sydney, Australia
B.Sc. 1968 University of Aberdeen, Scotland

Professional Experience
Professor of Petroleum Geochemistry, University of Oklahoma. June 1987 - to date
Interim Director, School of Geology, University of Oklahoma. Jan 1987 to July 1989
**Research Interests**
Petroleum, Environmental and Forensic geochemistry with the emphasis on molecular and isotopic characterization of oils, gases, rock extracts and contaminants for the purposes of source determination, characterization of depositional environments, biodegradation, correlation, and monitoring natural attenuation.

**Professional Activities**
American Chemical Society
European Association of Organic Geochemists
Association of Latin American Geochemists

**Awards**
George Lynn Cross Research Professor, University of Oklahoma, April 1990.
Assoc. Editor of *Chem. Geol.*
Regents Award for Outstanding Research, University of Oklahoma, April, 1989
Joe and Robert Klabzuba Professor of Organic Geochemistry, University of Oklahoma, July 1984-
Best Paper of 1974-1975 award presented by the Organic Geochemistry Section of the Geochemical Society

**ENROLLMENT**
In order to allow sufficient time for arranging travel plans, early enrollment is recommended. Registration will be closed on 27 October 2014. Late enrollment may result in course cancellation.

**CANCELLATION, SUBSTITUTION & REFUND**
The tuition fee will be refunded (less US$ 100 registration fee) only if notification of cancellation is received at least 10 days prior to the commencement.

Non payment of tuition fee does not constitute automatic cancellation of participation. Substitution may be made at any time for those enrolled.

**CERTIFICATE**
A certificate of participation will be awarded to each person completing the course

**TUITION FEE**
Tuition fee at USD 3,650.00 + 10% VAT per delegate is due and payable upon confirmation of enrollment. The fee is excluded accommodation. Payment should be settled at the latest on 27 October 2014. Any bank charges in connection with payment in US Dollars must be added to payment. Tuition fee includes admittance to the course, course materials, daily refreshments and full lunch.

Payment can be made to PT. Geoservices:
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