Cool deltas

Sedimentary environments of the Salpausselka I and II moraine ridges near Lahti, Finland

Bartosz Kurjanski[1,2] (*bkurjanski@abdn.ac.uk*), Brice R. Rea[1], John Howell[2], David Cornwell[1], Matteo Spagnolo[2], Jukka-Pekka Palmu[3]

[1]*Department of Geology and Petroleum Geology, University of Aberdeen*
[2]*Department of Geography & Environment, University of Aberdeen*
[3]*Geological Survey of Finland (GTK)*

Centre for Doctoral Training (CDT) in Oil and Gas

NERC SCIENCE OF THE ENVIRONMENT

Photography encouraged

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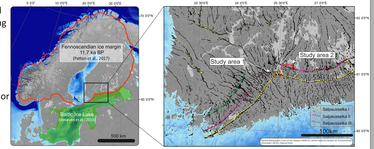
Outstanding Student Poster & PICO Contest

1. Study area & rationale

- The study area is located in the Lahti region, where moraine ridges, Salpauselka I and Salpausselka II, "bend"
- The ridges were deposited during sillstands of the Fennoscandian ice sheet linked to the Younger Dryas (Rinterknecht et al., 2004; Saarnisto and Saarinen, 2001)
- Ice margin was, at that time, grounded in a large proglacial lake, the Baltic Ice Lake.
- The sediments were deposited as ice-contact deltas, over a very short period (180-250 years)

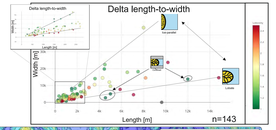
- Ground penetrating radar(GPR) profiles and outcrops analyzed and interpreted providing information on formation mechanism, sedimentary environments and reservoir properties of ice-contact deltas
- This study aims to provide insights for analogous deposits (Pleistocene and older) which can be prospective for hydrocarbons or water reservoirs.

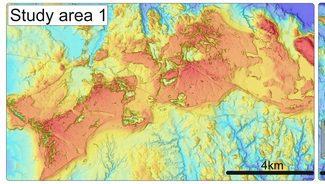


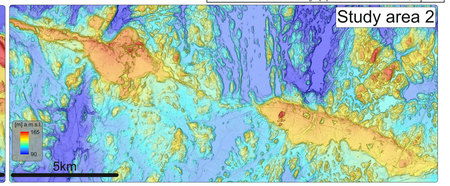
2. Morphology & metrics

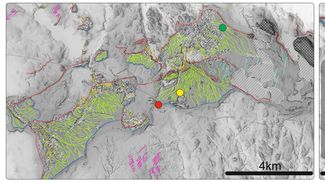
- High resolution LIDAR data (2m horizontal, 0.3m vertical) was used to map the morphology
- The deltas, at present, form flat topped hills standing proud of the topography
- Distributary channels network still visible on the flat delta top
- Multiple kettle holes formed where buried ice blocks melted out. They are more abundant in Study area 1.

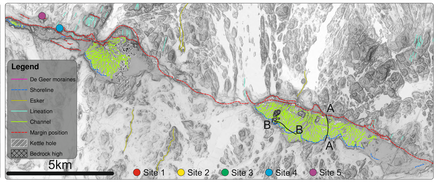
- Sediments supplied to the ice margin via meltwater conduits and/or bedrock troughs
- Where no meltwater conduit was present only a narrow, steep ridge was formed
- The largest deltas form by amalgamation of several smaller ones
- Evidence for ice margin oscillations and partial overriding of deltas



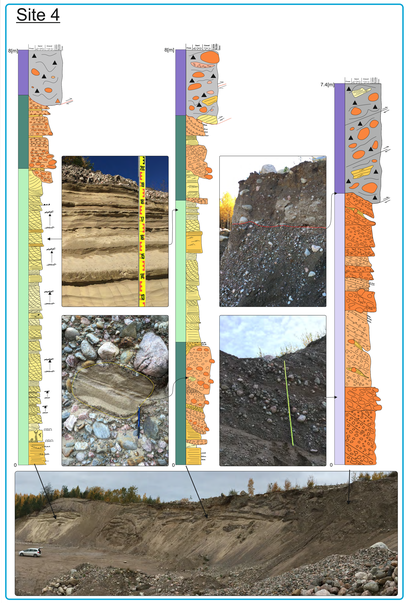




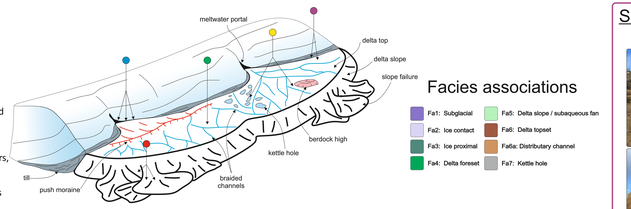


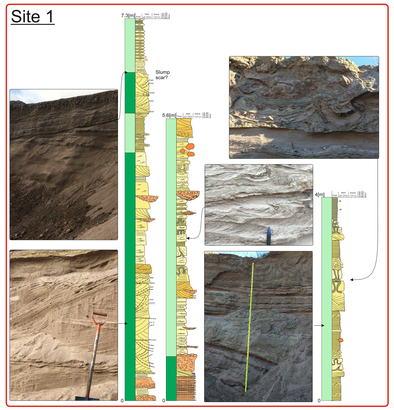


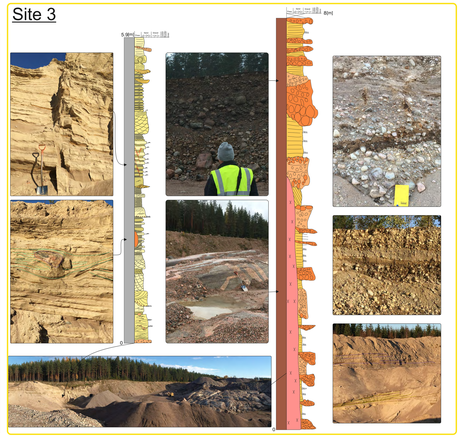
3. Sedimentology

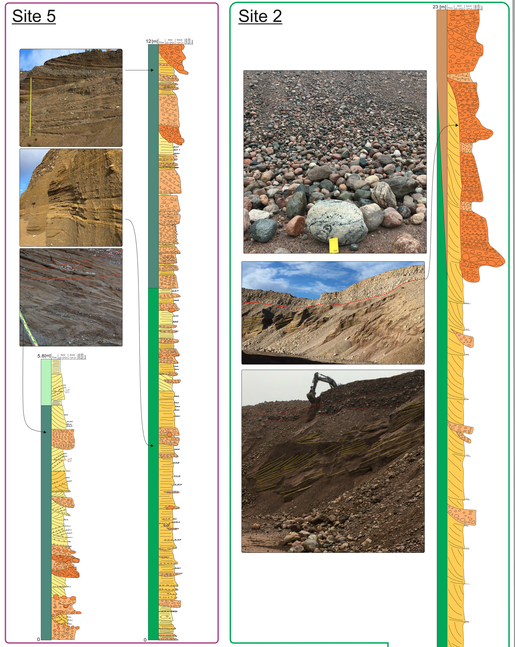


- Isolated, moderate-quality outcrops only in active sand and gravel pits
- Exposures of unconsolidated sediments prone to slope failure
- 8 facies associations identified
- Ice contact facies comprised mostly of very poorly sorted conglomerates and diamictons
- Average grainsize decreases distally and laterally from a sediment input point/meltwater portal
- Delta top facies comprised of moderately sorted boulders, cobbles and gravels
- Prevalence of erosional basal contacts
- Low textural and/or mineralogical maturity of sediments







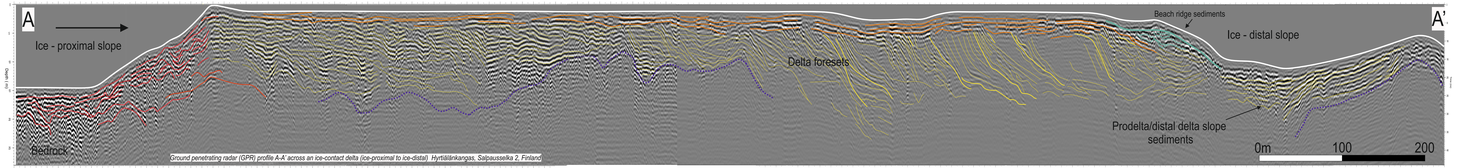


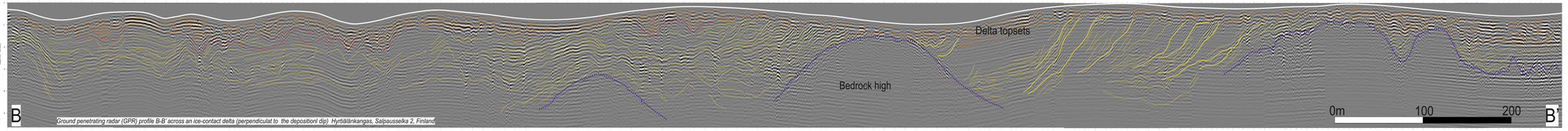
4. Ground penetrating radar survey results

- GPR profiles acquired using 80 MHz antenna
- Penetration depth ranges between 15 m and 25 m
- Vertical resolution 0.2m-0.5m
- Multiple steeply-dipping reflectors interpreted as delta foresets
- Discontinous and/or chaotic reflectors in the ice proximal part of the delta interpreted as ice contact/ ice proximal facies
- Flat reflectors in the upper part of the delta interpreted as delta topset facies
- Bedrock highs often blanketed by glaciofluvial, deltaic sediments

- Reflections are mostly discontinuous implying erosional contacts within the strata
- Clear angular unconformity between topset and foreset facies
- GPR penetration depth not enough to image the whole thickness of strata

Try and draw your interpretation!





5. Conclusions

World-class example of ice-contact, Gilbert-type deltas which can be used as a direct analogue for similar deposits in the subsurface

- Mostly good, reservoir-quality sediments in the medial and distal part of the delta
- Topsets often composed of boulders and cobbles which may cause potential drilling hazards
- Ice contact (Gilbert type) deltas rather than "typical" frontal moraines
- Rapid deposition controlled by the ice margin position as it retreats (backfilling) and depth of the proglacial lake
- Abrupt facies change laterally and distally from the efflux point at a scale of 10s/100s of meters
- Kettle hole facies can be misinterpreted as ice distal sediments

- Large ice contact deltas are an amalgamation of several lobes (bajada-style)
- The largest and but also the most complex deltas formed in the interlobate zone (a rule?)
- Ice contact facies are considered as non-reservoir facies due to their poor sorting.
- GPR profiles provide good understanding of the structure of the delta which can be ground-proved in isolated, moderate quality outcrops.
- Another technique (electrical resistivity tomography?) required to image the full thickness of sediments.

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