Available online at www.sciencedirect.com
ScienceDirect
International Journal of Coal Geology 73 (2008) 99–114
International Journal of COAL GEOLOGY
www.elsevier.com/locate/ijcoalgeo

Adapting palynological preparation methods in subbituminous and bituminous coals from Colombia to improve palynofacies and hydrocarbon source rock evaluations

Astrid Blandon [a], Norberto Parra [b], Georges E. Gorin [c,*], Fredy Arango [a]

[a] *Facultad de Minas, Universidad Nacional de Colombia, Calle 65, # 78-28, Medellin, Colombia*
[b] *Facultad de Ciencias, Universidad Nacional de Colombia, Calle 59A, # 63-020, Medellin, Colombia*
[c] *Dpmt. Geology-Paleontology, University of Geneva, 13 rue des Maraîchers, 1205 Geneva, Switzerland*

Received 9 October 2006; received in revised form 31 January 2007; accepted 22 February 2007
Available online 6 April 2007

Abstract

Apart from their potential as fossil fuel, bituminous and subbituminous coals in Colombia may prove to be potential source rocks for the generation of hydrocarbons. The assessment of such properties requires the combination of petrographic and palynofacies studies. The latter correspond to the microscopic investigation in transmitted white and reflected UV lights of sedimentary organic matter insoluble in organic and inorganic solvents. To date, mineral acid and Schulze methods have failed to produce good samples of palynofacies constituents from Cenozoic coals in Colombia, so that the latter method had to be modified. The main modifications consist in adapting the $KClO_3$ to HNO_3 ratio in the Schulze mixture and introducing two extra phases of oxidation with NaOH and NH_4OH, which permit the washing off of humic substances.

This method yields the full spectrum of palynofacies constituents, which are not destroyed or damaged by the alkali treatment. Neither is their fluorescence colour affected by the initial acid treatment. On the contrary, the particle fluorescence intensity tends to increase because of the dissolution of humic acids, making their identification easier. The achievements of the modified method are threefold: 1) it permits the correlation between macerals in petrographic polished sections and their equivalent in palynofacies slides, making the two methods complementary; 2) palynofacies provides a better identification of sporomorphs than petrography, resulting in better paleoenvironmental interpretations; 3) palynofacies tend to give a more precise quantitative evaluation of the liptinitic constituents, and consequently, of the coal hydrocarbon generation potential.
© 2007 Elsevier B.V. All rights reserved.

Keywords: Cenozoic; Fluorescence; Microscopy; Paleoenvironment; Palynomorphs; Petrography

1. Introduction

Colombia contains large coal reserves (INGEOMINAS, 2004). In the last fifteen years, the interest in these coals has increased, because it has been demonstrated in various sedimentary basins around the world that coals can generate hydrocarbons in commercial quantities (Fleet and Scott, 1994; MacGregor, 1994), particularly in some basins presenting similar geological and structural characteristics (*e.g.*, in Venezuela, Canónico et al., 2004). Consequently, the detailed study of organic matter in low-rank Colombian coals, such as those of the Amaga Formation (Figs. 1 and 2), has become of prime

* Corresponding author. Tel.: +41 22 379 66 07.
E-mail address: Georges.Gorin@terre.unige.ch (G.E. Gorin).

0166-5162/$ - see front matter © 2007 Elsevier B.V. All rights reserved.
doi:10.1016/j.coal.2007.02.008

importance and a combination of standard petrographic observations with palynofacies studies is required.

The term "palynofacies" was defined by Combaz (1964) as representing the total organic content of a sedimentary rock as seen under a microscope (also called kerogen), which is resistant to inorganic acids (hydrofluoric, HF, and hydrochloric, HCl). In this paper, we shall use the definition of Durand (1980) who described kerogen as the organic matter recovered from sedimentary rocks which is insoluble in both organic and inorganic solvents. Following a palynological preparation of the rock sample, this microscopic content can be studied. Such a microscopic investigation of palynological matter includes the identification of palynomorphs, structured organic matter (phytoclasts and zooclasts), and unstructured organic matter (amorphous organic matter, AOM; gelified materials, resins and ambers; solid bitumen, *etc.*), as well as evaluation of the relative abundance, size and state of preservation of constituents (Combaz, 1964, 1980; Batten, 1999). This definition has been accepted by numerous authors (*e.g.*, Traverse, 1988; Powell et al., 1990; Gorin and Steffen, 1991; Tyson, 1995; Batten, 1996, 1999).

In this paper, we use the definition and classification of Steffen and Gorin (1993), who considered palynofacies study to be the microscopic investigation of kerogen (*sensu* Durand, 1980) constituents in both transmitted white and reflected UV lights. The combined use of white and UV lights is an efficient tool to identify paleoenvironments and the petroleum potential of source rocks. It also contributes to sequence stratigraphic and paleoclimatic studies (Bombardiere and Gorin, 1998; Pellaton and Gorin, 2005).

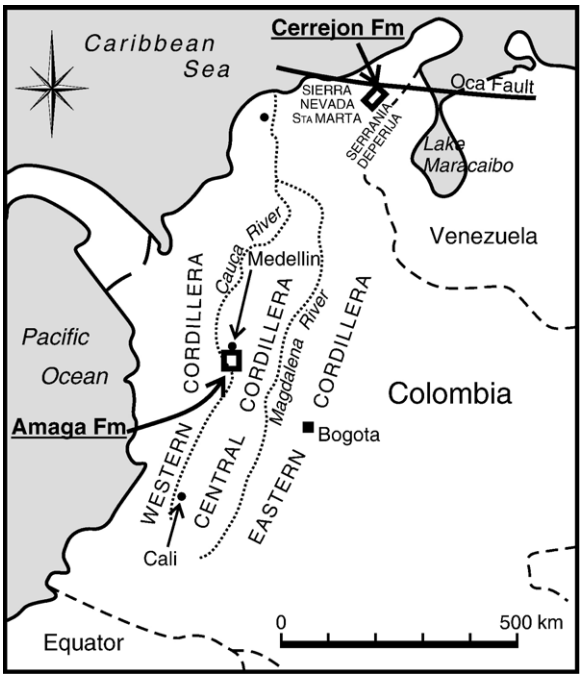

Fig. 1. Location map showing areas where the Amaga and Cerrejón Formations crop out.

The quality of palynological preparations is of utmost importance for palynofacies investigations. In order to obtain the best results, preparation methods have to be adapted according to the type of rocks and study. In this work, we are interested in investigating all insoluble organic constituents and not only spores and pollen grains. So far, common methods for the palynological preparation of subbituminous and bituminous coals in Colombia have not permitted the distinction of these constituents because of poor disaggregation of coal particles. Moreover, acids (HF, HNO_3) often decrease the quality of the fluorescence (Wood et al., 1996). This paper details a Schulze-modified preparation method that has been shown to surmount these issues in coals and organic-rich rocks, thereby improving the resolution of palynofacies analyses and associated petrographic studies, as well as the assessment of the hydrocarbon generation potential of the coals. It was developed using subbituminous coals of the Eocene–Oligocene Amaga Formation in Central Colombia, and bituminous coals of the Paleocene Cerrejón Formation in Northern Colombia (Figs. 1 and 2). The Amagá Formation contains coal beds of economic value and has been studied sedimentologically (Grosse, 1926; Gonzales, 1980; Blanco et al., 1980). The Cerrejón Formation contains one of the largest coal mines in Colombia and is also well studied (Bayona et al., 2004; INGEOMINAS, 2004; Arango and Blandón, 2006).

2. Overview of palynological preparation methods in coals

Palynofacies studies are usually carried out in carbonate or siliciclastic sedimentary rocks (marls, clays, limestones) and sapropelic coals. They are less frequently applied to humic coals. This investigation technique is complementary to the petrographic study of these coals, which can be potential source rocks for liquid hydrocarbons (Banks, 1959; Hedberg, 1968; Brooks, 1970; Teichmüller and Teichmüller, 1973; Killops et al., 1994, 1998; Isaksen et al., 1998; Wilkins and Georges, 2002; Weng et al., 2003).

Before describing the method proposed in this paper, it is necessary to refer to some palynological (for the study of pollen and spores) and palynofacies (for the study of all organic constituents insoluble in inorganic and organic solvents) preparation processes. Methods for preparing

Download English Version:

https://daneshyari.com/en/article/1753929

Download Persian Version:

https://daneshyari.com/article/1753929

Daneshyari.com