Horsfield, B., Scheck-Wenderoth, M., Krautz, H. J., Mutti, M. (2010): Geoenergy: From visions to solutions. - Chemie der Erde - Geochemistry, 70, Suppl. 3, 1

DOI: 10.1016/j.chemer.2010.06.002

Introduction to the GeoEn Special Issue

Geoenergy: from Visions to Solutions

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The European Commission, in its strategic energy review of 2007, stated that "a diverse portfolio of clean, efficient and low-emission energy technologies" is needed to shield Europe from potential external energy crises and to achieve supply-security and environmental sustainability in the long term. While replacing fossil energy resources by renewable energies would be the ideal choice, technical and economical arguments dictate that this solution is something for the distant future, and that for many years to come the diverse energy mix will remain in force. The composition of the energy mix – the desired share of coal, nuclear, gas or renewables – is essentially a matter of national sovereignty.

This special volume of *Chemie der Erde / Geochemistry* is devoted to Geoenergy, namely research and technological activities that are concerned with the exploration and production of energy resources from the Earth's crust. While conventional oil and gas as well as coal are the dominant providers of energy from subsurface environments worldwide, future mixes will contain a higher proportion of renewable and environmentally friendlier sources running alongside the mainstay fossil energy supplies. Mitigation and adaptation strategies to battle climate change are part and parcel of these developments. That geothermal energy, shale gas and Carbon Capture and Storage (CCS) are the principal thrusts of the current volume is a reflection of the range of components which are likely to assume an important role in Germany's energy mix of twenty years from now and beyond.

Geothermal Energy - Geothermal has the potential to provide huge amounts of sustainable power. International activities in geothermal research and development are increasing, particular in the USA, Australia, and Europe through coordinated programmes. In Germany, investments in geothermal research has already attracted growing interest by industry, based on generating energy itself and the added value of exporting reliable geothermal plant system components. An *in-situ* laboratory consisting of two deep geothermal research wells (>4 km) at Groß Schönebeck in the German state of Brandenburg is an ideal site for fulfilling these objectives. In the current special volume the chemical and physical properties of both the fluids and rock matrix, as well as regional numerical models of mass and energy transport, are presented.

Shale Gas - This unconventional fossil fuel resource is exclusively produced in the U.S. and accounts for about 10 % of gas production. By 2035 that number is expected to reach 35%, according to the U.S. Energy Information Administration (EIA). While no shale gas production has been realized in Europe yet, many companies are actively exploring in Sweden, Germany, Poland and elsewhere. Whether this turns out to be a bonanza or not will unfold over the next ten years. Understanding the workings of shale gas systems will clearly play a key role in this regard, and requires basic research aimed at process understanding on different scales. Here we present two examples from Germany where the type, content and thermal maturity of organic matter, and the lithology and diagenetic history of the inorganic matrix are discussed in terms of gas-in-place and producibility.

Carbon Dioxide Capture and Storage – Carbon dioxide capture and storage (CCS) is considered to be one of the options, beside others, to mitigate climate change by reducing the amount of carbon dioxide (CO_2) released to the atmosphere. The focus is set on point sources, such as coal-fired power stations, steel and cement production plants as well as the petrochemical industry.. In the special volume we present generalized overviews of various combustion and transport technologies, and examine the corrosion problems that come into play. Concerning the CO_2 itself, long-term storage is the next step after capture and transport. For the studies reported here, this takes place at Europe's first *in-situ* laboratory at Ketzin, near Potsdam in Brandenburg. Here we report on rock-fluid interactions within the saline reservoir and with the cap-rock, which are modelled geochemically and monitored via seismic plus geoelectric methods.

The seventeen papers published here come from "GeoEn", a pilot project (Grant 03G0671A/B/C) funded by the German Ministry of Education and Research (BMBF) under the initiative *Spitzenforschung und Innovation in den Neuen Ländern*. All articles went through the normal review process laid out by Chemie der Erde / Geochemistry. We would like to thank Prof. K. Heide and the Advisory Board of the journal for taking the insightful step of publishing this multidisciplinary contribution. Our thanks are also extended to Sabine Kunst (UP), Reinhard Hüttl (GFZ) and Walther Christoph Zimmerli (BTU) for their support.