THE ATRIUM, SOUTHERN GATE, CHICHESTER, WEST SUSSEX P019 8SQ

IMMEDIATE RESPONSE REQUIRED

Please follow these instructions to avoid delay of publication

☐ **READ PROOFS CAREFULLY**

- This will be your only chance to review these proofs. **Please note that once your corrected article is posted online, it is considered legally published, and cannot be removed from the Web site for further corrections.**
- Please note that the volume and page numbers shown on the proofs are for position only.

☐ **ANSWER ALL QUERIES ON PROOFS** (Queries for you to answer are attached as the last page of your proof.)

- List all corrections and send back via e-mail to the production contact as detailed in the covering e-mail, or mark all corrections directly on the proofs and send the scanned copy via e-mail. Please do not send corrections by fax or in the post.

☐ **CHECK FIGURES AND TABLES CAREFULLY**

- Check size, numbering, and orientation of figures.
- All images in the PDF are downsampled (reduced to lower resolution and file size) to facilitate Internet delivery. These images will appear at higher resolution and sharpness in the printed article.
- Review figure legends to ensure that they are complete.
- Check all tables. Review layout, title, and footnotes.

☐ **COMPLETE CTA (if you have not already signed one)**

- Please send a scanned copy with your proofs and post your completed original form to the address detailed in the covering e-mail. **We cannot publish your paper until we receive the original signed form.**

Reprint and journal issue purchases

- **Paper reprints** (minimum quantity 100 copies) are available on publication to contributors. Quotations may be requested from mailto:author_reprints@wiley.co.uk. Orders for additional paper reprints may be placed in advance in order to ensure that they are fulfilled in a timely manner on publication of the article in question. Please note that offprints and reprints will be dispatched under separate cover.
- PDF files of individual articles may be purchased for personal use for \$25 via Wiley's Pay-Per-View service (see <http://www3.interscience.wiley.com/aboutus/ppv-articleselect.html>).
- Please note that regardless of the form in which they are acquired, reprints should not be resold, nor further disseminated in electronic or print form, nor deployed in part or in whole in any marketing, promotional or educational contexts without further discussion with Wiley. Permissions requests should be directed to <mailto:permreq@wiley.co.uk>
- Lead authors are cordially invited to remind their co-authors that the reprint opportunities detailed above are also available to them.
- If you wish to purchase print copies of the issue in which your article appears, please contact our Journals Fulfilment Department <mailto:cs-journals@wiley.co.uk> when you receive your complimentary offprints or when your article is published online in an issue. Please quote the Volume/Issue in which your article appears.

Temperature-induced surfactant-mediated pre-concentration of uranium assisted by complexation

Alain Favre-Réguillon,¹ Denis Murat,² Gérard Cote,³ Jacques Foos² and Micheline Draye^{4*}

¹Laboratoire de Chimie Organique (UMR 7084), CNAM, 2, rue Conté, 75003 Paris, France

²Laboratoire des Sciences Nucléaires, CNAM, 2 rue Conté, 75003 Paris, France

³Laboratoire d'Electrochimie et de Chimie Analytique (UMR 7575), ENSCP, 11, rue P et M Curie, 75231 Paris Cedex 05, France

⁴Laboratoire de Chimie Moléculaire et Environnement, Université de Savoie, ESIGEC, 73376 Le Bourget du Lac Cedex, France

AQ1

Abstract: •Cloud-point extraction (CPE) was used with lipophilic chelating agent to extract uranium(VI) from aqueous solutions. The methodology used is based on the formation of metal complexes soluble in a micellar phase of a non-ionic surfactant, Triton X-114. The metal ions complexes are then extracted into the surfactant-rich phase at a temperature above the cloud-point temperature. The influence of surfactant concentration on extraction efficiency was studied and the advantage of adding 8-hydroxyquinoline (8HQ) as lipophilic chelating agent was evidenced. High extraction efficiency was observed, indicating the feasibility of extracting U(VI) using CPE. This study describes a four-step process – (1) extraction, (2) thermo-induced phase splitting, (3) back-extraction and (4) second phase splitting – for the recovery of uranium from water. During steps 1 and 2, uranium can be efficiently extracted at pH > 4 into the surfactant-rich phase formed by the splitting of the initial aqueous solution modified with a 1% Triton X-114. Thus, by using an 8HQ/U(VI) molar ratio of 10, the extraction yield is quantitative and the concentration factor obtained is superior to 100. Uranium can be then stripped with a diluted nitric acid solution (pH < 1) and the system can be recycled through a new four-step cycle.

© 2006 Society of Chemical Industry

Keywords: cloud-point extraction; uranium; 8-hydroxyquinoline; Triton X-114

INTRODUCTION

Assessment of the risk of impact from most radionuclides is based on the total radiological dose rate to the organism of concern. However, for uranium of natural isotopic composition there is a greater risk from chemical toxicity than radiological toxicity.^{1,2}

Typical environmental problems associated with mill tailings and waste dumps are radon emanation and leaching of contaminants, including radionuclides and heavy metals, into surface water and groundwater.³ Pyrite is a sensitive mineral in the geological environment, and its oxidation by iron-oxidizing bacteria produces sulfuric acid, which acidifies the pore water of abandoned metal tailings. Perturbations caused by aggressive mining/milling operations combined with highly acidic environments enhance metal mobilization, which is considered a direct pathway for groundwater contamination. Thus, because of the enrichment of uranium in ores of other metals and phosphate deposits, uranium is found in mine drainage from hard rock base- and precious metal mines, as well as industrial mineral mines.⁴ Uranium is also detected in the copper waste dump leaching solutions of many large-scale porphyry copper operations.⁵

In view of uranium toxicity, precise determination in environmental materials is of utmost importance prior to pollution control measures. However, the direct

analysis of geological and environmental samples by atomic absorption spectrometry (AAS), inductively coupled plasma atomic emission spectrometry (ICP-AES) or mass spectrometry (ICP-MS) is still difficult because of the very low concentrations of uranium and also the presence of complex matrix. Thus, elaborate sample preparation involving analyte isolation and pre-concentration is generally necessary before the final analysis. Commonly used methods for extraction and pre-concentration of uranium have been recently reviewed.⁶ Liquid–liquid extraction, ion exchange and solid phase extraction are commonly used methods. There is a trend to replace the solvent extraction procedure with ion exchange and solid phase extraction in order to minimize sample manipulation, analyte losses and use of toxic solvents. However, these methods are time-consuming and the tolerance of adsorbed matrix components is low. Thus alternative methods such as co-precipitation,⁷ nanofiltration⁸ and micellar systems have been developed.⁹

Separations and pre-concentration based on cloud-point extraction (CPE) are becoming a convenient alternative to conventional pre-concentration schemes.¹⁰ The solubility of non-ionic surfactants in aqueous solution is depressed above a well-defined temperature known as the cloud-point temperature (CPT). By setting the solution at a temperature

* Correspondence to: Micheline Draye, Laboratoire de Chimie Moléculaire et Environnement, Université de Savoie, ESIGEC, 73376 Bourget du Lac Cedex, France

E-mail: micheline.draye@univ-savoie.fr

(Received 22 February 2006; revised version received 23 May 2006; accepted 29 June 2006)

DOI: 10.1002/jctb.1618

Figure 1. Structure of Triton X-114 ($n = 6-8$).

Figure 2. Structure of 8-hydroxyquinoline.

above CPT, the solution separates into a concentrated phase containing most of the surfactant, the coacervate phase, and a dilute aqueous phase. In this method, any component originally present in the solution that interacts with the surfactant aggregate, i.e. the micelles, either directly or after chelation by hydrophobic ligand can thus be extracted and concentrated in the small volume of the surfactant-rich phase. CPE arises from the partitioning of a solute between the two water-based phases depending on its affinity to the surfactant. CPE can be used for the extractive pre-concentration, separation and/or purification of metal ions, metal chelates, biomaterials and organic compounds,^{9,10} and pilot-scale experiments for removal of wastewater contaminants have been developed.¹¹

The purpose of this study was to evaluate the possibilities of CPE for the pre-concentration of uranium from water. In particular, the influence of surfactant concentration (Triton X-114; Fig. 1) on uranium extraction efficiency was studied and the advantage of adding 8-hydroxyquinoline (8HQ) (Fig. 2) was investigated. The use of 8HQ as a chelating agent for the concentration of trace elements has a long tradition.¹² In that context, 8HQ or immobilized 8HQ derivatives have already been used for the extraction,¹³ separation and pre-concentration of uranium.^{14,15}

MATERIALS AND METHODS

All experiments were done in triplicate and data from representative batches are shown.

Figure 3. Cloud-point extraction experimental procedure.

Chemicals and reagents

All reagents used were of analytical grade. Stock solutions of uranium nitrate (●Prolabo) were prepared by dissolving the appropriate amount of its salt in ultra-pure water (●Millipore Alpha-Q). Triton X-114 (Fig. 1) provided by ●Aldrich was used without further purification. Concentrated nitric acid (●Acros Organics) was used to prepare back-extraction solutions.

Analytical procedure

ICP-AES measurements

Uranium concentration was determined by ICP-AES using La as internal standard. The apparatus used in this work was a Liberty II from ●Varian.

Temperature-induced phase separation

A thermostated bath (Haak CH from ●Fison) maintained at the desired temperature was used for CPT experiments.

Cloud-point procedure

CPE without 8HQ

This was performed by adding an aliquot of 50 mL of a solution containing U(VI) (0.1 mmol L^{-1}) to increasing amounts of pure Triton X-114. All surfactant concentrations were calculated as a percentage (w/w).

CPE with 8HQ

This was performed by dissolving an appropriate amount of 8HQ (Fig. 2) in pure Triton X-114. An aliquot of 50 mL of a solution containing U(VI) (0.1 mmol L^{-1}) was then added to the 8-HQ/Triton X-114 solution.

In both cases, after homogenization of the mixture at 10°C , the solution was left to stand at 40°C for 1 h to obtain phase separation of the micellar phase into a surfactant-rich phase and an aqueous solution depleted in surfactant. The upper aqueous phase (i.e., the surfactant-poor phase) was then removed and its U(VI) concentration was determined by ICP-AES. The experimental procedure is illustrated in Fig. 3.

CPE of U(VI) from micellar solutions was evaluated in terms of extraction efficiency E and concentration

factor $CF_{U(VI)}$, defined as follows:

$$E_{U(VI)} = \frac{C_i V_i - C_f V_f}{C_i V_i} \times 100$$

$$CF_{U(VI)} = \frac{\text{Total mass of U(VI) in the surfactant rich phase}}{\text{Total mass of U(VI) in the aqueous phase}} = \frac{C_i V_i - C_f V_f}{C_f V_f}$$

where C_i is the initial concentration of metal ion in the micellar solution, C_f is the concentration of metal ion in aqueous phase after CPE, V_i is the volume of the micellar solution and V_f is the volume of aqueous phase after CPE.

RESULTS AND DISCUSSION

Metal uptake by Triton X-114

In Fig. 4 the variation of U(VI) extraction percentage as a function of Triton X-114 is presented. Triton X-114 is effective for U(VI) extraction, which is markedly increased by a Triton X-114 increase to reach a maximum of 98% for a triton X-114 concentration of 2%.

Extraction of metal ions by CPE has already been demonstrated in the absence of chelating agent,^{12,13} but metal ion separation could be improved by the formation of hydrophobic complexes. Since Watanabe and Tanaka's pioneering work¹⁴ on nickel and zinc cation extraction, many chelating agents have been used to extract metal ions.^{15,16}

In order to minimize the surfactant concentration and increase the concentration factor we used the non-ionic surfactant Triton X-114 as the extractant in association with 8HQ as a chelating agent designed to form a U(VI) complex of altered solubility.

Metal uptake by Triton X-114 assisted by complexation

Uranium complexes with 8HQ are characterized by high thermodynamic stability ($\log \beta_3 = 23.8$, $T =$

Figure 4. U(VI) extraction efficiency (%) as a function of Triton X-114 concentration (weight %). $[U] = 0.1 \text{ mmol L}^{-1}$, $\text{pH} = 4$, $T = 40^\circ\text{C}$, equilibration time = 1 h.

Figure 5. Calculated speciation for U(VI) complexes with 8-hydroxyquinoline (8HQ) evaluated as a function of pH for molar ratio of $[8\text{HQ}]/[U] = 10$, $[U] = 0.01 \text{ mmol L}^{-1}$.

25°C , $\text{IS} = 0.1\text{M}$).¹⁷ CPT of pure 1% weight Triton X-114 is close to $23\text{--}25^\circ\text{C}$. We have previously shown that 8HQ depresses the CPT of Triton X-114.²⁰ In practice, overheating by more than 10°C is essential to obtain phase splitting of the micellar phase into a surfactant-rich phase and an aqueous solution depleted in surfactant. In this study, when using 8HQ, the temperature to obtain phase splitting is 40°C , offering advantages in terms of experimental procedure. Furthermore, the surfactant-rich phase is the heaviest, allowing an easier work-up, since the upper aqueous phase can be easily removed by suction.

The pH is a critical parameter for CPE of U(VI) by 8HQ. Figure 5 shows the distribution of U(VI) complexes as a function of pH with a tenfold excess of 8HQ built using the HySS computer program.¹⁹ U(VI) forms several complexes with 8HQ, i.e., $[\text{UO}_2-(8\text{HQ})]^+$, $[\text{UO}_2-(8\text{HQ})_2]$ and $[\text{UO}_2-(8\text{HQ})_3]^-$, and the complexation of U(VI) by 8HQ or 8HQ derivatives is dominated by proton competition, which limits the metal ion binding.

Figure 5 suggests that U(VI) is totally complexed by 8HQ as the neutral species $[\text{UO}_2-(8\text{HQ})_2]$ between about pH 4 and pH 6. We then investigated the CPE of U(VI) with increasing 8HQ/U(VI) molar ratios, at pH 4 and 0.7% weight Triton X-114 (Fig. 6).

Figure 6 shows that an 8HQ/U(VI) molar ratio of 5 allows the recovery of more than 85% of uranium, whereas in the absence of 8HQ the yield of extraction was close to 40%. With an 8HQ/U(VI) molar ratio of 10, more than 95% of uranium is extracted.

It was then found necessary to evaluate the influence of surfactant concentration on uranium extraction efficiency by varying the surfactant concentration for a constant 8HQ/U(VI) molar ratio. Figure 7 shows the results obtained for the CPE of U(VI) with increasing concentrations of Triton X-114, in the absence of 8HQ and with 8HQ/U(VI) molar ratios of 5 and 10, after 1 h at the settling temperature.

Figure 6. Effect of 8-hydroxyquinoline/uranium(VI) molar ratio on the extraction efficiency of U, 0.7 wt% Triton X-114, pH 4, [U] = 0.01 mmol L⁻¹, equilibration temperature 40 °C, equilibration time 24 h.

Figure 7. U(VI) extraction efficiency for increasing concentrations of Triton X-114 in the absence and the presence of 8HQ, [U] = 0.01 mmol L⁻¹, pH 4, equilibration temperature 40 °C, equilibration time 1 h, V_i = 45 mL, V_f = 44 mL.

In the absence of 8HQ and for increasing concentrations of surfactant from 0.5% to 1% weight, U(VI) extraction slightly increased with an efficiency of 49–60%. For the same surfactant concentrations, with a 8HQ/U(VI) molar ratio of 5, U(VI) extraction efficiency increased from 75% to 90%, whereas with an 8HQ/U(VI) molar ratio of 10 it increased from 94% to 99%.

Previous results showed that when increasing the 8HQ/U(VI) molar ratio from 5 to 10 an increase in Triton X-114 concentration from 0.5% to 1% exhibited a low influence on uranium extraction efficiency. Nevertheless, this low extraction efficiency dependence was correlated to a high CF increase varying from 9, when working with a 0.7% Triton X-114 concentration and an 8HQ/U(VI) molar ratio of 5, to 122 when working with a 1% Triton X-114 concentration and an 8HQ/U(VI) molar ratio of 10 (Table 1).

Table 1. Uranium concentration factor as a function of Triton X-114 concentration in the absence of 8HQ and for 8HQ/U(VI) molar ratios of 5 and 10. [U] = 0.01 mmol L⁻¹, V_i = 45 mL, V_f = 44 mL, pH = 4, equilibration time = 1 h, equilibration temperature = 40 °C

Triton X-114 (% wt)	0.5			0.7			1.0		
[8HQ]/[U]	0	5	10	0	5	10	0	5	10
CF	<1	<1	<2	3	10	9	15	17	122

Metal stripping

Figure 5 suggests that nitric acid can be used to strip U(VI) from the loaded organic solutions. Indeed, complexes formed with 8HQ can be back-extracted by bringing the surfactant-rich phase into contact with an aqueous solution at pH < 1. Thus, the surfactant-rich phase was brought into contact with a nitric acid solution. To obtain a homogeneous solution, the temperature of the mixture was lowered to 10 °C and then heated to 40 °C for 1 h to produce phase splitting. Using this procedure (1 mol L⁻¹ HNO₃, phase ratio) the yield of stripping of U(VI) was found to be quantitative, within experimental error. Thus, experimental results obtained suggest that the recovery of more than 98% of U(VI) can be obtained in one cycle (extraction/back-extraction) starting from a feed solution containing 0.1 mmol L⁻¹ of U(VI).

CONCLUSION

U(VI) can be extracted without using organic solvents by CPE using Triton X-114 as surfactant. Addition of 8HQ as chelating agent to the system leads to a decrease in Triton X-114 concentration needed and an increase in the concentration factor varying from 9 to 100, depending on the Triton X-114 concentration and the 8HQ/U(VI) molar ratio. The process consists of four steps: (1) extraction of U(VI) into the micelles of a non-ionic surfactant as a function of its association constants with a chelating extractant, 8HQ; (2) thermo-induced phase splitting; (3) back-extraction of U(VI) from the surfactant-rich phase using acidic solution; and (4) a second phase splitting. The separation can be achieved using an 8HQ/U(VI) molar ratio of 10 at pH 4 and U(VI) can be stripped with a dilute nitric acid solution (pH < 1).

REFERENCES

- Sheppard SC, Sheppard MI, Gallerand MO and Sanipelli B, Derivation of ecotoxicity thresholds for uranium. *J Environ Radioactiv* 79:55–83 (2005).
- Kocher DC, Relationship between kidney burden and radiation dose from chronic ingestion of U: implications for radiation standards for the public. *Health Phys* 57:9–15 (1989).
- IAEA-TECDOC-1296, *Technologies for the Treatment of Effluents from Uranium Mines, Mills and Tailings*. •International Atomic Energy Agency, Vienna (2002).
- Naftz D, Feltcorn E, Fuller C, Wilhelm R, Davis J, Morrison S, *et al*, Filed demonstration of permeable reactive barriers to remove dissolved uranium from groundwater, Fry canyon, Utah, September 1997 through September 1998. EPA 402-C-00-001, interim report. •Environmental Protection Agency, Washington, DC (2000).

- 5 Merritt RC, *The Extractive Metallurgy of Uranium*, ed. by Colorado School of Mines Research Institute. Johnson, Boulder, CO (1971).
- 6 Rao TP, Metilda P and Gladis JM, Preconcentration techniques for uranium(VI) and thorium(IV) prior to analytical determination: an overview. *Talanta* **68**:1047–1064 (2006).
- 7 Chou CL and Moffatt JD, A simple co-precipitation inductively coupled plasma mass spectrometric method for the determination of uranium in seawater. *Fresen J Anal Chem* **368**:59–61 (2000).
- 8 Favre-Reguillon A, Lebusit G, Foos J, Guy A, Draye M and Lemaire M, Selective concentration of uranium from seawater by nanofiltration. *Ind Eng Chem Res* **42**:5900–5904 (2003).
- 9 Huddleston JG, Willauer HD, Griffin ST and Rogers RD, Aqueous polymeric solutions as environmentally benign liquid/liquid extraction media. *Ind Eng Chem Res* **38**:2523–2529 (1999).
- 10 Hinze WL and Pramauro E, A critical review of surfactant-mediated phase separations (cloud point extractions): theory and applications. *Crit Rev Anal Chem* **24**:133–177 (1993).
- 11 Trakultamapatam P, Scamehorn JF and Osuwan S, Scaling up cloud point extraction of aromatic contaminants from wastewater in a continuous rotating disk contactor. I. Effect of disk rotation speed and wastewater to surfactant ratio. *Sep Sci Technol* **39**:479–499 (2004).
- 12 Seubert A, Petzold G and McLaren JW, Synthesis and application of an inert type of 8-hydroxyquinoline-based chelating ion exchanger for sea-water analysis using online inductively coupled plasma mass spectrometry detection. *J Anal Atom Spectrom* **10**:371–379 (1995).
- 13 Singh MS, Panda CR, Chakravorty V and Dash KC, Liquid–liquid extraction of thorium(4+) and uranyl ions by LIX-26 and its mixtures. *J Radioanal Nucl Chem* **120**:65–73 (1988).
- 14 Sohrin Y, Iwamoto SI, Akiyama S, Fujita T, Kugii T, Obata H, *et al*, Determination of trace elements in seawater by fluorinated metal alkoxide glass-immobilized 8-hydroxyquinoline concentration and high-resolution inductively coupled plasma mass spectrometry detection. *Anal Chim Acta* **363**:11–19 (1998).
- 15 Singh BN and Maiti B, Separation and preconcentration of U(VI) on XAD-4 modified with 8-hydroxyquinoline. *Talanta* **69**:393–396 (2006).
- 16 Akita S, Rovira M, Sastre AM and Takeuchi H, Cloud-point extraction of gold(III) with non-ionic surfactant-fundamental studies and application to gold recovery from printed substrate. *Sep Sci Technol* **33**:2159–2177 (1998).
- 17 Luconi MO, Fernanda Silva M, Olsina RA and Fernandez LP, Cloud-point extraction of lead in saliva via use of non-ionic PONPE 7.5 without added chelating agent. *Talanta* **51**:123–129 (2000).
- 18 Watanabe H and Tanaka H, A non-ionic surfactant as a new solvent for liquid–liquid extraction of zinc(II) with 1-(2-pyridylazo)-2-naphthol. *Talanta* **25**:585–589 (1978).
- 19 Wang C, Martin DF and Martin BB, Cloud-point extraction of chromium(III) ion with 8-hydroxyquinoline derivatives. *J Environ Sci Health A34*:705–719 (1999).
- 20 Draye M, Favre-Reguillon A, LeBuzit G, Thomas S, Guy A, Cote G, *et al*, Cloud-point extraction for selective removal of Gd(III) and La(III) with 8-hydroxyquinoline. *Sep Sci Technol* **40**:611–622 (2005).
- 21 Stary J, *Critical Evaluation of Equilibrium Constants Involving 8-Hydroxyquinoline and its Metal Chelates*. IUPAC Chemical Data Series no. 24. Pergamon Press, Oxford (1979).
- 22 Favre-Reguillon A, Draye M, Lebusit G, Thomas S, Foos J, Cote G, *et al*, Cloud point extraction: an alternative to traditional liquid–liquid extraction for lanthanides(III) separation. *Talanta* **80**:63–66 (2004).
- 23 Alderighi L, Gans P, Ienco A, Peters D, Sabatini A and Vacca A, Hyperquad simulation and speciation (HySS): a utility program for the investigation of equilibria involving soluble and partially soluble species. *Coord Chem Rev* **184**:311–318 (1999).

TS1

QUERIES TO BE ANSWERED BY AUTHOR

IMPORTANT NOTE: Please mark your corrections and answers to these queries directly onto the proof at the relevant place. Do NOT mark your corrections on this query sheet.

Queries from the Copyeditor:

- AQ1 Please reduce abstract to around 150 words maximum, if possible.
- AQ2 Please give location (city, country) for all manufacturers/suppliers named.
- AQ3 City and country?
- AQ4 City and country?
- AQ5 City and country?
- AQ6 City and country?
- AQ7 City and country?
- AQ8 Watanabe and Tanaka do not appear in ref. 14, though they do appear in ref. 18. Please check reference numbering.
- AQ9 If 'M' is molar, please change to mol L⁻¹.
- AQ10 ref. 23 on list?
- AQ11 Please check my addition.
- AQ12 Please check my addition.

Queries from the Typesetter:

- TS1 Citation(s) are missing for Reference(s) 18,21,22.
-

WILEY AUTHOR DISCOUNT CARD

As a highly valued contributor to Wiley's publications, we would like to show our appreciation to you by offering a **unique 25% discount** off the published price of any of our books*.

To take advantage of this offer, all you need to do is apply for the **Wiley Author Discount Card** by completing the attached form and returning it to us at the following address:

The Database Group
John Wiley & Sons Ltd
The Atrium
Southern Gate
Chichester
West Sussex PO19 8SQ
UK

In the meantime, whenever you order books direct from us, simply quote promotional code **S001W** to take advantage of the 25% discount.

The newest and quickest way to order your books from us is via our new European website at:

<http://www.wileyeurope.com>

Key benefits to using the site and ordering online include:

- Real-time SECURE on-line ordering
- The most up-to-date search functionality to make browsing the catalogue easier
- Dedicated Author resource centre
- E-mail a friend
- Easy to use navigation
- Regular special offers
- Sign up for subject orientated e-mail alerts

So take advantage of this great offer, return your completed form today to receive your discount card.

Yours sincerely,

Verity Leaver
E-marketing and Database Manager

*TERMS AND CONDITIONS

This offer is exclusive to Wiley Authors, Editors, Contributors and Editorial Board Members in acquiring books (excluding encyclopaedias and major reference works) for their personal use. There must be no resale through any channel. The offer is subject to stock availability and cannot be applied retrospectively. This entitlement cannot be used in conjunction with any other special offer. Wiley reserves the right to amend the terms of the offer at any time.

REGISTRATION FORM FOR 25% BOOK DISCOUNT CARD

To enjoy your special discount, tell us your areas of interest and you will receive relevant catalogues or leaflets from which to select your books. Please indicate your specific subject areas below.

Accounting ☐ • Public ☐ • Corporate ☐	Architecture ☐
Chemistry ☐ • Analytical ☐ • Industrial/Safety ☐ • Organic ☐ • Inorganic ☐ • Polymer ☐ • Spectroscopy ☐	Business/Management ☐
Encyclopedia/Reference ☐ • Business/Finance ☐ • Life Sciences ☐ • Medical Sciences ☐ • Physical Sciences ☐ • Technology ☐	Computer Science ☐ • Database/Data Warehouse ☐ • Internet Business ☐ • Networking ☐ • Programming/Software Development ☐ • Object Technology ☐
Earth & Environmental Science ☐	Engineering ☐ • Civil ☐ • Communications Technology ☐ • Electronic ☐ • Environmental ☐ • Industrial ☐ • Mechanical ☐
Hospitality ☐	Finance/Investing ☐ • Economics ☐ • Institutional ☐ • Personal Finance ☐
Genetics ☐ • Bioinformatics/Computational Biology ☐ • Proteomics ☐ • Genomics ☐ • Gene Mapping ☐ • Clinical Genetics ☐	Life Science ☐
Medical Science ☐ • Cardiovascular ☐ • Diabetes ☐ • Endocrinology ☐ • Imaging ☐ • Obstetrics/Gynaecology ☐ • Oncology ☐ • Pharmacology ☐ • Psychiatry ☐	Landscape Architecture ☐
Non-Profit ☐	Mathematics/Statistics ☐
	Manufacturing ☐
	Material Science ☐
	Psychology ☐ • Clinical ☐ • Forensic ☐ • Social & Personality ☐ • Health & Sport ☐ • Cognitive ☐ • Organizational ☐ • Developmental and Special Ed ☐ • Child Welfare ☐ • Self-Help ☐
	Physics/Physical Science ☐

[ ] I confirm that I am a Wiley Author/Editor/Contributor/Editorial Board Member of the following publications:

SIGNATURE: .....

PLEASE COMPLETE THE FOLLOWING DETAILS IN BLOCK CAPITALS:

TITLE AND NAME: (e.g. Mr, Mrs, Dr) .....

JOB TITLE: .....

DEPARTMENT: .....

COMPANY/INSTITUTION: .....

ADDRESS: .....

.....

.....

.....

TOWN/CITY: .....

COUNTY/STATE: .....

COUNTRY: .....

POSTCODE/ZIP CODE: .....

DAYTIME TEL: .....

FAX: .....

E-MAIL: .....

YOUR PERSONAL DATA

We, John Wiley & Sons Ltd, will use the information you have provided to fulfil your request. In addition, we would like to:

1. Use your information to keep you informed by post, e-mail or telephone of titles and offers of interest to you and available from us or other Wiley Group companies worldwide, and may supply your details to members of the Wiley Group for this purpose.
[ ] Please tick the box if you do not wish to receive this information
2. Share your information with other carefully selected companies so that they may contact you by post, fax or e-mail with details of titles and offers that may be of interest to you.
[ ] Please tick the box if you do not wish to receive this information.

If, at any time, you wish to stop receiving information, please contact the Database Group (databasegroup@wiley.co.uk) at John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, UK.

E-MAIL ALERTING SERVICE

We offer an information service on our product ranges via e-mail. If you do not wish to receive information and offers from John Wiley companies worldwide via e-mail, please tick the box [ ].

This offer is exclusive to Wiley Authors, Editors, Contributors and Editorial Board Members in acquiring books (excluding encyclopaedias and major reference works) for their personal use. There should be no resale through any channel. The offer is subject to stock availability and may not be applied retrospectively. This entitlement cannot be used in conjunction with any other special offer. Wiley reserves the right to vary the terms of the offer at any time.

Ref: S001W