Organic geochemical characterization of the density fractions of a Permian torbanite

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Abstract—Two distinct organic components, the *Botryococcus*-related alginite (*Reinschia*) and the amorphous organic matrix, were isolated by high-resolution density gradient centrifugation (DGC) from a Permian torbanite (New South Wales, Australia). On the density profile, the alginite (1.03–1.10 g/ml) and the matrix (1.16–1.21 g/ml) appear to be two distinct peaks. With fluorescence microscopy, the alginite shows bright yellow to orange fluorescence and well-preserved algal structure, whereas the matrix has a reddish brown fluorescence of medium intensity. The H/C and O/C atomic ratios indicate that the alginite is equivalent to a Type I kerogen, whereas the matrix falls into the Type II kerogen category. The more "heavy" O and S, and less "light" H content in the matrix also helps in explaining the higher density of the matrix relative to the alginite. Flash pyrolysis-GC/MS of the CH_2Cl_2-extracted density fractions shows that the pyrolyzates of both the alginite and the matrix are dominated by normal alk-1-enes and alkanes, which range up to C_{31}. However, these normal hydrocarbons are relatively more abundant in the alginite than in the matrix. The alginite also produced a *n*-α,ω-alkadiene series which was not detected in the matrix. Compared to the alginite, the matrix pyrolyzate is enriched in C_{19}–C_{31} straight-chain aliphatics and aromatic, phenolic and hopanoid compounds, suggesting that the matrix was formed through incorporation of degraded algal material and humic matter. The higher Methylphenanthrene Index (MPI) value of the matrix pyrolyzates relative to the alginite indicates that the MPI is affected by organic matter type.

Key words—density gradient centrifugation (DGC), torbanite, *Botryococcus*-related alginite, organic matrix, flash pyrolysis-gas chromatography/mass spectrometry