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Peltaspermalean seed ferns with preserved cuticle from the Upper Triassic Karamay Formation in the Junggar Basin, northwestern China

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ABSTRACT

Foliage of a new peltaspermalean seed fern is described on the basis of a large collection of well-preserved plant adpressions with cuticle from the Upper Triassic Karamay Formation in Xinjiang Province, NW China. Pinnae are lanceolate with undulate-dentate margins and with fascicular lateral veins in lobes. Tertiary veins are simple as are interfascicular veins that occur between fascicular lateral veins. Cuticles are thick, amphistomatic, with abaxial and adaxial cuticles being similar to each other and having clear costal and intercostal areas. Stomata are sunken and randomly distributed on both the abaxial and the adaxial cuticle. The stomatal complex is monocyclic and comprises 4–7 subsidiary cells. Papillae are present on ordinary cells and on subsidiary cells surround the stomatal aperture. The adaxial leaf surface has a stomatal index of 3.27 and an average stomatal density of 15 per mm^2, whereas the abaxial surface has a stomatal index of 5.25 and an average stomatal density of 30 per mm^2. This is the first report of the cuticular structure of *Scytophyllum* from the Junggar Basin, which now enables detailed comparison with other species of the genus from Eurasia. Analysis of the sedimentary succession containing *Scytophyllum* suggests a humid or seasonally dry environment, but the thick cuticles with sunken stomata and abundant papillae indicate that the plant was adapted to living in water-stressed conditions.

1. Introduction

The Junggar Basin is one of three large sedimentary basins in Northwest China's Xinjiang Uygur Autonomous Region (Fig. 1) and is of considerable economic importance due to its vast oil, natural-gas, and coal resources (Tang et al., 1997). Research on Mesozoic plant fossils from the basin began in the early 20th Century with Seward (1911) documenting an assemblage based on specimens previously collected by Obrutschew in 1905–1906. Since that time plant fossils within the basin have been extensively studied in the course of regional geological surveys and resource exploration, primarily to facilitate biostratigraphic correlation (e.g., Sze, 1953, 1956a, 1956b; Yang et al., 1986; Sun et al., 2010). Within the basin, Permian–Triassic plants are comparatively well-known and floral assemblages are now well established (Table 1; Yang et al., 1986). Whereas isolated examples of *Pecopteris* sp. occur in the Jiucaiyuan Formation (Yang et al., 1986), the stratigraphically lowest floral assemblage including multiple species is the Anisian to Carnian *Danaeopsis-Bernoullia* assemblage (Table 1) mainly occurs in the Karamay Formation in the Dalongkou section at Jimsar (Yang et al., 1986). The overlying Upper Triassic floras from the Junggar Basin consist of two floristic assemblages (Table 1), namely the *Danaeopsis-Nanzhangophyllum* assemblage from the Huangshanjie Formation dated to the Carnian-Norian stages of the Triassic, and the *Glossophyllum-Cycadocarpidium* assemblages from the Haojiagou Formation dated to the Norian-Rhaetian stages of the Triassic (Sun et al., 2010).

The genus *Scytophyllum* Bornemann, the index plant of the *Scytophyllum* Flora is widely distributed in Russia and Europe during the Triassic (Dobruskina, 1994). Its leaves commonly occur association with peltaspermalean reproductive organs (Dobruskina, 1969; Kustatscher et al., 2007), and similarities of cuticle structure in *Scytophyllum* and the peltasperm *Lepidopteris*, including the type of stomatal apparatus and number of the subsidiary cells indicate that *Scytophyllum* was most likely a peltaspermalean pteridosperm (e.g., Bateman and Hilton, 2009). *Scytophyllum* was recognized for the first time within the Junggar Basin by Shi et al. (2014) who documented *Scytophyllum* sp. from the Karamay Formation at the Dalongkou section (Fig. 1b). Unfortunately, the specimens documented by Shi et al. (2014) were

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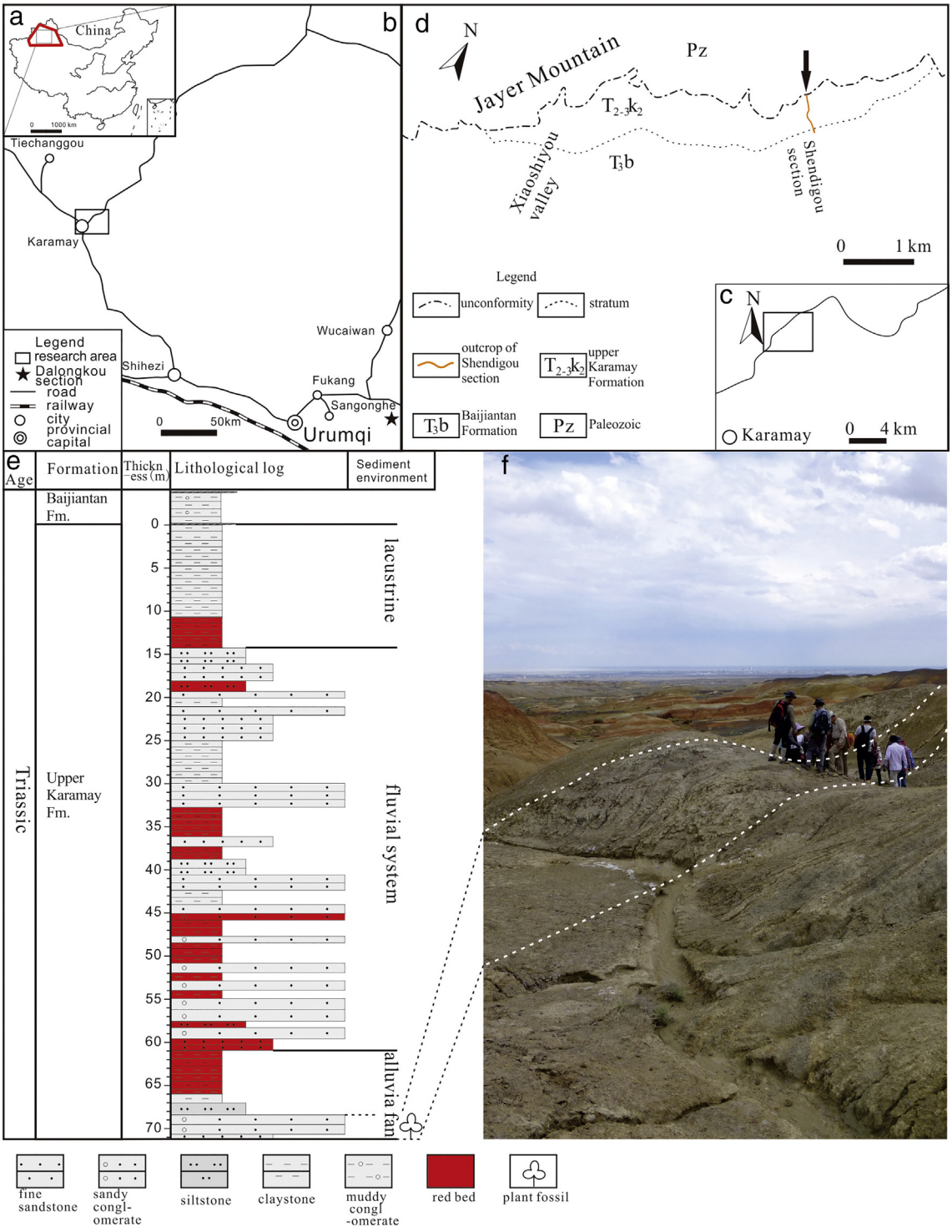

Fig. 1. Location of the Shendigou section and the sedimentary log of the outcrop. a. Index map showing position of the research area (boxed area) in China. The thick red lines marks the approximate margin of Junggar Basin; b. Locality of research area (boxed area) in the Junggar Basin to the at north of Karamay; c Location of the research area (boxed area); d. Summary geological map showing the formation outcrop patterns and the location of Shendigou section (arrow); e. Sedimentary log of the Upper Karamay Formation, showing the sedimentological context and stratigraphic position of the fossil layer; f. Photo of the outcrop with dashed line marking the position of the fossil plant layer.

imperfectly preserved and showed neither venation nor cuticular details, so that their identification to species level was not possible.

During fieldwork in 2013 we collected specimens of *Scytophyllum* with preserved cuticle from the Karamay Formation to the north of Karamay City (Fig. 1). In the present paper we describe these specimens as a new species and provide detailed comparisons to other species of the genus. *Scytophyllum karamayense* sp. nov. adds additional information about the floristic assemblage from the Karamay Formation and its floristic relevance to Triassic floras worldwide. Evaluation of sedimentary facies and cuticle analysis enabled us to infer the palaeoecology of *Scytophyllum* from the Junggar Basin.

2. Geological setting

The Junggar Basin (Fig. 1a) is located on the Junggar Plate, which was a part of the eastward extension of the Kazakhstan Plate that