Aromatic Hydrocarbons of Wondama Coal, Papua Barat

Christoffel S. I. Maweikere[1], R. Y. Perry Burhan[1]

Abstract – Wondama coal were subjected to solvent extraction and aromatic hydrocarbon fractions obtained by thin layer chromatography with n-hexane as eluent. Aromatic fractions identified by Gas Chromatography-Mass Spectroscopy (GC-MS). Aromatic seskuiterpenoids, diterpenoid and triterpenoids were found in Wondama coal. This composition illustrates sources of organic matter derived from terrestrial higher plants.

Index Terms – Aromatic hydrocarbons, Wondama coal.

INTRODUCTION

Terpenoids from higher plants occur in various geological samples such as coal, petroleum and sediments [1]. In particular, aromatic terpenoids are commonly found in mature sediments [2].

Biological terpenoids are presumably transformed to aromatic terpenes during early diagenesis via microbially mediated reactions. Aromatic terpenoids which are generally used as a biological marker are diterpenoid and triterpenoids. Aromatic diterpenoid can be used as a marker chemotaxonomic of gymnosperms, while triterpenoids derived from angiosperms [1].

METHOD

To obtain hydrocarbons, sample extracted by soxhlet method. For soxhlet extraction, 50 g of bulk coal was extracted with 250 mL dichlorometane-methanol (93:7 by volume) mixture for 72 h. After extraction, the solvent was evaporated at room temperature under vacuum [5].

The aromatic hydrocarbons were obtained by fractionation on preparative thin layer chromatography eluting with *n*-hexane and then identified by GC-MS [4]

RESULT AND DISCUSSION

Aromatic terpenoids were identified as seskuiterpenoids, diterpenoids and triterpenoids. Seskuiterpenoids we found as naphthalene skeleton such as calamenene (*m/z* 159, M^+ 202; I), cadalene (*m/z* 183, M^+ 198; II), 1,2,3,4-tetrahydro-1,1,6-trimethylnaphthalene (*m/z* 159, M^+ 174; III), 1,2,3,4-tetrahydro-6-(1,1-dimethyl)-naphthalene (*m/z* 173, M^+ 188; IV) [3],[6]. (Fig. 1). Their compound have been considered indicators of terrestrial organic matter, derived from different plant types [7]. Cadalene occurs in a wide variety of vascular plants, it derives from cadinane and cadinol. It occurs in plant resins and some conifers [7].

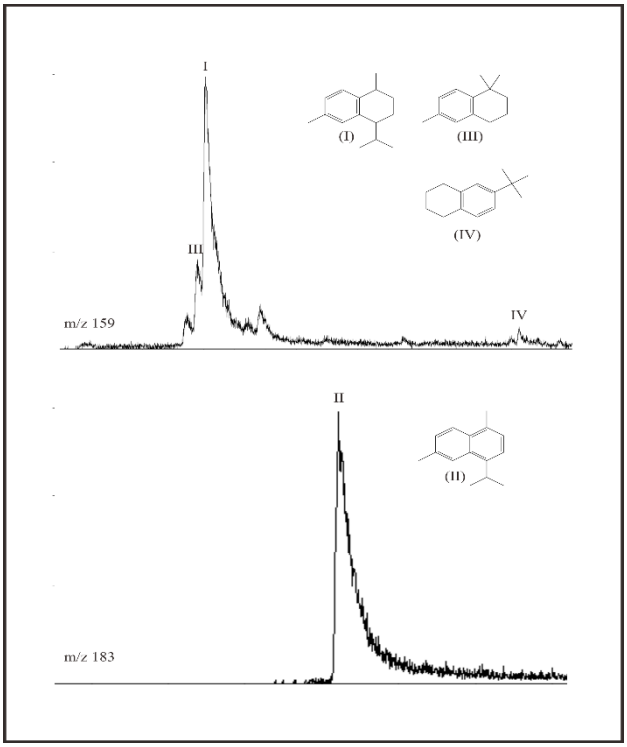

Figure 1. Aromatic seskuiterpenoids of wondama coal.

Aromatic diterpenoids were identified as 3,8-dimethyl-hexahydrophenantrene (*m/z* 197, M^+ 212; V) and 3,4-dihydroretene (*m/z* 221, M^+ 236; VI) (Fig. 2). These compounds are derived from precursor abietic acid, which is a major constituent of gymnosperms, especially conifer resins [1],[6].

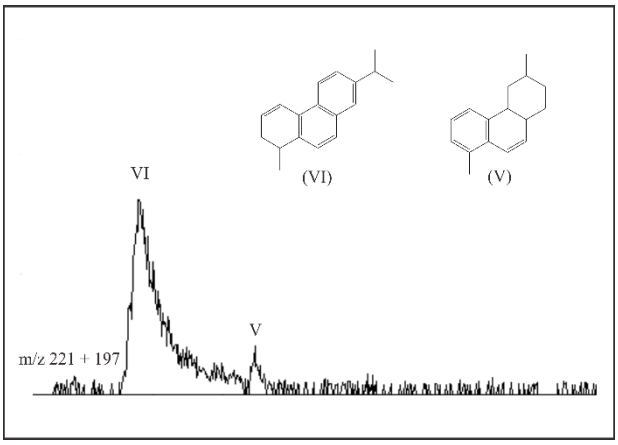

Figure 2. Aromatic diterpenoids of wondama coal.

Aromatic tritrpenoids were detected as a diaromatic. The mass fragments of *m/z* 292 show a series of A ring degraded-diaromatic (VII-IX) (oleanane, ursane and lupane skeleton) [1]. Fig 3 show diaromatic triterpenoids of Wondama Coal.

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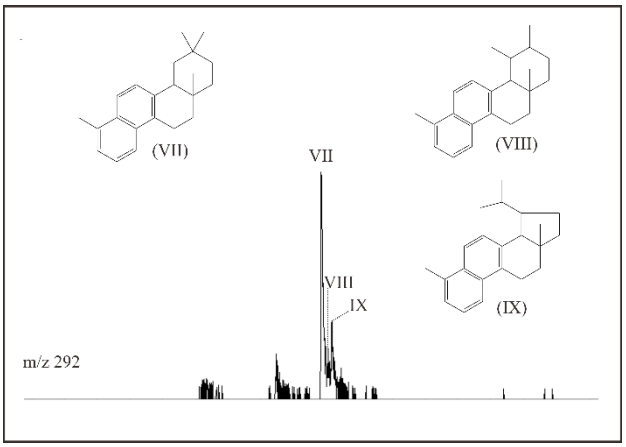

Figure 3. Aromatic triterpenoids of wondama coal.

These aromatic triterpenoids are intermediates in a series of postulated pathways for progressive aromatization of angiosperms triterpenoids, probably derived from β- and α-amyrins [1],[6].

The presence of des-A-triterpenoids shows that there are activities of microorganisms in the environment of Wondama coal formation [7].

CONCLUSION

Organic matter of Wondama coal contributed from conifer resins gymnosperms such as 3,4-dihydroretene and considered from vascular plants angiosperms such as aromatic triterpenoids. Source of Wondama coal organic matter commonly from higher plants. Aromatic hydrocarbons in this study showed that the coalification of Wondama coal has entered diagenesis stage and influenced by the activity of microorganism.

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REFERENCES

[1] Nakamura, H., Sawada, K. dan Takahashi, M. (2010), "Aliphatic and Aromatic Terpenoid Biomarkers in Cretaceous and Paleogene Angiosperm Fossils from Japan", *Organic Geochemistry*, Vol. 41, hal. 975–980.

[2] van Aarssen., B.K., Alexander, R., Kagi, R, (2000), "Higher Plant Biomarkers Reflect Palaeovegetation Changes During Jurassic Times", *Geochimica et Cosmochimica Acta*, Vol. 64, No. 8, hal. 1417–1424.

[3] Romero-Sarmiento, M.F., Riboulleau, A., Vecoli, M., Lagoun-Défarge, F. dan Versteegh, G.J.M. (2011), "Aliphatic and aromatic biomarkers from Carboniferous coal deposits at Dunbar (East Lothian, Scotland): Palaeobotanical and palaeoenvironmental significance", *Palaeogeography, Palaeoclimatology, Palaeoecology*, Vol. 309, hal. 309-326.

[4] Fabiańska, M.J. dan Kurkiewicz, S. (2013), "Biomarkers, Aromatic Hydrocarbons and Polar Compounds in the Neogene Lignites and Gangue Sediments of the Konin and Turoszów Brown Coal Basins (Poland)", *International Journal of Coal Geology*, Vol. 107, hal. 24-44.

[5] Farhaduzzaman., Abdullah, W.H., Islam., A. (2012), "Depositional Environment and Hydrocarbon Source Potential of the Permian Gondwana Coals from the Barapukuria Basin, Northwest Bangladesh", *International Journal of Coal Geology*, Vol. 90-91, hal. 162-179.

[6] Wang, T.G., dan B. R. T. Simoneitt, B.R.T, (1991), "Organic Geochemistry and Coal Petrology of Tertiary Brown Coal in the Zhoujing Mine, Baise Basin, South China", *Fuel*, Vol. 70.

[7] Romero-Sarmiento, M.F., Riboulleau, A., Vecoli, M. dan Versteegh, G.J.M. (2011), "Aliphatic and Aromatic Biomarkers from Gondwanan Sediments of Late Ordovician to Early Devonian Age: An Early Terrestrialization Approach", Organic Geochemistry, Vol. 42, hal. 605-617.