行政院所屬各機關因公出國人員出國報告書
（出國類別：開會研習）

參加「第 4 屆亞太冬季電漿光譜化學研討會」報告

服務機關：行政院衛生署食品藥物管理局
姓名職稱：陳石松副研究員
派赴國家：中國
出國期間：99 年 11 月 26 至 12 月 1 日
報告日期：99 年 12 月 27 日

目次

摘要

2010 年第 4 屆亞太冬季電漿光譜化學研討會(The 4th Asia-Pacific Winter Conference on Plasma Spectrochemistry, 2010 APWC)於 99 年 11 月 26 日至 30 日假中國成都市望江賓館舉行，本次之學術演講內容豐富，與會者來自 17 個國家共 240 位學者專家，發表包括 5 篇大會報告(plenary lecture)，26 篇主題報告(keynote lecture)，14 篇邀請報告（ invited lecture)，17 篇口頭論文（ contributed oral presentation)及 62 篇壁報論文（ poster presentation)，主要針對各種重金屬檢測設備、技術及其於元素物種分析、生物釋放物質分析、環境分析、食品及藥物分析、奈米物質光譜各領域之應用。

本次參加第 4 屆亞太冬季電漿光譜化學研討會，除了參與研討會了解國際最新分析技術外，並以台灣地區水產品中砷物種含量調查（Arsenic Speciation in Seafood Products in Taiwan）提供壁報與國際人士討論，對未來實驗的研究方向有更近一步的瞭解。

參加國際研討會除分享相關領域之新知外，在會中能與多位專題演講的專家學者見面，並互相討論與交換研究心得，增進國際交流機會，獲知國際最新訊息，實在受益良多，藉由參予此次研討會，提升國際視野及增進檢驗技術。

壹、 目的

此次於中國成都市舉辦之「第4屆亞太冬季電漿光譜化學研討會(The 4th Asia-Pacific Winter Conference on Plasma Spectrochemistry, 2010 APWC)」，係由中國家自然科學基金委員會(National Natural Science Foundation of China) 主辦，四川大學、廈門大學及中國科學院地球化學研究所協辦。本次 2010APWC 主要針對各種重金屬檢測設備、技術及其於元素物種分析、生物釋放物質分析、環境分析、食品及藥物分析、奈米物質光譜各領域之應用，其目的是提供來自國際間的訊息交換與專業知識之討論，並提出最新的研究方向與技術。APWC每2年舉辦一次研討會，來自全世界各地區各個領域的專家學者齊聚一堂，彼此交換研究心得。本局爲我國政府有關食品衛生安全品質之最高檢驗及研究機關，爲保障食品衛生安全及品質、維護消費者權益及國人健康，必須瞭解重金屬檢驗最新的發展趨勢及概念，收集有關檢驗方法之研究，以提升本局重金屬檢驗之研究水準，並增加本局實驗室品質之管制及管理能力。參加此次年會目的爲：1.與專家交換研究心得，以增進本局與國際交流。2.收集世界各國有關重金屬分析研究之最新動態與資訊，作爲本局未來重金屬檢驗研究發展方向之重要參考依據。3.參加有關重金屬分析研習會，以提升本局重金屬檢驗分析水準，進而有助於本局業務之推行。4.壁報發表，將本局之研究心得與國際間討論，與世界接軌。

貳、 過程

一、行程與工作記要

日期	工作記要
98 年 11 月 26 日	啓程，到達中國成都市
98 年 11 月 26-30 日	轉車至望江賓館參加第 4 屆亞太冬季電漿光譜化學研討會，發表壁報論文及與各國專家學者交流
98 年 12 月 1 日	回程

二、研討會日期及地點

2010 年 APWC 於中國成都市望江賓館舉行第 4 屆亞太冬季電漿光譜化學研討會 (The 4th Asia-Pacific Winter Conference on Plasma Spectrochemistry, 2010APWC)，會期由 11 月 26 日起至 30 日止共計 5 天。本次之學術演講內容豐富，來自 17 個國家共 240 位學者專家，發表包括 5 篇大會報告（plenary lecture），26 篇主題報告（keynote lecture），14 篇邀請報告（invited lecture），17 篇口頭論文（contributed oral presentation)及 62 篇壁報論文（poster presentation）。

三、研討會內容

研討會議程相當豐富與緊湊，包括口頭論文、壁報論文及儀器設備展示。口頭論文分爲主要演講與論文發表，休息時間則參觀儀器商的展覽及壁報論文，詳細議程之相關資料如附件一。研討會內容包括電漿光譜分析、電漿質譜分析、光譜分析儀器、微小化/可攜式光譜儀、元素物種分析、生物釋放物質分析、環境分析、食品及藥物分析、奈米物質光譜及樣品前處理等議題。期間並有許多國際知名分析儀器廠商參展與發表新產品，包括 Thermo fisher、Shimadzu、Agilent、PerkinElmer 及 Nu 公司等儀器設備及實驗相關產品展出。會議期間除了參觀儀器廠商發表新品外，更提供了與參

加的人員資訊交流的一個機會。針對與本局業務有關之主題，綜合整理如下：

(一)、口頭論文發表部份：

首先由 Gray M. Hieftje 開場，題目爲 Novel mass spectrometers for plasma spectrochemistry，介紹一新穎的電漿質譜檢測器，其爲擴大飛行式質譜之概念，傳統飛行式質譜儀係採用時間飛行模式(time-of-flight)，此新開發之儀器係採用距離飛行模式(distance-of flight)，其兩者基本原理略有不同，前者係利用檢測不同離子於固定距離之飛行時間差異，後者則係利用檢測不同離子於固定時間之飛行距離差異，配合陣列式檢測器可同步接收各離子之訊號。其研究室利用此設備於金屬組學(metallomics)之分析可提升其分析能力及提供準確同位素資料。

來自中國科學院的 Zhifan Chai 等使用 ICP-MS 及核融合技術(Nuclear hybrid techniques）於奈米毒理學(Nanotoxicology)之研究，探討奈米物質（奈米碳管）於生物體之吸收、分布、代謝、排泄及毒理學。

Ryszard Lobinski 介紹以 ICP-MS 作爲層析及電泳之檢測器之應用，傳統之分子質譜法均採用電灑法(ES)或 MALDI 進行游離化，但對金屬蛋白質(metal-protein) 則因偵測極限或高鹽基質之影響而難以檢測。利用 ICP-MS 對非金屬(如硫、磷及硒等)之偵測能力、高靈敏度、基質耐受性及寬廣線性範圍，可作爲層析及電泳之有效的檢測器。缺點是 ICP-MS 僅能提供檢測物之元素特性質譜而無法提供其分子特性質譜。

Patrick J. Parsons 等使用四極柱 ICP-MS 分析血液及尿液中之錳含量，比較標準模式及動態反應池模式（dynamic reaction cell, DRC）對於去除干擾之效果。以 ICP-MS 檢測時 ^{55}Mn 極易受到其他元素複合離子之干擾，以 DRC 模式以氨氣爲反應氣體可解決此困擾。

來自加拿大的 Baowei Chen 等探討砷物種分析方法及砷與蛋白質間之交互作用。其使用 HPLC 串聯 ICP-MS 及電灑串聯質譜儀進行砷物種分析，探討砷之新

陳代謝及其毒性，並進一步探討砷與蛋白質間之交互作用以瞭解其作用機轉。

Weiyue Feng 等以 HPLC-ICP-MS 檢測實驗動物及職業暴露者尿液中之汞(包括甲基汞、無機汞及含汞蛋白質）及鉻（三價鉻及六價鉻）含量。探討汞於成年及幼兒間不同之毒性作用機轉。六價鉻爲致突變性及基因毒性之物質，而三價鉻爲人體必需之微量元素，監測職業暴露者保障其安全及健康是必要的，以離子配對逆相高效液相串聯感應耦合電漿質譜法（ion-pair reversed-phase HPLC-ICP-MS）分析尿液中及空氣暴露之六價鉻含量，結果顯示，監測職業工作者尿液中之六價鉻爲保障其安全及健康之有效方法。

Chengbin Zheng 等探討以光化學蒸氣產生法（Photochemical vapour generation, PVG）取代傳統之化學蒸氣產生法（Chemical vapour generation, CVG），CVG 具有高基質分離效果，高選擇性，低干擾，及高注入效率，可降低偵測極限，並可串聯預濃縮系統或層析技術應用於物種分析，但其需使用大量化學試劑及檢測時基線不穩定之狀況，而 PVG 利用光化學反應即可達到相同之效果，節省化學試劑及減少廢液產生。

Liuxing Feng 等以同位素稀釋質譜法（isotope dilution mass spectrometry, IDMS）於檢體中添加待測元素之同位素進行驗證參考物質(certified reference material, CRM)之驗證，IDMS 具有高準確性，其不受基質之影響，適用於元素、物種或化合物之分析。

Xiaoyu Jia 等以離子試劑(ionic liquid) 對化粧品檢體進行液-液微萃取(liquid-liquid microextracton, LLME) 配合 HPLC-ICP-MS 進行汞物種分析。先以 ammonium pyrroidinethiocarbamate (APDC) 與無機汞、甲基汞及乙機汞形成化合物，再以 1-hexyl-3-methylimidazolium hexafluorophosphate 進行 LLME，配合 HPLC-ICP-MS 進行汞物種分析，其偵測極限分別爲 1.3、7.2 及 5.4 ng/L。

PerkinElmer公司也經由此次研討會發表以最新機型Nexon 300 系列ICP-MS所作的實驗，此機型結合研究與例行性檢驗分析，此機種具有三錐接口(triple cone interface, TCI)、四極柱離子偏轉器(quadruple ion deflector)及通用池技術

(Universal cell technology, UCT)之設計，特別是 UCT 除標準模式外，並具有動態反應池（dynamic reaction cell, DRC）及碰撞池(collision cell, CC)模式，可解決樣品基質干擾之困擾。

Shimadzu 公司發表以 Chelex-100 離子交換樹脂前處理去除高鹽基質，配合 ICP-AES 分析鉛及鎘含量，其回收率分別爲 94.0%及 106%。

(二)、壁報論文部分：

Cheng-Hsing Lin 等以 Chip-based photo-catalyst reduction 配合 HPLC-ICP-MS 分析四價硒及六價硒。

Gao Ge 等將鎢-銥（W-Ir）塗覆於石墨管內之平板上作爲基質修飾劑，分析水及食品中之鎘含量，其背景訊號甚低並可提高其感度。配合一般基質修飾劑（$NH_4H_2PO_4$ ＋ $Mg(NO_3)_2$)可降低原子化溫度，延長石墨管之使用期限。

Wei Guo 等以 ICP-MS 分析動物性食品中微量鎘，以 DRC 模式可有效去除基質中氧化物之干擾。以氧氣爲反應氣體其背景訊號可降低 100 倍，定量極限(LOQ)可達 0.1 ng/g。

Lanlan Jin 等以雷射剝蝕（Laser ablation）配合感應耦合電漿飛行式質譜儀(ICP-TOF-MS)直接固體進樣分析樹葉之元素成分（包括銅、錳、鋅及鉛），結果顯示，此方法可檢測植物葉片上元素之分布。

Kenneth Ong 等探討以 HPLC-ICP-MS 分析魚肉中之甲基汞。將魚肉樣品以甲苯萃取後，再以 0.1% L-cysteine.HCl 反萃取後，以 HPLC-ICP-MS 可分析無機汞及甲基汞含量，其檢量線範圍爲 0.5-6 ppb，相關係數 > 0.995，偵測極限可達 0.5 ppb。

參、研習心得

(一)、本次與會專家學者之研究採用原子螢光光譜儀、感應耦合電漿質譜儀或電灑質譜儀等各類質譜裝置，應用於食品、藥品、環境及生化等各領域之分析，或串聯層析裝置（如高效液相層析儀、氣相層析儀及毛細管電泳儀）進行重金屬物種之分析，並進行未知重金屬物種之分析，本局目前僅串聯高效液相層析儀及感應耦合電漿質譜儀進行食品中重金屬物種之研究，未來可嘗試以高效液相層析串聯質譜儀進行未知重金屬物種之分析，跳脫以往之研究模式進行研究工作。

(二)、會中發表之論文有關重金屬物種分析除汞及砷物種外，並涵蓋如硒、鉻及錫等其他重金屬物種，而本局目前僅完成水產品中汞及砷物種及食用油中無機砷含量之研究，未來應擴展研究範圍，建立各類食品中各種重金屬物種之檢驗方法。

(三)、有關重金屬分析係屬超微量分析，爲達到準確分析之結果，專家學者均採用高解析之檢測儀器，本局本年度已採購一部感應耦合電漿飛行式質譜儀，設備已達到國際水準，未來應精進相關研究，並培養研究人才。

(四)、此次觀摩其他專家學者之研究，對世界各國有關重金屬分析及研究之最新脈動極有感觸，非親臨現場難以感受，所收集之資料可作爲本局未來重金屬檢驗與研究發展方向之重要參考依據，提升專業素質及能力，對本局業務有相當助益。

(五)、此行與多位專家研討重金屬檢驗之最新技術及未來技術發展之趨勢，分享心得，交換經驗並促進交流，有助益於工作之推展。交流中深感本局檢驗設備、人才及能力已具相當水準，可積極參與國際實驗室間共同試驗等國際交流活動，以提升本局國際知名度，達到實質交流目的，進而增進本局檢驗技術與能力。

(六)、國際語言之精通對於國際交流是極爲重要的，爲增進語言之能力，除了個人努力外，本局已利用各種資源與管考系統創造客觀之環境，積極培養同仁之語文能力，使同仁得以兼顧語文與專業能力。

(七)、此次代表本局參加研討會，在研討會中所收集到之資料，回國後亦將所得之資料交予相關業務之同仁，俾使此次出國之投資獲得最大之效益。

肆、建議

一、持續積極參與 APWC 等之相關活動，以充分瞭解世界各國之相關研究與技術。

二、由國際會議中論文發表情況，了解國際研究趨勢，作爲研究計畫規劃時之重點方向參考。

三、本局有關重金屬微量分析設備已達國際水準，未來應精進相關研究，培養研究人才，並積極參與國際實驗室間共同試驗等國際交流活動，以提升本局國際知名度。

四、本局有關食品中重金屬物種分析目前僅完成砷物種及甲基汞分析，未來希望能投入更多於物種分析之研究及儀器設備之精進，如有機汞、有機錫及其他重金屬物種之分析。

伍、附件

一、會議邀請函與簡介。

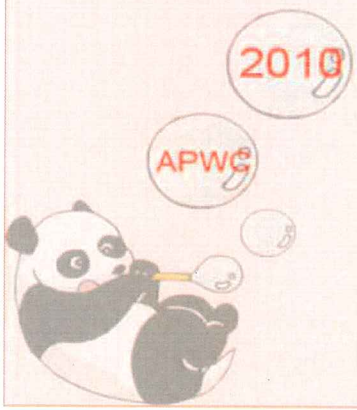
二、台灣地區水產品中砷物種含量調查（Arsenic Speciation in Seafood Products in Taiwan）壁報論文。

三、研習會詳細議程與手冊。

The 4th Asia-Pacific Winter Conference on Plasma Spectrochemistry (2010 APWC)

(Chengdu, China)

November 26-30, 2010



INVITATION

Welcome to the 4th Asia-Pacific Winter Conference on Plasma Spectrochemistry (2010 APWC), which will be held at Wangjiang Hotel, Chengdu, China from November 26 to 30, 2010. The 2010 APWC organizing committee cordially invites you to participate in this grant event on plasma spectrochemistry in China.

The purpose of the conference is to bring together analytical spectral chemists worldwide to stimulate contacts and to exchange research ideas and experiences. The 2010 APWC conference will consist of plenary lectures, invited keynote lectures, invited talks and oral presentations, a poster session, and an analytical instrument exhibition. Abstracts of all presented papers will be included in the proceedings book of 2010 APWC. It is expected that around 200 participants from 20 countries and regions will be present. We hope that this conference will meet all of participants' scientific and social expectations, as well as provide a satisfying Chinese cultural experience.

2010 APWC conference strives to create a forum for in-depth and informed discussions, with vital coverage of fundamental developments, new and improved instrumentation, spectroscopic diagnostics, and applications of spectroscopy across all disciplines, focusing on the following topics:

- ☆ Plasma-based optical spectrometry
- ☆ Plasma-based mass spectrometry
- ☆ Analytical spectral instrumentation
- ☆ Miniaturized/portable spectral instruments
- ☆ Spectroscopy in elemental speciation
- ☆ Spectroscopic sensing of bio-related species
- ☆ Environmental analysis
- ☆ Food and pharmaceutical analysis
- ☆ Nanomaterial-based spectroscopy
- ☆ Sample preparation in spectral analysis

An instrument exhibition program will be organized during the meeting. Companies interested in participating in this exhibition are encouraged to direct their inquiries to the organizer.

Organizing Committee of 2010 APWC

Arsenic Speciation in Seafood Products in Taiwan

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Introduction

Arsenic may enter the environment from industrial processes or being used in agriculture as inorganic arsenic pesticides and fertilizers. Arsenic is very well known for its toxicity which depends on not only the total concentration but also the chemical form. Of the inorganic forms, arsine is highly toxic, and arsenite is regarded as being more toxic than arsenate. The methylated species, monomethylarsonic acid (MMA) and dimethylarsinic acid (DMA), are less toxic than the inorganic forms; arsenobetaine (AsB) and arsenocholine (AsC) represent precursors of more complex organic and non-toxic forms. In fact, humans are exposed to arsenic through food, water, air, soil, and as well as in occupational settings. In Taiwan, seafood (i.e., fish, cephalopod, shrimp, bivalve and dried algae.) is very popular; also, large amounts of seafood are now cultivated and harvested. Based on total-diet studies pointed out in various countries had shown that fish and shellfish were the most significant dietary source of arsenic. However, there is no arsenic species defined legislative of seafood in Taiwan; we intend to analysis arsenic species in seafood through high-pressure liquid chromatography (HPLC) hyphenated inductively coupled plasma mass spectrometry (ICP-MS).

Table 1. Equipment and operating conditions

ICP-MS	Perkin Elmer Elan DRC-e
ICP parameters	
Nebulizer	Concentric
Spay Chamber	Concentric
Oxygen gas flow rate	0.05 l min^{-1}
RF power	1400 W
Ar plasma gas flow rate	17.0 l min^{-1}
Ar auxiliary gas flow rate	1.1 l min^{-1}
DRC parameters	
Rejection parameter a	0.0
Rejection parameter q	0.5
Methane Cell gas flow rate	0.3 ml min^{-1}
Measurement parameters Mass (m/z)	^{75}As

HPLC	Perkin Elmer Mode : Series 200
Injection volume	50 µl
Column	Hamilton PRP-X100 Anion Exchange , 10 µm (4.6 mm i.d. x 250 mm length)
Column temperature	Ambient
Mobile phase	A: Water B: 100 mM $(NH_4)_2CO_3$ in 3% (v v^{-1}) methanol (pH 8.5)
Gradient flow rate	0-10 min: 95% A, 5%B (0.8 ml min^{-1}) 11-20 min: 50% A, 50% B (1.0 ml min^{-1}) 20-25 min: 95% A, 5% B (0.8 ml min^{-1})

Table 2. Distribution of arsenic species in seafood (µg/g)

Seafood		MMA	DMA	AsC	AsB	As^{3+}	As^{5+}	Inorganic As
fish	fresh weight	N.D. - 0.19	N.D. - 0.39	N.D. - 0.04	N.D. - 3.59	N.D. - 0.02	N.D. - 0.40	N.D. - 0.40
	dry weight	N.D. - 0.82	N.D. - 1.71	N.D. - 0.20	N.D. - 17.26	N.D. - 0.10	N.D. - 2.17	N.D. - 2.17
cephalopod	fresh weight	N.D. - 0.34	N.D.	N.D.	0.03 - 6.79	N.D.	0.01 - 0.42	0.01 - 0.42
	dry weight	N.D. - 2.95	N.D.	N.D.	0.22 - 50.31	N.D.	0.05 - 3.62	0.05 - 3.62
shrimp	fresh weight	N.D. - 0.07	N.D.	N.D. - 0.04	N.D. - 1.71	N.D. - 0.25	0.03 - 0.11	0.03 - 0.36
	dry weight	N.D. - 0.30	N.D.	N.D. - 0.20	N.D. - 8.99	N.D. - 1.13	0.12 - 0.50	0.12. - 1.63
Bivalves	fresh weight	N.D. - 0.05	N.D.	N.D. - 0.05	0.05 - 0.42	N.D. - 0.51	N.D. - 0.10	0.01 - 0.51
	dry weight	N.D. - 0.32	N.D.	N.D. - 0.66	0.28 - 2.08	N.D. - 2.39	N.D. - 0.97	0.14 - 2.39
algae	fresh weight	0.12 - 22.38	0.07 - 0.92	N.D. - 0.03	N.D. - 0.08	N.D. - 0.03	N.D. - 0.22	N.D. - 0.22
	dry weight	0.13 - 25.63	0.08 - 1.08	N.D. - 0.03	N.D. - 0.10	N.D. - 0.03	N.D. - 0.28	N.D. - 0.28

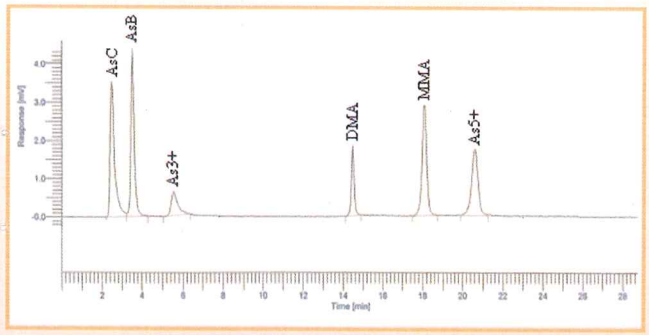


Figure 1. Chromatograms of arsenic species analyzed by HPLC-DRC-ICPMS.

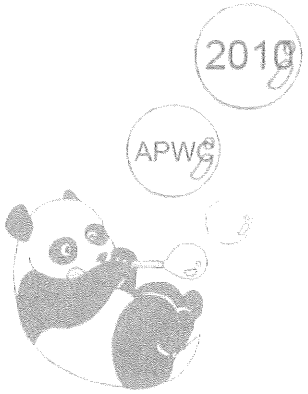
Table 3. Weekly intake of inorganic arsenic from seafood

	average amount of inorganic As (µg/g)	per capita daily intake of seafood (g/day)		per capita dairy intake of inorganic As in seafood	
		males	females	males	females
fish	0.07	53.23	47.44	3.73	3.32
cephalopod	0.10				
shrimp	0.12	17.05	22.06	2.73	3.53
bivalve	0.16				
dried algae	0.11	2.39	3.61	0.26	0.40
dairy intake of inorganic As (µg)				6.72	7.25
body weight for person aged 19-64 years (kg)				70.61	58.40
weekly intake of inorganic As (µg/kg body weight/week)				0.67	0.87

Conclusion

According to the analytical result of a total 106 seafood samples, it were indicated that DMA in shrimp, bivalve, and cephalopod were undetectable; besides, AsC and AsIII in cephalopod were undetectable, too. AsB was detected as the major arsenic species in all fish, cephalopod, shrimp, and bivalve samples. In Taiwan, the weekly intake of inorganic arsenic of males and females were 0.67 and 0.87 µg/kg body weight calculated based on seafood consumption; nonetheless, it is lower than the provincial tolerable weekly intake of 15 µg/kg body weight/week for inorganic arsenic recommended by the WHO. Therefore, the risk of inorganic arsenic poisoning due to seafood intake is lower in Taiwan.

The 4th Asia-Pacific Winter Conference on Plasma Spectrochemistry (2010 APWC)



November 27-30, 2010

Host:
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Sichuan University, China
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2010

PREFACE

It is our great honor and pleasure to host the 4th Asia-Pacific Winter Conference on Plasma Spectrochemistry (2010 APWC). On behalf of the ornization committee of 2010 APWC, I warmly welcome you to Chengdu to participate in this biannual event on plasma spectrochemistry.

Previous 3 APWCs were held in Chiang Mai, Bangkok of Thailand and Tsukuba of Japan. We would like to thank the former organizers for their valuable suggestions and support during the organization of the present conference. Especially, the success of this conference would not be possible without the great support and encouragement from Prof. Ramon M. Barnes and Professor Naoki Furuta. We also thank generous financial support from Nationtional Natural Science Foundation of China and analytical instrument manufacturers.

The purpose of the conference is to bring together analytical spectral chemists worldwide to stimulate contacts and to exchange research ideas and experiences. In this conference, there are five plenary lectures, twenty six keynote lectures, fourteen invited lectures and seventeen contributed oral presentaions, as well as sixty two poster presentations.

During the conference, we also provide opportunities to visit Dujiangyan Dam, Sanxingdui Museum, or Chengdu Giant Panda Research Base, and to experience local culture. We sincerely hope you would find your long trip to Chengdu for the 2010 APWC rewarding and exciting.

Xiandeng (Dan) Hou
Chairman of 2010 APWC
Sichuan University, Chengdu, China

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