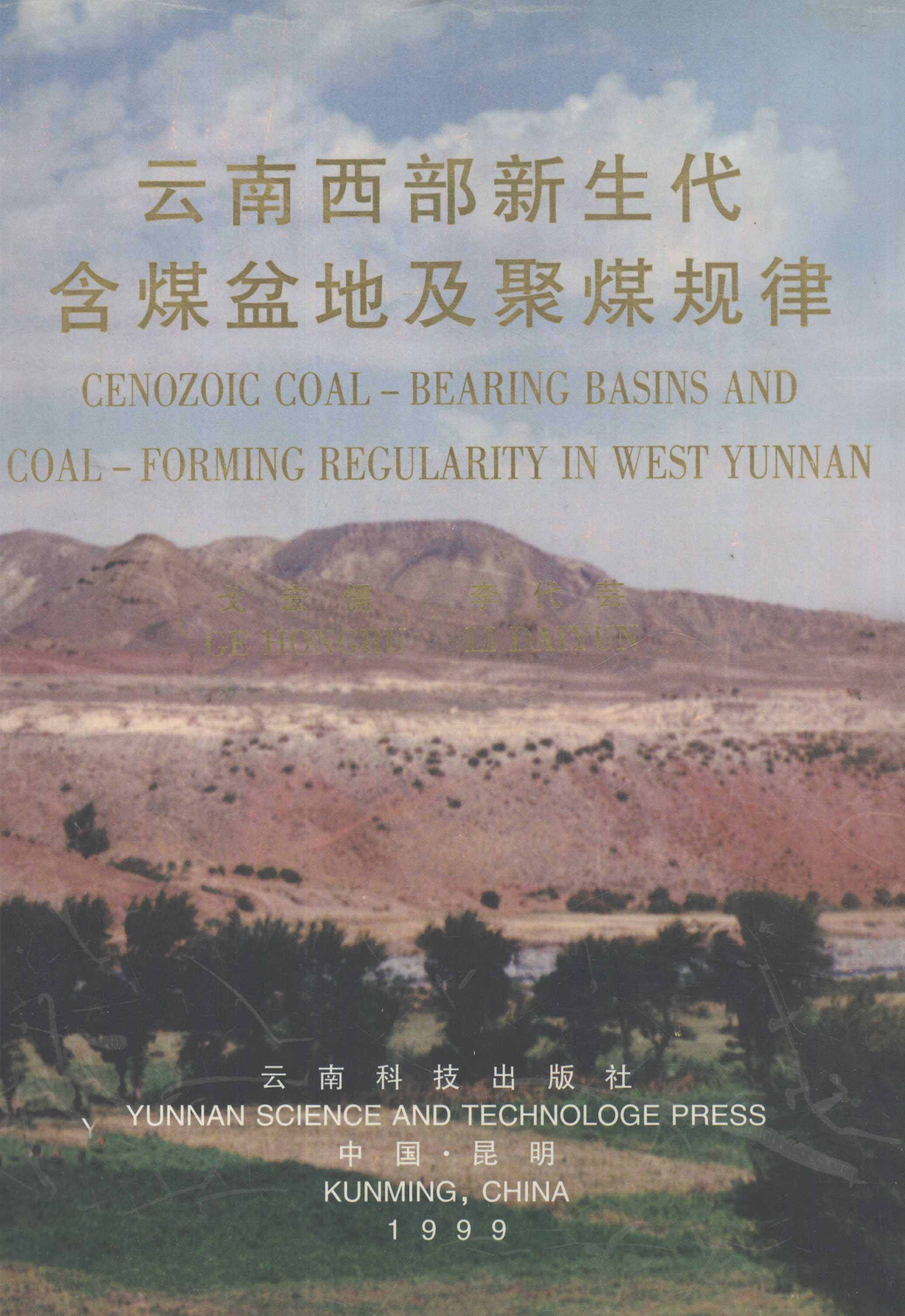

云南西部新生代含煤盆地及聚煤规律

CENOZOIC COAL-BEARING BASINS AND COAL-FORMING REGULARITY IN WEST YUNNAN

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GE HONGRU　LI DAIYUN

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内容简介

本书对云南西部新生代盆地的分布、成因类型及控制盆地的复杂地质背景、沉积特征与含煤层层序、盆地构造作了系统的论述。首次依据古植物群的特征探讨成煤时的古气候、古环境及成煤物质，并将成煤和聚煤分为二个时代三个期和五个时期；从煤的宏观和微观特征论证了成煤的原始质料与形成条件；阐明了各类盆地的成煤特征，提出了新的成煤机制；剖析了典型盆地的基底构造和控煤规律；概括了区内煤层煤质特征，归纳了含煤盆地的变化规律，指出了富煤方向。

本书可供从事煤田地质学、区域地质学、沉积学、地层学、古植物学、能源规划与开发的科研、技术人员和有关大、专院校的师生参考使用。

前　　言

在当今国内外石油、天然气、新能源广泛开发利用的情势下，煤作为一次性能源，仍居首要地位。不少国家增加煤炭的使用量，注意中小型煤矿的开采。世界上拥有煤炭资源的多数国家，煤田地质的研究和勘探开发利用尚在深入发展，采用新技术、新方法扩大矿区远景，发掘新矿田。但多是对某一时代，或某一成矿模式的研究，确很少见到一个区域性的成煤作用的全面系统研究。

我国是世界第三产煤大国，在较长的时间内，能源工业中，仍以煤炭为主。因此，对煤炭资源的研究，还是至为重要。新生代的赋煤量虽然逊于中生代、古生代的藏量，但由于新生代含煤盆地地质构造简单，埋藏浅，一些盆地内煤层厚大，适于露天开采。在国内一些省、市地区，新生代煤矿已成为当地的重要燃料基地。

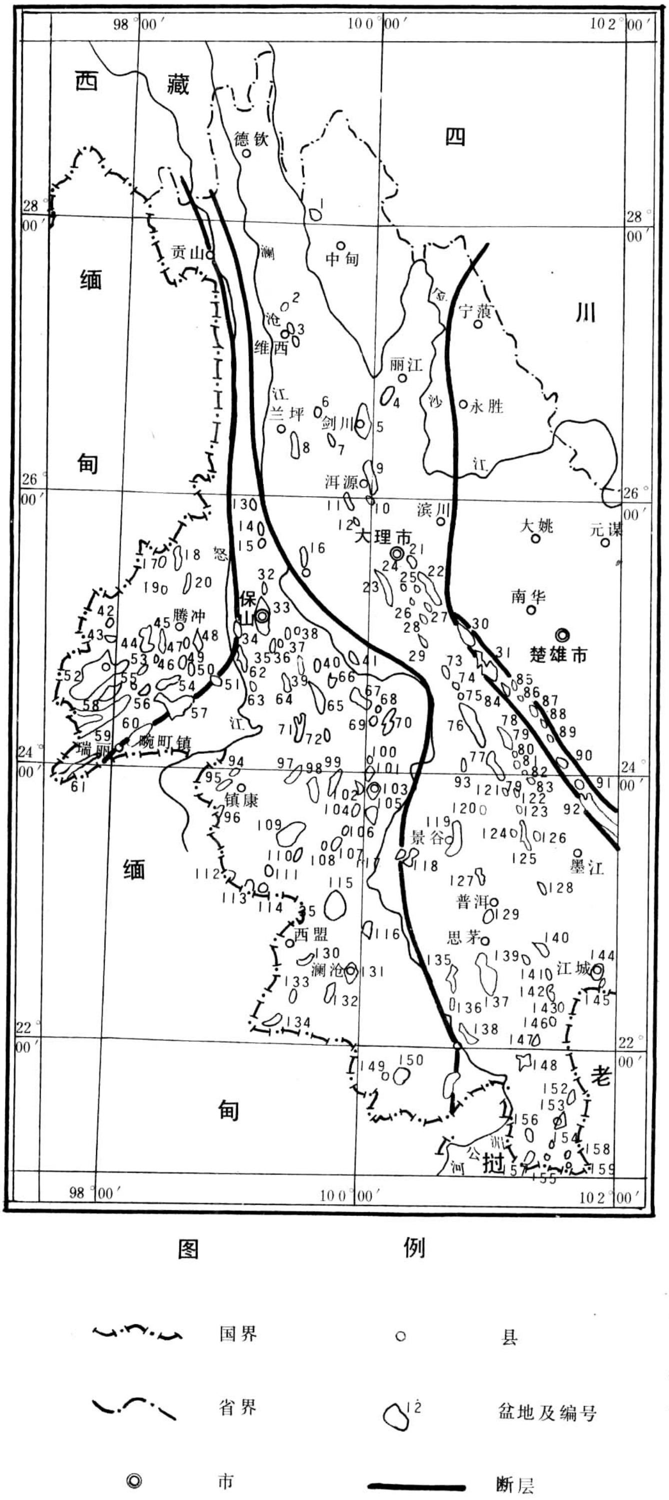
云南能源资源的产布常概括为“东煤西水”。西部煤炭埋藏量较少，煤种不全，规模不大，分布范围较小。但在各时代的煤炭资源中，新生代煤矿所占的比重最大。滇西地处云南边疆，我国的西南边陲，是以少数民族为主的多民族聚居地区，西邻缅甸，南接老挝，是连接东南亚、南亚的重要通道，为我国西南的重要经贸区。随着边贸经济的发展，对煤炭的需求与日俱增。因此，研究该区的煤炭资源，作为发展经济的先行工作，振兴云南，巩固边防，加强民族团结，提高我国的国际威望，以及保护景色秀丽的滇西的水土流失，生态环境，都有极为重要的理论意义和实际意义。

在哀牢山以西，地质上为红河大断裂—程海断裂—金沙江断裂以西范围，行政区属迪庆、怒江、保山、德宏、临沧、西双版纳等六个地州，和丽江、思茅地区、大理州的大部份地区。地理位置为东经97°31′~101°52′29″，北纬21°08′~29°16′（图1）内，有数以百计的新生代含煤盆地，零星的散布在区内45个县市内，互不相连，呈孤立状，盆地面积最大者达300多千平方米，小者不足1000平方米。含煤盆地形态各异，展布方向随地不同，主要受所在地区的地质构造控制。含煤沉积的时代从晚第三纪至第四纪更新世，在滇西境内广泛分布，发育完好，层序齐全，岩石类型多样，岩性岩相变化大，沉积厚度由数十米至2000多米不等，一般多在500米以内，产在不同成因的内陆山间盆地和山间谷地之中。是我国西部新生代成煤区南段的主要地区，赋存一定的煤炭资源，其成煤机理有重要的代表性。区内除盛产煤外，还赋存有油页岩、石油、硅藻土、高岭土、粘土、铀、锗及各类砂矿；产种类繁多、类型多样的植物化石。因此，研究云南西部新生代含煤盆地，不仅只是探讨成煤条件和赋煤规律，也是研究自中新世以来，晚新生代沉积的形成、发展、演变，及与煤矿有关的古植物性质、演化和成煤关系的重要场所。

本区为喜山褶皱新成造山带，通称三江褶皱带。在时间上，表现为多阶段的发育特

图1 滇西新生代含煤盆地分布图

1：6000000



1. 尼西
2. 龙转湾
3. 维西
4. 汝南
5. 剑川
6. 德胜沟
7. 通甸
8. 兰坪
9. 洱源
10. 大松甸
11. 乔后
12. 长邑
13. 崇仁
14. 漕涧
15. 羊巢
16. 永平
17. 高克河
18. 明光
19. 曹家寨
20. 界头街
21. 松毛坡
22. 弥渡
23. 巍山
24. 大树坪
25. 永华
26. 勤劳
27. 弥趾
28. 文盛街
29. 南涧
30. 多依厂
31. 大马街
32. 黄竹凹河
33. 保山
34. 蒲缥
35. 石龙坪
36. 补麻
37. 丙麻
38. 奎阁
39. 柯街
40. 昌宁
41. 鲁史
42. 苏典
43. 勐弄
44. 梁河
45. 长坡
46. 遮岛
47. 勐连
48. 芒棒
49. 蒲川
50. 团田
51. 镇安
52. 盈江
53. 芒东
54. 曼岭
55. 盖岭
56. 勐养
57. 潞西
58. 户撒
59. 陇川
60. 遮放
61. 瑞丽
62. 施甸
63. 姚关
64. 湾甸
65. 勐佑
66. 勐统
67. 凤庆
68. 洛党
69. 大兴
70. 云县
71. 永康
72. 乌木龙
73. 大文路
74. 瓦缺窑
75. 灰窑
76. 景东
77. 恩乐
78. 景东大街
79. 花山
80. 南浩
81. 三章田
82. 那庄田
83. 者东
84. 秀水
85. 龙潭
86. 波罗
87. 岩子头
88. 鄂嘉
89. 者龙
90. 大荒地
91. 戛洒
92. 元江
93. 勐大
94. 甘遮厂
95. 勐堆
96. 南伞
97. 户迺
98. 小石城
99. 勐撒
100. 大柏树
101. 腊东
102. 帮卖
103. 临沧
104. 下寨
105. 勐托
106. 勐库
107. 双江
108. 西安
109. 耿马
110. 勐省
111. 勐角
112. 上班老
113. 芒回
114. 沧源
115. 上允
116. 孟良
117. 昔峨坝
118. 景谷永平
119. 景谷
120. 古城
121. 那丘田
122. 中海牛
123. 凹必田
124. 峦旦山
125. 民乐
126. 平地
127. 勐烈
128. 把边
129. 普洱
130. 勐梭
131. 澜沧
132. 勐滨
133. 景冒
134. 孟连
135. 整糯
136. 曼老
137. 普文
138. 小勐养
139. 曼练山
140. 大树脚
141. 中董
142. 整董
143. 曼汤
144. 江城
145. 红疆
146. 象庄
147. 勐保
148. 勐仆论
149. 大河沟
150. 勐混
151. 大勐龙
152. 勐伴
153. 勐腊
154. 南亮东南
155. 会青西
156. 勐棒
157. 勐满
158. 尚岗
159. 尚勇

征，具明显的多旋迴性，发育众多的深大断裂；在空间上，地跨多个大地构造单元，若干次级构造，为新生代盆地发育的地质背景。含煤盆地的形成与发展，严格受所在地质构造单元主、从构造的制约。依据盆地基底构造和对含煤沉积的控制条件，将这些盆地分为：断陷盆地和构造浸蚀盆地。沉积建造为碎屑岩。依据岩性组合、沉积构造和生物标志，将沉积环境分为冲积、河流及湖泊三种相环境。首次探讨了古植物与成煤时期的古地理、古气候，和成煤物质的因果关系；正确的划分了成煤时代、成煤期与成煤时期及其纵横分布规律；论证了多个沉积中心，次级盆地控煤和多元复合迭加的成煤机理，期望能对我国新生代盆地成矿作用的研究起到推动和抛砖引玉的作用。

本书，历经多年的室内外调查研究，在研究过程中卿炜工程师参加过前期部份工作；我所绘图、照相、资料、图书等部门协助和大力支持；中国科学院北京植物所陶君容研究员提供部分照片；成都理工大学吴熙纯教授审定外文摘要；云南省科学技术委员会基础处；云南省地质矿产厅在出版方面给予大力支持和鼓励，谨此一并致谢！

Cenozoic Coal – bearing Basins and Coal – forming Regularity in West Yunnan

Summary

The mentioned area in this book is in West Yunnan, including 6 prefectures or autonomous prefectures such as Diqing, Nujiang, Baoshan, Dehong, Lincang, Xishuangbanna, and including Lijiang and Simao areas and a large part of Dali prefecture. The area is relevant to 52 counties and cities. The geographic location is 21°8′— 29°61′ N and 97°31′— 101°52′ E, which is connected with Burma to the west, with Laos to the south and with Tibet and Sichuan to the north. The area geologically belongs to the Three Rivers Folded Belt.

Coal resources are less in West Yunnan, which has been taken as a coal – deficient area. But Cenozoic coal – bearing basins are widely distributed. There are 159 coal – bearing basins in the area, after a detailed survey (Fig. 1). Such coal – bearing basins are characterized by simple geologic structures and shallow buried coal beds. Some basins contain thick coal beds, with the coal reserve more than 100 million tons. Such coal beds are easy to be mined in open pits. Some coal mines have become important fuel bases locally. Additionally some basins contain diatomaceous earth, bentonite, kaolinton and other clay mineral, oil shale, petroleum, natural gas, uranium, germanium and other mineral sands. Hence the study of geotectonic background, sedimentary mechanism, paleo-environment, coal-bearing and coal-forming of the Cenozoic basins is not only of great significance to the coal survey, but also of practical meaning in searching for relevant minerals.

Cenozoic coal – bearing series of West Yunnan developed in about 400 individual basins, isolated from each other and with different sizes. The lithologic character, lithofacies and thickness of the series change quickly. The series is abundant in plant fossils, which underlays Quaternary system conformably or unconformably.

According to sedimentary development and paleo-flora features, the distribution of coal – bearing series can be subdivided into six subareas, such as Lijiang – Dali, Lanping – Yongping, Simao – Jinghong, Lincang – Lancang, Baoshan – Changning and Tengchong – Lianghe subareas (Tablel). The series in different subareas is entirely composed of clastic rocks. The Miocene Dajie, Shuanghe, Manghui, Nanlin, Mengbin

and Bangmai formations can be subdivided into the lower Conglomerate Member, the middle coal-bearing member and the Upper Sandstone-claystone Member, in the total thickness of 229 – 2450m, generally around 500m. The pliocene Sanyeng, Mengyang, Huxi, Yangyi and Mangbang formations also can be subdivided into three members. At the top of the series in some basins there exist conglomerate beds. The Quaternary coal – bearing series, represented by Songmaopo and Mingguang formations, is composed of sandstones-conglomerates-fine sandstones-siltstoes, intercalated by coal beds, or of sandy conglomerates-sandstones, intercalated by coal beds. The series is in the thickness of 80 – 390m, being able to be compared everywhere.

The area belongs to Alps-Himalaya orogenic belt, which is a new-born orogenic belt of Himalaya folded system, commonly called the Three Rivers Fold Belt. The Fold Belt has developed in time by multi-stages, which is characterized obviously by multi – cycles. There have developed many major deep faults along the belt. The studied area acrosses several tectonic elements in space, including many second-order structures. The tectonics serves as the geologic background of the development of Cenozoic basins. The formation and development of coal – bearing basins are strictly controlled by the primary and secondary structures of the geotectonic element, in which they are located. Faults have well developed in the area. Most of Cenozoic basins are confined by faults. Major geotectonic systems are such as Jinsha River – Red River major deep fault, Amo River fault zone, Lancang River fault, Nu River fault Li River – Dali platform-marginal folded and faulted block, Zhondian folded belt, Lanping – Simao folded belt, and Gongshan – Tengchong folded belt. Under the control of these faults and folds and through Yanshan and Himalaya movements, the West Yunnan area has suffered widely from uplifting and depressing, where depressions have been confined by forming faults. Against this background, numerous intermountain basins disconnected with each other and in different sizes. According to the characteristics of interaction between basement structure and coal-bearing sediments, these basins can be roughly subdivided into fault basins and tectonically erosional basins.

Fault basins are distributed along major faults and derived fault belts, or along subsidiary fractures. The formation and development of such basins have been all controlled by faults. For different basins the degree of subsidence is different. The subsidence of different basins is always asymmetrical. The center of subsidence of a basin has moved in time and space caused by faulting. Hence the coal-bearing formation, sequence of strata and coal beds are all asymmetrical. The direction of basinal axes corresponds approximately to the trend of faults. The following fault basins are furnished, such as Jingdong—Dajie—Huashan—Zhengyuan—Sanzhangtian, Lijiang Runan, Changning Kejie, Longchuan Husa, etc.

Tectonically erosional basins were caused mainly by erosion and more or less by a certain effect of tectonic movement except for erosion, intensive dissolution in some basins caused their basement to form rugged and rough topography. Distribution of the coal-bearing formation and thickness of coal beds were controlled by topography and geomorphology. Two or more sedimentary centres often occurred in a basin. There are secondary basins within the main basin or along the margin of the basin, which link up or are partly connected with the main basin. Coal series and coal beds are usually thick near the subsidence center, and become thin or pinch out to the margin. The direction of coal-rich zone always coincides with the long axis of a basin. The following tectonically erosional basins are furnished, such as Baoshan, Lancang, Changning Shangyou and other basins.

The coal-bearing sedimentary strata are mostly in dull, colors, mainly in gray, deep gray, grayish dark and grayish brown, secondarily in grayish white, light gray, locally with intercalated violet red and variegated colors. The lithology of the coal series is characterized by containing mainly every grade of clastic rocks and claystones, intercalated by coal beds and carbonaceous rocks. Some basins yield diatomaceous earth, oil shale, marl, siderite nodules, pyrite, petroleum, uranium germanium and other clays and mineral sands. Rock composition is always controlled by the basement of a basin and rock character along its margin.

Sandstones are bad in roundness, poorly sorted and low in maturity. The composition of gravels are various. Gravel diameters are different. According to the statistics for some basins, of the total clastic rocks, conglomerates amount to 2.97—40.67 %, sandstones to 24.05—84.03 %, and claystones to 9.81—75.59 %.

The content of microelements and heavy minerals are quite different everywhere. In the sedimentary rocks there are commonly inclined bedding, horizontal bedding, wavy bedding, blocky bedding and syngenetically deformed structures and nodules, which indicating different sedimentary environments and hydrodynamic conditions.

Coal-bearing basins in west Yunnan belong to inland intermountain basins. The sedimentary formation is composed by clastic rocks with simple sedimentary structures. Based on the rock nature and association, sedimentary structure and biological marke, the sedimentary facies, environments of every basins are sorted into alluvial facies, stream bed facies and lacustrine facies.

The alluvial facies are commonly of quickly downloaded accumulation, in which three kinds of microfacies, such as sheet flood sediment, stream bed filling and rock flow are seen. Coal beds often along contain in inter-fan depression or on the outer margin of sheet flood sediments of a fan end. The fluvial facies are often anastomosing stream, river island and abandoned channels, which contain mineable coal beds limited in scope or scale.

According to the developing stages, the lacustrine facies are sorted into terrigenous detritus filled lakes and swamping lakes. And according to the water depth, the facies can be sorted into shore lakes, shallow lake, bathyal lake and deep lake facies zones. In case the peat swamp extended from the shore toward the center of a lake, there occurred a favorable environment to the coal-forming, so as to form stable mineable coal beds.

Plants in this are luxuriant. According to statistics, 4 phyla, 59 families, 132 genera and more than 180 species, have been found in this area, which are mainly Angiosperms, secondly Gymnosperms and Pteridophytes. The Algae are mainly Bacillariophytes. During Miocene, there were mainly evergreen broad leaf forest, mixed with deciduous and broad leaf arbor forest. Forests often intergrew with brushes and lianas, indicating tropical and subtropical humid climate with abundant rainfall and a lush growth of plants. The plants provided rich material resources to the coal-forming. The Pliocene deposits are mainly distributed in the northern part on the area. Pliocene plants are mainly Quercus semicarpifoliates forming stalked leaf evergreen forest, chequered and accompanied with deciduous and broad leaf arbor woods of temperate zone, and mixed with genera and species of the pulse family and the rose family, indicating a subtropical mountainous climate. Another assemblage of Pliocene plants consists of mainly broad leaf and deciduous forest, mixed with large type Ulmaceae, Betulaceae and other of evergreen deciduous indicating a warm temperate zone.

During Quaternary, there were mainly Pinus and Picea, with mostly stalks, seeds and fruits preserved. The climate at that time became cold. Hence the climate during coal-forming age, from Miocene through Pliocene up to Quaternary, was gradually changed from tropical through subtropical, subtropical mountainous warm temperate to cold.

Cenozoic lignite yields generally from the middle part of the coal series vertically, and mostly from heavily subsided part of basin horizontally. The trend of coal bed extension coincides with the basinal extension. The length of coal beds is often 2—3 times as great as the width, and the different of coal bed thickness between the longitudinal and lateral trends of a basin is up to 20—30 times. Coal beds are unstable and change greatly in their dimensions. The changement of coal beds follows a multispike curve. The occurrence of coal beds are often on lenses or lenticles. Coal beds in large basins are stratified or similarly stratified.

Cenozoic coal mineral is mostly lignite, seldom of long flame coal. Coal rock types are of clarain coal, semibright coal, semidull coal and durian coal. The degree of coalification is generally low with less exception. The moisture content and volatile component in the coal are high. The fixed carbon content and caloric value are comparably low. The content of sulphur and pliosphorus changes greatly. Supphus content is commonly higher than that of phosphorus.

There are two coal-forming periods in west Yunnan in Cenozoic, the one was in Neoggene, the other was in Quaternary. There were three coal forming epochs: Miocene, Pliocene and Pleistocene. And there were five coal-accumulative ages, the Late and Early Miocene, the Early and Late Pliocene, and Quaternary, Pleistocene. The formation of coal was better in Miocene, secondary in Pliocene, and bad in Quaternary. Miocene coal – bearing basins are mostly distributed in the southern part of west Yunnan. Pliocene deposits are well developed to the north of Yongping. Early formed coal beds are all distributed in the southern part of west Yunnan and the coal – bearing capacity over there is better. Coal – forming age becomes newer toward the north and the coal – bearing capacity becomes coorse northwards. Tectonically erosional basins are large areally, so that the coal – bearing capacity is commonly better, and the scope of coal content in great. Fault basins are generally small areally, so that the coal – bearing capacity is bad and unstable, sometimes such basins contain thick coal beds but with minor scope.

In the light of the law of coal formation, using new technology and new methods to carry out a comprehensive survey and exploration and to study the basinal coal – forming conditions, we can find out new favorable coal – bearing basins and can extend the perspective of existing coal – bearing basins efficiently, so as to develop reliable energy resources for the provincial economy.

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