# Pyrogallol Transformations as Catalyzed by Nontronite, Bentonite, and Kaolinite

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**Abstract:** The catalytic power of Ca-nontronite, Ca-bentonite, and Ca-kaolinite in promoting the abiotic ring cleavage of pyrogallol (1,2,3-trihydroxybenzene) and the associated formation of humic polymers was studied in systems free of microbial activity. The presence of Ca-kaolinite and especially Ca-nontronite in the pyrogallol solutions at pH 6.00 greatly enhanced the absorbance at both 472 and 664 nm of the supernatants. At an initial pH of 6.00 and at the end of a 90-hr reaction period, the amounts of $CO_2$ released from the ring cleavage of pyrogallol and the yields of the resultant humic polymers formed in the reaction systems followed the same sequence: Ca-nontronite > Ca-kaolinite > Ca-bentonite. The data indicate that the catalytic power of Fe(III) on the edges and in the structure of nontronite was substantially greater than that of Al on the edges of kaolinite and montmorillonite and of a small amount of Fe(III) in the structure of montmorillonite in promoting the reactions. The infrared and electron spin resonance spectra and the solid-state, cross-polarization magic-angle-spinning $^{13}C$ nuclear magnetic resonance spectra of humic polymers formed in the reaction systems resembled those of natural humic substances.

**Key Words:** Bentonite • Catalysis • Humic polymers • Infrared spectroscopy • Kaolinite • Nontronite • Nuclear magnetic resonance • Pyrogallol

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