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Additional evidence for the Mesozoic diversification of conifers: Pollen cone of *Chimaerostrobus minutus* gen. et sp. nov. (Coniferales), from the Lower Jurassic of Antarctica

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ABSTRACT

Paleontological data indicates that the Late Triassic–Early Jurassic was a critical time interval for the phylogenetic and morphological diversification of conifers, especially modern families. In this study a new genus and species, *Chimaerostrobus minutus*, is characterized based on an anatomically preserved pollen cone from the Lower Jurassic of Antarctica. The cone was prepared using the cellulose acetate peel technique and studied using light and scanning electron microscopy. The pollen cone of *Chimaerostrobus* is subspheroidal with tightly imbricate microsporophylls. Microsporophylls contain a single vascular bundle and abundant transfusion tissue. There are 22 pollen sacs per microsporophyll that are both abaxially and adaxially attached to the stalk and distal laminar head. In situ pollen grains are oblate, 15–20 μm in equatorial diameter, and asaccate. *Chimaerostrobus* has a combination of characters indicative of Araucariaceae and extinct conifers such as voltzialeans and *Kobalostrobus*; however, due to its unique character mosaic it cannot be assigned to an established group. This new species sheds light on the complexity of pollen cone evolution and the diversity of conifers that were evolving during the Late Triassic and Early Jurassic.

1. Introduction

Conifers experienced a considerable diversification during the Late Triassic and Early Jurassic, which resulted in the divergence of several modern families (Nathorst, 1908; Townrow, 1967a; Arrondo and Petriella, 1980; Escapa et al., 2008; Taylor et al., 2009; Leslie et al., 2012; Rothwell et al., 2012). Modern conifers are considered to have evolved from voltzialean ancestors (Florin, 1951; Stewart and Rothwell, 1993; Taylor et al., 2009); however, despite recent advancements in phylogenetics, paleobotany, and evolutionary developmental biology, the overall pattern of conifer evolution remains incompletely understood (Rothwell et al., 2012; Escapa and Catalano, 2013; Spencer et al., 2015). One method to help sort out early conifer evolution is to systematically sample Upper Triassic and Lower Jurassic deposits for taxa with unique character mosaics that potentially contain data important for reconstructing ancient evolutionary patterns and relationships (see Donoghue et al., 1989; Crane et al., 2004; Rothwell et al., 2011, 2013).

Over the past decade, several studies have characterized a number of permineralized Mesozoic conifers from different geographical regions (Escapa et al., 2010, 2012, 2013; Rothwell et al., 2011, 2012, 2013; Stockey and Rothwell, 2013). Due to their well-preserved cellular anatomy, these fossils are essential for deciphering organ homologies, character evolution, and phylogenetic relationships. Unfortunately, there is a paucity of permineralized material recovered from Lower Jurassic Gondwanan deposits (Bomfleur et al., 2011). The Carapace Nunatak area of the Transantarctic Mountains, however, is one of the few reported Gondwanan assemblages of this age that contains abundant well-preserved fossil plant material (Townrow, 1967b, 1967c), including permineralized conifers and other plants (Stigall et al., 2008; Hieger et al., 2015).

In this study, a new conifer genus and species, *Chimaerostrobus minutus* gen. et sp. nov., is characterized based on a permineralized partial pollen cone from Carapace Nunatak. This cone has a unique character mosaic indicative of extinct voltzialean taxa and modern Araucariaceae; however, it does not clearly conform to either stem or crown group. The description of this new extinct plant increases the known diversity of ancient conifers and adds to an ever-growing database of permineralized Triassic–Jurassic fossils that will be important for understanding the overall pattern of conifer evolution.

2. Materials and methods

A single anatomically preserved pollen cone has been recovered from a moraine-debris field on the S-SW side of Carapace Nunatak

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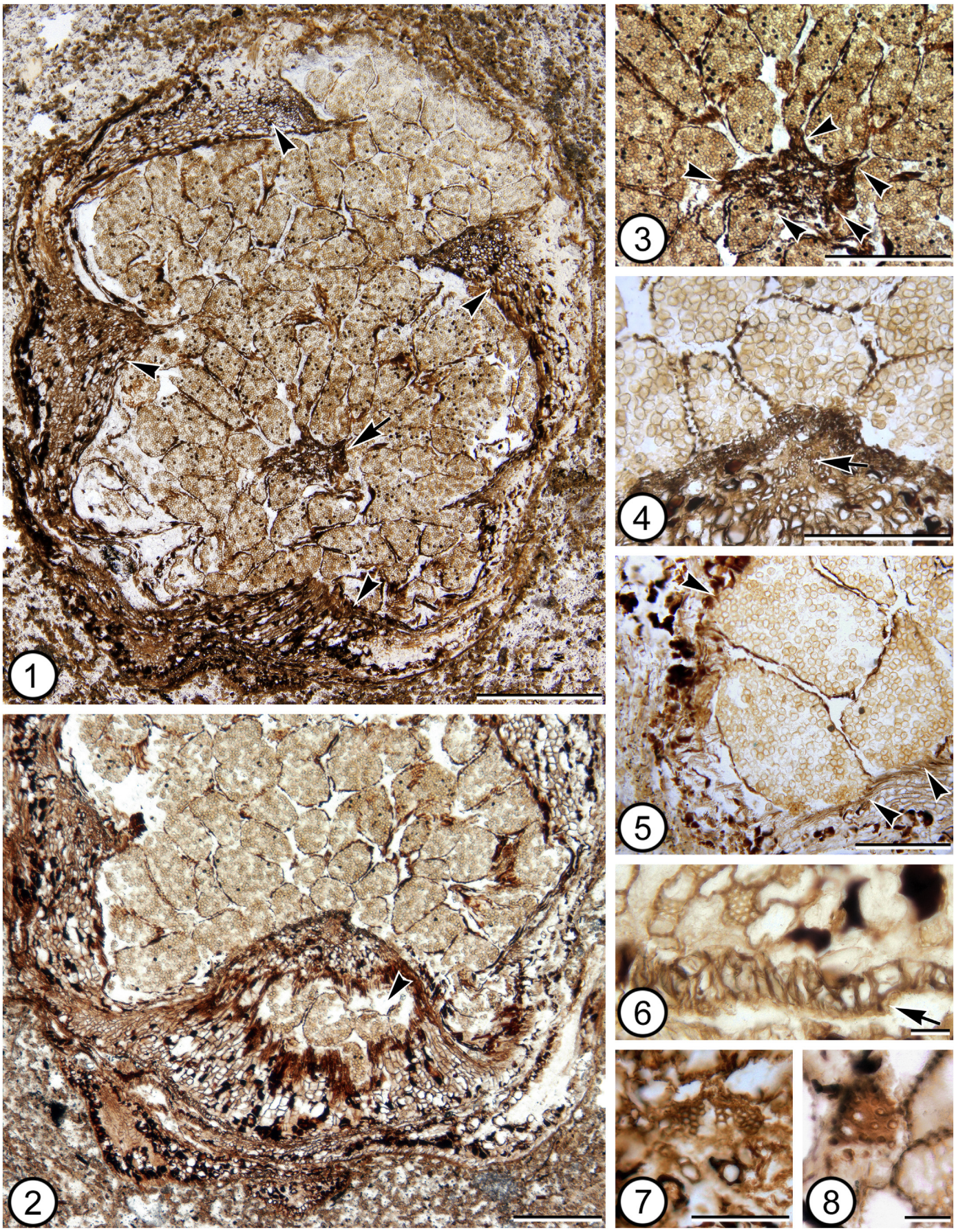
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