

# Fossil Fruits of the London Clay: A New Insight from X-Ray Analysis

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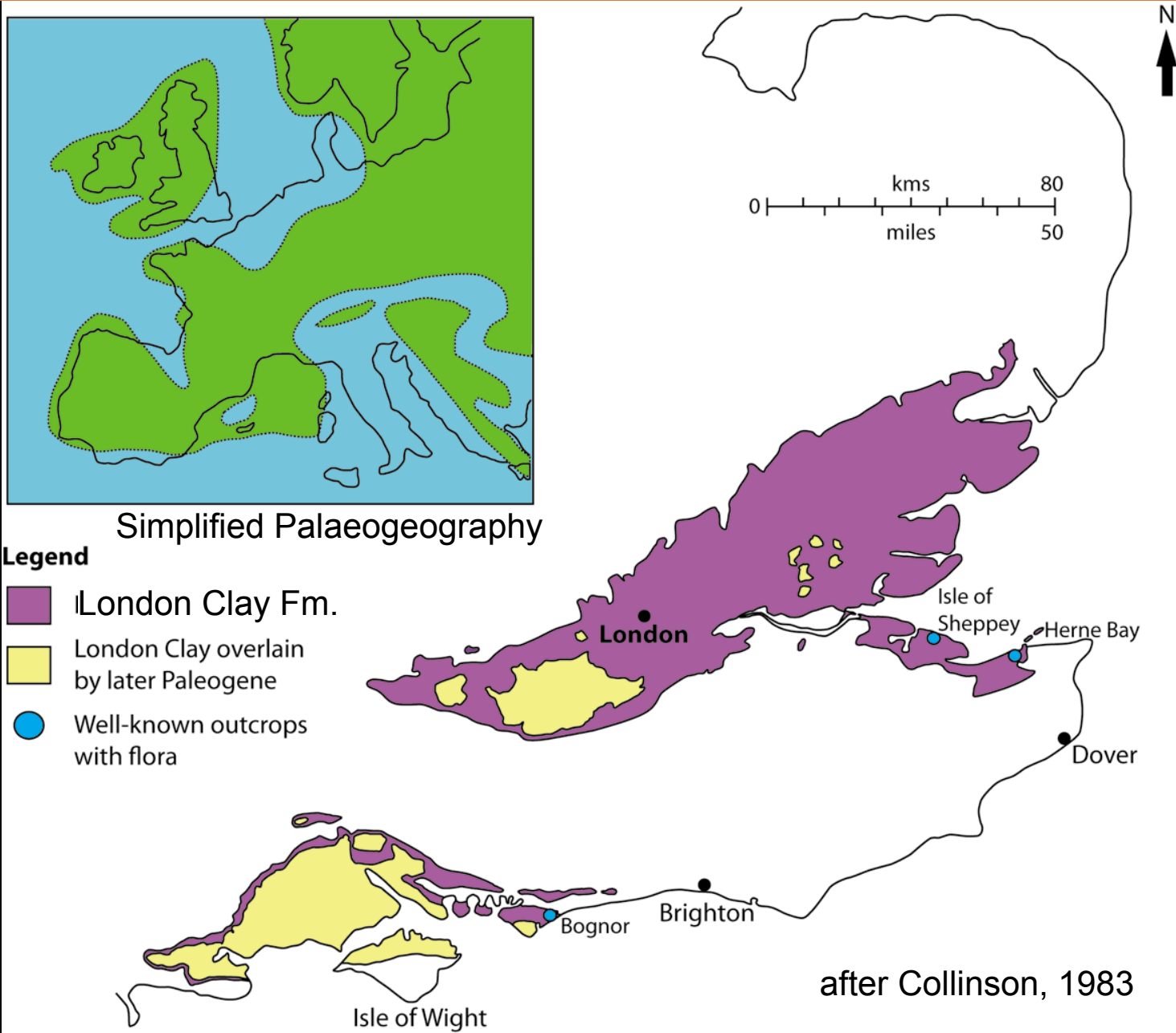


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## 1. Significance of the Flora

The London Clay Formation has yielded one of the most diverse floral assemblages from the Early Eocene (52-49Ma), with over 300 species, and has become a global benchmark for the vegetation of the Early Eocene Climatic Optimum (EECO).

Here we focus on the Anacardiaceae (the cashew family) and Icacinaceae (mainly lianas), which are typical examples of tropical families in this flora.



## 2. Why Study London Clay Holotypes using X-Rays?

Traditional destructive sectioning is inappropriate for holotypes.  $\mu$ CT can generate a high-resolution, 3D dataset non-destructively, without having to remove the specimen from the silicone oil, in which it is stored in to retard pyrite decay.  $\mu$ CT enables previously unseen internal organization to be visualized to investigate the diversity of tropical species and to resolve relationships with modern tropical taxa.

### $\mu$ CT Methodology

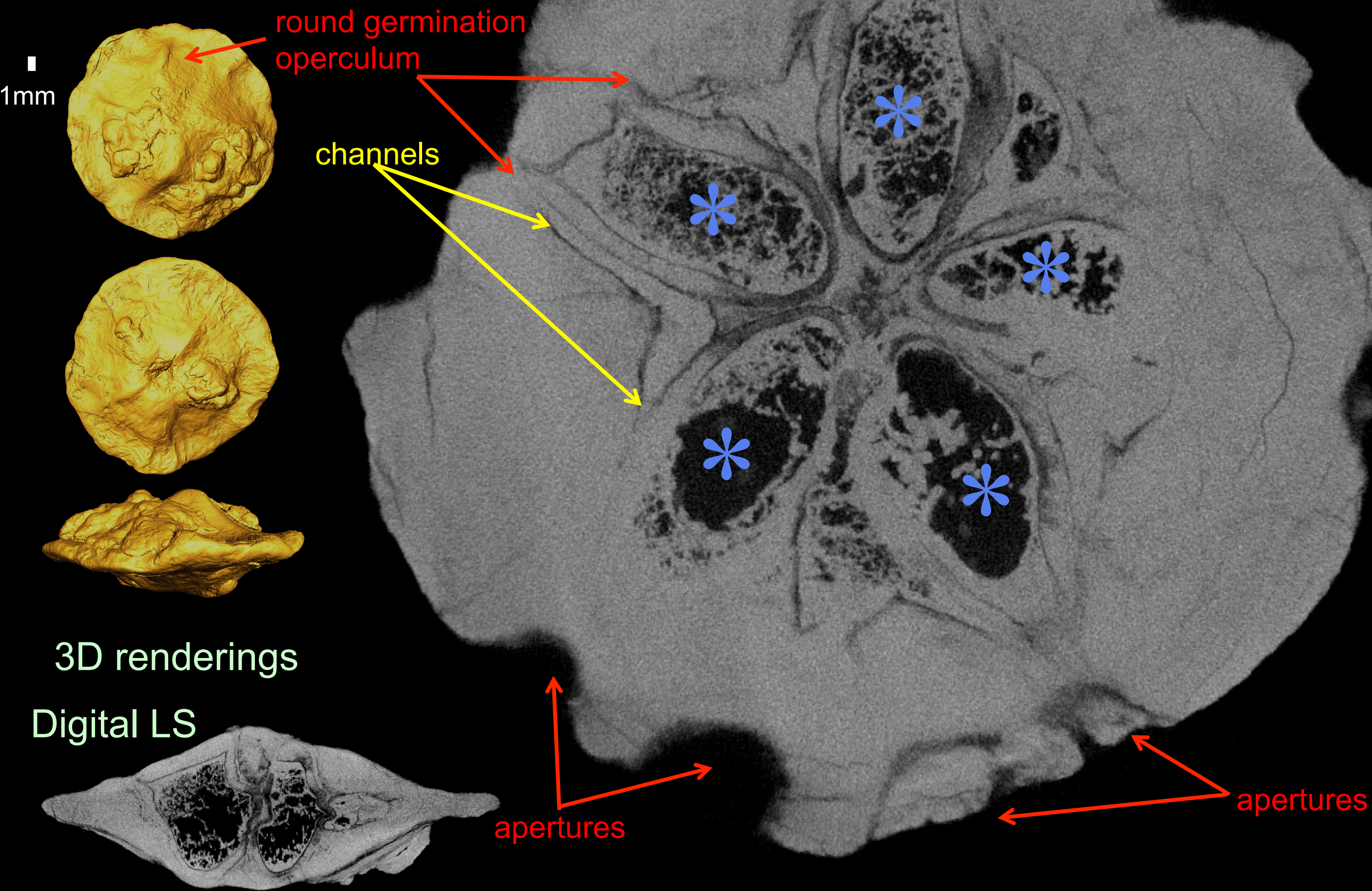
4 species of Anacardiaceae and 16 of Icacinaceae were scanned by the Nikon Metrology HMX ST 225  $\mu$ CT system at the Natural History Museum, London. Scans were single stacks using 220kV voltage, a current of 200 $\mu$ A, a tungsten reflection target and a copper filter, with an exposure time of 708ms and a resultant voxel size of 7-13 $\mu$ m. 3D datasets were reconstructed using CT Pro (Nikon Metrology, Tring, UK), and images/movies were captured, using the software package Avizo (FEI VSG, Bordeaux, France).

## 3. Key Characters of Holotypes Revealed by $\mu$ CT – Anacardiaceae

*Pseudosclerocarya subalata*

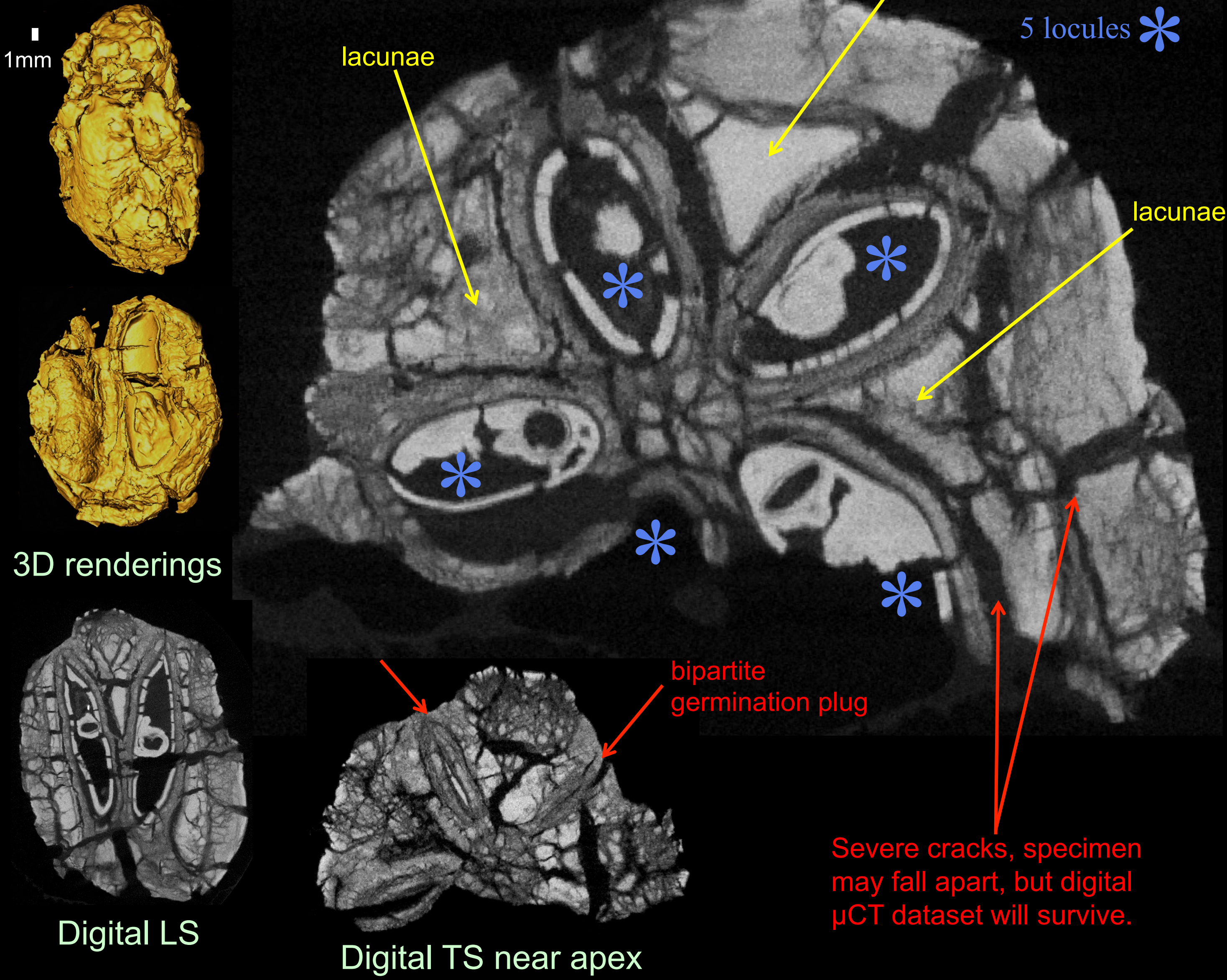
Holotype V22553

New  $\mu$ CT data suggest affinity with extant *Dracontomelon*



*Choerospondias sheppeyensis*

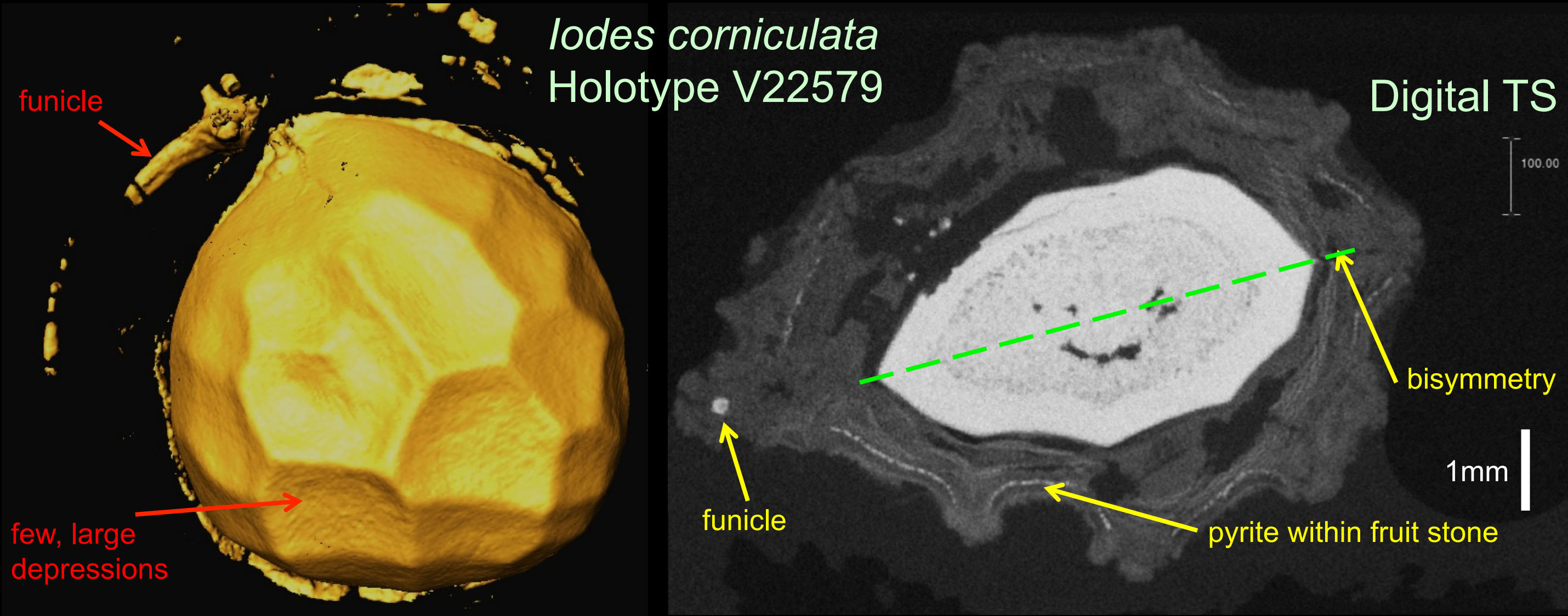
V30103



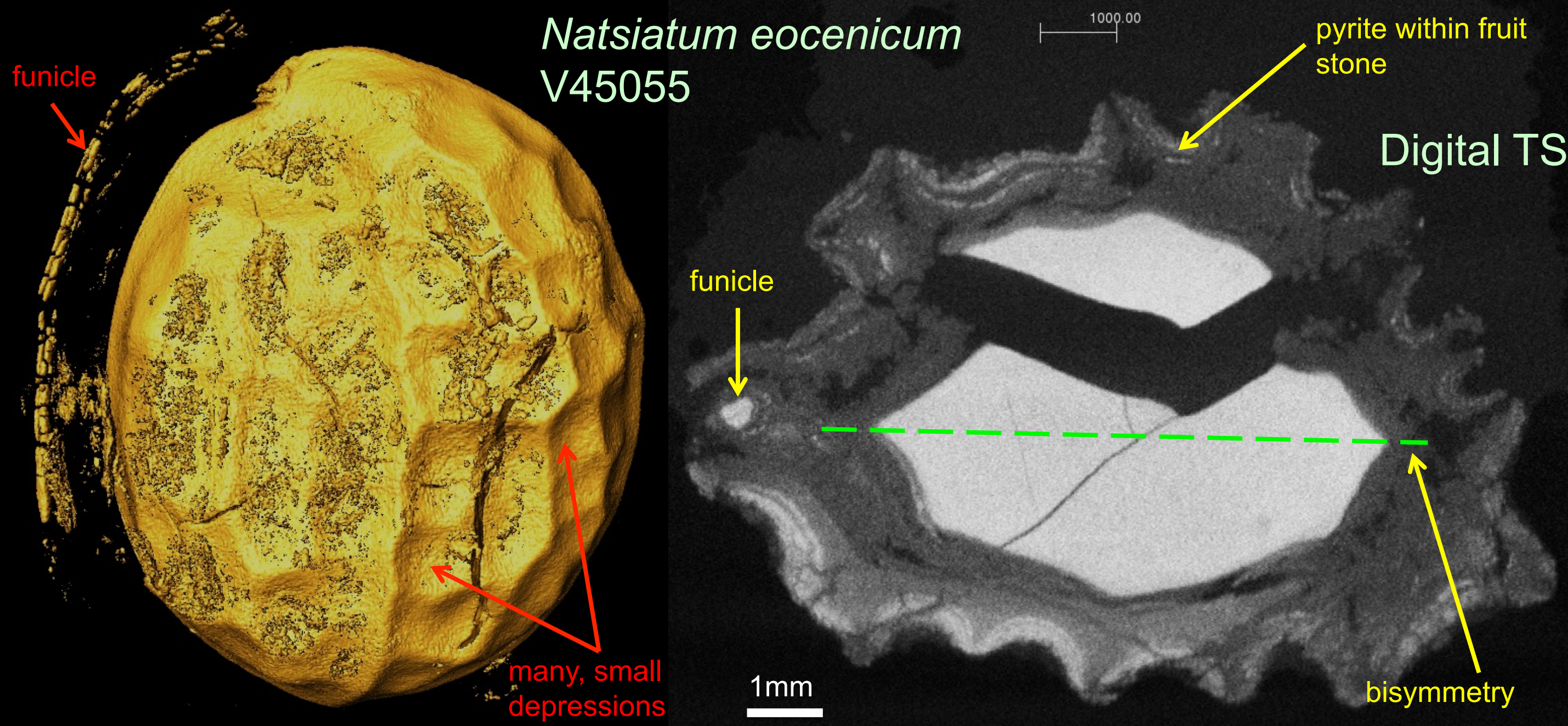
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## 4. Key Characters of Holotypes Revealed by $\mu$ CT – Icacinaceae

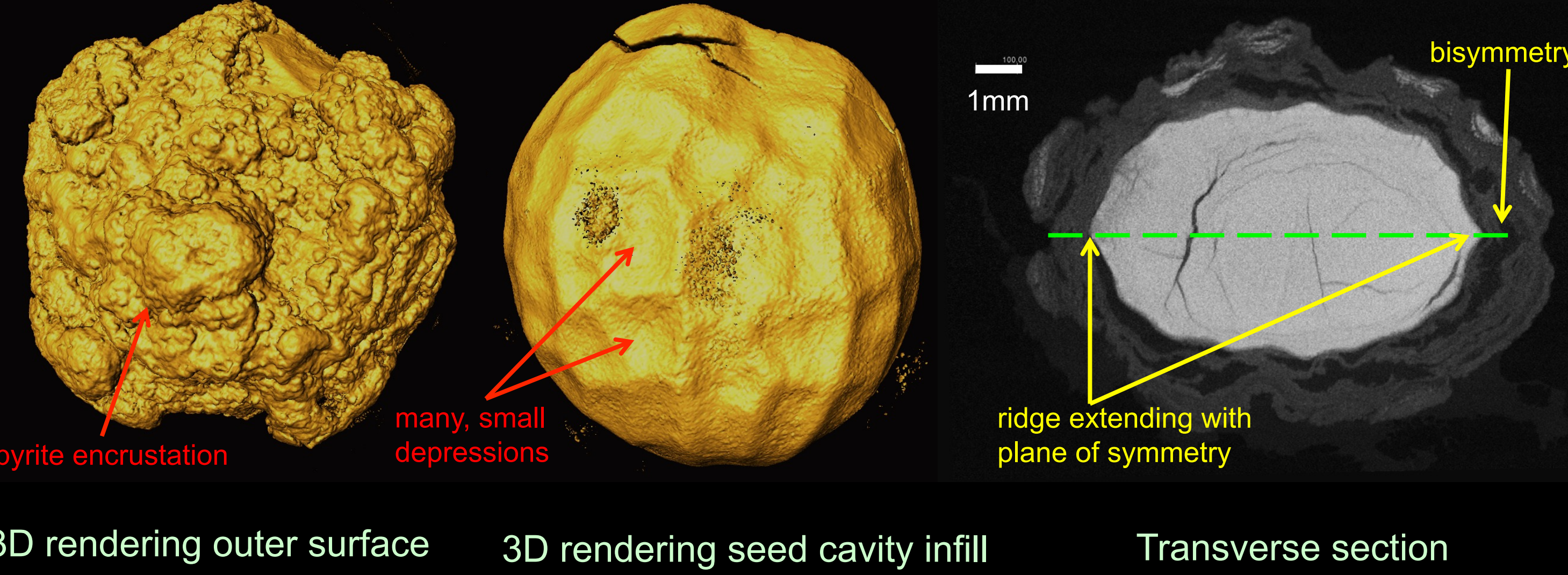


The *Iodes corniculata* holotype shows a funicle in the fruit stone wall. This feature is diagnostic of the modern genus *Iodes*, and therefore its presence in the fossil confirms the taxonomic placement of the fossil in this modern genus. Today, *Iodes* is confined to tropical rainforests of Africa, Madagascar, and Southeast Asia. The presence of this genus in London Clay flora is therefore of considerable biogeographic and ecological significance.



The *Natsiatum eocenicum* holotype shows a funicle in the fruit stone wall, which is lacking in modern *Natsiatum* but is diagnostic of modern *Iodes* (Manchester, 1999). This could suggest an incorrect original taxonomic assignment, which was based solely on the outer features that could be identified by light microscopy (Reid & Chandler, 1933; Chandler, 1964). *Natsiatum eocenicum* may actually belong in the genus *Iodes* based on this characteristic.

*Iodes multireticulata* Holotype V22589



Heavy pyrite encrustation on the outer surface obscures key characters. Digital rendering of the seed cavity infill shows a unilocular fruit with bilateral symmetry and a ridge extending in the plane of symmetry around the surface – all characteristic of Icacinaceae (Pigg *et al.*, 2008). However, the absence of the funicle may indicate that this does not belong in *Iodes*. Further study of the CT-scans might allow us to determine its correct taxonomic position.

## 5. Conclusions

- Key internal characteristics were visualized for the first time in these holotypes.
- Digital extraction of seed cavity infills has revealed key taxonomic characters in encrusted specimens.
- Affinities with modern tropical families are confirmed, but generic assignments are questioned for some fossils.
- Taxonomic & nomenclatural revision may be necessary for the genera *Iodes*, *Natsiatum* and *Pseudosclerocarya*.
- $\mu$ CT has provided a permanent record of damaged specimens, which may subsequently fall apart.  $\mu$ CT records can be used to monitor any future changes.

## References

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