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**Abstract**

*Shurabia taewani* sp. nov., is first representative of the reculid family Geinitziidae described from the Upper Triassic of South Korea. The preservation of numerous wing venation characters on this new fossil allows for its placement in the genus *Geinitzia* and a deep comparison with other genera of Geinitziidae. This discovery suggests that the insect paleofauna of the Amisan Formation is rich and needs to be further investigated. *Shurabia*

*taewani* sp. nov. differs from the other species currently included in the genus, *inter alia*, because its vein ScP ends near wing mid-length, its fork of M is at the same level as the fork of R, its RP has five branches, its MA four branches, its MP two branches, and its vein m-cua 'M5' originates from the stem of M and ends into CuA.

**Résumé**

*Shurabia taewani* sp. nov., est le premier représentant de la famille de Geinitziidae (Reculida) décrit du Trias supérieur de Corée du Sud. La préservation de nombreux caractères de nervation alaire sur ce nouveau fossile permet de le ranger dans le genre *Shurabia* par une comparaison complète avec les autres genres de Geinitziidae. Cette découverte suggère que la paléo-faune de la Formation d'Amisan est riche et doit faire l'objet d'une étude plus approfondie. *Shurabia taewani* sp. nov. diffère des autres espèces actuellement incluses dans le genre, *inter alia*, par sa nervure ScP se terminant près du milieu de l'aile, la fourche de M au même niveau que celle de R, la RP avec cinq branches, la MA avec quatre branches, sa MP avec deux branches et la vein m-cua 'M5' provenant de la tige de M et se terminant dans CuA.

**Keywords** *Shurabia*, Reculida, new species, fossil record, taxonomy

**Mots clés** *Shurabia*, Reculida, nouvelle espèce, registre fossile, taxinomie

## Introduction

The ‘Grylloblattodea’ is a group, likely polyphyletic or paraphyletic, of insects composed of the extant apterous order Grylloblattida Walker, 1914, and numerous fossil families and genera of uncertain affinities. To date, there is still no evidence (synapomorphy) supporting the relationships within this group or the monophyly of the ‘Grylloblattodea’. Nevertheless, Storozhenko (1998) proposed a first revision and phylogenetic analysis of the group providing crucial state of art and information for the following decade. Unfortunately, his phylogenetic analysis was not polarized (i.e., no outgroup) and needs to be updated. Recently, Aristov (2015a) revised the group but additional work is to be conducted to fully disentangle the relationships within this lineage. Aristov (2015a) notably transferred some former ‘Grylloblattodea’ families, such as the speciose Geinitziidae, into the order Reculida.

Despite the recent progress in phylogenetic analyses, the systematic of many clades within the ‘Grylloblattodea’ and the Reculida remains blurry and the current delineations of the families are poorly justified. This issue stems from the fossil material – often poorly preserved and partial (i.e., wings only) – that often consists of a single isolated wing that does not allow for the circumscription of the variability of the venation (a similar problem is known for other Polyneoptera see Jouault et al., 2021). It is to be hoped that future descriptions will bring additional information on the morphology of this group, and its evolution to refine the limit of its constitutive families.

The fossil representatives of the ‘Grylloblattodea’ including the Reculida span from late Carboniferous to mid-Cretaceous with numerous species known from the Permian and Triassic epochs (Cawood et al., 2022). Similarly, they are worldwide known – even in Gondwanan deposits (Lara and Aristov, 2017), which are often poorly documented – suggesting that they could be used to investigate the impact of at least three extinctions

events: the end-Permian mass extinction, the Triassic-Jurassic extinction, and the Toarcian anoxic event (Zhang et al., 2022). However, before proposing hypotheses on the potential impact of these extinctions on the 'Grylloblattodea' and the Reculida in particular, it is necessary to clarify their systematic. Embracing this vision, we describe the first species and representative of Geinitziidae from the Korean Peninsula and provide a detailed justification for its placement. This species belongs to *Shurabia* Martynov, 1937 one of the most speciose genera of the family, known between the Middle Permian and the Late Jurassic, with a maximum of species in the Jurassic (Table. 1).

**Material and methods**

A single forewing with preserved venation was discovered in the middle shale unit of the Amisan Formation exposed in the Myeongcheon section (36°20'21"N, 126°37'34"E; see Park et al., 2022: fig. 1). The Amisan Formation is known to 1,000 m thick and consists of the lower sandstone units, the lower shale unit, the middle sandstone unit, the middle shale unit, and the upper sandstone unit (Yang, 1999). To date, the Amisan Formation is thought to be of Triassic age but the floral analyses of Kimura and Kim (1984) have to be challenged because of the life span extension (to the early Jurassic or Cretaceous) of numerous genera initially assumed to be restricted to the Late Triassic (Kim and Kimura, 1988; Kim, 1990, 2009, 2013; Kim et al., 2002; Lee et al., 2004; Kim and Roh, 2008). The analysis of clam shrimp fauna supports a Triassic age (Kim and Lee, 2015), but the only bivalve genus *Margaritifera* Schumacher, 1816 known from the Formation is possibly indicative of a post-Triassic age (Kim et al., 2015), although a recent phylogenetic analysis of the Margaritiferidae supports a Triassic origin for this family (Araujo et al., 2017). Radiometric

analyses established a Jurassic age for the Nampo Group, encompassing the Amisan Formation, questioning the Triassic age derived from the paleontological evidences (Koh, 2006; Jeon et al., 2007). Finally, the composition of insect fauna, with Titanoptera and Triadophlebiomorpha, indicates a Triassic age for the Formation (Park et al., 2022; Jouault et al., 2022). Herein, we consider the age of the Amisan Formation to be Late Triassic until clear-cut analyses clarify the age of the formation.

The samples were photographed using a Canon EOS 6D camera with an attached Canon EF 100 mm f/2.8 USM macro lens. Images were cropped and enhanced using Adobe Illustrator and Adobe Photoshop CC2019. The specimen of *Shurabia taewani* sp. nov. is housed in the Gongju National University of Education under the collection number GNUE112003.

Venation abbreviations are as follows: C costa; CuA cubitus anterior; CuA1 first branch of cubitus anterior; CuA2 second branch of cubitus anterior; MA media anterior; MP media posterior; m-cua or M5 (supposedly the fifth branch of the media), also interpreted as a strong crossvein between M and R; RA radius anterior; RP radius posterior; ScP subcosta posterior.

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**Systematic paleontology**

Class Insecta Linnaeus, 1758

Clade Polyneoptera Martynov, 1938

Order Reculida Handlirsch, 1906

Family Geinitziidae Handlirsch, 1906

Genus *Shurabia* Martynov, 1937

Type species: *Shurabia ovata* Martynov, 1937

Other species included in the genus: *Shurabia aleda* (Wappler, 2001), *Shurabia angustata* Martynov, 1937, *Shurabia anomala* Rasnitsyn, 1982, *Shurabia australis* Rasnitsyn, 1982, *Shurabia bashkuevi* Aristov, 2011, *Shurabia creta* Aristov, 2020, *Shurabia elegans* (Fujiyama, 1973), *Shurabia ferganensis* Rasnitsyn, 1982, *Shurabia grandis* (Huang and Nel, 2008), *Shurabia hissarica* Aristov et al., 2009, *Shurabia inferior* Aristov, 2015, *Shurabia izyumica* Aristov, 2022, *Shurabia kapokkraalensis* (Wappler, 2001), *Shurabia lukashevichae* Aristov, 2011, *Shurabia magna* Rasnitsyn, 1982, *Shurabia minuta* Rasnitsyn, 1982, *Shurabia minutissima* Aristov, 2022, *Shurabia ovata* Martynov, 1937, *Shurabia parvula* Rasnitsyn, 1982, *Shurabia permiana* Aristov, 2013, *Shurabia postiretis* (Huang et al., 1991), *Shurabia serrata* Aristov et al., 2009, *Shurabia sogutensis* Rasnitsyn, 1982, *Shurabia tanga* Aristov, 2018, and *Shurabia taewani* sp. nov.

*Shurabia* ***taewani*** **sp. nov.**

(Figs. 1-2)

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***Etymology***

The specific epithet honors Mr. Kim Taewan, a mentor of (G-SN) and renowned fossil collector in Korea; and is to be treated as a noun in a genitive case.

***Material***

Holotype GNUE112003 (a nearly complete wing, with basal and distal part slightly damaged), housed in the collection of the Gongju National University of Education, Gongju, Republic of Korea.

***Locality, unit and age***

Amisan Formation, Upper Triassic, Myeongcheon Section, Seongju-myeon, Boryeong City, Chungcheongnam-do, Republic of Korea.

***Diagnosis***

Space between each vein relatively broad; costal space broad; ScP ending near wing mid-length, slightly s-shaped; fork of M and fork of R into RA and RP at same level; RP with five branches, not pectinate; MA with four branches (three directed anteriorly), distinct from RP along its entire length; first fork of MA slightly anteriad fork of MP; fork of the anterior branch of MA close to wing apex; MP with two branches; m-cua ('M5') originating from stem of M and ending into CuA; fork of CuA1 located near wing mid-length, space between posterior branch of CuA1 and anterior branch of CuA2 broad; CuA1 with two branches.

***Description***

Macropterous forewing, at least 10 mm long (likely ca. 12-13 mm if fully preserved) and ca. 4.5 mm wide, sides convex; crossveins present between main veins (number impossible to certify because of preservation); ScP short and slightly sigmoidal, with at least 10 branches ending into anterior wing margin; costal space more than twice as broad as subcostal space; R with two distinct branches (i.e., no fusion); RA branches ending into anterior wing margin, first fork of RA located well before first fork of RP, second fork of RA slightly anteriad first

fork of RP; space between RA and RP slightly wider near first fork of RA; RP field nearly twice as broad as RA field; RP branches ending into anterior wing margin, first fork of RP closer to MA that RA; M divided into two distinct branches (i.e., no fusion); MA encompassing wing apex; MA fork located slightly anteriad fork of MP, second fork of MA distad first fork of MP; MP field reduced, nearly half the size of MA field; space between M (or MA) and CuA broad, broader than space between R (RP) and M (MA); m-cua ('M5') vertical; fork of CuA located distad m-cua; CuA1 fork located closer to M fork than to MP fork.

Color: colored stripes along crossveins and main branches (difficult to detail).

Remark: The wing is partly preserved and the breaking point along the posterior margin likely follows the CuP (even if the vein itself is not preserved and therefore not figured on our drawing).

## Discussion

*Systematic placement and discussion on the limit of wing venation characters*

Following the key to grylloblattodean families of Storozhenko (1998), the new specimen keys out in the family Geinitziidae because of its wings fully developed; the vein m-cua developed (i.e., strong and oblique crossvein between M and CuA, so-called 'M5'); ScP with anterior branches, ending into C; MP fully developed but medially desclerotized; RA with anterior branches. Additionally, the diagnostic characters of the forewings, as detailed and translated from Storozhenko (1998), are all present in the new specimen: forewing of medium size, membranous, densely and finely pubescent, with a characteristic pattern of

transverse spots and stripes, more or less clearly attached to the crossveins; apex of the wing broadly rounded; costal field moderately wide, usually crossed by simple branches of ScP; RA branches reaching anterior wing margin; fork of R located anteriad wing mid-length; RP forked with branches in same axis as its stem; M divided into MA and MP, with its fork located anteriad wing mid-length; stem of MP (i.e., before its fork) desclerotized; strong crossvein m-cua (M5) present and originating from M; CuA divided into CuA1 and CuA2, both distinct, with three to five branches directed toward posterior wing margin; CuP simple, feebly sclerotized; area between CuA and CuP slightly widened basally, crossed by several crossveins or two-three rows of cells; anal field small, with two-four simple anal veins; crossveins mostly simple, sometimes (exceptionally) forming two-three rows of cells.

To date the delineation of the grylloblattodean families is unsatisfactory, resulting from the lack of apomorphic characters, incompletely documented intraspecific variability, and homoplasy. Nevertheless, the following genera are currently included or considered to belong to the family Geinitziidae: *Fletchitzia* Riek, 1976, *Geinitzia* Handlirsch, 1906, *Geinitziella* Aristov, 2022, *Permoshurabia* Aristov, 2009, *Permovalia* Aristov, 2015b, *Permuliercula* Aristov, 2020, *Prosepididontus* Handlirsch, 1920, *Sauk* Aristov, 2018 (in Aristov and Sukatcheva, 2018), *Say* Aristov, 2018 (in Aristov and Sukatcheva, 2018), *Shurabia* Martynov, 1937, *Sinosepididontus* Huang and Nel, 2008, *Stegopterum* Sharov, 1961, and *Sukhonia* Aristov, 2013.

Cui et al. (2012: 259) proposed a key to the genera of Geinitziidae, and following the latter the new specimen keys out in the genus *Shurabia* because of the following couplets: M with more than three branches; RA branched; M branching on MA and MP before or near the rise of RP; CuA with three branches; RP irregularly pectinate, forming an anterior or

posterior comb of branches. Aristov (2020) further considered that a vein CuA with four branches is typical for the genus *Geinitzia*, while species of the genus *Shurabia* have a CuA with only three branches. Therefore, affinities with the genus *Shurabia* appear likely, but we prefer to investigate additional differences with the other genera currently placed in the Geinitziidae.

The new specimen differs from the genus *Fletchitzia* because the fork of M is at the same level as the fork of R (vs. fork of M far distad the fork of R in *Fletchitzia*), the fork of CuA1 is located near wing mid-length (vs. distad), CuA is only composed of dichotomous CuA1 and CuA2 (vs. CuA1 with four branches), and the lack of crossveins between subcostal veinlets (vs. present) (Riek, 1976).

The ScP curved and relatively short (vs. straight and long in *Sinosepididontus)*, and the developed RA with three branches reaching the anterior margin of the wing precludes affinities with the genus *Sinosepididontus* that only possesses a simple RA (Huang and Nel, 2008). Note that on the drawing on *S. chifengensis* in Huang and Nel (2008: fig. 2), the CuA2 is in fact the posterior branch of the CuA1, which is dichotomous. Similarly, the CuA3 figured in the original description of *S. chifengensis* is the CuA2. Cui et al. (2012: fig. 6D) interpreted the CuA of *Sinosepididontus* with three branches but it is clearly a misinterpretation of the CuA1, with two branches, and the CuA2 simple.

The genus *Geinitziella* was recently described from the Triassic of Kyrgyzstan and not included in the key of Cui et al. (2012). Aristov (2022) proposed the following diagnosis for the genus (vein nomenclature adapted): ScP slightly S-shaped. RP comb-like anteriorly. CuA1 with three branches, comb-like posteriorly, CuA2 straight. The interradial space is narrowed at its base. The ScP slightly S-shaped is not clearly visible in the photograph or the

drawing proposed to illustrate the genus (Aristov, 2022: fig 1e, pl. 4,4). Aristov (2022: 266) suggested that the main difference between the new genus and *Geinitzia* is the condition of CuA1 (dichotomous in *Geinitzia* vs. with three branches in *Geinitziella*). Because *Shurabia* species have a CuA1 dichotomous (similar condition found in *Geinitzia*), we consider this difference sufficient to preclude affinities of the new fossil with the genus *Geinitziella*.

The configuration of the ScP, i.e., short and slightly s-shaped, differs between the new fossil and *Permoshurabia*. In fact, ScP is nearly straight and not s-shaped in *Permoshurabia* (Aristov, 2009; Lara and Aristov, 2017). Additionally, the new fossil further differs from this genus owing to its RP with five branches (vs. four in *Permoshurabia*).

*Permovalia* was created based on specimens from the Belebeevo Formation of Russia (Aristov, 2015b). The genus is considered to be brachypterous (the new fossil is macropterous) and possesses a MP simple (vs. forked) (Aristov, 2015b: fig. 4). The validity of this genus is to be considered as doubtful given the relatively poor preservation of the type material, but we restrain from proposing any taxonomic changes until additional material is found.

The new fossil differs from *Permuliercula* because of the vein m-cua (M5) connected to CuA (vs. connected to CuA1 in *Permuliercula*). The particular configuration of m-cua found in *Permuliercula* is shared with *Prosepididontus* precluding affinities with the latter genus (Aristov, 2020a). The new specimen further differs from *Permuliercula* because it possesses a vein RA with three branches (vs. two in *Permuliercula*) (Aristov, 2020a: fig. 1h).

The genus *Prosepididontus* was described from the Jurassic of Germany (Handlirsch, 1920; Ansorge and Rasnitsyn, 2000). The new specimen strongly differs from this genus because of its RA with three branches (vs. simple in *Prosepididontus*), RP with five branches

(vs. three), and MA with four branches (vs. two). Note that m-cua is connected to CuA1 in *Prosepididontus*.

The new fossil differs from the genus *Sauk* because its vein ScP ends near wing mid-length (vs. in distal one-third of the wing for the genus *Sauk*), RP starting before wing mid-length (vs. near the middle of the wing), and CuA1 forked (vs. simple) (Aristov and Sukatcheva, 2018).

The genus *Say* is characterized by a vein RA with four branches (vs. three in the new fossil), MA and MP with more than two branches (vs. with two branches), and CuA1 with three branches (vs. with two branches) (Aristov and Sukatcheva, 2018).

The new fossil cannot be attributed to the genus *Stegopterum* because it possesses a forewing without a trace of sculpture (vs. forewing with finely tuberculate sculpture in *Stegopterum*) (Sharov, 1961; Aristov, 2020a). Additionally, most of the *Stegopterum* species have long ScP (i.e., terminating distad wing mid-length), with numerous veinlets while the ScP of the new fossil is comparatively shorter and with fewer veinlets (Sharov, 1961; Aristov, 2020a: fig. 1c, D).

The genus *Sukhonia* strongly differs from the new fossil because of its thin costal space (vs. broad in the new fossil), RP encompassing wing apex (vs. finishing anteriad wing apex along anterior wing margin), basal branch of MA fused with MP (vs. not fused), and CuA1 with three branches (vs. two) (Aristov, 2013: fig. 73g).

The genus *Roemerula* Bode, 1953 was placed in the Geinitziidae by Bode (1953) but this placement has never been revised. The description of the genus *Roemerula* is old and the illustration poor (Bode, 1953: pl. 1, fig. 6). The drawing of the wing of *Roemerula* is not

sufficiently accurate to provide a detailed comparison with the new fossil. However, they clearly differ in the length of the vein ScP (short in the new fossil vs. long in *Roemerula*), the size of the radial field (encompassing about a third of anterior wing margin and distinct from wing apex vs. encompassing wing apex), the patterns of MA and MP (both with two branches vs. MA with three? branches and MP simple), and a different configuration of the cubital field.

Cui et al. (2012) indicated that 'the combination of a branched RA and the presence of only three branches of the CuA in the forewing is characteristic of *Shurabia*'. Therefore, the new fossil is a representative of the genus *Shurabia* because its CuA has three branches.

Therefore, it appears that the new fossil is mostly similar to the genus *Shurabia* because its vein ScP is relatively short, the costal space broad, the RA has three branches, the RP five branches, MA and MP have both two branches, and CuA has three branches. The delineation of genera within the family Geinitziidae seems to be mainly based on the configuration of the RA, RP, CuA (i.e., number of branches), and the position of the forks of main branches. These characters are extremely plastic in Polyneoptera and have to be deeply investigated before to ensure their robustness and their utilization in genus diagnoses. The plasticity of the wing venation of Polyneoptera could be problematic and has to be investigated (see Plecoptera: Béthoux, 2005; Béthoux et al., 2011). It has notably been demonstrated that the position of the connection between MP and CuA is highly variable in species of the order Plecoptera, and it is likely that similar plasticity existed for the 'Grylloblattodea' or the Reculida. With some restrictions linked to this potential variability, but based one the comparison provided before, we place the new fossil in the genus *Shurabia*, which is one of the most speciose genera of the family.

*Differences with other species of the genus Shurabia*

Currently, the genus *Shurabia* encompasses the following species: *S. aleda*, *S. angustata*, *S. anomala*, *S. australis*, *S. bashkuevi*, *S. creta*, *S. elegans*, *S. ferganensis*, *S. grandis*, *S. hissarica*, *S. inferior*, *S. izyumica*, *S. kapokkraalensis*, *S. lukashevichae*, *S. magna*, *S. minuta*, *S. minutissima*, *S. ovata*, *S. parvula*, *S. permiana*, *S. postiretis*, *S. serrata*, *S. sogutensis*, and *S. tanga*.

The new species differs from *S. aleda* because of its MA with at least four branches (vs. two in *S. aleda*), and its CuA1 forked (vs. simple) (Wappler, 2001). The species *S. angustata* differs from the new fossil because its RA has fewer branches (at most two vs. three in the new species), and a different branching pattern of RP (Rasnitsyn, 1982: fig. 1b-e). The new specimen cannot be placed in *S. anomala* because it lacks the presence of numerous crossveins (vs. present in *S. anomala*), the completely different branching pattern of the medial field with MA possessing four branches (vs. apparently simple), MP with two branches (vs. with at least three branches), and the space between CuA1 and CuA2 broad (vs. extremely narrow) (Rasnitsyn, 1982: fig. 4e).

The new specimen does not fit inside *S. australis* because of its wide costal area (vs. thin in *S. australis*), its ScP s-shaped (vs. straight), its RA with three branches (vs. two), RP with five branches (vs. four), MA apparently with four branches (vs. apparently three) (Rasnitsyn, 1982: fig. 4f). Additionally, the space between main branches appears to be larger in the fossil than in *S. australis*, notably between the first abscissa of RP and MA, and between the first abscissa of CuA1 and CuA2. The new specimen clearly differs from *S. bashkuevi* because of its RP with five branches (vs. two in *S. bashkuevi*), MA with four

branches (vs. two), and the wide space between the posterior branch of CuA1 and CuA2 (Aristov, 2011: fig. 2b). The species *S. creta* is the only species of the genus known from the Cretaceous period. The preservation of the type material is not perfect, but this species differs from our new species because its interradial field is not widened (vs. widened in *Shurabia taewani* sp. nov.), RP with two(?) (vs. five), MA pectinate backward (vs. encompassing wing apex) (Aristov, 2020b). The temporal range of the two species (Cretaceous vs. Late Triassic) is another argument supporting their placement into two different species. The new specimen differs from *S. elegans* because of its short ScP (vs. long in *S. elegans*), its RA with three branches (vs. four), MP with two branches (vs. three), and the forks of R and M nearly aligned (vs. fork of R clearly distad fork M) (Fujiyama, 1973: fig. 16).

*Shurabia ferganensis* has a long ScP (vs. short in *Shurabia taewani* sp. nov.), a comparatively thin costal space (vs. broad) the fork of R clearly distad fork M (vs. nearly aligned), MA branches mostly directed toward the posterior wing margin (vs. anterior wing margin and apex) (Rasnitsyn, 1982: fig. 4a-d). The new species differs from *S. grandis* because of its ScP short (vs. long), its RP with five branches (vs. three?), and the fork of R nearly aligned with the fork of M (vs. fork of R clearly distad the fork of M) (Huang and Nel, 2008: fig. 3). The new species differs from *S. hissarica* because of its RP with five branches (vs. three in *S. hissarica*), its MA with four branches (vs. two) (Aristov et al., 2009). The new species differs from *S. inferior* because its RA has three branches (vs. two in *S. inferior*), its RP with five branches (vs. three and of different shape), and its MA with four branches (vs. simple) (Aristov, 2015b: fig. 3d).

The new species differs from *S. izyumica* by its smaller size (forewing 12-13 mm vs. 16 mm) (Aristov, 2022: fig. 1d), the fork of the anterior branch of MA is much more distal

than that of the posterior one (vs. nearly aligned), the fork of MP is distad that of MA (vs. anteriad in *S. izyumica*), the forking of RP not anteriorly pectinate (vs. anteriorly pectinate). The new species differs from *S. kapokkraalensis* because all its costal veinlets are simple (vs. sometimes forked), its RA is simpler (three vs. six? branches in *S. kapokkraalensis*), its RP with five branches (vs. three), the fork of MA anteriad the fork of MP (vs. distad MP), MP with two branches (vs. three) (Wappler, 2001). Affinities with *S. lukashevichae* are excluded because the new species has a RP with five branches (vs. three), the fork of MA slightly anteriad the fork of MP (vs. distad), MA with four branches (vs. apparently with fewer branches) (Aristov, 2011).

The new species differs from *S. magna* because of its smaller size (forewing length 12-13 mm vs. 22-27 mm in *S. magna*), its RP has five branches (vs. at most four), and the fork of MA is anteriad fork of MP (vs. distad) (Rasnitsyn, 1982: fig. 1f,g). The new species differs from *S. minuta* because its costal field is broad (vs. thin in *S. minuta*), its ScP is comparatively short and s-shaped (vs. long and straight), its RP has five branches (vs. four), the fork of MA anteriad the fork of MP (vs. far distad), and its MA has four branches (vs. three) (Rasnitsyn, 1982: fig. 3a). The new species differs from S. minutissima, at least, because of its larger size (ca. 12-13 mm vs. 5 mm in S. minutissima), its broad costal area (vs. thin), its RP with five branches (vs. two?), and its MA with four branches (vs. apparently simple) (Aristov, 2022).

The ovoid wings of *S. ovata* preclude affinities with the new species (Martynov, 1937: fig. 34). The new species further differs from *S. ovata* because its ScP is comparatively short (vs. long in *S. ovata*), its RA has three branches (vs. two), its RP five (vs. three), the fork of R and the fork of M nearly aligned (vs. fork of R far distad fork of M), its MA with four

branches (vs. two), and the fork of MA slightly anteriad the fork of MP (vs. fork of MA distad fork of MP) (Martynov, 1937: fig. 34). The new species differs from S. parvula, at least, because its RP has five branches (vs. three in *S. parvula*), and its MA has four branches (vs. two) (Rasnitsyn, 1982: fig. 2a,d).

The new species differs from *S. permiana* because of it short and s-shaped ScP (vs. straight and long in *S. permiana*), RA with three branches (vs. often more), its fork of R and M nearly aligned (vs. fork of M strongly anteriad fork of R), its MA with four branches (vs. at most three), its fork of MA anteriad fork of MP (vs. distad fork of MP) (Aristov, 2013: fig. 73). The species *S. postiretis* possesses a thin costal space (vs. broad in the new species), a pectinate RP directed toward the anterior margin of the wing (vs. not pectinate), and a fork of MA distad the fork of MP (vs. slightly anteriad) (Huang et al., 1991: fig. 4). The new species differs from *S. serrata* because its RA has three branches (vs. two), its RP is not pectinate (vs. pectinate), its MA with a different branching pattern, and more space between main branches (Aristov et al., 2009: fig. 1f). The apex of the veins RA and RP of the holotype specimen of *S. sogutensis* are not preserved but the paratype specimen provides important information on this part of the wing (Rasnitsyn, 1982: fig. 1h,i). The RP of *S. sogutensis* have three branches (vs. five in the new species), MA seems to possess at most three branches (vs. four), and the fork of MA is distad the fork of MP (vs. anteriad the fork of MP) (Rasnitsyn, 1982: fig. 1h,i).

Finally, the new species differs from the species *S. tanga* because it lacks the distinctive feature of the latter species i.e., a long s-shaped crossvein in the interradial field (Aristov, 2018: fig. 1d). Both species further differ because the MA is directed toward posterior wing margin in *S. tanga* while directed toward the anterior margin in the new species.

The temporal ranges of these species are also potential arguments to preclude affinities between each other. For example, it is expected that Cretaceous species or Jurassic species would greatly differ from the Permian ones, an argument already proposed by Rasnitsyn (1982). This assumption stems from the longevity of fossil species that is often a few million years (sometimes more), and suggesting a 'cyclic decline' of species through time. Additionally, even if the similarity of the wing venation is the main criterion to discriminate *Shurabia* species, it is also expected that the other parts of the body may have differed between species (e.g., genitalia). Therefore, superficial wing venation similarities cannot be considered unalterable arguments to group specimens from different geographical areas or temporal periods. Biogeographical constraints such as insularism, or the presence of mountains may result in allopatric speciation not necessarily detectible on from wing venation alone.

## Conclusion

The description of *Shurabia taewani* sp. nov. serves to increase the diversity of Geinitziidae documented from Asia during the Triassic period and adds to the morphological diversity of the genus *Shurabia* of this period. Similarly, it extends the distribution of the genus already known from the Triassic of Australia, Japan, Kyrgyzstan, South Africa and Ukraine.

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## Disclosure statement

The authors declare that they have no known competing interests or personal relationships that could have appeared to influence the work reported in this paper.

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Table 1: Species diversity of the genus *Shurabia.*

Table 1: Diversité spécifique du genre *Shurabia.*

| Species | Locality | Age | Formation | Country | Reference |
|---|---|---|---|---|---|
| *Shurabia aleda* (Wappler 2001) | Nuwejaarspruit (Nuw 111) | Carnian | Molteno Formation | South Africa | Wappler, 2001 |
| *Shurabia angustata* Martynov, 1937 | Shurab II, Ditch 63(8) | Toarcian | Sulyukta Formation | Kyrgyzstan | Martynov, 1937 |
| *Shurabia anomala* Rasnitsyn, 1982 | Madygen, Dzhailoucho area | Ladinian | Madygen Formation | Kyrgyzstan | Rasnitsyn, 1982 |
| *Shurabia australis* Rasnitsyn, 1982 | Mount Crosby Insect Bed | Norian | — | Australia | Rasnitsyn, 1982 |
| *Shurabia bashkuevi* Aristov, 2011 | Lower Lyulyuikta-1 | Changhsingian | Khungtukun Formation | Russia | Aristov, 2011 |
| *Shurabia creta* Aristov, 2020 | Khasurty | Aptian | — | Russia | Aristov, 2020b |
| *Shurabia elegans* (Fujiyama, 1973) | Hazegatani coal mine, Omine | Carnian | Momonoki Formation | Japan | Fujiyama, 1973 |
| *Shurabia ferganensis* Rasnitsyn, 1982 | Madygen, Dzhailoucho area | Ladinian | Madygen Formation | Russia | Rasnitsyn, 1982 |
| *Shurabia grandis* (Huang & Nel, 2008) | Daohugou | Callovian/Oxfordian | Daohugou Formation | China | Huang and Nel, 2008 |
| *Shurabia hissarica* Aristov et al., 2009 | Kugitang | Callovian/Oxfordian | — | Tajikistan | Aristov et al., 2009 |
| *Shurabia inferior* Aristov, 2015 | Soyana | Roadian | Iva-Gora Beds Formation | Russia | Aristov, 2015b |
| *Shurabia izyumica* Aristov, 2022 | Garazhovka | Norian | Protopivka Formation | Ukraine | Aristov, 2022 |
| *Shurabia kapokkraalensis* (Wappler, 2001) | Kap 111, Kapokkraal | Carnian | Molteno Formation | South Africa | Wappler, 2001 |
| *Shurabia lukashevichae* Aristov, 2011 | Lower Lyulyuikta-1 | Changhsingian | Khungtukun Formation | Russia | Aristov, 2011 |
| *Shurabia magna* Rasnitsyn, 1982 | Sai-Sagul, Shurab III | Toarcian | Sagul Formation | Kyrgyzstan | Rasnitsyn, 1982 |
| *Shurabia minuta* Rasnitsyn, 1982 | Madygen, Dzhailoucho area | Ladinian | Madygen Formation | Kyrgyzstan | Rasnitsyn, 1982 |
| *Shurabia minutissima* Aristov, 2022 | Madygen, Dzhailoucho area | Ladinian | Madygen Formation | Kyrgyzstan | Aristov, 2022 |
| *Shurabia ovata* Martynov, 1937 | Shurab II, Ditch 63(8) | Toarcian | Sulyukta Formation | Kyrgyzstan | Martynov, 1937 |
| *Shurabia parvula* Rasnitsyn, 1982 | Ust-Baley | Toarcian | Cheremkhovskaya Formation | Russia | Rasnitsyn, 1982 |
| *Shurabia permiana* Aristov, 2013 | Isady | Wuchiapingian | Poldarsa Formation | Russia | Aristov, 2013 |
| *Shurabia postiretis* (Huang et al., 1991) | Meixi, Yiyang County | Sinemurian | Menkoushan Formation | China | Huang et al., 1991 |
| *Shurabia serrata* Aristov et al., 2009 | Madygen, Dzhailoucho area | Ladinian | Madygen Formation | Kyrgyzstan | Aristov et al., 2009 |
| *Shurabia sogutensis* Rasnitsyn, 1982 | Sogyuty | Sinemurian | Dzhil Formation | Kyrgyzstan | Rasnitsyn, 1982 |
| *Shurabia tanga* Aristov, 2018 | Sauk-Tanga | Toarcian/Aalenian | — | Kyrgyzstan | Aristov and Sukatcheva, 201 |
| *Shurabia taewani* sp. nov. | Myeongcheon Section | Late Triassic | Amisan Formation | South Korea | This study |

Figure 1. *Shurabia taewani* sp. nov., holotype GNUE112003. Photographs with different colorations. **A**, Normal; **B**, Enhanced with Photoshop; **C**, Contrast of coloration patterns exaggerated. Scale bars = 2 mm.

Figure 1. *Shurabia taewani* sp. nov., holotype GNUE112003. Photographies avec différentes colorations. **A**, Normale; **B**, Améliorée avec Photoshop; **C**, Constraste du motif de coloration accentué. Barre d'échelle = 2 mm.

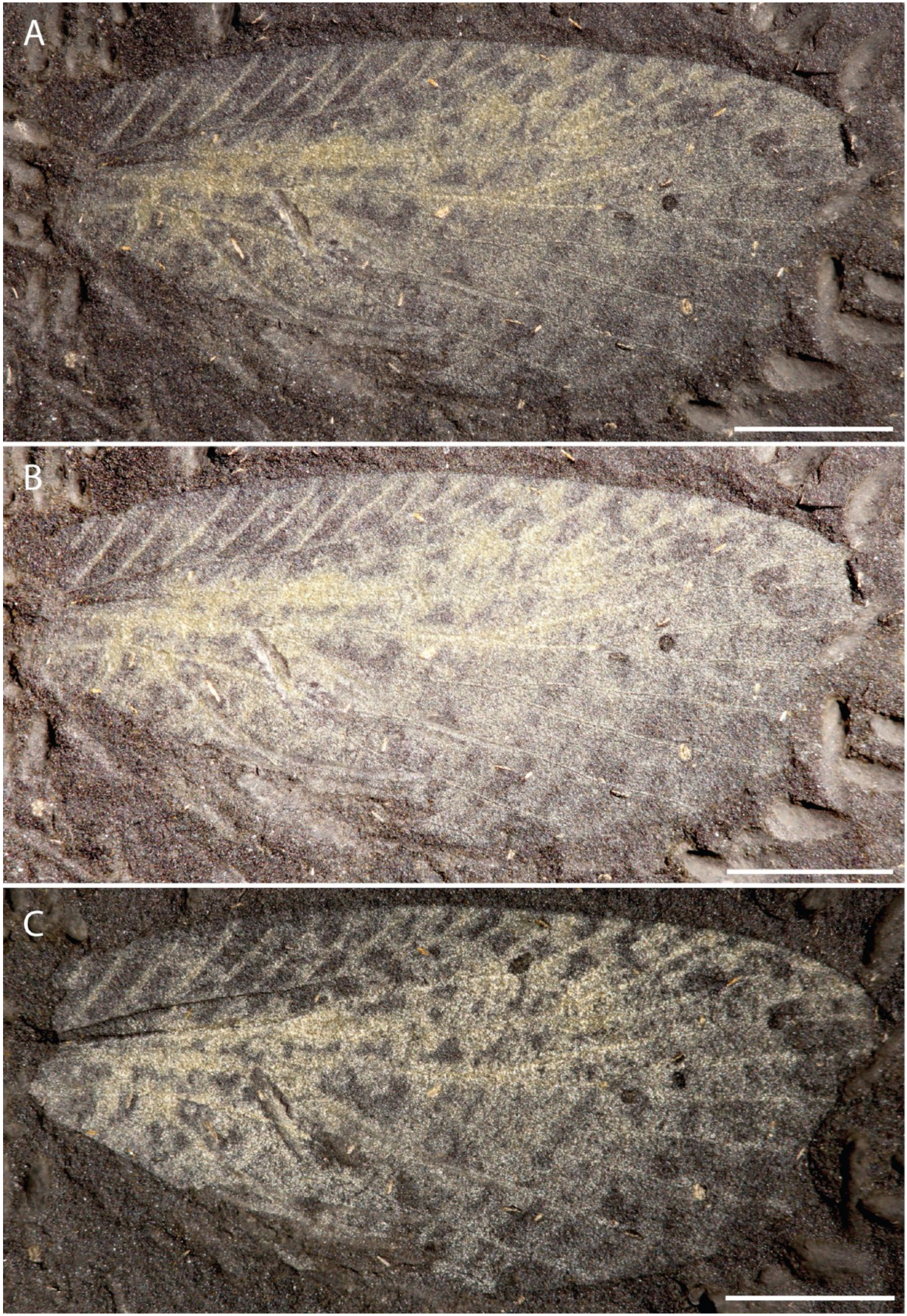
A
B
C

Figure 2. *Shurabia taewani* sp. nov., holotype GNUE112003. Interpretative line drawing of forewing venation with names of main veins labeled. Scale bar = 2 mm.

Figure 2. *Shurabia taewani* sp. nov., holotype GNUE112003. Dessin interprétatif de la nervation de l'aile antérieure avec indications des noms des nervures principales. Barre d'échelle = 2 mm.