ImpactMin WP7.4

Chelyabinsk-Orenburg Case Study, Russia

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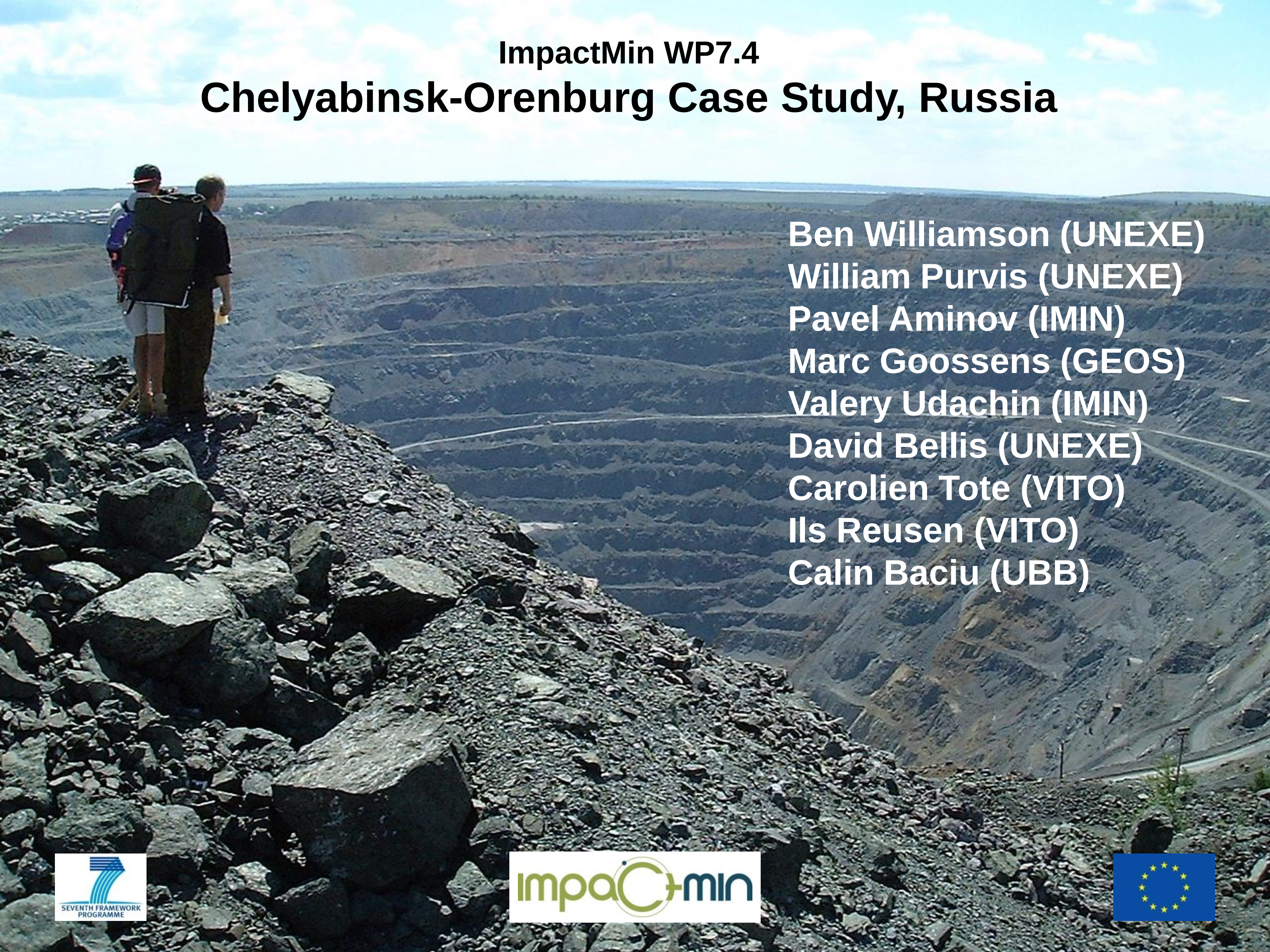
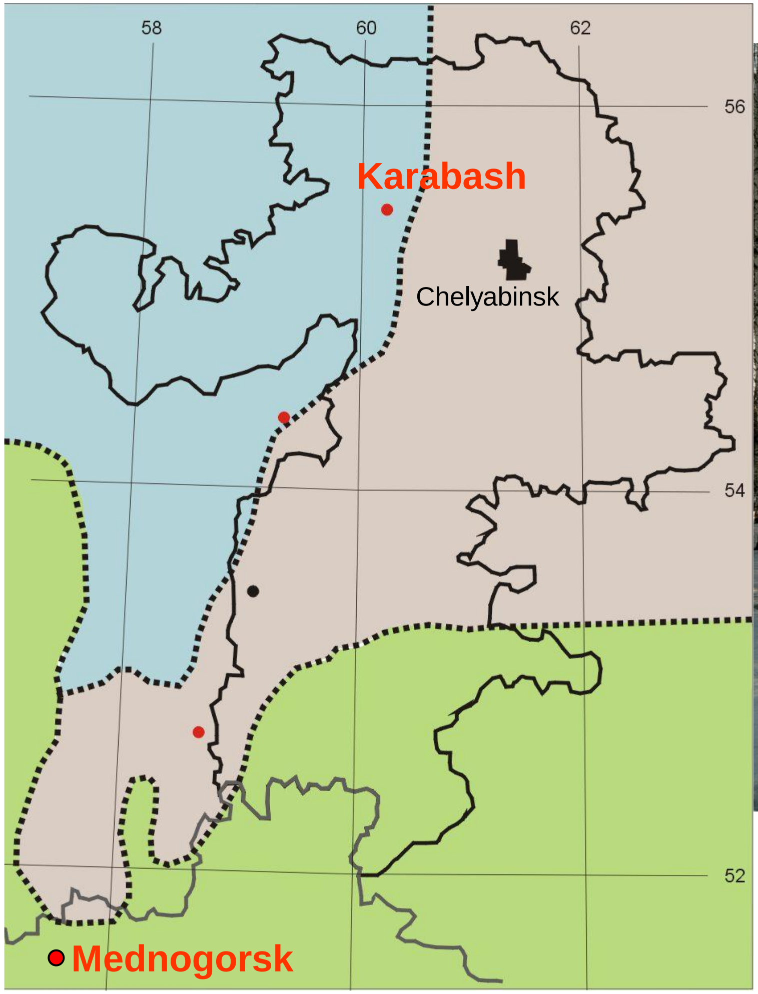
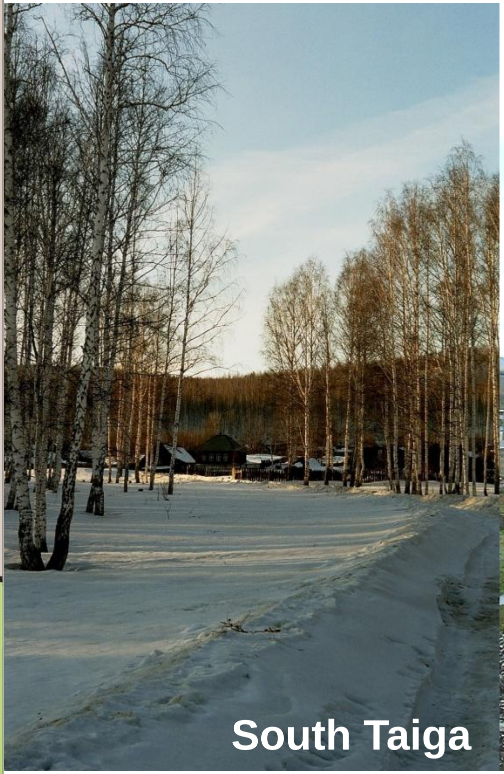


Areas of study





South Taiga, high precipitation, mainly poorly buffered soils.

Forest-steppe, moderate precipitation and moderately buffered soils.

Steppe with periodic drought and highly buffered soils.

Aims of study

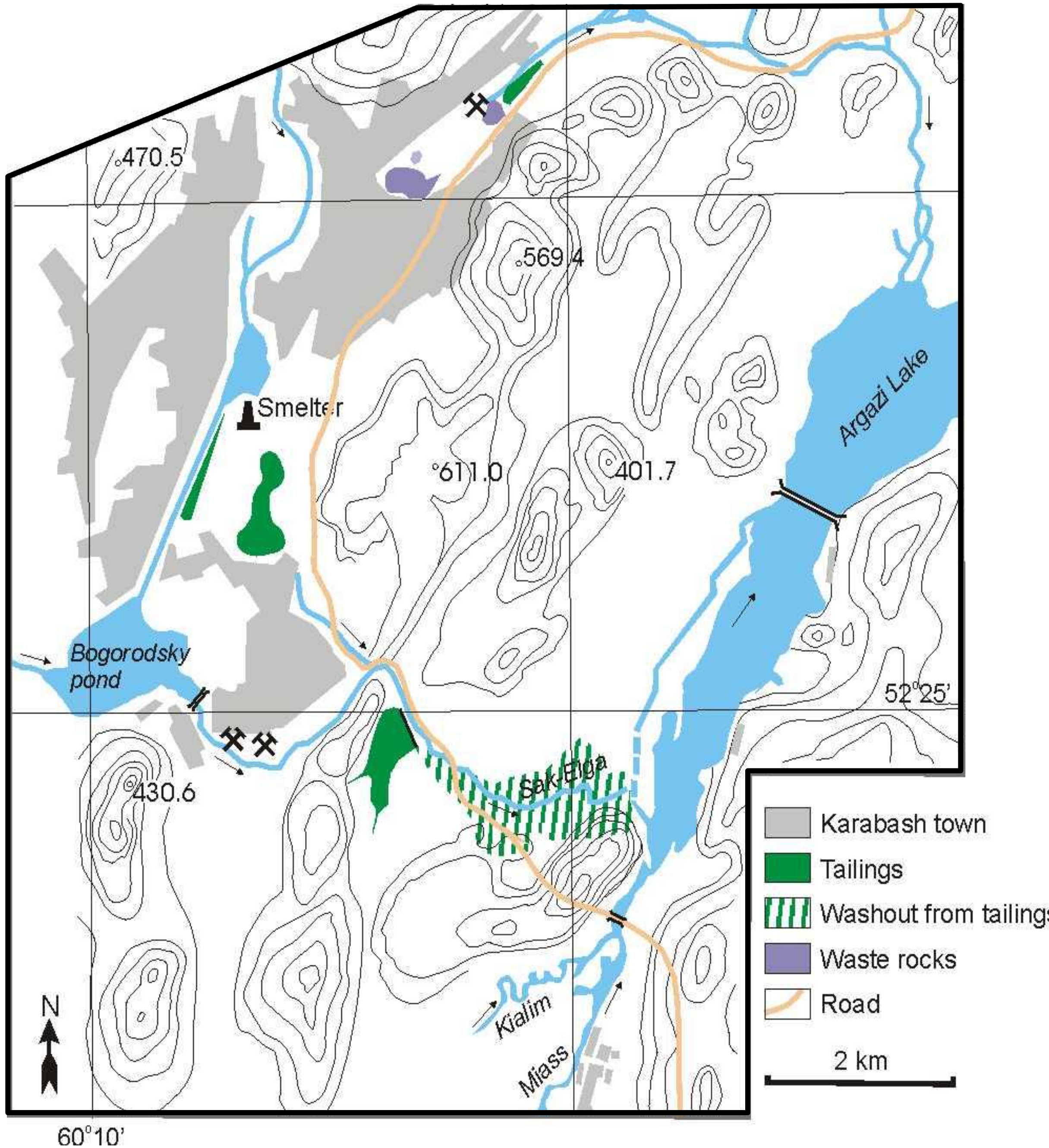
Determine the impacts of mining-related activities in Karabash and Mednogorsk

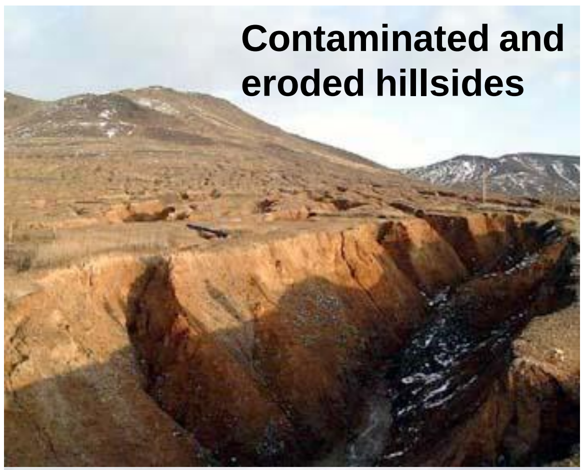
Ground-truth data acquired using remote sensing

Assess environmental effects of the installation of a cleaner Ausmelt smelter in 2006

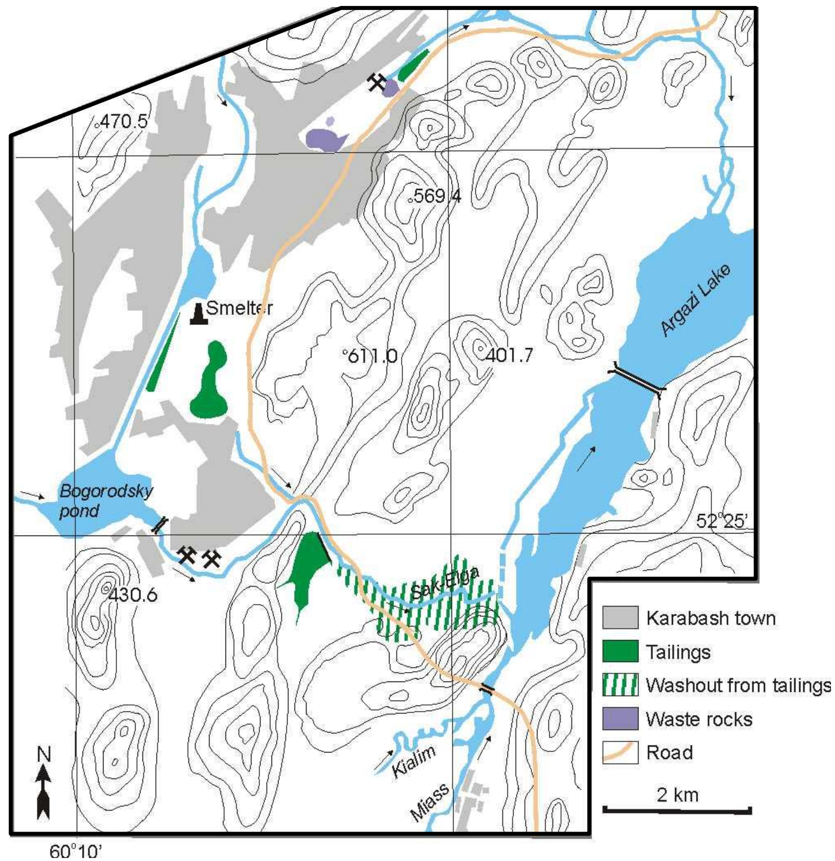
United Nations Environment Programme 1992 – **Karabash, one of the most polluted towns in the world!**

Nesterenko (2006) ‘ecological disaster zone’




Contaminated and eroded hillsides


18 Mt of tailings


470.5
569.4
Smelter
611.0
401.7
Argazi Lake
Bogorodsky pond
52°25'
430.6
Sak-Elga
Kialim
Miass
N
60°10'
Karabash town
Tailings
Washout from tailings
Waste rocks
Road
2 km

Project limitations

Political problems preventing access to smelter sites and output and emissions data.

Lack of meteorological data.

Lack of on-site logistical support.

Difficulties in import/export of equipment and samples.

Brief history of Karabash

1910 – Large scale Cu smelting begins.

1925 - Beneficiation mill built to produce Cu (+Zn) concentrates.

1991 – Smelter, mill and last mine closed.

1997 – **Locals said they would rather be poisoned than starve!** Smelter reopened!

2006 – New 'Ausmelt' smelter, replacing blast furnace.

According to locals – 'scrubbers' often switched off at night.

http://www.yokogawa.com/iab/suc/metals/iab-suc-ausmelt-en.htm (Nov, 2012)

Turgoyak ‘reference site’

Karabash

Lichen studies

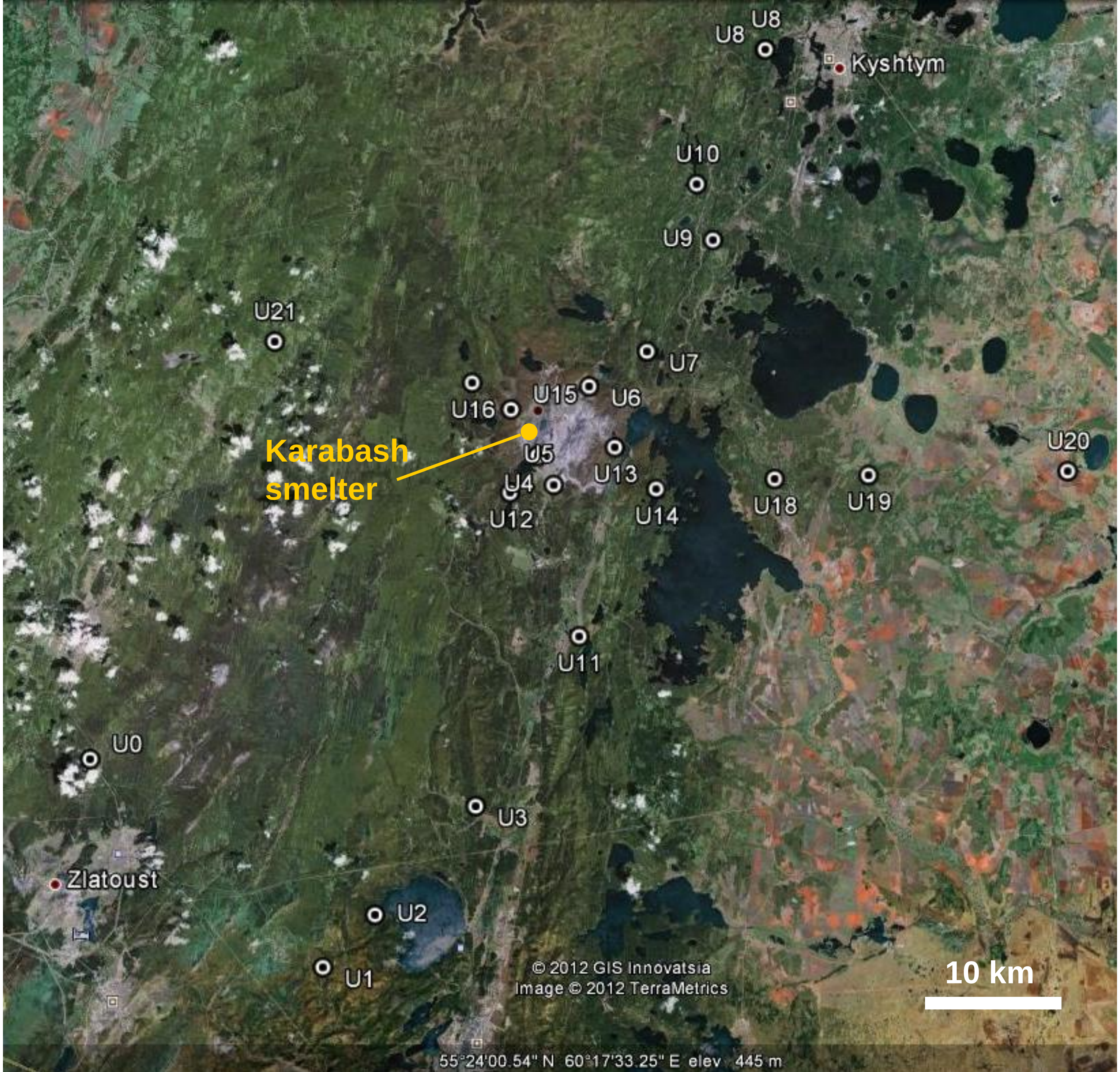
Aims

Determine nature and spatial distribution of fallout from the Karabash smelter – “ground-truth remote sensing studies”

Benefits of lichen transplant monitoring

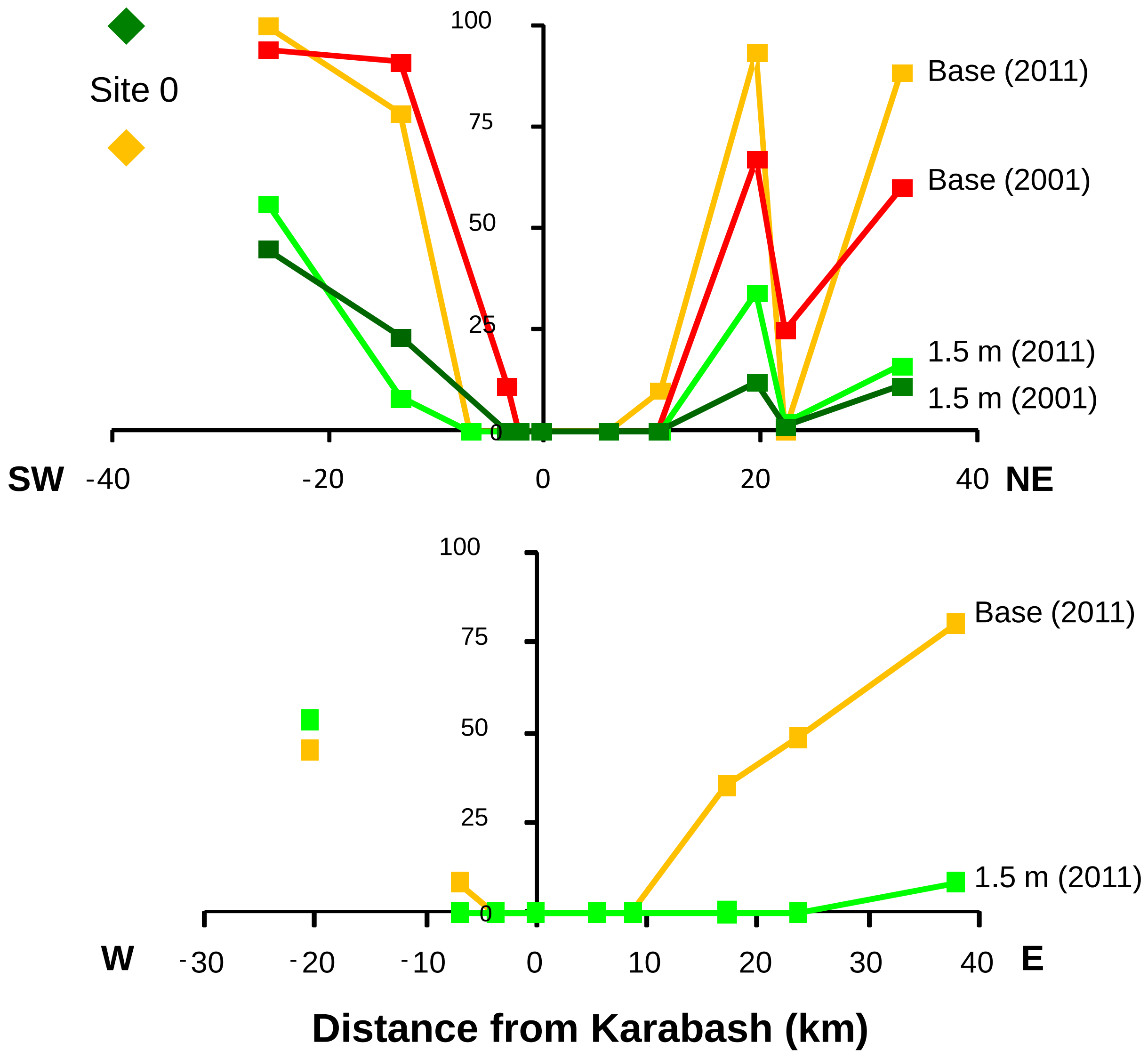
Low cost - Discreet





U8
U8
Kyshtym
U10
U9
U21
U7
U15
U6
U16
Karabash
smelter
U5
U13
U20
U4
U18
U19
U12
U14
U11
U0
U3
Zlatoust
U2
U1
© 2012 GIS Innovatsia
Image © 2012 TerraMetrics
10 km
55°24'00.54" N 60°17'33.25" E elev 445 m

Hypogymnia physodes frequency at base of birch tree and at 1.5m



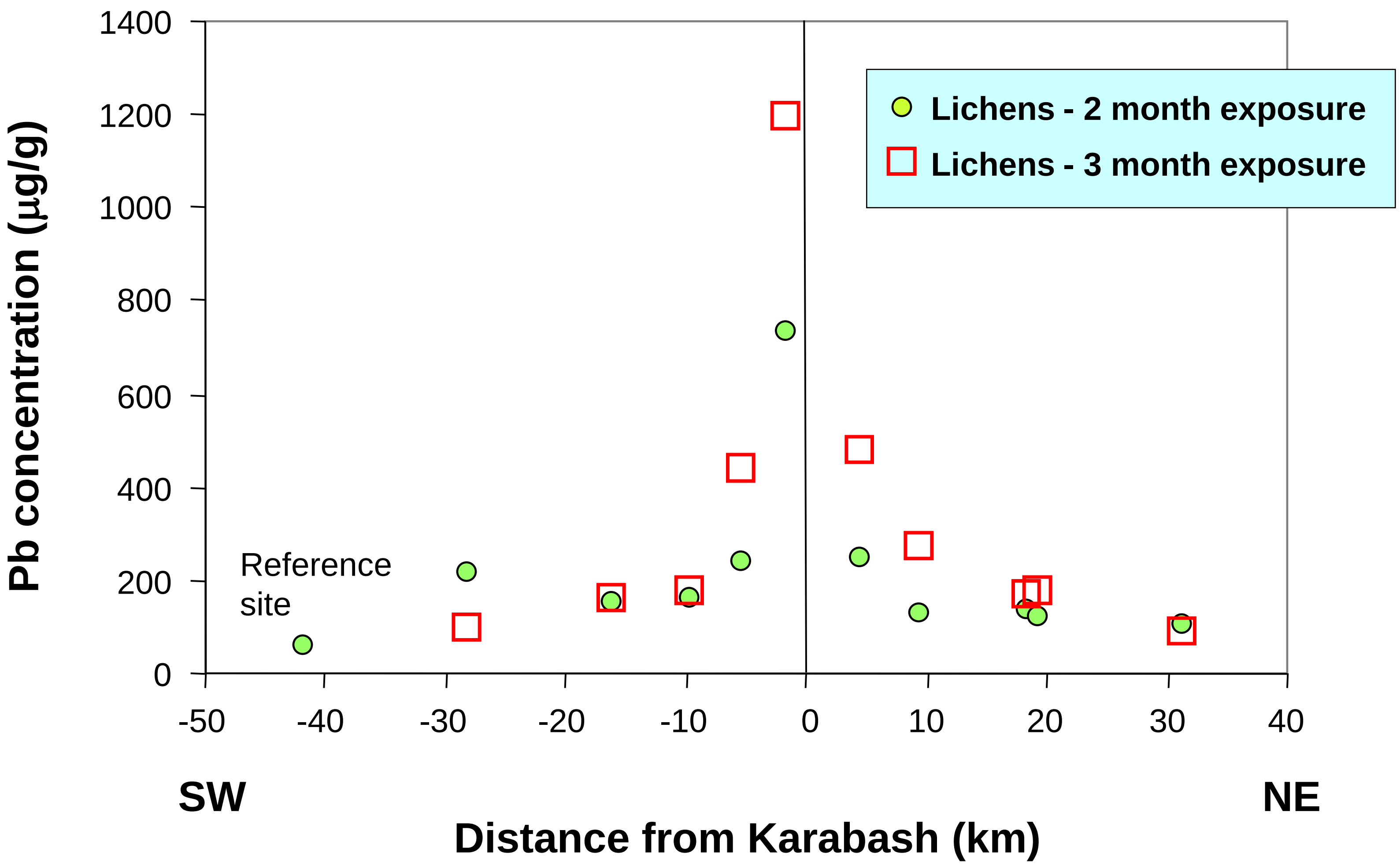
Transplant method

Two twigs, covered with Hypogymnia thalli, **from 'reference' site attached to 6 trees at each transplant station.**

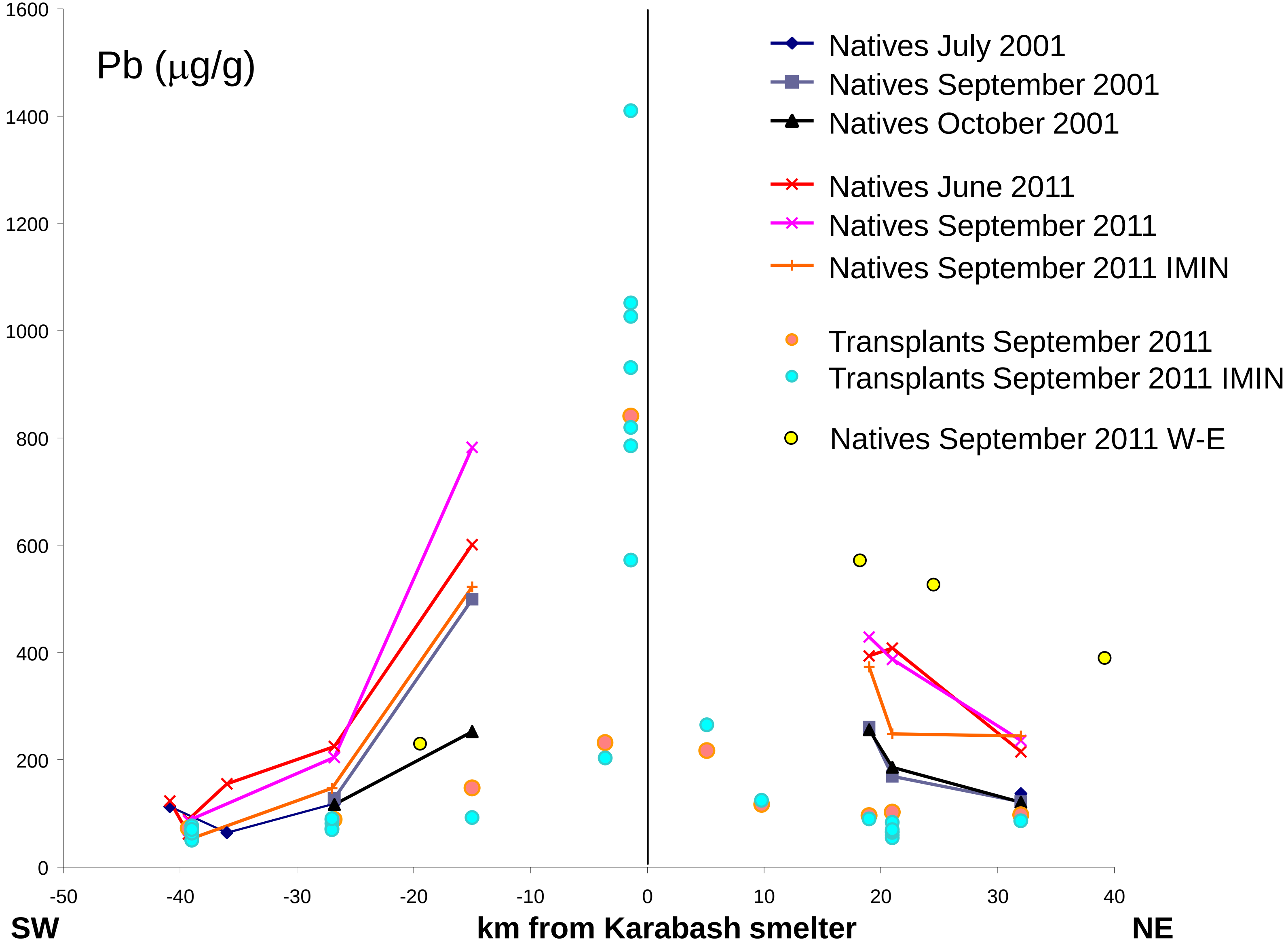
3 month exposure period

June to September 2011

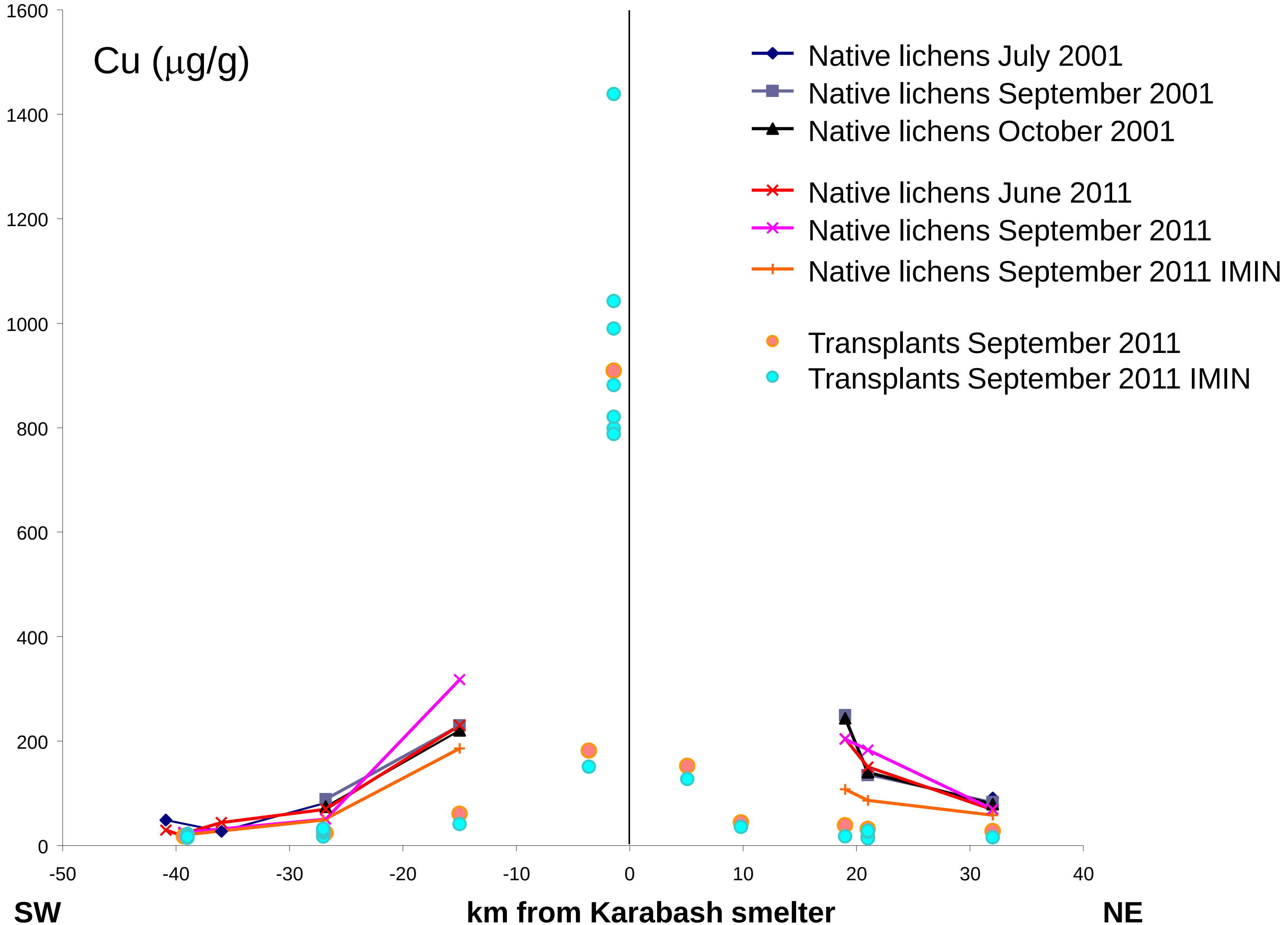
Whole-sample chemistry 2001



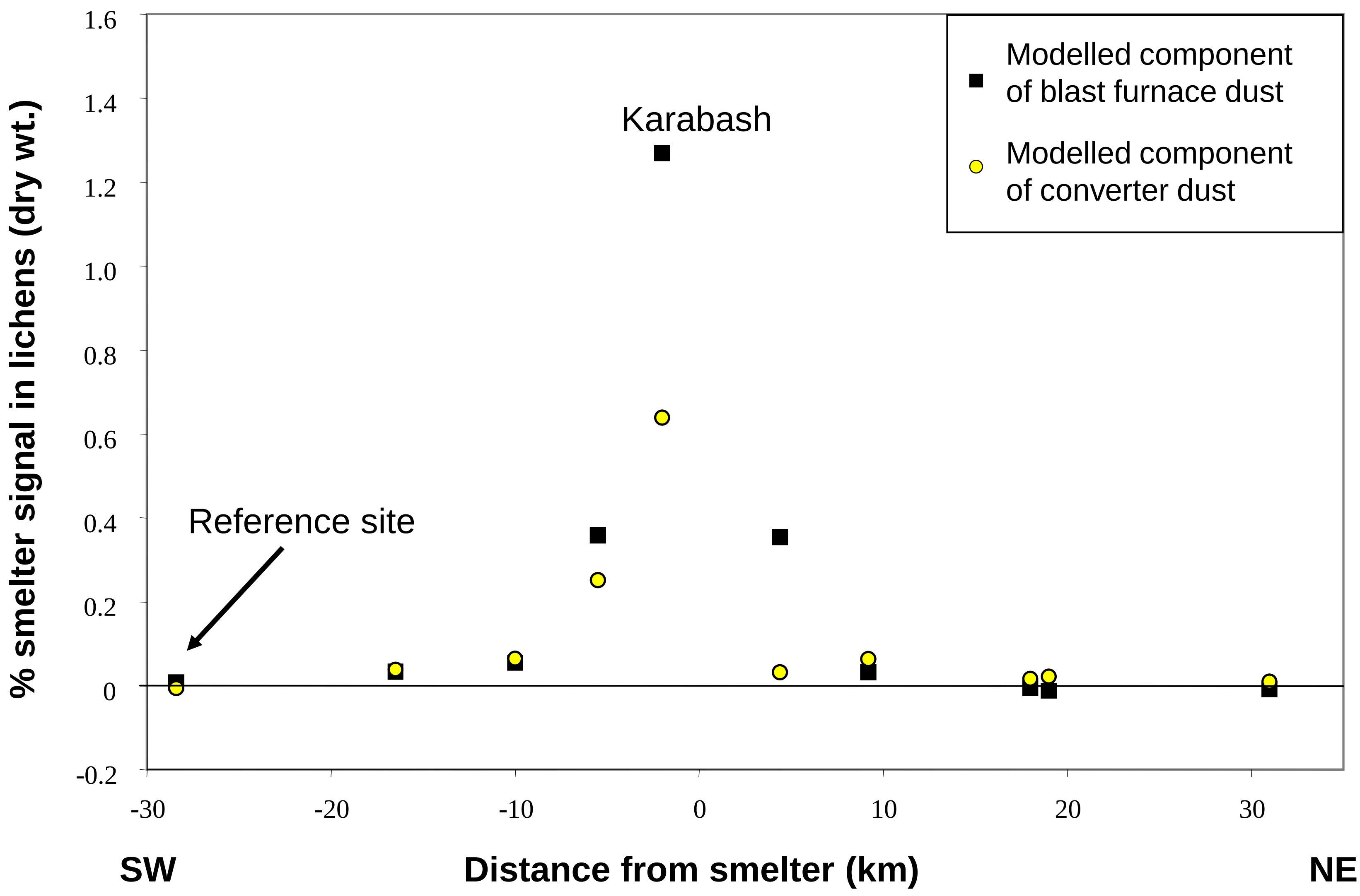
Pb in native and transplanted lichens



Cu in native and transplanted lichens



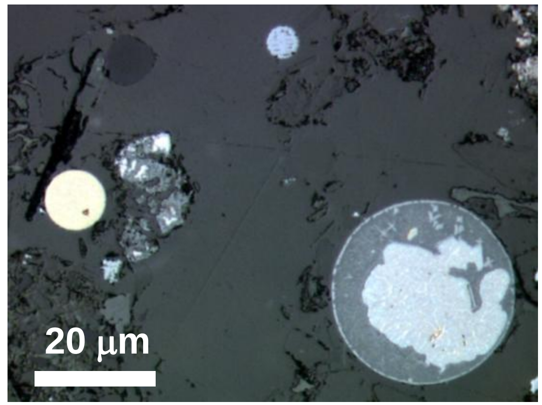
Least squares modelling 3 month exposure 2001

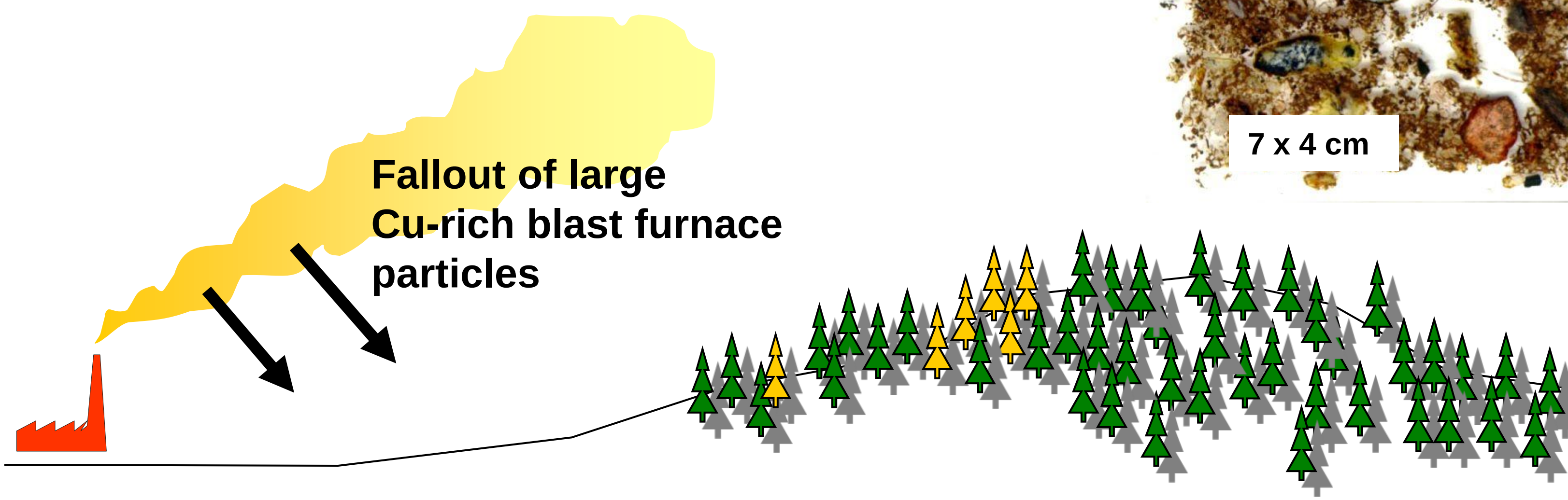


Cu smelter operations

Blast furnace: concentrate + flux heated in O-enriched air, producing matte (Cu_2S) and slag.

Emits some SO_2 and relatively large splash particles of matte and slag.

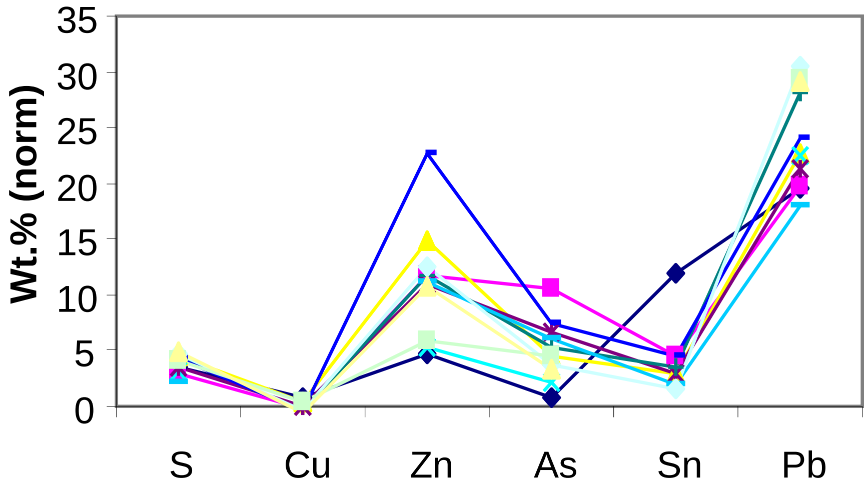


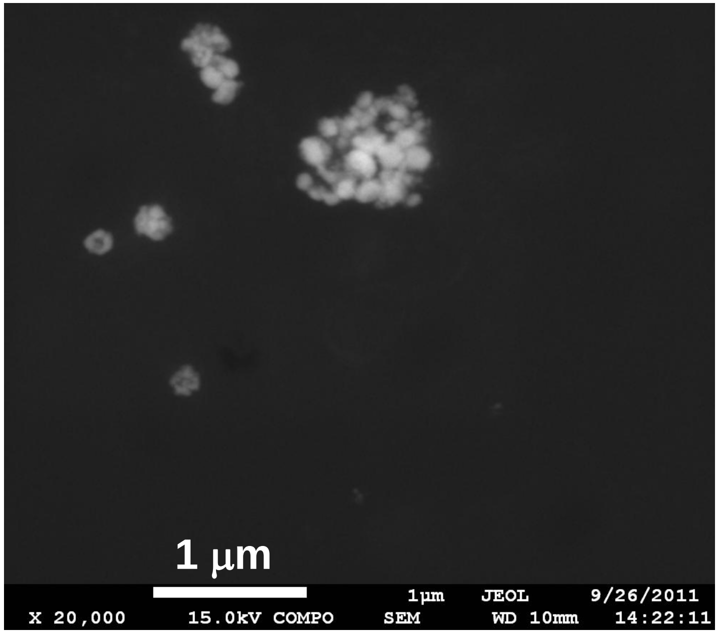


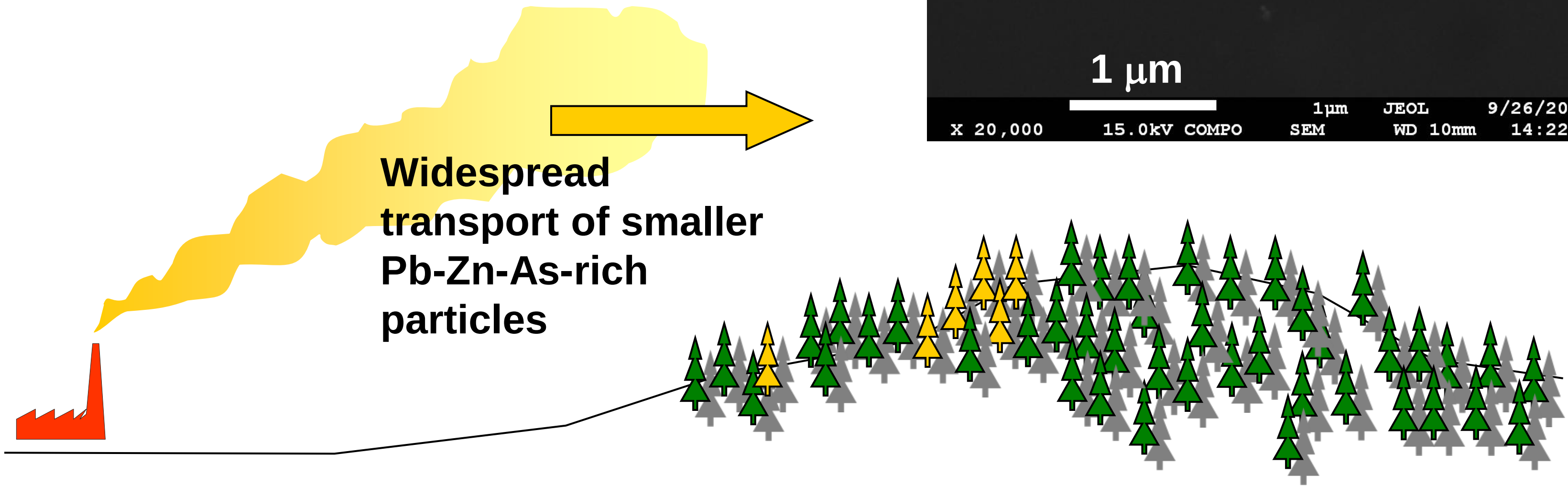
Cu smelter operations

Converter: Matte heated in O-rich air to produce SO_2 and impure Cu.

Emits SO_2 and gas condensates rich in Pb, Zn and As

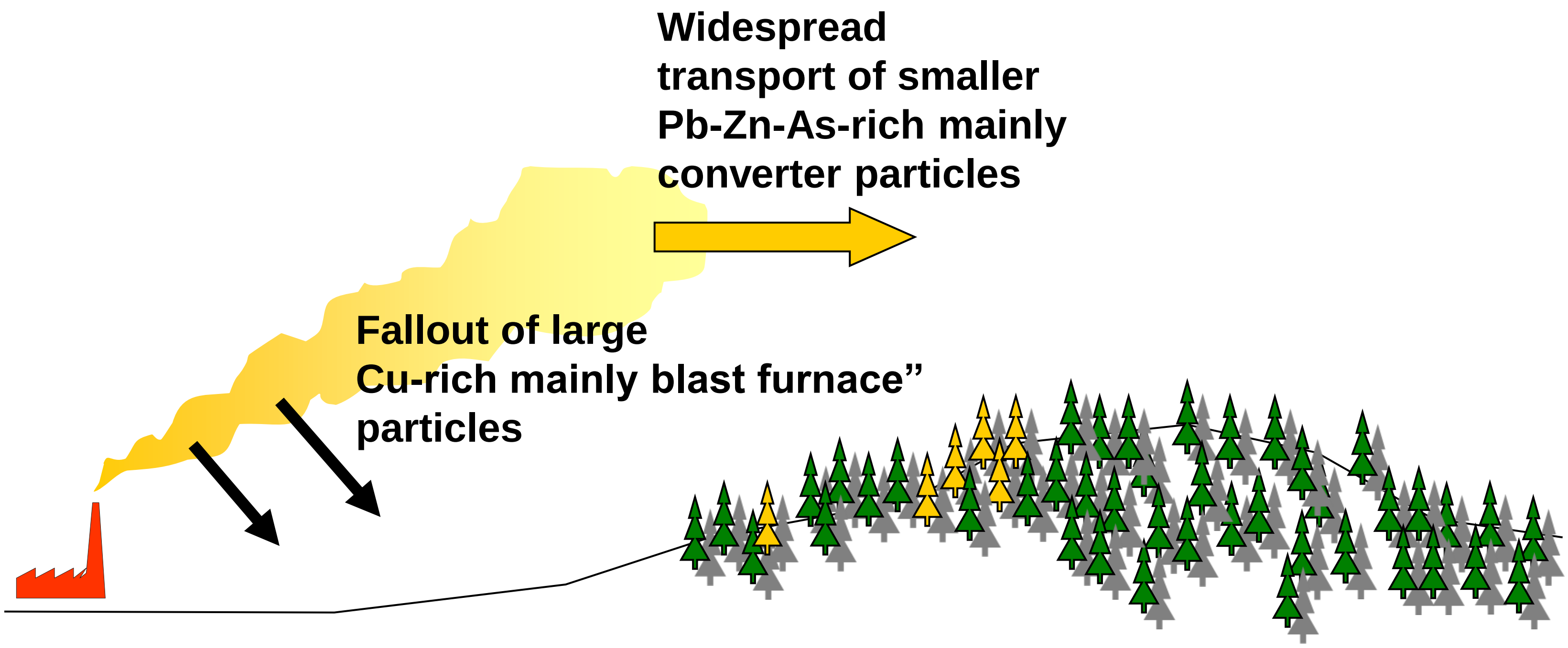




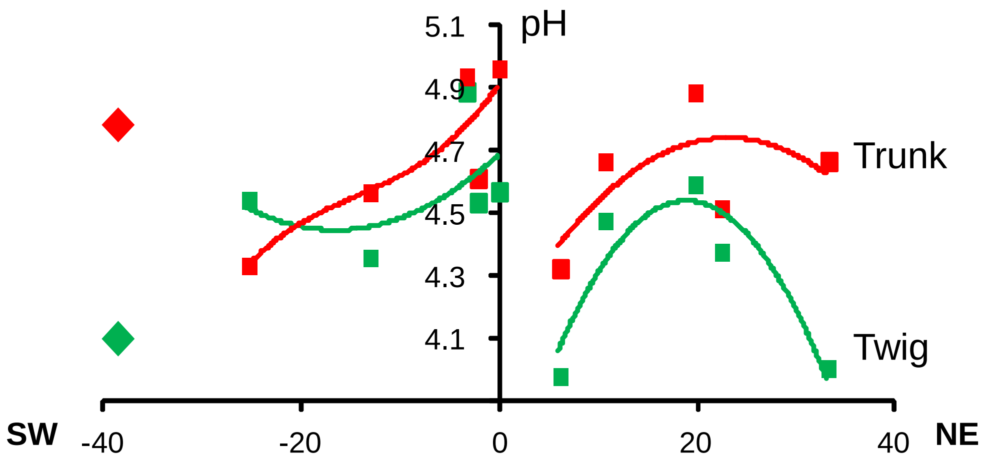


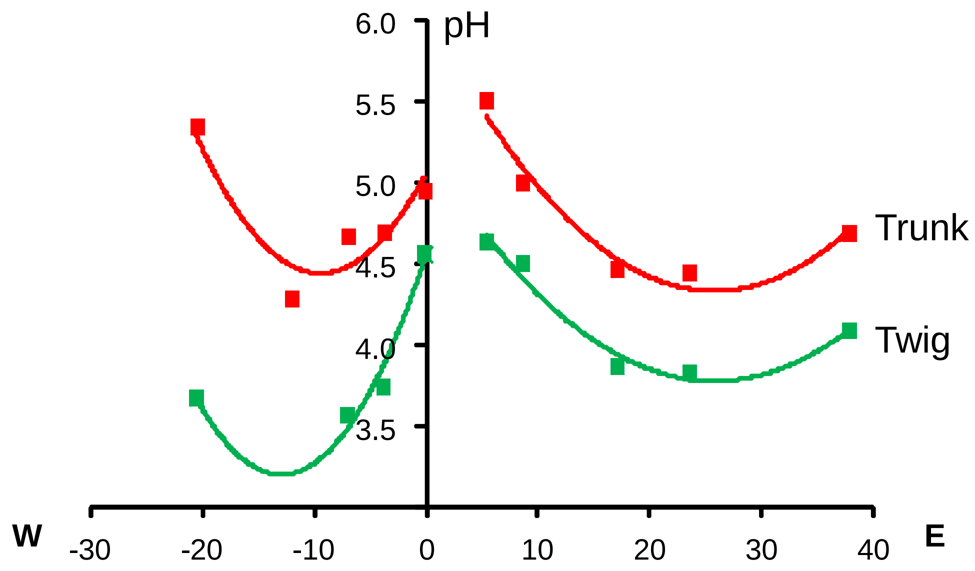
Cause of continued fallout of Pb

Ausmelt process (operating since 2006) largely replaced blast furnace, rather than the converter.



SO_2 and fallout of acid aerosols - Birch trunk and twig bark pH 2011





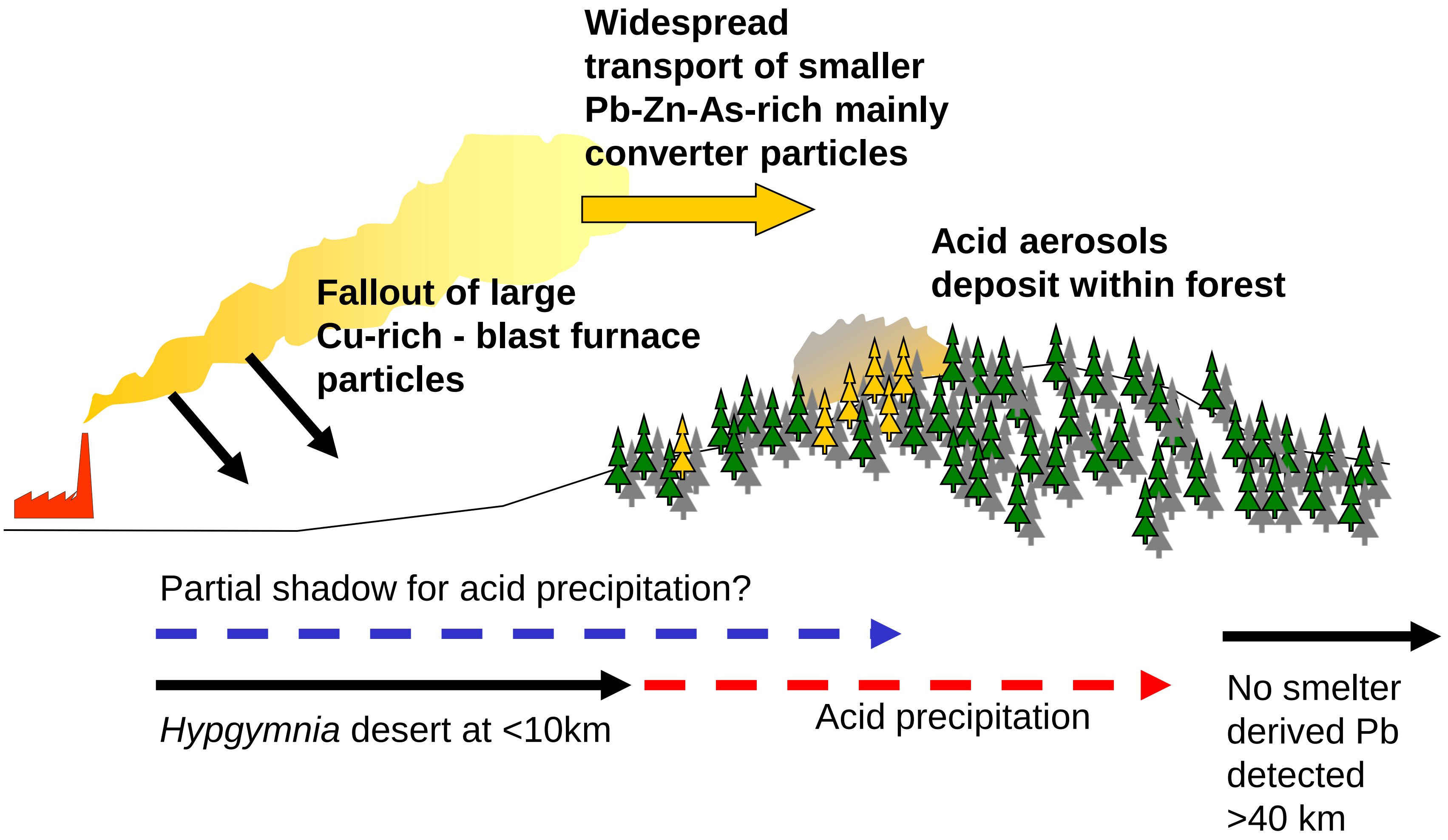
Distance from Karabash (km)

SO_2 and fallout of acid aerosols - Birch trunk and twig bark pH 2011

GeoEye image of July 27th 2010, showing green birch-tree forest.

WV-2 image of September 15th, 2011, showing the same area but where leaves have turned brown.

Summary of field and laboratory observations



Conclusions

Main zone of impact around smelter 8 to 15 km in radius, depending on wind direction

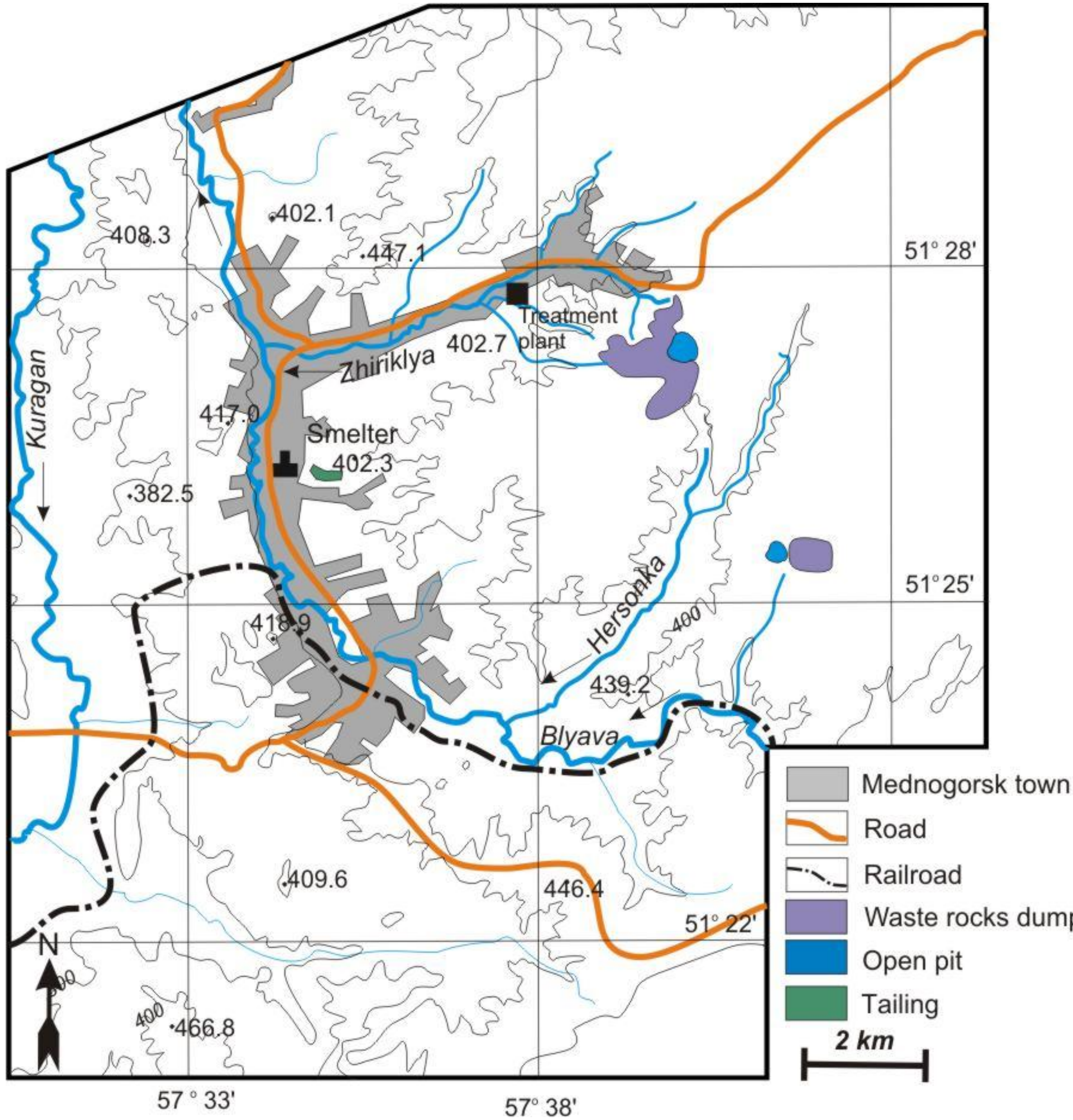
Preliminary results from lichen studies suggest fallout of Pb higher in 2011 than in 2001

Installation of Ausmelt smelter (replacing blast furnace) may have reduced Cu emissions relative to Pb

"Because of new deposits being developed, production from Karabash smelter expected to double in next 10 years" (Udachin V. 2011)

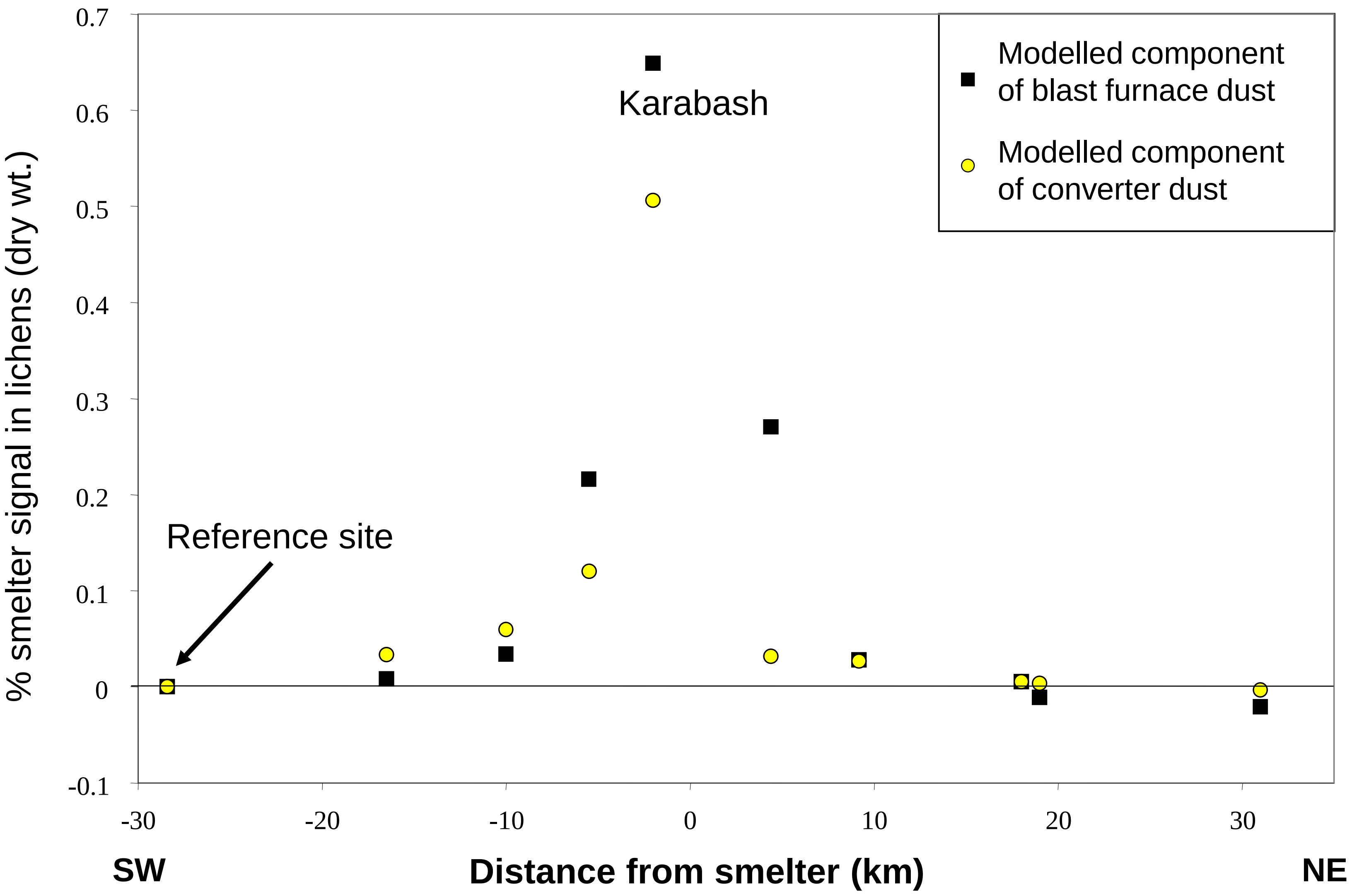
End

Mednogorsk



408.3
402.1
447.1
51° 28'
Treatment plant
402.7
Zhiriklya
Kuragan
417.0
Smelter
402.3
382.5
51° 25'
Hersonka
400
418.9
439.2
Blyava
409.6
446.4
51° 22'
N
400
466.8
57 ° 33'
57° 38'
Mednogorsk town
Road
Railroad
Waste rocks dump
Open pit
Tailing
2 km

Least squares model   2 month exposure



Pb in birch twig bark