HIGH-PRESSURE EXPERIMENTAL TECHNIQUES AND APPLICATIONS TO THE EARTH'S INTERIOR

International Short Course at the Bayerisches Geoinstitut

The annual international short course High-Pressure Experimental Techniques and Applications to the Earth's Interior was held at the Bayerisches Geoinstitut (Bayreuth, Germany) over a five-day period in February 2010 and attracted more than twenty participants. Through lectures, practicals, and laboratory sessions, the scientific staff of the Bayerisches Geoinstitut gave a comprehensive introduction to modern experimental and analytical methods of mineralogy, geochemistry, and geophysics, which are required to obtain a better understanding of the composition, structure, and dynamics of the Earth's interior. Technical aspects discussed included high-pressure and high-temperature experimental techniques, as well as spectroscopic, X-ray diffraction, and electron microscope methods. Scientific areas included thermodynamics and phase equilibria, high-pressure crystal chemistry, equations of state, kinetics of phase transformations, diffusion, and solid-state deformation. The participants came primarily from countries outside of Germany and included graduate students and postdocs from Austria, the Czech Republic, Denmark, France, Italy, Japan, Mexico, the Netherlands, and Spain. For the duration of the short course, scientists and laboratory supervisors were available on an informal basis for discussions with the participants. This was the twelfth time the annual international short course on high-pressure experimental techniques has been held at the Bayerisches Geoinstitut. The German Mineralogical Society kindly provided financial support and enabled three of the participants to attend through the provision of travel grants.

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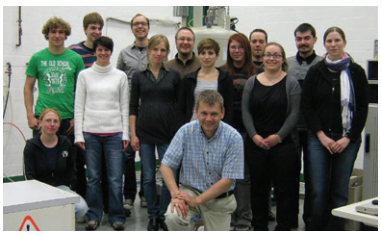
APPLICATIONS OF SOLID-STATE NMR SPECTROSCOPY IN MINERALOGICAL AND GEOSCIENTIFIC RESEARCH

A short course by the German Mineralogical Society (DMG) and the German Society for Crystallography (DGK) – Spectroscopy Subsection



DMG short courses are now a yearly tradition. This one took place under the direction of Michael Fechtelkord, in cooperation with the spectroscopy subsection of the DGK, at the Ruhr-Universität in Bochum from 25 to 28 May 2010. The goal of this four-day short course was to provide an overview of the basics of NMR spectroscopy and an appreciation of the experimental methods, as well as to evaluate the data collected during the course.

Each day started with a presentation of the theory necessary for understanding the experimental work. Michael Fechtelkord provided many descriptive illustrations and equations, without going too deeply into the physical fundamentals. The information was easy to follow even by those without previous NMR experience. The strengths of solid-state NMR spectroscopy were impressed on the 15 participants by means of simple examples from mineralogical research. On the first day, participants learned how to determine the activation energy of methyl-group rotation in $(CH_3)_4I$ using variable-temperature ^1H spin lattice-relaxation experiments. On the second day, the magnetic dipolar and chemical shift interaction was on the agenda. MAS NMR spectra of ^{29}Si, ^{19}F, and ^1H nuclei were recorded from a synthetic phlogopite. Fitting of the spectra by Lorentzian and Gaussian line shapes was done with the computer program DMNT2010. The third day was devoted to multipulse techniques. Thus, $\{^1H\}$ ^{29}Si cross-polarization experiments (CPMAS) on kaolinite were carried out, and H–Si distances were computed. On the last day, the basics of the double-rotation technique (DOR), multiquantum magic angle spinning (MQMAS), and satellite transition spectroscopy (SATRAS) were discussed. Finally, evaluations of the ^{23}Na MAS NMR spectra recorded from different salts and of a ^{27}Al MAS NMR SATRAS spectrum were carried out in the afternoon.

Overall this course offered a very good overview of the possibilities and limits of solid-state NMR spectroscopy as applied to the structural investigation of inorganic solids. All participants had the opportunity to carry out NMR experiments by themselves. All agreed that the evaluation of the spectra and the computation of the important parameters demand a lot of experience.

The workshop program was complemented by a pleasant first evening in the beer garden, as well as by a Bavarian bowling evening. Participants relaxed between courses and at lunch time by strolling around the beautiful university-owned botanical garden. We thank Michael Fechtelkord, who organized and delivered this course. He answered numerous questions with much patience, and was particularly tireless during the evaluation of the data.

Hanna Lühr, University of Bremen

PRESSING MATTERS: A NEW TYPE OF MULTIANVIL PRESS FOR THE BAYERISCHES GEOINSTITUT

PhD student Geertje Ganskow in front of the newly installed multianvil press at the Bayerisches Geoinstitut, Bayreuth

A new, partially DFG-funded multianvil press has been installed at the Bayerisches Geoinstitut, Bayreuth. Featuring a novel type of compression system, the flexible design allows a range of large-volume, high-pressure applications, including deformation at deep-mantle conditions and the use of inner sintered-diamond anvils that should achieve pressures >50 GPa (equivalent to depths in the Earth of >1200 km). The device comprises six 800-tonne hydraulic rams aligned at right angles, which compress a cubic high-pressure chamber using hard outer anvils. Each hydraulic ram has an independent pressure-control system, and the position of each anvil can be measured and controlled to within 0.2 micrometers. The press alone weighs approximately 40 tonnes, while the hydraulic pumping system occupies a similar floor space. The ability to maintain a precise geometry of the high-pressure chamber means that the press is optimal for use with sintered-diamond inner anvils, which require a high level of symmetry in the distribution of force in order to prevent tensile stresses from damaging the anvils. As each hydraulic ram can be advanced independently, even under high loads, deformation experiments will be a major function of the device. The accessibility of the high-pressure chamber makes the design well suited for in situ applications, and the instrument would work well in combination with an X-ray or neutron source.