Available online at www.sciencedirect.com
ScienceDirect
International Journal of Coal Geology 74 (2008) 13–27
International Journal of COAL GEOLOGY
www.elsevier.com/locate/ijcoalgeo

Radiometric age determination of tonsteins and stratigraphic constraints for the Lower Permian coal succession in southern Paraná Basin, Brazil

Margot Guerra-Sommer [a,*], Miriam Cazzulo-Klepzig [a], João Orestes Schneider Santos [b], Léo Afraneo Hartmann [a], João Marcelo Ketzer [c], Milton Luis Laquintinie Formoso [a]

[a] *Instituto de Geociências, Universidade Federal do Rio Grande do Sul, Avenida Bento Gonçalves, 9500, 91501-970 Porto Alegre, Rio Grande do Sul, Brazil*
[b] *Centre for Global Targeting, University of Western Australia, Crawley, Perth 6009, WA, Australia*
[c] *Instituto de Meio Ambiente, Pontifícia Universidade Católica, Avenida Ipiranga, Porto Alegre, Rio Grande do Sul, Brazil*

Received 9 July 2007; received in revised form 11 September 2007; accepted 15 September 2007
Available online 9 October 2007

Abstract

Ion microprobe (SHRIMP II) dating of zircons from tonsteins interbedded with coal seams from the Candiota and Faxinal coalfields (Early Permian, Rio Bonito Formation, Paraná Basin, Brazil) is presented. The mean ages obtained (290.6±1.5 Ma) are more precise than previously published intervals. Calibrations of chronostratigraphic data with radiometric ages show that the main coal succession from the southern Basin is constrained to the Middle Sakmarian. The ±2 Ma time interval of deposition supports the hypothesis that the coal-generating process was quite rapid in terms of geological time. In a general context, Faxinal and Candiota coals are assigned, into the *Protohaploxypinus goraiensis* Subzone, besides some paleocological differences evidenced by palynological studies. This bio-interval does not correspond to a consistent palynostratigraphic tool and more accurate biostratigraphic zonation for the Carboniferous–Permian interval must be delineated. The new results have far-reaching significance for correlations of the Basin with sequences of the Argentinian Paganzo Basin (302±6 Ma and 288±7 Ma) and also with the Karoo Basin, with the lowermost Ecca Group (288±3 Ma and 289.6±3.8 Ma). This new evidence supports the presence of an active and widespread Lower Permian explosive volcanic event in western Gondwana, which is interpreted as the same volcanism which produced the Choiyoi Group in western Argentina. According to this correlation the ash-fall source is located about 1400 km to the southwest of their area of deposition.

Keywords: SHRIMP U–Pb geochronology; Coal-bearing strata; Tonstein; Paraná; Basin; Middle Sakmarian

1. Introduction

Evidence of volcanic activity is widespread in different coal successions in the southern Brazil, which are historically assigned to the Rio Bonito Formation (Fig. 1), a fluvial–marine sandstone and

* Corresponding author.
E-mail address: margot.sommer@ufrgs.br (M. Guerra-Sommer).

0166-5162/$ - see front matter © 2007 Elsevier B.V. All rights reserved.
doi:10.1016/j.coal.2007.09.005

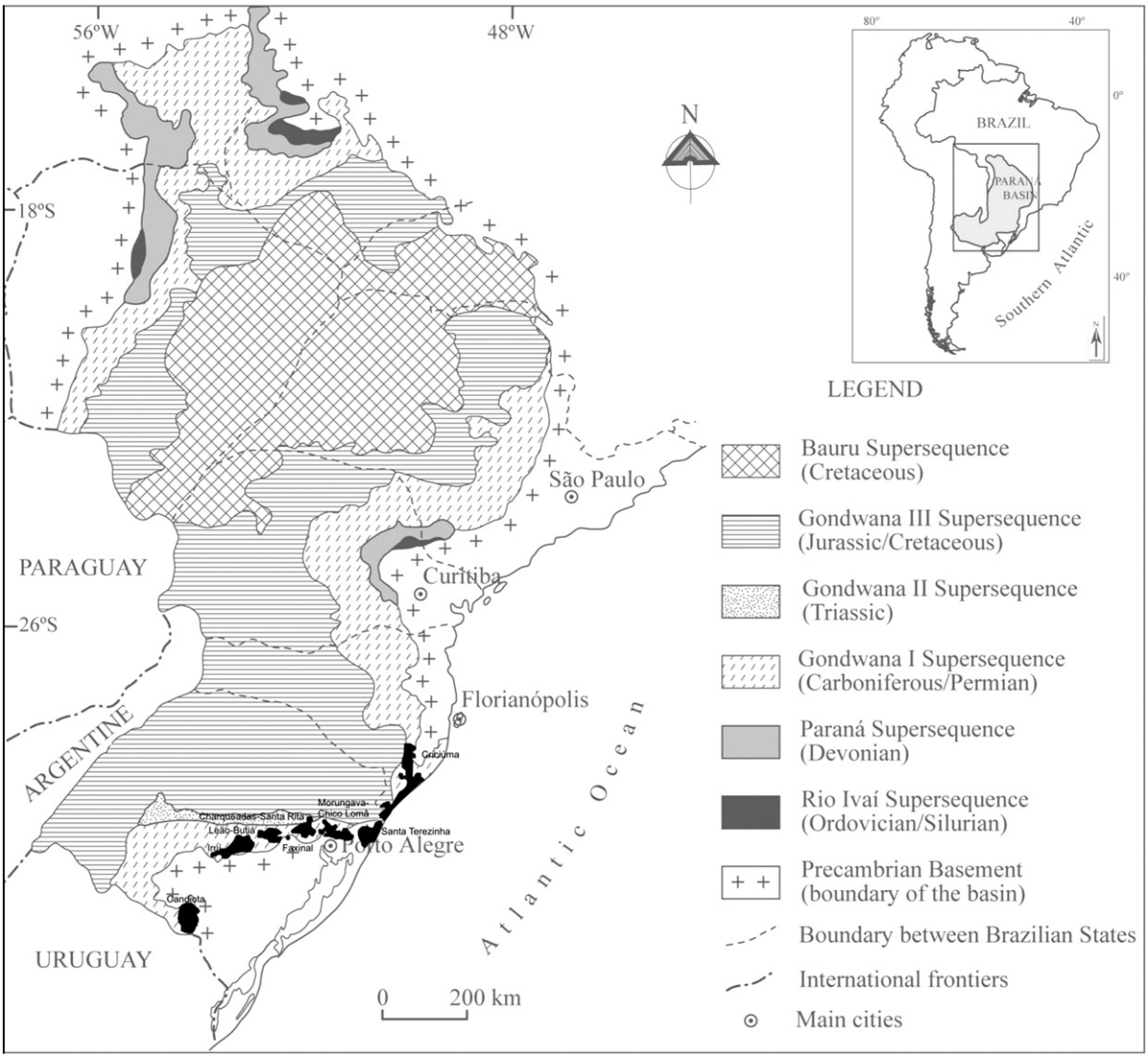

Fig. 1. Simplified geological map of the Paraná Basin in Brazil with major tectonic elements, geographic references (after Milani, 2003); location map of the coalfields in Rio Grande do Sul State, including Candiota and Faxinal.

shale prone lithostratigraphic unit. The volcanic rocks are recorded by discrete and continuous horizons of clay beds identified as tonsteins interbedded within coal seams in Candiota and Faxinal coalfields (Formoso et al., 1999, Guerra-Sommer et al., 2006, in press-a,b).They are excellent time markers for stratigraphic and basinal analyses, corresponding to units deposited during a limited period of time (Hudle and Englund, 1966). Consequently, radiometric data supplied by tonstein layers facilitate their application as isochronous markers. The radiometric accuracy will supersede previous time scales assessment in Basin, which were based mainly in litho and biostratigraphic correlations.

The first attempts to establish radiometric data in clay beds characterized as tonsteins in the southern Brazilian coal succession were made by Matos et al. (2000, 2001). They used IDTIMS U–Pb method to date zircons of the Tonstein A, interbeded with the Lower Candiota Coal Seam (Fig. 2a). The U–Pb age of 267.1 ±3.4 Ma constrained the interval of deposition to the top of the Kungurian, base of the Roadian, according to the chronostratigraphic framework of Jin et al. (1997) or to the Wordian, according to the Stratigraphic Chart of Gradstein et al. (2005). The absolute age of 267.1 ±3.4 Ma is, according to Matos et al. (2001), compatible with the potential source for the pyroclastic material of the basin: the explosive volcanic activity in the Choiyoi Province in