

Oil Generation Capacity and Expulsion Window of Humic Coals of Different Age: Implications for Deep Exploration

Petersen, Henrik I., and Hans P. Nytoft, Geological Survey of Denmark and Greenland (GEUS), Copenhagen, Denmark

The evolution of land plants from the Carboniferous towards the Cenozoic has had an overall control on the ability of coals to generate and expel oil. Major coal-sourced oil accumulations are generally associated with Cenozoic coals, whereas Carboniferous coals mainly have been related to gas accumulations. Long-chain aliphatic moieties in the coal structure are required for oil generation, and such aliphatic chains are more prominent within the structure of Jurassic and Cenozoic coals than in older coals, with nC₂₀–30+ in particular abundant in Cenozoic coals. In Carboniferous and Permian coals the aliphatic chains are shorter, generally <nC₁₉–24. The long-chain aliphatics in Cenozoic coals originate from a matrix of collodetrinite+liptodetrinite, which is abundant in these coals.

A time-lag occurs between onset of petroleum generation and oil expulsion from coals. Only for Cenozoic coals, oil expulsion occurs below a vitrinite reflectance of 0.85%Ro. The start of efficient oil expulsion is dependent on the generation potential and ability to generate long-chain aliphatics, and Cenozoic coals display both the largest oil generation potential and broadest effective oil window. Carboniferous coals are – despite high HI values – inherently gas-/condensate-prone. The overall absence of long-chain aliphatics restricts the oil expulsion efficiency, which agrees with the high extract yields obtained from North Sea Carboniferous coals. Generated liquid petroleum is retained in the coals and upon extraction HI is on average reduced with 30% in these coals. The extracts are dominated by shorter-chain aliphatics.