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Trace Constituents in Coal: Occurrence, Emissions, and Environmental Impact

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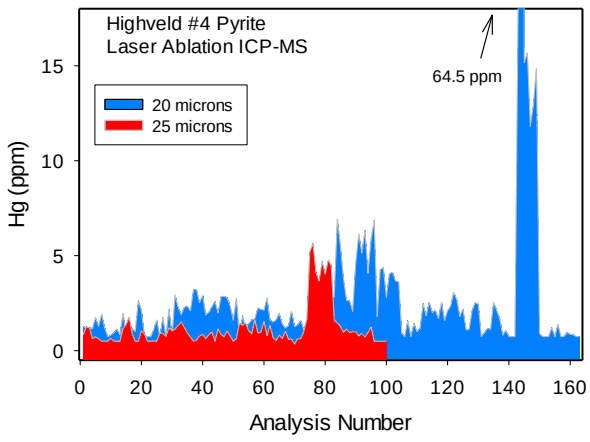
Coal remains the most commonly utilized fuel for commercial power generation in the world despite an increasing proportion of gas-fired generation. In South Africa, the proportion of electric power generated from coal is among the highest of any country, exceeding ninety percent in 2012 [1]. Apart from implications of coal combustion for climate change, coal contains a range of potentially harmful trace constituents that are emitted in varying quantities, species, and forms during coal combustion. Knowledge of the occurrence of potentially harmful constituents in coal is particularly helpful in devising strategies for reducing these emissions, especially where controls for gaseous emissions are absent. For mercury (Hg), a pyritic association is well known among Carboniferous coals of the northern hemisphere [2] and increasingly, this is recognized in Gondwanan coals (Fig. 1).

Globally, an overall decrease in atmospheric mercury over the last two decades is attributed to greater implementation of controls for SO_X and NO_x emissions which capture a portion of the Hg present as a co-benefit, together with switching to processed gas-fired generation and increased adoption of Hg-specific controls [3]. In China, which has experienced a pronounced increase in coal use over this period, release of mercury to the atmosphere from coal-fired utilities has increased at a lesser rate than could have been anticipated in 2000 when no utility boilers were equipped with scrubbers. By 2010, this proportion had increased to 86% [3, 4]. Globally, reduction in atmospheric Hg has occurred even as an agreement to limit Hg emissions has yet to fully take effect [3, 5].



Compared to global averages [6], South African coals have low average contents of zinc, arsenic, selenium, molybdenum, and lead, and higher than average contents of chromium and manganese [7, 8]. Mercury contents of South African coals vary with ash yield ranging from well below average in low-ash coal prepared for export to above average for un-beneficiated coals used for domestic power generation [7].

These and other topics are discussed more fully in a Congress-affiliated workshop.

Figure 1: Hg distribution in successive point analyses of pyrite grains in South African Highveld #4 Coal, determined by laser ablation ICP-MS. Ablation diameters of 20- and 25 µm were used, with a slightly lower detection limit attained at 25 µm as more material is ablated. Plot shows fine-scale variation and enrichment of Hg in pyrite relative to the Hg value of 0.3 ppm for the whole coal [7].

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