SIGNIFICANCE OF VITRINITE AND INERTINITE RATIO IN THE LOWER GONDWANA COALS OF PENINSULAR INDIA

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Abstract

The Lower Gondwana coals (Permian), in general, are classifiable into vitric, mixed and fusic types on the basis of quantitative maceral composition. While analysing maceral data from the coals of Damodar, Son-Mahanadi, Pench-Kanhan-Tawa (Satpura Gondwana) and Wardha-Godavari valleys it has been realized that the vitrinite and inertinite ratio may possibly be used for stratigraphic correlation on a regional scale and also for general assessment of coals.

Introduction

Lower Gondwana coals spreading over the peninsular and extra-peninsular parts of India in isolated but extensive patches are conspicuous by their rank variation and contrasted in maceral composition. These variations depict dissimilar palaeoenvironmental conditions during biochemical and geochemical stages of coalification induced by temperature and time. In other words, palaeoenvironmental and palaeodepositional conditions controlled the fusinization and vitrinization paths of the vegetal source material, the ultimate end products, in general, being vitrinite and inertinite. With the above facts in the background the present analysis has been made with a view to ascertain the application prospects of the ratio of the two (vitrinite and inertinite) end products of the vegetal coalification process.

The maceral data for the present work have been used from the available published literature (Sen & Sen, 1969; Ghosh, 1969; Sanyal & Subramanian, 1977) and our own laboratory analyses. The coalfields covered are the Raniganj, Jharia, Giridih, North and South Karanpura, East and West Bokaro, Daltonganj and Hutar of Damodar Valley; Korba, Chirimiri, Singrauli, Ib river and Talchir of Son-Mahanadi Valley; Pench-Kanhan of Satpura Basin and Umrer, Ghughus, Chanda, Ballarpur, Kothagudem, Yellendu, Tandur (Belampalli), Ramagundam and Ramakrishanapuram of Wardha-Godavari Valley.

Geology

The major Lower Gondwana coal deposits of India are extensively developed in the peninsular part of the country and are aligned roughly along the valleys of important rivers of the area. The Lower Gondwana coalfields as evidenced today are relicts of pre-existing larger basins and owe their present distribution probably due to trough faulting.

The Lower Gondwana sediments (Lower Gondwana Super group) have been divided, on the basis of flora (mega and microflora) and fauna, into four formations, viz., Karharbari, Barakar, Barren Measures and Raniganj in ascending order. Excluding

Barren Measures which has no economical coal deposit, the rest of the three formations account for about 90.0 per cent of the coal produced in India.

Vitrinite and Inertinite of Lower Gondwana coals

Macerals of vitrinite and inertinite groups in Lower Gondwana coals have been formed from both the macro-and microfragmental vegetal remains by vitrinization and fusinization processes. The extent to which these processes have lead is characteristically reflected in the ultimate coal deposition.

Vitrinite—The vitrinite maceral of the Lower Gondwana coals consists chiefly of structured and structureless, homogeneous vitrinite. The maceral telinite if at all present is of poor occurrence. In fact the structured vitrinite is of telocollinite variety. Structureless collinite, telocollinite and desmocollinite are the common macerals present in the Gondwana coals along with corpocollinite. Apart from these, pseudovitrinite (with stepped margin, roughly aligned fine and small fissures and partially structured) and semivitrinite (having semifusinite reflectivity) have been observed commonly in some of the coals from Damodar, Son-Mahanadi and Wardha-Godavari valleys.

Inertinite—The Lower Gondwana coals, in general, contrain high amount of inertinite macerals. Almost all the macerals of the inertinite group alongwith transitionary stages have been recorded from these coals. However, chief constituents of the inertinite group are semifusinite and fusinite. Besides, inertodetrinite, pseudoclerotinite, fusinized resins, macrinite and micrinite have been recorded. Most of the semifusinite and fusinite present in the coal of different coal basins are degrado-semifusinite and fusinite. The maceral inertodetrinite is of common occurrence and has semifusinitic to fusinitic reflectivities. Pseudosclerotinite (sclerotinite) and fusinized resins are quite frequent in some of the coals. Macrinites are commonly associated with clarodurite and durite bands whereas, micrinite has common association with clarite, trimacerite and durite microlithotypes.

Distribution of vitrinite/inertinite in Lower Gondwana coals—The general distribution pattern of the macerals in the Lower Gondwana coals has been worked out by Navale (1974, 1975), Sen *et al.* (1967), Sen and Sen (1969), Ghosh (1969), Sanyal and Subramanian (1977), Navale, Misra and Anand Prakash (1983) and many others. Based on the data on published literature as well as the data gathered at our laboratory, the authors have attempted to broadly generalize the coals of the Lower Gondwana sequence.

Karharbari Formation (the basal portion of the Lower Gondwana Sequence)—The Karharbari coals, other than from Giridih Coalifield of Damodar Valley, are usually hard, compact and dull in lusture. They are either non-banded or bright bands occur only sparingly giving an overall dull to dull-banded appearance. The Karharbari coal from the Giridih Coalfield, the type area of the Formation, on the other hand, are thinly banded in nature.

Microscopically the Karharbari coals (barring Giridih coal of Damodar Valley) from known coalfields are inertinite rich. The vitrinite fraction is characterized mostly by structureless collinite while telocollinite is always associated. The desmocollinite fraction is usually quite high being associated with durite, clarodurite, duroclarite and vitrinerite microlithotypes. These latter microlithotypes constitute the major part of the Karharbari coals. Among the inertinite macerals, fusinite predominates over semifusinite. Degradofusinite over-shadows other varieties of fusinite, although rank and pyrofusinite have also been recorded commonly in Damodar Valley. Pseudosclarotinite and fusinized resins are quite common. Occurrence of inertodetrinite, macrinite and micri-

nite is frequent. The Karharbari coals contain lesser amount of vitrinite 25-44 per cent but in the Giridih Coalfield the vitrinite content reaches up to 53 per cent. The total inertinite content ranges from 32 to 62 per cent.

Barakar Formation (Lower part of the Lower Gondwana Sequence)—The Barakar Formation is associated with dull-thinly banded to semi-bright banded coals. The dull and thinly banded coals are usually present in basal part of the formation and thus the coals of this part of the horizon have almost similar characteristic to that of Karharbari Formation.

The coals in the middle part of the formation show increase in the vitrinite content over inertinite. The most common vitrinite macerals are structureless collinite and telocollinite. The desmocollinite is quite common here also. The maceral corpocollinite is well represented as discrete bodies as well as in the form of bark tissues. The inertinite macerals are well represented. The dominant degradofusinite occurrence of Karharbari coals is partly shared by rank and pyrofusinite in these coals. Fusinized bark tissues are also present here. Transitionary stages from vitrinite to semifusinite and semifusinite to fusinite are frequently observed. Inertodetrinite, pseudosclerotinite and fusinized resin bodies are very common in the coals from Pench-Kanhan Valley. Among the microlithotypes, vitrite and clarite are significant. The latter microlithotype being occasionally quite significant in some of the coalfields of Damodar and Wardha-Godavari valleys. Durite and clarodurite are usually predominant but a tendency of their decrease has been marked in the upper part of the formation in Damodar and Wardha-Godavari valleys. The vitrinertite microlithotype is quite persistent in occurrence.

The general vitrinite contents of the coals from Barakar Formation varies from 18 to 62 per cent whereas, the inertinite shows a variation from 15 to 52 per cent.

Raniganj Formation (Upper portion of the Lower Gondwana Seqnence)—The coals of the Raniganj Formation are present only in few coalfields of the Damodar and Son-Mahanadi valleys. Progressive increase in the vitrain than the coals of underlying horizons is well marked in these coals. The coals are distinctly banded and range from semibright to bright banded in appearance. The conspicuous presence of vitrain has rendered the coal friable in nature along vitrain bands.

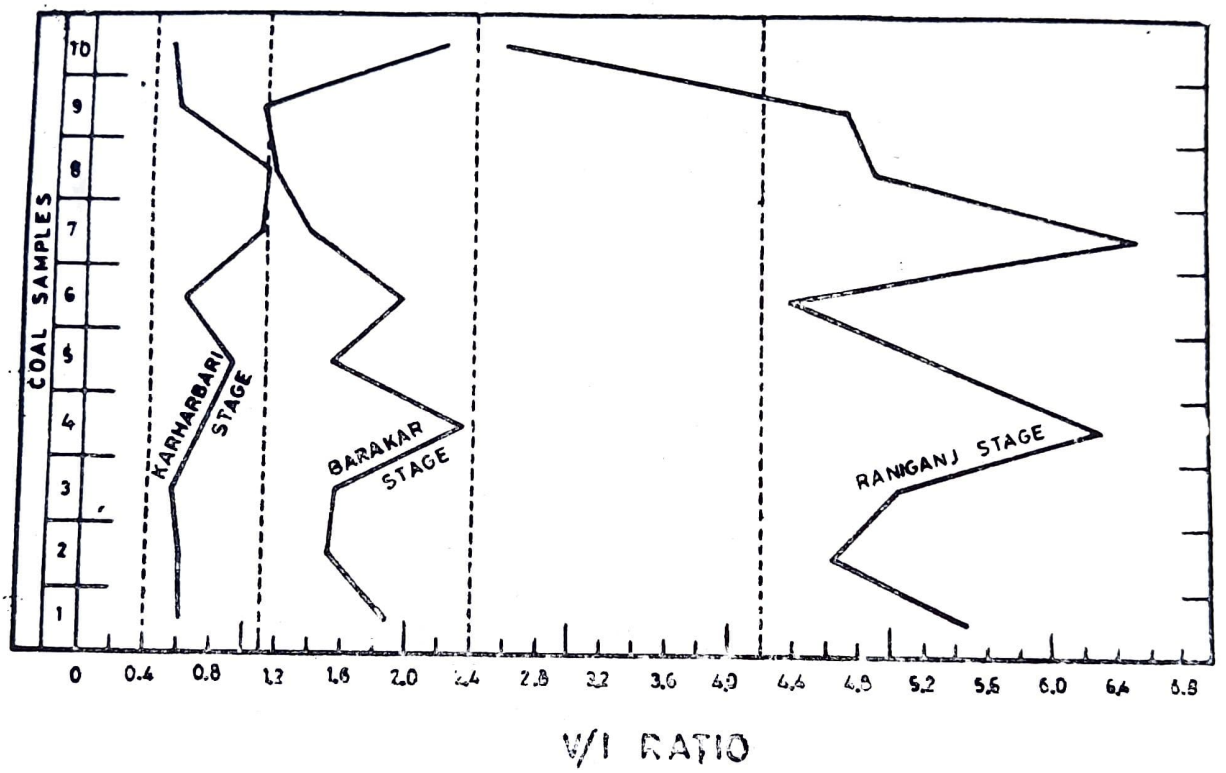
Microscopically vitrinite group is dominant in which collinite and telocollinite are the chief constituents. Desmocollinite as usual is frequent, whereas the maceral corpocollinite is characteristically represented by well preserved vitrinized bark tissues in these coals. The vitrinites occur in the form of thick to thin bands. Fragments, shreds and streaks of vitrinite are rather less common in the total fraction of the maceral. Among the inertinite macerals, semifusinite and fusinite are usually the chief constituents with only subordinate proportions of inertodetrinite, pseudosclerotinite and fusinized resins. In fact the latter two macerals are less significant quantitatively. Macrinite and micrinite are comparatively less common than the coals of the underlying horizons. Quantitatively semifusinite and fusinite in the Raniganj coals overlap each other. We have observed that semifusinite appears to predominate over the fusinite. Although degradofusinite (sf.) is still the major variety but the rank and pyrofusinite are significantly present here in comparison to those of the Barakar and Karharbari coals.

A wide and significant compositional variation, as is common in the Lower Gondwana coals of India, has been observed in the Raniganj coals. The vitrinite varying from 42 to 71 per cent and 45 to 82 per cent has been recorded from coals of Raniganj (Damodar Valley) and Singrauli (Son Valley) coalfields respectively. The inertinite content

of these coals are significantly low-up to 30% but the usual range recorded is 6 to 19 per cent and 5.6 to 26.5 perc ent, respectively from Raniganj and Singrauli coalfields.

Importance of vitrinite/inertinite

The significance of vitrinite and inertinite in the ultimate coal composition is not of recent origin to the coal petrologist and solid fuel technologist. Recently, Navale (1978) realized that these two constituents can be used for stratigraphic correlation of the Lower Gondwana coals on regional scale and also its applicability in the utilization prospects (Text-fig. 1).

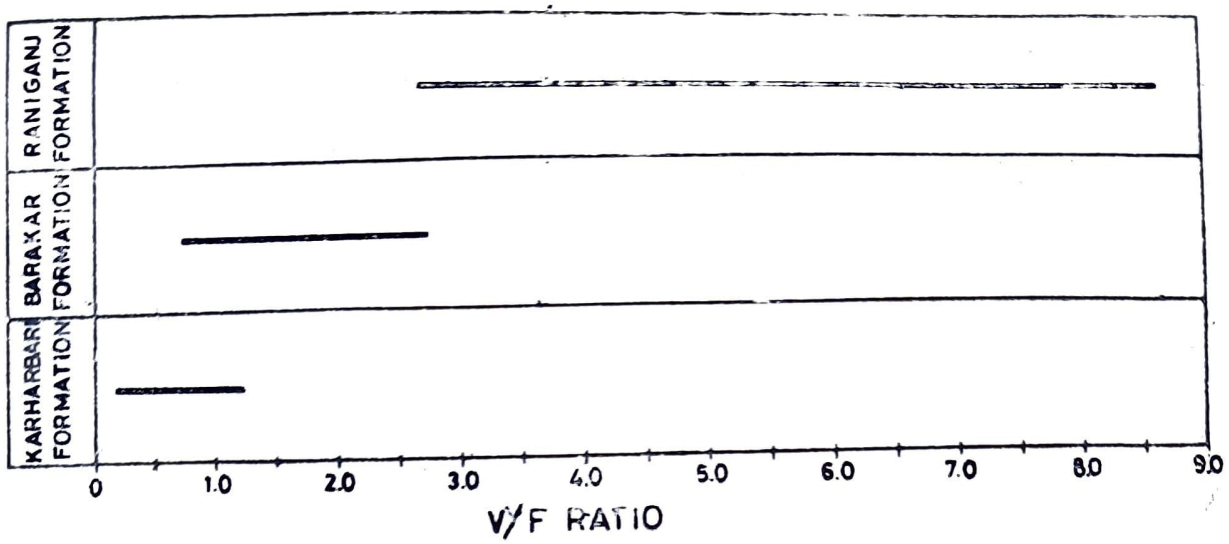


Text-fig. 1. Vitrinite/Inertinite (V/I) ratio in Permian coals of India (modified after Navale, G.K.B., 1978).

V/I Ratio—Following the earlier work of Navale (1978), we have accumulated valuable quantitative maceral data from different coalfields of the Indian Lower Gondwana Sequence and compiled other published data (Sen & Sen, 1969; Ghosh, 1969; Sanyal & Subramanian, 1977; Navale, Misra & Anand Prakash, 1983) to validate our contention for utilizing of vitrinite/inertinite ratio.

While computing V/I ratios, the coals having more than 40% minerals matter content have been deliberately omitted from our consideration. In our opinion, they do not possess the same maceral composition as those of normal overlying and underlying coals. Secondly, we have separated out the maceral data of coals belonging to different formations (Karharbari, Barakar and Raniganj) to facilitate our plottings.

The Text-fig. 2 showing V/I ratio lines, illustrates a general ratio of the Lower Gondwana coals of India. The Karharbari coals have a V/I ratio ranging from 0.2 to 1.22 whereas, in the Barakar Formation, the ratio varies between 0.72 to 2.72. In the succeeding Raniganj Formation the coals exhibit a V/I ratio ranging from 2.94 to 14.64. However, V/I ratio of a sample from the Raniganj Coalfield has shown a little lower value



Text-fig. 2. Vitrinite/Fusinite (V/I) ratio in the Lower Gondwana (Permian) coals of India.

(2.74) than the normal lowest value recorded for these coals. It is apparent from the data presented here (Text-fig. 2) that by V/I ratios delimitation of the Karharbari, Barakar and Raniganj formations can be achieved with fair degree of reliance. The Raniganj Formation stands out clearly whereas, an overlap in the V/I ratios of the Karharbari and Barakar coals is distinct. The latter may be due to two factors firstly, as has been mentioned earlier that the Lower Barakar coals are rich in inertinite and the Karharbari coals of Giridih Coalfield (type area) are rich in vitrinite. Secondly, some of the maceral data obtained for the Barakar coals might have been from the samples taken from inertinite rich part of the seam, since many workers collect samples according to lithotype banding. We have witnessed such instances with very vide variation in the vitrinite and fusinite content when closely placed different lithotype bandings were analysed microscopically.

From the foregoing discussions it is apparent that inspite of some anomalies recorded, the V/I ratio provides a useful parameter for regional stratigraphic correlation of Lower Gondwana coals (Permian) of India which at times is difficult to be solved by conventional geological methods.

Besides, regional stratigraphic correlation it has also been observed that most of the semicoking and coking coals of Lower Gondwana sequence have a V/I ratio falling in the range of 1 to 2.4. In view of this fact the V/I ratio can indirectly help in delimiting coking (semi-coking) and noncoking coals and thereby suggesting coking and blending potentialities provided their rank is known.

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