



## SUSTAINABLE DEVELOPMENT IN THE MINERALS INDUSTRY

6th International Conference

Milos Island, Greece



Ageria quarry, Milos

# Mining waste management of Estonian mineral resources

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Eesti tuleviku heaks



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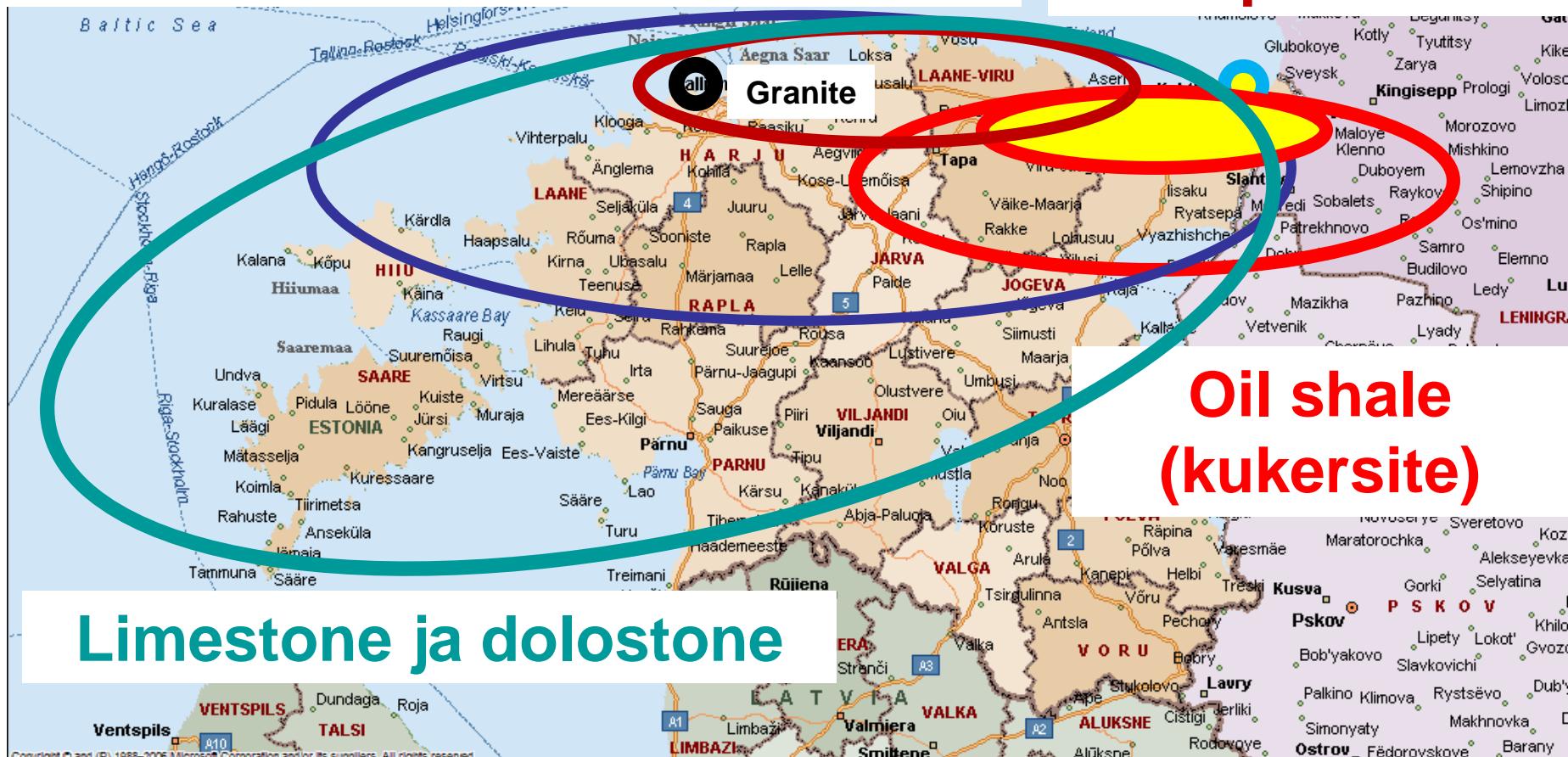
# Estonia

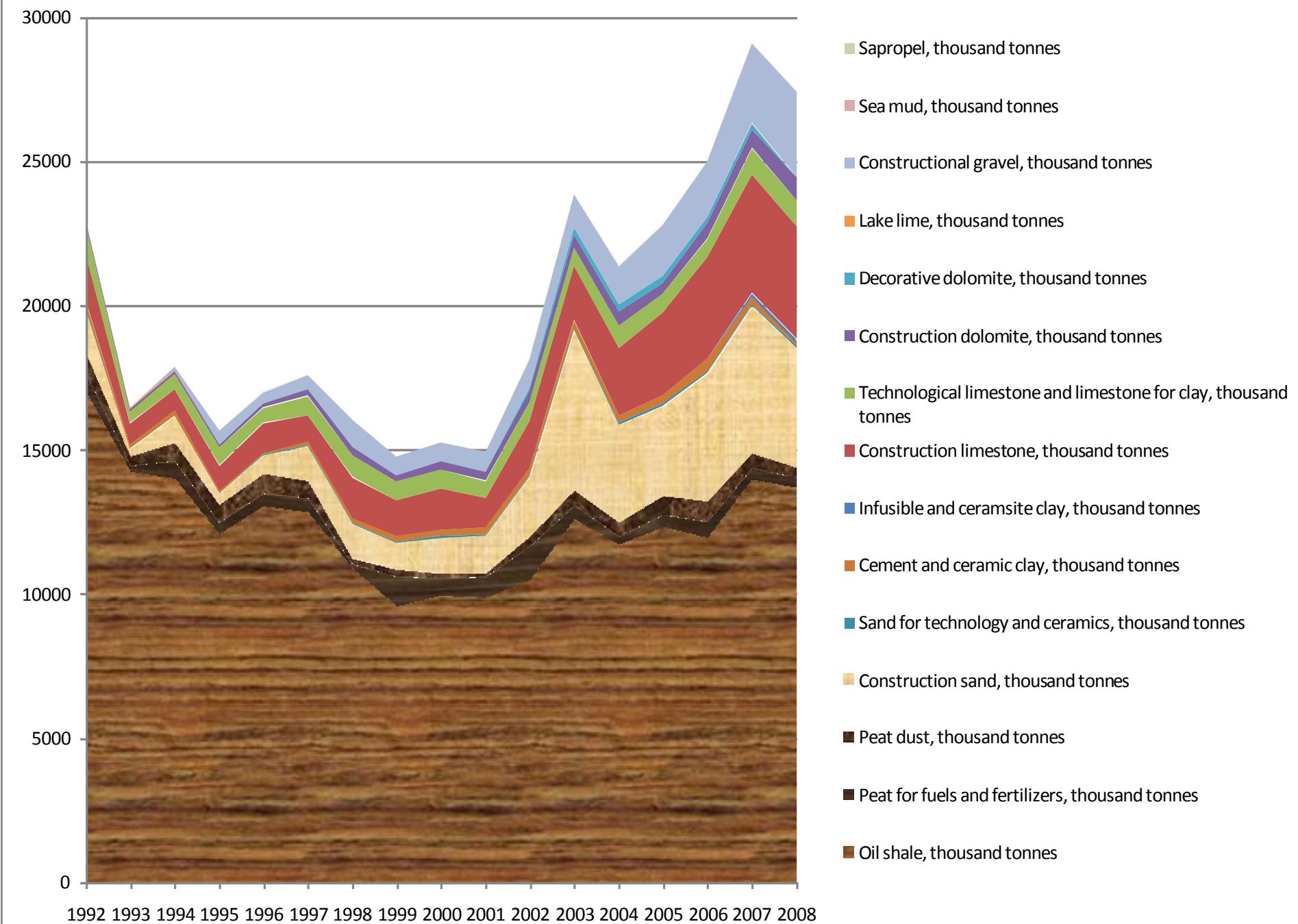
- Small country (45000 km<sup>2</sup>, 1,3 Mill.inhabit)
- Largest oil shale mining country
- Oil Shale is used for:
  - power generation,
  - oil production
  - fuel for cement kilns

# Estonian Mining areas

## Black shale (Dictyonema argillite)

## Phosphate rock







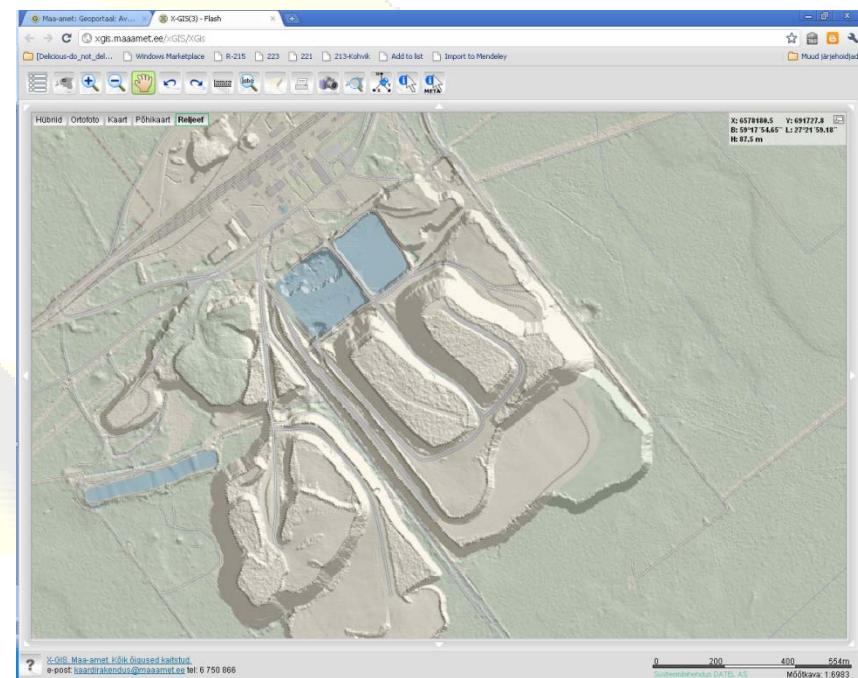
# Aim of study

- What type mining waste facilities have
  - Hazardous
  - Inert
- Is mining waste usable
  - As a by product
  - New raw material
- Mining waste heaps properties





# Oil shale waste rock



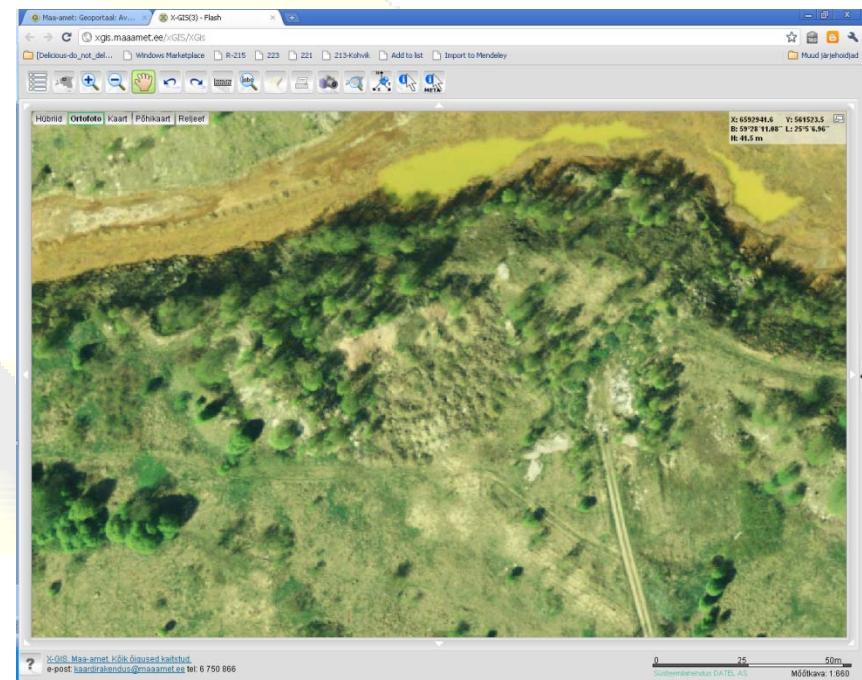
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# Burned black shale heaps



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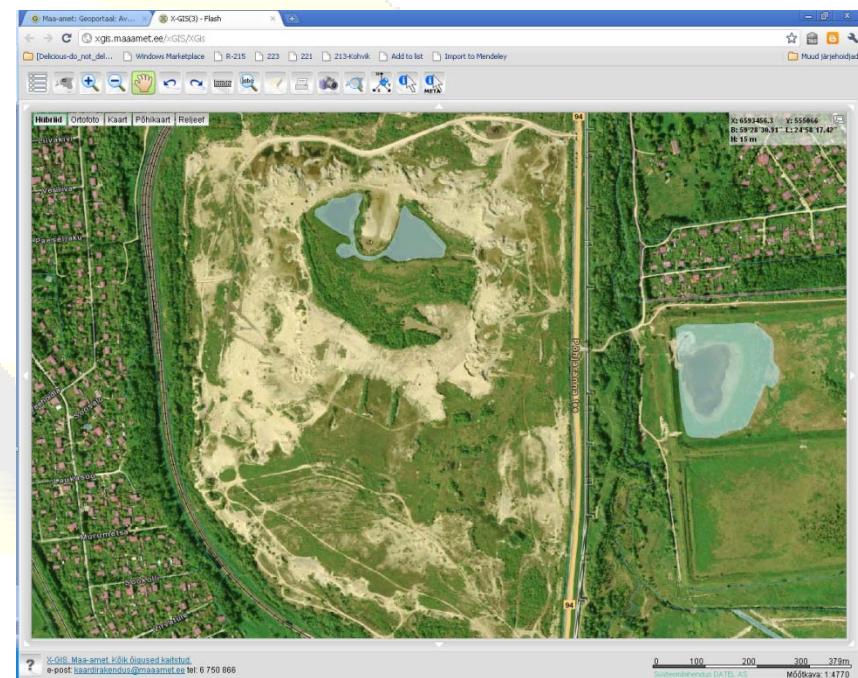
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# Flotation sand



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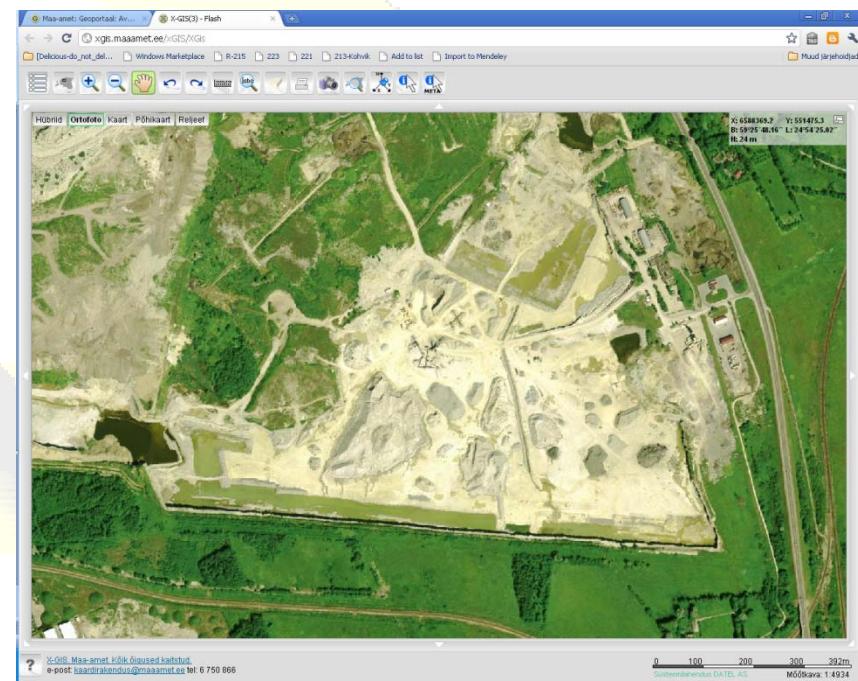
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# Limestone production fines (0-4mm)



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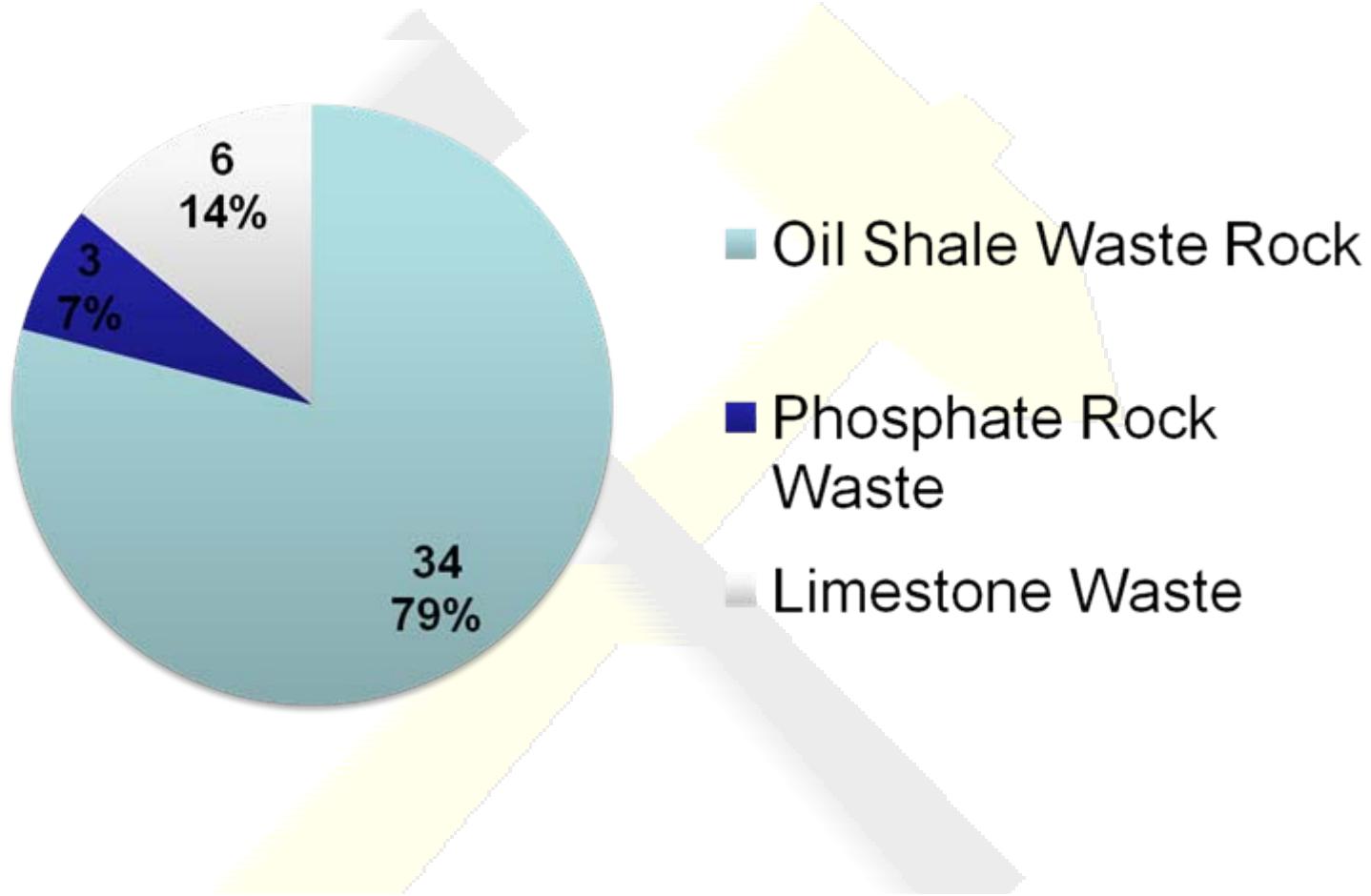


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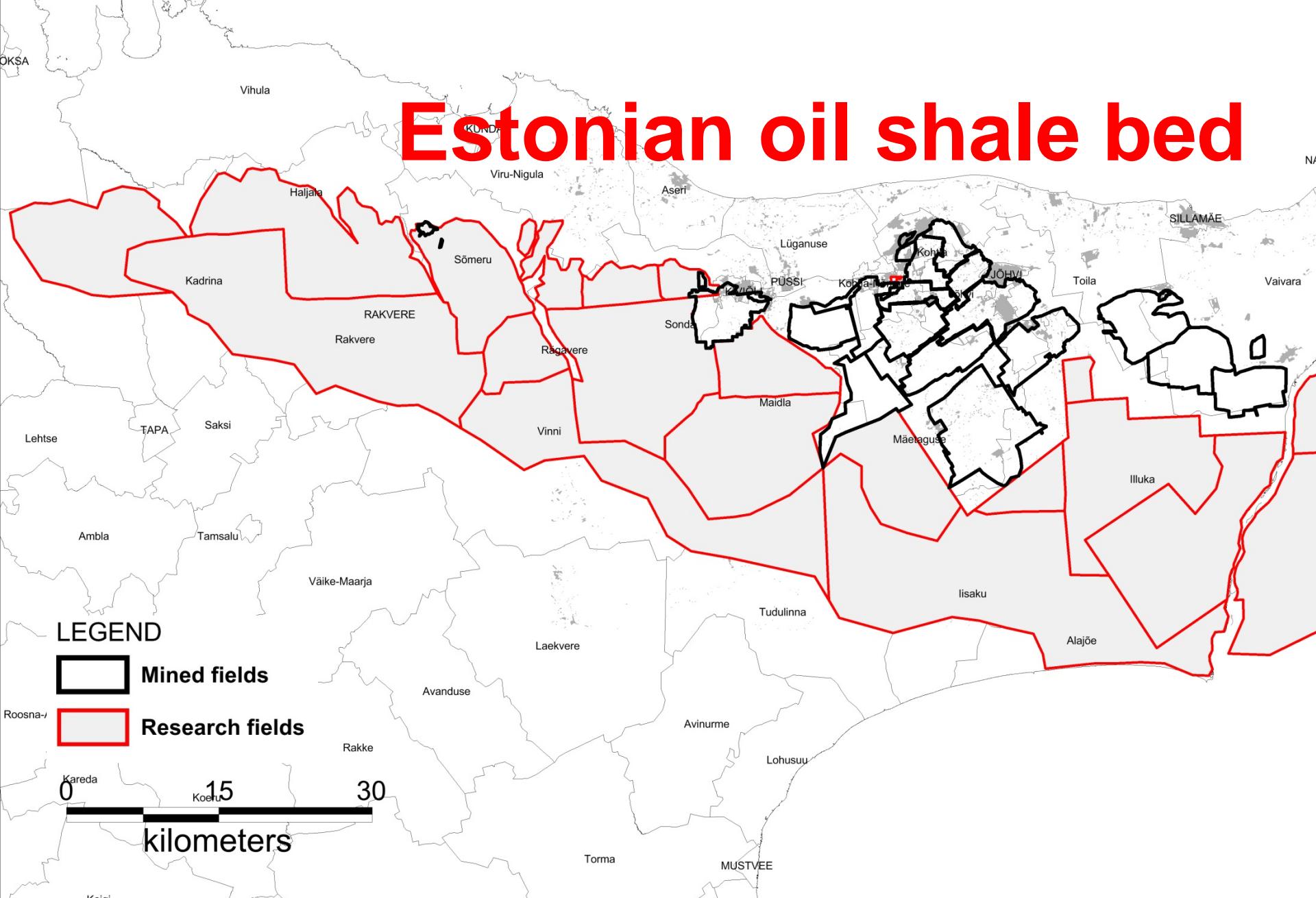
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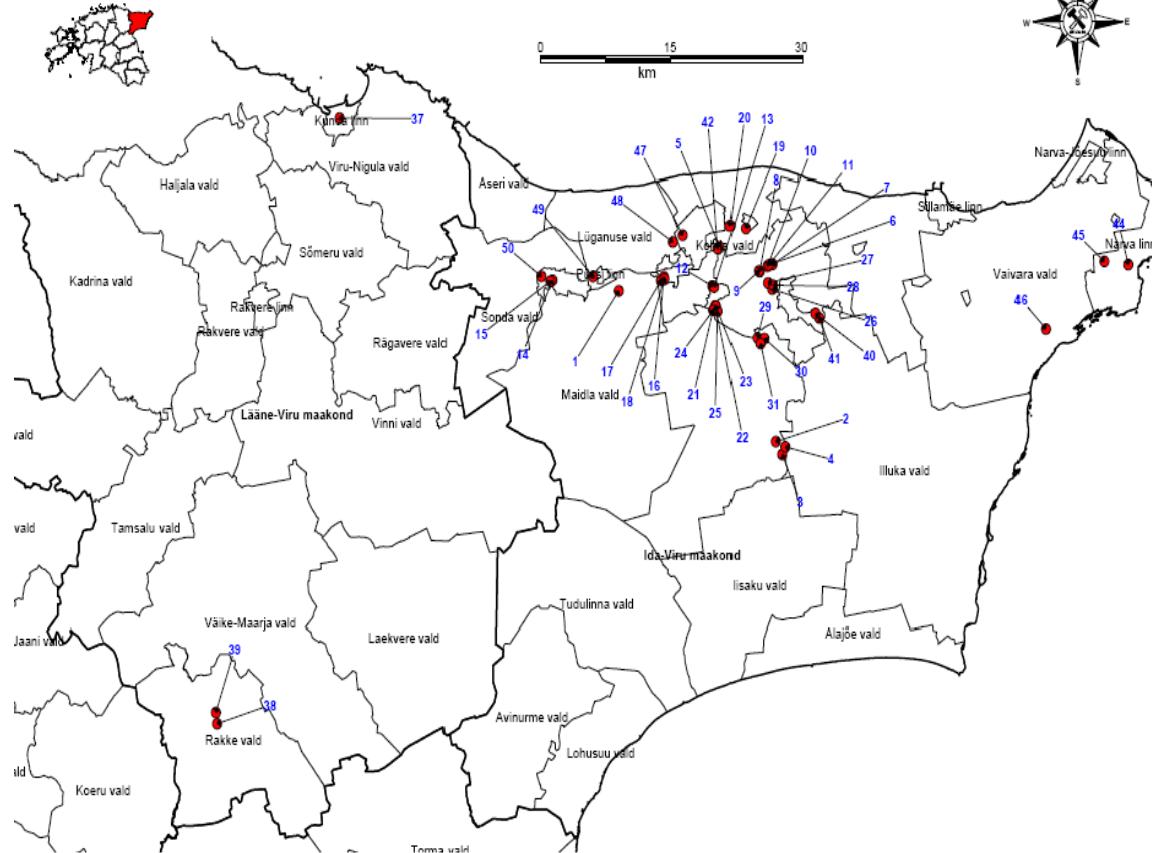
# Mining waste facilities in Estonia



# Estonian oil shale bed



# Oil shale waste heaps



## Main characteristics

- Volume
- Mining method
- Organic material
- Shape of heap

# Oil shale seam

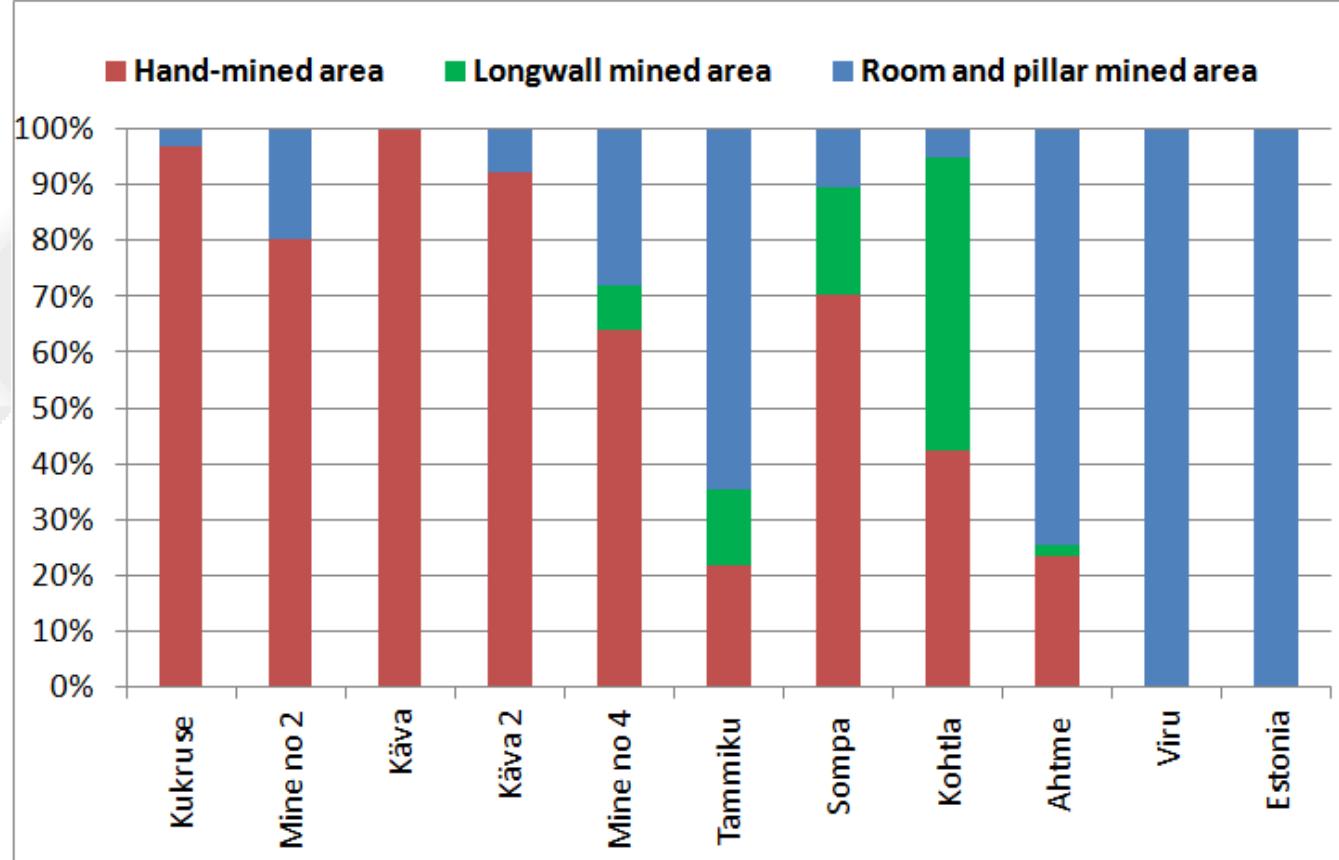
Lithology	Layer	Layer thickness, m	Height from layer A, m
	F2	0.30	3.03
	F1	0.34	2.73
	E	0.59	2.39
	D/E	0.10	1.80
	D	0.07	1.70
	C/D	0.29	1.63
	C	0.45	1.34
	B/C	0.08	0.89
	B	0.37	0.81
	A/B	0.21	0.44
	0.23	0.23	

- Mining methods
  - Hand mining
  - Longwall mining
  - Room and pillar mining

# Used mining methods

## Mined area

- Hand-mined
  - 70.75 km<sup>2</sup>
- Longwall
  - 14.10 km<sup>2</sup>
- Room and pillar
  - 133.60 km<sup>2</sup>



**Oil shale waste rock**



Pilot unit



**Oil shale for oil or electricity**



**Limestone for aggregate or backfilling**



# Pilot unit process



**Crushing with bucket**

**Sieving crushed material**





# Jigging

Separating  
oil shale and limestone



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Eest

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**Oil shale on top**

**Limestone on bottom**



# Preliminary Results

- We have tested crushing bucket to crush
  - Hard lime
  - Oil shale waste rock
- We have testing separation unit
  - Oil shale waste rock from open cast
  - Oil shale waste rock from underground mine





# Crushing hard lime





# Crushing oil shale waste rock





# Jigging oil shale waste rock



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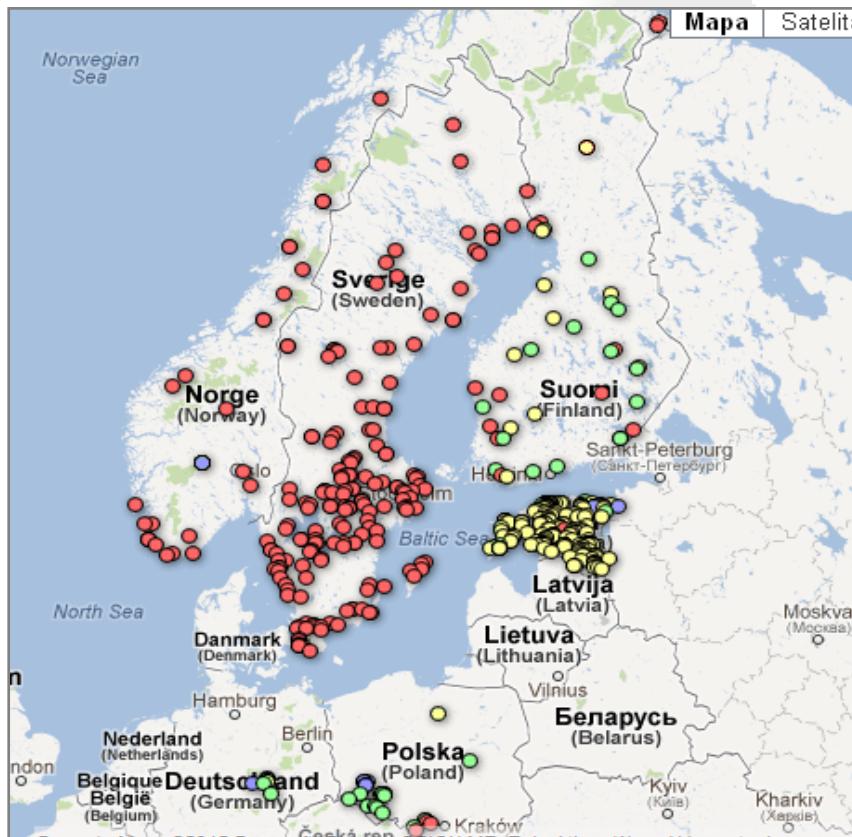
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# Mining waste information

<http://mi.ttu.ee/db/>



<http://mi.ttu.ee/miningwaste/>

The screenshot shows a blog post titled "Mining waste" from May 27, 2012. The post discusses a study tour with MIN-NOVATION partners from Finland. It includes two photographs: one of people at a mining museum and another of a limestone quarry. The sidebar features a sidebar with various posts and links related to mining waste and research.



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# EU Baltic Sea project MIN-NOVATION

- Min-Novation website: [www.min-novation.eu](http://www.min-novation.eu)
- Sign up for Min-Novation newsletters
- Min-Novation conference at the end of 2013 in Poland
- Contact project manager:  
[ostrega@agh.edu.pl](mailto:ostrega@agh.edu.pl)  
or communication officer:  
[piotr.szmigielski@fii.org.pl](mailto:piotr.szmigielski@fii.org.pl)

The image shows four issues of the MIN-NOVATION Newsletter, each with a blue header and white text. The first issue (No 1 April 2011) features the project logo and logos for the European Union and the Baltic Sea Region. The second issue (No 2 July 2011) includes a photo of a mining site. The third issue (No 3 October 2011) features a photo of two people standing near a large industrial facility. The fourth issue (No 4 April 2012) features a photo of a green pond or reservoir. The newsletters also mention various partners and activities.

**Newsletter No 1 April 2011**  
Part-financed by the European Union (European Regional Development Fund)

**Newsletter No 2 July 2011**  
Part-financed by the European Union (European Regional Development Fund)

**Newsletter No 3 October 2011**  
Part-financed by the European Union (European Regional Development Fund)

**Newsletter No 4 April 2012**  
Part-financed by the European Union (European Regional Development Fund)

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Baltic Sea Region  
Programme 2007-2013



# Conclusions

- Aim is find usage for mining waste
- We have established pilot unit
  - Crushing bucket,sieving unit and jigging unit
- We have promising preliminary results
- Database on mining enterprises
  - <http://mi.ttu.ee/db/>
- More information:
  - <http://mi.ttu.ee/miningwaste>
  - <http://mi.ttu.ee/mining>



# THANK YOU !

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