[PC2008 #001]

Glass spherules related to the El'gygytgyn impact crater (Siberia)

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The 3.6 Ma El'gygytgyn (Ø ~18 km, NE Siberia), one of only two terrestrial impact craters set in a volcanic region, is currently target of an ICDP drilling project [1]. Impact-related glassy material (and their alteration products) may occur in different geological settings in and around impact craters, yet only a few distant ejecta deposits contain glass spherules (e.g., the K/T boundary clay). The 760- to 30-µm-sized glassy objects of the current study were collected at ~10 km distance from the crater center. Their color ranges from amber, dark brown to nearly black. Three of the translucent spherules are spheres, and four elongated spheroids. They contain circular bubbles, and very rarely mineral clasts. According to our microprobe data (defoc. beam Ø 10 µm; JEOL JXA 8900, WWU), the glassy spherules have a very homogeneous composition, which is either dacitic, andesitic, or basaltic-andesitic. The latter type of glasses must have a precursor lithology, which is very rare in the El'gygytgyn target region but probably will be encountered in the drilling.

References: [1] Melles, M. (2006) Leipziger Geowissenschaften 15/16:148.

[PC2008 #002]

Ba, Nd, & Sm Isotopic Anomalies in Chondrites.

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Recent studies of variations in the Sm, Nd, & Ba isotopic compositions of bulk meteorites have yielded contradictory results, in terms of early planetary evolution. A key question is whether the observed variations in ^{142}Nd are due to different contributions of nucleosynthetic (p-, s-, & r-process) components, or are caused by differing Sm/Nd ratios generated through planetary differentiation whilst ^{146}Sm was alive. Whereas C-chondrites are deficient in p-process ^{144}Sm, the ^{148}Sm/^{154}Sm & ^{145}Nd/^{144}Nd ratios of chondrites, eucrites, shergottites, Moon, & Earth are constant; & these indicate that the Solar Nebula possessed a uniform ratio of r/s nuclides. However, C-chondrites exhibit anomalies in ^{135}Ba & ^{137}Ba consistent with an excess in r-process nuclides. The Ba isotopic compositions of O-chondrites & eucrites are indistinguishable from that of Earth. Thus the Ba, Sm, & Nd isotope ratios that are sensitive to variations in the r/s ratio are consistent, except those of C-chondrites, suggesting that whereas s- & r-process nuclides were homogeneously distributed in the inner Solar Nebula, radial isotopic heterogeneities existed within the nebula. The issue of whether different planetary bodies accreted with the same bulk solar Sm/Nd ratio remains unresolved.

[PC2008 #003]

The initial abundance ^{205}Pb in the early solar system – constraints from thallium isotope anomalies in primitive

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The nuclide ^{205}Pb decays to ^{205}Tl with a half-life of 15 Myrs [1]. Recent evidence for the existence of ^{205}Pb in the early solar system was provided by a Pb-Tl isochron for IAB iron meteorites. However, significant uncertainty remains over the initial solar system abundance of ^{205}Pb [2]. Acapulcoites and lodranites exhibit equilbrated, metamorphic textures and they have been dated at 9 ± 5 Myr based on Pb-Pb and Hf-W analyses. These primitive achondrites are inferred to have cooled rapidly [3] and hence they are ideally suited for isochron studies.

We will present new Pb-Tl concentration and isotope data for mineral separates and whole rock samples of acapulcoite NWA 725 and lodranite NWA 2714. The results will be used to obtain improved constraints on the initial ^{205}Pb/^{204}Pb ratio of the solar system.

References: [1] Wasserburg G. J. et al. (1994) *Astrophys. J.*, 424, 412-428. [2] Nielsen S. G. et al. (2006) *GCA*, 70, 2643-2657. [3] Touboul et al., (2007) *LPSC XXXVIII*, #2317.

[PC2008 #004]

Evidence for Condensation of Sub-Micron Refractory Metal Alloys in the Early Solar System.

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Alloys of refractory metals (RM: Re, W, Mo, Pt, Os, Ir, Ru and Rh) in Ca,Al-rich inclusions of primitive meteorites are among the earliest condensates in a cooling nebular gas. Oxidation, sulfurization, and exsolution have altered the RM-metal alloys to complex opaque assemblages [1]. We report on a population of sub-micron sized refractory metal nuggets (RMN) identified in an acid-resistant residue of the Murchison meteorite. These unaltered RM particles provide direct evidence for condensation as solid alloys. Of the 458 RMN identified by SEM, 88 were selected for quantitative analysis by energy dispersive X-ray spectroscopy (EDX). Individual grains show large variations in chemistry, with Mo, Os, Ru and Ir accounting for more than 89 % by mass. The average composition of the analyzed grains indicates a smooth volatility controlled CI-normalized pattern of RM with strong depletions of the two most volatile RM, Pt and Rh. The measured compositions show striking agreement with condensation calculations.

References: [1] Palme, H., Wlotzka, F. (1976) Earth Planet. Sci. Lett. 33, 45–60.

[PC2008 #005]

Hf-W isochron for Ca-Al-rich inclusions: implications for the age of the Solar System and the timing of asteroidal core formation.

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Application of ^{182}Hf-^{182}W chronometry to constrain the duration of early solar system processes requires the precise knowledge of the initial Hf and W isotope compositions of the solar system. To determine these values, we investigated the Hf-W isotopic systematics of bulk samples and mineral separates from several calcium-aluminum-rich inclusions (CAIs) from the CV3 chondrites Allende and NWA 2364. All investigated fractions plot on a single well-defined isochron corresponding to an initial ^{182}Hf/^{180}Hf~9.7×10-5 and an initial ^{182}W/^{184}W of ϵ^{182}W~-3.3. The initial ^{182}Hf/^{180}Hf corresponds to an absolute age of 4568.5±0.5 Ma, which may be defined as the age of the Solar System. This age is ~1.5 Ma older than the Pb-Pb age for Efremovka CAI E60, which does not seem to date the formation of CAIs. Tungsten model ages for magmatic iron meteorites, calculated relative to the newly and more precisely defined initial ϵ^{182}W of CAIs, indicate that core formation in their parent bodies occurred in less than ~1 Ma after CAI formation. This confirms earlier conclusions that the accretion of the parent bodies of magmatic iron meteorites predated chondrule formation and that their differentiation was triggered by heating from decay of abundant ^{26}Al.

[PC2008 #006]

In situ and remote sensing investigation of gullies in Svalbard as a potential Martian analog

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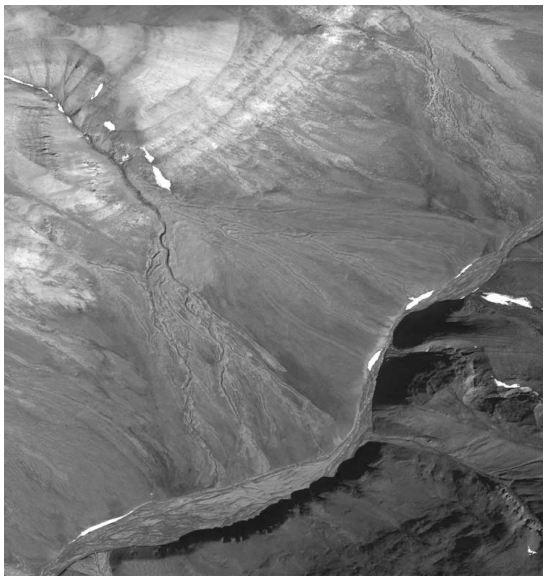
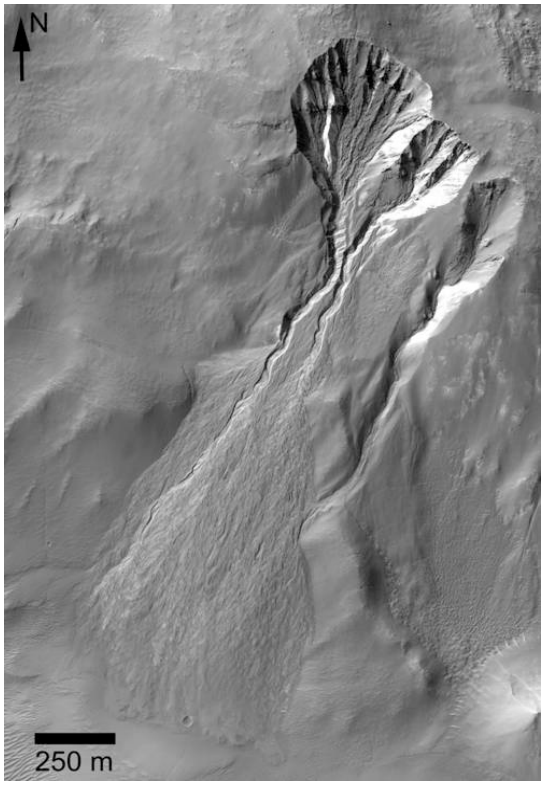
The aim of this study is to improve the understanding of the formation mechanisms of Martian gullies and to investigate whether water could be the eroding agent [1]. The study consists of three phases: (1) Monitor annual variations of soil moisture and ground temperature of gully alcoves of different slopes aspects (2) Remote sensing data over gully locales using stereo imaging HRSC-AX data, a similar methodology used for Martian gullies [2][3]. (3) *In situ* ground truth investigation of soil/ground characteristics and carry out detailed morphometry, and link these to local climate conditions. From these observations and environmental data we expect to derive correlations between gully morphology and environmental parameters that can be used to help determine if the gullies on Mars were caused by processes related to conditions in the ice rich permafrost.

References: [1] Malin, M.C. and Edgett K. S. (2000), *Science*, 288, 2330-2335. [2] Heldmann, J.L. and Mellon, M.T. (2004), *Icarus*, 168, 285-304. [3] Heldmann, J.L. et al. (2007), *Icarus*, 188, 324-344.



a) HRSC-AX image of gully in Hanaskog Valley, Svalbard. Image is unprojected.



b) HiRISE (PSP0068881410) image of gully on Mars showing distinct alcove, channel and apron.

[PC2008 #007]

Noble Gas Compositions of Antarctic Meteorites from Grove Mountains.

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We have measured a group of 20 Antarctic meteorites, which were recovered by the Chinese National Antarctic Research Expedition (CHINARE 2002 and 2005) from the Grove Mountains icefield. Here we report on the first measurements of noble gas abundances in these samples, all ordinary chondrites that range from L4 to L6 and H3 to H5, performed on a self-made sector-field mass spectrometer at the University of Bern. Overall, the data are consistent among all samples, and even measurements of different aliquots of many of them agree within uncertainty. Despite belonging to different meteorite groups, all samples show interestingly low $^{4}He/^{3}He$ values, suggesting loss of radiogenic ^{4}He, together with relatively low radiogenic ^{40}Ar. The analysis of their cosmic ray exposure histories will confirm whether some of these meteorites are paired. Ne isotopic ratios ($^{20}Ne/^{22}Ne$ and $^{21}Ne/^{22}Ne$) are strongly cosmogenic. The terrestrial component in all samples is negligible or very small, with the Ar ratios being the ones most influenced by the atmosphere.

[PC2008 #008]

Impact-related pseudotachylitic breccias in the Schurwedraai and Baviaan-Krantz alkali granite complex in the collar of the Vredefort Dome.

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The formation of pseudotachylitic breccias in larger impact sites is still a matter of debate. To contribute to the understanding of the formation of such pseudotachylit bodies, macro- to microscopic structural, petrographic and geochemical analyses were applied. In the alkali granite complex pre-impact textural and structural features are scarce and the geochemical composition and pre-impact conditions are somewhat different in contrast to the more thoroughly investigated Archean gneiss of the core of the dome. First results show that larger pseudotachylitic breccias zones seemingly follow a concentric and radial pattern with respect to the center of the Vredefort Dome. XRF and microprobe analyses indicate a similar composition for pseudotachylitic breccias and host rock, suggesting that the melt is not allochthonous. Besides this, shear planes connected with larger pseudotachylitic breccia occurrences were observed. This may suggest that friction due to shear strain produced melt which was injected into dilatational sites during the crater modification stage.

[PC2008 #009]

The ^{81}Kr-Kr dating technique for meteorites

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In order to check the ^{81}Kr-Kr dating technique (e.g., [1,3]) for meteorites we perform a systematic comparison of ^{81}Kr-Kr and ^{36}Ar-^{36}Cl ages for meteorites with long exposure ages and high metamorphic grades (H5, L5, L6). We separated and cleaned metal samples and measured ^{10}Be, ^{26}Al, and ^{36}Cl by AMS and ^{3,4}He, ^{21,22}Ne, and ^{36,38}Ar by noble gas mass spectrometry. The data enable to calculate reliable cosmic-ray exposure ages for all 14 studied objects using the ^{36}Cl-^{36}Ar method. Bulk samples of the selected objects have already been analyzed for ^{3,4}He, ^{21,22}Ne, and ^{36,38}Ar, enabling to experimentally check the model calculations of cosmogenic production rates [2] as well as to study diffusion losses of ^{3}H and/or ^{3}He in metal and silicate phases. The study will be completed by the analysis of Kr and Xe isotopes, with a special emphasis on ^{81}Kr, and with new model calculations of the cosmogenic production of Kr and Xe isotopes.

[1] Eugster, O. et al. (2006) MESS II, 829-851. [2] Leya, I. Masarik, J. (2008) MAPS. [3] Wieler, R (2002) RiMG 47, 125-170.

[PC2008 #010]

Morphologic, stratigraphic and morphometric investigations in eastern Libya Montes, Mars: Implications for long-term fluvial activity.

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The Noachian highland Libya Montes, located at the southern edge of Isidis Planitia, represents one of the oldest regions [1] that have been most heavily modified by fluvial processes. In this ancient region, long and broad "longitudinal valleys" are pervasive. They are indication for intensive, long-term and multiple fluvial processes [2-4]. In addition, widespread "dendritic valley networks", particularly their extended branching, are evidence for atmospheric precipitation [5].

We conclude that the "dendritic valley networks" (Ø age ~4.0 Ga) have formed earlier than the "longitudinal valley" systems (Ø age ~3.7). Due to the distinct morphology of the "dendritic valleys" (emergence at local summits), we propose that an initial valley formation in the Noachian Epoch was controlled by precipitation and surface runoff.

[1] Scott & Tanaka (1986) *U.S. Geol. Surv. Misc. Invest. Ser.*, Map I-1802-A. [2] Crumpler & Tanaka (2003) *JGR*, 108, ROV 21-1. [3] Jaumann et al. (2005) *GRL*, Vol. 32, 16203. [4] Jaumann et al. (2007) *LPICo*. 1353. [5] Mangold et al. (2004) *Science*, Vol. 305, 78-81.

[PC2008 #011]

Fractionation of refractory highly siderophile elements in the early solar system.

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Element abundances in bulk chondritic meteorites are commonly assumed to reflect fractionation processes in the solar nebula such as volatile element depletion and phase separation prior to formation of parent bodies. This paradigm has recently been challenged by the suggestion that olivine aggregates in chondrules may have been derived from differentiated planetesimal precursors. Systematic differences between ordinary and enstatite chondrites relative to carbonaceous chondrites occur for refractory siderophile element ratios, such as Re/Os, Os/Ir and Rh/Ir. Previously, the differences in Re/Os between different chondrite classes have been explained by preferential incorporation of Re over Os in condensing phases at high temperatures. Evaluation of planetary processes using available partitioning coefficients fail to explain the observed differences in refractory HSE abundances of chondrites. Refractory HSE fractionation in chondrites may be consistent with mixing of different isostructural alloys that would condense between 1930 and 1450 K from a gas of solar composition.

[PC2008 #012]

Mössbauer minor phase analysis of outcrop and float rocks at Meridiani Planum, Mars

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The two Mars Exploration Rovers Spirit and Opportunity have been exploring their landing sites on the Martian surface for more than four years. Backscatter Mössbauer spectra on over 300 rock and soil targets have been obtained with their miniaturized Mössbauer spectrometers (MIMOS II) [1, 2].

Along Opportunity's traverse, almost 70 spectra have been obtained on undisturbed, brushed and abraded surfaces of sulfate rich outcrop rocks. Spectra are available in 13 different temperature windows [1, 3]. This data set is used to identify potential minor mineralogical phases. Indications for minor phases (close to the detection limit) are also present in the spectra obtained on two float rocks: Bounce Rock (Sols 66-70) is chemically and mineralogically similar to SNC meteorites [4]. Heat Shield Rock (Sols 348-351) was classified as an iron meteorite [5].

References: [1] Klingelhöfer, G., et al. (2003) *JGR 108*, E12, 8067. [2] Morris, R.V., et al. (2006b), *JGR, 111*, E12S15. [3] Morris, R.V., et al. (2006b), *JGR, 111*, E12S15. [4] Zipfel, J., et al. (2008) *MAPS*, submitted. [5] Schröder, C., et al. (2008), *JGR, 113*, E06S22.

[PC2008 #013]

Cosmic spherules from Permian salt?

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Cosmic spherules recovered from Earth sediments are classified into Iron spherules (I-Type), high iron-glassy spherules (G-Type) and stony spherules (S-Type) [1]. In most sediments the relative proportion of I-Type spherules increases with age compared to G- and S-Type spherules. This is commonly attributed to a preferred weathering of the silicate phases in the pelagic to hemi-pelagic marine sediments. Surprisingly recent research indicates that in Triassic salt deposits also the G- and S- Type spherules can be recovered, thus offering the opportunity of tracing cosmic dust flux throughout geological time [2]. We will report on magnetic spherules recovered from Permian salt. Based on petrography and geochemistry we will discuss the likelihood of an extraterrestrial origin of these particles and the possibility of preservation of extraterrestrial material in salt deposits.

[1] Talor and Brownlee 1991 MAPS 26, 203-211; [2] Davidson et al. 2007 LPSC #1545

[PC2008 #014]

Preliminary study of natural remnant magnetization of suevite collected from Ries crater

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Characteristic of natural remanent magnetization (NRM) of suevite from Ries crater was studied magnetically to understand the cooling history after ejection. A block of suevite was collected from a quarry located in ~10 km south from Nordringen. As it consists of a glassy and matrix portions, samples were obtained distinguishing glassy and matrix portions. NRM of these samples was stable up to 60 mT against AF demagnetization. The NRMs were thermally demagnetized at 580 C, while their intensity of glassy portion took a hump between 420 and 580 C. Thermomagnetic curves showed only magnetite Curie point at 580 C for both samples. The NRM directions of both portions made a cluster with precision of K=240 and confidence a95=1.8 degree. The paleointensity was estimated by Thellier method as 22 uT that was consistent with the result reported by Pole (1977). From these results, the sample seems to acquire thermal remanent magnetization after landing of suevite. Namely, landing temperature of suevite at the sampling site was higher than 580 C.

[PC2008 #015]

Ni-isotopic and chemical composition of ureilite components

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Vein metal and silicates of 8 different ureilites with varying fayalite contents were analyzed. Composition, mass balance calculations and thermodynamic calculations indicate that ureilite olivine is not genetically linked to ureilite vein metal.

^{60}Fe decays to ^{60}Ni with a half-life of 1.49My. Anomalies in ^{60}Ni can be used to constrain processes in the early solar system. Silicate-rich, metal-rich and a bulk fraction from 4 ureilites were analyzed. Both the metal-rich and the bulk fraction of all ureilites give ^{60}Ni* close to 0ε. The silicate-rich fraction ranges from -0.77±0.31ε (Kenna) to -0.12±0.21ε (EET87517). The data show that ^{60}Fe was either absent of present at only very low abundances while the ureilite parent body formed. This suggests that ^{26}Al was the only heat source for the melting and differentiation of the ureilite parent body.

[PC2008 #016]

The APXS within the Rosetta Mission.

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In March 2004 the Rosetta Mission was launched. After a long cruise of 10 years (including three earth flybys and one mars flyby) in-situ observations of the comet 67P/Churyumov-Gerasimenko will be carried out from the Orbiter and Lander (Philae). The APXS (part of the Lander) consists of an alpha mode for alpha spectroscopy (Rutherford backscattering) and an x-ray mode for alpha-particle and x-ray induced x-ray spectroscopy. The APXS combines these methods in one single instrument while being low in mass (640 grams) and power consumption (1.5 W in operation mode) [1]. For the X-ray detection a SDD is used delivering an energy resolution of 180 eV at 6.4 keV at temperatures below -40°C. Philae can rotate and drill on the surface. The data on the chemical composition obtained with the APXS combined with the results from other instruments will shed light on state, evolution, and origin of the comet and the solar system.

[1] Klingelhöfer, G. et al. (2007) *Space Science Reviews* **128**:1-4, 383-396

[PC2008 #017]

Meteorite statistics in the Sultanate of Oman.

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760 man-days of meteorite search in the Sultanate of Oman (7 campaigns 2001-2008) produced a large fraction of meteorites from strewn fields. Classification of all stones using thin sections and/or magnetic susceptibility measurements, in combination with plotting find localities on maps, showed that the 5094 individual stones recovered belong to ~530 fall events. Whereas ~4% of observed falls are iron meteorites, so far only one single iron meteorite find is reported from Oman.

Although recovery rates of different field campaigns fluctuate due to different proportions of strewn field meteorites, the recovery rates of meteorites (excluding strewnfields) remained remarkably constant. Average recovery rates are 0.70 ± 0.18 meteorites per person-day and 40 ± 12 km drive per meteorite.

The age distribution of all recovered LL meteorites and of all 99 ^{14}C dated meteorites show a similar pattern with a peak at ~20 kyr, demonstrating that the distribution is not an artifact of sample selection. Meteorites <15 kyr seem to be underrepresented.

[1] Meteoritical Society database (2008) http://tin.er.usgs.gov/meteor/metbull.php.

[PC2008 #018]

Asymmetric structure of lunar impact craters due to oblique impacts?

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The majority of lunar impact craters are nearly circular in plan view, even though it is well known that most impacts occur at oblique angles of incidence to the target. Despite the distribution of ejecta, when preserved, structural asymmetries diagnostic of an oblique impact angle are not easily recognized. We used Lunar Orbiter and Clementine data to investigate deviations of the position of the central peak in complex craters from the geometric centre of the crater. To avoid target heterogeneities as a possible explanation for observed offsets we restricted our study area to lunar mare basins and chose craters in a size range between 20-80 km. We identified 20 craters where the ejecta distribution gives clear evidence of the impact direction; however in most cases the ejecta deposits are not well preserved and the direction of impact is difficult to identify. In contrast to previous studies by [1] for Venusian impact craters our preliminary results show a trend towards an offset of the central peak from the geometric centre in downrange direction.

[1]Ekholm, A.G., Melosh, H.J. (2001), GRL 28, 623-626

[PC2008 #019]

Microscopic Views of the Soil at the Phoenix Landing Site

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The Optical Microscope (OM) onboard Phoenix (PHX) has returned high-resolution images (4 µm/px) of Martian soil collected on magnetic and non-magnetic substrates. Different types of material can be distinguished: (a) Orange sub-micron dust that is similar to classic Martian air-fall dust. (b) Dark (almost black) particles: 50-80 µm across, subrounded, substantially magnetic. (c) Translucent particles: Similar to previous type except for the color that ranges from ruby to brown. (d) Whitish splotches: No more than 10 µm across. Appear in all types of samples. Types (b) and (c) may actually be the dark, magnetic particles observed during the Mars Exploration Rover (MER) mission, but may also contain glassy volcanic particles or tectites from the nearby Heimdall crater. Type (d) may be dominated by salts. Soil particles appear to be very sticky, especially late in the (90 sols long) Primary Mission. Soil at the PHX site may be more altered than at previous landing sites as a result of diurnal and seasonal water vapor transported across the top soil layer.

[PC2008 #020]

NanoSIMS Ion Imaging of SiC Stardust

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Automated ion imaging systems developed for Cameca IMS3f and IMS6f ion microprobes are very useful for the analysis of large numbers of presolar dust grains, in particular with respect to the identification of rare types of presolar grains. The application of these systems is restricted to the study of micrometer-sized grains, thereby by-passing the major fraction of presolar grains, which are submicrometer in size. The new generation Cameca NanoSIMS 50 ion microprobe combines high spatial resolution, high sensitivity, and simultaneous detection of up to 7 isotopes, which makes the NanoSIMS an unprecedented tool for the analysis of presolar materials [1]. Recently, we reported on the development of an ion imaging system for the NanoSIMS, which permits the fully automated isotope analysis of a large number of individual grains [2]. Here we report on the application of this analysis procedure to submicrometer-sized SiC stardust separated from the Murchison meteorite.

[1] Hoppe, P. (2006) Appl. Surf. Sci. 252, 7102. [2] Gröner, E. & Hoppe, P. (2006) Appl. Surf. Sci. 252, 7148.

[PC2008 #021]

Magnetotactic bacteria technique (MTB) and application on SNC meteorites

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Several Martian meteorites (SNC) are known to contain brown/black colored olivines. Recently, nano particles of Fe/Fe-Ni or magnetite were found suggesting to be the reason for the dark color [1,2]. Already in 1979 native Fe particles were detected as a magnetic phase in ALH 77005 by Funaki (Pers. Comm.). However, due to the low concentration and small size, it was not clear whether these nano phases can carry a stable magnetic remanence. For the first time, [3] applied the MTB technique to test the concentration and distribution of nano magnetic particles in Fe-bearing silicates in SNC meteorites. For this purpose, cocci type MTB of about 1 µm in size were cultivated in a natural medium of sludge/water after sampling in a lake in Tokyo. The bacteria living in the northern hemisphere should migrate to the S magnetic poles along the magnetic field lines. This feature can be used to detect the presence of likely stable magnetic recorders, even in a paramagnetic (olivine) matrix, by the S pole distribution observed in an optical microscope.

[1] Mars Meteorite Compendium, 2008. [2] Kurihara T. et al., and Hoffmann et al., LPSC 2008. [3] Hoffmann et al., METSOC 2008 and references herein.

[PC2008 #022]

Meteorite finds from Oman – sources of bias and a unique chance.

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Systematic search activities in the Sultanate of Oman yielded >2248 officially recognized meteorites since 1999 [1]. Many more paired stones are known from strewnfields. The mass of Omani finds is ≥6000 kg. Searches are conducted both by institutional and private teams. While our search efforts aim to document all finds, an analysis of the population of reported finds and comparison with the population documented by our team indicates an underrepresentation of ordinary chondrites (OC) and irons, while achondrites (e.g. Lunar meteorites) are over-represented. The Oman hot desert finds represent a unique situation in that a very large number of meteorites are well documented with precise find (=fall) locations, a situation unmatched in Antarctica (ice movement), NWA (mostly unclear locations) or Australia (significantly lower number). Documentation of all finds independent of their "commercial value" would provide a unique database.

[1] Meteoritical Society database (2008) http://tin.er.usgs.gov/meteor/metbull.php.

[PC2008 #023]

The Ibbenbüren diogenite - historical aspects and new results.

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The meteorite Ibbenbüren fell June 17, 1870 in north-west Westphalia. It is one of 183 approved meteorites classified as a diogenite [1]. Shortly after the fall two pieces totaling 2.034 kg were recovered [2].

Our new studies on the Ibbenbüren diogenite show that the rock is a monomict breccia. Large, lithic clasts are embedded within a fine-grained classic matrix. Orthopyroxene (mean: $Fs_{24.9}Wo_{2.2}$) is the dominating mineral constituent. As minor phases Ca-pyroxene ($Fs_{7.7}Wo_{47.1}$), plagioclase ($An_{94.8}Or_{0.1}$), an SiO_2-Phase, chromite, troilite, kamacite (~3.8 wt% Ni; ~5.8 wt% Co)), and taenite (~29 wt% Ni) are present and have been analyzed [3]. The mineralogical data and the historical aspects will be presented and discussed at the colloquium.

References: [1] http://tin.er.usgs.gov/meteor/metbull.php. [2] von Rath G. (1872) Monatsberichte, Berl. Akad. 463-475. [3] Horstmann M. (2008) Bachelor-Thesis, Institut für Planetologie, Universität Münster, 1-79

[PC2008 #024]

First Results of the New Noble Gas Time-of-Flight Mass Spectrometer (EGT)

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The EGT is a newly developed Time-of-Flight spectrometer able to measure He, Ne, Ar, Kr, and Xe isotopes with high precision and high sensitivity. Recent advances in noble gas sector field instruments comprise the development of a compressor ion source for the light noble gases [1] and the set-up of multidetector systems for the heavy noble gases. However, while compressor sources are technically very challenging, multi-detector systems usually suffer from alteration of the various channeltrons, which compromise precise measurements of isotope ratios and require regular calibrations. In contrast, ToF systems enable to measure total mass spectra with a high transmission (there are essentially no slits) and, depending on the length of the flight way, also a high mass resolution. In addition, in ToF systems also background gases, which are not object of the analysis but which might compromise the noble gas study, are measured routinely.

The ion source of the EGT is an iron trap with a variable pulse frequency and the detector is a self-made multi-channel plate (MCP). Considering the performance of the EGT a very impressive fact is its huge dynamic range of more than 106 and the relatively high mass resolution of ~700 (at Kr). Here we will present some of the major advantages of the EGT.

[1] H. Baur, EOS Transactions, AGU Volume 80(46).

[PC2008 #025]

3D modeling of ground-truth data - the formation of the Vredefort Central Uplift, South Africa.

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The formation of large complex impact craters and the evolution of their central uplifts are still poorly understood. Based on own ground-truth data as well as from literature [1] and numerical models [2] we constructed a 3D structural model for the overturned upper parts of the Vredefort Central Uplift. From the orientation and truncation relationships of sedimentary rocks and major dislocations a succession of movements through the modification phase was deduced. Concentric faults with respect to the crater center mark the collapse of the transient cavity. They are cut by radial faults which formed as reverse and thrust faults in a stage of constrictive rock movements during the growth of the central peak. After the central uplift reached its maximum height the structure collapsed and material moved outward. Thus, the rocks rotated to their present overturned orientation.

[1] Bisschoff, A.A. & Mayer, J.J. (1990), Council for Geoscience, Pretoria, Geol. Map 1:50.000. [2] Ivanov, B. (2005) Solar System Research, 39, 381-405.

[PC2008 #026]

The new dimict ureilite JAH0703-24 – Evidence of assembly by impact under durable high temperatures

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An extremely unusual ureilite provides new clues on the behavior of the ureilite parent body during impact. The ureilite JAH0703-24 (Sultanate of Oman), is a finely recrystallized dimict ureilite (grain size < 10 µm), in which dunitic clasts and matrix are distinguished. The groundmass is composed of olivine (Fa_{10-17}), orthopyroxene, rare augite, abundant graphite and diamond and numerous vesicles. The dunitic clasts are zoned concentrically from core to rim. The core corresponds to nearly pure homogeneous olivine (Fa_{19-21}). Along a rim of 200-300 µm, olivine composition evolves progressively toward the matrix composition (Fa_{13-16}). Within this rim, olivine grains are bordered by interstitial material interpreted as melt relics. Strong reduction around the vesicle contours argues for a Fe reduction concomitantly

with CO liberation in a melt. Ureilite JAH0703-24 appears as the result of a melt infiltration in a dunitic lithology, provoked by a major impact under durable high temperatures.

[PC2008 #027]

Identifications for aqueous minerals detected by the MER Mössbauer spectrometers

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The two Mars Exploration Rovers Spirit and Opportunity have been exploring their landing sites for more than four years. Backscatter Mössbauer spectra on over 300 rock and soil targets have been obtained with their miniaturized Mössbauer spectrometers (MIMOS II) [1]. The identification of aqueous minerals is strong evidence for past water activity at both landing sites. At Spirit's landing site in Gusev crater, the iron oxide hematite and the iron oxyhydroxide goethite were identified in rocks, which shows that water played a major role in the formation and alteration of rocks and soils in the Columbia Hills [2]. Along Opportunity's 11 km traverse in Meridiani Planum, the ferric sulfate hydroxide mineral jarosite was identified in outcrop rocks. Millimeter-sized spherules were identified as the source of hematite detected from orbit [3].

References: [1] Klingelhöfer, G., et al. (2003) *JGR 108*, E12, 8067. [2] Morris, R.V., et al. (2006a), *JGR, 111*, E02S13. [3] Morris, R.V., et al. (2006b), *JGR, 111*, E12S15.

[PC2008 #028]

Closed system formation of chondrules

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Chondrules are igneous spherules that formed by a short but intensive melting event at near-liquidus temperatures (~1400-1900°C), followed by a fast cooling. In most cases, olivine (ol) is the first phase to crystallize. Chondrule of unequilibrated chondrites may contain significant amounts of Na and K. Evaporation experiments [1-3], however, show that alkalis should have evaporated within minutes, i.e. chondrules should be Na- and K-free. In order to address the problem of alkalis in chondrules, we have analyzed Na in chondrule olivine and mesostasis. The data are compared with experimentally determined ol/melt Na partitioning data.
Chondrule ol contains between 0 and 270 ppm Na_2O. The fact that chondrule ol contains Na suggests that Na was present during ol crystallization. The experimentally determined D_{Na} is ~0.003 [4]. The observed Na contents and Na distribution within ol phenocrysts can only be understood in terms of a *closed system behavior* of chondrules. This means that Na did not evaporate during melting [5-8]. The conclusion is in agreement to the observed lack of K isotope fractionation in chondrules [9, 10]. It has been suggested [8] that chondrule formation must have occurred in regions with very high dust/chondrule density.

[1] R. H. Hewins, GCA, 1991. 55(4): p. 935-942. [2] A. Tsuchiyama, et al., GCA, 1981. 45(8): p. 1357-1367. [3] R. Hewins, et al. (2005), in Chondrites and the Protoplanetary Disk, p. 286-316. [4] A. Borisov, et al. (2008) GCA (in press) doi:10.1016/j.gca.2008.08.009. [5] A. Kropf and A. Pack. 39th LPSC. 2008. Houston, [6] A. Kropf and A. Pack, GCA, 2007. 71(15): p. A526-A526. [7] C. M. O. D. Alexander, et al. (2007) MAPS. 42: p. A12-A12. [8] C. M. O. Alexander, et al., Science, 2008. 320(5883): p. 1617-1619. [9] M. Humayun and R. N. Clayton, GCA 1995. 59(10): p. 2131-2148. [10] Y. Yu, et al., GCA, 2003. 67(4): p. 773-786.

[PC2008 #029]

Investigation of the erosional level of terrestrial impact craters: Comparison of numerical modeling and field data.

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The observed morphology and morphometry of terrestrial meteorite impact craters significantly depend on the amount of erosion crater structures were exposed to. Since the erosional level is often unknown it is difficult to determine the original crater diameter. Assuming that the relative size ratio between certain morphological features, such as rim-to-rim diameter or the diameter of the surrounding syncline are characteristic for a specific erosional level it may be possible to reconstruct the original crater morphology. We used numerical simulation (iSALE hydrocode [1]) of crater formation to quantify the size-ratio of typical structural features at different levels of depth. To calibrate our models we first tried to reproduce two relatively well preserved impact structures on Earth. Then we carried out a series of models with different final crater diameters and compared our results with terrestrial impact structures to determine the level of erosion. We present preliminary results of this new method to determine the amount of erosion at impact craters.
[1] Wünnemann et al, 2006, Icarus 180, 514-527.

[PC2008 #030]

NanoSIMS Investigation of Presolar Grains in the CR Chondrite NWA 852.

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Primitive meteorites contain varying amounts of presolar dust grains that formed in the winds of evolved stars or in the ejecta of stellar explosions [1]. Presolar silicates and oxides are among the most abundant types of these grains [2–5]. First studies of CR chondrites indicated only low presolar dust abundances. Recently, much higher abundances in individual meteorites of this group were found [6,7]. About 10600 μm^2 of fine-grained matrix of the CR2 chondrite NWA 852 were investigated with the NanoSIMS 50. $^{16}O^-$, $^{17}O^-$, $^{18}O^-$, $^{28}Si^-$, and $^{27}Al^{16}O^-$ ion images were acquired in multi-collection mode. 15 presolar silicate and 5 oxide grains were identified so far by their O-isotopic composition, representing an abundance of 147 ppm for silicates and 70 ppm for oxides, respectively.

[1] Hoppe, P. and Zinner, E. (2000) JGR 105, 10371–10385. [2] Nguyen, A. & Zinner, E. (2004) Science 303, 1496–1499. [3] Mostefaoui, S. & Hoppe, P. (2004) ApJ 613, L149–L152. [4] Nguyen, A. et al. (2007) ApJ 656, 1223–1240. [5] Vollmer, C. et al. (2008) ApJ 684, 611–617. [6] Floss, C. & Stadermann, F. J. (2007) MAPS 42, A48. [7] Floss, C. & Stadermann, F. J. (2008) LPSC 39, abstr. #1280.

[PC2009 #031]

Ge isotopes in iron meteorites with implication for core formation.

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Iron meteorites have been studied for their Ge isotopic compositions in order to investigate processes of metal-silicate fractionation and core formation. We show that δ^{74}Ge of magmatic irons are constant (δ^{74}Ge = +1.77±0.22‰ 2σ), but heavier than non-magmatic irons (IAB=1.15±0.2‰; IIE=-0.27 to +1.40‰) [1], and terrestrial reference samples including BIR geostandard (+0.96±0.04‰) and ore sample. The lack of correlation between Ni content as a tracer of redox conditions would indicate (1) no apparent isotopic fractionation under fO_2 conditions of core formation or (2) isotopic equilibration during core formation after metal-silicate isotopic fractionation [2]. In these two models, ^{74}Ge of magmatic irons would represent the Ge isotopic composition of the parent body. The isotopic composition of silicate sample could be explained with the 2nd model.

δ^{74}Ge-Ge contents negative correlation for IIE non-magmatic irons can be consistant with evaporation processes during their complex formation by impact break up.

[1] Luais (2007) EPSL 262, 21-36; [2] Roskosz et al. (2006) EPSL 248, 851-867.

[PC2008 #032]

Destruction of SiC in protoplanetary disks.

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A large amount of presolar silicon carbide (SiC) and graphite grains was found in many primitive meteorites (Murchison, Orgueil) and some chondrites. The high isotopic anomalies of Si and C found in these grains cannot be explained by processes in the interstellar medium (ISM) but show them to be stardust. The main goal of this work is a simulation of destruction of SiC grains and a study of survival mechanisms of these grains in a protoplanetary disk. A second point of interest is a comparison with destruction processes of carbon to explain observed relative abundances of these two components in meteorites.

[PC2008 #033]

Sodium solubility in silicates melts: application to chondrule formation

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The fact that alkali contents in chondrule mesostases vary by almost three orders of magnitude is still poorly understood [1,2]. Variable degrees of evaporation, direct condensation from gaseous nebular environments [3] or low temperature alteration in the parent body are some of the possible explanations. Recent study [4] on Na partitioning between olivine and chondrule mesostases, show that a closed system [5] and very high PNa(gas) are required for chondrule formation. In order to shed light on these challenging questions, we have developed a new experimental method able to simulate the condensation of Na(gas) into chondrule melts under nebular conditions. Its consists in equilibrating in a closed system at high temperature molten silicates with alkali vapour established by a Na_2O-xSiO_2 binary melt [6]. The sodium evaporates from the source according to:

$NaO1/2(source) \rightarrow Na(g) + 1/4\ O2$ (1)

bathing the samples in alkali vapor, which dissolves in the molten silicate samples in agreement with:

$Na(g) + 1/4\ O2 \rightarrow NaO1/2(sample)$ (2)

For this talk, we will show that this design is pertinent to address some key questions concerning chondrule formation, such as: i) effect of sodium on chondrule phase relationships, ii) Na partitioning between olivine and chondrule mesostases, iii) Na nebula partial pressure PNa(gas) during chondrule formation.

References: [1] Hewins et al., (2005) ASPCS 341, 286–317. [2] Grossmann and Alexander, (2008) LPSC, 2084. [3] Georges et al, (2000) Meteorit. Planet. Sci. 35, 1183. [4] Alexander et al, (2008), Science, 320, 5883. [5] Borisov et al., GCA, in press. [6] Mathieu et al., JNCS, in press.

[PC2008 #034]

A regolith pre-exposure signature in sediment-dispersed extraterrestrial chromite grains from an Ordovician asteroid collision?

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We have analyzed 32 individual sediment-dispersed extraterrestrial chromite (SEC) grains (63 – 150 µm) from an Ordovician limestone in southern Sweden. Several fossil meteorites have been found in the same limestone and have been attributed to the L chondrite parent body breakup event ~470 Ma ago [1]. At least 30 of the SEC grains contain surface-implanted helium and neon of fractionated solar wind composition, implying that these grains were probably transported to Earth as individual micrometeorites. Cosmogenic ^{21}Ne was found in several grains and cosmic ray exposure (CRE) ages of up to ~50 Myrs were calculated. These ages exceed both dynamical lifetimes for micrometeorites of this size as well as CRE ages for fossil meteorites found in the same sediment bed [3],[4]. We discuss different models and argue that some of the SEC grains have been pre-exposed to cosmic radiation in the regolith layer of the pre-breakup L chondrite parent body asteroid.

References: [1] Schmitz et al. (2001), EPSL 194, 1-15, [2] Heck et al. (2004), Nature 430, 323-325, [3] Heck et al. (2008), MAPS 43, 517-528

[PC2008 #035]

Ries crater, Germany: The new Enkingen drill core SUBO18

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A new drill core through crater fill of the Ries crater has been obtained near Enkingen in the SE of the crater in 2006. The 100 m long core was retrieved at the south east of the inner ring where a local magnetic anomaly had been indicated before [1,2].

The core stratigraphy involves: 0 to 4.5 m - fluviatile Quaternary deposits, clay and gravel; 4.5 to 21 m - Neogene clays of the Ries crater lake; from 21 to 100 m suevite and local concentration of impact melt. For the first time in a drill core of the Ries crater a considerable volume of impact melt could be intersected, over a width of 13 m.

Our preliminary investigations showed that the transition from suevite to strong accumulation of impact melt is gradational from melt poor to melt agglomerates with limited groundmass. The component grain sizes increase with depth with concomitant decrease of sorting. The melt particles show a strong sub- horizontal orientation with respect to the core axis, along the entire samples section.

[1] Engelhard L. (1971) Z. für Geophysik 37, 667-678. [2] Pohl et al. (2008), LMI (2008), Abstract # 3030

[PC2008 #036]

Small-scale pseudotachylitic breccias and microfracture networks from the central uplift of the Vredefort Impact Structure in South Africa.

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Pseudotachylitic breccias represent the most prominent impact-induced deformation structures in the central uplift of the Vredefort Impact Structure [1, 2]. The exact mechanisms by which such melt breccias in impact structures form, by either impact melting, friction melting, decompression melting, or a combination of these processes, remains to be elucidated [3]. Although field studies have previously been conducted, they have not been adequately related to microscopic studies. This study uses a new approach by analysis of a polished 3 x 1.5 m granite slab from a dimension stone quarry in the core of the Vredefort Dome. Detailed microstructural investigations of pseudotachylitic breccias and two systems of microfractures, supplemented by field data, have resulted in improved understanding of emplacement of melt into Archean gneiss of the Vredefort dome.

[1] Dressler, B. O. & Reimold W. U. (2004) Earth-Science Reviews 67, 1-60. [2] Reimold W. U. & Gibson R. L. (2006) GSA SP 405, 407pp. [3] Reimold, W.U. & Gibson, R. (2005) GSA SP 384, 329-349.

[PC2008 #037]

CR2 CHONDRITES AS ANALOGUES FOR LONG TERM CORROSION PROCESSES .

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Nuclear waste has to be stored safely for a time frame of at least 10^5-10^6 years – something difficult to simulate in a laboratory environment. In France, radionuclides are stored in a boro-silica glass, which is contained in steel containers, which could be stored in a clay-rich geological repository [1]. CR chondrites provide a good analogue material:

- mesostasis/ FeNi metal *as analogue for* the contact between the nuclear glass and the container,
- FeNi metal/matrix, for steel containment in clay environment

CR chondrites show alteration over the whole range from type 3 to 1, thus allowing the investigation of all steps in alteration of the materials [2, 3].

We will present first results of EMPA studies of CR 2 and 1 chondrites, with a focus on the corrosion of big FeNi grains in the matrix.

[1] ANDRA (2005) Référentiel de comportement des colis de déchets à haute activité et à vie longue. Dossier ANDRA, Paris [2] Abreu 2007, PhD thesis [3] Weisberg M.K. and Huber H. 2007 *Meteoritics & Planetary Science* 42.

[PC2008 #038]

Matrices of carbonaceous chondrites: Characterization by synchrotron IR microspectroscopy.

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Here we demonstrate the diagnostic potential of reflectance IR microspectroscopy for non-destructive characterization of matrices of carbonaceous chondrites (CCs) *in situ* using conventional polished sections. Polished sections of Orgueil (CI1), Kainsaz (CO3), Efremovka (CV3), Mighei (CM2), Cold Bokkeveld (CM2), Murray (CM2), Isheyevo (CH-CB_b), metamorphosed carbonaceous chondrites (MCCs) Dhofar 225, Dhofar 735, and NWA 4757 were used in this study. The IR spectra between 1.5 and 14 μm were acquired at the IRIS infrared beamline at the electron storage ring facility BESSY. We show that IR reflectance microspectroscopy is a useful tool for characterization of CC matrix constituents in terms of their hydration states. It allows one to distinguish between various types of CC matrix materials, including hydrated, anhydrous and thermally metamorphosed. In particular, in Isheyevo (CH-CB_b) we detected three different types of hydrated matrix lumps, none of which could be identified with a known CC group.

[PC2008 #039]

High field strength element constraints on formation of the lunar magma ocean.

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The compositional diversity of lunar rocks is commonly explained by melting of fossil cumulate layers formed during LMO crystallisation. HFSE ratios in lunar rocks, determined by high-precision measurements ([1] and new data) employing isotope dilution, confirm this model. Highland rocks display Nb/Ta and Zr/Hf above the bulk lunar value (ca. 17), whereas mare basalts display lower ratios. Notably, high-Ti mare basalts display lower Nb/Ta and Zr/Hf than low-Ti basalts and elevated Ta/W, which cannot be explained by melting of ilmenite- and clinopyroxene-rich cumulates. Combined modelling of HFSE abundances rather suggest a model where high-Ti basalts are hybrid melts formed by the interaction of low-Ti melts with ilm- and cpx-rich cumulate layers. During the assimilation process, parent-daughter ratios of extinct nuclide systems are decoupled from their ambient isotope compositions. Hence, the W and Nd compositions of mare basalts can be reconciled with an "old" (50 Myr) age for LMO crystallisation. Likewise, the large range of time integrated Lu/Hf in mare basalt sources can be explained by the model.

[1] Münker, C. et al. (2003) Science 301, 84–87.

[PC2008 #040]

Shock effects on magnetic properties of impactites from Lonar impact crater, India and laboratory experiment.

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Shock effects on magnetic properties were investigated through studies of experimentally impacted andesite and basalt from Lonar crater in India. An initial peak pressure of 5 GPa was generated. Natural remanent magnetization (NRM) was partially demagnetized at peak pressures higher than 1 GPa. In high-pressure range (>3 GPa), the minimum susceptibility was oriented toward the shock direction. The initial orientations of AMS (anisotropy of magnetic susceptibility) were, however, significantly changed at around 0.4-1 GPa; the maximum susceptibility was induced parallel to the shock direction. The samples from the lower crater wall of Lonar crater showed predominantly oblate shape of AMS ellipsoid. Substantial, but not strict, parallelism between the maximum principal axes and the radial direction from the crater center was observed. This fact and the result of the shock experiment indicate that radially expanding stress waves reoriented the initial AMS. Shock demagnetization might be occurred in Ries Crater, that may be identified by precise magnetic survey. We are providing of a small UAV for aeromagnetic survey on Ries crater.

[PC2008 #041]

MICRO-INFRARED SPECTROSCOPY OF INSOLUBLE ORGANIC MATTER EXTRACTED FROM PRIMITIVE CHONDRITES

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Most of the organic matter in primitive chondrites consists in Insoluble Organic Matter (IOM). Its polyaromatic structure and isotopic compositions are consistent with a presolar origin [1]. Similar polyaromatic compounds have been reported in IDPs [2], STARDUST grains and Micrometeorites. The search of such compounds in both Interstellar Medium and comets requires to determine the optical properties of IOMs and to find a link between their spectroscopic variations and their geological history.

To date, it has been established that large isotopic, compositional and structural [3] variations of IOMs depend on post-accretion processes, and possibly heterogeneity in the accreted precursors.
We measured mid-infrared spectra (4000-650 cm^{-1}) at E.S.R.F. on ID21 beamline. IOMs were extracted with a HCl/HF attack by continuous filtration. The IOM was then flattened on a BaF_2 window. Absorption spectra were acquired in transmission through a confocal microscope.
IOMs from unmetamorphosed carbonaceous chondrites have typical spectra of kerogen-like compounds [4]. We will present a classification of IOMs extracted from 3 CI, 6 CM mostly based on aromatic, oxygenated and hydrogenated functions bands.

References: [1] Robert F. et al 1982. *GCA* 42:81-95 [2] Quirico E. et al. 2005. *PSS* 43:1443-1448 [3] Bonal L. et al. 2006. *GCA* 70:1849-1863 [4] Gardinier A. et al. 2000. *EPSL* 184: 9-21

[PC2008 #042]

Preliminary results: zirconium and hafnium in meteorites.

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Zr and Hf are incompatible, lithophile, and refractory trace elements. With respect to meteorites, they may help decipher condensation conditions and sequences during the early stages of solar system formation.
We analyzed 34 bulk samples via laser ablation ICP-MS. Our objective was the identification of possible systematic fine-scale variations among different meteorite classes.
Recent work defined a chondritic Zr/Hf ratio of 34.2 ± 0.3 as based on 2 carbonaceous chondrites and 5 monomict eucrites [1]. Another investigation examining 34 different meteoritic samples returned a similar result (34.3 ± 0.1 [2]).
We normalized our Zr/Hf data to the chondrite-only ratio (Orgueil, CI1) of [1] (34.1 ± 0.6). We then obtained relative values in percent deviation from this reference point (gamma values). Deviations appear to be systematic and include a negative trend, i.e. lower Zr/Hf for EL6 chondrites and a positive trend, i.e. elevated Zr/Hf for H chondrites. All carbonaceous chondrites yield Zr/Hf ratios equal to Orgueil.

References: [1] Weyer, S. et al. (2002) Chem. Geol. 187, 295-313. [2] Shima, M. (1979) GCA 43, 353-362.

[PC2008 #043]

Matt Wilson, Australia: Structural insights on elliptical crater formation.

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The vast majority of impact craters are circular. Only if the impact angle is lower than 10-15° from the horizontal, elongated impact craters form. The crater forming process that produces elliptical shapes is still poorly understood. Here we document the structural inventory of Matt Wilson crater in Northern Territory, Australia, the first elliptical crater on Earth that contains a central uplift and provides insights to the mechanisms of crater formation at a critical angle of ~10-15°. The inner central uplift consists of imbricate thrust faults of deeper lying, uplifted strata that show a preferred direction of movement of top to the SW, which coincides with the orientation of the long axis of the ring ellipse. We interpret the preferred stacking of thrust sheets both in the central uplift as an uprange to downrange transport of rock. This motion is most likely caused by remnant momentum transferred from the impacting projectile coming from the NE to the target and interferes with the characteristic inward material flow during crater collapse and central uplift formation.

[PC2008 #044]

A systematic experimental study of the volatility of elements.

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Volatile elements consist of the two types: 1. moderately volatile elements (e.g. P, Au, Mn, Li, Na, K, Rb, Sr, Ga, B, Se, S) exhibiting 50% condensation temperature between Cr and the sulfide formation of 670K; and 2. highly volatile elements with 50% condensation temperatures below the sulfide formation (e.g.: Pb, Tl, Bi, Cd, In, Hg). To date extensive efforts have gone into the experimental investigation of the partitioning of siderophile and lithophile elements between various planetary phases. However, relatively little effort has been spent on the systematic experimental investigation of the volatility of elements from phases relevant to planetary formation. Volatility of an element plays a major role in its condensation behavior and subsequently for the formation of matter ultimately condensing or agglomerating to planetesimals and planets.
This study applies a well-characterized method known from element partitioning studies: the so-called mechanically assisted equilibration method. This method has been adapted to serve the investigation of volatility. Preliminary experiments with alka-

line elements (Li, Na, K, and Rb), performed in anorthite-diopside 1 bar eutectic melts (AnDi) have demonstrated its applicability and efficiency in determining the volatility-related loss from a molten phase as a function of fO_2 and temperature.
In a follow-up study, a crucible filled with a synthetic, CI chondritic element composition, doped with various volatile elements will be kept under constant fO_2 and temperature while being continuously stirred. Time series sampling will be performed. The samples generated are being analyzed by Electron Microprobe (EMP) and Laser-Ablation Inductively-Coupled Plasma Mass Spectrometry (LA-ICPMS) depending on absolute elemental concentration. Both single element and multi-element studies can be performed. The first series of experiments in AnDi illustrate relative volatilities of individual elements, and will be duplicated in the CI chondritic composition. Another set of experiments including a wide range of volatile elements will duplicate more closely natural complex elemental fractionation due to volatility differences.

[PC2008 #045]

What do we learn from isotopes about nucleosynthesis, chronology, and processes in the early solar system?

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Nucleosynthetic anomalies provide information on the stellar environment and the astrophysical context of the birth of the solar system, and the spatial and temporal distribution of nuclides injected into the solar nebula or into the protoplanetary disk constrains its dynamics. According to new isotope data, a perfect homogeneization is not achieved for all elements in the early disk, which makes the use of some short-lived radio-chronometers quite challenging. Several isotope systems can nonetheless be used as reliable chronometers and provide strong constraints on the nebular and planetary processes within the first 50 Ma of the solar system history. Focusing on differentiated meteorites, there is evidence of metal segregation at the planetary scale less than 2 Ma after CAIs, while basaltic meteorites like eucrites and angrites formed slightly later. Primitive achondrites are of special interest and recent results obtained on these meteorites will also be discussed. Last but not least, cooling of iron meteorites as well as scenarii for the formation of chondrules can be inferred from mass-dependent isotope fractionation.

[PC2008 #046]

The Ramsdorf ordinary chondrite - historical aspects and new results.

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The meteorite Ramsdorf fell July 26, 1958 in Westphalia. It has been classified as a L6 ordinary chondrite [1]. Shortly after the fall 4.682 kg were recovered [1].
Our new studies on several thin sections revealed that Ramsdorf clearly is an impact melt breccia. The impact melt encloses relatively large fragments of L5 lithology (olivines having ~Fa_{24}) probably representing the parental material for the melt. Also embedded in the impact melt are smaller-sized, highly recrystallized, olivine-rich fragments having a different chemical composition of olivine (~Fa_{22}) compared with olivines in all other constituents of the rock. It is likely that these recrystallized olivine-rich fragments are relicts of the projectile incorporated within the impact melt. After formation of the Ramsdorf impact melt breccia the rock was shocked again resulting in the formation of shock veins.
Based on these results Ramsdorf should be reclassified as an L-chondrite impact melt breccia [2].

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[PC2008 #047]

Isotopic signatures of volatile element fractionation in the early solar system

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Inner solar system bodies are depleted in volatile constituents relative to CI chondrites but the origin of this signature is only poorly understood. The short-lived ^{107}Pd-^{107}Ag and ^{205}Pb-^{205}Tl decay systems are suitable for studying the time scales of volatile loss in the early solar system. Such studies must be carried out with care, however, as Ag and Tl exhibit isotopic variations from radiogenic ingrowth *and* the stable isotope fractionations that can accompany redistribution processes such as evaporation, condensation, and diffusion. Silver and Tl have only two isotopes, and such superimposed effects are thus only discernable by stable isotope analyses of an additional volatile "monitor" element. Investigations of stable isotope variations for volatile elements, such as Cd and Zn, are interesting in their own right, however, because they provide insights into the processes that governed volatile element fractionations in the solar nebula and on meteorite parent bodies.

[PC2008 #048]

Testing experimentally the interpretation of the IOM deuterium enrichment

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The benzylic, aliphatic and aromatic hydrogen of the Insoluble Organic Matter isolated from Carbonaceous Meteorites (IOM-CC's) has δD values of +1250‰, +550‰ and +150‰, respectively. Accordingly, D/H ratios are correlated with the C–H bond energy. Such a correlation suggests that the different bonds of the IOM have acquired their D/H ratios after their formation, by an exchange with a deuterium-rich reservoir (H_2D^+ ?). To test this interpretation, Ethylnaphthalene (containing 10 aromatic C-H bonds, 1 benzylic and 1 aliphatic), adsorbed on a chromatographic silica thin layer, has been subjected to D_3^+ produced via a high frequency discharge apparatus. After the reaction, the D/H ratio of individual bonds has been determined by GC-Mass. The IOM-CC's correlation was reproduced. Isotopic exchange rate constants were calculated and rates were applied to circum-solar disk conditions.

[1] Remusat, L. et al. (2006) EPSL 243, 15-25. [2] Gourier, D. et al. (2008) GCA 72, 1914-1923. [3] Remusat, L. et al. (2007) CRAS 339 (2007) 895–906.

[PC2008 #049]

Zirconium-bearing phases in meteorites.

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Zirconium-bearing minerals such as zircon ($ZrSiO_4$), baddeleyite (ZrO_2), and zirconolite ($CaZrTi_2O_7$) are accessory phases in both differentiated and undifferentiated meteorites. To find possible systematics behind their distribution and to describe typical mineral parageneses in different meteorite classes, electron microscopy studies were performed. So far, Zr-bearing phases (zircon and baddeleyite) were mostly found in differentiated meteorites, mainly within basaltic eucrites (e.g., Millbillillie, Dar al Gani 391). Most grains are smaller than 5 μm in diameter, but some are as large as 20 μm. The latter were used for *in-situ* Hf-W dating using the Cameca IMS 1270 (NordSIM) in cooperation with M. Whitehouse (Stockholm) and G. Srinivasan (Toronto). The aim of this study is to obtain new information about differentiation processes of planetary bodies in the early Solar System [1]. In addition, zircons and baddeleyites grains have been separated from a relatively coarse-grained, basaltic eucrite to be used for U-Pb dating and measuremenrts of initial Hf isotope composition applying ion-exchange chemistry , MC-TIMS and MC-ICP-MS techniques. More details will be presented at the colloquium.

[1] Srinivasan et al. (2007) Science, 317, 345-347.

[PC2008 #050]

Chemical and isotopic compositions of Ca,Al-rich inclusions from Rumuruti (R) chondrites.

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Detailed mineralogical and chemical studies on more than 100 Ca,Al-rich inclusions (CAIs) in R-chondrites show that these CAIs are distinct [1-3]. On a three–isotope oxygen diagram, compositions of individual minerals in most analyzed CAIs fall along a line with a slope of ~1. Based on the variations in $\Delta^{17}O$ values of distinct constituents within the same inclusion, the R chondrite CAIs are divided into: (i) uniformly ^{16}O-rich ($\Delta^{17}O$ ~–23‰ to –26‰), (ii) uniformly ^{16}O-poor ($\Delta^{17}O$ ~–2‰), and (iii) isotopically heterogeneous ($\Delta^{17}O$ range: –25‰ to +5‰). One of the hibonite-rich CAIs, H030/L, has an intermediate $\Delta^{17}O$ value of –12‰ and a highly-fractionated composition ($\delta^{17}O$ ~+12‰, $\delta^{18}O$ ~+47‰). Hibonites of this CAI show resolvable excess of ^{26}Mg ($^{26}Mg^*$) corresponding to an initial $^{26}Al/^{27}Al$ ratio of 8×10^{-7}, but hibonites and plagioclase of three other CAIs show no $^{26}Mg^*$.

[1] Rout, S. S. and Bischoff, A. (2008) LPSC XXXIX abst. #1255. [2] Rout, S. S. and Bischoff, A. (2008). MAPS, *in press*. [3] Rout, S. S. et al. (2008), GCA, *to be submitted*.

[PC2008 #051]

Laboratory simulations of space weathering and impact heating of planetary surfaces: the TEM studies.

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Space weathering processes darken and redden surfaces of airless planetary bodies. Using synthetic analogue samples we plan to simulate the effects of micrometeorite impacts and solar wind interaction on surfaces of Mercury and other airless solar system bodies in laboratory and analyze their effects on the VNIR and TIR spectra, followed by nano-scale analyses of the samples. As a test for our proposed analytical techniques we characterized three types of glasses prepared by heating the martian soil analogue JSC Mars-1 in a resistance furnace (F & S-glasses) and by pulse laser irradiation (L-glasses) [1, 2]. All three glasses show different spectral properties depending on the method of preparation. Here we present the results of our TEM studies, which allowed us to explain the observed optical differences between the samples. In particular, we detected α-Fe nano-inclusions in the L-glasses.

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[PC2008 #052]

Numerical simulation of shock propagation in heterogeneous rocks.

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Shock propagation in heterogeneous rocks results in dissimilar distribution of shock metamorphic effects on micro- to mesoscopic scales [1]. Refraction and reflection of the shock wave at pore spaces or material interfaces may lead to very localized shock pressure amplification or attenuation. By using mesoscale hydrocode modeling [2,3,4] we quantify the generation of shock features in complex material compositions. Up to now we simulated the collapse of pore spaces by means of simplified pore geometries and distributions. We examine the pressure ranges surrounding the pore and observe different collapse processes, "shrinking" and "jetting" [1], depending on the amplitude of the shock wave. Our results may aid mineralogical shock pressure evaluation (shock barometry [5]) of impactites.

[1] Kieffer, S. W. et al. (1976) Contrib. Mineral. Pertol.59, 41–93. [2] Ivanov, B. A., (2005), 36th LPSC, .#1232, [3] Riedel (2000), Thesis, University of the German Armed Forces, Munich, [4] Schade S. and Wünnemann K. (2007) 38th LPSC, #1338, [5] Stöffler D. and Langenhorst F. (1994) Meteoritics 29, 155-181.

[PC2008 #053]

Lu-Hf systematics of meteorites: complexities

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As a chronometer and geochemical tracer, the ^{176}Lu-^{176}Hf system should be able to place firm constraints on early silicate differentiation events on planetary bodies. However, meteorites often yield Lu-Hf ages that are 4-6% too old when using the ^{176}Lu decay constant (λ^{176}Lu) of 1.867×10^{-11}yr^{-1} [1-3], which was determined from terrestrial minerals and rocks. This discrepancy must be understood before meaningful interpretations of meteorite Lu-Hf data can be made. The λ^{176}Lu value has indeed been constant since ~3 Ga [1-3] and it has not been significantly affected by branched decay to ^{176}Yb [1]. Assuming that meteorites cannot be older than ~4.57 Ga, there must be another reason why meteorite "isochrons" are too steep, such as photoexcitation of ^{176}Lu by gammas [4]. However, this does not explain why the initial ^{176}Hf/^{177}Hf of eucrite and chondrite isochrons are consistently a few epsilon units lower than the average age-corrected composition of chondrites.

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[PC2008 #054]

The nature of impacting projectiles on Earth, Moon and Mars

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A key issue for understanding the origin of planets is the knowledge of the abundances of highly siderophile elements in crust and mantle of Earth, Mars and Moon, as well as rocks from impact craters. Iron meteorites (N=20) and chondrites (N=20) have been identified as projectiles for 40 of about 174 known craters on Earth. The impacting asteroid(s) that added the HSE into the Earth mantle are probably from formation regions closer to the sun (Mercury-Venus region), not sampled by our meteorite collections. The HSE and Ni systematics of the Earth upper continental crust (UCC) closely resembles IIIAB iron meteorites, pallasites, and the evolved suite of Martian meteorites, possibly representing the elemental pattern of the Martian crust. It is interesting to know that rocks from the Nördlinger Ries crater (suevite, graded unit, etc.) have similar HSE and Ni systematics. Estimates show that about 160 impacting asteroids (M-type objects like 16 Psyche and 216 Kleopatra) with radii of 10 km would yield the total abundances of HSE and Ni in the UCC assuming that whole abundances of HSE and Ni are added by impacts.

[PC2008 #055]

Magnetite spherules in Cenozoic cave sediments of the Schwäbische Alb, SW Germany

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We recently discovered magnetite spherules in Cenozoic (probably Pleistocene and older) cave sediments of the Laierhöhle [1] and Laichinger Tiefenhöhle [2] that are hosted by karstified Upper Jurassic limestones of the Schwäbische Alb, Baden-Württemberg, SW Germany. Spherules exhibit various shapes (hollow spherical to drop-shaped; some are broken) and surface textures (smooth to spinifex-textured microcrystalline and coarser crystalline). The origin (impact ejecta, cosmic, volcanic, sedimentary-concretionary, or anthropogenic) and age of the spherules, as well as their possible relation to Cenozoic terrestrial impact events [3] and the timing of regional karst hydrogeologic processes [1-2] are discussed. Detailed analytical studies are currently ongoing.

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[PC2008 #056]

Microstructural indications for protoenstatite precursor of cometary $MgSiO_3$ pyroxene: A further high temperature component of comet Wild 2.

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Microstructural studies by Transmission electron microscope (TEM) techniques of a microtomed cometary enstatite (Mg/Si 0.858; Fe/Si 0.027; Ca/Si 0.01; Al/Si 0.009; Cr/Si 0.01) from Wild 2 sampled during NASAs *Stardust* mission were conducted. The enstatite is characterized by high stacking disorder parallel (100) which includes alternating clinoenstatite and orthoenstatite lamellae and (100) twins. In addition a widespread occurrence of 4.5 Å wide half planes parallel (100) are detected, which leads to 13.5 Å and 22.5 Å polytypes of the structure [see also 1]. These microstructural features are indicative of the direct transformation from a protoenstatite precursor [2], which requires temperatures of more than 1275 K and rapid cooling (10 K/h [3]). Our finding represents a further high temperature component originally present in the cold icy region where Comet Wild 2 is formed.

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[PC2008 #057]

A pristine K-T boundary in ODP Leg 207: Shocked carbonates and element anomalies

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Six cores from ODP Leg 207 (Demerara Rise, tropical western Atlantic, ~4500 km from the Chicxulub crater center; water depth ~2 km) recovered a ~2 cm thick, graded, non-bioturbated complete K-T ejecta deposit [1,2]. The excellent preservation allows documentation of the original sedimentary sequence and its geochemical characteristics on the sub-μm scale using electron microprobe and La-ICP-MS. Outstanding features of this K/T boundary deposit are: (i) The discovery of carbonate ejecta clasts with features reminiscent of experimentally shocked carbonates, in addition to the presence of silicic ejecta spherules. (ii) La-ICP-MS revealed chemical components characteristic for the projectile (PGEs) and for the ejecta (REE, Ni/Cr) as well as for the contemporaneous seawater (Nd, part of the Sr) in yet unconstrained proportions. Therefore, we consider this K-T boundary to be a key for understanding the generation, distribution, and deposition of the various projectile and ejecta components by the Chicxulub impact event.

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[PC2008 #058]

Neutron capture-induced Sm isotope anomalies in IAB and IIE silicate inclusions and Winonaites

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The Sm isotope composition of silicate fragments included in metal provide information on the cosmic ray irradiation history of IAB and IIE iron meteorites. This is compared to the exposure history of Winonaites to understand the moderation properties of metal. Silicate inclusions of IAB metal show measurable deviations only for the $^{149}Sm/^{152}Sm$ (up to -0.6 ε-units) and $^{150}Sm/^{152}Sm$ (up to +0.9 ε-units) ratios. The anomalies correlate with the cosmic ray exposure ages of the meteorites and are due to secondary neutron capture by ^{149}Sm to produce ^{150}Sm at thermal and epithermal neutron fluences $<5.7\times10^{14}$ n/cm^2. For the IIE silicates, deviations of -0.5 and +0.8 ε-units for the ^{149}Sm and ^{150}Sm abundances correspond to fluences of 6.8×10^{14} n/cm^2. In contrast, the Winonaites show deviation of up to -2.5 and +4.2 ε-units which translates to higher neutron fluences of up to 3.4×10^{15} n/cm^2. The data indicates that longer exposed metal-shielded silicates have experienced lower thermal neutron fluences than the shorter exposed Winonaites, suggesting that metal may not be an effective moderator of neutrons.

[PC2008 #059]

Post-impact hydrothermal alteration on Mars.

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During the early, Noachian history of Mars, impact cratering was a dominant geologic process. Central melt sheets, impact melt breccias, and uplifted basement material created local hot spots that establish temperature gradients along which fluid flow with subsequent mineral alteration will occur. Using the computer code CHILLER we found three characteristic mineral assemblages to be produced: serpentine–chlorite–(amphibole–talc–magnetite ±garnet ±quartz) at low water/rock ratios (W/R), hematite–clay–(pyrite ±quartz ±chlorite) at intermediate W/R and almost pure hematite at high W/R. The amount of hydrous phases, e. g., clays, varies with temperature and W/R. Clay minerals are kaolinite and nontronite. Zeolites and hydrous silica are products of plagioclase-dominated alteration and water precipitation, respectively. These theoretical mineral as-

semblages are similar to those observed by ongoing orbiter mission (OMEGA and CRISM instruments aboard Mars Express and Mars Reconnaissance Orbiter, respectively). For further details and literature references see [1].

[1] Schwenzer, S.P. & Kring, D.A. (2008) Workshop on Martian Phyllosilicates: Recorders of Aqueous Processes?– Abstr. # 7014.

[PC2008 #060]

No nucleosynthetic heterogeneity between chondritic and terrestrial Hf.

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The long-lived ^{176}Lu-^{177}Hf system provides a powerful tool for reconstructing the early silicate differentiation history of Earth, provided the initial Lu-Hf parameters of the bulk silicate earth (BSE) are well constrained. Because Lu and Hf are refractory and lithophile, a chondritic BSE with respect to Lu/Hf and ^{176}Hf/^{177}Hf is commonly assumed. Isotopic evidence [e.g., 1] indicates nucleosynthetic heterogeneity of the solar nebula. To test for nucleosynthetic heterogeneity in Hf, we measured the stable, nonradiogenic Hf isotope compositions of terrestrial rocks, and carbonaceous- and ordinary chondrites by MC-ICP-MS (Micromass Isoprobe). Solution replicates (n = 19) of one terrestrial basalt yielded an external reproducibility (2sd) of 20 ppm for ^{178}Hf/^{177}Hf and 34 ppm for ^{180}Hf/^{177}Hf (for 40–60 ng Hf per analysis). Chondrites have homogenous ^{178}Hf/^{177}Hf and ^{180}Hf/^{177}Hf regardless of type. The mean chondritic values overlap with those of terrestrial rocks. The tightly constrained terrestrial and chondritic populations imply homogeneity to within 20 ppm excess of pure s- or r-process Hf.

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[PC2008 #061]

A heavy nitrogen isotope component in IOM of Orgueil.

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The δD and δ^{15}N of the insoluble organic matter (IOM) of carbonaceous chondrites are heterogeneous at a sub-microscopic scale [1, 2, 3, 4]. In NanoSIMS imagery, local *anomalous* isotopic enrichment are referred to as *hotspots*. In few Orgueil *hotspots*, D and ^{15}N were found to be spatially associated [2]. Each *hotspot* and their surrounding area, define an internal ^{15}N/^{14}N-D/H correlation compatible with a two end member mixing model. It is then possible to derive the ^{15}N/^{14}N ratio of the ^{15}N-rich end member *provided* its D/H ratio is known. Since D-rich *hotspot*s were ascribed to organic radicals having D/H ratios equal to 1.5±0.5 10^{-2}, the corresponding ^{15}N/^{14}N ratios of the ^{15}N-rich carrier were calculated. They range from 7.1±1.1 x10^{-3} to 4.4±1.3 x10^{-2}. The upper value was never reported in extraterrestrial matter for the N isotopic ratio.

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[PC2008 #062]

Noble gas studies of the two ureilites Kenna and RaS 247

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In our study of ureilites we cover five objects, Kenna, Dar al Gani 319, and three new ureilites found in the Omani desert, Ramlat as Sahmah (RaS) 247 and two without a name yet. Here we present first results for Kenna and RaS 247. The bulk measurement for Kenna is in reasonable agreement with literature data (e.g., [1]), which seem to scatter much more than the data for other meteorite types. For RaS 247 our data indicate that there is essentially no trapped air. In addition to the bulk analysis we also performed step-wise heating experiments. Although not sufficient for separating the different noble gas components, some results are nevertheless interesting. For both meteorites cosmogenic gas release starts at 600°C. A similar release pattern has also been observed in [1] and has been attributed to gas release from graphite. However, we found also cosmogenic Ne in the low temperature steps, contradicting this interpretation. Besides of these data, we present bulk measurements to check the reproducibility and data for the temperature dependent gas releases from irradiated graphite targets.

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[PC2008 #063]

Overcoming the accretion barrier in protoplanetary discs by conditions prevailing at chondrule formation.

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A serious obstacle of planetesimal formation in protoplanetary discs is dynamical decoupling of gas and meter sized bodies, resulting in radial drift loss and/or destructive collisions [1]. One possibility to overcome this so called “meter-size” barrier is dust to gas enrichments of a factor of 100-10000. Such conditions are typical for chondrule formation [2], and likely enable coagulation to km sized planetesimals. Such a fast growth of chondrite parent bodies after chondrule formation is supported by chondrite formation time scales obtained from their internal

heating from 26Al decay and chondrule 26Al-26Mg ages of specific chondrule populations, as well as chemical complementarity [3]. Hence, the mechanism responsible for chondrule formation may also be responsible for - or at least accompanied by – planetesimal formation.

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[PC2008 #064]

P-process nebular heterogeneity in Sm and Nd isotopes: evidence from chondritic meteorites

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Bulk samples of chondritic meteorites have anomalous $^{144}Sm/^{152}Sm$ and $^{142}Nd/^{144}Nd$ relative to terrestrial values. The $^{142}Nd/^{144}Nd$ anomalies range between -41 and -12 ppm and do not correlate with their Sm/Nd. The variations in $^{144}Sm/^{152}Sm$ are larger, ranging from -118 to +68 ppm. ^{144}Sm is a p-only nuclide, whereas ^{142}Nd is produced by both s- and p-processes. For all Sm and Nd isotopes not having p-process contributions, chondrites, and Earth have identical compositions, indicating that s- and r-process Sm and Nd nuclides were uniformly distributed in the solar nebula. Thus, the anomalous $^{144}Sm/^{152}Sm$ in chondrites must be attributed to a heterogeneous distribution of p-process Sm nuclides in the nebula. Likewise, the variation in $^{142}Nd/^{144}Nd$ is due to p-process heterogeneity that affected ^{142}Nd through variable primary production of p-^{142}Nd and variable ingrowth from α-decay of its p-process parent, ^{146}Sm. The ^{142}Nd anomalies do not correlate with ^{144}Sm, suggesting that supernova source(s) that contributed Sm and Nd nuclides to the solar nebula had variable production ratios for p-isotopes.

[PC2008 #065]

Effects of aerogel capture on Wild 2 particles.

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Cometary particles from the Jupiter family comet, Wild 2, were collected by the Stardust spacecraft at 6.1 km/s using aerogel capture media and then returned to Earth for laboratory analyses [1]. Much of the initial analytical work was performed on the relatively pristine terminal particles [e.g., 2,3]. However, materials deposited along the impact tracks, which suffered alteration during capture, also provide important information about the characteristics of Wild 2, but they are more difficult to analyze. By understanding the effects of aerogel capture on the particles, through laboratory experiments [e.g., 4,5], and physical, compositional [e.g., 6] and mineralogical [e.g, 7] analyses of the materials along the impact tracks, we can infer how the current materials relate to the original pre-capture Wild 2 particles [8].

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[PC2008 #066]

High precision ^{26}Al-^{26}Mg systematics of type I and type II chondrules from Semarkona (LL3.0)

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Because of technical limitations, earlier measurements of ^{26}Al-^{26}Mg systematics [1, 2] are limited to chondrules with high Al/Mg ratios (>40 in mesostasis and plagioclases) and are not precise enough to give more information than an age for chondrule formation (≈ 2Ma after CAIs [3]).

Using the ims 1270 ion probe of the CRPG, we developed high precision measurements of Mg isotopes in Semarkona chondrules (with low Al/Mg ratios in mesostasis). All of the 15 studied chondrules show well resolved ^{26}Mg excesses, with inferred initial $^{26}Al/^{27}Al$ ratios ranging from $(1.576\pm0.167)\times10^{-5}$ to $(0.348\pm 0.125)\times10^{-5}$ and $\delta^{26}Mg^*$ initial ranging from -0.017 (± 0.014)‰ to 0.006 (±0.0092)‰.

These results allow (i) to resolve precisely different episodes of chondrules formation (i.e. precursors' extraction, distinct melting events…) and (ii) to constrain the homogeneity and the initial of ^{26}Al and Mg isotopes in the solar nebula.

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[PC2008 #067]

Bulk Solar Wind Kr and Xe – first results from Genesis Si Targets

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The Sun's composition, being considered the best proxy for the solar nebula's composition, can be derived by analyzing its outflowing particle stream, the Solar Wind (SW). Therefore, the Genesis mission returned a series of target materials irradiated with SW for about two years. Amongst others, we use these targets to determine the bulk SW Kr and

Xe isotopic and elemental composition, which, so far, could only be deduced from SW irradiated regolith samples [1]. Ar, Kr, and Xe, extracted from Si targets by UV laser ablation, have compositions in broad agreement with lunar soil data [2]. However, Xe abundances and thus the Kr/Xe ratios vary by about 20%. In order to better control Xe abundances, more analyses of flown Si targets and in particular of Si spareflight material are under way and will be presented at the conference. The results will have important implications on the understanding of fractionation processes operating between the Sun and the SW.

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[PC2008 #068]

Combined NanoSIMS / TEM studies of silicate stardust in the ungrouped chondrite Acfer 094.

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Silicate grains condense in cooling O-rich ejecta of evolved stars and stellar explosions and are detected as isotopically anomalous "presolar" silicates in primitive meteorites and cometary samples by high resolution mass spectrometers [e.g., 1]. By studying the isotopic, chemical and structural characteristics of this dust we can investigate circumstellar and interstellar conditions in a laboratory on Earth. We report here on O- and Si-isotopic data of presolar silicates from the ungrouped carbonaceous chondrite Acfer 094 obtained by NanoSIMS and further chemical and structural studies by high resolution analytical electron microscopy (SEM / Auger / FIB / TEM). Our results show that grains from type II supernovae possibly contribute ~ 10 % to the silicate stardust inventory, whereas the vast majority derives from low mass (1 – 2.5 M_{sun}) AGB stars of solar or slightly lower-than-solar metallicity. To date, only olivine but no pyroxene have been documented by TEM, which points to different formation pathways for these two kinds of circumstellar minerals.

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[PC2008 #069]

Barium isotope anomalies in chondrite leachates.

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The presence of nucleosynthetic isotope anomalies in chondrites is often assumed to be limited to presolar grains. However, evidence for Ba isotope anomalies in bulk carbonaceous chondrites has been reported [1, 2, 3]. Here, precise Ba isotope compositions were determined in bulk chondrites and HCl leachates for different chondrite classes. No sample displays resolvable anomalies for the rare p-only nuclides. HCl leachates from two CM2 chondrites show much larger r-process isotope excesses compared to the bulk samples. This observation shows that isotope anomalies for heavy refractory elements like Ba (but also Mo, Zr, Os) are (nearly) balanced in bulk chondrite samples. A leachate from the unequilibrated ordinary chondrite Bishunpur LL3.1 also displays r-process enrichments, which provides evidence that similar nucleosynthetic components are present in (unmetamorphosed) ordinary chondrites. Thus, the data suggests that dust in the carbonaceous and ordinary chondrite source region was never completely vaporized.

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[PC2008 #070]

Mapped Distribution of Scalloped Terrain, South of the Hellas Basin, Mars

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In order to investigate the effect of climate change on the surface morphology of Mars, we produced a detailed map of the location of scalloped shaped depressions, a type of dissected mantle terrain [1], located on the southern wall of the Hellas Basin in the area of Malea Planum containing Amphitrites and Peneus Paterae. The region is covered by a latitude-dependent, several meters thick, surface mantle interpreted as an airfall deposit of dust and water ice related to obliquity-driven ice activity as recently as 2.1-0.4 Myr [2]. Scallops are believed to form by enhanced sublimation of interstitial ice from pore spaces in the mantle material which create asymmetric slope profiles [3]. We studied these features to determine the recent geologic evolution of the region and to study if the regional climate of the Hellas basin has had an impact on the formation of these scallops. We also surveyed the southern hemisphere to determine the extent of these features for any longitudinal dependency.

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[PC2008 #071]

Effects of terrestrial weathering in the JaH 091 strewnfield in Oman – water-soluble salts

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Within the 7.2 x 52.2 km JaH 091 (L5) strewnfield in the interior of Oman, we studied the effects of terrestrial weathering and contamination. Many

stones from this strewnfield show a hygroscopic behavior. The alteration mineralogy, weathering grade and the quantity of water-soluble ions (as determined by ion chromatography) has been investigated for 16 samples collected from different parts of the strewnfield. Water-soluble ions have been compared with soil samples and local saline waters.

Notwithstanding the same terrestrial age, the samples showed large differences in weathering grade (W2-W4) and concentrations of water-soluble ions. The major cations are Mg^{2+} (meteoritic origin) and Ca^{2+} (soil-derived). Main anions are Cl^{-} (external) and SO_4^{2} (partly external, partly meteoritic). In Cl-rich samples, salts are present as highly concentrated brines under most natural conditions.

The presence of high concentrations of salts in these meteorites has a significant influence on weathering. Since the geochemistry of the soils is homogeneous in the hot desert of Oman [1], parameters like the amount of fine-grained material in soils and the size of the meteorite may have an important influence the quantity of contaminants.

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