Recovery potential of metals and rare Earth's elements from landfills

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Introduction

Metals and rare Earth elements (REEs) are fundamental to economy and growth as well as often are essential for maintaining and improving technological processes. Securing reliable, sustainable and undistorted access of certain raw materials is of growing concern within the EU and across the globe. In the case of critical raw materials, supply from the EU sources is even more limited [1]. Landfills and dumpsites can be specifically significant sources of pollution due to the presence of hazardous waste including heavy metals, but also can be counted as potential storages of valuables and scarce resources buried in past. Landfill mining (LFM) can be described as ''a process for extracting minerals or other solid natural resources from waste materials that have been previously disposed of by burying into the ground'' [2]. The process involves the excavation, screening, and separation of material from older landfills [3, 4]. The aim of this study was to determine elemental content of colloidal, clayey and silty aggregates from excavated waste during landfill mining (LFM) projects in order to provide science-based information for recovery potential of metals and REEs. The comparison of pilot results from LFM and industrial sites in Latvia, Estonia and Sweden is given, screening analysis of bottom and fly ashes were performed as well to give the insight in REEs and other elemental contents. This pilot study is extending the knowledge on sustainable and justified planning for future recovery of metals and REEs from landfills.

DATA

Preliminary studies on elemental content for REEs, metals and metalloids comprehensively indicate that landfills have interesting potential for further hydrometallurgical studies. See Figures 3, 4 and 5.

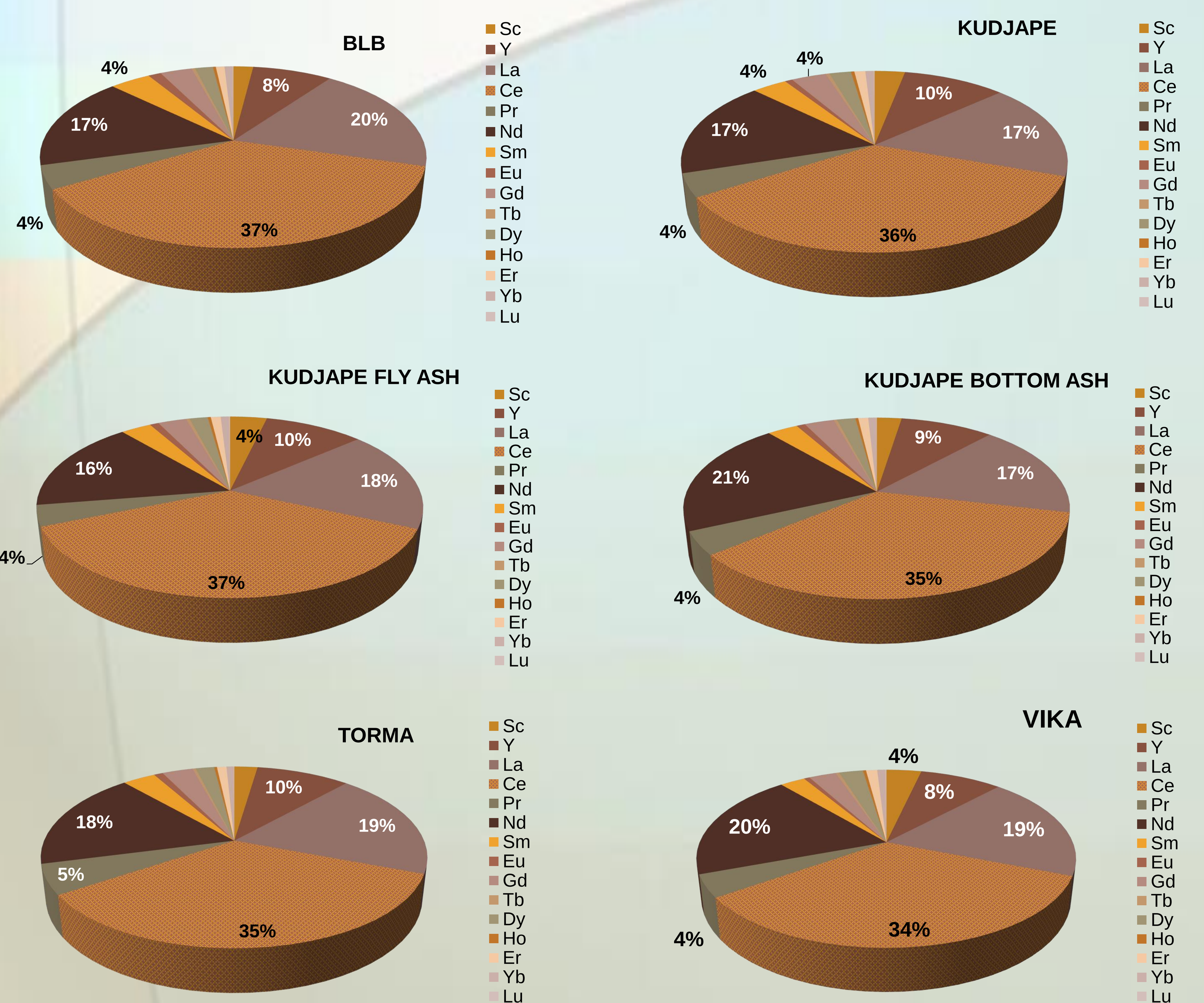

Fig.3. Proportions of REE content in fine fraction of various landfills and incineration bottom and fly ash

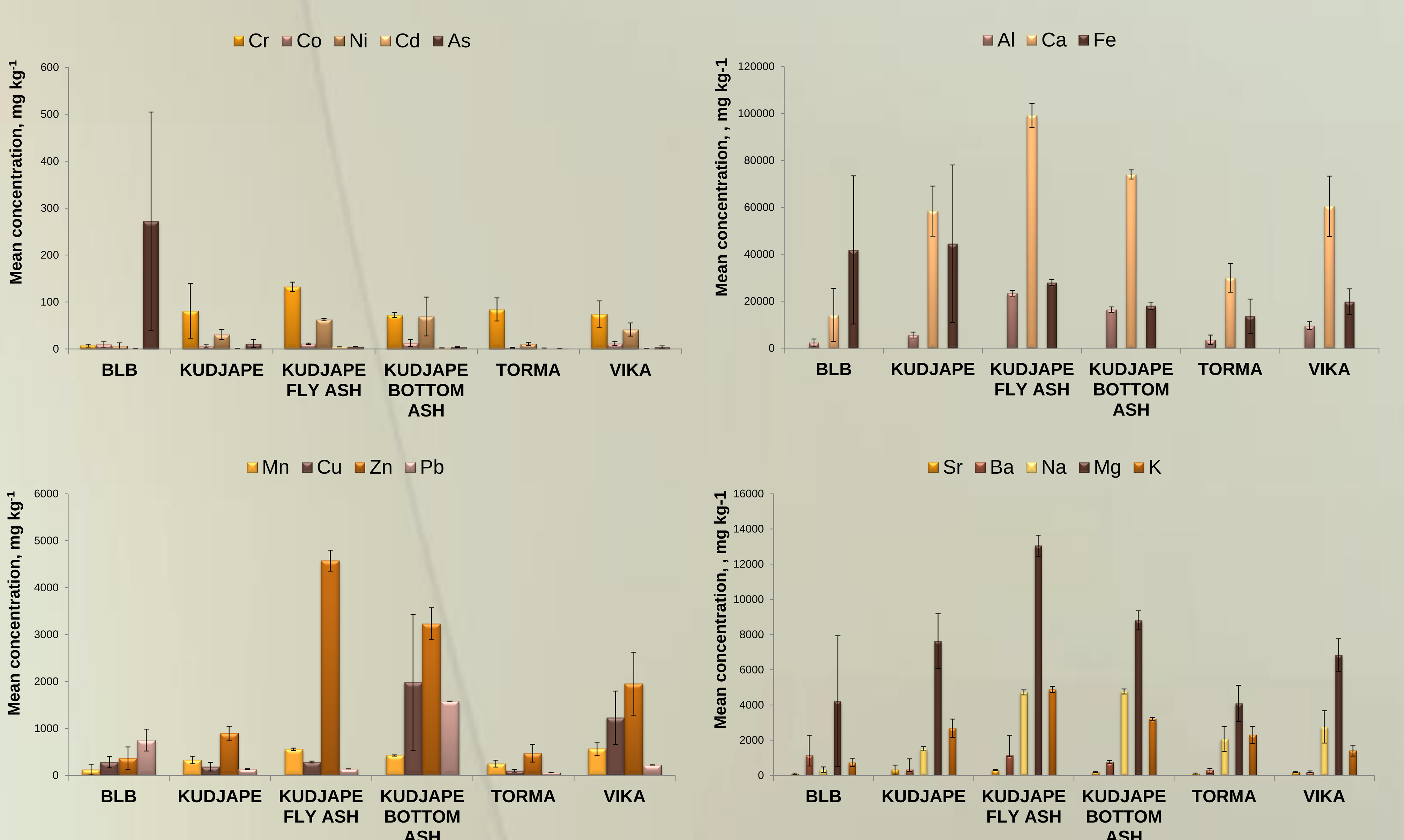

Fig.5. The comparison of summary content in fine fraction of various landfills and incineration bottom and fly ash of other elements

Materials & Methods

4 different landfills were studied: BLB as industrial landfill soil in Latvia; Vika as industrial landfill in Sweden, Kudjape and Torma as municipal landfills in Estonia (Fig.2). Landfill mined waste after shredding, separating and homogenization until was recognized as fine fraction was studied by analytical research. It was performed by using acid digestion and followed by ICP-MS and AAS measurements. Incenerated waste from Kudjape was analyzed to determine elemental contents in bottom and fly ashes.

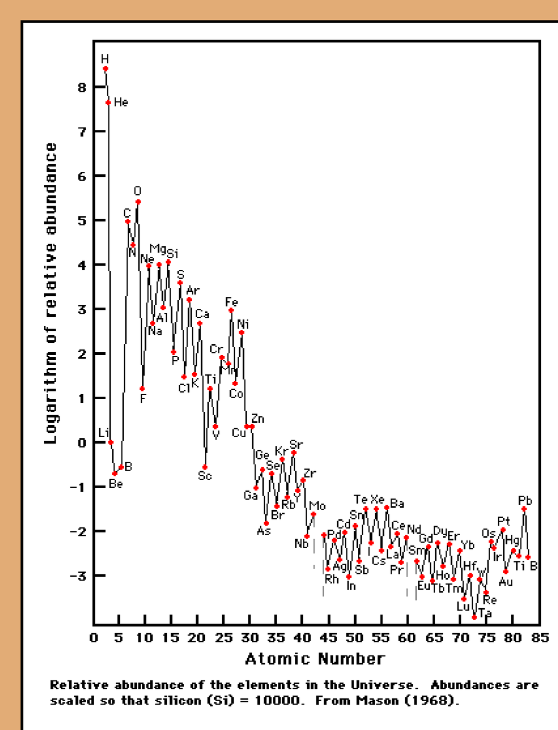

Fig.1. Abundance of elements and REEs in Earth core

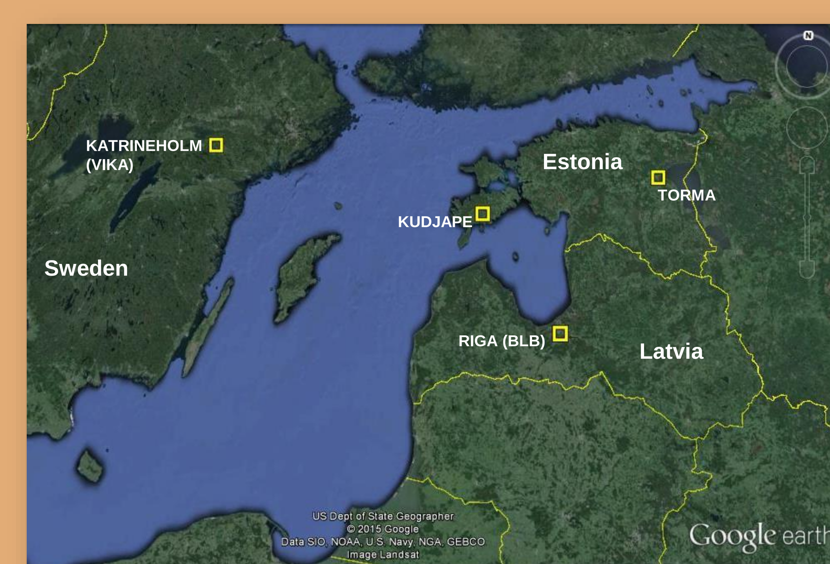

Fig.2. Case study sites in Latvia, Estonia and Sweden

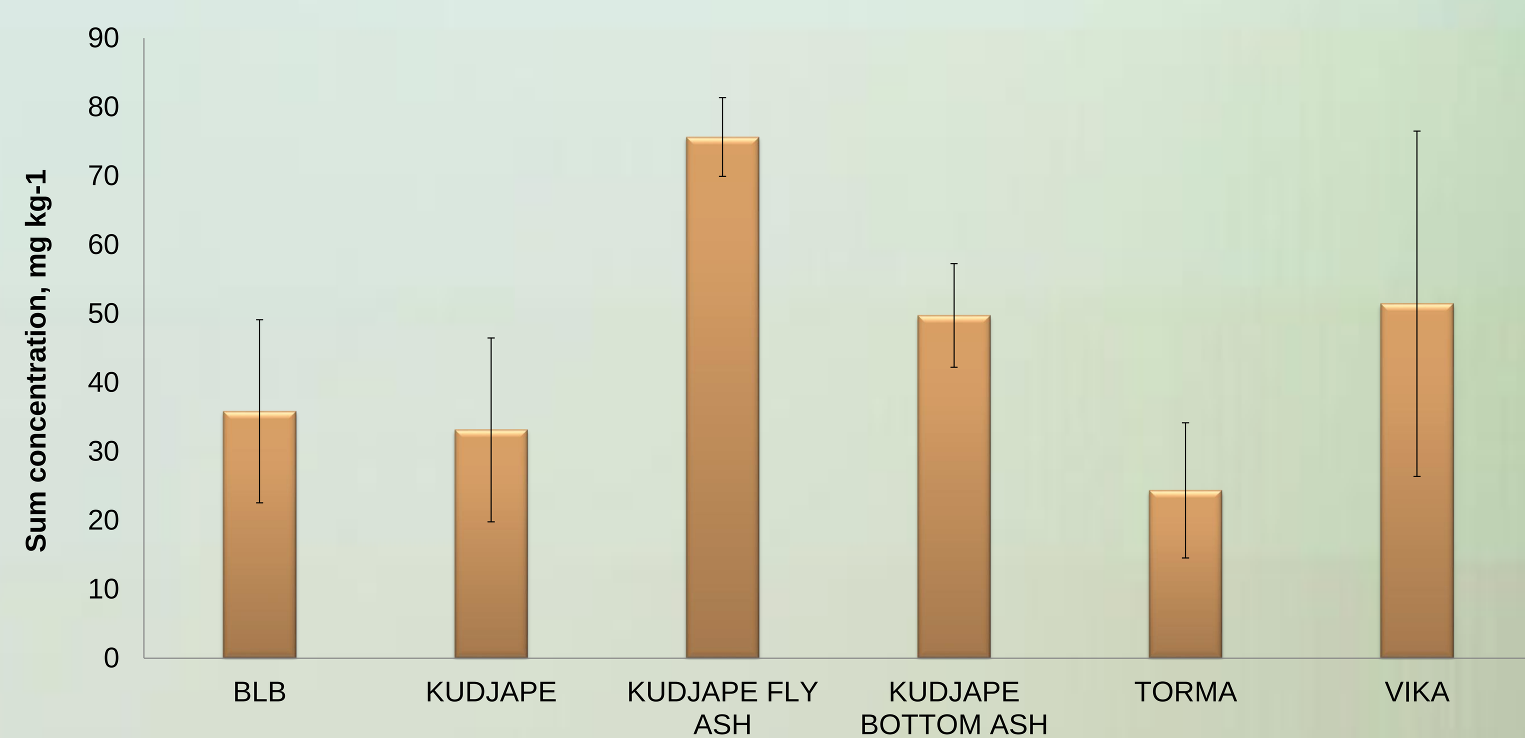

Fig.4. The comparison of REE summary content in fine fraction of various landfills and incineration bottom and fly ash

Conclusions

Research provided results on fine fraction of landfill waste containing potentially recoverable scarce metal resources. Amount of rare Earth elements can be feasible if the landfill mining approach for remediation of landfills and degraded industrial soils would be applied. Although the concentration of REEs is significantly lower than in convential mining areas, the concentration of elements such as Fe, Al, Cu, Pb, Ni and other is interesting for extraction in nearest future. Studies on speciation and potential hydrometallurgical approaches for extraction of metals, metalloids and REEs are to be continued.

References

[1] *Report on critical raw materials for the EU*, May 2014. [2] Krook *et al.* (2012) *Waste Manage.* **32**, 513-520. [3] Hogland (2002) *Environ. Sci. Pollut. Res.* **1**, 49-54 [4] Burlakovs *et al.* (2015) *Int. J. Environ. Anal. Chem.*

Acknowledgements

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