

# ACS DIVISION OF GEOCHEMISTRY

## FALL 2000 NEWSLETTER

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220<sup>th</sup> NATIONAL ACS MEETING

WASHINGTON, DC

### Message from the Chairperson:

As this is my first report as Chair, I would like to thank our immediate past Chair, Bill Casey, for his sterling efforts. There are now a few new faces on the Executive Committee, and I am happy to welcome George Cody (Program Chair / Chair Elect), Peggy O'Day (Program Chair Elect) and Virender Sharma (Secretary).

I am also very happy to welcome back to the Exec Ken Anderson as our Councilor. Ken and George Luther, our Alternate Councilor, bring a wealth of experience to the Division, which all will no doubt draw upon. They will ensure that the voice of the Geochemistry Division is heard clearly by the governance of ACS.

The Spring National Meeting in San Francisco was a great success for the division. We hosted seven symposia, which were all very successful. Many of the symposia shared a petroleum geochemistry theme, and we attracted much industrial participation for these topics, but the symposia on '**Geochemistry and the Origin of Life**' and '**Geochemical Advances in the New Millennium**' also did well.

Looking forward to Washington DC in the fall, we have a smaller schedule planned, but no less interesting. The Geochemistry Division will be hosting a symposium entitled 'The Chemistry of the Early Solar System.' A larger program is planned for the San Diego meeting next spring, and some details are enclosed in this newsletter. The big event at the San Diego meeting though will be the inauguration of the **Geochemistry Division Medal**. We will be hosting a symposium honoring the first recipient of this prestigious prize.

I am also pleased to report that '**Geochemical Transactions**,' the division's own journal, is meeting its targets for the number of papers submitted and exceeding its goals with respect to publication times. This is the first electronic journal devoted to geochemistry, and is an excellent way to get your research published in months rather than

years. If you have not tried it yet, I urge you to go online and take a look.

Finally, I would like to take this opportunity to remind everyone that this is your division, and we are always happy to encourage the greater participation of the membership in our day to day affairs. You can do this by organizing a symposium on a topic in which you are interested, or by merely suggesting a topic. We can then find someone to organize it. We are also always keen to find individuals who are interested in joining the Exec. The duties are not too burdensome, and it can be a very rewarding experience. If you are interested in running for a position, or you wish to nominate someone, then please feel free to contact me or any of the members of the Executive Committee.

**Andy Bishop**  
Chairperson

### Geochemical Transactions:

**Geochemical Transactions**, the new electronic journal published by the Royal Society of Chemistry in collaboration with the Division of Geochemistry of the American Chemical Society, was launched successfully in March 2000. The journal is devoted to publication of articles in all areas of geochemical research, including organic and inorganic geochemistry, biogeochemistry, aquatic and marine chemistry, chemical and elemental cycles, numerical and computational modeling, and instrumental and analytical techniques. Several articles have been published to date, with many more in the works.

Appearing soon will be a collection of papers in honor of Professor Hubert L. Barnes. The average handling time of manuscripts from submission to publication has been on the order of 30 days. Moreover, the electronic format permits considerable freedom in the presentation of results (e.g., color, movies, expandable spectra, etc.). The subscription rate for Division of Geochemistry members and affiliates is only \$40!

I would like to invite all members and affiliates to check out the journal website (<http://www.rsc.org/geochem>) for information on subscription and submission of articles. Please consider submitting a manuscript to *Geochemical Transactions*. Remember, it's your journal, and its continued success depends on your support, both by publishing in it, and by subscribing to it. Also, please encourage your institutional libraries to subscribe to *Geochemical Transactions*.

**Scott Wood, Editor**  
**Geochemical Transactions**

#### **Report from the Treasurer/Editor:**

I am pleased to inform our members that the Division is in reasonable financial shape. One recent change we have made is to switch banking institutions so that we could increase interest revenues on our accounts.

You have probably realized that you are receiving the newsletter in a different format than earlier versions. Due to scheduling conflicts, the Executive Committee decided to try on a trial basis printing the newsletter & abstracts without the assistance of ACS. This allows us to prepare the newsletter on a more convenient schedule and ensures that you should receive it at least two weeks before the meeting.

One of our most important goals is to keep membership dues at the current level. One mechanism members can use to help us provide high-quality programming, while keeping dues low, is to apply for ACS PRF type SE (Scientific Education) grants when they organize symposia at major meetings.

ACS PRF type SE grants of up to \$2,000 are available to help defray the travel costs of invited foreign speakers at major symposia in North America. **The application is short, and the Division Treasurer takes care of much of the work!** You can find out about ACS PRF type SE grants at the following website: [www.acs.org:80/prf/index.html](http://www.acs.org:80/prf/index.html)

**John C. Schaumloffel**  
**Treasurer/Editor**

**GENERAL BUSINESS MEETING**  
**Monday, August 21, 2000. 5-6 pm.**  
**Convention Center Room 28**

#### ***Geochemistry Division Medal***

**To be awarded for outstanding contributions  
in any area of the field of Geochemistry.**

The Division of Geochemistry of the American Chemical Society has received numerous nominations for the inaugural awarding of the ***Geochemistry Division Medal***. The medal is to be awarded to an individual for outstanding accomplishment in any area of Geochemistry.

The award consists of a bronze medallion plus \$2000. The awardee will receive an allowance for travel to the award ceremony, as well as registration costs for the ACS meeting at which the award will be conferred. The first award will be presented in conjunction with the celebration of the 20<sup>th</sup> anniversary of the Division at the 221st ACS National meeting to be held in San Diego, April 1-5, 2001

The award committee is currently deliberating and sorting through all of the outstanding nominations that they have received. The committee will meet during the Washington, DC National Meeting to select the first recipient.

For more information, please contact Bob Byrne at [byrne@marine.usf.edu](mailto:byrne@marine.usf.edu)

#### **Future ACS National Meetings**

San Diego: April 1-5, 2001

Chicago: August 26-30, 2001

Orlando: April 7-11, 2002

Boston: September 8-12, 2002

## **UPCOMING SYMPOSIA**

### **221<sup>ST</sup> ACS NATIONAL MEETING: San Diego**

#### **Geochemistry Division Medal Symposium and 20th Anniversary Celebration**

Please join us in celebrating the 20<sup>th</sup> Anniversary of the Division of Geochemistry and in recognizing the first recipient of the **Geochemistry Division Medal**.

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#### **Biogeochemistry of Terrestrial Organic Matter Decomposition**

Terrestrial organic matter is the most abundant biomass on earth and the soil and peats formed in part from its decomposition make up the largest pool of actively cycled carbon. Knowledge of the mechanisms and rates of the biogeochemical transformations of terrestrial biomass are critical to understanding the global carbon cycle. Experimental and field-related investigations addressing a wide variety of questions related to the biogeochemistry of the microbial alteration of terrestrial organic carbon are invited to contribute to this special session. In addition to invited presentations, contributed papers are solicited that also discuss issues including ecosystem and environmental controls on decomposition of TOM, dissolved organic matter production, fungal alteration, redox chemistry of microbially degraded residues, enhanced preservation of woody tissue, bacterial utilization of terrestrial carbon.

Prof. Timothy Filley  
Tfilley@gl.ciw.edu

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#### **Biogeochemistry of Archaea**

Archaea are one of the three kingdoms of life on Earth. However, organic geochemical analyses of recent and ancient sediments have primarily focused on eubacteria and eukaryotes and their role in the (paleo) environment. With the advent of molecular biology it is now clear that archaea are widespread and important organisms in non-extreme marine, lacustrine and terrestrial environments and thus should have a pronounced impact in (paleo) environments. In this symposium contributions are welcomed which provide insights into the biogeochemistry of archaea in past and present environments. Specific topics include:

- Sedimentary records of compounds and organic matter of archaea
- Molecular biological and organic geochemical analysis of archaea
- Impact of archaea on past and present environments
- Methane cycle and archaea: methanogenesis and anaerobic methane oxidation
- Ecological significance of non-thermophilic Crenarchaeota
- Specific biomarkers for archaea
- Isotopic fractionation patterns of archaea
- Archaea in (past) extreme environments

Any other contributions on the biogeochemistry of archaea are, however, also welcomed. For any further information please contact:

Stefan Schouten,  
schouten@nioz.nl

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#### **Biogeochemical consequences of the dynamic interactions between benthic infauna, microbes, and aquatic sediments**

Biogeochemical processes in the vicinity of water-sediment interface in marine, estuarine, and fresh-water environments play crucial roles in large-scale biogeochemical cycles of carbon and nutrients, as well as in degradation and preservation of contaminants.

Benthic infauna introduces temporal and spatial heterogeneity to aquatic sediments through processes such as burrow irrigation and sediment ingestion/egestion. Mega-, macro-, and meiofauna actively participate in the sedimentary biogeochemical cycles by their metabolic consumption and production of oxygen, sedimentary organic carbon, and metabolites. At the same time, they affect the microbial reaction regime spatially and temporally by altering redox boundaries and chemical fluxes in sediments. Thus, if we are to understand and quantitatively describe biogeochemical processes in the vicinity of water-sediment interface in aquatic sediments, we must first understand and quantitatively describe the interactions between infauna, microbes, and sediments.

This symposium will be a forum for those who study physical, chemical, and biochemical interactions between benthic infauna, microbes, and sediments.

The goal is to take an inventory of the current research projects, and to find out what else needs to be done before we have an adequate understanding of the dynamic interactions.

Yoko Furukawa, Ph.D.  
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#### **Advances in Stable Isotope Biogeochemistry**

Mark A. Teece  
mteece@esf.edu

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#### **Chemical Reactivity of Aromatic and Sulfur-Containing Aromatic Hydrocarbons in Natural Systems**

P. G. Hatcher  
Hatcher.42@osu.edu

F. Behar  
francoise.behar@ifp.fr

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#### **Applications of Accelerator Mass Spectrometry in Geochemistry**

Tim Filley  
tfilley@gl.ciw.edu

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#### **High Temperature and Pressure Aqueous Inorganic and Organic Geochemistry**

Anurag Sharma  
a\_sharma@vt.edu

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#### **Surface Complexation Models: A Bridge between Spectroscopy and Fate and Transport**

Susan Carroll  
carroll6@llnl.gov

Mavrik Zavarin  
zavarin1@llnl.gov

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### **222<sup>nd</sup> NATIONAL MEETING: Chicago**

#### **Surface Reactivity and Catalytic Properties of Minerals**

Martin Schoonen  
mschoonen@notes.cc.sunysb.edu

Daniel Strongin  
dstrongi@nimbus.ocis.temple.edu

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#### **Future ACS Geochemistry Division Programming**

Too often in the past, the Geochemistry programming at the National Meetings has been random, with little synergy between the different symposia. Long-range planning has also been limited.

In an attempt to build better sets of symposia, the Geochemistry Division will in future invite symposia around concentrated themes. This does not mean to say we will no longer welcome unsolicited topic suggestions, these we will always be very happy to accept. But by moving towards more organized, and offering more longer range programming we will be able to offer more dynamic meetings, attracting a wider range of geochemists from around the world.

We welcome a dialogue on the types of themes you would like to see covered. Peggy O'Day (Program Chair-Elect) is responsible for long-range programming, and would be happy to hear your suggestions (Email: oday@asu.edu).

#### **THE 2000 ACS MEMBERSHIP CERTIFICATE FREE TO ALL MEMBERS**

Let the world know that you belong to the premier society for chemists, chemical engineers, and allied professionals. Order your 2000 ACS Membership Certificate today! Each personalized certificate is signed by the President and Executive Director of ACS, and is suitable for framing and display in your office, laboratory, or at home. To request yours online, visit the 2000 Membership Certificate Site at [www.acs.org/membership/certificate.html](http://www.acs.org/membership/certificate.html).

## **Geochemistry Division Officers:**

### **Chairperson**

Andy Bishop  
bishoan@texaco.com

### **Awards Chair/Past Chair**

William H. Casey  
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### **Chair Elect/Program Chair**

Dr. George Cody  
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### **Program Chair Elect**

Peggy O'Day  
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### **Membership Chair**

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### **Secretary**

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### **Councilor**

Ken Anderson  
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### **Alternate Councilor**

George W. Luther III  
luther@udel.edu

## **GEOC ABSTRACTS FOR THE 220<sup>TH</sup> NATIONAL ACS MEETING IN WASHINGTON, DC.**

**PLEASE CHECK YOUR COPY OF THE MEETING PROGRAM  
FOR THE TIMES AND LOCATIONS OF PRESENTATIONS.**

### **ORGANIC CARBON IN INTERPLANETARY DUST**

George J. Flynn<sup>1</sup>, Lindsay P. Keller<sup>2</sup>, Chris Jacobsen<sup>1</sup>, and Sue Wirick<sup>1</sup>. <sup>1</sup>Department of Physics, State University of New York, 101 Broad Street, Plattsburgh, NY 12901, [george.flynn@plattsburgh.edu](mailto:george.flynn@plattsburgh.edu). <sup>2</sup>MVA, Inc

We examined 11 interplanetary dust particles (IDPs), hydrated and anhydrous, and 3 terrestrial particles collected/curated in the same manner as IDPs using synchrotron-based FTIR. The terrestrial particles showed weak absorption at 2965 cm<sup>-1</sup>, the C-H3 stretching vibration of silicone oil (in which the particles were collected). Eight of eleven IDPs exhibited strong absorption at 2926 cm<sup>-1</sup> and weaker absorption at 2854 cm<sup>-1</sup>, C-H2 stretching vibrations of aliphatic hydrocarbons, and the CH3 absorption at 2960 cm<sup>-1</sup>. This is similar to the 3 micron absorption in the interstellar medium [Sandford et al., 1991]. We performed C-XANES spectroscopy on 12 IDPs, hydrated and anhydrous. Ten have C-XANES spectra similar to acid insoluble organic extract from hydrated carbonaceous meteorites. Both

hydrated and anhydrous IDPs have high abundances of organic compounds, including aliphatic hydrocarbons, suggesting there was abundant organic matter in the dust of the early solar system prior to aqueous influences on parent bodies.

## **ANALYTICAL METHODS FOR INVESTIGATING STRUCTURE OF MACROMOLECULAR SOLIDS RELEVANT TO THE ORIGIN OF LIFE**

Robert D. Minard<sup>1</sup>, George D. Cody<sup>2</sup>, and A. Daniel Jones<sup>1</sup>. <sup>1</sup>Department of Chemistry, Pennsylvania State University, 210 Whitmore Lab, University Park, PA 16802, Fax: 814-863-5319, [rminard@psu.edu](mailto:rminard@psu.edu). <sup>2</sup>Geophysical Laboratory, Carnegie Institution of Washington.

There are numerous examples of complex macromolecular solids found in carbonaceous chondrites and IDPs or formed in simulation experiments (tholins) and the polymerization of hydrogen cyanide. These macromolecular solids provide extremely challenging analytical problems. Both non-degradative methods (solid state NMR, MALDI, SIMS, XANES, etc) and degradative methods (pyrolysis/MS, pyrolysis/GC-MS, hydrolysis/LC-MS or TMAH thermochemolysis/GC-MS) have been applied to some or all of these solids and provide some insight into their substructural units. As an example of the latter method, by heating HCN polymer or a tholin produced from a CH<sub>4</sub>/N<sub>2</sub> glow discharge Titan simulation experiment with tetramethylammonium hydroxide at 250-300°C, concomitant bond cleavage and in situ methylation takes place yielding a large number of products that can be separated and analyzed by GC-MS (Minard et al., 1998). Many products from both HCN polymer and the tholin were the same and imply substructural units of many types: diacyl, amino acyl, purine/pyrimidine, or triazine that are relevant to biochemistry. The application of this and other analytical methods to the unraveling of the structure of macromolecular materials relevant to the origin of life will be presented.

## **COMETARY WATER AND ORGANIC MATTER IN IDPS AS RECORDED BY THEIR D/H RATIOS: AN ION-IMAGING MICROPROBE STUDY**

Jérôme Aléon<sup>1</sup>, Cécile Engrand<sup>2</sup>, François M. Robert<sup>3</sup>, and Marc Chaussidon<sup>1</sup>. <sup>1</sup>CNRS CRPG Nancy, 3 rue Notre Dame des Pauvres, Vandoeuvre les Nancy BP20 54501, France, [aleon@crpg.cnrs-nancy.fr](mailto:aleon@crpg.cnrs-nancy.fr). <sup>2</sup>CSNSM, CNRS-IN2P3 <sup>3</sup>Laboratoire de Minéralogie, Muséum Paris

Ion microprobe imaging consists in the acquisition of ion images of the sample where pixel intensities are ion counts allowing to recalculate isotopic ratios. Lateral resolution is given by the beam size, here 1.5-2 µm. The processing consists in extracting data from the raw images within masks representing the particle, obtained by several operations applied on the images of the various elements. We looked for relationships between D/H and chemistry within 5 IDPs. All the isotopic determinations reported in diagrams with D/H versus the C/H ratios define correlations reflecting the mixtures in different proportions of at least two organic components with phyllosilicates. Most phyllosilicates have chondritic D/H ratio (150±50 x10<sup>-6</sup>), while organics have typical cometary signatures (D/H up to 1800 x10<sup>-6</sup>). Carbonaceous matter is present in all IDPs but with highly variable D/H ratios corresponding either to chondritic or to cometary values.

## **LABORATORY STUDIES OF CATALYSIS OF CO TO ORGANICS ON COSMIC GRAIN ANALOGS**

Robert F. Ferrante<sup>1</sup>, Marla H. Moore<sup>2</sup>, Joseph A. Nuth III<sup>2</sup>, and Theresa Smith<sup>3</sup>. <sup>1</sup>Chemistry Department, U. S. Naval Academy, 572 Holloway Road, Annapolis, MD 21402, Fax: 410-293-2218, [ferrante@brass.mathsci.usna.edu](mailto:ferrante@brass.mathsci.usna.edu). <sup>2</sup>Astrochemistry Branch, Code 691, NASA/Goddard Space Flight Center. <sup>3</sup>University of Maryland.

Experiments simulating heterogeneous conversion of H<sub>2</sub> and CO into simple hydrocarbons in astrophysical environments have been performed, utilizing realistic cosmic grain analogs of Fe-doped silicates as Fischer-Tropsch-Type catalysts. Catalysis was studied for temperatures in the range 470-670 K and reactant gas mixtures of H<sub>2</sub>/CO with ratios 2-100; total gas pressure was near 0.5 bar. Iron content varied from 2 to 50 percent by mass. Major products were methane, ethane, ethylene, carbon dioxide and water. Products were identified by IR spectroscopy of ices formed from the processed gas mix. <sup>13</sup>CO and 2H<sub>2</sub> were utilized to confirm assignments and to discriminate between gas-solid reactions and the parallel reduction of minor C impurities in the solid state. Maximum conversion rates of a few percent were achieved over a 3-h time period. Results suggest that realistic iron-doped silicate grains can effect conversion of CO to simple gas-phase organics on time scales comparable to metallic grains, despite the significantly lower density of active surface sites. Continuing efforts are aimed at further assessing the behavior of the catalysts, and at evaluating our preliminary observation of the formation of organic solid residues in the grain. The implications of these experiments for the production of organics in the early solar system will be discussed.

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#### INVESTIGATING THE LINK BETWEEN PRETERRESTRIAL AQUEOUS ALTERATION AND THE ORGANIC CONSTITUTION OF CM CHONDRITES

Mark A. Sephton<sup>1</sup>, Philip A. Bland<sup>2</sup>, Colin T. Pillinger<sup>1</sup>, Iain Gilmour<sup>1</sup>, and Frank J. Berry<sup>3</sup>. <sup>1</sup>Planetary Sciences Research Institute, Open University, Walton Hall, Milton Keynes MK7 6AA, United Kingdom, Fax: +44 1908 655910, [m.a.sephton@open.ac.uk](mailto:m.a.sephton@open.ac.uk). <sup>2</sup>Department of Mineralogy, Natural History Museum, Cromwell Road, London SW7 5BD, United Kingdom, [p.bland@nhm.ac.uk](mailto:p.bland@nhm.ac.uk). <sup>3</sup>Department of Chemistry, Open University. The CM carbonaceous chondrites provide an accessible source of primitive extraterrestrial organic matter. Yet, to what extent this organic matter has been produced or altered by parent body processes is only partly understood. Deciphering the organic record of parent body alteration would advance our attempts to understand planetary evolution in the early solar system. Hence, we have investigated the relationship between preterrestrial aqueous alteration and organic constitution in six CM chondrites: Cold Bokkeveld, Erakot, Kivesvarra, Mighei, Murray and Nogoya. Relative preterrestrial aqueous alteration levels were determined using <sup>57</sup>Fe Mossbauer spectroscopy. Organic constitution was assessed using flash pyrolysis-gas chromatography-mass spectrometry. The results from these analyses will be presented at the meeting.

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#### ENERGETIC PROCESSING OF HCN-BEARING ICES IN THE LABORATORY

Perry A. Gerakines<sup>1</sup>, Marla H. Moore<sup>1</sup>, and Reggie L. Hudson<sup>2</sup>. <sup>1</sup>Astrochemistry Branch, Code 691, NASA/Goddard Space Flight Center, Greenbelt, MD 20771, Fax: 301-286-0440, [perry.a.gerakines@gsfc.nasa.gov](mailto:perry.a.gerakines@gsfc.nasa.gov). <sup>2</sup>Department of Chemistry, Eckerd College.

Absorption near 2.2mm has been observed in the spectrum of various bodies in the Solar System and is well-matched by the C<sup>15</sup>N stretching overtone of HCN polymer: a material that could play a key role in the synthesis of amino acids. We have studied the thermal and energetic processing of laboratory ices as analogs of these planetary surfaces, with an emphasis on the polymerization of HCN and its conversion into more complex molecules. Infrared spectra from 2.0 to 25mm of samples containing pure HCN and mixtures of HCN with H<sub>2</sub>O and NH<sub>3</sub> (in various mixing ratios) have been studied. Ices were processed at about 15K by proton bombardment (E=0.8 MeV), and residues formed during processing have been analyzed.

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#### LABORATORY INVESTIGATION OF THE FORMATION OF PRE-SOLAR OXIDE GRAINS AND GRAINS IN THE EARLY SOLAR SYSTEM

Steven E. Kooi, Brian D. Leskiw, and A.W. Castleman, Department of Chemistry, Pennsylvania State University, 152 Davey Laboratory, University Park, PA 16802, Fax: 814-865-5235, [sek10@psu.edu](mailto:sek10@psu.edu)

Our research on the stoichiometry, structure, and nucleation of silicon oxide clusters and their application to cosmic oxide grain formation and nucleation will be presented. The role of clusters in the chemical pathways leading to the formation of grains in cooling outflows of circumstellar shells in evolved stars, and possible oxygen isotope effects in grains will be illustrated. The silicon oxide clusters were produced in a laser vaporization source and either the cationic or anionic clusters were investigated by pulsed field extraction in a time-of-flight mass spectrometer, or the neutral clusters were probed by multiphoton ionization with a femtosecond laser (40 fs @ 800 nm). This is the first detailed specific experimental study of the role of clusters on the formation of cosmic grains.

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#### TRANSMISSION ELECTRON MICROSCOPY AND SPECTROSCOPIC STUDIES OF DEUTERIUM AND <sup>15</sup>N-RICH IDPS

Scott Messenger, Laboratory for Space Sciences and Physics, Washington University, St. Louis, MO 63130, Fax: 314-935-4083, [dbunny@howdy.wust.edu](mailto:dbunny@howdy.wust.edu), and Lindsay P. Keller, MVA, Inc.

Some interplanetary dust particles (IDPs) and meteorites exhibit substantially elevated D/H and <sup>15</sup>N/<sup>14</sup>N ratios relative to terrestrial materials. These isotopic anomalies are thought to reflect the partial preservation of presolar molecular cloud material. Recent studies have shown that the fragile 'cluster' IDPs have more common, larger and more variable H and N isotopic anomalies than other IDPs or meteorites, reaching the values of some interstellar molecules. Owing to their extremely small sizes, little has been learned about the nature of the D- and <sup>15</sup>N-rich phases in IDPs. Transmission electron microscopy (TEM) studies of a <sup>15</sup>N-rich IDP have shown the main carrier of N to be organic matter. Here we will present the first TEM study of IDPs with extremely large D/H ratios, reaching 50 times the terrestrial value.

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#### SIGNATURES OF DISEQUILIBRIUM CHEMISTRY IN THE SOLAR NEBULA

Steve Desch, Monika Kress, Chris Dateo, and Winifred Huo, NASA Ames Research Laboratory, Moffet Field, CA 94035-1000, Fax: 202 686 2419, [desch@cosmic.arc.nasa.gov](mailto:desch@cosmic.arc.nasa.gov).

Carbonaceous chondrites contain N-bearing organics, of which isotopic analyses reveal that half are of interstellar origin and half were processed in the solar nebula (Alexander et al. 1998); yet thermodynamic equilibrium favors nitrogen in the form of N<sub>2</sub>. We associate this signature of disequilibrium chemistry with the heating events that melted the chondrules, millimeter sized melted silicate spherules ubiquitous in chondrites. Heating mechanisms consistent with chondrule petrology are shock waves and lightning discharges. Lightning would heat gas to 10000 K and quench it within 0.1s to 2000 K (Morfill et al. 1993); shock waves are qualitatively similar. CO and N<sub>2</sub> would dissociate in such a heating event but not have time to recombine before the temperature dropped. At T = 2000 K, the stable molecules N<sub>2</sub> and HCN are both available to N, with HCN preferred due to the greater abundance of carbon. HCN is easily incorporated into organics, and should also be detectable in other protoplanetary disks by the Atacama Large Millimeter Array.

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#### CHEMICAL STRUCTURE OF THE INSOLUBLE MATTER IN CARBONACEOUS CHONDRITES

Sylvie Derenne<sup>1</sup>, Francois Behar<sup>2</sup>, Alain Gardinier<sup>1</sup>, F. Robert<sup>1</sup>, and Claude Largeau<sup>1</sup>. <sup>1</sup> Laboratoire de Chimie Bioorganique et Organique Physique, Ecole Nationale Supérieure de Chimie de Paris, 11 Rue Pierre et Marie Curie, Paris 75231, France, Fax: 33-1-43257975, sderenne@ext.jussieu.fr, <sup>2</sup> IFP

The chemical composition of the soluble organic matter in carbonaceous chondrites has been extensively studied. In contrast, although accounting for 70 to 90% of total carbon, the chemical structure of the insoluble organic fraction is far from being understood. However, such insoluble organic carbon seems to be a common component not only in chondrites but also in primitive objects of the solar system like comets. The present study is concerned with the insoluble organic fraction of two carbonaceous chondrites, Orgueil and Murchison. A combination of spectroscopic (<sup>13</sup>C NMR, FTIR, X-ray diffraction and XANES), pyrolytic techniques (Rock-Eval, Curie point pyrolysis-GC-MS and preparative pyrolysis with analysis of the released gases) and high resolution transmission electron microscopy was used to obtain information at a molecular level on this macromolecular fraction. Taken together, all these data will be used to derive a model of chemical structure.

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#### NEAR-CRITICAL AQUEOUS ORGANIC CHEMISTRY IN PLANETESIMALS

Kenneth M. Arnoult, Thomas J. Wdowiak, Daniel C. Killilea, and Brandon Coltress, Astro and Solar System Physics Program-Department of Physics, University of Alabama, Birmingham, AL 35294, Fax: 202-686-2419, wdowiak@uab.edu.

The study of chondritic meteorites can provide insight into conditions within the original planetesimals as far back in time as 4.57 Ga. There is substantial evidence for aqueous activity was present in planetesimals. The source of water was likely cosmic ices that melted as the bodies warmed. Organic matter is also commonly present with concentrations as great as one percent. As planetesimals were of sufficient size to have served as chemical reactors functioning at elevated temperature (> 373K) and pressure (>1 bar), we are investigating high T and P aqueous chemistry of plasma modified PAHs, such as naphthalene, as analogues of molecular species introduced into the solar nebula from interstellar space. These experiments yield a synthetic product having characteristics similar to the organic component of meteorites and provide insight into the nature and production

of organics serving as exogenic resources for life's origins on Earth and perhaps elsewhere.

This work is supported by the NASA Origins of Solar Systems and Exobiology Programs.

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#### INTERESTING CANDIDATES FOR INTERSTELLAR CHROMOPHORES

Thomas J. Wdowiak, Kenneth M. Arnoult, Daniel C. Killilea, and Brandon G. Coltress, Astro and Solar System Physics Program-Dept. of Physics, University of Alabama, Birmingham, AL 35294, Fax: 202-686-2419, wdowiak@uab.edu.

Spectral signatures of complex and presumably carbon-based interstellar matter exist in absorption and emission at ultraviolet, visible, and infrared wavelengths. The spectral signature are referred to as the 2175 Å extinction feature, diffuse interstellar bands (VIS and NIR), extended red emission including both continuum and structured features (VIS and NIR), galactic infrared absorption (3.4 micron/2940 cm<sup>-1</sup> region), and the unidentified infrared emission bands (3-25 micron/3333-400cm<sup>-1</sup>). We have been examining whether polycyclic aromatic/polycyclic alkane hybrids can provide panspectral signatures at UV and IR wavelengths consistent with astronomical observations. We are particularly attracted to polyparaphenylene structures in both the benzenoid and quinoid forms because these conformations may be source of the diffuse interstellar bands spanning over 300 specific wavelengths. The origin of these bands remain as one of the great spectroscopic mysteries in both astronomy and molecular chemical physics.

This work is supported by the NASA Visible, Ultraviolet, and Gravitational Astronomy and Exobiology Programs.

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#### SOURCES OF EXTRATERRESTRIAL WATER IN MARTIAN METEORITES: MAGMATIC, HYDROTHERMAL, OR SHOCK IMPLANTED?

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Polycyclic aromatic hydrocarbons were reported in martian meteorite ALH84001 and were interpreted as evidence for ancient life on Mars. For life to exist on any planet, water must be present. We determined the H isotope composition of minerals and glasses in martian meteorites ALH84001, EETA79001, and ALHA77005 by SIMS. All water-bearing phases in these meteorites show evidence of deuterated extraterrestrial component mixed with a terrestrial H contaminant. Glasses in magmatic melt inclusions have low D and very low water abundances relative to impact melted glasses which suggests that the water in the latter is derived from a different source. The source is either a surface water that interacted with the fractionated martian atmosphere, or a less fractionated fossil underground water that became progressively enriched in D by devolatilization of H during impact.

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#### UNRAVELING THE STRUCTURE OF MACROMOLECULAR ORGANIC MATTER IN THE MURCHISON METEORITE WITH MOLECULAR SPECTROSCOPY

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We present high quality <sup>13</sup>C solid state NMR spectra of pure organic matter isolated from the Murchison meteorite using both CP and SPE MAS. The SPE spectra were obtained using small nutation angles (30°) and recycle delays of 10 seconds to accommodate an estimated longitudinal relaxation time, T<sub>1</sub>, of 50 seconds. SPE NMR of carbon is inherently less sensitive than CP, nevertheless, signal averaging over ca. 1 week resulted in a very respectable spectrum. The critical aspect of comparing both CP and SPE, is that CP essentially reveals the carbon chemistry proximal to hydrogen, whereas SPE reveals all of the carbon (i.e. the spectra are not dependent on proximity to hydrogen). If there exists within the macromolecular phase large carbonaceous domains devoid of hydrogen, e.g. fulleroid or graphitoid like domains, one should see this manifested by significant differences between CP and SPE. Remarkably, we observe minimal difference in the various organic functional groups detected using either NMR experiment. Combining these results with solid state <sup>1</sup>H spectral data allows us to propose a statistical molecular model consistent with the observed functional group information.

#### **PRESOLAR ORIGIN AND ASTEROIDAL MODIFICATION OF ORGANIC MACROMOLECULAR MATERIAL IN METEORITES**

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Organic matter appears to have been present in all chondrite groups, despite the very different nebular environments (from highly reducing to very oxidizing) the host chondrites appear to have formed in. The carbon isotopic composition of the organic matter is quite uniform between the chondrite groups, but the H and N isotopic compositions and elemental abundances are highly variable within and between groups. In this talk I will argue that most of the variation within and between chondrites is due to asteroidal processes, and that the meteorites with the most isotopically anomalous organics retain the most pristine material. The very heavy H and N isotopic compositions of some meteorite organics require a significant presolar component. Based on the relatively constant ratio of organic matter to known presolar material, the Solar System organic contribution is 30% or less.

#### **FROM INTERSTELLAR POLYCYCLIC AROMATIC HYDROCARBONS AND ICE TO EARLY SOLAR SYSTEM CHEMISTRY AND PERHAPS THE ORIGIN OF LIFE**

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Tremendous strides have been made in our understanding of interstellar material over the past twenty years thanks to significant, parallel developments in observational astronomy and laboratory astrophysics. The first part of this talk will describe how infrared studies of interstellar space, combined with laboratory simulations, have revealed the composition of interstellar ices (the building blocks of comets) and the high abundance and nature of interstellar PAHs. The laboratory database has now enabled us to gain insight into the identities, concentrations, and physical state of many interstellar materials.

Within a dense molecular cloud, and especially in the solar nebula during the star and planet formation stage, the materials frozen into interstellar/precometary ices are processed by ultraviolet light and energetic particles, producing more complex molecules. The remainder of the presentation will focus on the photochemical evolution of these materials. As these materials are thought to be the building blocks of comets an related to the carbonaceous components of micrometeorites, they are likely to have been important sources of complex organic materials on the early Earth and their composition may be related to the origin of life.

#### **HYDROGEN ISOTOPIC EVOLUTION OF INTERSTELLAR ORGANIC MATTER IN THE PROTOSTELLAR NEBULA : A 2D SIMULATION MODEL**

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A 2D model describing the evolution - as a function of time and heliocentric distances - of the turbulent protosolar nebula has been used to reproduce the hydrogen isotopic exchange between interstellar - deuterium-rich - organic matter and molecular hydrogen. In the inner and hot (T > 900 K) zones of the nebula, organic matter reaches rapidly the isotopic equilibrium with H<sub>2</sub> and thus, exhibits low D/H ratios, while the isotopic exchange is frozen at temperatures < 500K. However, at the entire disk scale, the D/H ratio in organic matter evolves rapidly due to turbulence : molecules with low D/H ratios - from the inner zones - are transported outwards in the coldest regions of the disk. In such a situation, it is possible to calculate the relations between the water and the organic D/H ratios. Comparisons with solar system data - comets and carbonaceous chondrites - are in close agreement with this theoretical approach.

#### **A YEAR OF ACCOMPLISHMENTS FOR ORGANIC LETTERS**

During the 220th ACS National Meeting, Organic Letters editor-in-chief, Amos B. Smith III and members of the editorial staff will be at the ACS Publications Booth #836 at the Washington Convention Center to discuss the journal and celebrate its first full year of publication. Additionally, SPARC and ACS will announce the latest news regarding their second venture, the journal Crystal Growth & Design, to be published in 2001.

Two years ago, ACS made publishing history as the first scholarly publisher to collaborate with the Scholarly Publishing & Academic Resources Coalition to produce a series of high-quality scientific journals at lower cost designed to meet the needs of the user communities -- scientific and university librarian. A year later, the first ACS-SPARC collaboration was launched: Organic Letters, the ACS journal offering rapid communication of original, concise, peer-reviewed and timely reports of significant research authored by eminent scientists from academe, government, and industry. Because of the overwhelming response from researchers in the field, Organic Letters published its 1,000th letter before the end of its first year of publication. Furthering its speed of publication, 85 percent of all contributions are submitted, reviewed and approved electronically. Papers are then posted as Articles ASAP within 24 to 48 hours of author approval -- weeks before being published in print. Currently, Organic Letters' Articles ASAP are available for free access on the web -- now through December 31, 2000.