THULE RESEARCH SEMINARS

PROGRAMME AND EXTENDED ABSTRACTS

Highlights in research of Northern and Environmental Issues

Edited by Arja Rautio and Kari Strand
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Foreword

The present seminar “Highlights in research of Northern and Environmental Issues” is a concluding research seminar of the Thule Research Programme period 2006-2011. The Thule Institute has organized its research to three research programmes (“Global Change in the North”, “Circumpolar Health and Wellbeing” and “Northern and Use and Land Cover”) in order to face the need for research knowledge on northern and environmental issues. This owns a wide perspective from climate and environmental change in the North and investigates also related societal and economic shifts to better understand human-environment relationships. Our dynamic modeling efforts for people and ecosystems in the changing environment combines cross-thematic and multidisciplinary issues, where new information on Earth’s physical, climatic and ecosystem changes could be integrated into valid socio-cultural and economic models, thus providing policy makers, communities and businesses with information facilitating the prediction of risks and functional decision making. During this six years period almost 60 PhD students in 20 projects or consortiums have finished their thesis work, and during this seminar we have many of those presenting their results. These research projects of three programmes in the Thule Institute have been vital important for understanding the complexities of natural and anthropogenic change in the Earth system and environment-human interaction and over 500 scientific articles have been completed.

This seminar planned to present the good part of research results and highlights along the six years programme period. This seminar consists mostly of the PhD students’ presentations and three focused key-note talks related to the three research programmes of the Thule Institute. The seminar will certainly look also for future activities related to the new programme period starting next year. It is important to receive advice how the programme activities and doctoral training should develop in near future.

Special thanks to Riitta Kamula and Pirjo Taskinen taking care of the seminar practical issues and thanks for Hannele Heikkilä-Tuomaala for abstract book production as well as Teresa Komu for text editing.

We warmly welcome you to the seminar and wish you stimulating discussions during the seminar days related to further develop northern and environmental research!

Kari Strand
Arja Rautio
Seminar programme

Highlights in research of Northern and Environmental Issues

Seminar of the Thule Institute’s Research Programme period 2006-2011
Building of the Environmental Sciences (Ympäristötietotalo), Lecture Hall IT112
19.-20. October, 2011

WEDNESDAY 19.10.2011
Chair Kari Strand
Building of the Environmental Sciences (Ympäristötietotalo), Lecture Hall IT112

8:30 Registration

9:00 Opening and welcoming words, Director, Prof. Kari Laine (Thule Institute)

9:15 People, Environment and Resources in a Global North (keynote lecture), Prof. Mark Nuttall (University of Alberta, Canada and University of Oulu, Finland)

10:00 Coffee

10:20 Prevention of marginalisation among children and adolescents (keynote lecture), Prof. emerita Irma Moilanen (University of Oulu, Finland)

10:50 Long-Term Change in the Upper Atmosphere – Space Weather and Greenhouse Forcing, Dr. Thomas Ulich

11:10 Palaeoevironmental changes in formerly glaciated areas – an example of rapid environmental changes in the White Sea Basin during the Younger Dryas Stadial, Prof. Juha Pekka Lunkka

11:30 Seasonality and Frost Hardiness of Northern Plants under Global Change and Environmental Stress, Dr. Kari Taulavuori

11:50 Sphagnum Mosses as Indicators of Light Climate, PhD student Anna Hyryrääinen

12:10 Lunch

13:10 Place and Environment in the Stories of Northern People – On the Borderline between Global and Local, PhD student Maija Lanas
Seminar programme

13:30 Default Mode Network in Young People with Familial Risk for Psychosis, 
*PhD student Tuomas Jukuri*

13:50 Fetal Exposure to Foreign Chemicals – The Role of Placental Transporter Proteins, 
*Dr. Päivi Myllynen*

14:10 Speciation of Small Aluminium Oxide Clusters in Aqueous Environment, 
*Dr. Giorgio Lanzani*

14:30 Coffee

14:50 Toward Eco-Efficient Use of Resources in Chemical Industry – Separation 
Technologies for Waste Minimization, *PhD student Junkal Landaburu*

15:10 Climate warming affects phenologies at several trophic levels - a northern 
perspective, *PhD student Emma Vatka*

15:30 Poster session

16:30 Closing of the day

THURSDAY 20.10.2011

*Chair Arja Rautio*

8:30 Registration

9:00 Stream Restoration: Enhancing Salmonid Fisheries, Lotic Biodiversity, or Both? (keynote 
lecture), *Prof. Timo Muotka* (University of Oulu, Finland).

9:30 Organic Rich Sediments and Suspended Solids in Peatland Drainage Catchments, 
*Dr. Hannu Marttila*

9:50 Boreal Forest Brook Restoration Using Wooden Structures, *PhD student Simo Tammela*

10:10 Coffee

10:30 Working in small groups for feedbacks, new openings and knowledge gaps 
Discussions

12:30 Concluding remarks and future plans, and closing of the day
LONG-TERM CHANGE IN THE UPPER ATMOSPHERE — SPACE WEATHER AND GREENHOUSE FORCING

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ABSTRACT

The upper atmosphere, i.e. the mesosphere and thermosphere and their charged part, the ionosphere, are coupled to both the lower atmosphere and to interplanetary space. Space weather clearly affects the upper atmosphere; the most visible prove thereof is the existence of the Northern Lights. However, the invisible changes in the upper atmosphere have much more far-reaching effects. Particle precipitation from space causes changes to atmospheric chemistry. It has been shown that energetic space particles produce odd nitrogen and odd hydrogen in the mesosphere, which leads to ozone destruction in the mesosphere and even in the stratosphere.

In addition to this forcing from space, the upper atmosphere is affected by changes of lower atmospheric chemical composition, most prominently it is assumed that increased greenhouse gases in the troposphere and stratosphere cause cooling of the stratopause region and the atmosphere above. Model predictions estimate that the cooling in the thermosphere could be as large as 50 K.

The Intergovernmental Panel for Climate Change (IPCC) stated in its 4th Assessment Report that solar radiative forcing on global climate is thought to be small in comparison to forcing due to enhanced greenhouse gases. However, the radiative forcing addressed by the IPCC is the forcing through electromagnetic radiation (light). The forcing of the atmosphere and climate due to particular radiation is still largely unknown and only recently studies of these effects have become feasible with the launch of ESA’s ENVISAT satellite, which can measure atmospheric chemical composition in the stratosphere and mesosphere.

The mesosphere, thermosphere and ionosphere are an important part of the Earth’s environment. For climate change studies, it is essential to understand how atmospheric layers are coupled and thereby how our atmosphere is coupled to space.

The work presented here has two parts. First, we will give an overview of observed long-term change in the upper atmosphere. Second, we will discuss the chain of chemical effects on the atmosphere due to particle forcing from space.
Palaeoenvironmental changes in formerly glaciated areas – an example of rapid environmental changes in the White Sea Basin during the Younger Dryas Stadial

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ABSTRACT

Fennoscandia and NW Russia were covered by the Scandinavian and Barents-Kara palaeo-ice sheets several times during the Weichselian cold stage (ca. 115 000 – 11 600 years age). Ice sheets that were waxing and waning during that time caused drastic long, medium and short term natural changes in physical environments. In the THULE Institute funded PACE-project, we have studied the nature of the past environmental changes and their rate. Herewith, we provide an example of an extremely fast environmental change that took place in the White Sea Basin area at around 12 000 years ago.

In this study, a total of six small basins were cored to determine the shoreline displacement of the Belomorsk area, NW Russia during the last deglaciation. Conventional shoreline displacement methods were applied where the isolation contacts of the sediment cores from lakes at different altitudes were determined using lithological and diatom taxa changes. The isolation contacts were subsequently dated using the $^{14}$C AMS-method. The results show that the area around the cored basins formed part of an extensive ice lake that existed in the White Sea Basin prior to 12,050 cal yr BP. Dating, together with lithostratigraphical and diatom results, indicate that the isolation of the lakes between 72 – 134 metres above the present sea level occurred at 12,050 cal yr BP and the relative water level in the White Sea Basin dropped at least 62 metres within c. 200 yr. It is estimated that at least 50 – 55 metres of the relative water-level fall was caused by a sudden drainage of the ice lake waters into the Barents Sea via the Gorlo Strait and 7-12 metres of the water-level decline was caused by glacioisostatic uplift. Preliminary calculations suggest that the total volume of water that burst into the Barents Sea was c. 3000 km$^3$. This, together with that of c. 7000 km$^3$ of water which drained into the North Atlantic as the result of the Baltic Ice Lake drop around 11,600 cal yr BP, must have affected the behaviour of the eastern flank of the Scandinavian Ice Sheet and had a cooling effect on local climate.
SEASONALITY AND FROST HARDINESS OF NORTHERN PLANTS UNDER GLOBAL CHANGE AND ENVIRONMENTAL STRESS

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1. BACKGROUND

The objective of the project was to research the effects of multiple stresses on northern plants under global change and changing environment. The special focus was on plant seasonality and frost hardiness, as they exhibit a process of plant survival in the north. The main stresses that were studied involve climate warming and consequent extremes in temperature changes, periodic droughts, effects of blue light, enhanced UV radiation and metal stress. The research produced results at the ecological and environmental assessment level, and increased ecophysiological understanding of the mechanisms behind.

The main questions to be studied were:
(1) How will climatic warming, alone and in combinations, with certain other stress factors associated with global change, affect plant seasonality and frost hardiness?
(2) How will plants respond to the shifting climatic envelopes caused by climatic warming: What will be the role of changing light environment (photoperiod, light quality) in plant seasonality?
(3) How will plant seasonality and frost hardiness respond to elevated UV radiation, trace metal pollution and drought-related stress?

2. SEASONALITY

Basic mechanisms related to autumn colouring (Taulavuori 2006; Taulavuori et al. 2011a; Sarala et al. 2011) and spring time leaf colouring were studied (Taulavuori et al. 2011; Sarala et al. 2011). It was shown that variable leaf colouring in spring depends on the plant origin. Seasonal changes in the activity of APTase (a cell membrane bound proton pump protein) activity were also studied, and it was found that the seasonal dynamics varies between species having different growth strategies (Taulavuori et al. 2007). Fascinating memory- effects were also observed in plant seasonality, where hardening temperatures of the previous autumn (Skre et al. 2008), or the overwintering temperatures (Tahkokorpi et al. 2007) may affect the growth and biomass of the next growing season.

3. ELEVATED WINTER TEMPERATURES

Our earlier studies on elevated winter temperatures indicated that warming climate could reduce the frost hardiness of dwarf shrub bilberry (K. Taulavuori et al. 1997). The same result was obtained later in mountain birch in experiment performed with cooperation with Norwegian colleagues (Taulavuori et al. 2004; Skre et al. 2008). Swedish collaboration indicated that sudden cold extremes after warm winter period may be fatal (Bokhorst et al. 2010). The absence of snow cover was observed to have negative effects of overwintering of a dwarf shrub (Taulavuori et al.
4. DROUGHT

While precipitation may be increased in northern areas as a consequence of changing climate, the probability of local and temporal summer droughts will be increased (ACIA 2005). For example, in 2006 in northern Finland, the late summer was very hot and water deficit resulting to premature leaf drops or browning in August. We have documented this elsewhere in more details comparing evergreen and deciduous life strategies (E. Taulavuori et al. 2010). We propose that although evergreen strategy is more common in dry habitats, the deciduous strategy may serve better the whole plant in under extreme drought. It was also indicated that juvenile leaves of deciduous species may by more drought-tolerant than mature leaves (E. Taulavuori et al. 2010). It was indicated that the anthocynin pigments, against as thought before, are not directly involved in the protection against drought and related stresses (frost, salt, metals) (Tahkokorpi 2010).

5. BLUE LIGHT

Global change obviously does not affect the light conditions of a given site (with the exception of UV-radiation). However, as the climate warms the vegetation from south may shift their ranges northward even 1000 KM to the boundary of Arctic Ocean (ACIA 2005). As the sun elevation is lower in the Arctic, the shorter wavelengths are scattered effectively from the solar beam. Thus the northward migrated vegetation from southern origin experience different light quality compared to that they have adapted. Because of the scattering of short wavelengths in the Arctic, the diffuse blue light exists at relatively high proportions during polar summer nights (K. Taulavuori et al. 2010). The novel finding was that blue light decreases the elongation (i.e. height growth) of some trees (Taulavuori et al. 2005a; Sarala et al. 2007; Sarala et al. 2009; Sarala 2010).

6. OTHER STRESS

Responses to UV-radiation were studied in FUVIRC experiment in Sodankylä, Northern Finland. The preliminary results indicated that plant frost hardiness could be reduced under elevated UV-B radiation, and a hypothesis according which there is a trade-off between UV-defence mechanism and development of frost hardiness was published (Taulavuori et al. 2005b). The results are partly consistent with the presented hypothesis although the responses were not as significant as expected. The major finding is that the plant frost hardiness response varies between plant species. The results suggest that the evergreen species are more vulnerable to UV-radiation, and especially to UV-A radiation (Taulavuori et al. 2011c).

Literature was reviewed and a hypothesis was constructed to test the effect of metal stress on plant frost hardiness (Taulavuori et al. 2005c). However, the uptake and translocation occurred only in below-ground stems of bilberry (Vaccinium myrtillus), no translocation to aerial parts occurred (Tahkokorpi et al. 2010). Therefore it is understandable that there were no differences in frost hardiness of bilberry stems.

7. CONCLUSIONS AND FUTURE PROSPECTS

In conclusion, the project resulted in plenty of valuable information in understanding the seasonality and frost hardiness of northern plants, especially in relation to global change and
variable environmental stress. The project provided knowledge of the plants responses and the underlying physiological mechanisms. Hopefully the results could be applied for the ecological and environmental assessment level of the global change. As for future prospects there are two key themes to continue in responses, acclimations and adaptations of northern plants to global change: (1) Arctic light in summer and (2) snow conditions in winter. The previous is because of the migration of the vegetation zones, and the latter is because of the expected decrease in snow cover and its duration.

8. ACKNOWLEDGEMENTS

We thank all collaborators, especially the doctoral (PhD Marian Sarala; PhD Marjaana Tahkokorpi) and the previous and current graduate students (MSc Johanna Keränen, MSc Anni Korteniemi; MSc Tanja Jylänki; Ms Paiivi Niemelä; Mr Valtteri Hyöky; Ms Sonja Hurskainen). Department of Biology (University of Oulu) is thanked for the excellent experimental facilities as well as many other experimental sites (SGO-Fuvirc; Kilpisjärvi Biological Station, Abisko Research Station etc.). We are also grateful to financial support given by Academy of Finland and many foundations. Special thanks belong to Thule Institute (University of Oulu) because of the overall support of this project.

9. REFERENCES


SPHAGNUM MOSSES AS INDICATORS OF LIGHT CLIMATE

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INTRODUCTION

The impact of light climate in boreal areas is a part of global climate change. Altered solar UV radiation, an essential player among the current environmental factors, is proven to affect various plant species in terms of their chemistry, physiology and morphology. Little is known of its effects on seasonal and interannual dynamics of light acclimation related compounds of Sphagnum mosses.

Sphagnum mosses are plants of unique structure, making them dependent on their environment and simultaneously sustaining its balance. These plants are the crucial regulating component in boreal peatlands where they dominate and affect water regime, pH levels, carbon balance and nutrient flow (Rydin & Jeglum 2006), creating specific niche for other plants and numerous microorganisms (Opelt et al. 2007). Bryophytes are also shown to be sensitive to unfavorable changes in the environment and therefore used in biomonitoring (Slack et al. 2011). Sphagnum mosses often react more clearly to attenuation, rather than enhancement, of solar UV radiation (Robson et al. 2003, 2004). That is why this research aiming to study the seasonal and interannual dynamics of light acclimation related compounds in Sphagnum mosses was based on a UV-B attenuation experiment. The research is a part of ECOREIN project (The ecological and socioeconomical responses of global change on reindeer pastures, 2006-2011).

MATERIAL AND METHODS

An open field UV-B attenuation experiment (2007-2009) was carried out in Finnish Lapland, on an oligotrophic bog near Vuotso (68°10’N, 26°42’E). Three peat moss species, Sphagnum balticum, S. jensenii and S. lindbergii (Fig. 2) were studied. The plants were exposed to: 1) attenuated UV-B radiation, elevated temperature, 2) ambient UV-B radiation, elevated temperature, 3) ambient UV-B radiation and ambient temperature. The conditions were manipulated by using plastic filters placed over the experimental plots yearly in the beginning of each vegetation season (Fig. 1). The increase of the air temperature at the plots under the filters was 0.5- 1.0°C (Martz et al. 2009).
Sphagnum samples were taken every year in June-September in order to follow interannual and seasonal changes in the plants. The UV-B radiation and pH were measured while sampling. Chlorophylls, methanol soluble and cell wall bound phenolics were extracted from the samples. The content of chlorophylls a and b, and the content of total phenolics were measured spectrophotometrically. The pilot analysis of individual phenolic compounds from air-dried and lyophylized samples was conducted by HPLC.

RESULTS

The preliminary results for chlorophylls did not show significant differences between the treatments. There was, however, noticeable seasonal dynamics in chlorophyll content, with the clear increase in July sampling. The content and ratio of chlorophylls a/b was specific for each studied species.
The spectrophotometric analysis revealed higher concentration of total phenolics in air-dried samples comparing to lyophilized ones (Fig. 3). The pilot HPLC analysis of individual phenolics showed no significant difference between the treatments 1) and 3).

![Graph](image)

*Fig. 3 Bulk UV absorbance of the soluble fraction (AUC280-420 mg⁻¹ DM)*

REFERENCES


Place and environment in the stories of Northern people
– On the borderline between global and local

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INTRODUCTION

In the PLACEs-project that has been a part of the Circumpolar Health and Wellbeing—programme of
the Thule institute, we have looked into life in northern rural villages in Finland, producing new
knowledge of Northern rural peoples’ experienced health and wellbeing in the middle of global
changes, and about their hopes and expectations for the future. We have gained understanding of
the relationships between places and people and, moreover, of the significance of such relationships
to education, identity formation and to the formation of local knowledge. We have gained knowledge
and understanding of how Northern people experience their health and general wellbeing between
globalisation and localisation.

This presentation will focus on one of the researches conducted within the project, doctoral research
begun and finished within the project, conducted by Maija Lanas. In her dissertation thesis “Smashing
potatoes—contesting student agency as utterances” Lanas looks into the relational dynamics of
schooling and northern rural village life. She analyses the intricacies of student and village resistance
to the imperatives of schooling.

METHOD AND FINDINGS, IN BRIEF

Lanas’s thesis represents narrative dialogical methodology (e.g. Clandinin & Rosiek, 2007; Gubrium &
Holstein, 2008; Heikkinen, 2002) and reflexive ethnography (e.g. Alvesson & Sköldberg, 2009; Davies,
1999). The aim in these methods is not to reach generalizable knowledge but to construct unique and
locally significant knowledge that may resonate with other researches globally. The data for Lanas’s
research consists of roughly 20 of the 50 narrative interviews produced in the project, a school
ethnography Lanas conducted in one of the research villages with her family for one semester in
2008, and dialogical face to face and e-mail discussions with villagers between 2006 and 2009.

In brief, Lanas found in her research that national inequalities in Finnish educational decision making,
cultural approaches in education and implicit educational goals lead to a situation in which:

1) Formal education tends to direct children away from the rural villages (M. Lanas, 2008)
2) Behind the teachers’ perception of rural students’ “misbehavior” there are broader societal,
communal, cultural and even issues and emotions related to these. (M. Lanas & Corbett, 2011; M.
Lanas, 2011)
In her dissertation Lanas analyses how broader societal inequalities between north and south, urban and rural, materialize in the small everyday choices that students must make in and regarding school and education, and how students, with their own agency, pursue to deal with the impossible choices and with the emotions involved in the choices. Moreover, Lanas argues that these juxtapositions between north and south, urban and rural are constructed, performed and maintained precisely through these small everyday choices, narratives and acts.

APPLICABILITY

Interestingly, the findings of this research find congruence with some national educational challenges usually framed as “multicultural issues”, which are generally imagined to be brought on by immigration. In Lanas’s research it was noted that the “when in Rome do as the romans do” (“maassa maan tavalla”) -speech often heard in the context of immigrants to smother the discussion of culturally flexible rules (Souto, 2011), is also applied in the rural north. For rural northerners, someone else, somewhere else, determines the ways according to which everyone should live in order to earn their place in the society (M. Lanas, Rautio, & Syrjälä, (under review)).

The results of this research are applicable in education. Already during the research process itself the villagers and the school teacher used the research to build co-operation and overcome the challenges brought on by the broader sociocultural politics. The same can be done, in a focused fashion, in teacher education. Instead of blindly reproducing societal traditions of which teachers are unaware, they could be educated to interrogate these traditions in their work.

CONCLUDING WORDS

In this project we have made entrances to a field of research and science that is still fairly untouched in Finland. Research on rural education and place sensitive education are gaining footing in educational research internationally, but issues central to northern Finnish rural villages are not yet nationally recognized. This derives

1) from the fact that, being “rural northern villager” is not a distinguishing marker like ethnicity, sexual orientation, language or gender are, for which reason it is not seen to serve as the basis for arguing for cultural or other kinds of rights.
2) from the fact that in educational research, international measurable standards and international competition force research to focus on how to achieve specific standards instead of evaluating these standards or the epistemology and content of education.

Research on the relationship between place and education, funded by Thule-institute, has made significant openings into re-envisioning education in northern Finland.
References


Lanas, M., Rautio, P., & Syrjälä, L. ((under review)). Beyond educating the marginals: Recognizing life in northern rural finland.


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DEFAULT MODE NETWORK IN YOUNG PEOPLE WITH FAMILIAL RISK FOR PSYCHOSIS

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BACKGROUND

The default mode network (DMN) is so-called task negative network, which activates while resting and de-activates during task performance (Raichle et al., 2007). DMN was identified using resting state functional magnetic resonance imaging (R-fMRI). The DMN is thought to characterize basal neural activity (Raichle et al. 2001). It is localized in the ventromedial prefrontal cortex extending to the ventral anterior cingulate cortex, the posterior cingulate cortex (PCC), and the precuneus and lateral parietal cortex (Raichle et al. 2001). The DMN probably plays an important role in person’s individuality as it is believed to be responsible for spontaneous thoughts during mind-wandering/daydreaming, and it might be an essential component of creativity (Buckner et al. 2008). It is also noticed that the DMN is associated with the processing of episodic memory (Cole et al. 2010) commonly known as working memory and it may be involved in processes such as attention to internal emotional states (Raichle et al. 2007), self-referential processing (Gusnard et al. 2001) and task-independent thought (McGuire et al 1996).

DMN’s abnormal baseline activity during rest has been described in patients with psychosis (Whitfield-Gabrieli et al. 2009, Salvador et al. 2010). There is lack of research describing DMN’s activity during rest in first-degree relatives of psychotic subjects (Familial Risk, FR). In present study we applied the spatial domain independent component analysis (ICA) to resting-state fMRI data in order to identify DMN changes in subjects with FR.

METHODS

In 2007-2010, a resting state functional MRI (R-fMRI) field experiment was conducted on a 1.5 Tesla scanner in the University Hospital of Oulu, Finland. Overall 72 FR subjects and 72 matched controls (ethnicity, age, birth year) were scanned. Both groups had exactly same gender distribution. All subjects were aged 20-24 years and they were members of the general population based Northern Finland 1986 Birth Cohort. To detect FR subjects we used the Finnish Hospital Discharge register to find out parental psychosis. All R-fMRI data gathered were pre-processed using typical FSL pipeline. MELODIC PICA with model order 30 followed by dual regression approach was used to assess differences between groups. Results were corrected for multiple comparisons (p<0.05) using TFCE (Threshold-Free Cluster Enhancement).
Table 1. Demographic data on research group (mean SD or N (%))

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Education₆

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<td>41</td>
<td>(57)</td>
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a) Intelligence was assessed by Wechsler Intelligence Scale III, Finnish version.
b) One control subject was missing education data

RESULTS

In comparison with the control subjects, the FR subjects demonstrated lower levels of activation in the posterior cingulate cortex that is associated with Brodmann’s area 23 and 31. The volume of the focal maximal intensity area in control subjects as compared to FR subjects was 41mm³.

Fig.1 The default mode network in control group with model order (30) ICA.
Fig 2. The default mode network in FR group with model order (30) ICA.

Fig 3. Controls show increased connectivity in the PCC part of the DMN with model order (30) ICA.

DISCUSSION

To the best of our knowledge this was the first rather large R-fMRI study comparing the activation of the DMN between young FR subjects and control subjects. The finding emphasises the importance of PCC as a key part of the DMN which contributes to the vulnerability for psychotic disorders.

REFERENCES


FETAL EXPOSURE TO FOREIGN CHEMICALS – THE ROLE OF PLACENTAL TRANSPORTER PROTEINS

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Pregnant mothers are exposed to environmental contaminants and other foreign chemicals inevitably. Most of the foreign chemicals that have been studied so far cross the placenta at least to some extent by simple passive diffusion. The physiochemical properties of xenobiotics such as molecular weight, pKa and lipid solubility affect the transplacental transfer by passive diffusion. However, placenta expresses also multiple transport systems leading to polarized transport across the placenta (Evseenko et al. 2006; Myllynen et al. 2009). In human placenta transporter proteins are found both in the brush-border membrane facing maternal blood space and basolateral membrane facing fetal capillaries where they transfer compounds in and out of syncytiotrophoblast. Also fetal capillary endothelium expresses transporters both in apical and basal membranes. The substrate specificity of the transporter proteins is not restricted only to their physiological substrates because transporter proteins also transfer foreign compounds such as therapeutic agents, environmental pollutants and chemical carcinogens bearing structural resemblance to their physiological substrates.

Based on current knowledge transporter proteins may have a crucial effect on placental transfer and fetal exposure. A prime example is a mouse study by Lankas et al. (1998) in which the Abcb1 genotype was linked with fetal outcome after avermectin exposure: All Abcb1 deficient mouse fetuses had a cleft palate while none of the wild-type mouse fetuses with abundant Abcb1 expression in the placenta showed malformations. Interestingly, the heterozygotes expressing an intermediate level of placental Abcb1 showed intermediate sensitivity towards avermectin induced malformations. During past decade multiple studies in several species including humans have been published suggesting that ABC transporters including ABCB1, ABCC2 and ABCG2 decrease fetal exposure to xenobiotics (Jonker et al. 2000; Kalabis et al. 2005; Myllynen et al. 2008; Molsa et al. 2005; Pavek et al. 2003).

We have recently focused on heterocyclic amines which are major food borne carcinogens formed during frying meat and fish. Using ex vivo perfused human placenta we showed that placental transfer of PhIP but not that of IQ correlates with ABCG2 expression level in the placenta (Immonen et al. 2010; Myllynen et al. 2008). Although the fetoprotective function of ABCG2 (Pollex et al. 2008) and variation in ABCG2 expression in the placental tissue have been established also in several other studies (Meyer zu Schwabedissen et al. 2006) our results are the first to show that ABCG2 expression may result in person to person variation in placental transfer and fetal exposure in humans.

The expression level of transporter proteins is known to change dynamically during pregnancy (Meyer zu Schwabedissen et al. 2006). They are up- and downregulated in similar
manner to xenobiotic metabolizing enzymes (Klaassen and Slitt 2005) both exogenous and endogenous factors having affecting their expression levels. For instance ABCG2 is regulated via several different factors, such as hormonal and pharmacological factors, cytokines, hypoxia, methylation and nuclear receptors (estrogen, progesterone, Ahr, PPAR-gamma) through transcriptional mechanisms (Robey et al. 2009). Therefore, it is feasible to assume that exposure to environmental contaminants bearing estrogenic characteristics affects the expression level of ABCG2 and other transporters in the placenta. According to our unpublished results bisphenol A, a well-established endocrine disrupting chemical, down-regulates the ABCG2 transporter expression in the placental BeWo choriocarcinoma cells (Metsälä, Sieppi et al. unpublished results). However, xenobiotics may also affect transporter function without having an effect on transporter expression. We found out that cadmium inhibits the function of ABCG2 transporter leading to increased cellular accumulation of PhIP while cadmium does not affect the ABCG2 mRNA or protein expression level (Kummu et al., 2001, manuscript under preparation). Interference with ABCG2 or other placental transporter may increase the fetal accumulation of xenobiotics. However, besides the fetoprotective role other physiological roles of ABCG2 in the placenta have also been described. Placental transporters such as ABCG2 are also involved in regulating placental estrogen synthesis by mediating the concentrations of dehydroepiandrosterone sulfate (DHEAS) and estrone 3-sulfate in the placenta (Grube et al. 2007). Thus, interference with transporter function may impair placental kinetics of endogenous compounds.

REFERENCES


SPECIATION OF SMALL ALUMINIUM OXIDE CLUSTERS IN AQUEOUS ENVIRONMENT

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Aluminium is one of the most widely used metals moreover one of the most frequently found compounds in the Earth’s crust. Its ions play a very important role in many chemical and industrial processes, including alumina-based sol-gel synthesis and hydrolysis, and are used in large quantities as flocculants in water treatment plants all over the world. Due to its natural abundance, aluminium is commonly regarded as a harmless element, but despite this, high levels of the water-soluble form of aluminium may negatively affect terrestrial and aquatic life in different ways (Schowoney 2000).

Despite this, hydrolyzed Al species are widely and safely used for water purification purposes (Tchobanogous and Burton 1991) but there are still a number of factors concerning structures and chemical composition during coagulation that need to be clarified, to maximize the efficiency of these chemicals in an environmentally safe usage. For this reason, it is necessary to understand the distribution of various aluminium species and the properties of the hydrolyzed Al formed during coagulation, since these can markedly affect the flocculation process. Our group has integrated computational and experimental state-of-the-art methods in a novel way to study the aquatic chemistry of aluminium oxide clusters to develop novel materials and energy efficient water treatment chemicals for coagulation and adsorption purposes (Sarpola 2007 & Saukkoriipi 2010).
The investigation of the in situ formation of hydrolyzed Al species has been performed using electrospray ionization--mass spectrometry (ESI-MS). These measurements allow to identify that at higher pH, the polymeric tridecameric aluminium plays a key role in the flocculation process, according to the results previously obtained from different authors using NMR measurements. Moreover, a monomeric hexacoordinated cation $[\text{Al}(\text{H}_2\text{O})_6]^{3+}$ and a tetrahedral anionic aluminate $[\text{AlO}_4]$ are found with similar methods under these conditions. However, the PACI widely utilized for the coagulation of natural colloids in water treatment applications, generate solutions with an initial nominal concentration of Al(III) in the range 0.03-0.3 mM with an initial pH below 5 and very few investigations have focused on the detailed role of small oligomeric Al species, like trimeric aluminium complexes that, according to different studies, should play a key role in the hydrolysis process under these conditions. For this reason the authors has focused their attention to identify the species present in acidic environment. The obtained fingerprint spectrums in the ESI-MS technique suggest that the trimeric cations were the most abundant species and that their formation is causing the depletion of the monomeric and dimeric cations. Also, in a speciation study considering oligomeric species generated by water treatment chemicals, trimer turned out to be definitely the only detected oligomer along with the well-established Al polymers. When an independent component analysis (ICA) was applied to the mass spectra of aluminium sulphate, one of the three independent components consisted of signals that could merely be assigned to the trimeric species. All this refers to a remarkable role of the trimeric species in the hydrolysis process of aluminium.

Despite the success of this approach in the study of aquatic aluminium, there are still many phenomena that cannot be unambiguously resolved by these measurements. The results previously obtained from the authors clearly prove that computational studies can provide additional information on structures, stability and electronic properties of aluminium compounds in aqueous environment. However, the previously applied constrained-MD approach is not optimally suited for such a study (Lanzani et al. 2011). Besides being computationally time demanding, a strong bias is imposed on the reaction pathway that it is going to be explored, thus being not flexible enough to thoroughly explore the configuration space. The metadynamics approach is, instead, more flexible and the investigator bias on the explored space can be systematically reduced (Laio and Parrinello 2002). Neither initial estimates nor the knowledge of final and intermediate states are required. Moreover, metadynamics provides a faster and efficient procedure to estimate free energies and barriers. The method is based on an artificial dynamics (metadynamics) performed in the space defined by a few collective variables, which are assumed to provide a correct coarse-grained description of the processes of interest. Therefore, this approach is suitable to investigate the transformation pathways involved in the structural rearrangement of trimeric aluminium complexes in aqueous environment.

The forming reaction of the trimeric aluminium complexes and their transformation between cyclic and linear structures has been studied in liquid water by metadynamics (CP2K 2011). The first task was the selection of the relevant collective variables that are able to describe the transformation pathway also can provide an accurate representation of the free energy surface $F(s)$. To find the most
important structural parameters that distinguish the different conformers, the linear and cyclic structures have been first optimized in gas phase, and then equilibrated at finite temperature into a 16.0 Å cubic cell containing 141 water molecules. This system size is sufficient to represent a solvated Al cluster in water, avoiding spurious effects due to interactions with the periodic images. On the other hand, it is small enough to allow the simulation of several picoseconds per day on the available computational facilities. However, the cell is too small to be used for the estimate macroscopic properties such as pH or concentration. The MD simulations have been carried out in the canonical ensembles (NVT) using the Quickstep approach that is based on the Gaussian and plane waves method (GPW). The temperature of the simulations is kept constant at 300 K by means of the chain of Nose-Hoover thermostats with a characteristic frequency of 2500 cm⁻¹, which was fixed high enough to ensure that the OH moieties were thermostated properly and to have a better control of the fictitious kinetic energy. The equations of motion were propagated using velocity Verlet algorithm. The time step is 1 femtosecond, which is small enough to integrate correctly the equations of motion, since deuterium has been used instead of hydrogen. Becke-Lee-Yang-Parr (BLYP) density functional was used throughout the simulations. It was selected for the investigations due to the proven accuracy in describing the structural characteristics and the stability of the aluminium (III) in aquatic environments. Gaussian basis sets of triple-valence quality (TZVP-GTH) and periodic boundary conditions have been used for the simulations. Detailed information and reference about the computational methodology used have been described in detail elsewhere (Lanzani et al. 2011). After solvation and energy minimization, the systems were equilibrated for 25 ps. The analysis of the parameter’s evolution during these two simulations suggested choosing as CV the root mean square displacement (RMSD) regarding the atoms constituting the Al-O ring, and the difference of distance (DD) between metallic atoms. It has to be noticed that this choice of CV is partially biasing the simulated process. Indeed, by using these variables the three linking O atoms of the cyclic structure are treated as special O atoms, and they are not equivalent. Moreover, the opening of the ring is going to occur at one specific linking O atom. Evaluation of how this bias can affect the description of the process and the estimate of the free energy is still possible a
The choice of different sets of variables is also possible, but it is going to require additional computational time. One can always consider these options, in the case it turns out that the bias might alter the understanding of the process. Along the metadynamics simulation, history-dependent Gaussian hills (MTD potential) are added to the underlining potential to modify the statistical probability of already visited configurations. This potential builds up until it counterbalances the local underlying free energy, allowing the system to escape to nearby minima. If the exploration is carried out smoothly and the system has the time to sufficiently sample each not-equivalent (in the sense of the CV) configuration, the procedure is going to lead the trajectory along the minimum energy pathway, which connects all the intermediate states. When all minima are sufficiently sampled, the system should be able to move barrier-less over the whole space, since the sum of the underlying free energy and MTD potential should result in an almost flat potential landscape (maximum corruation of the order of the hill size). Hence, once these conditions are verified, the free energy surface can be estimated as the negative of MTD potential. The simulation has been protracted for 210 ps. This simulation time has been sufficient to observe the chemical behavior leading to the transformation of interest here. Also this simulation was performed at 300 K. The settings for the MTD potential are given by the hill's height, 0.0027 eV, and the hills' width assigned through CV scaling factors, 0.15 and 1 for RMSD and DO, respectively.

In Fig. 2, the free energy surface for the system [Al$_2$O$_4$]$^{1^+}$ + 141 H$_2$O is plotted as a function of the two CV. The geometries corresponding to the local minima (marked with red letter) and saddle points (blue letter) are reported as well. Following the results of the simulation, it is possible to draw the energetic scheme reported in Fig. 3 that identify a reaction path for the formation of a compact ciclic trimeric cluster (structure G) starting from monomeric and dimeric clusters (structure A). It is remarkable to notice that the reaction path here identified involve a multistage mechanism and it is not single step process, as suggested previously from the results of constrained dynamic simulations (Lanzani et al. 2011). The overall result was a spontaneous multistage reaction ($\Delta F = -0.86$ eV) with the biggest activation barrier of 0.53 eV. In similar way it is possible to identify a reaction path connecting the cyclic trimeric cluster (structure G) to the linear one (structure N). The G cluster is opening to generate a new structure constituted of a ring of four atoms, two aluminum atoms and two oxygen atoms of a bridging hydroxyl groups, connected with the remaining metallic atom (structure I). This could afterward open to generate the linear trimer (structure N). The corresponding free energy barriers are estimated to be 0.71 eV for the formation of the I trimer and 0.49 eV from the I trimer to form the linear trimer. It has been observed that cyclic trimeric aluminium cluster (G structure) is 0.87 eV more stable than the linear one.

It is possible to conclude that several interesting observations have been made, and unexpected pathways have been determined. Most importantly, we remark that indeed the metadynamics technique offers great advantages over other, previously applied methods (Lanzani et al. 2011), to enhance the sampling of the configuration space. A reliable estimate of the free energy surface subtending the process has been possible.

REFERENCES

Toward eco-efficient use of resources in chemical industry
Separation technologies for waste minimization

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INTRODUCTION

In recent decades the environmental performance of chemical industry has substantially improved and cleaner technologies have been adopted. However, chemical industry continues to contribute to global change and other major environmental problems.

Human health and environmental quality are undergoing continuous degradation by the increasing amount of hazardous wastes being produced during manufacture, storage, transport, use of disposal of chemical products. In addition, the chemical industry is also a major energy and water consumer. The main waste management route for chemical wastes, especially hazardous waste is disposal and physical or chemical treatment. There is a need to prevent or minimize hazardous waste generation by improving chemical industry’s waste management practices. Versatile, portable, small-scale, resource-efficient effluent treatment technologies are needed to be used within the process, to achieve waste minimisation within industry and to reduce industry’s impact on environment and to enhance the sustainable use of northern resources. On-site recycling by the use of separation technologies is a key tool for reducing the amount of hazardous wastes exiting in industry, as well as the resources use in industry. This would ultimately result also in cost reduction for industry, and thus promote eco-efficiency.

The main objective of this research project is to promote an eco-efficient use of resources by the use of membrane technologies for the on-site recovery of hazardous components from chemical effluents. The use of membrane technologies can also lead to the possibility of utilizing valuable compounds recovered from the effluents, thus contributing to resource (use) optimization.

REMOVAL OF HEAVY METALS FROM PHOSPHOROUS RICH WASTEWATERS

Phosphorous (P) is a fundamental nutrient for living organisms and for crop production. However, in excess, nutrients such as phosphorous often cause environmental problems such as eutrophication of aquatic ecosystems and pollution of groundwater. Most of the phosphate fertilizers are produced by processing phosphate rocks with sulphuric acid or nitric acid. Modern agriculture is dependent on phosphate fertilizers and it is estimated that the demand for phosphorous fertilizers will increase during the next 50 years in the range of 50-100 % due to the increase in population, demand on meat and dairy-based diets and non-food crops like biofuel crops. There is a concern that the exploitation of this non-renewable resource to meet the current demands is not sustainable. Therefore, in order to increase the life expectancy of the world’s phosphorus resources, to make the fertilizer production more sustainable and to reduce the anthropogenic impact of phosphorous, special attention has grown towards the recovery of phosphorous from waste streams.

This research was conducted in collaboration with a fertilizer company, which was interested in recovering phosphorous from their phosphorous rich drainage waters. However, the drainage water
contains heavy metals as well such as cadmium and copper, which need to be removed from the waters prior to their utilization in-site. Metal inputs to agricultural soils via mineral fertilizers are of great concern due to their potential risk to the environment and human health. When heavy metals are in the soil, they can accumulate in less soluble forms, be transferred to watersheds through leaching and erosion and enter in the food chain. In this study, Micellar-enhanced ultrafiltration (MEUF) is proposed to be a viable technique to remove heavy metals from phosphorous rich wastewaters obtaining the purification of the nutrient rich effluents for further utilization in-site.

MICELLAR-ENHANCED ULTRAFILTRATION (MEUF)

In MEUF, the anionic surfactant forms large amphiphilic aggregate micelles when it is added to aqueous streams at a concentration higher than its critical micelle concentration (CMC). The heavy metal cations can be more tightly trapped by the micelles due to electrostatic interaction and thus are retained by the ultrafiltration membrane. Anionic phosphates will not be trapped by the micelles and they will pass through the membrane to the permeate leading to the separation from the heavy metals. In addition, the metal cations not trapped by the micelles and the surfactant monomers will also pass through the ultrafiltration membrane to the permeate side. Fig. 1 shows the schematic diagram of the micellar-enhanced ultrafiltration process.

Fig. 1. Schematic diagram of the Micellar-enhanced ultrafiltration process.

STATISTICAL DESIGN OF EXPERIMENTS

Traditionally, the study of MEUF has been conducted using the one-variable-at-a-time approach, where the effect of each factor is investigated separately. However, this approach implies a significant amount of experiments and, therefore, an inefficient use of resources. Further, the process optimization using the one-variable-at-a-time approach is inefficient due to the difficulty of finding the true optimum in a reasonable amount of experiments. The use of statistical experimental methods overcomes the limitations of the one-variable at a time approach. The use of statistical experimental design reduces the number of experiments needed for the analysis of the main effects, for process modeling and for simultaneous optimization of several process variables. In this way, use of time, raw material and natural resources is decreased.
In this case study statistical design of experiments is used to study the effect of pH and surfactant feed concentrations (Table 1) on the rejection coefficients of cadmium and copper. The rejection coefficients of the heavy metals are described as following,

\[ R_i = 1 - \frac{C_p}{C_r} \]  

(1)

where \( i \) is the compound analysed, \( C_p \) is the concentration of the i compound in the permeate and \( C_r \) is the concentration of the i compound in the feed.

**Table 1. Factors and levels studied.**

<table>
<thead>
<tr>
<th>Factors</th>
<th>Level</th>
<th>Star points (-)</th>
<th>Low (-1)</th>
<th>Centre (0)</th>
<th>High (+1)</th>
<th>Star points (+)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDS feed concentration (mM)</td>
<td>31.7</td>
<td>40.0</td>
<td>60.0</td>
<td>80.0</td>
<td>88.3</td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>3.20</td>
<td>3.50</td>
<td>4.25</td>
<td>5.00</td>
<td>5.31</td>
<td></td>
</tr>
</tbody>
</table>

**RESULTS**

The phosphorous was not retained by the micelles and passed through the ultrafiltration membrane. Therefore, the success for separating the nutrient from cadmium and copper was shown to be dependent on the removal efficiency of MEUF towards the heavy metals. The results showed that increasing the surfactant the feed concentration increases the rejection coefficients of cadmium and copper. In addition, low pH shows better performance, achieving higher rejection coefficients of cadmium and copper.

Table 2 summarizes the experiments conducted and the results achieved when simultaneously removing heavy metals using Micellar-enhanced ultrafiltration.

**Table 2. Experiments conducted with the real wastewater and the rejection coefficients obtained for cadmium and copper.**

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Factors</th>
<th>Responses</th>
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<tbody>
<tr>
<td></td>
<td>( C_{SDS} ) (mM)</td>
<td>pH</td>
</tr>
<tr>
<td>1</td>
<td>40.0</td>
<td>3.5</td>
</tr>
<tr>
<td>2</td>
<td>80.0</td>
<td>3.5</td>
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<td>3</td>
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<td>4</td>
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<td>5</td>
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<td>6</td>
<td>88.3</td>
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<td>7</td>
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<td>8</td>
<td>60.0</td>
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<td>9</td>
<td>60.0</td>
<td>4.25</td>
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<tr>
<td>10</td>
<td>60.0</td>
<td>4.25</td>
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<tr>
<td>11</td>
<td>60.0</td>
<td>4.25</td>
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</tbody>
</table>
CONCLUSIONS

The novel output of this study is that MEUF has been proven to be a viable technique for separating phosphates from heavy metals since phosphorous was not retained by the micelles and passed through the ultrafiltration membrane. Therefore, the research presented in this manuscript could lead to novel uses of MEUF for the purification of nutrients from wastewater streams prior to their recovery. This could lead to a change of paradigm in viewing nutrients such as phosphorous in wastewaters as valuable resource rather than a pollutant and, ultimately, contribute to closing phosphorus cycles in anthropogenic systems.
CLIMATE WARMING AFFECTS PHENOLOGIES AT SEVERAL TROPHIC LEVELS – A NORTHERN PERSPECTIVE

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Warming springs would result in trophic mismatches if temperature responses varied in different levels of the food chain. We studied how spring temperatures correlate with phenology at four trophic levels in a boreal food chain (birch – caterpillars – passerine birds – birds of prey) and how the respective temporal trends in timing vary. We tested the “temperature hypotheses” that a mismatch would rise due to the unequal increases of early and late spring temperatures. We examined breeding success in relation to the synchrony with the caterpillar food peak in a boreal passerine (willow tit Poecile montanus) and two broad leaved forest specialists (blue tit Cyanistes caeruleus and great tit Parus major, which are considered as new-comers at high latitudes) using (generalized) linear models. Phenology is highly temperature related at all trophic levels, but the responses vary and thus temporal trends differ. Insects have advanced the most with warming springs. However, climate change has not induced mismatch with the caterpillar food peak in any of the three tit species we studied in northern Europe. Instead, migratory pied flycatcher (Ficedula hypoleuca) is facing mismatch. Our results show only moderate influence of synchrony in breeding success of boreal and southern passerines. The study provides an interesting point of comparison to the studies carried out in the Central Europe, also concerning several trophic levels.
Organic rich sediments and suspended solids in drained peatland catchments

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ABSTRACT
Sediment delivery and erosion processes have been studied in a number of peatland drainage areas and catchments in order to determine the effects of drainage on sediment and erosion dynamics and mechanics. This information is necessary for water protection management of catchments where sediment cause a serious risk to water courses. Results from recent studies performed in peatland forestry and peat mining in Finland are shortly reviewed and discussed. The issues especially covered are erosion and transport of organic peat material and future challenges.

KEY WORDS sediment transport; erosion; peatland drainage; organic and inorganic sediment; future challenges

INTRODUCTION
Peatlands are an integral part of northern landscape. They function as a transition zone between upland and aquatic systems, storing and attenuating waters between these zones, and affecting waters passing through them. Peatland drainage alters this natural transit and affects strongly to peatland hydrology, vegetation and transport of dissolved and particulate matter. Increased transport of organic sediments has resulted in eutrophication, sedimentation and loss of biodiversity in downstream watercourses, especially to headwater areas. In natural conditions these headwaters supply little sediment and are valuable habitats. Excess sediment changes stream and lake bed (bottom) characteristics, aquatic biodiversity and spawning grounds.

In Finland, peatlands have been used centuries for agriculture, forestry and peat mining. At present, 70 000 ha of open-drained land are maintained every year for forestry (Statistical Yearbook of Forestry, 2008) and 65 000 ha for active peat mining (Väyrynen et al., 2008). These activities result in significant sediment loads, especially organic particulate matter, to surface waters. Plans are currently being developed in Finland to increase drainage in order to maintain the forestry drainage network and increase bioenergy supply from drained peatlands. Recently, suspended sediment transport has been classified as most harmful pollutant from forestry areas (Finer et. al. 2010). Thus, non-point pollution and erosion are key water quality problems in peatland drainage.

SEDIMENT TRANSPORT AND EROSION PROCESSES IN DRAINED PEATLAND AREAS
Sediment transport processes must be understood if pollutant loads from peatland drainage networks are to be decreased. These processes relate to discharge and its spatial and temporal variability; and to local hydraulics where water volume, velocity, transport capacity and their spatial and temporal changes determine the load transported (Martiila 2010).

In natural peatlands, nutrient leaching is controlled by plant uptake and microbial activity, while dense ground vegetation controls suspended solid transport. Therefore, there is only minor
leaching of nutrients or erosion. Further, catchment properties such as slope, topography, soil and sediment type, vegetation and landuse determinates the rate of erosion. Processes of erosion can be divided into three distinct processes (Evans and Warburton 2007); wind erosion, water erosion and chemical oxidation. Peatland drainage enhances erosion conditions and large amounts of suspended solids transport to downstream directions can occur (see review by Marttila 2010). Peatland forestry drain maintenance operations have similar effects. Further, drainage increases organic matter decomposition which increases erosion and weathering of drainage channels.

The observed sediment transport concentrations from drained areas are high (up to 2800 mg l⁻¹) and illustrate the potential for rapid removal of organic peat or inorganic sediment from drains. Contrary, in natural peatland, runoff contains usually only 1–10 mg SS l⁻¹. Drainage increases the response rate, increasing peak flows in the channels, increasing drainage density and hydrological connectivity, and causing increasing erosion of drainage channel bed and walls, especially if drains extend into mineral soil under a peat layer. Previous studies have emphasized the importance of the spring snowmelt period, while recent studies show a dramatic difference in sediment transport processes and underlying mechanics between peak hydrographs (Marttila & Kløve, 2008, 2010). Summer peak flows can play a dominant role in annual sediment yield.

Generally erosion in peatland drainage can be attributed to few factors: i) drainage operations produce suspended solids to transport; ii) drainage ditch is subjected to shear stress by flowing water; and iii) ditches are exposed to rainfall and weathering processes, which produce sediment for delivery. Additionally, in peat mining iv) suspended solids is typically eroded from bare production surfaces in interaction with surface runoff and rainfall. In peatland forestry, erosion usually decreases over time, but the erosion yield can increase significantly if drainage channels extend into the mineral soil below the peat profile. Bare peat surface and poorly decomposed peat layers and coarse mineral soils are more resistant to erosion. It is evident from the literature that the effect of drainage is highly dependent on local conditions. The main drains, which collect large amounts of runoff and are located in shallow peat areas, pose the clearest risk of erosion.

Rain, snowmelt and runoff are the major causes of erosion in drained areas. Weathered material is rapidly exported because of the low density of the peat. In addition, peat properties affect erosion processes and yield. In blanket peatland areas, the sediment supply features have been shown to control the sediment yield (see Evans and Warburton 2007) including intra-storm, inter-storm and seasonal changes. Spring snowmelt and storm events erode ditch banks, with the majority of SS transport occurring during such events. Bank erosion has been observed to significantly affect the fluvial sediment budget.

In peat mining areas erosion processes differs from peat forestry areas as whole peat surface is subjected to erosion. In these areas, rain and peat mining operations deliver sediment from the bare soil surface to ditches, whereas with erosion in peatland forestry the source of sediment is channel erosion (Marttila & Kløve, 2008). The nature of sediment supply controls the sediment load from these areas. Rainsplash and micro-rill formation are dominant processes for overland flow-induced sediment production (Kløve, 1998), but channel inter-storm storage and flow transport capacity control the sediment load transported downstream (Marttila & Kløve, 2008).

The rain splash force and surface infiltration capacity define the erosion conditions at production surface and erosion is largest in the beginning of the rain event (Kløve 1998). Organic matter content affects detachment, and the sediment transport at peat surface is affected by the
transport capacity of micro-rills on the peat surface. The suspended solids peaks are highest during summer storm events when peat is dry, light and partly hydrophobic, but autumn rainfall and spring snowmelt also cause remarkable SS concentrations.

For more details on peatland drainage influences, see Kløve (1997), Joensuu (2002), Holden et al. (2004) and Marttila (2010) for excellent reviews of previous research at peatland drainage sites regarding impacts on water quality, hydrology and erosion.

PROPERTIES OF ORGANIC SUSPENDED SOLIDS AND ORGANIC RICH SEDIMENTS
By their very nature, peatlands involve the presence of organic material. As in-channel processes dominate the rate of sediment transport, the bed sediment properties play an important role for sediment entrainment, while the characteristics of transported particles affect settling behaviour. The formation of flocs and floc settling are strongly affected by particle concentration and properties (size and composition); flow conditions, chemistry, water temperature and microbiology; and electrochemical forces (see review by Marttila 2010). The sedimentation of fine sediments occurs only when local boundary shear stress is below a critical value for settling. The bulk density of organic sediment is low, resulting in easier siltation of bed material. The critical shear stress for erosion is the leading factor for particle entrainment from the bed surface.

The near-surface structure of deposited cohesive sediment beds depends on the structure of particles, flocs and aggregates that settle on the bed. Furthermore, sediment properties such as organic and inorganic content, water content, permeability, biological activity, gas content and dry and moist bulk density determine the erodibility (see review by Marttila 2010). Mixtures of organic and inorganic sediments behave differently; increasing proportion of inorganic material decreases the critical shear stress. Sediment stratification structure can be described as the formation of settling aggregates, where sediments layers form as compacted deposited particles (Krone 1999). The erosion strength increases during the time between the end of the deposition and start of the erosion, which is called ‘consolidation’ time. In contrast to non-cohesive sediments, it is currently not possible to generally predict the critical erosion stress of cohesive sediments from one or more easily measurable parameters, such as grain size distribution. Few multiclass models have also been developed (Ganaoui et al. 2004). However, usually, sediment erosion and transport models do not include aggregation of suspended sediment or consolidation of the deposited sediment which are essential processes in the natural cycle.

The study of cohesive sediment properties and processes should contain both laboratory and field experiments. The conditions in the laboratory can be controlled and occasional processes can be isolated and further studied. However, field studies allow examination of undisturbed sediments, long-term dynamic equilibrium between erosion and sedimentation and natural seasonal processes affecting sediment properties including desiccation, oxidation, freeze-thaw and biofilms.

CONCLUSIONS
New information on sediment erosion and transport processes in drained peatland areas help to improve water quality control in these areas. Direct erosion and transporting forces result from intensive storm flows, which erode material from the soil surface in peat mining areas or from the drainage channel base and side walls in peatland forestry areas. In-channel processes are important for both peatland uses, since the drainage network often constitutes temporary inter-storm storage for eroding and transporting material. Therefore, controlling these processes is a key to effective water quality management.
Even though, we have basic understanding from organic rich sediments and suspended solids we still have a lack of information related to organic peat sediment properties such as erosion and settling behaviour of natural sediment mixtures, bed armouring and biofilms (see Marttila 2010). Also organic rich material bound nutrients and their bioavailability need further studies. Future studies should also focus on transformation of organic material in fluvial network. For example, how does organic particulate material break up during transport from drainage areas to headwaters and further to larger water courses? This relates to transport and settling behaviour and connections to nutrients, dissolved organic matter and humus formation, hyporheic conditions and further to transport modelling. Little or none have been done to fingerprint organic material transport from land uses to downstream. Also biological and ecosystems connections in organic rich environments and beds still need further studies. All these questions are worked at the moment, to get better understanding of our valuable peatlands and connections in headwaters ‘were the land meets the water’.

REFERENCES
Boreal forest brook restoration using wooden structures

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ABSTRACT

Headwater brooks are ecologically valuable habitats for many species. Extensive drainage operations in Finland, have altered the state of small boreal forest brooks reducing biodiversity. One option to restore altered brooks is to use passive wooden structures to improve local hydrodynamic conditions. For this reason, wooden restoration structures were studied in laboratory and on site to find best restoration structures to restore brooks suffering from excessive sediment load. In this paper, results from recent studies performed in forest brooks in Northern Finland are shortly reviewed and discussed.

INTRODUCTION

Small forest brooks are ecologically valuable habitats for many species. They are important e.g. for brown trout (Salmo trutta L.) as spawning and rearing grounds. In Finland, these habitats have, however, changed after extensive peatland drainage operations during 1950-1980. Many brooks have been dredged and straightened and increased landuse in catchment areas has dramatically increased sediment transport to natural channels. This has caused sedimentation of organic and inorganic sediments to brooks beds causing reduced biodiversity and spawning grounds of migrating fishes (Yrjänä 2003).

Restoration methods for brooks are various. Basically they can be divided into two classes, active and passive methods. Active methods include dredging of the settle sediment from brook bed, changing stream profile, building new spawning grounds by adding gravel. In catchment area it may include building of overland flow fields, sedimentation ponds or other water protection methods. Contrary, passive methods are aiding the brook to change towards a more natural state for example by adding wood debris and stones (Hassan et al. 2005). They can also be used to build dams and deflectors into the brook. The effects of different methods are not very well known. Bed scouring has been studied by Biron et al. (2004), Raikar and Dey (2005) and Dey and Singh (2008), but no information can be found how these methods function in small brooks. Passive methods can be expensive and often it does not remove the source of the problem e.g. water quality. Therefore, catchment restoration or improved water protection actions needs to be done together with channel restoration.

Restoring forest brooks for trout spawning often demands gravel adding. The main problems are covering the spawning gravel by transported sediment and erosion of the gravel itself (Pekkala and Pekkala 1995). Water flow velocity is the most important factor in sedimentation and transportation
of sediment and gravels. It can be manipulated by changing channel shape and building different structures for changing flow direction and velocity. Furthermore, the brooks natural flooding processes can be aid using wooden structures effecting especially to sediment yield and natural sorting. This paper reviews shortly studies made in forest brooks which suffer extensive sediment load from land uses and passive methods tested to improve channel local conditions.

METHODS

Studies were made in field and laboratory conditions (Tammela et al. 2010, Marttila et al. 2011). In altered brooks flow conditions using continuous and local hydrodynamic measuring, and tracer experiment were studied before and after brook restoration. Sediment transport, brook bed conditions and catchment erosion conditions were intensively sampled. The main focus was on brook hydraulics, flow peak attenuation, brooks local bed conditions and sediment transport and further how restoration affect them. Also catchment geomorphological factors were studied. Aims were to obtain information about channel geometry for restoration purposes and to study brook response to extensive sediment load from land use.

Problems with gravel adding were studied at Porojoki-stream using 2 dimensional water flow modeling to determine suitable places for adding spawning gravel to a riffle section. The aim was to find places which would have suitable flow velocities and water depths for spawning of brown trout but also stabile areas during flood conditions.

In laboratory, restoration structures were studied in a laboratory flume to understand their capability to modify the siltated brook bed. Similar structures were built into field sites where the overall functionality was observed. In laboratory, structures were tested with two different sediment grain sizes in flood flow to study the effects of restoration structures on sediment movement and flow fields.

RESULTS AND DISCUSSION

In laboratory flume tests (Tammela et al. 2010), a structure built perpendicular to flow (Fig. 1) direction was proved to be most efficient in scouring. However, it created a homogenous cross section scour and sediment pack after the structure. Changing the angle towards flow direction created larger scour in area and sediment settles to side of a channel leaving minimum flow channel to the other side. Structures had a very small effect to water surface elevations upstream from the structure. In the beginning of test run surface elevation was significantly higher, but after scouring started, the surface elevation dropped back to original level. Same observations were done in field experiment sites. Sediment moved from 1 to 2 meters from the structure. During summer low flow situations dark organic sediment settled to scour holes. Structures had no effect on water surface elevation but deeper water areas were created because of scouring e.g. providing shelter areas for fishes.
The results from field experiments (Marttila et al. 2011) showed that headwater meandering parts have limited sediment transport capacity and can require a long period to recover from extensive sediment input from peat drainage. However, different reaches can be prioritised for restoration according to the characteristics of silted bed sediment or sediment origins. Sites silted with fine fractions need only minor restoration actions, whereas coarser fractions such as coarse sand may require heavier operations. The values of hydraulic depth fell within the range presented in the literature. Brook width appeared to have large natural variation, causing great local velocity variations. This needs to be taken into consideration when restoring straightened reaches in small headwater areas; e.g. width in restored reaches cannot be uniform but should include variations. The morphology values and other details of channel geometry variations obtained in the study can be useful when considering restoration actions for small brooks, especially those that are fully drained and straightened and where local channel formations cannot be adapted from adjacent pristine channel sections.

Salt tracer test were carried out before and after restoration to study the change in flood peak attenuation. In addition to wooden and stone structures, some sedimentation pools were built. A change in flood retention was observed and tail in retention curves became longer. This indicates
that some of tracer remained in pools and turbulences for some time creating more connections with hyporheic zone. Also slightly increased in water depths extends retention curve tail.

Spawning gravel was placed to Porojoki-stream by modelling results. Optimum places given by modelling were not used because difficulties in gravel transportation. Gravel moment has been observed visually once and only little movement was observed.

CONCLUSIONS

Episodic erosion processes caused by forest drainage have led to extensive siltation of brook reaches in Finland. Consequently, the restoration work required needs to be prioritised, for example by categorising altered reaches according to their ability to transport sediment. Wooden restoration structures are useful to change local bed conditions in altered brook reaches. They also affect to brook hydrodynamics. Results from the laboratory test can be used to create optimum structure and location. Flow modelling can be used to determinate optimal gravel locations, but in practise it is not always possible to add gravel to these locations.

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MOTHERS’ AND FATHERS’ JUDGEMENTS OF THEIR INFANTS AND TODDLERS BY USING THE BRIEF INFANT-TODDLER SOCIAL AND EMOTIONAL ASSESSMENT (BITSEA) IN THE NORTHERN FINLAND

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BACKGROUND

There is a lack of studies comparing mothers’ and fathers’ assessments of their children’s behavior and skills, especially considering infants and toddlers. The few earlier studies report good inter-rater agreement between the parents in evaluating their infants’ and toddlers’ social-emotional competencies and problems by using the Brief Infant-Toddler Social and Emotional Assessment (BITSEA)(Karabekiroglu et al. 2009, Briggs-Gowan and Carter 2006, 2004). However, there are no earlier studies examining possible differences between mothers and fathers in their BITSEA assessments. By means of this study it is possible to acquire remarkable information about social-emotional development and problems in young Northern Finnish children and their parents’ experienced challenges in parenthood.

OBJECTIVE

The aim of this study was to explore differences and similarities in the way Northern Finnish mothers and fathers assess their infants’ and toddlers’ social-emotional skills and problems by using the BITSEA.

METHODS

The data collection was carried out in collaboration with public health care nurses in child health centres. The BITSEA questionnaires were delivered to parents with a 12/18-month-old child attending a routine health examination by the nurse in all child health centres in Oulu. In the years 2008-2009 both parents of 18-month-old children (n = 173, 98 girls, 75 boys, M = 19.4 months ± 1.4) filled in the BITSEA. In the years 2010-2011 our data collection was carried out among 12-month-old children and their parents (n = 185, 94 girls and 91 boys, M = 13 months ± 1.1). Concerning the 18-month-old toddlers the parents also filled in the Child Behavior Checklist (CBCL) 1½-5 (Achenbach and Rescorla 2000), the Parenting Stress Index (PSI, Abidin 1990), The Infant Characteristics Questionnaire (ICQ, Bates et al. 1979) and a background information form. The parents of the 12-month-old infants filled in the same questionnaires, excluding the CBCL 1.5-5 which is not appropriate for younger than 18-month-old children. The parents filled in the questionnaires at home and returned them to the researchers by post. Those children who were scored as having possible problems and/or deficits in competencies in the BITSEA and/or PSI and a typically developing control group were invited with their parents to a clinical child psychiatric examination in
Oulu University Hospital. The data was analysed by PASW 18v program using the Wilcoxon test (two related samples) and Cohen’s Kappa.

RESULTS

The 18-month-old toddlers: Maternal BITSEA competence mean score was significantly higher than paternal mean score both in boys (M = 17.6 vs. 16.7, p = .016) and girls (M = 18.6 vs. 17.8, p = .033). Agreement between mothers’ and fathers’ competence ratings was fair in boys (κ = .18) and poor in girls (κ = -.06). Maternal BITSEA total problem mean score was significantly higher than paternal in boys (M = 8.8 vs. 6.5, p = .001), but not in girls (M = 6.2 vs. 6.1, NS). Agreement between mothers’ and fathers’ total problem ratings was fair in boys (κ = .25) and moderate in girls (κ = .42). By the BITSEA Examiner’s Manual (validated for 12 to 36 –month-old children in USA), at the age of 18 to 23 months the competence cut score was 14 for both genders and the total problem cut score was 15 for boys and 13 for girls (Briggs-Gowan and Carter, 2006). So far we do not have any cut scores validated for Finnish children.

![Bar chart showing BITSEA competence mean scores in boys and girls](image1.png)

**Fig. 1.** The BITSEA competence mean scores in the 18-month-old toddlers by mothers and fathers

![Bar chart showing BITSEA total problem mean scores in boys and girls](image2.png)

**Fig. 2.** The BITSEA total problem mean scores in the 18-month-old toddlers by mothers and fathers
The 12-month-old infants: There were no significant differences between the competence mean scores by mothers’ and fathers’, neither in boys (15 vs. 14.7, NS) nor in girls (15.6 vs. 15.7, NS), or between parents’ ratings in the total problem mean scores in girls (5.9 vs. 5.6, NS). A suggestively significant difference was found between parents’ ratings concerning the total problem mean scores in boys, as mothers rated higher problem scores to boys than to girls (6.5 vs. 5.8, p = .049). Agreement between mothers’ and fathers’ competence ratings was moderate in boys (κ = .47) and poor in girls (κ = .01). Agreement between parents’ total problem ratings was fair in boys (κ = .29) and poor in girls (κ = .04). By the manual, at the age of 12 to 17 months the competence cut score was 12 and the total problem cut score was 13 for both genders (Briggs-Gowan and Carter, 2006).

![Fig. 3. The BITSEA competence mean scores in the 12-month-old infants by mothers and fathers](image)

![Fig. 4. The BITSEA Total problem mean scores in the 12-month-old infants by mothers and fathers](image)

In our study, concerning all age and gender groups, the competence mean scores were quite at the same level comparing to those in USA; there in 18 to 23–month-old boys 17.3 and girls 17.7, in 12 to 17–month-old boys 15.4 and girls 15.7 (Briggs-Gowan and Carter, 2006). On the contrary in our study the total problem mean scores were fairly low, again in all age and gender groups, when comparing to those in USA; in there 18 to 23–month-old boys had mean score 9.9 and girls 9.2, and
correspondingly 12 to 17-month-old boys 8.2 and girls 7.7. Similarly as in USA, in the both age-groups girls scored higher in competence items than boys and boys scored higher in problem items than girls. When comparing the Finnish samples of 12 and 18-month-old children, both genders in the younger group scored lower in competence scores and in total problem scores, than the older ones.

DISCUSSION

Mothers seem to perceive their toddlers’ (18-month-old children) social-emotional competences more sensitively than fathers do. Same kind of significant difference between parents’ ratings cannot be seen in infants (12-month-old children). Parents’ inter-rater agreement concerning their children’s competences was lower when assessing girls than in assessment of boys. Mothers might experience their little sons more challenging than fathers do. Further research is needed to elucidate factors behind these preliminary results.

REFERENCES

Experienced maternal stress and toddler’s behaviour

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Background: Infant’s development has many phases and developmental wellbeing is mainly depending on parental care.

Aims: To examine relations between maternal stress in infancy and follow-up toddler’s behavioural development from 50 mothers of infants (16 boys and 34 girls), who participated in this study. Mothers’ educational levels varied from students to professionals and households’ educational level varied from lower secondary level to tertiary levels which are typical educational levels at Oulu region.

Methods: Mothers rated their own parenting stress with the Parenting Stress Index- Short Form (PSI, Abidin, 1999) when their infants were eight months of age and rated their toddlers’ development at 18 and 36 months of age with the Childrens’ Behavioural Checklist (CBCL, Achenbach 2001, Finnish version by Almqvist 2001).

Results: Maternal stress in the parenting role and in the parenting-child-interaction at infant’s age of eight months was correlated with the toddler’s behavioural problems. Conclusions: Mothers reporting stress during the first year of the infant’s life experience their infants as having greater behavioural problems. Future work is needed to address relations between early maternal stress and parenting practices and observed toddler behaviour.
METABOLIC ADAPTATION OF THE GREAT TIT (PARUS MAJOR)

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INTRODUCTION

Metabolic rate is a key trait in the energy management of small birds. In winter, high metabolic capacity is needed to survive in low ambient temperatures. The most common variable for measuring metabolic capacity is basal metabolic rate (BMR), which defined as metabolic rate (oxygen consumption) in a resting, post-absorptive animal at thermoneutrality. Because the physiological energy equivalent of oxygen is very closely the same for all metabolic fuels (ca. 20.1 kJ/liter), it can be used as an index of energy use. Another important variable is resting metabolic rate (RMR), which measures the energy cost of maintaining homeothermy at various ambient temperatures. Here, we describe the main results of our project on metabolic adaptation of the great tit (Parus major) to winter.

![Graph showing basal metabolic rate (BMR) of great tits originating from Lund or Oulu and cross-fostered by female great tits in Oulu.](image-url)

Fig. 1: The basal metabolic rate (BMR) of great tits originating from Lund or Oulu and cross-fostered by female great tits in Oulu (redrawn from Broggi et al., 2005). N=6-8, shown are means ± S.E.M.
PHENOTYPIC FLEXIBILITY OR LOCAL ADAPTATION?

Initially, we observed a difference in the BMR and cold-induced RMR between birds in Oulu (Broggi, et al. 2004). Oulu birds maintained a higher BMR during the whole winter and also had higher thermoregulatory (RMR) costs in cold. This could represent physiological acclimatization to local conditions (phenotypic flexibility) or a genetic difference between populations. To elucidate this difference, we performed a cross-fostering experiment (Broggi, et al. 2005), where eggs from the Lund population were incubated by females in Oulu. The control females incubated eggs transferred from local nests. In autumn, the BMR of the young birds was measured. In the ambient conditions of Oulu, Lund birds developed a BMR that was higher than in Oulu birds, thus reversing the situation of local populations (Fig. 1) . This is a strong indication of a local genetic adaptation in metabolic machinery of the great tit. This is surprising, as other studies show a strong gene flow from the core area of the population towards the periphery. Such flow often annihilates the development of local genetic adaptations. Indeed, in a follow-up study (Broggi, et al. 2011), we observed that the structure of contour feathers, another important trait in adaptation to cold temperatures, (contour feathers form the main thermal insulation of plumage) in the same birds did not show local adaptation, i.e. the differences were environmentally determined.

ENVIRONMENT, AGE AND BMR

Despite the ability to local genetic adaptation, BMR is influenced by a number of environmental factors, such as season, locality, and the temperature of the preceding week were found to have an effect (Broggi, et al. 2007). An interesting observation was that the BMR of great tits declines with age (Broggi, et al. 2009, Broggi, et al. 2010). Demonstration of an age-related change in BMR necessitates that BMR in great tits is a repeatable trait. By measuring birds caught two or more times on same or successive years, we were able to demonstrate long-term repeatability of BMR in the great tit. Repeatability is a necessary condition for a trait to be heritable and thus subject to natural selection.

COOLING DOWN TO SAVE ENERGY

The metabolic costs of homeothermy can be decreased by allowing body temperature to decrease during the rest-phase of the daily cycle. This has been called nocturnal hypothermia or shallow torpor. Shallow torpor has recently been found more common in birds than previously thought. In preliminary studies (Hohtola et al. unpublished), we have shown that great tits are able to decrease their body temperature during cold night more than normally. At -10 °C, the body temperature was 3 °C lower than at 25 °C. This will decrease the cost of thermoregulation and increase starvation resistance.
Fig 2: Nocturnal body temperatures of great tits at various ambient temperatures. The birds were caught in late afternoon in November-February and brought to the laboratory for overnight measurements. N=6, points are means ±S.E.M. Hohtola, Kupari et al., unpublished.

REFERENCES

GLACIAL ICE IN THE GREENHOUSE ARCTIC

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INTRODUCTION

Oceanic temperature and stratigraphic record of sea-level change have shown that the Earth’s global cooling culminated to an extreme shift from greenhouse to the icehouse conditions between 33.8 and 33.5 Ma (e.g. Katz et al. 2008). At least since then, the continental ice sheets have appeared on Antarctica (Zachos et al. 2001; Miller et al. 2005). It has been generally accepted that Arctic glaciers started to develop only after this shift to the icehouse. However, some of the latest research has shown that Arctic glaciers were able to deposit ice rafted debris to the central Arctic Ocean already between ~44 and ~46 Ma (Moran et al. 2006; St. John 2008; Tripati et al. 2008). It is obvious that ice sheet growth and decay was feasible in the Arctic also during the times of marked global warmth, in the “greenhouse”.

MATERIAL AND METHODS

Glacial history of the Cenozoic Arctic is studied by analyzing the mineralogical characteristics of Integrated Ocean Drilling Programs’ Arctic Coring Expedition 302 deep-sea sediments from the submarine Lomonosov Ridge. The appearances of the highest frequencies of glacialic grain surface microtextures were observed in order to detect the depositional phases with iceberg-rafted debris. Quartz sand grains were separated, their surface microtextures analysed with Scanning Electron Microscope and the microtexture classification and interpretation made following the primary concepts of previous studies (e.g. Mahaney et al., 1996; Helland et al., 1997; Newsome and Ladd, 1999; Strand et al., 2003). Statistical significance of microtexture distribution was calculated by assorting the observations above and below the standard deviations that determine the average differing values of each observation. The samples with at least two statistically significant microtexture distributions were discerned as a strong indication of its specific origin.

RESULTS AND DISCUSSION

A total of 12 sediment samples with significant glacial influence were observed (Fig. 1). The results show that earliest glacial sands deposited to the central Arctic Ocean already at the late Paleocene at ~56 Ma. The surface microtextures show relative common fresh fractured grain surfaces that support a glacial source. The dominance of angular to very angular and subrounded to subangular grains is clear. The abundance of crescentic gouges, steps and subparallel linear fractures together with abundant edge abrasion may refer to glaciomarine current reworking at proglacial setting. Microtextural data reconciles on the recent sedimentological, palynological and geochemical data from the Arctic Spitsbergen (paleolatitude ~75°N) that imply elevated terrestrial runoff to the Arctic Ocean prior to Paleocene-Eocene Thermal Maximum (PETM) resulting in sea level rise and water column stratification (Harding et al., 2011).
Fig. 1. Global deep ocean temperature development based on global deep-sea benthic foraminifera $\delta^{18}O$ isotope records (Zachos et al. 2001). The record shows gradual trends of warming and cooling, but also an extreme shift from “greenhouse” to “icehouse” temperatures ca. 34 Ma. Red shading indicates the warmest period called “super greenhouse” between 49 and 53 Ma. Blue shadings indicate the coldest time periods. ACEX 302 sediment recovery is combined with oceanic temperature record. The depositional phases with glacial influence, based on the results of this study, are indicated with grey shaded lines.

North Atlantic opening led to Lomonosov Ridge’s separation from the Siberian shelf during the late Paleocene. This event was associated with a rifting-induced kilometre-scale regional uplift that eventually formed a land bridge between the Europe and Greenland during the Paleocene-Eocene transition (Maclennan and Jones 2006). The land bridge development is thought to have encouraged abrupt changes in ocean circulation. Rifting-induced topographic elevation, which probably had started already during the early Atlantic opening, and the moisture released into the atmosphere during the rifting, presumably offered viable conditions to ice sheet development in the Arctic. As it has been shown by Eyles (2008), there is evident relationship between rifting caused uplift and glacier formation.

REFERENCES

WHITE MATTER ABNORMALITIES IN MIDDLE-AGED SUBJECTS WITH SCHIZOPHRENIA - THE NORTHERN FINLAND 1966 BIRTH COHORT

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INTRODUCTION

The disconnectivity model suggests that disturbed integration of neural communication plays a fundamental role in the pathology of schizophrenia (Friston and Frith, 1995). Schizophrenia and bipolar disorder (BD) are strongly associated with white matter (WM) abnormalities (McDonald et al., 2004). It is not clear whether these abnormalities affect the entire white matter or whether they are localized to specific structures. The existing literature on schizophrenia and diffusion tensor imaging (DTI) is largely inconsistent and the underlying pathology of abnormalities remains unclear.

DTI, a non-invasive MRI technique, measures the diffusion of water molecules throughout the biological tissues. DTI offers a method of examining WM microstructure and anatomical connectivity in vivo (Kanaan et al., 2005). We used DTI in order to determine whether white matter abnormalities are present and at which extend in middle-aged schizophrenia patients.

METHODS

The Northern Finland 1966 Birth Cohort is an unselected, general population birth cohort. The cohort is based upon 12, 058 children, representing 96% of the live born children in the provinces of Lapland and Oulu with an expected date of birth during 1966 (Rantakallio, 1969).
In 1999-2001, a psychiatric field study was conducted. It was based on 160 people with a history of at least one psychotic episode by the end of 1997, according to the Finnish Hospital Discharge Register, and 187 non-psychotic control subjects. The follow-up of the field study was conducted in 2008-2011. Altogether 54 subjects with schizophrenia, 51 with other psychotic disorder (bipolar disorder, schizophrenia spectrum disorder, psychotic depression, unspecified nonorganic psychosis, or acute psychotic disorder), 198 control subjects and 27 siblings of the psychotic subjects participated. Field study consisted of MRI scans of the brain, mental-health-related interviews and cognitive tests. After exclusions voxelwise approach of white matter fractional anisotropy (FA) and tract-based spatial statistic (TBSS) were used to compare 37 subjects with schizophrenia, 35 subjects with some other psychotic disorder and 165 control subjects.

RESULTS

The demographic characteristics of the sample are shown in Table 1.

Table 1. Demographic data on research groups

<table>
<thead>
<tr>
<th>Demographic variables</th>
<th>Schizophrenia (n=37)</th>
<th>Other psychoses (n=35)</th>
<th>Controls (n=165)</th>
<th>For x²</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender, female (N(%) )</td>
<td>13 (35.1)</td>
<td>21 (60.0)</td>
<td>85 (51.5)</td>
<td>x²=4.8</td>
<td>0.090</td>
</tr>
<tr>
<td>Age, years (M(SD))</td>
<td>43.1 (0.8)</td>
<td>43.7 (0.6)</td>
<td>43.8 (0.8)</td>
<td>F=10.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Handedness, right (N(%) )</td>
<td>36 (100)</td>
<td>32 (91.4)</td>
<td>156 (94.5)</td>
<td>x²=2.8</td>
<td>0.240</td>
</tr>
<tr>
<td>Age of onset (years (SD))</td>
<td>25.6 (6.5)</td>
<td>33.4 (6.4)</td>
<td></td>
<td>F=26.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>IQ. (M(SD))</td>
<td>78.1 (36.3)</td>
<td>87 (30.4)</td>
<td>110.2 (22.6)</td>
<td>F=28.3</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

1 Handedness was missing for one person

Subjects having schizophrenia or some other psychotic disorder showed widespread areas of reduced anisotropy (Fig. 1 and Fig. 2) and increased mean diffusivity in the majority of the WM fiber bundles. Gender, antipsychotic medication load or alcohol abuse did not correlate with FA. In contrast, there was no area where FA was higher in the psychotic groups.
CONCLUSIONS

This is, the best of our knowledge, the first study to demonstrate white matter abnormalities in subjects with psychosis in general population. We replicated the results of the most of the previous studies regarding decreased FA in WM widespread, but extended the findings through the use of a general population sample of the same age among schizophrenia patients with nearly 20 years illness duration. This finding may reflect the progressive nature of schizophrenia illness. Our findings provide support for earlier findings and disconnectivity models of schizophrenia.

REFERENCES


Actual aspects of international cooperation on healthy lifestyle in the Barents Euro-Arctic Region

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The cooperation of cooperation of the Barents Euro-Arctic Region (BEAR) countries is a perspective coordination widening of which could improve the stability in the world and Europe ("Kirkenes Declaration" January, 11, 1993) [Bulatov et.al, 2005]. The structure includes the BEAR regions such (2010) as: Russia: (Arkhangelsk oblast, Murmansk oblast, Nenets Autonomous Area, the Republic of Karelia and Komi Republic), Finland (the province of Lapland, Oulu, Kainuu), Norway (Finnmark, Norland, Troms), Sweden (province of Norrbotten, Västerbotten).

Declaration regards the cooperation on two levels- central and regional- through Barents Council and Regional Barents Council. [Pittersen, 2002]. It depicted the priority fields of cooperation: economics, trade, science and technologies, tourism, infrastructure, education, cultural changes and projects connected with the improving of the status of the indigenous people of the North.

According the Kirkenes Declaration and the goals of creating BEAR were identified priority areas of cooperation such as environment, economic cooperation, scientific and technical cooperation, regional infrastructure, health, indigenous people, people to people contacts and cultural ties, tourism.

The aim of public health policy of the countries is providing people with equal opportunities, tendency to the achievement of the highest level of health by negotiation of risk factors and creation healthy life conditions [Shraga, 2009].

International cooperation in the field of healthy life is based on the cooperation program on the problems of public health and social issues in BEAR. Since the existence of the region the strictly organized structure has been established which is aimed at realization of the programs and active participation of BEAR countries in public health.

The priorities of the direction are preventive measures and fight against infectious diseases, social problems, children and youth support, development of primary medical care, public health and social services, preventive measures in the healthy life sphere- everything has the main aim- sustainable development of Northern low-populated areas.
The actual aspects were formulated for the good work of BEAR countries in the sphere of healthy life. New projects appear annually.

The program in the sphere of healthy life:

1) The increase of knowledge and preventive measures against diseases and social problems-smoking, bad nutrition, alcoholism, drug habit and violence, and influence on human health.

2) Propaganda of healthy life among the youth. The support of the rehabilitation programs development for alcohol and drug addicted people and their attendance, as well as measures connected with the youth and families.

3) Support the development of rehabilitation programs for alcoholics and drug addictions, and observation services for them, including those aimed at young people and families. Major cooperation projects on healthy lifestyles are actively implemented in the framework of international projects in the Barents Euro-Arctic Region at the present stage, which generally leads to the conclusion of the increased emphasis on health and social well-being of border states in the BEAR:

1) “Together Against Tobacco and alcohol - a community program to prevent alcohol and tobacco use among youth” (2006-2008). Location Republic of Karelia. The program is aimed at increasing responsibility in the community for young people and promote smoke and alcohol free lifestyle among adolescents. The project aims to increase knowledge about alcohol-related social pressure among youth and adolescents, skills training to refrain from smoking and alcohol consumption [Together against tobacco and alcohol - a community programme to prevent alcohol consumption and smoking among youth, 2007].


3) “Let us learn to live without alcohol” (2009-2010). The project is carried out in areas populated by indigenous peoples in the North-West Russia, as well as the rest of the area of the Saami and Russian North

The project aims to focus on indigenous peoples' own competence and knowledge in business with alcoholism in the first place, you must:

1) recognize that alcoholism is a problem among the indigenous population of the North;

2) implementation of a model of sobriety;

3) to promote a healthy lifestyle [Project catalogue, 2009].
4) The “Quit and Win” (2 times a year) - an international project developed by the Center for Preventive Medicine and other institutions in Arkhangelsk. They organize the participation of citizens, the day of quitting on radio programs among students [Preventive anti-smoking program, 2010]

5) The Russian-Norwegian project to prevent smoking among adolescents (from 2010) is aimed at creating a new program to prevent smoking among adolescents on the basis of the Norwegian experiment program «FREE» [Russian-Norwegian project to prevent smoking among adolescents, 2010].

6) “ArcticChildren II” (2006 - 2008) Cross-border training programs to support the school in promoting the psychosocial well-being (as one component of a healthy lifestyle) in the BEAR, to find ways for a balanced relationship between people, community and environmental environment.

7) Centre for Social Health and Family Planning Youth (since 1997). The joint project of the Committee on Youth of the Murmansk administration and Vadsø - municipality (Norway) to study, sexually transmitted diseases, AIDS prevention, substance abuse, healthy lifestyles, psychological teenagers and their parents [Your window to the Barents Region, 2009].

8) The “Children and youth at risk” (2010-2012). The program aims to promote international co-operation of public authorities, social services and nonprofit organizations to address the problems of children and youth at risk who need support and knowledge in the field of health, for social security [Kokanova, Golubeva, 2010]. Etc.

References:


Pittersen O. 2002. Dream come true: the regional Barents co-operation: 9


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**ABC transporters and heavy metals in BeWo human choriocarcinoma cells**

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**Background**

Heavy metals such as cadmium, lead and methylmercury may cause reproductive toxicity. They are known to be neurotoxic to developing fetus and they may also play a role in cancer initiation already in fetal period of life. The exposure level to heavy metals during pregnancy varies depending on lifestyle factors as well as geographical location (Rudge *et al* 2009). The main sources for lead and methylmercury are fish and other marine food. Cadmium is also ubiquitously present in food, water and air. In cadmium contaminated areas pregnant women are exposed via nutrition and water. In addition to dietary sources cigarette smoke is an important source for cadmium, lead and inorganic mercury (Chiba & Masironi 1992; Kutlu *et al*. 2006).

Placenta is a critical organ in xenobiotic exposure. All the nutrients and waste products are transported through placenta. Xenobiotics may affect placental functions as steroid synthesis and transport function. ABCG2 is an efflux transporter located in the maternal facing membranes of the human placenta. It is known to protect fetus from xenobiotics by transferring compounds from the placenta to the maternal circulation. Interference of the xenobiotics with ABC transporter function may lead to synergistic effects such as elevated accumulation of other toxic compounds to fetal circulation. ABC transporter expression can also be induced by their substrates or downregulated by environmental compounds (Vähäkangas & Myllynen 2009, Myllynen *et al* 2010).
Methods

The aim of this study was to clarify whether heavy metals (CdCl₂, PbCl₂, MeHgCl) affect the expression and function of ABCG2 transporter in BeWo human placental choriocarcinoma cells. BeWo cells are commonly used as human placental models. The expression of ABCG2 was determined by immunoblotting and RT-PCR using Taqman probes. Cytotoxicity of heavy metals was assessed by MTT assay in BeWo cells. After a 24 hour adjustment period cells were exposed to 0.1 nM-1 mM concentrations of the heavy metals CdCl₂, PbCl₂ and 0.001 - 100 μM concentrations of MeHgCl. Cytotoxicity was assessed after 24, 48 and 72 hours. Functional activity of ABCG2 transporter protein was studied using fluorescent substrate mitoxantrone and 14C-labelled food carcinogen PhIP, which is a known ABCG2 substrate.

Results

All of the studied metals showed cytotoxicity, MeHgCl being the most cytotoxic. CdCl₂ inhibited mitoxantrone in 10 and 100 μM concentrations and ¹⁴C-PhIP efflux in 1 and 10 μM concentrations suggesting inhibition ABC transporter function. PbCl₂ had no effect on mitoxantrone efflux. According to protein data these heavy metals did not affect transporter protein expression. Also mRNA expression of ABCG2 was not affected by heavy metals. In conclusion, it seems that CdCl₂ affects function but not expression of ABCG2. This may lead to elevated placental transfer of other compounds substrates to ABCG2. There is no former data about the effects of cadmium to transporter proteins in human placenta. This is concerning result and requires further studies to be extrapolated in in vivo situation.

References

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SOCIAL ANXIETY IN CHILDREN AND ADOLESCENTS WITH AUTISM SPECTRUM DISORDERS

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BACKGROUND

Autism Spectrum Disorders (ASDs), such as high-functioning autism (HFA) and Asperger syndrome (AS) are defined by the early onset of qualitative impairment in reciprocal social development, variously accompanied by deviant and delayed development of verbal and nonverbal communication, and a markedly restricted repertoire of activities and interest (American Psychiatric Association; APA 2000, World Health Organization; WHO 1993).

There is growing research attention to the association between autism or AS and a broad range of anxiety symptoms (reviewed in White et al. 2009). However, care must be taken in evaluating social anxiety, in particular, in individuals with HFA/AS due to the specific symptoms of social anxiety (such as social withdrawal, preference for being alone, and avoidance of speaking in social situations) may overlap with symptoms of HFA/AS, which may suggest the diagnosis, or even mis- or over-diagnose social anxiety in individuals with HFA/AS. In fact, social anxiety disorder (SAD) is described as the fear of humiliation or embarrassment in social and/or performance situations, which may lead to avoidance of social situations and social isolation (APA 2000, WHO 1993). Thus, socially anxious individuals may be socially awkward and may express difficulties (e.g., social withdrawal) in non-verbal communication as well as a lack of emotional expression. Further, it is common for anxious individuals to create stereotyped routines and rituals to ease anxiety symptoms. That is, some of the stereotypic and repetitive behavior among individuals with HFA/AS may reflect anxiety symptoms. Importantly, the literatures shows that high-functioning young people with autism and AS are responsive to treatment (e.g., cognitive psychotherapy, cognitive-behavior therapy) of anxiety symptoms, such as SAD (e.g., Chalfant et al. 2007).

AIM OF THE STUDY

The objective of this study was to examine social anxiety symptoms in high-functioning children and adolescents with autism or AS by using revised (i.e., without symptoms overlapping with HFA/AS core symptoms) self-reports, parental and teacher ratings.

PARTICIPANTS

We recruited 52 eight to 17 year old participants with HFA/AS from a list of all eight to 17 year-old patients with HFA/AS or AS-traits gathered from Oulu University Hospital patient-records in 2003 (Weiss et al. 2009). Additionally, six 11 year-old children with HFA/AS, who were not in the patient-records of Oulu University Hospital, were recruited from the epidemiological study (Mattila et al. 2007) from the same area. All participants with HFA/AS had a FSIQ higher than 70 (Wechsler 1991)
and did not meet criteria for other severe developmental disorders (e.g., Fragile X, dysphasia). All 58 participants with original HFA/AS diagnoses were re-evaluated and following this re-evaluation 35 individuals met diagnostic criteria for AS, and 21 met criteria for HFA according to the ICD-10 (WHO 1993). Two participants met the diagnostic criteria for PDD-nos; these individuals were excluded from all subsequent analyses. The final total sample included 56 children and adolescents with HFA/AS.

Eight to 16 years old community participants (N=353, participation rate of 52.6%) were collected from all mainstream compulsory education schools in the city of Oulu, Finland using randomized cluster sampling selection (Kuusikko et al. 2009).

MEASURES

All children and adolescents completed the Finnish versions of the Social Phobia and Anxiety Inventory for Children (SPAI; Beidel et al. 1998) and the Social Anxiety Scale for Children (SASC-R; La Greca & Stone 1993). Participants who were 11 to 17 years old also completed the Youth Self-Report (YSR; Achenbach & Rescorla 2001). All parents of the children completed the Child Behavior Checklist (CBCL; Achenbach & Rescorla 2001) and teachers of the HFA/AS participants, completed the Teacher’s Report Form (TRF; Achenbach & Rescorla 2001).

For each of the measures included in this study we created revised scales (i.e., R-SPAI-C, R-SASC-R, R-CBCL. R-YSR, R-TRF) to assess social anxiety by excluding items that overlap with the HFA/AS symptoms obtained with the Autism Diagnostic Interview (ADI-R; Lord et al. 1995), diagnostic criteria of HFA/AS, and observed symptom manifestation of HFA/AS in the clinical setting. Items that were not specific to social anxiety symptoms were similarly removed from the revised R-CBCL/R-YSR/R-TRF. In this same light, CBCL/YSR/TRF items which were specific to social anxiety symptoms, but were not included on the original Internalizing scales, were added to the revised scales.

RESULTS

Analyses were performed with The Statistical Package for Social Sciences (SPSS 2008) version 17.0 for Macintosh. Variables were not normally distributed: therefore data derived from the measures were log-transformed in order to conduct subsequent parametric tests on main effects. Age was included in the statistical models due to 1) of the increase in social demands and growing complexity of social interactions as children approach and enter into adolescence, 2) there was a statistically significant difference in the mean ages of the HFA/AS and control groups. In order to optimize statistical power, children were divided into two age groups, those under 12 years of age (HFA/AS, n=36; controls, n=136) and those 12 years or older (HFA/AS, n=18; controls, n=169). Despite the presence of gender differences in the control sample (control girls scored significantly higher than control boys on the R-SASC-R), gender was not included as a covariate in subsequent multivariate models due to limited power in the HFA/AS group (12 girls, 42 boys). There were no gender differences within HFA/AS group on any of the measures employed.

We conducted MANOVA with status group predicting total outcome score of the R-SPAI-C and R-SASC-R. Result revealed a statistically significant main effect of status group (Wilk’s Lambda = 0.97, F(2, 354) = 5.06, p < .01, η² = .03). The main effect of age group approached significance (Wilk’s Lambda = 0.99, F(2, 354) = 1.9, p = ns, η² = .01); the interaction was not significant (Wilk’s Lambda = 0.99, F(2, 354) = 2.5, p = ns, η² = .01).

The results of MANOVA tests for the R-SPAI-C and R-SASC-R subscales revealed a main effect of status group, with the HFA/AS group reporting elevated symptoms relative to the control group (R-SPAI-C subscales, Wilk’s Lambda = 0.91, F (5, 351) = 7.3, p < .001, η² = .09; R-SASC-R subscales, Wilk’s
Lambda = 0.93, F (3, 353) = 9.0, p < .001, η² = .07). In addition, there was a significant interaction between age group and status group on the R-SPAI-C subscales (Wilk's Lambda = 0.97, F (5, 351) = 2.3, p < .05, η² = .03).

Follow-up univariate analyses indicated significant interactions between age and status group on the R-SPAI-C Behavioral Avoidance subscale (F(1, 355) = 10.5, p < .001, η² = .03) and the R-SASC-R Fear of Negative Evaluation subscale (F(1, 355) = 4.5, p < .05, η² = .01). Specifically the HFA/AS group reported elevated symptoms relative to the control group on the R-SASC-R subscales, as well as on all R-SPAI-C subscales with the exception of the Physical and Cognitive Symptoms of Social Anxiety subscale (See Table 1). Furthermore, there was a main effect of age on the Behavioural Avoidance subscale of the R-SPAI-C (F(1, 355) = 3.9, p < .05, η² = .01) and on the R-SASC-R Fear of Negative Evaluation (F(1, 355) = 6.0, p < .05, η² = .02). The mean scores on the Behavioural Avoidance subscale of the R-SPAI-C (M = 0.7±0.5 vs. 1.0±0.2, t = 2.7, df = 52, p < .01) and the R-SASC-R Fear of Negative Evaluation (M = 2.7±0.4 vs. 3.0±0.4, t = 2.2, df = 52, p < .05) increased with age in the HFA/AS group, but not within the control groups (M = 0.6±0.4 vs. 0.5±0.4, t = 1.7, df = 303, p = ns; M = 2.7±0.4 vs. 2.7±0.4, t = 0.5, df = 303, p = ns).

Table 1. HFA/AS versus Controls on the R-SPAI-C and R-SASC-R Subscales

<table>
<thead>
<tr>
<th>Revised Questionnaires</th>
<th>Subscales</th>
<th>F(1,355)</th>
<th>η²</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-SPAI-C</td>
<td>Social Assertiveness</td>
<td>4.0***</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>Fear of General Conversation</td>
<td>16.2***</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td>Behavioral Avoidance</td>
<td>18.9***</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>Fear of Public Performance</td>
<td>14.2***</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td>Fear of Negative Evaluation</td>
<td>3.9**</td>
<td>0.01</td>
</tr>
<tr>
<td>R-SASC-R</td>
<td>Social Avoidance, Inhibition and Discomfort</td>
<td>7.6**</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>Generalized Social Avoidance, Inhibition and Discomfort</td>
<td>26.4***</td>
<td>0.07</td>
</tr>
</tbody>
</table>

**p < .01, ***p < .001, all t-tests = 2-tailed. HFA/AS > Controls in all scales.

ANOVA was used to explore the main effects of age and status groups as well as their interactions in relation to the total score on the parent-reported R-CBCL. There was a main effect of status group (F (1, 351) = 52.6, p < .001, η²=.13). Specifically, HFA/AS participants scored higher than their control counterparts in both younger and older individuals (younger group: M = 8.1±5.5 vs. 3.0±3.0, t = 6.5, df = 70, p < .001; older group: M = 7.0±4.4 vs. 2.8±2.8, t =4.3, df = 185, p < .001). The main effects of age group and the interaction between status and age did not reach statistical significance.
Associations between revised self-report measures were calculated in the total sample including HFA/AS and control groups; a strong relationship emerged between self-reported social anxiety symptoms on the R-SPAI-C and R-SASC-R total scores (r = .737, p < .01). Moderate associations were found between youth self-reported and parent-reported social anxiety symptoms on the R-CBCL (R-SPAI-C, r = .223; R-SASC-R, r = .217; p < .01). The associations between parents and adolescents with HFA/AS regarding social anxiety symptoms on the R-CBCL and R-YSR was moderate (r = .314, p < .001), and between teachers and adolescents on the R-TRF and R-YSR was excellent (r = .600, p < .001).

CONCLUSIONS

Results suggest that adolescents, in particular, with HFA/AS experience more social anxiety symptoms and have increased rates of clinically relevant social anxiety disorder (SAD) than do their control counterparts. Parents reported higher levels of anxiety symptoms in their children with HFA/AS regardless of the child’s age; however, individuals with HFA/AS self-reported anxiety symptoms increased later in their development (i.e., adolescence). The association between parents and adolescents regarding social anxiety symptoms were moderate, whereas teachers and adolescents with HFA/AS demonstrated excellent concurrence regarding the report of adolescents’ social anxiety symptoms. Compared to parents, teachers may be able to observe adolescents in certain school environment, where deficits in social skills may trigger or increase anxiety. Especially, in sparsely populated Northern-Finland, social anxiety symptoms of children could be prevented and intervened in the children’s natural settings, such as in the school and day care. Results suggest that social anxiety is clinically important to assess in children and adolescents with HFA/AS and that multi-informant reports to detect psychiatric comorbidity in HFA/AS are needed. For more information about the study, please see Kuusikko-Gauffin (2011).

REFERENCES


400 MILLION YEARS OF GEOLOGICAL EVOLUTION AND PALEOClimATIC HISTORY OF THE TELEMARK BASIN-FILLS (SOUTH NORWAY) SINCE THE MESOPROTEROZOIC ERA (1.6–1.0 GA)

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BACKGROUND

Precambrian time encompasses approximately 90% of Earth’s geological history between 4600 and 542 Ma (Fig. 1), and contains major part of the global mineral resources. Earth’s atmospheric, oceanic, and sedimentary environments experienced dramatic changes during this time. The geological evolution has been more complex in character (rates and intensities of processes), and it is well-preserved in sedimentary basin-fill record. Ancient basin-fill deposits provide fundamental information about the global geological events and history of the Earth, such as supercontinent cycles, sea level changes, glaciations (e.g., Snowball Earth Hypothesis), evolution of the paleoclimates (e.g., Great Oxidation Event).

STUDY AREA

Mesoproterozoic (1.6–1.0 Ga) Telemark basin-fills in southern Norway, is made up of an approximately 10-km-thick succession of volcanic-sedimentary rocks that are an integral part of the Fennoscandian Shield and record ca. 400 Ma years of sedimentation during evolving tectonics (Figs. 1 and 2). The Fennoscandian Shield is the northern part of the (proto)Baltica or the East European Craton. It is composed of an Archean core in the northeast and progressively younger Proterozoic crustal domains towards the southwest. The East European Craton was formed between 2.0 and 1.7 Ga by the successive collision of three once autonomous crustal segments or blocks. These segments or blocks are Fennoscandia to the northwest, Sarmatia to the south and Vologo-Uralia to the east, which each of them comprises Archean and Proterozoic crust (Fig. 2). The assembly of the craton began at ca. 2.0 Ga when Sarmatia and Vologo-Uralia joined each other to form the Volgo-Sarmatian protocraton. The Volgo-Sarmatian protocraton existed as a separated until ca. 1.8–1.7 Ga when it docked with Fennoscandia forming a unified craton.

RESEARCH METHDOS AND AIMS

Main research methods and analytical tools include: (i) regional mapping and lithostratigraphy, (ii) facies analysis, (iii) sequence stratigraphy, (iv) clastic petrofacies analysis, (v) geochemistry, and (vi) sedimentary basin paleotectonic reconstruction. The combination of these approaches is necessary to understand a sedimentary basin as a dynamic system and to reveal ancient sedimentation processes, depositional environments, and tectonic evolution for building a coherent tectonic-sedimentary model. The main aim of this study is to understand the effects of autogenic (internal) and allogetic (external) processes on the depositional systems and geochemical compositions of the Telemark basin-fills.

CONCLUSIONS

The studied formations comprise alluvial fan, braidplain, fluvial, tidal, estuarine-lagoon, and shallow marine depositional environments. This study concludes that the Telemark basin-fills carry a testimony of the tectonic and sedimentary evolution from an extensional continental rift to a strike-
slip influenced tectonic setting (Fig. 3). These basin tectonic regimes are separated with a first-order unconformity, which represents a ca. 170 Ma hiatus in the stratigraphic record. The provenance studies show that at the early stage of the basin evolution, at around 1.5 Ga, the Telemark sedimentation basin was likely located near the Laurentia supercontinent and moved to its present location along a sinistral strike-slip fault. The sedimentological and geochemical studies in this study indicate that the evolution of the basin rifting, in the Telemark, can be subdivided into (i) syn-rift, (ii) late-syn rift, (iii) early-post rift, and (iv) late-post rift stages, which are characterized by different volcanic-sedimentary patterns in different sedimentation environments. The allogetic (external) process caused a fluctuating base level, which created an accommodating space for basin-fills during the pure extensional tectonics. The lack of a deepwater sedimentation prism and oceanic crust, and the non-evolution to passive margin indicate that the rifting failed to complete the continental break-up. At the strike-slip stage, the faulting and volcanism of the basin was likely activated either at a later stage or in certain individual basins. The strike-slip stage comprises deposition of the early Sveconorwegian units in diverse sedimentation environments.

This study shows that although limited outcrops of the Precambrian bedrock can be deformed and metamorphosed, it is possible to build a coherent paleotectonic reconstruction of the ancient sedimentation basin. The main findings of this thesis are: (i) interpretation of sedimentation processes and reconstruction of depositional environments, for the key formations of the Telemark basin-fills; (ii) finding of sediment provenance for the studied rift basin; (iii) discovery of alteration of the bedrock in ancient periglacial climate along one of the prominent first-order unconformity in Telemark; (iv) construction of a comprehensive tectonic-sedimentary model for the Telemark basin-fills; (v) building a plate reconstruction.

![Diagram of geological time scale and evolution related to the Mesoproterozoic Telemark basin-fills](www.geologytimes.com)
Fig. 2. A) A geological sketch map of southwest Fennoscandia showing the principal tectonic units. B) Close-up view of southwest Fennoscandia showing the Telemark Block and basin-fills.
Fig. 3. Schematic summary of tectonic-sedimentary evolution of the Telemark basin-fills. RST/LST: regressive/lowstand systems tract, CTS: conformable transgressive surface, TST: transgressive systems tract, MF: maximum flooding surface, HST: highstand systems tract, R: transgressive ravinement surface.
MINERALOGICAL CHARACTERISTICS OF THE 56–23 MA OLD MARINE SEDIMENTS: A CASE STUDY FROM THE PRYDZ BAY AND WILKES LAND (EAST ANTARCTICA)

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BACKGROUND

Clastic sedimentary packages are geological archives that record and preserve signatures of past geological events in source provinces, during transit, and at the depocentre. Therefore mineralogical characteristics (heavy-minerals and quartz grains) of the marine sedimentary strata provide fundamental information about the sediment provenance, glacial dynamics and paleoclimates. Heavy minerals represent the detrital occurrence of essential rock-forming minerals (e.g. garnet, pyroxenes, micas) or accessories (e.g. zircon, tourmaline, apatite). They typically comprise ~1% of siliciclastic sediments, so to study them effectively, they must be concentrated.

The East Antarctic Ice Sheet appear to have been variably dynamic in response to global climate change. The elevated topographies in the drainage areas can have influence on initiation of early glaciers in East Antarctica. In this study, sediment characteristics from the Prydz Bay and Wilkes Land (Figs. 1a and b), such as quartz sand grain surface textures and heavy mineral assemblages, are used to evaluate provenance and onset of glaciations in East Antarctica during the Eocene/Oligocene time period (56–23 Ma).

METHODS

Typically microtextural analysis of quartz sand grains is done in fraction between 0.250 and 0.6 mm and from each sample at least 30 grains is analyzed by using scanning electron microscope (SEM) and counted for frequencies of critical textures. For heavy mineral content in each sample, approximately 40–50 randomly selected grains in 0.125–0.250 mm fraction are typically analyzed with electron probe microanalyzer (EPMA) and frequencies counted.

CONCLUSIONS

The Antarctic continental shelf sediments off Prydz Bay have well indicated several critical states of initiation of the East Antarctic glaciers and ice sheet. In quartz grain surfaces, angular outlines, mechanical textures such as concoidal fractures, crescentic gouges were the most frequent in glacially influenced deposits. The inland ice sheet may have reached sea level as early as ca. 37 Ma in Prydz Bay. Distribution of major heavy minerals is indicating distinct source area changes related to the later ice-sheet evolution. The Wilkes Land Margin sediments from sites U1356 and U1360 can be seen as a prominent resource for fully detecting source area characteristics during periglacial-glacial transition in East Antarctica. It is critical to obtain evaluation the nature of initiated glaciers and when the continental ice reached at the sea level in the Wilkes Land Margin complementary to those intervals obtained in Prydz Bay.
Fig. 1. A) Locations of the IODP Exp 318, Wilkes Land and ODP Leg 188, Prydz Bay. B) Seismic profile from the Wilkes Land continental margin and the location of the Site U1356.
The use of contextual information in pragmatic language comprehension in children with Asperger syndrome or high-functional autism

**Background:** Asperger syndrome (AS) and high-functioning autism (HFA) are characterised by pragmatic impairments including difficulties to utilise contextual information and to integrate information from different sources in language comprehension. The purpose of this paper is to present some of the key findings of Loukusa (2007) and associated papers.

**Aims:** The study analysed whether two age groups of children with AS/HFA and normally developing control children differ in their ability 1) to answer different kinds of contextually demanding questions and 2) to explain correct answers.

**Materials and methods:** The clinical groups consisted of 39 children diagnosed with AS or HFA by the paediatrician (M-LM) or the psychologist (KI) by using ICD-10 criteria based on all available information (e.g. ADI-R and ADOS). These children were divided into two groups according to their ages, 7- to 9-year-olds (n = 16) and 10- to 12-year-olds (n = 23). Children’s normal current linguistic ability was verified by three subtests of Nepsy (SK) and language tests. The control group consisted of 23 healthy 7- to 9-year-olds. All participants were asked questions targeting contextual comprehension involved in reference assignment, enrichment, routines and implicatures and understanding of feelings. Additionally, they were asked to explain most of their correct answers to elicit their awareness of their own understanding.

**Results and conclusions:** Compared to the control group, the younger AS/HFA group performed less well when answering contextually demanding questions, and the performance of the older AS/HFA group fell in between the younger AS/HFA group and control group. Both AS/HFA groups showed difficulties in explaining how they had used context in arriving at correct answers. The topic drifts after first giving a correct answer were the most typical for the younger children with AS/HFA suggesting that they had difficulties with stopping processing at a relevant point.

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NARRATIVE ABILITIES OF CHILDREN WITH AS OR HFA: A MULTI-CASE STUDY

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INTRODUCTION

The ability to narrate is a crucial part of social interaction and communication which requires both pragmatic and linguistic aspects of language. So far narrative abilities of children with AS/HFA haven’t been studied in Finnish and the few English research findings have been somewhat conflicting (e.g. Losh & Capps, 2003; Norbury & Bishop, 2003; Young et al, 2005). However, previous studies show that AS/HFA children have difficulties in the social aspects of language, for example, pragmatic comprehension and inference abilities (Loukusa & Moilanen, 2010). Thus, it is possible that difficulties are also seen in pragmatic aspects of the narrative. The purpose of this study is to assess narrative abilities of children with AS or HFA. Both linguistic structure and story content are studied. This abstract is based on earlier research results presented in 14th International Congress of ESCAP (see Mäkinnen et al. 2011).

PARTICIPANTS AND METHOD

The data of five Finnish speaking children with AS/HFA (mean age 7;1) and their age and sex matched controls are presented. The A3 story of ENNI (The Edmonton Narrative Instrument) was chosen as an narrative elicitation task (Schneider, Dubé & Hayward, 2005). The AS/HFA children were recruited from the area of Northern Ostrobothnia Hospital District in Finland. The study is carried out in Northern Finland and hereby concerns the health and wellbeing of children living in Northern parts of Finland.

RESULTS

The data shows that AS/HFA children may have difficulties in some aspects of narration. Their story grammar scores were clearly poorer than their controls, which means that AS/HFA children included less relevant information in their stories. There were no clear differences between the groups in the linguistic measures (number of utterances and words, syntactic complexity; number of main and dependent clauses) although the control group performed somewhat better.

CONCLUSIONS

These results are only suggestive due to the small number of participants and the great variance in the results in the AS/HFA group. However, the data shows that AS/HFA children’s narrative abilities should be researched more carefully. It may be that the linguistic abilities stay intact but the demands of narration are seen in a more pragmatic aspect of the narrative: the story content.
REFERENCES


The Closing of Schools and its Associations on Pupil’s Experiences of Bullying, Self-experienced Health and Social Exclusion. The Northern Finland Birth Cohort Study 1986.

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During the last two decades 65 % of small Finnish schools, with under 50 pupils, have been closed down. The closings have been going on since 1960’s due to decreasing birth rate and urbanization. Finland has traditionally been an agricultural society and majority of the population has been living in rural areas. The school network has been dense because of compulsory education law in 1921, which stated that the distance to school could not be over five kilometers for the students. When a school is closed down it has an effect to the whole town and its future. Other services are likely to be reduced and it is difficult to get new inhabitants to the town.

The closings escalated in the 1990’s due the decentralization of the Finnish educational administration and the recession in the beginning of the decade. After the recession, government cut down on the costs of Ministry of Education and reformation in state subsidies system in the fields of education and culture was done.

The global and local economics and policies affect the conditions of the Finnish educational system. Decreasing number of pupils is no longer the main reason for school closings, but the national government’s centralization tendencies and economic issues on national and global level are affecting local decision making processes. Especially European Union has affected Finnish educational politics which now aims to raise the competitiveness of the European Economic Area. In many municipalities a way to balance difficult economic situations is to offer educational services in larger units so that producing them is more cost-effective.

In this recently inhibited PhD-study, the aim is to research the associations of school closures on students schooling paths, experiences on bullying, self-experienced health and social exclusion in the Northern Finland Birth Cohort (NFBC) 1986. The main interest is to study what kind of effects do the school closures have on student’s lives.

The NFBC 1986 is a longitudinal cohort study of all the people born (n=9432 live born) in the two most northern provinces in Finland (Oulu and Lapland) in 1986. The data has been collected by postal questionnaires since the mothers enrolled at their first antenatal clinic visit, after the birth, at the ages of 7 and 8 and 15-16 and from various hospital records and statistical register data. In this study there are two study populations; those who have studied in the same primary school (classes 1-6) and those who have experienced the closure of their school during their primary school education in the years of 1993-1999. The methodological standpoint is triangulation; study is going
to be conducted using quantitative methods (statistical method and path analysis), qualitative case study method, biographical in-depth interviews and narrative analysis of those, to study the student’s experiences of the school closures.
CLAY MINERAL DISTRIBUTION AND ICE RAFTED DEBRIS IN GLACIAL-HOLOCENE SEDIMENTS OF THE SOUTH-WESTERN BARENTS SEA: EMPHASIS ON TRANSPORT MECHANISMS AND SEDIMENT SOURCES.

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Ice rafted debris (IRD) has become a unique part of this study as it is displaying detailed sediment source locations along with the clay minerals. This material is transported when deglaciation occurs or sediments become entrenched in the ice and moved along. Dropstones (≥1 mm) have been identified as being granulites and schists throughout the sediment cores which leads us to believe that the provenance from which this IRD originated could only have been the Fennoscandian shield. Meltwater pathways of the last glacial retreat flushed the material out in pulses into the Barents Sea. Evidence of this is found in the 3 cores retrieved by the drilling party. It was expected that the IRD encountered would mostly be sedimentary in nature due to the provenances surrounding the core localities such as material from Svalbard or Franz Josef Land. Currently the clay mineral distribution, most specifically kaolinite, and the frequency of the metamorphic clasts is under analysis. We know that kaolinite corresponds to weathering of granulite areas as documented in many papers, however, Franz Josef Land is also a kaolinite sink. How did the varying climatic conditions impact the transportation and deposition mechanisms of these dropstones? It is obvious that some are sedimentary and are found aside these metamorphic ones. Perhaps the kaolinite was being transported from numerous sites, however the presence of Fennoscandian shield material is something to investigate further.