TRR 170 NEWSLETTER #6 08_2022

TRR 170
LATE ACCRETION
ONTO TERRESTRIAL PLANETS

> Editorial

Dear Colleagues,

The date of the evaluation as part of the application for the 3rd funding period of the TRR 170 has now been set and we are already in the intensive phase of preparing the preliminary application, which we would like to advance through various measures and joint exchange.

We would particularly like to mention that in June the new mass spectrometer was installed at the FU Berlin at the Institute for Geological Sciences, which is used in several projects at the FU. Congratulations!

A major focus of this newsletter is on changes in the status group of PhD students and postdocs as well as several fellows who are participating in the TRR for some months. We would like to welcome the new employees and we are hoping that the TRR will offer you great network enabling first-class science.

We were really happy that our Annual Retreat 2021 finally took place in May 2022 in Potsdam. It was a very successful meeting with intense discussions and communications between the TRR 170 members of all status groups and at both locations.

Our congratulations go to Dr. Guillaume Florin (FU Berlin) who received an award for the best written paper by a French scientist on isotopic research.

Please also note the schedule with important dates. Please add to them to your calendar!

We hope you will enjoy reading the newsletter.

All the best and stay healthy!
Sabine Hunze & Harald Hiesinger

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➢ New Neoma mass spectrometer

June 2022

Installation of the new Neoma mass spectrometer at Freie Universität Berlin

A new Mass Spectrometer was installed in the Geochemistry labs at the Institute of Geological Sciences, Freie Universität Berlin.

The Neoma instrument represents a new generation of MC-ICP-MS instruments, and its acquisition was jointly funded by DFG and the Freie Universität Berlin to support TRR 170 research. It provides various technical advances that result in excellent sensitivity, large mass dispersion and enhanced mass resolving power.

Within the TRR170 program, it will be used to analyze mass-dependent stable isotope variations of Zn, Cu, and K in lunar samples (subproject B1), chondrites and their components (subproject B8) and experimental charges (subproject C1).

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> Personnel

New PhD students

	**Maxence Regnault** (FU, project B8) m.regnault@fu-berlin.de My research as a PhD student within the TRR-170 consists of studying the coupled behavior of mass-dependent isotope variation of three moderately volatile elements (zinc, copper and potassium) in carbonaceous chondrites (bulk rocks, chondrules, matrices and separated minerals) in relation to the bulk silicate Earth. The choice of these elements is linked to their different volatilities, chemical characteristics and to their variable depletions in chondrites. Correlations are observed between the depletion of moderately volatile elements (e.g., Zn) accompanied with an enrichment of light isotopes and no consensus exists today on the origins (nebular vs. planetary origins). The aim of this project is to decipher how these intriguing signatures are produced with a spirit of linking these features to Earth volatile budget. Before joining the TRR-170 project, I worked on the topic of chondrule formation during my Master thesis by coupling high-current X-ray mapping, chemical analysis and oxygen isotopic measurements in CR and Rumurutiites chondrites.
	**Kelly Cairns** (WWU, project Z) k.cairns@uni-muenster.de I attained my bachelor's and master's degree in geosciences at the University of Münster with a focus on the geomorphology of Mars. During my PhD studies I will continue investigating this topic. Currently I'm working at the University of Münster in public relations where I help organize activities for TRR-170 PhD students to support gender equalities. Additionally, I work at the LWL Planetarium in Münster as a presenter. In my spare time, I really enjoy martial arts, bouldering, drumming, and astronomy.

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New Postdoc

Dr. Max Collinet (DLR, project A5)
Max.Collinet@dlr.de
I am an igneous petrologist experienced in the study of achondrite meteorites from Mars and asteroids, high-pressure/high-temperature experiments and the modelling of deep magmatic processes. I work at the department of planetary physics at DLR where I couple petrologic and geophysics modelling (mantle convection) to constrain the formation of the Martian and Lunar crusts. I collaborate primarily with the A5 team to model, with Sabrina Schwinger, and using constraints from Cordula Haupt and Jonas Schneider, how the lunar magma ocean crystallized. With the C4 team, I work alongside Irene Berndt and other DLR scientists to model the formation of the secondary (basaltic) lunar crusts.

Fellowships

Dr. Aelita Girich (07/2022-06/2023, WWU, Addi Bischoff)
Aelita.girich@gmail.com
My main scientific interest is the investigation of new types of cosmic material and primitive fine-grained silicate material in unequilibrated ordinary and carbonaceous chondrites.
As part of the TRR-170, I will study the mineralogy of lithologies from carbonaceous chondrites as an analogue to samples from the asteroids Ryugu and Benno. The main focus will be on mid-infrared spectroscopy of brecciated CM chondrites, which contain numerous clasts. The proposed research will combine accurate microscopic, analytical and high-resolution spectroscopic techniques in order to provide a well-defined mineralogical basis for the interpretation of the spectral data obtained. This will help to better characterize extraterrestrial materials that may have existed as very similar components in the early days of accretion of planetesimals and planets.

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Fellowships

Cécile Deligny (04-09/2022, FU Berlin, Harry Becker)
cecile24@zedat.fu-berlin.de
I completed my PhD at the Centre de Recherches Pétrographiques et Géochimiques (Nancy, France) in cosmochemistry focused on the timing and the origin of volatile elements accreted by early-formed planetary bodies. I joined the TRR170 at the Freie Universität to study Yamato type carbonaceous chondrites (i.e., CYs chondrites). These objects have the heaviest oxygen isotopic compositions among carbonaceous chondrites and are supposed to derive from similar nebular reservoirs as CM or CV. However, their exotic siderophile volatile elements composition suggest that CY's are sampling a new, unknown parent body and thus define their own CC group. Therefore, to understand their origin, and the processes leading to their formation, I have analysed bulk CY highly siderophile elements contents (Re, Ir, Ru, Pt, Rh, Pd, Au) and Re/Os isotopic ratio. Last but not least, to establish how volatility-controlled processes affect parent bodies composition before and after accretion, I will measure the abundances of the moderately volatile elements (S, Se, Te).
Aside my scientific work, I enjoy climbing, doing yoga and baking.

Paul Béguelin (04-09/2022, WWU, Andreas Stracke)
beguelin@uni-muenster.de
My current research focuses on the use of novel isotope techniques (radiogenic Ce and stable Fe isotopes) to gain precious new information on the source of mantle-derived lavas. From the Ce isotope systematics of hotspot lavas, I seek to quantify the extent of prior melt-depletion of convecting mantle peridotite, with key implications on mantle evolution and dynamics. My work with Fe isotopes consists in understanding their variance and systematics in mantle-derived lavas, and explore their use as a potential tracer of core contribution, upper mantle metasomatism, and crystal fractionation.
A central goal of my research is to explore new paradigms and approaches to mantle geochemistry, in order to enable a more direct and robust multidisciplinary integration with the field of geodynamics.

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> Publications (February -August 2022)

Bischoff A., Bannemann L., Decker S., Ebert S., Haberer S., Heitmann U., Horstmann M., Klemm K. I., Kraemer A.-K., Lentfort S., Patzek M., Storz J., and Weyrauch M. (2022): Asteroid 2008 TC3, not a polymict ureilitic but a polymict C1 chondrite parent body? - Survey of 248 Almahata Sitta fragments. Meteoritics & Planetary Science 1–26. doi: 10.1111/maps.13821

Bischoff A., Storz J., Barrat J.-A., Heinlein D., Jull A. J. T., Merchel S., Pack A., and Rugel G. (2021): Blaubeuren, Cloppenburg, and Machtenstein - three recently recognized H-group chondrite finds in Germany with distinct terrestrial ages and weathering effects. Meteoritics & Planetary Science 57, 1. 136-153. DOI: 10.1111/maps.13779

Burkhardt, C. (2021): Planetary Genealogy. Elements 17,6. DOI: 10.2138/gselements.17.6.395

Flemetakis, S., Tiraboschi, C., Rohrbach, A., Berndt, J., and Klemme, S. (2022): The stability of antigorite in subduction zones revisited: The effect of F on antigorite stability and its breakdown reactions at high pressures and high temperatures, with implications for the geochemical cycles of halogens. Contributions to Mineralogy and Petrology, 177(7). DOI:10.1007/s00410-022-01934-5

Gaillard, F., Bouhifd, M.A., Furi, E., Malavergne, V., Marrocchi, Y., Noack, L., Ortenzi, G., Roskocz, M., and Vulpius, S. (2021): The Diverse Planetary Ingassing/Outgassing Paths Produced over Billions of Years of Magmatic Activity. Space Science Reviews (217), 1-54. doi: 10.1007/s11214-021-00802-1

Gleißner, P., Salme, J., and Becker, H. (2022): Siderophile volatile element inventory in lunar magmatic rocks and mantle sources. Earth and Planetary Science Letters. https://doi.org/10.1016/j.epsl.2022.117680

Goodrich, C. A., Collinet, M., Treiman, A., Prissel, T. C., Patzek, M., Ebert, S., Jercinovic, M. J., Bischoff, A., Pack, A., Barrat, J.-A., and Decker, S. (2022): The first main-group ureilite with primary plagioclase: A missing link in the differentiation of the ureilite parent body. Meteoritics & Planetary Science 57, 1589-1616. DOI: 10.1111/maps.13889

Kerraouch, I., Kebukawa, Y., Bischoff, A., Zolensky, M.E., Wölfer, E., Hellmann, J.L., Ito, M., King, A., Trieloff, M., Barrat, J.-A., Schmitt-Kopplin, P., Pack, A., Patzek, M., Hanna, R.D., Fockenberg, T., Marrocchi, Y., Fries, M., Mathurin, J., Dartois, E., Duprat, J., Engrand, C., Deniset, A., Dazzi, A., Kiryu, K., Igisu, M., Shibuya, T., Wakabayashi, D., Yamashita, S., Takeichi, Y., Takahashi, Y., Ohigashi, T., Kodama, Y. & Kondo, M. (2022): Heterogeneous nature 1 of the carbonaceous chondrite breccia Aguas Zarcas – cosmochemical characterization and origin of new carbonaceous chondrite lithologies. Geochim. Cosmochim. Acta. https://doi.org/10.1016/j.gca.2022.07.010

Kumari, S., Stracke, A., and Paul, D. (2021): 182 W- 142 Nd isotope evolution in an open-system model of the Earth: Implication for geodynamic processes in early Earth. Geochimica et Cosmochimica Acta. DOI:10.7185/gold2021.3577

Pangritz, P., Renggli, C.J., Berndt, J., Rohrbach, A., and Klemme, S. (2022): Synthesis of Large Amounts of Volatile Element-Bearing Silicate 2 Glasses Using a Two-Stage Melting Process. ACS Earth and Space Chemistry. https://doi.org/10.1021/acsearthspacechem.2c00020

Renggli C.J., Klemme S., Morlok A., Berndt J., Weber I., Hiesinger H., and King P.L. (2022): Sulfides and hollows formed on Mercury's surface by reactions with reducing S-rich gases. Earth and Planetary Science Letters, 593, 117647. https://doi.org/10.1016/j.epsl.2022.117647

Schmidt, J.M. and Noack, L. (2021): Clinopyroxene/Melt Partitioning: Models for Higher Upper Mantle Pressures Applied to Sodium and Potassium. International Journal On Advances in Systems and Measurements, 14 (1&2), 125-136. http://www.thinkmind.org/index.php?view=article&articleid=sysmea_v14_n12_2021

Schwinger, S. and Breuer, D. (2022): Employing magma ocean crystallization models to constrain structure and composition of the lunar interior. Physics of the Earth and Planetary Interiors, 322. doi: 10.1016/j.pepi.2021.106831

Steller, T., Burkhardt, C., Yang, C., and Kleine, T. (2022): Nucleosynthetic zinc isotope anomalies reveal a dual origin of terrestrial volatiles. Icarus, 386, 115171. https://doi.org/10.1016/j.icarus.2022.115171

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> INF project and database TRR170-DB

TRR170-DB tool: Work continues on an orbit explorer tool to combine spatial and lunar analysis data, including data from TRR 170 projects. A first test version will be released in the fall.

Training: We will email a questionnaire to TRR 170 PhD students and postdocs in September to find out how we can best support you to get the most from our training opportunities. Here, you can specify your interests and needs related to research data management and the TRR170-DB repository.

Contributions to this year's Goldschmidt and GeoMinKöln conferences discuss metadata examples for isotopic data in cosmo- and geochemistry data repositories and how to improve metadata for FAIR planetary replication datasets.

NFDI4Earth activities: Together with colleagues from various institutions in Germany, we are finalizing a proposal to NFDI4Earth to set up an interest group (IG) on metadata standards for geochemical data. The IG is supposed to start work in the fall. If you are interested to learn more, please contact Elfrun (elfrun.lehmann@fu-berlin.de) or Harry (hbecker@zedat.fu-berlin.de).

Check back the TRR170-DB website for regular updates.

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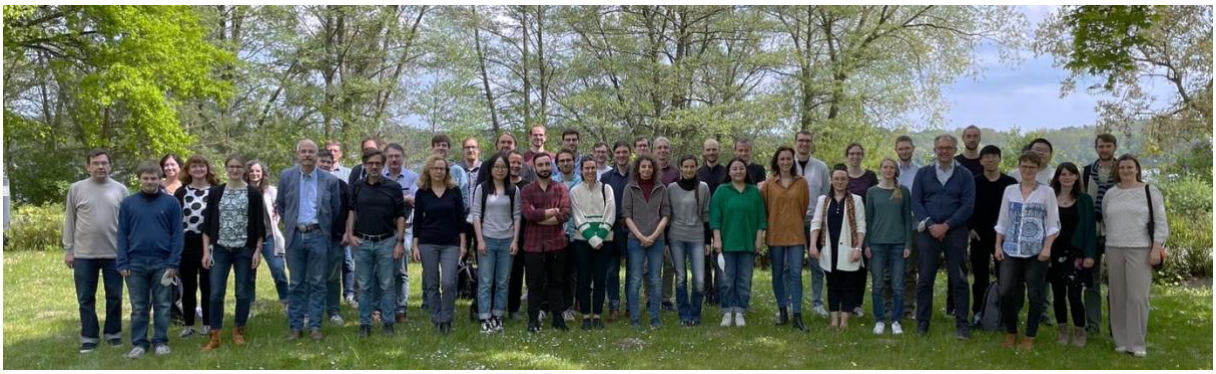
> Activities

May 4-6, 2022

Annual Retreat Potsdam 2022

Because of the Corona situation we had to move the year 2021 Annual Retreat from October 2021 to May 2022. But finally we met at the Seminaris Seehotel Potsdam. More than 50 scientists of the TRR 170 including PhD students, postdocs, and project leaders met and spent two days together discussing science using lectures and posters.

At the last day of the meeting we had a meeting of the project leaders, where we discussed the progress of the single projects. We really enjoyed the really nicely located hotel at the Templiner See and many interesting discussions. In particular, the relaxed atmosphere and the active exchange between the participants must be highlighted! Thanks to everyone involved for their contribution!



Participants of the TRR 170 Annual Retreat 2022 in Potsdam.

One highlight of the meeting was the award ceremony, especially because - for the first time - two prizes were awarded this year.

The price for the 'TRR 170 Outstanding Paper Award 2021' was given to **Dr. Christian Maas** (WWU Münster). The award honors a junior scientist that best exemplifies the science of the TRR 170. The awarded paper should be of interdisciplinary nature and covers more than one research area of TRR 170. The scientist was selected by voting of the TRR 170 project leaders.

Additionally, we have launched another price in 2022, the 'TRR 170 Young Scientist Award' to honor the series of papers in high-ranking journals. This price was awarded by the TRR 170 spokesperson Prof. Dr. Harald Hiesinger to **Dr. Tiantian Liu** (MfN Berlin). Tiantian published three papers in 2021 in highly ranked journals.

Congratulations to both award winners!

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> Gender Activities

May 12, 2022
'Women in Science' series #2
Prof. Dr. Véronique Dehant (Royal Observatory, Brussels/Belgium)

As part of the TRR 170 colloquium in Berlin we had a special guest, Prof. Dr. Véronique Dehant, who gave a virtual lecture on "The InSight results in relation to habitability". Dr. Dehant works at the Royal Observatory of Belgium, where she is responsible for the Operational Directorate "Reference Systems and Planetary Science". She is also Extraordinary Professor at the Université Catholique de Louvain. She is Academician since 2010. In 2015, she has obtained a European Research Council Advanced Grant and in 2020, a second Grant (Synergy), both for working on the Earth rotation and core.
After the online lecture and discussion, we continued with an informal gathering where we talked with Véronique about her career, her experiences, how she sees herself as a female role model, how to most effectively promote women nowadays, and insights about her work-life balance.
Many thanks to Lena who was responsible for organizing this session.

> Outreach

December 03, 2021
Award to Guillaume Florin
Dr. Guillaume Florin received an award by the Société Française des IsotopeS (SFIS) for the best paper written by a French scientist in 2020. The award was given during the annual meeting of the SFIS in spring 2022. This prize is intended to honor a publication that deals with the results of particularly remarkable basic or applied isotope research in all scientific fields. The goal is to recognize one background study each year that enables significant progress. The choice of the item to be awarded is made by the members of the SFIS Board in a secret vote. The prize 2021 rewards a publication in 2020 and is endowed with €1000.

The award was given to Guillaume Florin for the article:
Florin G. , Luais B., Rushmer T., Alard O. (2020): Influence of redox processes on the germanium isotopic composition of ordinary chondrites. Geochimica et Cosmochimica 269, 270-291. DOI : 10.1016/j.gca.2019.10.038

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February 22, 2022
Organic compounds and salt deposits in Urvara crater

Dwarf planet Ceres: Organic compounds and salt deposits in the Urvara impact crater

Data from NASA's Dawn mission, evaluated for the first time, suggest that brine welled up from the depths in the Urvara crater and organic compounds were deposited. The third-largest crater on the dwarf planet Ceres was geologically active at least once more, many millions of years after its formation. In a recent study published in the journal Nature Communications, researchers from the Max Planck Institute for Solar System Research (MPS) in Göttingen, the Westfälische Wilhelms-Universität Münster (WWU) and the National Institute of Science Education and Research (NISER) in India presented the most detailed investigation of the Urvara crater to date.

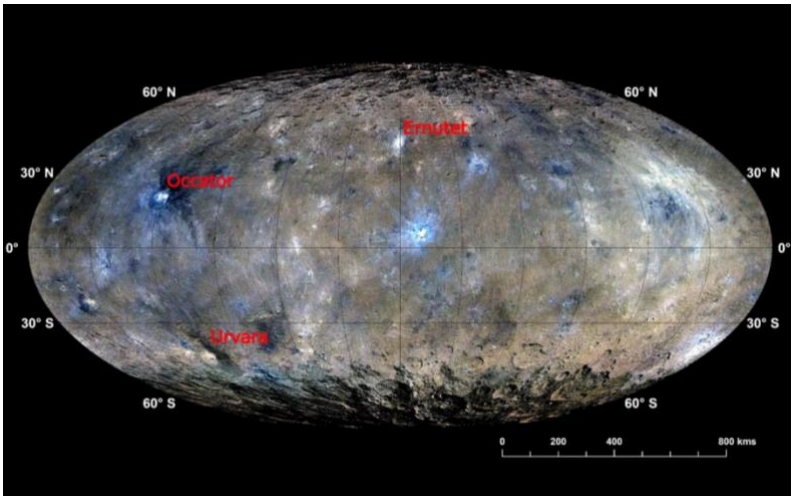

Figure: Numerous large, prominent craters can be found on the surface of the dwarf planet Ceres.

For the first time, they evaluated camera data from the last phase of NASA's Dawn space mission, which revealed geological structures only a few meters in size. The Dawn spacecraft entered orbit around the dwarf planet in 2015 and studied it closely for about three and a half years. Like Occator crater, Urvara crater may have been the site of cryovolcanic activity, the researchers say.

For further details see https://www.mps.mpg.de/organische-verbindungen-und-salzablagerungen-im-urvara-krater

Publication:

A. Nathues, M. Hoffmann, N. Schmedemann, R. Sakar, G. Thangjam, K. Mengel, J. Hernandez, H. Hiesinger, J.H. and Pasckert: The Urvara basin on Ceres – brine residues and organics, Nature Communications, 22. https://doi.org/10.1038/s41467-022-28570-8

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July 26, 2022

Meteoritic evidence for very early volcanism in the nascent solar system

Scientists from Freie Universität Berlin, University of Bristol, Northwest University Xi'an and the Institute of Geochemistry of the Chinese Academy of Sciences have published the results of a new determination of the crystallization age of 4566.6 ± 0.6 million years for a meteorite called Erg Chech 002 (EC 002). The new age, determined using the manganese-chromium dating method, shows this rock crystallized only 0.7 ± 0.6 million years after the formation of the solar system.

"This makes the meteorite at present the oldest known volcanic rock in the solar system", as Dr. Ke Zhu, a former Alexander von Humboldt postdoctoral fellow at Freie Universität and now at University of Bristol, explains. At the same time, the age of the rock represents a minimum age for crust formation on its parent body and thus shows that separation into crust and mantle occurred very early. Based on additional isotope data for the elements chromium and oxygen, the scientists conclude that EC 002 likely is related to a group of meteorites called brachinites, which originate from the inner solar system. "The different textures and compositions of EC 002 and the brachinites could imply the existence of a chemically heterogeneous parent body or the existence of multiple parent bodies with distinct chemical composition" says Prof. Harry Becker of Freie Universität Berlin. The dating result requires that the parent body of EC 002 must have grown within a few hundred thousand years since the formation of the solar system, which corresponds to the time scale of astrophysical growth models of such small bodies. The study was published in the in the journal Monthly Notices of the Royal Astronomical Society Letters.

Previous studies of the meteorite, which was found in Algeria in 2020, have shown that EC 002 represents solidified magma which formed new crust as volcanic rock near the surface of its parent body. The rock is relatively rich in silicon, similar to rocks on Earth called andesites. Shi-Jie Li, staff scientist in Institute of Geochemistry, CAS, who provided this sample concludes "because rocky planets yield significantly younger ages, the parent body may have been an asteroid. However, the composition of the meteorite suggests a chemically more variable crust compared to typical asteroids which have basaltic crust". The heat source for such early magmatism on asteroids is believed to be the radioactive decay of 26-aluminum, which was present in the early solar system, but then decayed within a few million years.

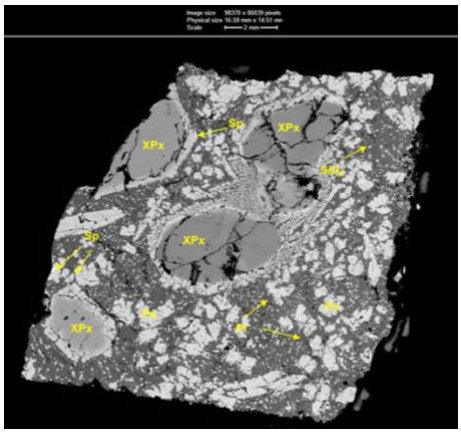

Figure: Back scattered electron image showing the fabric of EC 002 in a thin section. Large crystals of the mineral orthopyroxene occur in a more fine-grained matrix of feldspar, pyroxene and other minerals. The length of the bar in the header is 2 mm.

Publication:

Zhu, K., Becker, H., Li, S.-J., Fan, J., Liu, X.-N., Elliott, T. (2022): Radiogenic chromium isotope evidence for the earliest planetary volcanism and crust formation in the Solar system. Monthly Notices of the Royal Astronomical Society Letters, 515, L39-L44. https://doi.org/10.1093/mnrasl/slac061

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> Upcoming events

2022			
Oct 4	Meeting of project leaders **Braunschweig**	Planning of projects, preparation of Pre-proposal	All PIs (current and new ones)
Oct 4-8	Summer School #2 **Braunschweig**	Planetary Geodynamics (D. Breuer/H. Becker)	PhD students + interested postdocs
Nov 23	Submission of Pre-Proposal	TRR 170 (3rd funding period)	ALL
Nov/Dec	Workshop (online)	'Visualization'	PhD students
Nov/Dec	Workshop (online)	'Argumentation'	PhD students
Dec (or Jan 2023)	Annual Retreat (Location?)	TRR 170 Annual Retreat	ALL
2023			
March 20	Submission of Proposal	TRR 170 (3rd funding period)	ALL
May 31 + June 1	Evaluation **Berlin or Münster**	TRR 170 (3rd funding period)	ALL **Mandatory for all TRR 170 members!**

Upcoming international conferences which cover aspects of TRR 170

Planet Formation and Evolution PFE-SPP 1992 joint meeting,
September 12-14, 2022
Freie Universität Berlin, GeoCampus Lankwitz
https://pfe-spp1992-joint-meeting.spp1992-exoplanetdiversity.de/

EUROPLANET SCIENCE CONGRESS EPSC2022

September 18-23, 2022
Granada/Spain

AGU FALL MEETING

Chicago, IL & Online Everywhere
12– 16 December 2022

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> Impressum

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