

Arsenic and Mercury in brown and hard coals from deposits of Poland

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Problem of the environmental pollution by As and Hg emitted during coal combustion is important. The aim of the study was a determination of As and Hg concentrations in coals extracted in Poland and mostly burned there.

Material and methods

Concentration of arsenic and mercury have been determined in 250 samples of brown and hard coals from deposits of Poland. Hard coal samples were collected from Carboniferous Upper Silesian (USCB), Lower Silesian (LSCB) and Lublin Coal Basins (LCB) and brown coal samples were collected from mined deposits in Poland – Turów, Bełchatów, Koźmin, Lubstów, Adamów and Kazimierz. Arsenic contents have been determined with the ICP-MS spectrometry and mercury contents by AAS method.

Results

The mean arsenic concentration in the hard coals is 16 mg/kg. Coals from LCB contain in average 47 mg/kg of arsenic, coals from LSCB – 61 mg/kg. In coals from USCB mean concentrations of As range from 2 mg/kg (NW part of the basin) to 20 mg/kg (SW part of the basin). The average As contents in brown coals is 9 mg/kg (Turów 29 mg/kg, Bełchatów – 3 mg/kg, Konin-Adamów – 1 mg/kg). The average mercury content in the hard coal samples is 85 ppb. The mean Hg content in hard coal from the LSCB is 399 ppb, USCB 60 ppb and 105 ppb in coals from LCB deposit. Coals from the eastern part of USCB contain higher mercury concentration than coal from western part of basin. They might be caused by sulphide mineralization in Triassic dolomites overlying this part of USCB. The average Hg concentration in all tested brown coal samples is 322 ppb and it is four times higher than average Hg concentration in hard coals. The highest average Hg content in lignite is observed from Bełchatów deposit - 416 ppb and the lowest - 199 ppb from Lubstów deposit. Coals from tectonic grabens are enriched in Hg in comparison with lenticular deposits which were not tectonically influenced.

Conclusion

Obtained results permit to estimate that about 28t/a of mercury and about 2000t/a of arsenic are excavated and emitted with hard and brown coals burned in Poland.

Melt mixing and crystallisation in the plumbing system of the 1783 Laki eruption

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The 1783 Laki fissure eruption of SE Iceland is the second largest basalt eruption in recorded history, extruding ~15km³ of lava and minor tephra over the course of 8 months and producing a notorious ‘dry haze’ of poisonous volcanic smog, leading to famine, disease and the death of 25% of Iceland’s population [1]. Large scale basalt eruptions are common in Iceland (e.g. Eldgjá, 934 AD and Thjorsa, ~8000 yBP; 19km³ and 21km³ respectively) and are fed by discrete batches of magma accumulating in large crustal reservoirs. The relationship between crystallisation and mixing in the storage reservoirs that give rise to such volumous, long-lived eruptions has been the focus of recent SIMS analysis at the University of Edinburgh.

The concentrations of REEs and selected trace elements, including Zr, Y, Nb and Sr, were measured for 90 olivine-hosted melt inclusions from Laki using a Cameca 4f ion microprobe. The range of REE concentrations measured in the melt inclusions (representing discrete batches of parental melt) is not seen in whole rock compositions, implying that this variation is destroyed by mixing in the storage reservoir prior to eruption. Olivine compositions vary from Fo₈₇ – Fo₇₃, corresponding to a 50°C drop in crystallisation temperature. The standard deviation of La/Yb in melt inclusions hosted in olivine with Fo>85 mol% is 0.75 (n=40), but only 0.25 (n=16) in olivines with Fo<78 mol%, showing that cooling, and subsequent crystallisation of less forsteritic olivine, was therefore concurrent with mixing. The variation in La/Yb reflects variation in the composition of mantle melts being supplied to the crust under SE Iceland. A similar relationship between mixing and cooling has been found in a smaller, more primitive flow from northern Iceland [2], indicating that coupled mixing and crystallisation is common in the plumbing systems of Icelandic volcanoes.

References

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