Q. Copy of article in JST on rapid formation of coal

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Raking theory over the coals

A new recipe for cooking up some coal in the laboratory casts doubt on the widely held theory about how nature makes that material.

According to conventional geochemical wisdom, coal began forming during the Carboniferous Period of the Paleozoic Era, when the earth was mostly steamy swampland. When the huge plants that flourished in that moist climate died, they fell into the warm swamp waters where they were decomposed by fungi and bacteria. Layers upon layers of the decomposing masses of dead plants gradually were transformed by immense pressures and temperatures into coal, accordir , to the widely held theory.

But research led by Randall Winans and Ryoichi Hayatsu of Argonne National Laboratory in Argonne, Ill., shows that the process could have involved materials less decomposed and temperatures lower than heretofore imagined. In work to be described in September at the International Organic Geochemistry Conference in the Netherlands, Winans and colleagues made simple coals by heating lignin — a sort of "glue" for the cellulose fibers in woody plants — to about 300° F in the presence of Montmorillite or illite clay.

Running that procedure for periods ranging from two weeks to nearly a year, the Argonne researchers discovered that the longer heating times produced higher-grade coals (which release more heat energy, or BTUs, per pound than do lower-grade ones). In addition, Winans and associates found that the clays appear to serve as catalysts, or substances that speed the reaction, since the lignin is fairly unreactive in their absence.

Winans believes that nature used the same recipe for forming coal. He notes that temperatures around 300° F are fairly common in geological formations and that clays are found in natural coal. Additional evidence, Winans says, comes from the work of Patrick Hatcher of the U.S. Geological Survey in Reston, Va., who, with the aid of analytical chemistry probes has found lignin structures in precursors to coal such as solidified wood.

The objective of such research, Winans says, is to understand the precise chemistry of coal and then to apply what is learned to industrial processes. The work could lead, for example, to the development of methods for converting lower grade coals to higher grade ones, for burning coal more "cleanly" or for producing new coal-based raw materials.