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A METHOD FOR CONCENTRATING LIPTINITE MACERALS FROM LIGNITES

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One of the major constituents of lignites and other coals is the hydrogen-rich maceral-group, liptinite. Liptinite is composed of waxes, fats and oils (1) primarily from plant cuticles, as well as spore and pollen exines (palynomorphs). Liptinite is being mechanically separated from North Dakota lignites as a means of better understanding coal chemistry and the coalification process.

The basic procedure consists of first collecting a lignite sample which has been visually determined to be rich in the lithotype durain, and is therefore more likely to contain a relatively high percentage of liptinite macerals. The lignite sample is then ground to -325 mesh (<45 microns) by standard procedures, followed by further pulverizing to approximately 3 microns average particle diameter in a Micron-Master jet pulverizer. Depending on the actual operating conditions and properties of the particular coal used, this may take three runs in the jet pulverizer before the small particle size needed is reached.

Although the majority of the coal particles average 3 microns in diameter, most of the liptinite macerals (especially palynomorphs) tend to remain much larger (typically from 5 to 40 microns in size). Many palynomorphs are morphologically intact, displaying complex exine morphologies, often allowing for detailed taxonomic assignments. It may be that the palynomorphs retain a larger size through the pulverizing process due to their elastic nature when compared to other coal macerals. This apparent elasticity allows for a more complete liberation from the relatively brittle coal matrix.

After the coal has been sufficiently pulverized it is thoroughly suspended in an aqueous $ZnCl_2$ solution which has a specific gravity of 1.25. Suspension is achieved by first thoroughly mixing the coal and the $ZnCl_2$ solution then agitating the mixture in an ultrasonic bath for approximately 10 minutes. The mixture is centrifuged for approximately 1/2 hour at approximately 3,000 revolutions per minute. After collecting and filtering the supernatant, the solids from the filtration are then resuspended in an aqueous $ZnCl_2$ solution (specific gravity 1.25) and the centrifugation step repeated. When this procedure was performed on North Dakota lignites, the supernatant was filtered and the resulting residue was found to be rich in liptinite macerals, especially palynomorphs. Listed in Table 1 are petrographic analyses for durain-rich Hage1 lignite collected in the Center Mine, Oliver County, North Dakota.

The procedure outlined above is a relatively quick and easy way to produce concentrations of liptinite macerals. This procedure may be further refined in the future, to produce even higher concentrations of macerals. Dyrkacz and Horwitz (2) have described a complex maceral separation method used for bituminous coals. However, it appears that the macerals present in North Dakota lignites are easier to separate. Low-rank coal macerals have remained more distinct entities, perhaps making them easier to separate from each other, than macerals from coals of higher rank.

Table 1
Petrographic Analysis

Hage1 Lignite (Durain-rich) Before Separation	
Huminite Group Macerals	74.4%
Liptinite Group Macerals: Sporinite	5.2%
Others	12.7%
Inertinite Group Macerals	5.9%
Hage1 Lignite (Liptinite Concentrate) After Separation	
Liptinite Macerals	87%
Morphologically Recognizable Palynomorphs	56%
Other Liptinite Material	31%
0 fragments	13%

1. Stach, E., and others (1982), Coal Petrology, Gebrueder Borntraeger, Berlin, Stuttgart.
2. Dyrkacz, G.R., and Horwitz, E.P., Separation of Coal Macerals, Fuel, vol. 61, p. 3-12.