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FTIR, XANES SPECTROSCOPY AND ELECTRON MICROSCOPIC ANALYSIS OF HYDRATED IDPs.

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Introduction: Chondritic hydrated interplanetary dust particles (IDPs) comprise up to 50% of all IDPs collected in the stratosphere. Although much is known about the mineralogy, chemistry and carbon abundance of hydrated IDPs controversies still exist regarding their formation, history, and relationship to other primitive solar system materials. Hydrated IDPs are probably derived from asteroidal sources that have experienced aqueous alteration. However, the high C contents of hydrated IDPs (2 to 6X CI [2,3]) indicate that they are not derived from the parent bodies of chondritic meteorites. This study presents our recent progress in understanding the relationship between the organic content and mineralogy of hydrated IDPs.

Methods: We studied four 15-30 m hydrated IDPs by transmission electron microscopy (TEM), and Fourier-transform infrared spectroscopy (FTIR) and x-ray absorption near-edge spectroscopy (XANES) for C distribution and bonding states. The TEM analyses were performed at JSC, and the XANES and FTIR measurements were performed on beamlines X1A and U10B at the National Synchrotron Light Source at Brookhaven National Laboratory. The particles were embedded in elemental S and 70 nm-thick sections were obtained by ultramicrotomy. Sections were transferred to C-coated grids for TEM and SiO grids for XANES and FTIR analyses.

Results and Discussion: Our TEM observations are consistent with previous mineralogical studies of hydrated IDPs. Although distinct magnetite rims are observed on the IDPs (formed during atmospheric entry heating), the interior clay minerals are intact. The IR spectra show absorption features from phyllosilicates (Si-O) lattice vibration at 750 ~ 1110 cm^{-1}, interlayer water around 3400 cm^{-1} and the structural hydroxyl at 3650 cm^{-1}. The spectra also show CH_2+CH_3 stretching vibrations due to aliphatic hydrocarbon at 2860 ~ 2950 cm^{-1}. More detailed information on the nature of the organic matter is offered by the XANES spectra. C-XANES spectra of IDP and meteorite organic matter are characterized by three main absorption peaks: one at ~285 eV from C=C, one at 286.5 eV from C=O or C-N, and one at ~288.5 eV from a mixture of functional groups. While one of the IDPs studied here (L2011S4) has a typical IDPs XANES spectrum, the C-XANES spectra from IDPs L2047D26 and L2011Q9 are different from other anhydrous and hydrated IDPs [4,5]. L2047D26 has an unusually weak absorption at ~285 eV, its 288 peak is slightly shifted at ~288.7 eV, and it has a broad absorption feature at ~289.8 eV which is consistent with aliphatic hydrocarbons. These data suggest L2047D26 has much more aliphatic and less aromatic carbon than other hydrated IDPs [4]. L2011Q9 also exhibits unusual spectra. A strong 288.2 eV π^* peak suggests simple aliphatic single C bond chain, similar to PMMA but with more carbon, and less C=O [6]. Interestingly, a small (~800 nm) area in L2011Q9 has a 289.5 eV peak that does not match any literature standards.

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CHARACTERISTICS OF PHYLLOSILICATES IN MICROMETEORITES DERIVED FROM SYNCHROTRON X-RAY DIFFRACTION ANALYSIS.

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Introduction: Micrometeorites have many mineralogical and compositional features in common with hydrous carbonaceous chondrites [e. g., 1]. However, hydrous phases in micrometeorites easily decompose to amorphous materials or secondary anhydrous minerals during heating at parental objects and terrestrial atmosphere, because they are very susceptible to thermal effects. As a result, only limited number of micrometeorites retain phyllosilicates [2]. But micrometeorites with phyllosilicates are key objects for identification of parental objects and elucidation of the origin of interplanetary dust. We have continued characterization of bulk mineralogy of micrometeorites using combined techniques [3]: synchrotron X-ray diffraction of individual micrometeorites and transmission electron microscopy of ultramicrotomed slices of the X-rayed micrometeorites.

Results and discussion: We have selected 2500 samples of micrometeorites mainly from the JARE 39 and JARE 41 collections [e. g., 4]. Then samples that experienced heavy heating were excluded based on the textures of sample surfaces, because such samples have no possibility to have escaped phyllosilicate decomposition. Approximately 300 samples survived the elimination process and were individually exposed to X-rays for the diffraction analysis, and 40 samples have been identified as phyllosilicate-rich micrometeorites. They show clear 001 basal reflections and prism reflections of saponite and/or serpentine, which indicates that phyllosilicates are a major component in these micrometeorites.

Among 40 phyllosilicate-rich samples, the relative abundance between saponite and serpentine varies greatly, but predominant phyllosilicate is saponite: 28 samples contain only saponite, 5 samples contain only serpentine, and the remaining 7 samples contain both saponite and serpentine. The relative abundance of phyllosilicates is a measure for the identification of parental objects: Tagish Lake chondrite is dominated by saponite, CM chondrites are dominated by serpentine, and CI and CR chondrites contain both phyllosilicates. Our results thus indicate that the phyllosilicate variation of micrometeorites covers a whole range of carbonaceous chondrites and further implies that micrometeorites with saponite-dominated mineralogy is one of the main components in interplanetary dust, which shows a clear contrast to the very rare occurrence of saponite-dominated materials (Tagish Lake) as a meteorite-size object.

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THE NATURE OF ALTERATION CLAYS AND ELEMENT MOBILIZATION IN CHICXULUB YAXCOPOIL-1 DRILL HOLE.

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Introduction: We analyzed samples from the matrix between clasts in the upper portion above the melt sheet in the Yaxcopoil-1 (YAX) drill hole to understand the nature of the alteration and trace element mobilization, and to compare these findings with altered materials from other craters.

Analytical findings: Five samples were characterized using microprobe, SEM, Cameca IMS 4f ion probe, and X-ray diffraction. Our preliminary X-ray analyses and clay compositions are consistent with the presence of smectites in the samples (Dewey Moore, personal comm.). The chemical compositions for these alteration materials range from that of an average montmorillonite composition in the uppermost units (from 800.68m to about 836m), to that of iron and magnesium rich saponite in the lower units (846.7m to 861.72m). With increasing depth, the alteration chemistry produces strong linear trends toward either iron or magnesium (fig. 1). Alteration materials from Mistastin are chemically similar, but do not contain the broad chemical variations as those from Chicxulub, nor do materials from Lonar, which contain well-defined iron-rich saponite and celadonite [1].

Mobile elements in the YAX matrix clays are fractionated with depth. Ba is progressively depleted upward, while Li, Be, and B are enriched upward in the section.

Discussion and Conclusions: The nature of the matrix clays in the Yaxcopoil core above the melt sheet is consistent with hydration of fine-grained material, which could be either glassy dust, or metastable eutectic dehydroxylate (MED) condensates [2] from the impact cloud, as altered YAX compositions produce co-linear trends with a join between two MED end members. Vertical transport of Li, B, and Ba by hydrothermal fluids is also suggested by the trace element data.

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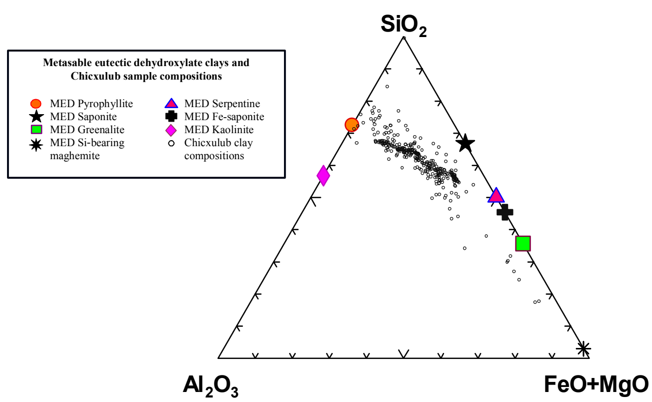


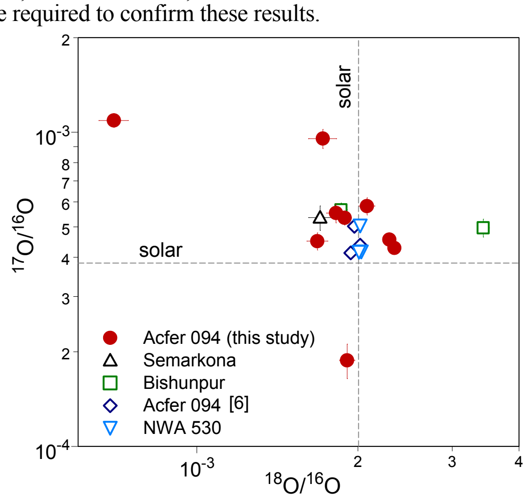
SURVEY OF PRESOLAR SILICATES IN PRIMITIVE CHONDRITES. A. N. Nguyen and E. Zinner. Laboratory for Space Sciences and the Physics Department, Washington University, St. Louis, MO 63130, USA. E-mail: nguyen@wustl.edu.

Introduction: Circumstellar silicate grains are observed in abundance around young stars and evolved O-rich stars [1], the main source of presolar oxide grains. In addition, they have been isolated in IDPs [2, 3] where their abundance is ~890ppm, much greater than any presolar phase in meteorites. These presolar silicates have diameters of a micron or less, making them difficult to spatially resolve. Most solar system minerals are oxides and silicates, which necessitates the measurement of a large number of grains in meteorites to find any isotopically anomalous silicate grain. The NanoSIMS ion probe is well-suited for presolar silicate searches because it can resolve submicron grains and efficiently measure many grains via raster ion imaging [4]. We analyzed 0.1-0.5µm matrix grains from the primitive carbonaceous chondrite Acfer 094, and the ordinary chondrites Semarkona and Bishunpur.

Experimental: Meteorites were disaggregated by freeze-thaw, and grains were size separated by centrifugation. Grains ≤0.5µm were dispensed onto a gold foil, and dense grain areas were chosen for analysis. A Cs^+ primary ion beam was rastered over 20x20µm^2 areas and the three O isotopes, ^{24}MgO, and ^{28}Si were measured simultaneously as negative secondary ions. Isotopic anomalies in the ^{17}O/^{16}O and ^{18}O/^{16}O ratio images identify presolar grain candidates, while the ^{24}MgO and ^{28}Si images aid in silicate grain identification.

Results: We identified nine anomalous silicate grains in Acfer 094 [5] in 16 images, resulting in an abundance of ~40ppm relative to the matrix, higher than the abundance of most other presolar phases. Nagashima et al. [6] calculated an abundance of 30ppm for Acfer 094 and 3ppm for NWA 530. In contrast, we found no anomalous grains in Semarkona or Bishunpur in 14 and 11 images acquired, respectively. We estimate an abundance of 240ppb and 7ppm for these meteorites. Mostefaoui et al. [7, 8] found three presolar silicates in these two meteorites, however, for a combined abundance of ~15ppm.

One presolar silicate from Acfer 094 was found to be enriched in ^{26}Mg by 119 15‰. We also relocated 6 of the anomalous grains in the SEM to acquire images and EDX spectra for preliminary mineralogical identification. Two appear to be pyroxenes, two are olivines, one is rich in Al, and one could be a GEMS. Further studies are required to confirm these results.



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EXPOSURE HISTORIES OF LUNAR AND MARTIAN METEORITES.

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Introduction: Cosmogenic nuclide studies of lunar and Martian meteorites have contributed significantly to our understanding of these objects. The specific goals of these measurements are to constrain or set limits on the following shielding or exposure parameters: (1) the depth of the sample at the time of ejection from the Moon or Mars; (2) the transition time from ejection off the lunar or Martian surface until capture by the earth; (3) and the terrestrial residence time. The sum of the transition time and residence time yield an ejection age. The ejection age in conjunction with the sample depth on the Moon or Mars can then be used to model impact and ejection mechanisms. We have measured cosmogenic nuclides in 21 (28 individual) lunar and 24 (29) Martian meteorites. Measurements of 9 additional meteorites are in progress. In this study, I summarize exposure and terrestrial histories of lunar and Martian meteorites.

Discussion: (1) More than half of the lunar meteorites have complex cosmic ray exposure histories, having been exposed both at some depth on the lunar surface before their ejection and as small bodies in space during transport from the Moon to the earth. On the other hand, we have not yet observed evidence of complex exposure histories for Martian meteorites. (2) Transition times of meteorites from the Moon and from asteroids to the earth have previously been predicted by Monte Carlo simulations [1, 2] and recent numerical simulations modeling the dynamical evolution of lunar and Martian impact ejecta have also been performed and can be used to explain the distribution of transition times for these meteorites [3, 4]. In general, the model predictions agree with our measurements that indicate that the intervals between ejection and capture by the earth are less than 1 Myr for lunar meteorites and much longer for Martian meteorites. As we increase the number of meteorites measured we obtain better statistics to help constrain or modify theoretical predictions. It seems that launch velocities of lunar meteorites are higher than those originally predicted. All lunar meteorites having exposure ages greater than 0.5 Myr were ejected from large depths within the lunar surface. These meteorites may in general have higher launch velocities than those lunar meteorites ejected from shallower depths. The distribution of transition times of Martian meteorites supports a ~2 Myr collisional lifetime of ejecta from Mars. (3) To date, at least 6 lunar meteorites and 4 Martian meteorites show clear SCR produced ^{26}Al at their near surface regions. Presence of SCR effects indicates minimal ablation during atmospheric entry, presumably the result of either low entry velocity or low entry angle. (4) Terrestrial ages (up to 0.5 Myr) of lunar and Martian meteorites, especially those recovered from hot desert regions, are longer than ordinary chondrites recovered from the same regions. Lack of metal in these meteorites slows the effect of weathering. (5) So far recovery rates of lunar and Martian meteorites are ~1:1. Since both meteorites may have similar resistance against terrestrial weathering, one possible explanation is that most lunar meteorites are ejected into heliocentric orbit rather than staying inside the Earth-Moon system so that capture rates of lunar meteorites are lower than predicted.

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PHYSICAL SEPARATION OF A FRACTION ENRICHED IN NOBLE GASES IN ORDINARY CHONDRITE.

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Introduction: It is now possible to separate the fraction enriched in noble gases from the carbonaceous chondrite by only physical means [1, 2, 3]. They disaggregated a chunk of Allende with the freeze-thaw method and recovered a fraction that floated on the surface of distilled water. The elemental abundances and the isotopic composition of noble gases in this "floating fraction" are very similar to those of HF-HCl resistant residue [1, 2, 3]. In this study, we have applied the above freeze-thaw disaggregation method to two ordinary chondrites, Dhofar 008 (H/L3.2/3.3) and an unnamed meteorite from northwest Africa ("Sample B", L4/5/6), meteorites which are harder than the carbonaceous chondrite, Allende. We measured the elemental abundances and the isotopic ratios of noble gases in bulk meteorite and the floating fraction with the sector-type mass spectrometer VG5400.

Samples: The Dho 008 meteorite is H/L3.2/3.3 chondrite from Dhofar, Oman recovered in 2000. The chemical composition is the range of L chondrite but the Fa of olivine and Fs of pyroxene percentages show the signature of H chondrite. Sample B has chemical compositions corresponding to the range of L4 to L6.

Results: After 250 cycles of the freeze-thaw disaggregation, we have obtained the floating fractions (0.1807 mg for Dho 008 and 0.1473 mg for sample B) from the bulk samples (394.46 mg for Dho 008 and 2599.43 mg for sample B). The weight percentage of the floating fraction to the bulk Dho 008 was 0.046 wt%, higher than 0.0057 wt% of sample B. The recovered efficiency of Dho 008 was similar to that (0.068%) of Allende CV3 meteorite [3]. The elemental abundances of heavy noble gases (Ar, Kr and Xe) in the floating fraction of sample B were higher than those of bulk meteorite by one to three orders of magnitude, but those of light noble gases (He and Ne) in the former were rather lower than those of the latter.

The noble gas data point of sample B is in the region of L5 to 6, and that of Dho 008 is in H/L3 when we plotted the concentration of ^{84}Kr vs. that of ^{132}Xe. Sample B is greatly enriched in ^{20}Ne and ^{22}Ne compared with the average ordinary chondrite and is plotted near solar component in the Ne three isotope plot, suggesting that this meteorites is exposed to the solar wind. We calculated the cosmic-ray exposure ages for these meteorites.

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HIGH INITIAL $^{26}Al/^{27}Al$ RATIOS IN PRESOLAR SIC GRAINS FROM NOVAE.

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Introduction: A small fraction (<1%) of presolar SiC grains in meteorites have isotopic signatures indicative of nucleosynthesis in nova explosions [1]. Nova models predict very high $^{26}Al/^{27}Al$ ratios [2], but Al-Mg ratios have only been measured in two previous nova grain candidates. Of these, one had an inferred $^{26}Al/^{27}Al$ ratio in the range of nova models, but the other had a lower ratio. Here we report Al-Mg isotopic data for two of the three new nova SiC grains we recently identified [3].

Methods and Results: The grains were previously located in a SiC-rich acid residue of Murchison [3]. Al and Mg isotopes were measured with the Mainz NanoSIMS, using previously reported techniques [4]. The two measured grains are strongly enriched in ^{26}Mg, with very high inferred $^{26}Al/^{27}Al$ ratios, > 0.2. Analysis of three randomly selected SiC grains on the mount yielded $^{26}Al/^{27}Al$ ratios of 6×10^{-4} to 3.8×10^{-3}, within the observed range of mainstream SiC grains. Isotopic data for our three nova SiC grains are summarized in the Table.

Table: Isotopic data for SiC grains from novae (1   errors)

Grain	$^{12}C/^{13}C$	$^{14}N/^{15}N$	^{29}Si	^{30}Si	$^{26}Al/^{27}Al$
151-4	4.02(7)	11.6(1)	-438±9	510±18	0.27(5)
334-2	6.48(8)	15.8(2)	-489±9	-491±18	0.39(6)
347-4	5.59(13)	6.8(2)	-166±12	927±30	---
Nova models [1,2]	0.3–3	0.1–10	-800–1800	-800–15,000	0.07-0.7

Discussion: The low $^{12}C/^{13}C$ and $^{14}N/^{15}N$ ratios observed in the SiC grains are a clear indication of nova nucleosynthesis and the Si isotopes indicate an association with the more massive ONe novae [1,3]. However, the data require extensive mixing of the nova ejecta with more isotopically normal material and there are several additional difficulties in explaining the data in terms of an origin in the ejecta of ONe novae [1]. We proposed that the grains form instead in AGB winds from the secondary star in the close-binary nova system [3]. The very high $^{26}Al/^{27}Al$ ratios found in the two nova grains are within the range expected for fresh nova ejecta and thus indicate that the grains formed soon after the nova event(s) in the parent star. Thus, if our suggestion for the grains' origin is correct, the nova explosions must have occurred during the AGB phase itself so that the surface composition of the secondary was being continually modified by reaccretion of nova ejecta, by dredge-up of He-shell material and possibly by cool bottom processing. Some recurrent novae are believed to arise from close binaries of a white dwarf and a giant star [5]. Similar systems might be the progenitors of the meteoritic grains, though much theoretical work remains to be done to test this idea. Additional isotopic measurements are planned to search for diagnostic signatures of their sources (e.g., *s*-process indicators of an AGB origin).

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THE METEORITE COLLECTION OF THE SCHOOL OF MINES, FEDERAL UNIVERSITY OF OURO PRETO.

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The Science and Technical Museum of the School of Mines of the Federal University of Ouro Preto – MG (MCT/EM/UFOP), counts nowadays with a collection of more than 60 thousand objects. This museum has started its activities with the foundation of the School of Mines, by the French Professor Claude Henri Gorceix, in 10.12.1876, constituting the first College of mining-metallurgical sciences in Brazil.

Gorceix had as conception to offer an holistic graduation to their students. Therefore, some mineral samples, fossils, didactic models, scientific instruments, books, and others objects were brought from Europe to structure this new Institute.

Currently, the whole collection has been structured, organized and displayed in topical sectors (Mineralogy, Natural History, Astronomy, Metallurgy, Mining, Electrotechnic, Iron and Steel Industry, Drawing, Topography, Memorial Nucleus, Rare Works Library and Imperial Chapel), that now tidies this museum up.

The Mineralogy Sector was brought from the former Mineralogy Laboratory of Rio de Janeiro. This Sector has been improved through donations from teachers, students and former students of the School who gathered samples in field researches for practical works and exchanges with collectors and other institutions. Today it has a rich collection of minerals and meteorites from all over the world.

In the collection of meteorites there are fragments from Argentina, Chile, Hungry, Mexico, USA and Brazilian meteorites. The Brazilian meteorites are: Barbacena, Bendengó, Conquista, Itutinga, Santa Catarina, Santa Luzia, Serra de Magé and Uberaba.

In the moment our team started the characterization of meteorite Itutinga, because its main mass [1] (47.500 g) belongs to the Science and Technical Museum of the School of Mines of the Federal University of Ouro Preto.

The Itutinga is an iron meteorite (IIIAB), medium octahedrite, briefly described by [2]. Classification and analysis were performed by [3], with the following contents: 7,2 % Ni, 18,6 ppm Ga, 36,0 ppm Ge, 13,0 ppm Ir.

There is another meteorite named Itumirim (114.7 g), found only 4 Km of Itutinga. These two pieces could be fragments of the same meteorite. In order to test this hypotheses, we are currently doing XRF, Mössbauer spectroscopy and microprobe analyses. The results will be ready to be presented by the time of this conference.

This is a first effort in order to attach a scientific value to the museum´s collection.

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SEDIMENTATION IN MERIDIANI TERRAE, MARS, OWING TO MAGMA-ICE INTERACTION WHEN THARSIS AROSE?

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Introduction: Cold temperatures on Mars [1] and a thin atmosphere prevent the occurrence of water in liquid form on the planet. However, sedimentary rocks at Meridiani Terrae show aqueous sedimentation. Catastrophic outgassing due to the Tharsis rise would result in increasing temperature and pressure, enabling water to exist on the surface for short periods of time. Magma–ice interactions during intrusive events that correspond to peak periods of Tharsis volcanic activity have been proposed as possible origins of surface materials in Xanthe, Margaritifer, and Meridiani Terrae [2]. New images from the Opportunity landing site show what appear characteristic of sedimentary sequences including gradation and cross-bedding. Turbulent flow of sediment-laden water deposits grains in a graded sequence, such as is common in turbidites. Jokulhlaup deposits (sediments from subglacial outburst floods resulting from volcanic activity) in Iceland also show graded deposition [3], superposed by cross bedding structures, reflecting deposition during both the rising and falling limbs of the flood hydrograph.

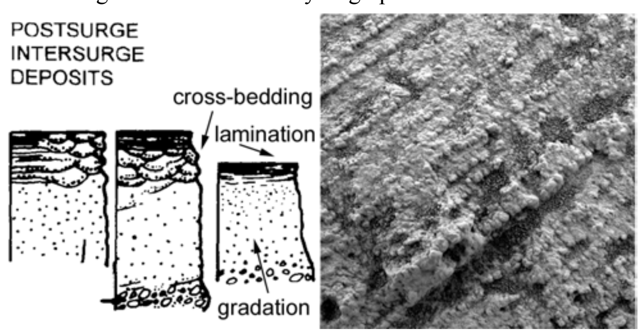

Fig. 1: Graded and cross-bedded sedimentary structures (adapted from Maizels 1997), and microscopic image of graded rocks from the Opportunity landing site, both are sequences thought to have been deposited by a waning, low density turbidity current in shallow lacustrine environment (image courtesy NASA/JPL/Cornell).

Conclusions and future work: Widespread changes in volcanic activity, atmospheric density, and water vapour triggered by Tharsis volcanoes should leave their footprints in martian rocks. At present, the only samples of the martian surface that we have in our collections are martian meteorites. Although they are all igneous rocks, they do contain pockets of melts produced by aqueous alteration [4]. We intend to investigate potential coorelations in the timing and extent of activity by means of laboratory measurements, especially IR-spectroscopy.

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THERMOGRAVIMETRIC MEASUREMENT OF THE VAPOR PRESSURE OF SILICON MONOXIDE FROM 1300K TO 1773K USING AN ALUMINA EFFUSION CELL

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Introduction: In this paper we will report new measurements of the vapor pressure of Silicon Monoxide (SiO), over the temperature range from 1573K to 1773K, obtained thermogravimetrically, in vacuo using alumina effusion cells. We have previously reported the vapor pressures of iron [1,2], nickel [3] and cobalt [4] metals also measured in vacuo using alumina effusion cells and the same commercially-obtained Thermo-Cahn TG-2171 Thermogravimetric system. In these previous studies we found that our nickel data agreed with current estimates of it's vapor pressure in the literature [5], while our measurements of cobalt were ~ 50% lower than the literature value [6] and our measurements of iron vapor pressure were a factor of two lower than previously predicted [7]. The major advantage of our technique over previous studies is that it directly tracks the mass lost from the effusion cell where the vapor of interest is maintained in thermodynamic equilibrium with its solid or liquid reservoir. This eliminates considerable confusion encountered in more open systems which must simultaneously measure both the vapor pressure of the material and the accommodation coefficient of the vapor as it condenses on the solid or liquid reservoir. The convolution of these factors can lead to wide variation in the estimates of the vapor pressure even for direct experimental measurements. The best estimate of the vapor pressure of SiO as a function of both temperature and oxygen fugacity was published by Schick [8], yet that vapor pressure curve is 5 orders of magnitude higher than recent measurements by Shornikov et al. [9].

New Measurements: Our measurements of the vapor pressure of SiO lie between those of Schick[8] and Shornikov et al. [9], though they are closer to the predictions of Schick [8]. At ~1300K our measurements show that the SiO vapor pressure is two orders of magnitude lower than predicted by Schick [8], but that this gap shrinks to less than an order of magnitude difference at 1773K. It appears that our measurements may intercept Schick's SiO vapor pressure curve below 2000K. We will make more measurements and push our experiment to higher temperatures (possibly as high as 1973K) and discuss the full range achieved at the meeting.

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EXPERIMENTAL INVESTIGATION OF SHOCK EFFECTS IN A PELITIC GRANULITE – IMPLICATIONS FOR SHOCK MELT GENESIS.

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Introduction: Most experimental shock investigations to date have concentrated on monomineralic or relatively anhydrous rocks, such as quartzite or granite. In contrast, rocks of pelitic composition, which typically display a complex mineralogy and a high proportion of hydrous minerals, have been little studied. Shock experiments were performed on a fine-grained, high-grade, migmatitic, garnet-cordierite-biotite-orthopyroxene metapelite from the Etivé aureole, Scotland, to (1) characterise shock effects in a complex polymineralic rock with a significant proportion of hydrous ferromagnesian minerals, both as a function of variable shock pressure and pre-shock temperature, and (2) explore the effects of shock impedance contrast between component minerals on the distribution of these features. Shock experiments were performed at 12, 25, 30 and 60 GPa at 25 C, and at 25 GPa at 400 C. The association of plagioclase, K-feldspar and quartz in the assemblage facilitates comparison with previously calibrated systems [1].

Results: Shock features (planar fractures - PFs, fracture arrays, planar deformation elements - PDFs, onset of isotropization, formation of diaplectic glass, and shock melting) have been characterized and calibrated in cordierite, biotite, quartz, garnet, plagioclase, K-feldspar, orthopyroxene, ilmenite, and pyrite with respect to shock pressure and pre-shock temperature. Shock metamorphic effects are also influenced by the spatial association of minerals – higher-P shock effects appear locally within a sample where shock impedance contrast between adjacent minerals is greatest, such as between garnet, on the one side, and cordierite, feldspar or quartz. The experiments also provide some constraints on the shock metamorphic effects in the Steynskraal Formation metapelites in the Vredefort dome, South Africa. The heterogeneity of shock effects observed in the experiments, and the mobilization of biotite and cordierite shock melts appear to have analogues in the form of pseudotachylitic breccia veinlets and the occurrence of mobile potassic phases [2]. Petrographic and SEM investigation of the metapelites that contain mm-wide pseudotachylitic breccia veinlets suggest increasing intensity of shock effects in all component phases in the matrix toward the breccias. SEM and EDS analysis indicate a strong correlation between local melt compositions and immediately adjacent minerals, with multi-component mixing becoming more pronounced in thicker veins. Biotite, cordierite and feldspar are the major contributing phases to the melts. These features are consistent with locally enhanced (cm- to mm-scale) shock effects in excess of 30 GPa in rocks that display shock P effects that are more consistent with background pressures of 15-20 GPa. This enhancement is attributed to refraction and/or reflection of the impact shock wave in the heterogeneous target lithologies.

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NOBLE GAS COMPOSITIONS OF ANTARCTIC COSMIC SPHERULES: EXTREMELY LONG EXPOSURE AGE OF AN ENIGMATIC SPHERULE.

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Introduction: Cosmic spherules are globular micrometeorites smaller than 1 mm in diameter. Although spherules had been considered to be extraterrestrial particles, strong evidence of extraterrestrial origin had not been obtained because volatile elements are significantly depleted due to the severe heating and the contents of cosmogenic nuclides are very low. In our previous work, extraterrestrial noble gases are detected for cosmic spherules using laser gas-extraction technique and a low blank mass spectrometer [1]. In this work, we measured noble gases for individual cosmic spherules collected at ice field around Yamato Mountains [2]. All samples were partially polished and their interior structures were investigated by SEM/EDS.

Results: Antarctic cosmic spherules are classified into seven types based on the interior structure: glassy, cryptocrystalline, barred olivine, porphyritic A, B, and C, and scoriaceous. Glassy, cryptocrystalline, and barred olivine spherules have relatively low concentrations of noble gases. Noble gas concentrations of Yamato spherules are much lower than those of unmelted micrometeorites [3,4] as in the case of Tottuki spherules [1]. Nevertheless, extraterrestrial noble gases are detected for about 40% of the samples. Lower $^{40}Ar/^{36}Ar$ ratios than that of terrestrial atmosphere (296) are observed for spherules with relatively high ^{36}Ar concentrations. Solar He and Ne are also detected for many spherules, indicating that these spherules are irradiated by solar wind in interplanetary space. No cosmogenic ^{21}Ne are observed for most of them, corresponding to unmelted micrometeorites [3,4].

2s410 and 2s413 are enigmatic cosmic spherules, which have exceptionally high $^{3}He/^{4}He$ (~0.01, 0.1, respectively) and $^{21}Ne/^{22}Ne$ ratio (0.2 for 2s410), showing the presence of cosmogenic nuclides. Long cosmic-ray exposure age of over 100 Ma is estimated for 2s410 when the production rate of a stony meteorite is adopted. Since no stony meteorite has such long exposure age, we conclude that the spherule was originally cosmic dust particle in interplanetary space and is not a fragment of a stony meteorite. We perform a model calculation, in which SCR and GCR are take into consideration [3]. Extremely long exposure age of about 400 Ma is estimated, in the case, the spherule is generated at 53 AU. The result suggests the possibility that the particle directly come from an Edgeworth-Kuiper Belt object (EKO). However, it is unknown whether EKO particles larger than 50 µm can arrive to the Earth [5], and collisional lifetime is shorter than orbital lifetime due to Poynting-Robertson effect [6]. The origin of the enigmatic cosmic spherule 2s410 is still unclear.

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NOBLE GAS STUDIES OF SAYH AL UHAYMIR 150 MARTIAN METEORITE.

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Introduction: Sayh al Uhaymir 150 (SaU 150), weighing 107.7 g, was found in Al Ghaba, Oman by Rainer and Sven Bartoschewitz, 2002 [1]. For it was classified as a basaltic shergottite and discovered in the same area with SaU 005/008/051/060 and 094, SaU 150 may be paired with them [1]. In this work, we report concentrations and isotopic ratios of noble gases of SaU 150 by stepwise heating method. K-Ar gas retention age and the cosmic-ray exposure age were calculated.

Experimental Method: A 0.0402 g of SaU 150 was analyzed by using a mass spectrometric system (modified-VG5400/MS-II). Noble gases in SaU 150 were extracted at different temperatures of 400, 600, 800, 1000, 1300 and 1750 °C. Then, the gases were purified by using Ti, Zr getters. Four fractions of noble gases (He-Ne, Ar, Kr, and Xe) were measured separately; He and Ar were measured by using the Daly-multiplier system, and most of Ne and Kr, Xe by an ion-counting system.

Result and discussion: The concentrations of the cosmogenic nuclides ^{3}He, ^{21}Ne, and ^{38}Ar (10^{-9}cm^{3}STP/g) are 21.8, 3.63, and 0.599, respectively. K-Ar ages and cosmic-ray exposure ages of SaU 150 and reported data of SaU 005/060 are given in Table 1. The ejection age of SaU 150 shows typical ejection age as basaltic shergottites summarized in [2]. K-Ar age is estimated by using ^{40}Ar concentrations (□1000ºC) and the average K concentrations of 183ppm for SaU meteorite [3]. The obtained ages are about 0.69~1.01 b.y., which are representative data for basaltic shergottites. The data also show the pairing between SaU 150 and SaU 005/060, not only for the Mars ejection age, but also for the pattern of the noble gas concentrations during the stepwise heating.

From the (^{40}Ar)/(^{36}Ar)$_t$ and ^{129}Xe/^{132}Xe ratios of SaU150, higher temperature data show the trapped Martian atmosphere components (Ar: 1383±305 at 1300°C, Xe: 1.314±0.064 at 1750°C). While those lower value of ^{129}Xe/^{132}Xe ratios (under 1000°C) observed from both SaU 150 and SaU 005/060 can be explained as terrestrial contamination due to desert weathering [5,6].

TABLE 1. The cosmic-ray exposure ages and K-Ar ages.

Meteorite	T_3	T_{21}	T_{38}	K-Ar age (□1000ºC)
	Ma			Ga (K=183ppm [3])
SaU 150	1.31	1.28	0.66	0.69±0.08
SaU 005[4]	1.27	0.83	0.87	1.01±0.11
SaU 060[4]	1.27	1.12	0.79	0.50±0.06

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SULFATE MINERALIZATION IN NAKHLA: A CATHODOLUMINESCENCE AND FULL-SPECTRUM X-RAY IMAGING STUDY.

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Introduction: If the recent discovery of a sulfate-rich mineral assemblage by the MER Opportunity team (*1*) holds-up to further scrutiny, it will represent the most definitive chemical evidence for ancient aqueous fluids on the surface of Mars. While the *in situ* spectroscopic identification of sulfates at the planet's surface represents new information about Martian history, meteorite-based observations regarding evaporitic mineralization beneath the planet were first reported well over a decade ago (*2*). Subsequent work on the petrographic context and geochemistry of secondary mineral assemblages in Nakhla suggests these minerals precipitated beneath Mars from a low-temperature saline fluid, possibly remobilized from surface evaporate deposits (*3*), or, precipitated directly from a concentrated brine (*4*). We present detailed microanalyses and images of a Nakhla alteration assemblage localized along grain boundaries in the mesostasis that contain an assemblage of anhydrite, low-T silicate (clay?), and Cl-apatite.

Methods: Polished thin sections of Nakhla were prepared using a water-free procedure. Specimens were then screened for areas containing salt-bearing secondary minerals using backscattered electron microscopy. Areas of interest were imaged for X-rays of all energies using a ThermoElectron NSS EDS analyzer. Spectral deconvolution and matrix corrections were applied to each pixel yielding fully-corrected elemental images created from >65,500 individual analyses extracted from the data cube. A Gatan MonoCl3+ was then used to collect panchromatic, as well as red, green, and blue filtered images. CL-generated UV/VIS/NIR spectra of sulfates were also collected at several spectral resolutions.

Results: Ca sulfate (anhydrite) is a trace component in two thin sections of Nakhla 38LNH examined, and represents ~ 72 ppm by volume. Anhydrites grains up to ~60 m in size were found situated along grain junctions of pyroxene and pockets of evolved igneous minerals (principally plagioclase An_{23}). Clusters of smaller Cl-apatite (up to 15 m long axis) are associated by anhydrite. These two minerals are incompletely surrounded by a thin envelope (3-4 m) of low-T silicates. The silicate alteration contains ~0.7 wt % Cl and its major element chemistry is not consistent with stoichiometric clay (an indication this material includes an amorphous component). Cl is also a minor element in anhydrite at ~0.3 wt % level. The cathodoluminescence signal in the secondary mineralization is quite intense as anhydrite and Cl-apatite are strong CL emitters. Spectra taken from anhydrite yields major features at 500, 830, and 870 nm which interestingly does not match the well-documented REE activators (*5*).

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Fe-Ni METAL IN NWA 1814, THE 6TH BENCUBBIN-LIKE METEORITE: PROPERTIES AND ORIGIN.

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Introduction: Bencubbin and its siblings are rare, metal-rich meteorites with intriguing properties. They have been ascribed a number of origins, especially for their metal constituents, from very primitive – condensation in the solar nebula – to highly processed – result of impact melting or vaporization. Here we describe the most recently found of these meteorites, NWA 1814 (total mass 156 g), with emphasis on the distinctive properties of its metal, and their implications for its possible origin.

Results: Overall, NWA 1814 is similar to Bencubbin, Weatherford and Gujba (BWG). It is made of large (several mm) clasts of Fe-Ni metal (about 60 vol %) and of barred to cryptocrystalline silicates. In between the clasts is a shock melted mixture of silicate and metal, with embedded silicate fragments. The metal clasts are roughly hemispheroidal, all with the same orientation, different from the ellipsoidal clasts of Gujba, and the more irregular clasts of Bencubbin and Weatherford. They are essentially made of kamacite (most with ~6 wt% Ni) containing varying amounts of P (0.2-0.3 wt%) and Cr (0.1-0.3 wt%). The metal clasts are polycrystalline, composed of large grains (100 to a few hundred µm in size), often looking warped, whose boundaries are highlighted by clusters of spongy, filamentous troilite. Compact, angular inclusions or rounded blebs of troilite, as are found in BWG, are extremely rare in NWA 1814. Subhedral crystals of daubréelite (1-10 µm across) are set in the troilite clusters, in which areas of tetrataenite (53 wt% Ni, up to ~50 µm in length) are also often observed. The Fe-Ni coarse grains themselves are in turn made of finer grains (typically 10 µm across), clearly products of recrystallization. The boundaries of these grains are often outlined by thin (0.5 µm in width), discontinuous ribbons of troilite, and by small grains of daubréelite or tetrataenite. Tiny inclusions of schreibersite and cohenite are also frequent.

Discussion: We interpret the microstructures of the NWA 1814 metal clasts as due to the rapid cooling of an S-poor metal-sulfide liquid, and their hemispheroidal shape as resulting from their fall, when they were hot and plastic spheres, onto a cooler planetary surface. Upon landing, the bottom part of the spheres became flat or even concave, depending on the shape of the surface beneath. The metal was quenched and the coarse grains became warped. The fine kamacite grains and their troilite ribbons probably formed at that time. Each hemispheroid had the time to harden before the next sphere fell upon it. If this hypothesis is correct, the Gujba metal globules were obviously much less plastic, i.e. less hot, when they landed. The NWA 1814 metal microstructures (coarse and fine grains) also exist in BWG, but the smaller grain sizes and the troilite morphology in NWA 1814 indicate faster quenching from high temperatures. Paradoxically, some observations (tetrataenite, daubréelite) also indicate that NWA 1814 remained at moderate temperatures (around 600°C) for a longer time than BWG. This may be due to a deeper burying after landing. Overall, we thus consider our observations consistent with an origin in an impact plume [1].

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THE KEURUSSELKÄ IMPACT STRUCTURE, CENTRAL FINLAND – PRELIMINARY GEOPHYSICAL DATA

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A new meteorite impact structure called “Lake Keurusselkä” was discovered in 2003 by S. Hietala and J. Moilanen (Hietala and Moilanen, 2004). The structure, centered at 62 08´N, 24 36´E, is located some 220 km north of Helsinki. The target rocks are Paleoproterozoic granites and mica schists with minor volcanic inliers. The original discovery was based on numerous shatter cone findings (in-situ and boulders) in a circular area of some 10 km in diameter between the village of Kolho and the western shore of the lake Keurusselkä. We started to investigate the available geophysical data in order to find whether the supposedly old impact structure will still show up in geophysical data sets. As noted by Hietala and Moilanen (op. cit) several possible remnants? of topographic rings may be seen in digital elevation data: the diameters of these rings vary from 10 km (the area where shatter cones were discovered) to ca. 30 km. The lake is 27 km long between the towns of Keuruu (north) and Mänttä (south) with several open lake areas somewhat east from the shatter cone findings. The deepest bathymetry (32 m) is in the central part of the lake. At first glance it does not have any direct connection to the impact structure, nor to the geophysical anomalies described below. The Bouguer gravity data are sparse in the area but the preliminary contour map delineates a negative, ca. 7 mGal anomaly. However, in the area there are also other negative gravity anomalies, for example one located some 20 km NE from the impact structure. Airborne magnetic data reveal a striking ring anomaly of ca. 10 km of diameter. This anomaly consists of positive anomaly patches surrounding the weak negative central anomaly. The magnetic ring anomaly is slightly east from the Bouguer anomaly. Airborne radiometric and electromagnetic data do not reveal any specific anomalies in the area. We note here that the geophysical data are typical to impact structures but in the same time, there are also similar gravity and magnetic anomalies in the central Finland of which not all are related to impacts. Petrophysical measurements are now under way to see whether the magnetic and gravity anomalies are explained by impact caused changes in physical properties of the rocks.

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MODELING POLARIZATION PROPERTIES OF STRUCTURE ANALOGS OF COMETARY DUST PARTICLES

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Introduction: Cometary dust atmosphere is believed to include grain aggregates that can be considered in some approximation as pre-fractal clusters. This is confirmed with investigations of interplanetary dust particles [1] and results of *in situ* measurements by the Halley comet missions, e.g., [2]. We study scattering properties of such pre-fractal clusters.

Used model of aerosol aggregates: To construct pre-fractal clusters, we use the Whitten – Sander model, generalizing it for the 3-D case. In a finite cubic lattice we randomly put a grain in a cell. Then new grains are randomly added into empty cells. Each new grain randomly moves with the Monte-Carlo method. The movement of the grain in the lattice volume proceeds till it finds the initial grain. Then it stops and a next grain repeats the process of random moving. In such a way a pre-fractal cluster grows (see fig. 1). We use the discrete dipole approximation (DDA) method to study the polarization properties of the pre-fractal clusters with size parameter x = 8, 10, 12. Each cluster contains from 10000 to 70000 grains (dipoles).

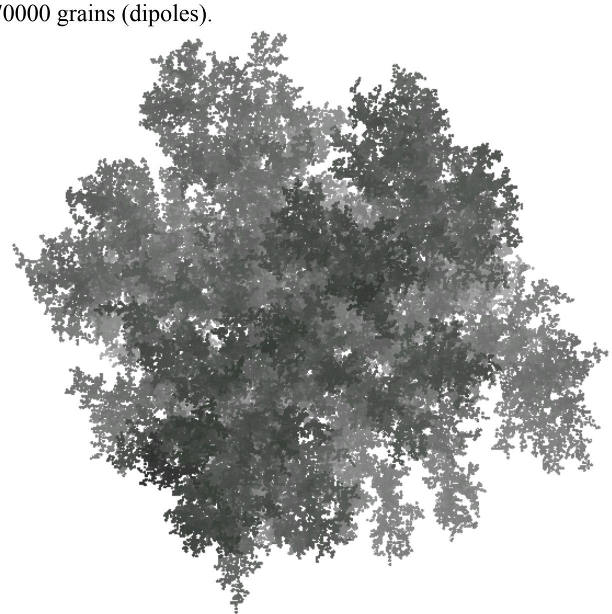

Fig. 1

Results and discussion: We have made calculations for various refractive indices of grains and different packing densities of clusters. We find that the clusters produce significant negative polarization branches at small phase angles, when packing density is large enough. The branches qualitatively consist with the observational data for cometary dust atmospheres. Increasing the packing density and the refractive index makes the negative polarization more prominent.

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NEAR INFRARED OBSERVATIONS OF COMET C/2000 WM1 (LINEAR)

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Introduction:

Near infrared continuum observations of comets are an important means to study the scattering and thermal emission properties of cometary dust. The infrared spectral distribution is governed by both intrinsic (amount and extent of dust, its production and distribution) and extrinsic (heliocentric an geocentric distances and phase angle) factors [1]. For < m, the observed light is primarily sunlight scattered by dust grains, while at longer wavelengths, thermal emission from the dust dominates the radiation . The imaging of comets in the infrared can be a powerful method of studying spatial variations in the optical properties of the dust. [2]. Among these properties are scattered radiation, thermal emission, and albedo.

In this work we present preliminary results of near-infrared (IR) observations of the comet C/2000 WM1 (LINEAR) in the period of Dec. 01-03, 2001 (pre-perihelion) and in Apr. 2, 2002 (post-perihelion). Observations were made with the 0.6-m telescope of the Pico dos Dias Observatory (Minas Gerais, Brazil), with filters I (1.10 / 0.200), J (1.25 / 0.285) and H (1.65 / 0.290). Color-indices are analyzed and compared with those for other comets.

Observations and Results:

The near-IR observations were made during Dec. 01-03, 2001 (pre-perihelion) and in Apr. 2, 2002 (post-perihelion) at the Pico dos Dias Observatory(LNA/MCT), Minas Gerais, Brazil. The infrared camera (CamIV) was attached to the 0.60-m (f/13.5) Boller & Chivens telescope. In the pre-perihelion phase the comet and standard stars were observed with filters I (1.10 / 0.200), J (1.25 / 0.285), and H (1.65 / 0.290). The heliocentric and geocentric distances of the comet were 1.214 AU and 0.316 AU, respectively. The corresponding phase angle was 38.6 degrees. Due to the high velocity of the comet in the sky and due to the restrictions in telescope guiding system, the exposures could never exceed 10s.

In the post-perihelion phase the Comet C/2000 WM1 was observed with filters J and H. The heliocentric and geocentric distances of the comet were, respectively, 1.5802 AU and 1.242 AU, and the corresponding phase angle was 41.4 degrees.

In the pre-perihelion phase the I-J color of Comet C/2000 WM1 seems to be similar to C/Kohoutek (1973 E1) and redder than C/Bradfield (1974 C1). This discrepancy is too high to be simply due to filter characteristics. J-H color of C/2000 WM1 seems to be a little bluer, but is similar to some published values for other comets. Also, J-H colors seems to be fairly uniform and independent of the scattering angle.

J-H colors of C/2000 WM1 in the post-perihelion phase is under analysis, as well as coma brightness distribution and morphology.

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HENRY A. WARD AND THE RECOVERY OF THE SANTA ROSA, COLOMBIA, METEORITE

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Henry A. Ward (1834-1906) was perhaps the shrewdest and most enthusiastic meteorite collector of his day. He was also very knowledgeable. Word of a massive iron meteorite in Santa Rosa, Colombia, captured his imagination. Ward's interest can best be viewed in the context of the confusion that existed between this meteorite and two other irons that had been found nearby, Tocavita and Rasgata. In an effort to clear up the mess--and also to see if he could acquire the meteorite in whole or in part--he decided to visit the desolate locale in 1906, a few weeks prior to his 72nd birthday. My account of Ward's Colombian trip is primarily based on the extensive collection of unpublished material in the Henry A. Ward papers at the University of Rochester, including diaries, correspondence, and photographs.

Upon arrival in Colombia, it took Ward nineteen days by steamer, mule, and carriage to reach Santa Rosa. He arrived at nightfall, but as soon as he looked out from his hotel window the next morning, he saw the large meteorite (612.5 kg) perched atop a fluted column in the middle of the town square. Ward realized the meteorite was highly venerated by the townspeople, and knew it would be extremely difficult--if not impossible--to acquire any of it. But he had a clever plan.

Calling on the Governor, Ward boldly proposed an exchange: in return for a promise to erect a statue in the town square of the President of the Republic (who happened to have been born in Santa Rosa), he would be given the entire meteorite. The Governor liked this idea, and at a stormy meeting with the Mayor and other municipal officers forced their approval. Late that night, in the middle of a large eating and drinking party which Ward threw at his hotel for the townspeople, the Governor and a party of 50 soldiers quietly overturned the column, placed the meteorite on a cart, and whisked it away.

Ward left for Bogota the next day, but shortly after reaching there heard that the Chief of the Colombian police had sent out a party that had captured his wagon, retrieved the meteorite, and locked up the cart driver. Although Ward insisted he had proper authorization for the meteorite, a heated legal battle ensued. A decision by the Minister of Public Instruction forbade him to leave the country with the meteorite, but he was allowed to cut off a large endpiece (147.5 kg) for his efforts. Ward took this back with him to New York, but he died tragically a few months after his return, when struck by an automobile while crossing a street in Buffalo.

Ward's unfinished report on the Santa Rosa meteorite will be examined, as will our present understanding of its relationship to Tocavita and Rasgata. The main mass of the Santa Rosa meteorite (about 460 kg) is now in the National Museum in Bogota, while Ward's endpiece was cut up and distributed to various museums throughout the world for study and curation.

AUTOMATIC CRATER DETECTION USING DEM AND CIRCULAR COHERENCY ANALYSIS – A CASE STUDY ON SOUTH AMERICAN CRATERS

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Introduction: Considering the fine resolution and worldwide coverage of digital elevation models (DEM) available through the Shuttle Radar Topographic Mission (SRTM), an algorithm of automatic detection of circular patterns becomes a valuable tool for pre-selecting potential images with impact craters. As they have quasi-circular shapes, the majority of detection methods are based on the presence of such geometries [1]. However, these features can be severely masked by means of natural geologic process, such as degrading and erosion, meaning that there are craters which are no longer circular or continuously depicted.

The Hough transform (HT) is a standard technique used to detect circular edges in image processing by computing another image in a two-parameter domain. Basically, the original data is summed along straight lines that are uniquely determined by the line slope and distance to the origin. This is computed in such a way so that the transformed image in the parameter domain enhances the presence of circular shapes. In the circular HT (CHT) variant, the data is no longer summed along straight lines, but along circles. In this case, the domain is parameterized by the two coordinates of circles centers. However, as craters loose their original geometry due to erosion, the circular transformed image produces insufficient results to identify complex craters.

Method: One way to improve the results of the circular HT is to substitute the operation of summation by a more sophisticated technique called semblance [2], which is a measurement of coherency of data. The coherency analysis provided by the semblance is often used in seismic exploration to estimate seismic velocities. The semblance depends on parameterized templates-typically, hyperbolic curves for seismic problems. For the crater detection approach circles were employed. As an additional feature, the semblance measure along a curve uses a tubular neighborhood around it, meaning that any shape close enough to a circle is going to be detected, including elliptical curves and deformed circles. Also, non-coherent data along a line do not degrade the overall coherency, implying that pieces of circular edges of craters are going to be detected likewise.

Results: a specifically tailored algorithm and the software for crater detection based on circular coherency analysis were designed as part of this work. The performance of the algorithm was tested against sections of a 12Gbytes SRTM (90m) mosaic of South America (SA) (this work) and ASTER (15m) DEMs. Several areas were tested in SA, but a particular case was made for the Monturaqui crater in Chile, which has a diameter of 460m. Although a few false positives were produced, the crater was successfully detected by the technique.

Conclusions: By aggregating coherency analysis by means of semblance measurements, the circular HT becomes more robust, and proved able to detect circular and quasi-circular structures as well as structures with missing pieces in many cases studied in SA, including Monturaqui.

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IMPACT SHOCK FEATURES OF THE VARGEÃO DOME, BRAZIL

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The Vargeão dome of western Santa Catarina state, Brazil, is approximately 12 km diameter and exposes shocked pre-Cretaceous quartzose sediments in an uplifted core surrounded by brecciated lowermost Cretaceous Serra Geral basalt flows. Although extensive annealing has occurred in the basalts, relict weak shock effects are preserved in plagioclase. The core rocks, with near-vertical slickenlines, carry multiple shock-deformation lamellae and planar fractures in clastic quartz grains recovered from brecciated conglomerate and sandstone. Planar deformation features (PDF's) in the quartz are typically decorated and somewhat curved. The template method [1] for evaluating Universal Stage measurements of planar deformation features indicates the following orientations: common: {10-11}; less common: (0001), {10-13}, {10-12}; and scarce: {11-21}. The scarcity of diaplectic quartz glass might indicate peak transient shock pressures less than 35 GPa [2]. Progress on X-ray investigations of peak-broadening in naturally shocked quartz and changes in unit-cell dimensions is summarized [3].

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THE NEW STATESBORO, GEORGIA L5 CHONDRITE

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About June 15, 2000, Harold Cannon found a strange stone in his produce garden and kept it for several years. In August, 2003, he had it analyzed and it was found to be a meteorite. This L5 meteorite was found about 10 km west of Statesboro, GA. It was classified by Tim McCoy - Smithsonian with an olivine composition of Fa24.6 ± 0.4 and orthopyroxene of Fs20.8 ± 0.2 Wol. 8 ± 0.3. This chondrite had a total weight of approximately 2158.26 gms. Michael Kelley of Georgia Southern University did the thin section analysis. The find site of the Statesboro is long. 81_ 54.'210 W. and Lat. 32_ 26.'241 N. This irregularly shaped stone has the basic dimensions of 150 x 105 x 80 mm. There is no fusion crust. There is an orange colored rind, approximately 2.5 mm thick. The interior is dark gray, possibly shock darkened. It shows some surface damage by the plow. A surface hunt for other fragments is now in progress.

On December 10, 1983, at 22:30 U.T. a fireball from the southeast with sonic booms occurred over southeast Georgia. A 1455 gm L6 chondrite impacted a mailbox 10 km SSE of Claxton, GA. This chondrite had many flat sides and a highly irregular shape indicating that fragmentation had likely occurred. The black shiny fusion crust was approximately .5 mm thick. The thin section and petrological analysis was done by Andrew Graham of the British Museum. The olivine content was Fa25.4. There was some indication of fragmentation since sonic booms were heard to the north.

The question now arises as to whether the Statesboro is a large mass of the Claxton. The appearance would suggest that it is not. The Statesboro's interior is dark and show no fusion crust while the Claxton interior is light. The effects of 19 years of weathering in the Georgia climate may account for this. The petrology is similar. The 355.1_ azimuth of the fall path and the find sites are remarkably aligned.

This fragment will likely be named the Statesboro, GA by the Meterorite Committee as it does not conflict with any other named meteorite and this is the nearest post office. This is the 23^{rd} meteorite found in Georgia. Photographs will be made available to any serious researcher.

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NEWLY DISCOVERED ANDA-TYPE AND STRETCHED INDOCHINITES FROM THAILAND

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A prominent area where Philippinites tektites are found is the Pangasinan Province. The Anda-type tektites are regarded as a subdivision of the Pangasinan tektites. These tektites have peculiar surface features which resemble imprints of seashells or even rodent teeth marks. To this date, this is the only area where these tektites have been found.

Recently, Clyde Barnhart closely examined approximately 800 kg of Thailand indochinites. Among other findings, one spectacular and several other less profound Anda-type tektites were found. This specimen is a splash form dumbbell with a weight of 67.9 gm and dimensions of 77 X 26 X 24 mm. The depth of the Anda-type surface features vary from 0.3 to 1.8 mm. The scientific importance of this finding shows that the Anda-type surface features are not unique to the Island of Anda.

I n 967, H. Nininger published an article of two stretched plastic tektites from Viet Nam. These showed molten interiors after the exterior surface hardened. They suffered some trauma which caused them to break open exposing their plastic interiors. These specimens have been very controversial and remained unique for many years. In 2001, Michaela Blood announced another specimen of a stretched indiochinite. In 2003, Clyde Barnhart found one spectacular specimen and a number of others with less prominent stretch features. This scientific value of this is that with the additional specimens, it may help establish the impacting conditions. Pictures of these specimens will be made available to any serious student of tektites.

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A GEORGIA TEKTITE WORKED INTO A CLOVIS TYPE ARROW POINT

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The area of the Georgia tektite strewn filed is approximately 8000 square miles covering at least 18 counties in east central Georgia. These fall along the Eocene-Oligicene boundary. Only about 2000 Georgia tektites are known and only about 8 of these have shown any sign of being worked by Paleo cultures.

In February 2004, the first author was alerted to a unique Clovis type arrow pint. It was originally found by Marie Johnston of Eastman, GA. The exact find site is not known but is thought to be near Bulloch County approximately 50 miles from the Atlantic Coast.

This specimen is small and delicate. It has the characteristic drab-olive green color with no inclusions and only one tiny bubble. It has the dimensions of 39 x 22 x 4mm. The weight is 3.570 gms. It has a long flute, 35mm on one side. The other side has a possible thinning flake which is off center. It is in excellent condition but shows normal weathering. The surface shows a slightly hazy patina.

The Clovis and Midland cultures were present in Georgia from approximately 9000 - 11,700 years ago.

In the future, this specimen may be analyzed by electron microprobe to determine the exact composition.

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THE FIRST GEORGIA TEKTITE FROM WILKINSON COUNTY, GEORGIA

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On January 23, 2004, the first Georgia tektite found in Wilkinson County, Georgia was identified. It was found several years earlier but not recognized. A significant period of search time had been attempted in this area of Wilkinson County but no specimens were found. This has been a problem area in that tektites have been found in the bordering counties of Washington, Johnson, Laurens, Bleckley and Twiggs but none in Wilkinson County. The geology was logical for finding tektites, especially in the southern third of the county.

The specimen was found by an Indian artifact collector, J. Walker. It was shown to the second author who immediately identified it as a tektite. It measures 34 x 25 x 18.5 x 6 mm and has the general shape of a trapezoid. It has a weight of 4.901 gms. It is an excellent specimen not having any chips or breaks. There does not appear to be any inclusions and only one tiny bubble. The surface is unusually eroded, the cause is currently being investigated. The rough coordinates are long. 83° 07' W. and lat. 32° 54' 30" N. This is found on the USGS 7.'5 Gum Pond, Georgia topographic map.

Only approximately 2000 Georgia tektites are known. These are found in approximately 18 counties which border on the Eocene-Oligocene boundary. With the finding of this tektite, the total area of the Georgia tektite strewn field is now almost identical in size to the bediasite tektite strewn field in eastern Texas. Both strewn fields have approximately 2400 square miles.

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NICKEL ISOTOPES IN EUCRITES AND THE DISCORDANCE BETWEEN ISOTOPIC CHRONOLOGIES

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Introduction: The exact time-scale for eucrites genesis is still controversial: there is evidence that they formed 8 to 10 Myrs after the start of the solar system [1 and references therein] and evidence that reflects an earlier formation [e.g. 2]. The ^{60}Fe-^{60}Ni short-lived chronometer (half-life=1.49 Myrs) has the potential to provide powerful constraints on the age of the oldest basalts of our solar system. The first data were obtained on Chervony Kut and Juvinas using TIMS [3]. To broaden the set of data and obtain a more comprehensive picture of Ni isotopes in eucrites, we have been readdressing this topic using MC-ICPMS.

Leaching experiments: Shukolyukov and Lugmair [3] have shown that Ni diffuses over a range of about 1 cm in the samples studied, and that up to 80% of the total Ni present in a sample can be lost by acid washing. As it is a major concern directly related to the quality of the final data, we decided to make exhaustive tests of this. The leaching procedure is indeed critical for removing possible terrestrial contamination. We first performed leaching experiments on a terrrestrial gabbro, as similar to eucrites as possible in terms of mineralogy, chemical composition and Ni content. Leaching has been performed using several different media and for different time periods between 1 and 30 minutes. Short leaching (up to 5 minutes) generally has no effect on the isotopic and concentration results, whereas Ni isotopic compositions and concentrations are affected by longer leaching indicating that artifacts are being introduced to the MC-ICPMS measurements. Dilute HCl has the weakest influence among the different solutions tested.

Results and Discussion for Eucrites: We started our investigation with the analysis of Juvinas and Bouvante, two non cumulate eucrites. Juvinas belongs to the main group of eucrites, whereas Bouvante is of particular interest because it is on the Stannern trend and presents the highest ^{182}W excess found up to now in eucrites. In a first stage, we analyzed several bulk rock samples for each meteorite, because eucrites are known to be heterogeneous [3]. All samples are characterized by ^{60}Ni-excesses, in good agreement with earlier results, but we find more radiogenic compositions for Juvinas than previously reported [3]. Ni-excesses correlate with the Fe/Ni ratio of the samples and define pseudo "internal isochrons" even if these lines are not mineral isochrons. The ^{60}Fe/^{56}Fe ratios deduced from the slopes of the isochrons are between 10^{-9} and $8*10^{-8}$. Assuming an initial ^{60}Fe/^{56}Fe between $1.2*10^{-6}$ [4] and $1.6*10^{-6}$ [5] for the solar system, the eucrites data define apparent ages of 6 to 16 Myrs after the start of the solar system.

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