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ANSWERING GEOPHYSICAL QUESTIONS CONCERNING GAS HYDRATES USING NEUTRON SCATTERING

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Gas hydrates, in particular methane hydrates, have received an ever increasing interest in geophysics over the last three decades due to their possible role as future energy resource, their role in the global climate change and their potential geo-hazards. Some gas hydrates also appear to play important roles in planetary bodies like the satellites of Saturn, the nuclei of comets and on Mars. Although gas hydrates are known for almost 200 years many properties are still not well established. Neutron scattering has proven to be a very powerful means of unravelling certain aspects of these materials.

Due to their high penetrating power neutrons are particularly useful for in-situ investigations of gas hydrates, which are stable only at elevated gas pressures. Neutron diffraction has provided the most accurate information on the compressibilities of gas hydrates and the gas content was determined for the first time on an absolute scale as a function of the p-T conditions. Compressibility is relevant for geophysical modelling and previously experimentally unknown p-T variations in gas content may trigger geological processes related to gas uptake and release eventually leading to catastrophic failures of gas hydrate bearing sediments. Gas hydrates show some unusual properties like the anomalously low thermal conductivity which is relevant in modelling geophysical processes in planetary bodies but also for geophysical gas hydrate exploration in continental and marine environments on earth. Insight into physical properties has been gained from inelastic neutron scattering.

The mechanisms of hydrate formation and decomposition are still poorly understood, yet they are of considerable importance in a geological context. Rapid decomposition

processes may lead to catastrophic events of gas release creating submarine slides followed by destructive tsunami waves. Formation and decomposition of gas hydrates has been followed by time-resolved in-situ neutron diffraction experiments and models with predictive power were constructed from the observed reaction kinetics. In particular, the previously unexplained effect of anomalous preservation has recently been unravelled by these experiments. The presentation will conclude with some perspectives of the future role of neutron scattering in the field of gas hydrates.