Available online at www.sciencedirect.com
SCIENCE DIRECT®
Review of Palaeobotany and Palynology 126 (2003) 49–64
Review of Palaeobotany & Palynology
www.elsevier.com/locate/revpalbo

Reconstructing palaeotemperatures using leaf floras – case studies for a comparison of leaf margin analysis and the coexistence approach

D. Uhl [a,*], V. Mosbrugger [a], A. Bruch [a], T. Utescher [b]

[a] *Institut für Geowissenschaften, Eberhard-Karls-Universität, Sigwartstr. 10, D-72076 Tübingen, Germany*
[b] *Institut für Geologie, Rheinische Wilhelms-Universität, Nußallee 8, D-53115 Bonn, Germany*

Received 19 November 2002; accepted 18 March 2003

Abstract

In the past the problems and advantages of the nearest-living-relative (NLR) and leaf physiognomy approaches have been repeatedly discussed and it has been demonstrated that both approaches frequently show broad agreement with each other. However, detailed comparisons of the various methods for accuracy in estimation of palaeoclimate at individual localities are still lacking. Such studies are needed before data obtained from different approaches can be integrated in palaeoclimate maps and models. Moreover, there are some indications that leaf physiognomy and NLR approaches may lead to different results. In this study we applied a physiognomic method based on leaf margin analysis and the coexistence approach, a recent variation of the NLR approach, to two Tertiary palaeofloras (Schrotzburg, Middle Miocene, south Germany; Kleinsaubernitz, Upper Oligocene, east Germany). We demonstrated that both approaches can produce reasonable and consistent results if the standard error of the leaf physiognomy palaeoclimate data is taken into account. However, our results and interpretations indicate that reconstructions based on leaf physiognomy are influenced by factors not related to climate, such as sample size and differential preservation or transport. In contrast, reconstructions for the same fossil assemblages based on the coexistence approach seem to be less affected by taphonomic variables, but may be less sensitive to minor climate changes.

Keywords: leaf margin analysis; leaf physiognomy; nearest living relatives; coexistence approach; palaeoclimate; taphonomy

1. Introduction

Fossil land plants represent excellent palaeoclimate proxies and various methods have been developed to extract climate information from them. Only a few of these methods, however, provide quantitative palaeoclimate data. A frequently used quantitative technique of palaeoclimate reconstruction is based on fossil leaf assemblages and makes use of the correlation between leaf physiognomy and climate parameters. Bailey and Sinnott (1915, 1916) were the first to observe that the percentage of woody species with entire-margined leaves is higher in tropical floras than in cooler climatic zones. Wolfe (1971, 1979) further analysed this correlation between leaf margin

* Corresponding author. Fax: +49-7071-29-5217.
E-mail address: dieter.uhl@uni-tuebingen.de (D. Uhl).

0034-6667/03/$ – see front matter © 2003 Elsevier B.V. All rights reserved.
doi:10.1016/S0034-6667(03)00058-7