Hydrogen fluoride may be the major cause of coal burning endemic fluorosis

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Professor Handong Liangfrom State Key Laboratory of Coal Resources and Safe Mining, China University of Mining and Technology Beijing and his group demonstrate that hydrogen fluoride is the prior releasing form of fluorine in long-term air-exposed coal under combustion and mild heating, which may change current understanding of the cause and prevailing mechanism of coal burning endemic fluorosis.

Proper amount of fluorine (F) ingestion can prevent tooth decay, yet longterm excessive intake of that could lead to fluorosis, including dental fluorosis and oseteofluorosis. Drinking water fluorosis is the most common type of fluorosis and has been intensively studied, the pathogen of which has been identified as high content of dissolved fluorine ion (F-) in groundwater, and the pathogenic pathway is the assimilation of fluorine ion through human digestive system. Another type of fluorosis, coal burning endemic fluorosis, caused by indoor domestic use of high fluorine coal and prevailing in thirteen provinces in South China, however, is first reported in 1946 and its pathogeny is yet not fully understood. The pathogenic mechanism is so far generalized as: the indoor domestic use of high fluorine coal releases fluorine/fluoride through combustion and thus contaminates indoor stored food such as corn and chili, the diet of which consequently leads to fluorosis. The exact form of fluorine released from coal, however, remains unknown, and to date most studies on coal burning endemic fluorosis have been focused on total fluoride.

Prof. Handong Liang from State Key Laboratory of Coal Resources and

Safe Mining, China University of Mining and Technology Beijing, has proposed an answer to this fundamental question in Chinese Science Bulletin (2011, 56(22): 2301-2304), suggesting that the domestic coal in endemic area in Guizhou, China releases hydrogen fluoride gas (HF) under both combustion and mild heating (200℃).

In coal-producing rural area of Guizhou and adjacent provinces of China, common sources of domestic coal in rural areas are crop coal and shallow coal exploited from local private mines, which always had undergone weathering due to the longterm exposure to air, with the common composition sulfur (S) content partially oxidized into sulfuric acid hydrate ($H_2SO_4 \cdot nH_2O$). The study of Prof. Liang's group indicates that it is this sulfuric acid hydrate that decomposes fluoride and fluorine-containing minerals in coal and leads to the release of highly volatile and poisonous gas of hydrogen fluoride (B.P. 19.5℃).

"The unique chemical and physical property of hydrogen fluoride may bring new insight into the pathogenic mechanism of coal burning endemic fluorosis, or even change the current understanding fundamentally." Prof. Liang said.

Severe cases with heavy deformity are relatively common in the endemic area of coal burning endemic fluorosis and other endemic areas in the coal-producing area in the world, but not so in the endemic area suffered solely from drinking water type fluorosis. This phenomenon may now be answered by this study: unlike "mild" fluorine ion or fluoride, the "fierce" corrosive gas of hydrogen fluoride with strong surface adsorptivity and penetrability can not only be absorbed directly and/or indirectly through human digestive system, but also may erode teeth, bones, and especially articulations such as knee through respiration or percutaneous absorption directly.

This study also indicates that the combustion of longterm air-exposed

coal may produce acidic aerosol comprising both hydrogen fluoride and sulfuric acid hydrate, which should be taken into account in further prevention of coal burning endemic fluorosis.

More information: "Liang H D, Liang Y C, Gardella J A Jr, et al. Potential release of hydrogen fluoride from domestic coal in endemic fluorosis area in Guizhou, China." *Chinese Sci Bull*, 2011, 56: 2301-2304, doi: 10.1007/s11434-011-4560-6

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