National Cooperative
for the Disposal of
Radioactive Waste

Hardstrasse 73
Postfach 280
5430 Wettingen
Switzerland

Tel +41 56 437 11 11
Fax +41 56 437 12 07
www.nagra.ch

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Media dossier CC 2017: Clays

International Clay Conference held for the first time in Switzerland

Critical analysis of research results by expert colleagues

The international exchange of the latest findings on disposal of radioactive waste in argillaceous rocks is the focus of the three and a half day Clay Conference (from 24th – 27th September) in Davos. Clays can serve as a host rock, and thus as a natural safety barrier, for a deep geological repository and clay materials can also be used as engineered barriers, for example for backfilling disposal tunnels and for sealing underground access structures.

What makes clay so suitable for the safe disposal of radioactive waste? This question was addressed by Dr. Andreas Gautschi on the opening day of the 2017 Clay Conference in Davos. Gautschi spent the majority of his career as a geologist with Nagra (National Cooperative for the Disposal of Radioactive Waste). He was extensively involved in geological investigation programmes (including deep boreholes) and geochemical studies (e.g. on the analysis of deep groundwaters). “The excellent properties of clay for radioactive waste disposal are attributable mainly to its low hydraulic conductivity and good swelling capacity”, explained Gautschi.

Clays are minerals with a sheet structure that are formed by the weathering of other minerals. The particle sizes are very small (less than two-thousandths of a millimetre). Clays also tend to have a very large specific surface area; for example, one gram of Opalinus Clay has a specific surface area of 100 to 200 square metres. By way of comparison: a tennis court has an area of 260 square metres. As the clay mineral surfaces are negatively charged, positively charged radioactive substances such as uranium and plutonium adhere to the surfaces and are retained. This prevents them from reaching our living environment.

Clays with a high smectite content can absorb water, causing them to swell. This swelling capacity leads to closure of fractures or fissures created by engineering activities in the rock, such as excavation of tunnels or construction of emplacement drifts. This effect is also known as the self-sealing capacity of clay. The swelling pressures can reach several MPa (megapascals). One MPa corresponds to the pressure exerted by a water column of 100 metres.

In Switzerland, it is planned to use bentonite in the engineered barrier system, as a backfill material for the emplacement drifts and for sealing the repository. Bentonite is volcanic ash that has been altered to clay minerals; it is rich in smectites and thus has a high swelling capacity. Special processing of the bentonite, such as compaction, can increase the swelling pressure even further. The swelling capacity of the bentonite ensures a tight backfill around the disposal canisters in the emplacement drifts, while the retention capacity ensures that the radioactive substances do not reach our living environment.

Despite all the advantages of the safe disposal of radioactive waste in suitable clay formations, clays do have weaknesses, said Gautschi. The low thermal conductivity means

that particular attention has to be paid to the heat production of the high-level waste and the removal of this heat through the rock (see media dossier CC 2017: FE Experiment). The geotechnical properties of clay also make it challenging in terms of construction engineering. “When considering engineering feasibility, the exchange with France is particularly important to us as they already have practical experience with the construction and operation of an underground facility in clay”, explained Gautschi.

The Clay Conference came to life based on an initiative of the French waste management organisation ANDRA and takes place every two and a half years. Following Reims (2002), Tours (2005), Lille (2007), Nantes (2010) and Montpellier (2012), it was held in Brussels in 2015. In 2017, the Conference is being held for the first time in Switzerland and is organised by Nagra. Cooperating partner organisations are ANDRA (France), COVRA (The Netherlands), KORAD (South Korea), NUMO (Japan), NWMO (Canada), ONDRAF/NIRAS (Belgium), POSIVA (Finland), PURAM (Hungary), RWM (United Kingdom), SKB (Sweden), SURAO (Czech Republic) and swisstopo (Switzerland).

More than 400 participants from 23 countries are attending the Conference. The programme includes 132 presentations, around 240 scientific posters and various networking sessions in which the latest scientific findings on clays and clay materials in the disposal of radioactive waste will be discussed and exchanged. “This is an opportunity to learn about the latest developments in international research – as a rule, results that have not yet been published are presented”, said Gautschi. The scientists expose their results to critical analysis by their experienced colleagues. “We learn from one another and with one another”, says Gautschi. The overall aim is to identify the remaining uncertainties in the field of waste disposal and the efforts required to reduce these further.

The Clay Conference may be over by the 27th of September but, for the Scientific Organising Committee under the lead of Andreas Gautschi, a period of intensive work is just beginning. “The new results that have been presented will be made available to the wider scientific community”, explained Gautschi. In the spirit of openness and good international collaboration, the contributions made at the Clay Conference will be published in a wide range of scientific journals.

According to Swiss nuclear energy legislation, the producers of radioactive waste are responsible for its safe management and disposal. In 1972, the nuclear power plant operators and the Federal Government set up the National Cooperative for the Disposal of Radioactive Waste (Nagra) to perform this task. Nagra, with headquarters in Wettingen (AG), is the national technical competence centre in the field of deep geological disposal of radioactive waste.

Out of a strong sense of responsibility for the long-term protection of man and the environment, 120 employees are involved daily in performing this important work. The high level of competence is secured by targeted research programmes in two Swiss underground rock laboratories and intensive international collaboration.