

02 - ORGANIC PETROGRAPHY OF CRETACEOUS COALS IN COLOMBIA, SUTATAUSA-CUCUNUBA REGION

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ABSTRACT

Organic petrography of Colombian cretaceous coals has been a useful tool to define depositional environments and coalification processes. The Guaduas Formation exhibits vitric coals indicating good preservation of the organic matter against the oxidizing processes. The vitrinite reflectance increases with depth reaching a maximum temperature of coalification of 134°C in the Sutatausa-Cucunuba region. The maceral composition suggests deposition in coastal environments with predominance of herbaceous vegetation and sporadic marine incursions that modified the water table in the peat.

Key words: Guaduas Formation, maceral, reflectance of vitrinite.

INTRODUCTION

The Sutatausa-Cucunuba region (Cundinamarca) is an important area where are extracted bituminous coals in Colombia (Ponguta 2016). The coal seams are found in the Guaduas Formation inserted in the *Cordillera Oriental* Basin formed during the Mesozoic synchronously with *Valle Medio del Magdalena* and *Llanos* basins (Lozano & Zamora 2014). This unit is overlaying the Guadalupe Group and it represents the last regressive event of the cretaceous sea which finished with the deposition of the Bogota and Areniscas de Socha Formations (Pérez 1991; Amaya et al., 2010; Neita et al., 2016). Previous studies attribute a cretaceous-paleogene age for the Guaduas Formation according with the palynological record

(Pérez 1991); lithologically, it is characterized by thick beds of mudstones and coals in the base and sandy layers in the top (Figure 1) (Amaya et al., 2010).

Organic petrography of coals in the Checua-Lenguazaque and Sueva synclines revealed a predominance of vitric macerals dominated by collodetrinite indicating at least, partially, a deposition in anoxic conditions in the peatbog with predominance of reed vegetation (Guatame & Sarmiento 2004; Umaña et al., 2006; Neita et al., 2016), the variation of the physicochemical properties of coals suggested variations in the paleotemperature during the burial history (Coalification process) and environmental conditions.

MATERIALS AND METHODS

Were extracted samples of coal seams in the lower member of the Guaduas Formation in the Checua-Lenguazaque syncline (Figure 1) using the channel method with collaboration of technical personals of *MINAS Y MINERALES S.A.* Each sample was prepared in the Laboratory to quantify moisture, ash, volatile matter, fixed carbon and sulfur (ASTM D5142). Also, were prepared coal polished tablets to define the organic constituents (Maceral description) (ASTM D2799) and the medium reflectance of vitrinite (ASTM D2798) using a petrographic microscope and a photometer. Also, was determined the maximum reached temperature for each coal with the Barker & Pawlewicz (1994) methodology (T_{peak}) (Equation 1) and was made a partial environmental interpretation according with the maceral distribution.

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[$T_{peak}: \frac{\{\ln(Rom)+1,68\}}{\{0,0124\}}$ \]

T_{peak}: Maximum reached temperature

Rom: Random medium reflectance of vitrinite

Equation 1-Determination of T_{peak} for each coal sample using the random medium reflectance of vitrinite method for basins without important hydrothermal processes (Barker & Pawlewicz 1994).

RESULT AND DISCUSSIONS

According to moisture, ash, volatile matter and fixed carbon values (Table 1), the coals can be classified as high volatile bituminous coals type A (ASTM D388-12). The sulfur content (0,42 to 0,94%) suggests reduced conditions, being the marine incursions the main source of it. The free swelling index (FSI) revealed values from 7 to 8,5 showed good cooking properties. The medium reflectance of vitrinite (Rom) shows values from 0,91 to 0,98, with an associated T_{peak} from 128 to 134°C indicating increase

of coalification with depth (Larry 2013).

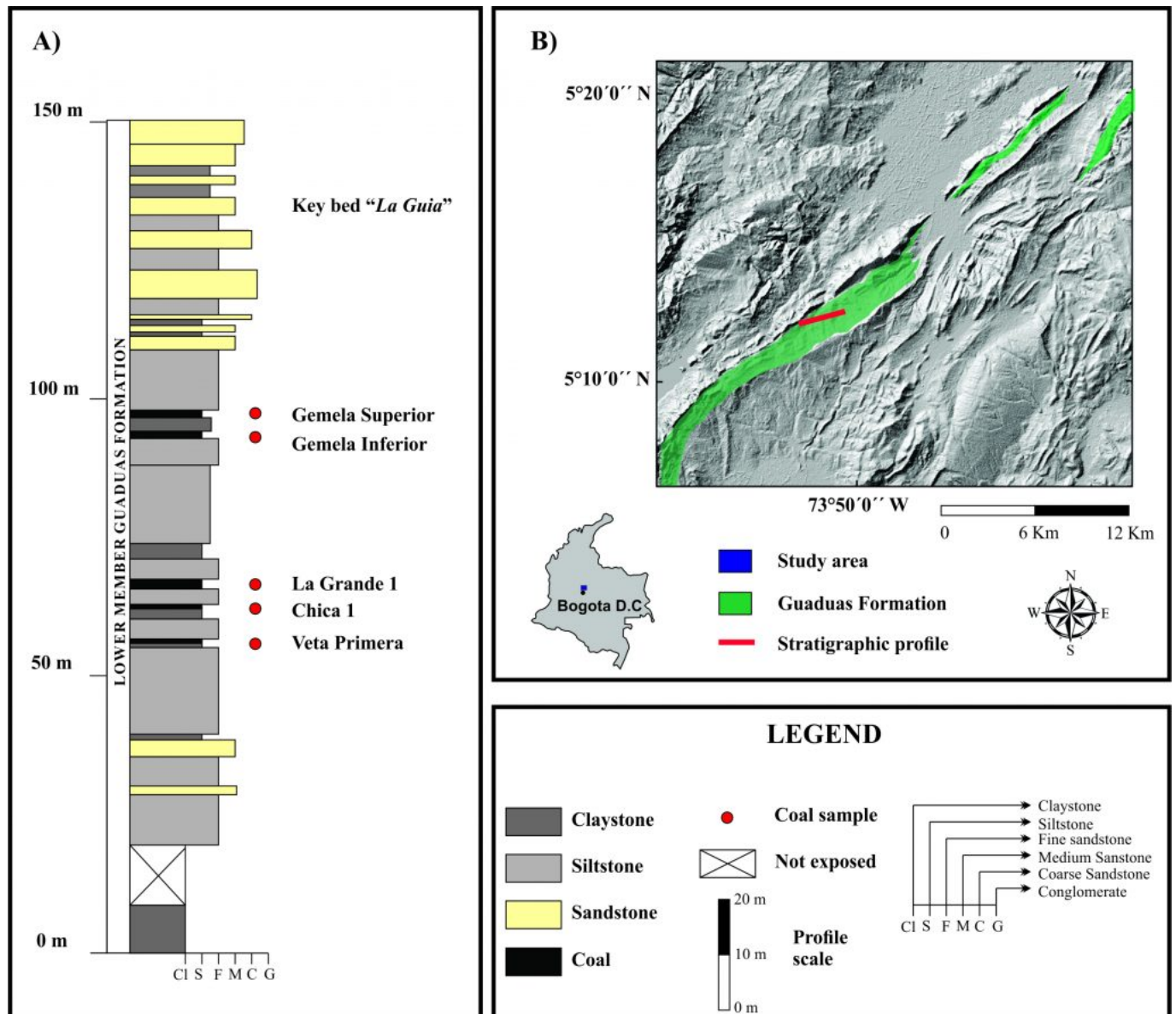


Figure 1- Stratigraphic profile of the lower member of Guaduas Formation. A) General geological stratigraphic section showing the place of coal sampling. B) Location map of the study area indicating the place of the stratigraphic profile.

The maceral composition of coal depends of vegetation, burial history and weather, with the structural, physical and chemical changes during the coalification process (Ruiz & Crelling 2008). For this case the samples are vitric indicating good preservation of the precursor organic matter and a peatbog covered by water inhibiting the oxidizing processes (Guatame & Sarmiento 2004).

The fusic trend (Figure 2) of samples due the content of inertinite suggests sporadic aerobic exposition or forest fires as product of variation in the water table. The distribution of maceral constituents indicated deposition in transitional environments in ombrotrophic conditions and predominance of reed vegetation (Diessel 1986; Calder et al., 1991; Singh & Singh 1996; Neita et al., 2016).

Table 1- Proximate analysis, reflectance of vitrinite and maceral composition. Rom: Random reflectance of vitrinite, Tpeak: Maximum temperature, V: Vitrinite, L: Liptinite, I: Inertinite, MM: Mineral matter, AD: As determined basis, D: Dry basis.

Seam name	Thickness (m)	Moisture (AD)	Ash (AD)	Volatile matter (AD)	Fixed carbon (AD)	Sulfur (D)	Rom	Tpeak (°C)	V	L	I	MM
Gemela sup.	0,30	0,75	9,11	28,79	61,35	0,54	0,91	127,88	80,20	3,20	11,00	5,60
Gemela sup.	0,80	0,81	4,28	31,94	62,97	0,52	0,92	128,76	72,60	4,80	19,60	3,00
Gemela Inf.	0,70	0,69	6,98	30,84	61,49	0,59	0,94	130,49	78,40	4,00	12,60	5,00
Gemela inf.	0,90	0,74	6,82	27,60	64,84	0,42	0,95	131,35	65,60	2,40	27,80	4,20
Grande 1	1,40	0,81	7,08	30,43	61,68	0,56	0,93	129,63	74,60	3,20	16,00	6,20
Grande 1	1,35	1,16	7,26	28,23	63,35	0,50	0,94	130,49	67,40	1,80	21,80	9,00
Chica 1	1,02	0,73	3,22	29,03	67,02	0,53	0,98	133,85	64,20	3,60	30,20	2,00
Veta primera	0,50	0,82	6,20	28,29	64,69	0,94	0,95	131,35	76,80	2,00	18,40	2,80

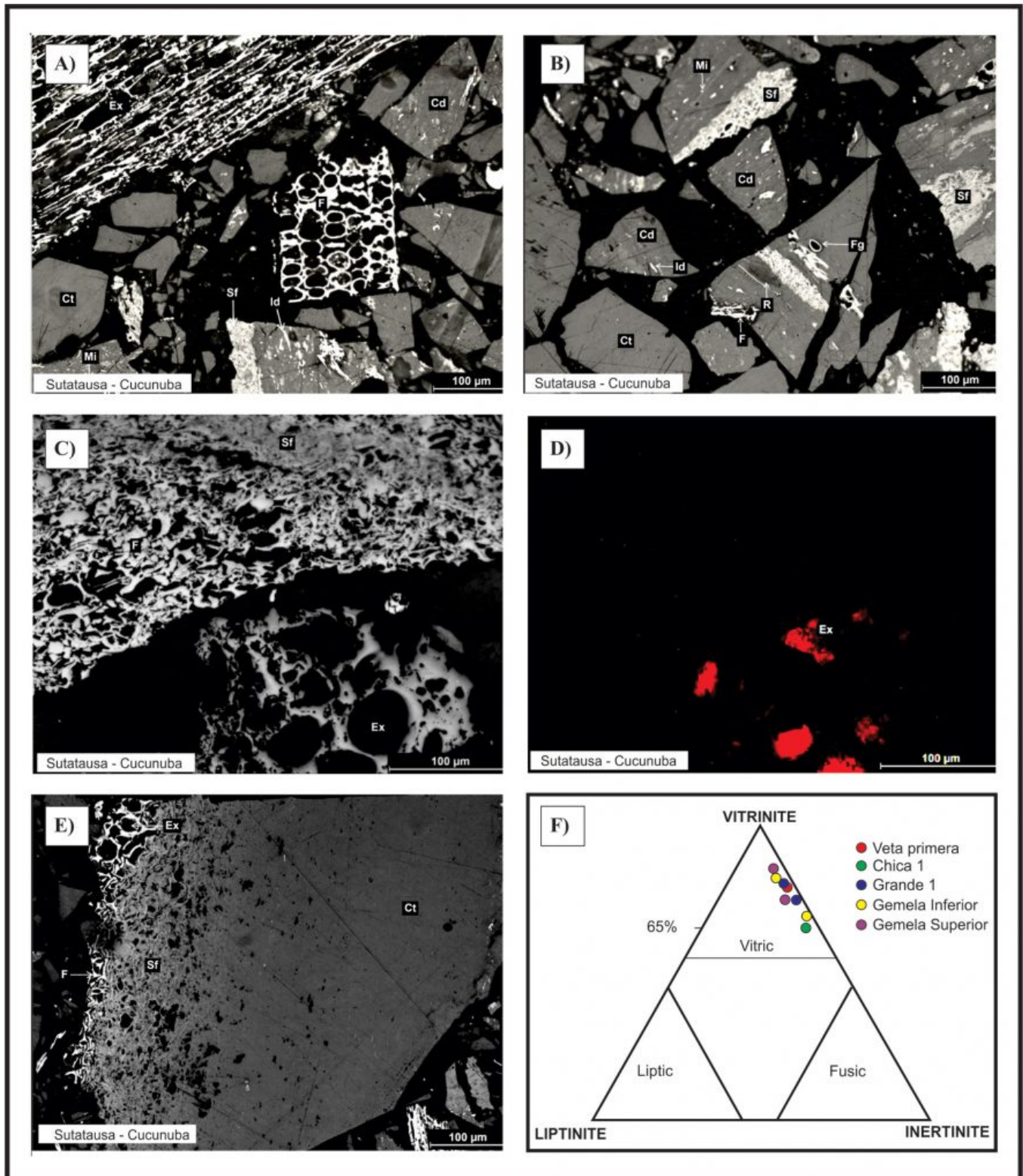


Figure 2- Microphotographs of maceral constituents. A) Coal with high content of fusinite and fragments of vitrinite, B) Fragments of vitrinite with semifusinite and funginite, could be recognize the banded structure, C) Fragments of fusinite and semifusinite, the tissue texture is good preserved and there are cavities filled by macerals of the liptinite group, D) Image get under fluorescent light to highlight cavities filled with exudatinite, (E) lateral changes in a coal fragment showing the relation between oxidized (White-fusinite) and preserved organic matter (Medium gray-vitrinite), F) Ternary diagram of maceral

constituents for coals. Cd: Collodetrinite, Ct: Collotelinite, Ex: Exudatinitite, R: Resinitite, F: Fusinitite, Sf: Semifusinitite, Id: Inertodetrinite, Mi: Micrinitite, Fg: Funginitite.

CONCLUSIONS

The Sutatausa-Cucunuba's coals were classified as high volatile bituminous coals type A and showed a decrease of the volatile matter content with depth and an increase of medium reflectance of vitrinite. The reflectance values increased as product of the coalification process associated with heat and pressure. Organic petrography shows predominance of the vitrinite group with gelled macerals partially degraded deposited in transitional environments dominated by herbaceous and forest vegetation in ombrotrophic to mesotrophic conditions and alternance of oxic and anoxic conditions.

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