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Review of Survey activities 2012

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Cover photographs from left to right

1. The 1097 m high Finnefjeld is located in the central part of the Maniitsoq impact structure, West Greenland. Photograph: Adam A. Garde.
2. Investigation of a coastal cliff section at a potential disposal site for radioactive waste. Photograph: Merete Binderup.
3. Setting up an automatic camera to monitor frontal variations of a glacier in West Greenland. Photograph: Robert Fausto.
4. Collecting samples in Cameroon, using a hand auger. Photograph: Christian Knudsen.

Frontispiece: facing page
In 2012 GEUS published a geological map of the island of Mors in north-west Jylland. The map sheet comprises the coastal cliff section Hanklit on northern Mors, with exposures of light layers of moler and dark layers of volcanic ash, overlain by glaciofluvial deposits from the last ice age. The moler has been folded and up-thrusted by ice advancing from the north. Photograph: Stig A. Schack Pedersen.

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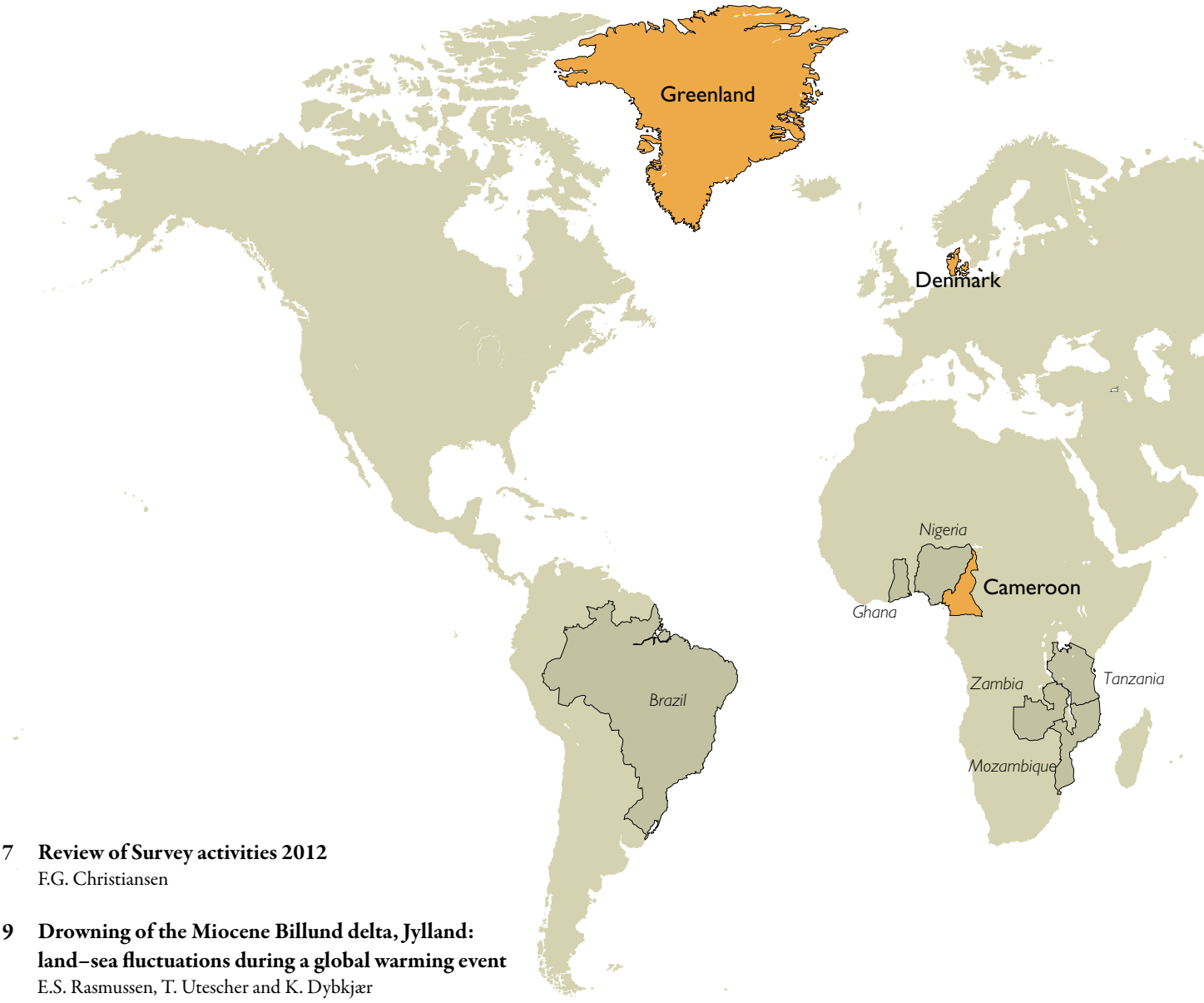

GEUS working areas 2012.
Orange areas are covered in this volume.

Review of Survey activities 2012

Flemming G. Christiansen
Deputy Director

2012 was a good and stable year for the Geological Survey of Denmark and Greenland (GEUS). In recent years GEUS has been through a long – and very constructive – process of establishing a new strategy that reflects the changes in society and new demands from many different stakeholders. With a new strategy in place there has been greater focus on GEUS' activities and research projects.

2012 was a very active year with many projects, field work and offshore data acquisition, which promises well for maintaining a high level of research in the coming years.

With the establishment of the new series *Geological Survey of Denmark and Greenland Bulletin* in 2003 it was decided to make a yearly *Review of Survey activities*. This issue is the tenth and, together with previous issues, provides a good overview of the Survey's wide range of research and advisory activities. This issue contains a total of 17 four-page papers, nine on Denmark, seven on Greenland and one on a project in Cameroon.

Activities in Denmark

The activities and research in Denmark by GEUS cover many different topics within our main programme areas: data, water, energy, mineral resources as well as nature and climate.

As a follow-up on many previous studies of the Miocene succession and its groundwater resources, one paper gives a detailed discussion of the drowning of the Billund Delta in Jylland during a period of previous global warming.

GEUS has been involved in the technical work that is required before a permanent disposal site can be selected for low- and intermediate-level radioactive waste. One paper describes the geological data and knowledge and key parameters such as lithology, groundwater, seismic activity, effect of climate change and local infrastructure that have been applied to narrow down the initial number of 22 areas to six potential sites.

GEUS is involved in many studies of Quaternary and recent geological processes. One paper describes deposits from the Baltic Ice Lake in the Arkona Basin in the southern Baltic Sea. Another paper presents results on the late glacial to early Holocene development of southern Kattegat. A third paper describes terrain subsidence interpreted from satellite radar scanning with special focus on Copenhagen and its tectonic framework.

Systematic geological mapping on a scale of 1:25 000 and publication of 1:50 000 scale systematic sheets continues. In some places it is appropriate to make regional maps of, for example islands, on a single sheet. An example of this is described in a paper on the map sheet Mors. Geologically, Mors is an interesting island with beautifully exposed glaciotectonic structures in cliff sections, and the characteristic Eocene clayey diatomite with volcanic ash layers, a unit known as 'moler'.

The use of groundwater is very important for Danish society and GEUS carries out many studies on water resources and possible future changes due to climate and use. One paper discusses models for urban groundwater table response to climate change and increased stormwater infiltration using the town of Silkeborg and a proposed course of a new motorway around Silkeborg as a case study. Another paper evaluates groundwater abstraction from public waterworks in Denmark by using advanced statistical methods to correct data.

GEUS records seismological events at six locations in Denmark. One paper describes the developments in detection level and completeness from 2000 to 2012 with examples of recent felt earthquakes (North Sea on 19 February 2010 and Kattegat on 6 August 2012) and explosions.

Activities in Greenland

There was a high level of field activities in Greenland in 2012 with a major mapping and geochemical programme in South-East Greenland, a large field and shallow-core drilling programme in North Greenland, and the LOMROG III cruise in the Arctic Ocean. The latter was the last data acquisition of the Danish Continental Shelf Project. Many other field studies were also carried out. Results from these large and small projects will be presented in the coming years. In this issue results are presented from other completed and ongoing projects.

One paper discusses the possibility that nickel and copper occurrences in the norite belt in the Maniitsoq area could be impact-induced as they are found in a recently described giant and deeply eroded, very old (3 Ga) impact structure

in this area. Gold occurrences have been reported during GEUS expeditions to West Greenland some years ago, and another paper provides more constraints on ore formation and fluid-rock interaction.

Corundum in gem quality (ruby) has been known since the 1960s near Fiskenæsset in southern West Greenland and it is possible that mining will start within a few years. One paper gives a detailed description of the geochemistry that can be used to fingerprint the Greenlandic rubies.

Since 2008, the Greenland Analogue Project (GAP) has carried out a wide range of studies in an area near Kangerlussuaq in West Greenland to understand the many different processes that might take place if a deep geological repository for spent nuclear fuel is affected by glaciation. One paper focuses on structural investigations in this area, especially the mapping of lineaments and other late features. As a follow-up on several decades of studies in the Nuussuaq Basin in West Greenland, a spectral gamma-ray characterisation has been made on the Cretaceous Atane Formation to set up a better model for interpretation of lithology and grain-size variation in wells without cores.

Systematic geological overview mapping of Greenland has been the backbone of the Survey's work in Greenland over the past 65 years ago. In the period 1971–2004, 14 maps were published on a scale of 1:500 000. With the development of the Internet, geological maps worldwide are rapidly changing from traditional paper sheets to digital publications. GEUS has produced a new seamless digital 1:500 000 scale map covering the whole of Greenland. One paper describes the background, the digitisation and the geological harmonization involved. It is expected that such maps will be widely used in the future. The new map is an important GEUS contribution to the global OneGeology portal.

The important monitoring programme of the Greenland Ice Sheet (PROMICE) continuously supplies new crucial data and one paper discusses the darkening of the Greenland ice sheet and the increase in surface melting.

International activities

Internationally GEUS works in many different countries with a variety of projects. The last paper in this issue is about titanium minerals in Cameroon and it focuses on understanding the primary formation, weathering and re-deposition of rutile in the area.