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Supplementary Materials for

Fossil scales illuminate the early evolution of lepidopterans and structural colors

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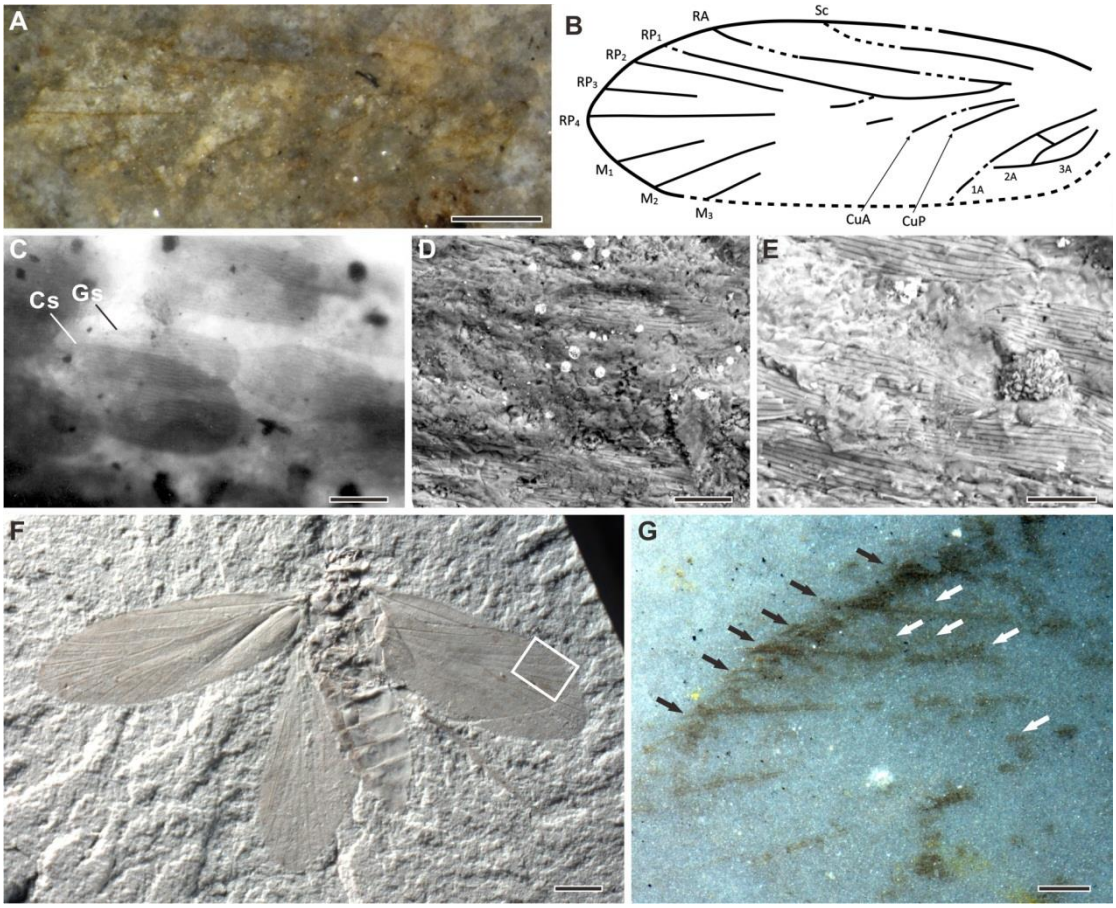

fig. S1. Jurassic Lepidoptera from United Kingdom and China. (**A** to **E**) *Archaeolepis mane* from the Lower Jurassic of Dorset in England, NHMUK In. 59397. (A and B) Image and line drawing. A, anal vein; M, median vein; CuA, anterior cubital vein; CuP, posterior cubital vein; Sc, subcostal vein; RA, anterior radial vein; RP, posterior radial vein. (C) Wing scales, under ultra-violet light. Cs, cover scale; Gs, ground scale. (D and E) Wing scales, SEM images. (**F** and **G**) *Mesokristensenia sinica* from the Middle Jurassic of Daohugou in China, NIGP150462. (G) Enlargement of wing tip in (F) (mirrored, under alcohol); note the faint trace of margin scales (black arrows) and cover scales (white arrows). Scale bars, 1 mm (A and F),0.2 mm (G) and 20 μm (C to E).

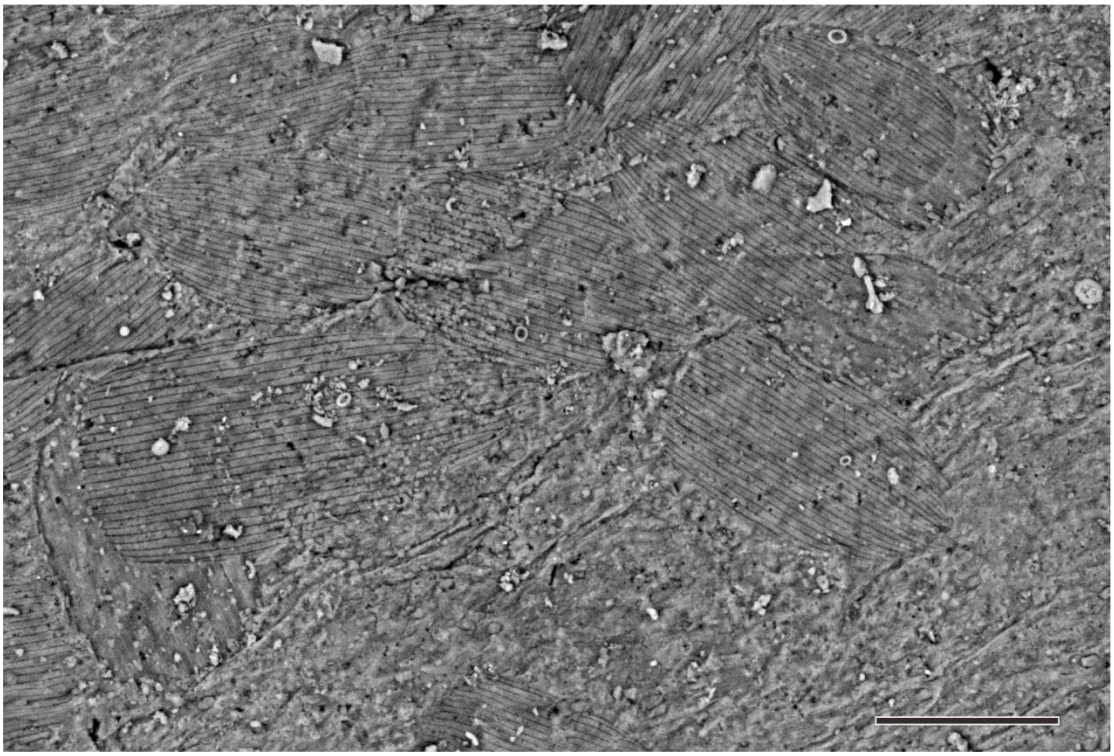

fig. S2. SEM image of forewing scales on Kazakhstan specimen PIN2239/607.

Scale 50 μm.

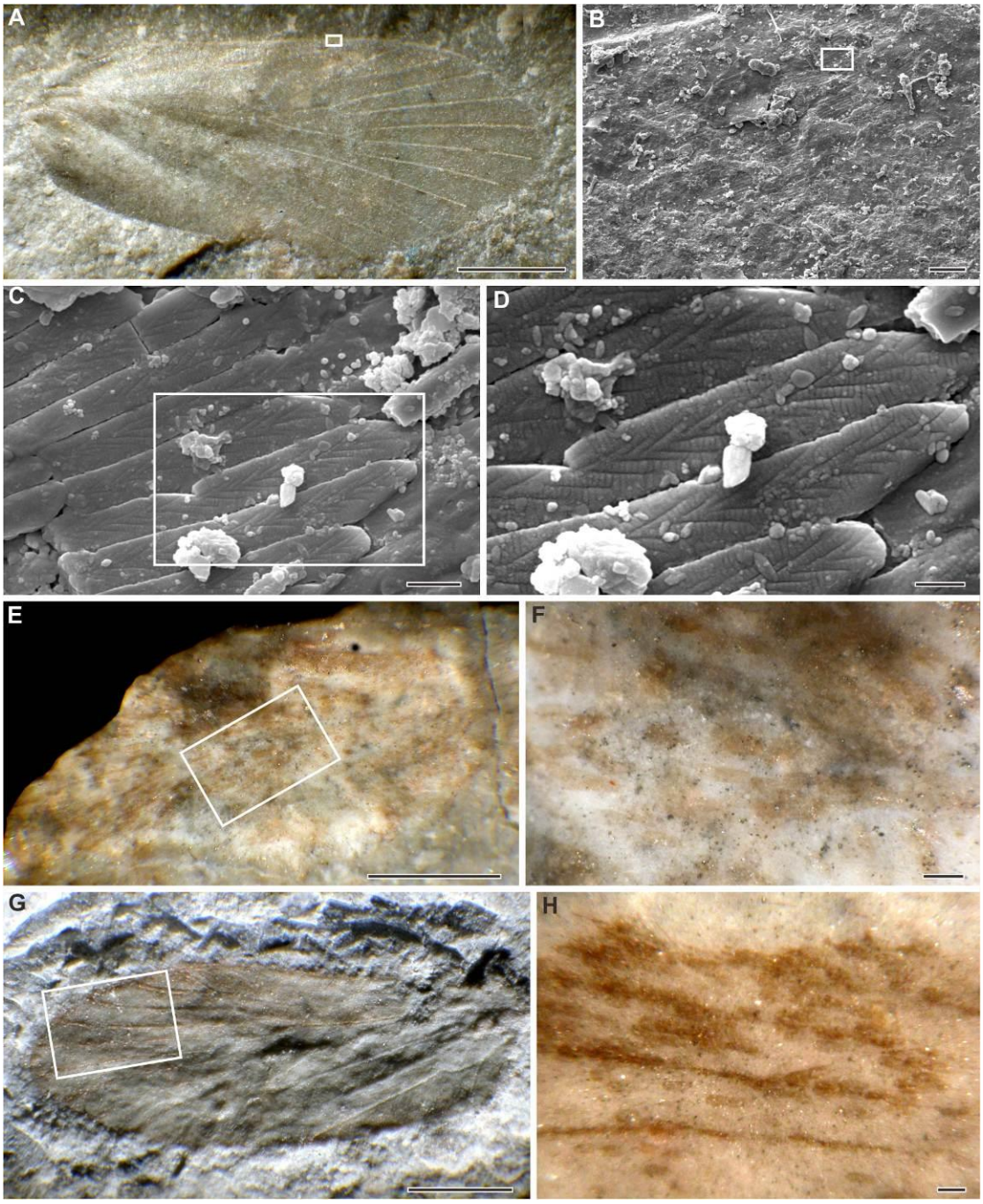

fig. S3. Jurassic Lepidoptera from Germany. (**A**–**D**) LGA1500. (B) Enlargement of forewing in (A), SEM image. (C) Enlargement of wing scale in (B), SEM image. (D) Enlargement of wing scale in (C), SEM image. (**E** and **F**) LGA968. (F) Enlargement of forewing in (E). (**G** and **H**) LGA2150. (H) Enlargement of forewing in (G). Scale bars, 1 mm (A, E, and G), 0.2 mm (F and H), 20 μm (B), 2 μm (C) and 1 μm (D).

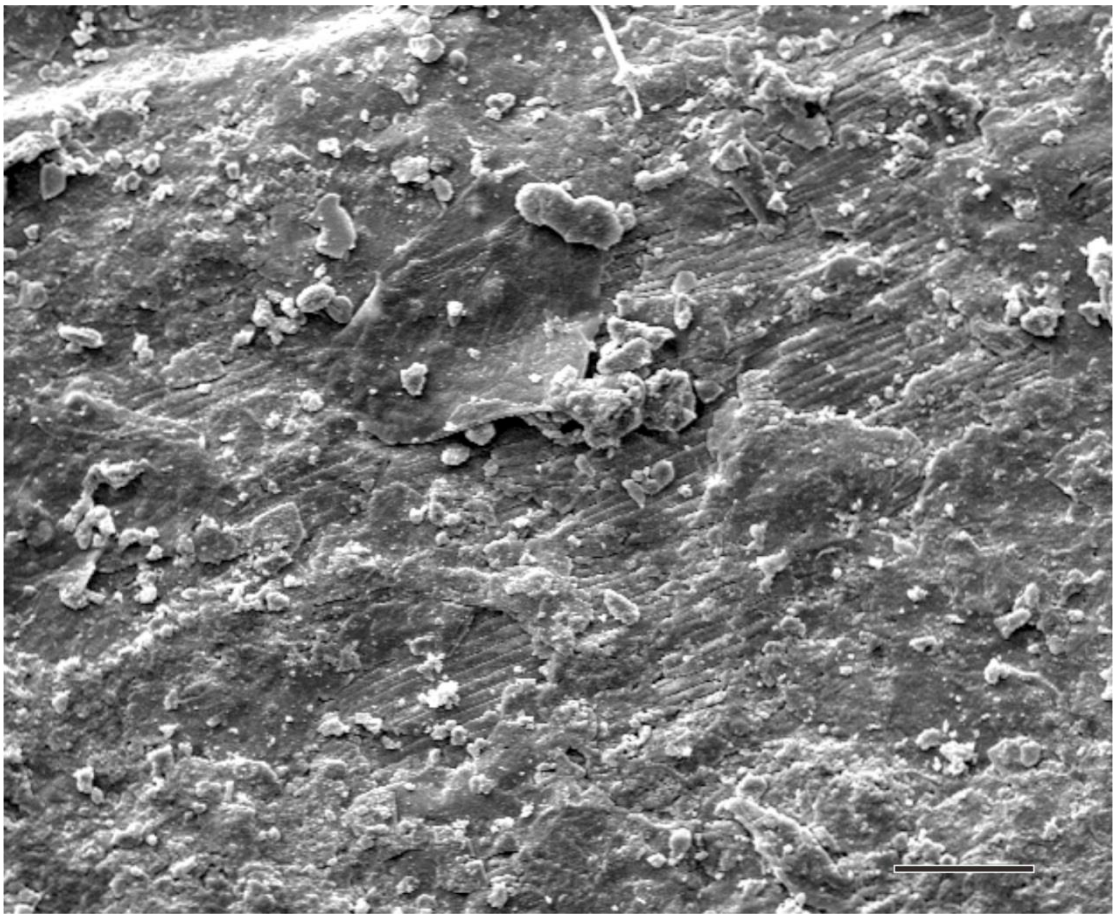

fig. S4. SEM image of forewing scales on Grimmen specimen LGA1500. Scale 20 μm.

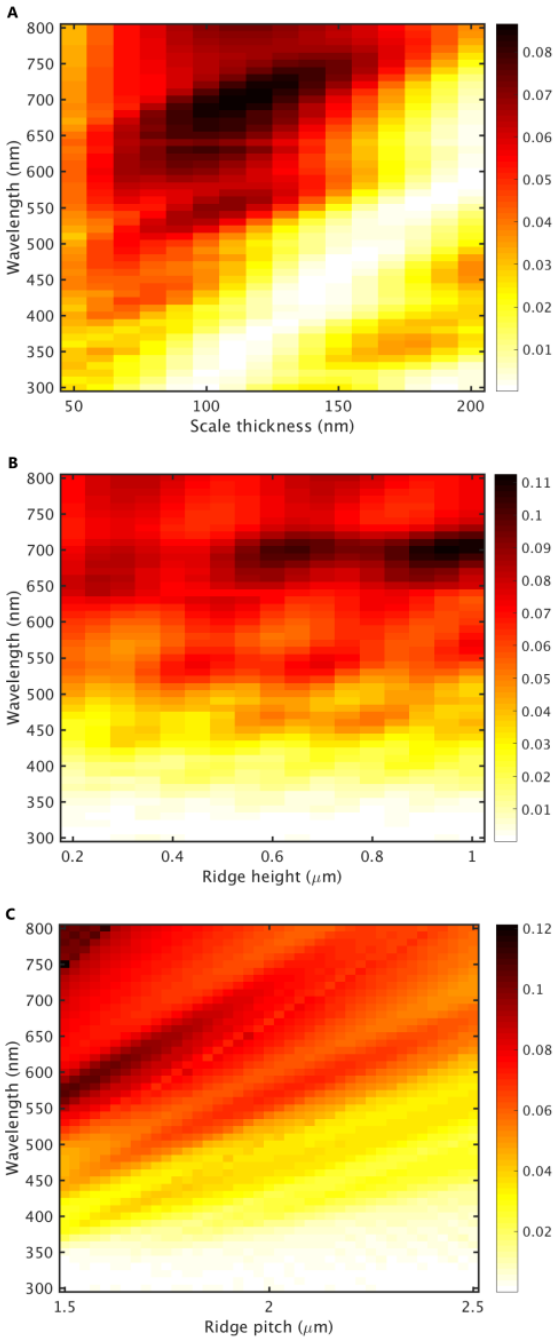

fig. S5. Reflectance color maps. Reflectance color maps showing the unpolarized zeroth-order reflectance (i.e. the solid black plot in Fig. 5B) as a function of: (**A**) Scale thickness; (**B**) Primary ridge height; (**C**) Primary ridge pitch. The varied structural parameters are labeled in the model schematic (Fig. 5A). The shift of spectral features in response to varying structural parameters can be tracked. The numeric values of the color bars correspond to the reflected intensity.

fig. S6. Structural color of extant Micropterigidae. (**A**) *Micropterix aruncella*, female (above) and male (below). (**B**) *M. calthella*, female (above) and male (below). Scale bars, 1 mm.