

Changes in element speciation during coal combustion

FRANK E. HUGGINS^{1*} AND GERALD P. HUFFMAN²

¹CFFS/CME, Univ. of Kentucky, Lexington, KY 40506 USA

(*correspondence: fhuggins@engr.uky.edu)

²CFFS/CME, Univ. of Kentucky, Lexington, KY 40506 USA

(huffman@engr.uky.edu)

It is well recognized that the inorganic components of coal undergo many fundamental changes during coal combustion that can result in the release of highly volatile elements (e.g. As, Hg) to the atmosphere or in oxidizing potentially hazardous elements (e.g. V, Cr) to forms that make them readily leachable to the environment during fly-ash disposal or utilization. Of basic importance to understanding the behavior of elements during combustion and their resulting environmental impact is the determination of their speciation in both coal and ash. In this work, we will present an overview of what is known regarding changes in element speciation between coal and fly-ash based principally on XAFS and other spectroscopic investigations.

For a specific element, changes in speciation between coal and fly-ash are determined not only by the conditions of combustion, but also by how the element occurs in the coal since the host mineral may enhance or obstruct an element's volatility. Elements (S, Fe, Ni, As, Se, Zn, Hg, etc.) associated with pyrite and other sulfide minerals that are released during the decomposition of their host mineral will behave as volatilized elements whereas those associated with illite (Cr, V, K, etc.) and other minerals that do not decompose during combustion will exhibit more refractory behavior. Once volatilized, an element may oxidize due to its exposure to oxygen and will condense on the surfaces of refractory particles or glass formed during the combustion process. Volatile elements tend to be concentrated on surfaces of smaller particles and differences in speciation are sometimes observed for different size fractions of fly-ash. Large changes in oxidation state have been observed by XAFS spectroscopy for S, As, and Se, which change from sulfide, arsenide, and selenide occurrences in pyrite and other sulfides to sulfate, arsenate, and selenite, respectively, in fly-ash. Variable valency transition metal elements such as V, Cr, and Fe also tend to exhibit higher oxidation states in fly-ash, even if they are not associated with sulfide minerals in the coal.

Occurrence and distribution of glycerol dialkyl glycerol tetraethers in a French peat bog

A. HUGUET^{1*}, C. FOSSE², F. LAGGOUN-DEFARGE³

AND S. DERENNE¹

¹BioEMCo, CNRS/UPMC UMR 7618, Paris, France

(*correspondence: arnaud.huguet@upmc.fr)

²Chimie ParisTech (ENSCP), Paris, France

³ISTO, UMR 6113 CNRS–Univ. d'Orléans, Orléans, France

The distribution and abundance of glycerol dialkyl glycerol tetraethers (GDGTs) were examined in peat samples extracted from surface and deep horizons of a peat bog in the Jura Mountains (France). GDGTs can take two broad chemical forms in soil: extractable, recoverable by solvent extraction, and non-extractable, linked to the soil matrix. In addition, within the extractable pool, core (i. e. 'free') and intact polar (i. e. 'bound') lipids can be distinguished. In this work, GDGTs present in the three aforementioned lipid pools were investigated. Extractable 'bound' GDGTs were found to represent a significant proportion of total extractable archaeal GDGTs, in contrast with bacterial GDGTs. Even though only low amounts of bacterial GDGTs were released after acid hydrolysis of solvent-extracted samples, non-extractable and extractable GDGTs could have different distribution patterns and different mean air temperature (MAT) and pH values could be derived from these two lipid pools. The distribution of bacterial GDGTs differed between surficial and deep horizons. Thus, samples from deep horizons gave lower GDGT-derived MAT values than those collected from surficial horizons, in agreement with measured soil temperatures at 7cm and 50cm depth from April to September. MAT estimates could be in closer agreement with spring and summer rather than with annual soil temperature. Peat samples were collected in two sites with different moisture levels. The variability in GDGT distribution could also reflect peat heterogeneity and variations in environmental factors such as peat moisture level and oxygen availability.