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Permian and Triassic Antarctic Palaeobotany: Glimpses of a Green Continent

Kurzfassung

Permische und triassische Floren der Antarktis sind von besonderer Bedeutung für paläogeographische Studien. Einzigartige verkieselte Torfe ermöglichen detaillierte Studien der bereits seit langem ausgestorbenen Pflanzen.

Abstract

Permian and Triassic floras from Antarctica are of special importance for palaeogeographical considerations. Moreover, the Antarctic has yielded a number of unique silicified peat occurrences, enabling detailed anatomical studies of these long extinct plants.

Résumé

Des flores permiennes et triasiques de l'Antarctique sont d'une importance particulière pour des études paléogéographiques. Le gisement sans pareil de la tourbe siliceuse permet des recherches détaillées sur des plantes disparues depuis longtemps.

Keywords

Antarctica, Palaeobotany, Permian, Triassic

1. Introduction

The small and fragmentary plant remains collected from the Beacon Sandstone during R. F. Scott's Discovery Expedition (1901–04) and described by ARBER (1907) were not only the first fossil plants known from the frozen continent but also the first proofs that Antarctica once was covered with a lush vegetation. In the past 100 years well over 400 publications dealing with fossil plants from the Antarctic have been published. The oldest plant fossils found are of Early Devonian age (EDWARDS 1990) – the time that land plants started to colonize the land, whereas Pliocene floras demonstrate that Antarctica was at least still partly green only few million years ago (WEBB & HARWOOD 1986, TRUSWELL 1990, WEBB et al. 1996).

2. Permian Floras

Permian floras are known from several localities in Antarctica. The palaeogeography during the Permian was very different from that of today. Antarctica, Australia, South America, Africa and the Indian Subcontinent together still formed a large landmass, named Gondwana and the south pole was probably situated in western Antarctica near the Ellsworth Mountains. Permian Gondwana floras typically are dominated by Glossopterids. *Glossopteris* is a genus of relatively large entire-margined leaves, with lateral veins usually forming a net venation (Fig. 1). In addition to *Glossopteris*, a number of other genera are recognized within this group. Although foliage is rather uniform, a large variety of fertile structures has been found, showing that Glossopterids were gymnospermous seed plants. Glossopterids were deciduous trees and bedding planes are often completely covered with leaves. Deciduousness is a typical for trees growing in cool to cold temperate climates. The typical glossopterid roots of the *Vertebraria* type show another adaptation to cold climates in the form of large air-filled cavities. The presence of growth rings demonstrates seasonality; some woods even clearly show frost damage. Upright standing silicified stems have been found as far as 85° South. Also during the Permian this location was situated at high latitude (80–85°S) and these trees must thus have survived half-year periods of darkness during polar winters (TAYLOR et al. 1992).

Fig. 1: *Glossopteris*. Skaar Ridge, Beardmore Glacier. Upper Permian. Palaeobotanical Collection Department of Ecology and Evolutionary Biology, University of Kansas, Lawrence KS.

Of special importance are silicified peat deposits (e.g. TAYLOR et al. 1989 and 2000, TAYLOR & TAYLOR 1990, TAYLOR 1996, PIGG & TAYLOR, 1992, PIGG & MCLOUGHLIN 1997). The Antarctic is the only part of Gondwana that yields anatomically preserved plant remains, other than fossil wood. Glossopterid leaves are the most common anatomically preserved plant remains (PIGG & TAYLOR 1990, PIGG & MCLOUGHLIN 1997). Most remarkable is the presence of very delicate mosses in silicified peat deposits (TAYLOR et al. 1989). The fossil record of mosses is at best very scanty and these mosses are the only anatomically preserved mosses known from Gondwanaland (TAYLOR & TAYLOR 1990).

3. Triassic Floras

By Triassic times Antarctica had moved northwards and most of eastern Antarctica was located north of 60°S. Although Triassic floras are more diverse than Permian floras, they are still rather monotonous in comparison to coeval floras from the northern hemisphere. Like Glossopterids are typical Permian elements, *Dicroidium* is a typical form for the Triassic. *Dicroidium* is a so-called seedfern, a gymnospermous plant with fern-like foliage but having real seeds. *Dicroidium* has very typical forked fronds and is known from Australia, southern Africa, the southern part of South America, the Indian Subcontinent and the Antarctic, demonstrating that these now separated land masses were still together.

One of the world's southernmost fossil plant localities is the so-called Alfie's Elbow outcrop, an unnamed ridge southeast of Schroeder Hill in the Shackleton Glacier area at ca. 85°23'S and 174°49'W. This locality was discovered in the austral winter of 1995 when during a reconnaissance flight dark strata were seen surfacing from the ice. A closer inspection revealed the presence of coal beds and associated sediments with an extremely rich but rather low diversity flora (TAYLOR et al. 1998). Some of the coals contain chert lenses, formed during an early diagenetic stage, when the coal was still peat. Except for petrified wood, anatomically preserved plant remains are extremely rare in the Triassic. The Antarctic is the only place in the world where such silicified plant remains are found. The clastic sediments contain numerous *Dicroidium* fronds (Fig. 2), associated by fertile organs. These seed-bearing structures and pollen organs provide important information on the natural affinities (TAYLOR 1996, AXSMITH et al. 2000). Two species of *Dicroidium* have been identified. Another typical element in this association is *Heidiphyllum*, a conifer that was originally described from South Africa and was later also found in South America.

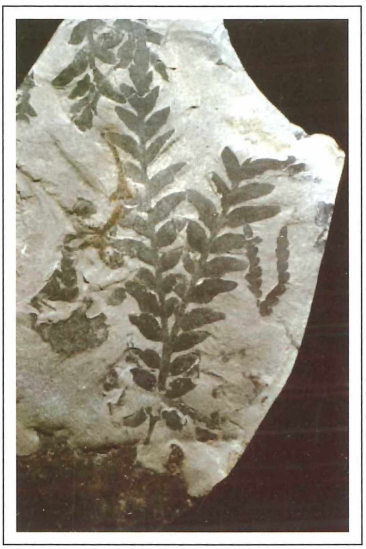

Fig. 2: *Dicroidium odontopteroides* with seed-bearing organ (left). Alfie's Elbow Locality, Shackleton Glacier. Paläobotanische Sammlung, Forschungsstelle für Paläobotanik, Münster.

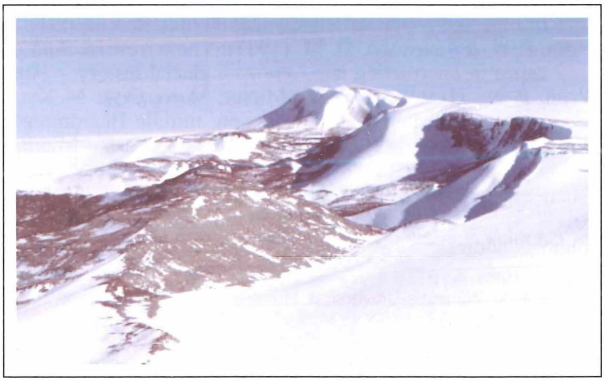

Fig. 3: Alfie's Elbow locality seen from the air with the Polar Plateau in the background (left).

Many other localities with Triassic plant fossils are known in the Antarctic, but only few are as rich as the above mentioned Alfie's Elbow locality. In other silicified peat localities delicate features such as endomycorrhizae are preserved (TAYLOR et al. 1989). One of the most remarkable finds is a silicified cycad stem at Fremouw Peak, Beardmore Glacier. This relatively slender stem looks very modern. Cycads nowadays occur in tropical and subtropical areas only. This find shows that cycads once had a much wider geographical distribution and once grew in more temperate climates than today (SMOOT et al. 1985).

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