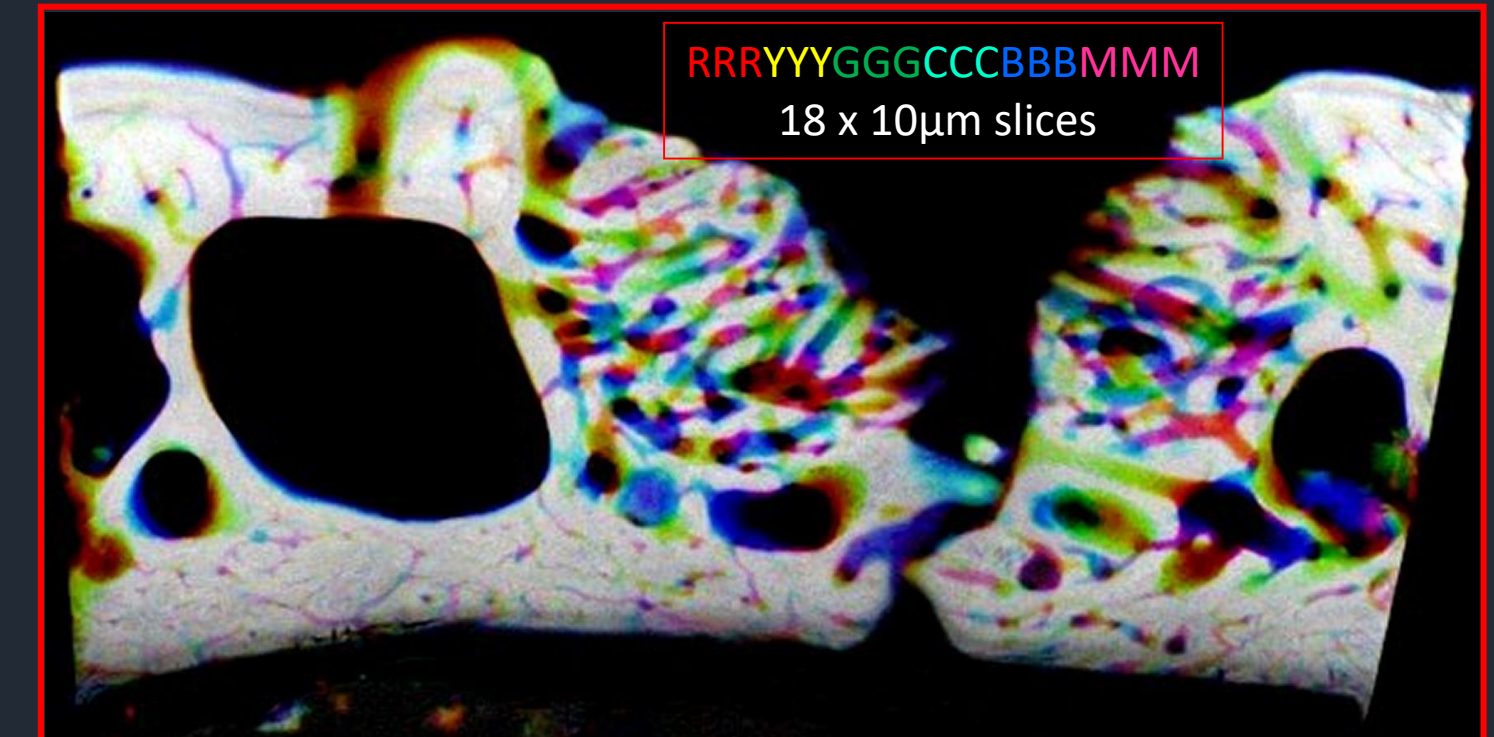
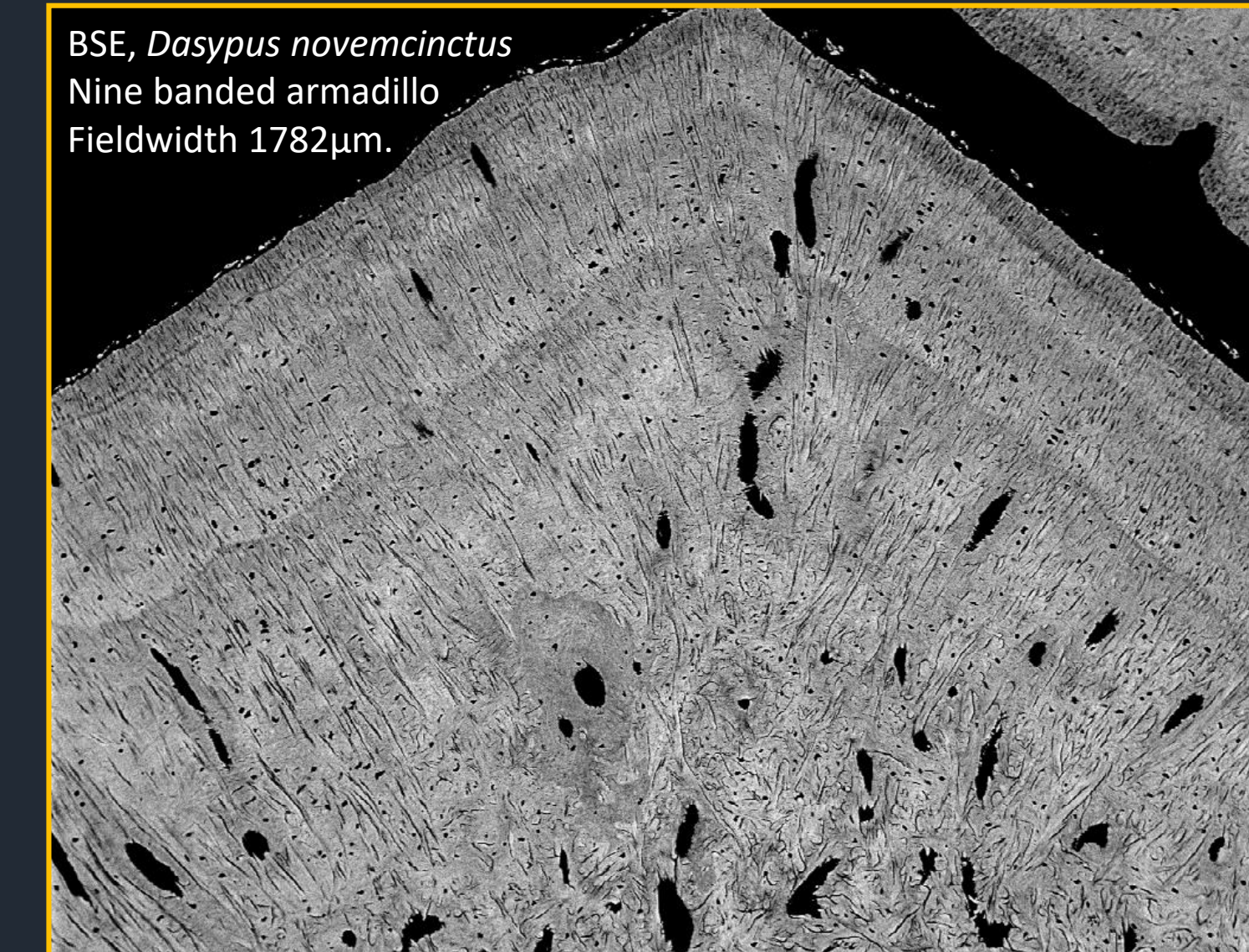
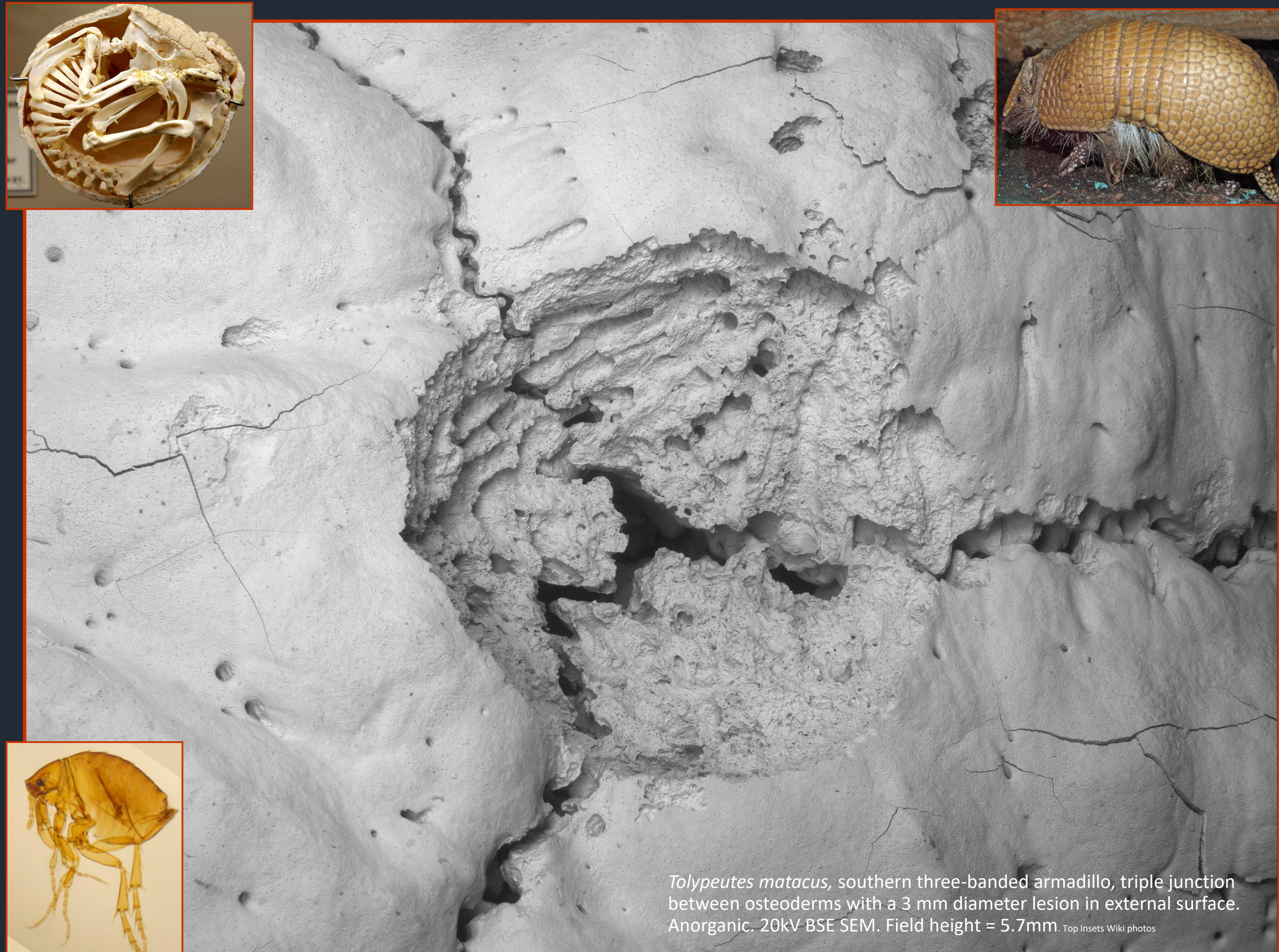


# Fleas and bites in bones.

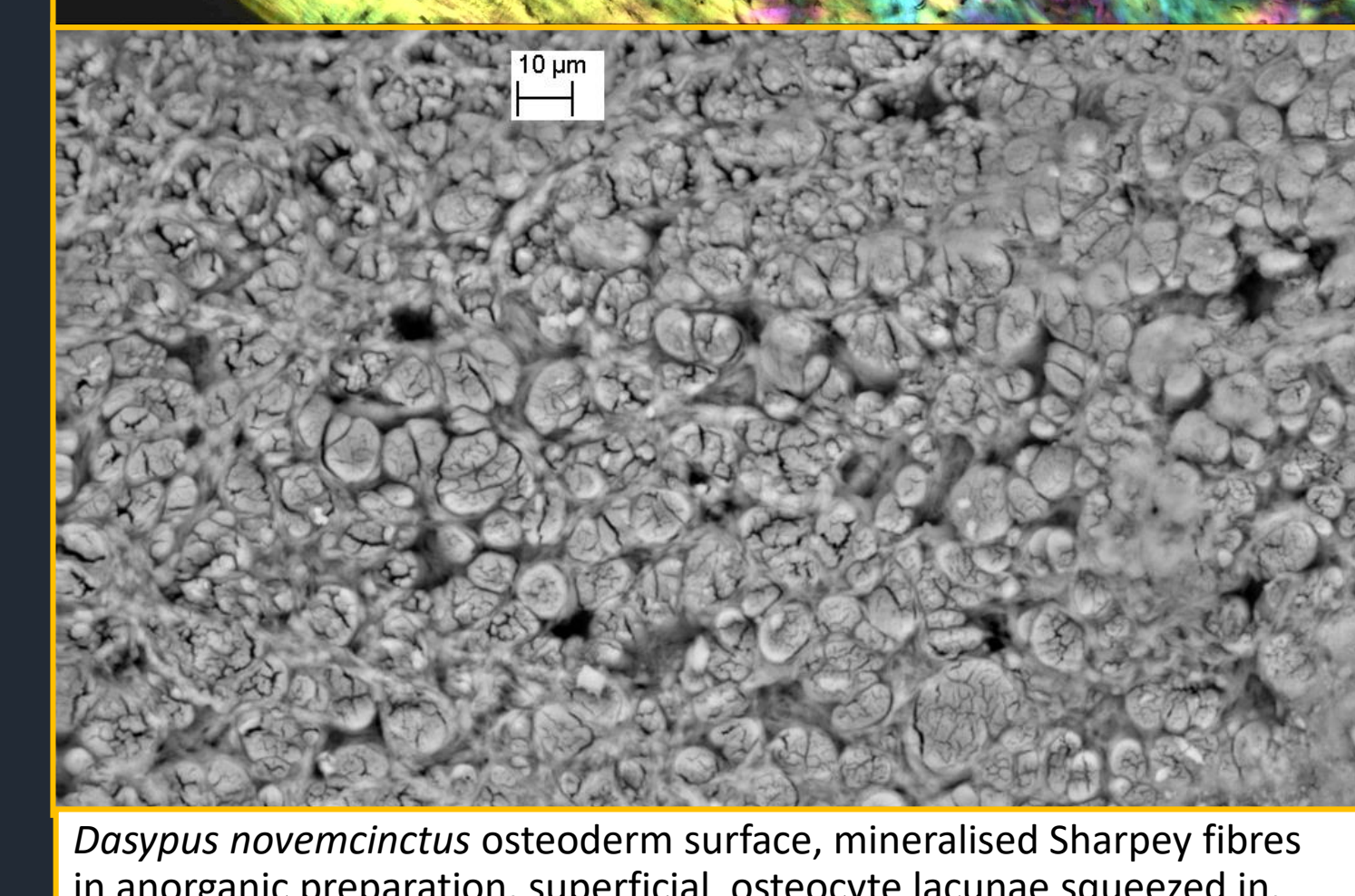
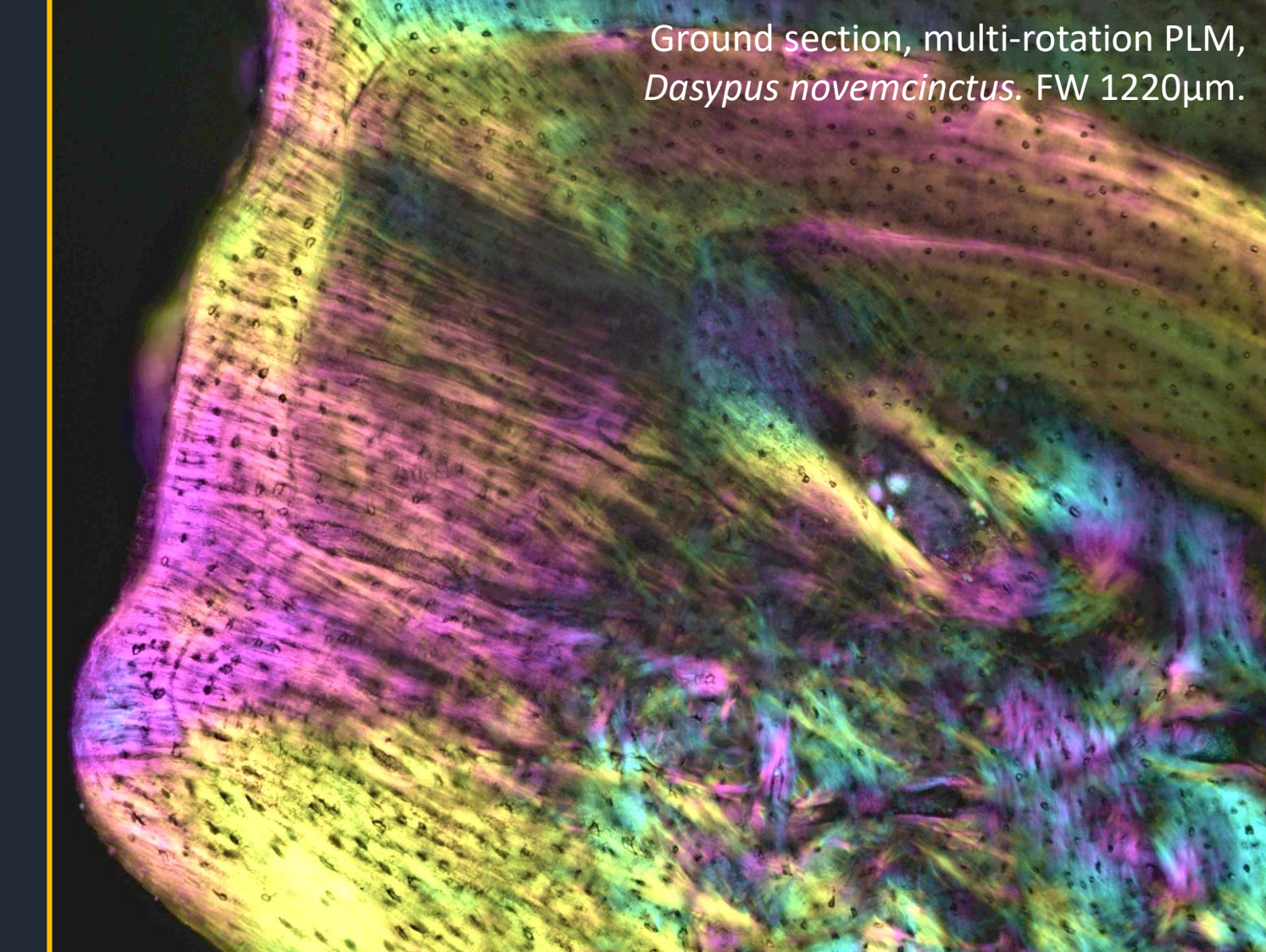
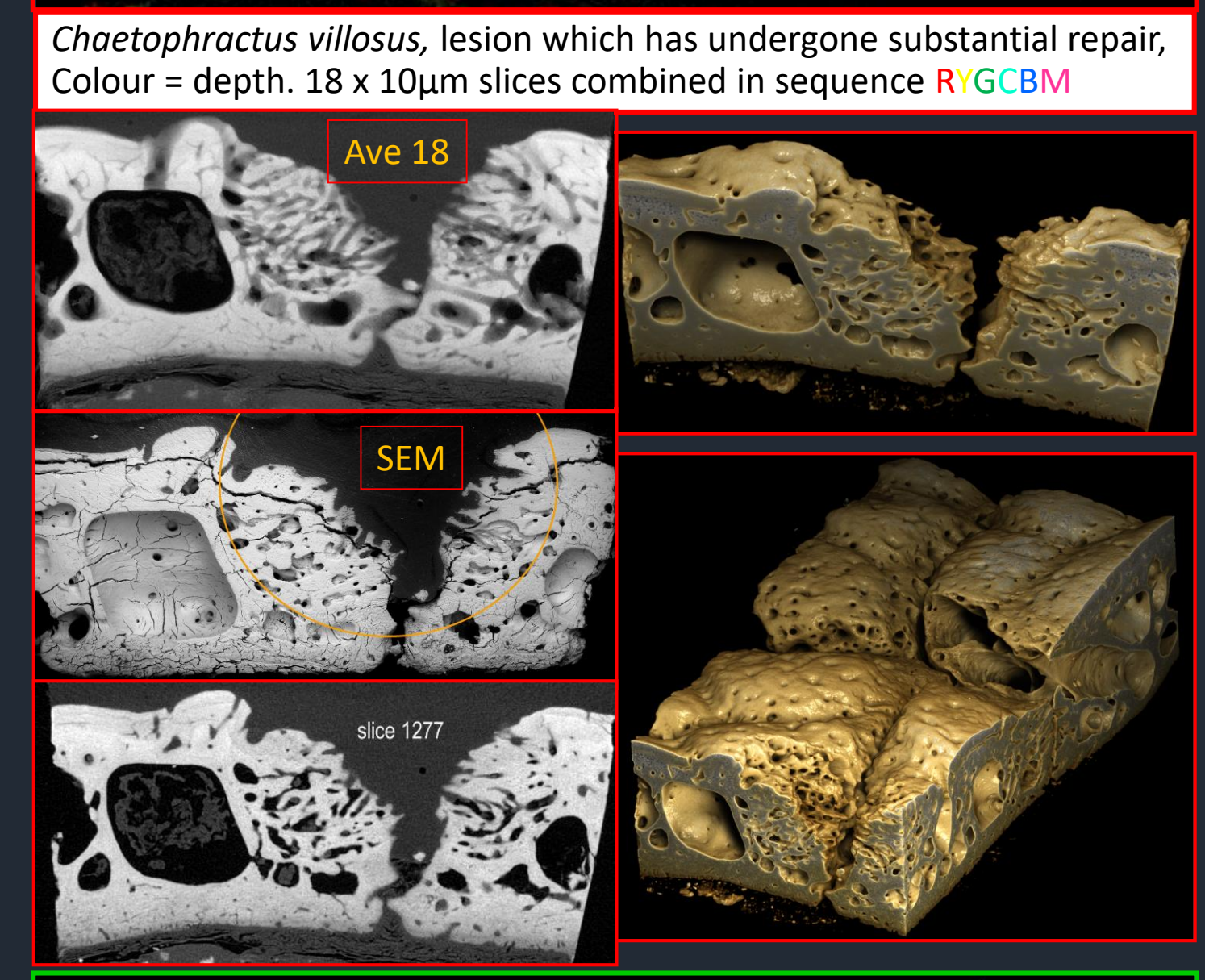
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Armadillo osteoderms are extrinsic (Sharpey) fibre bone on the outside, remodelled to secondary osteonal and trabecular bone internally. The whole arrangement is held together with Sharpey fibres running from one bone to the next.



Armadillos are bitten by several species of flea. Females of the genus *Tunga* penetrate the epidermis and when in place are fertilised by males, after which the abdomen increases in size by up to ten times to form a 'neosome'. Within the *penetrans* group of *Tunga*, a new species, *T. perforans*, discovered by Ezquiaga et al (Medical and Veterinary Entomology 2015 29 196–204) lesions perforate the bones within the integument.

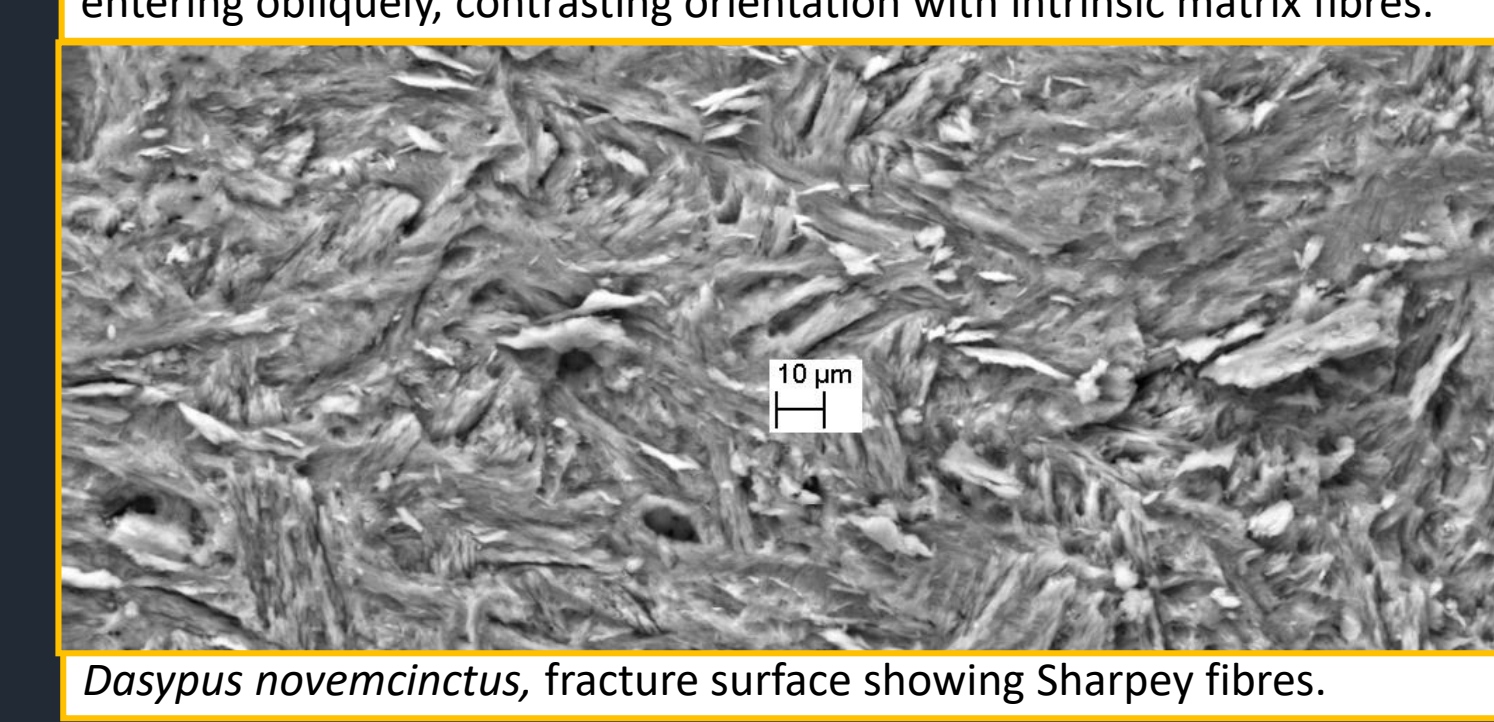
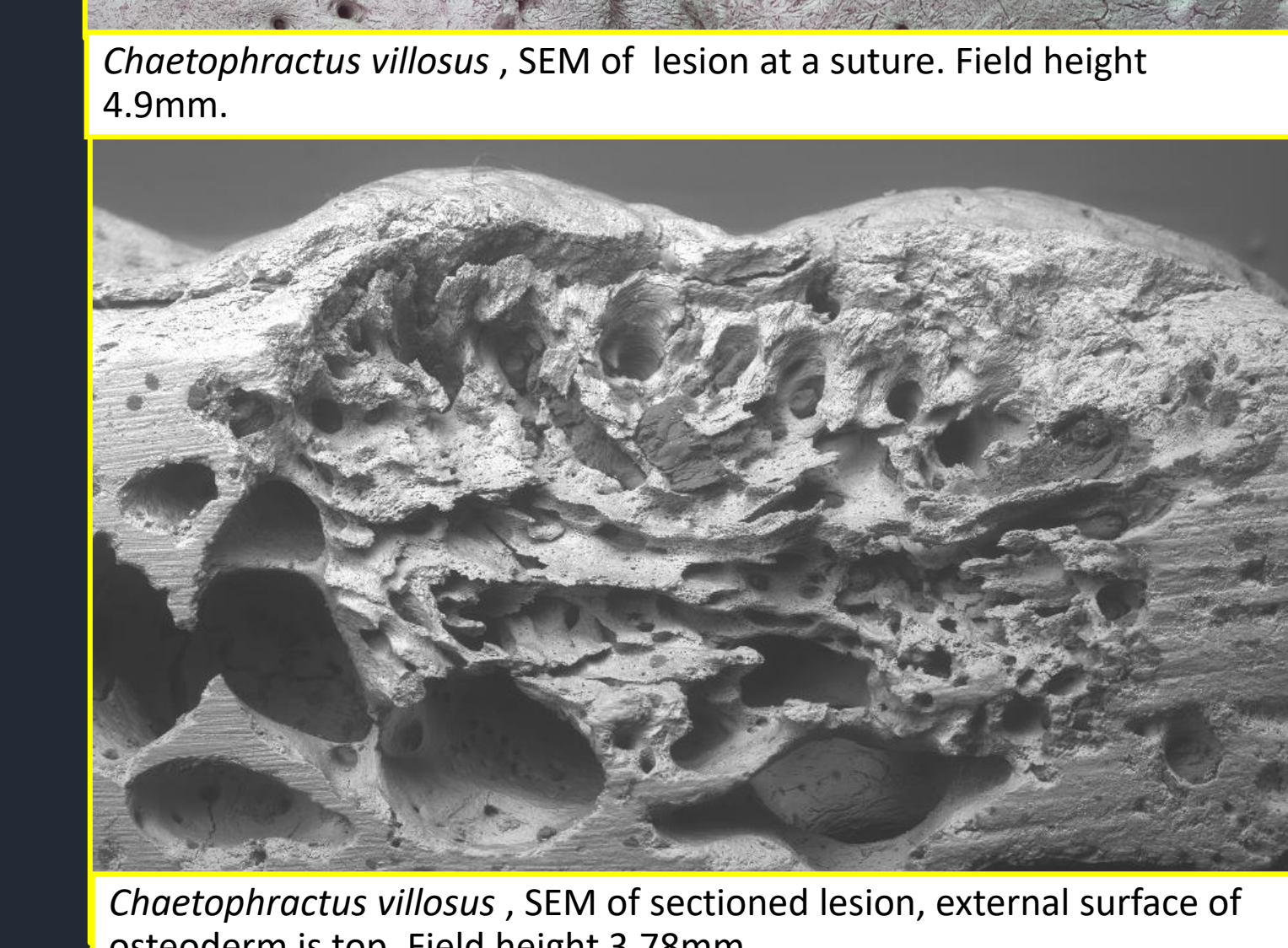
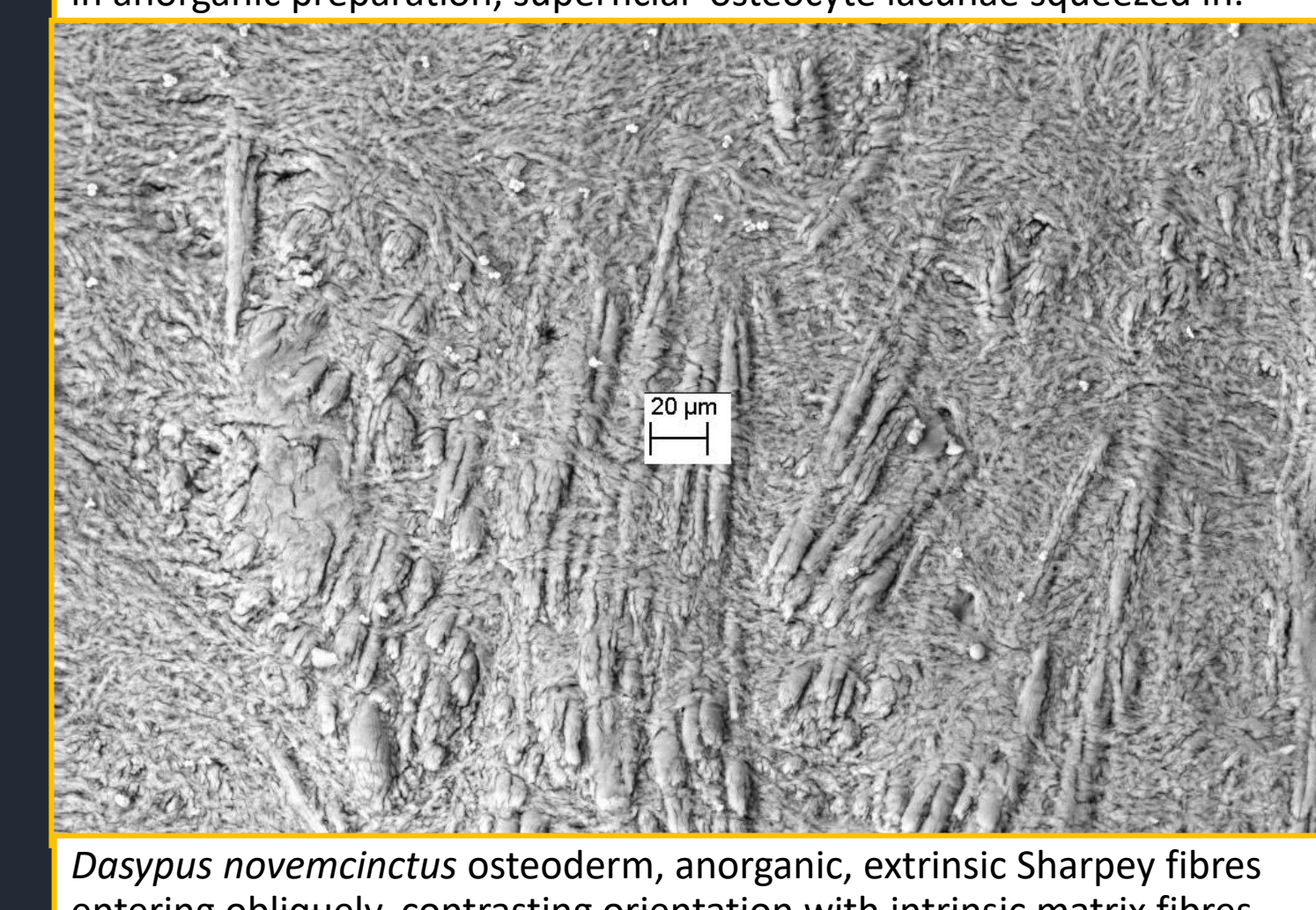
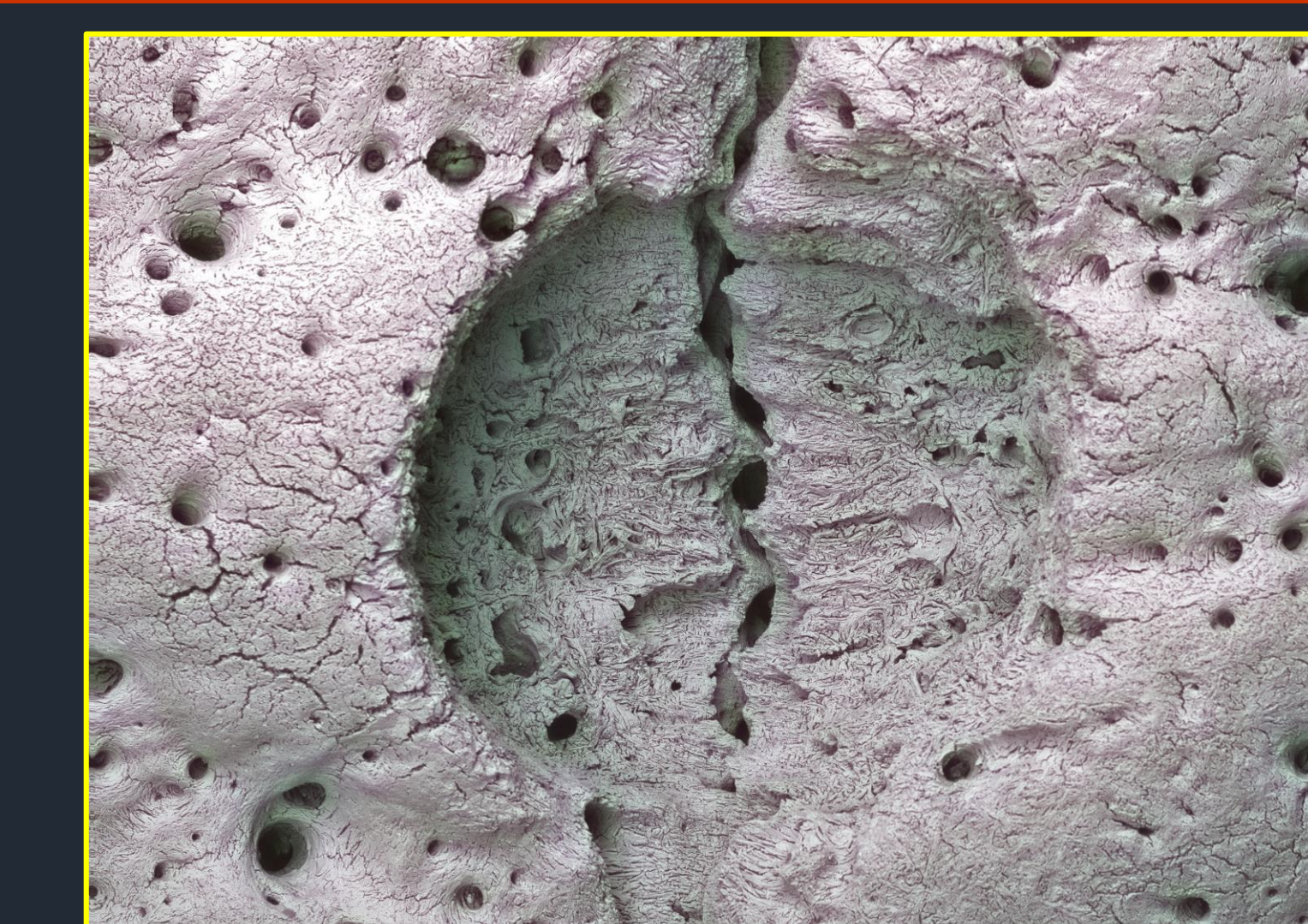
We hypothesised – and show here – that the cavities eaten into the bone might be generated by recruitment of the host's osteoclasts and that they would resemble Howship's lacunae, being formed of multiples of small resorption pits. We studied one species without 'flea-bites', the nine banded armadillo *Dasypus novemcinctus*, and two species with, the greater hairy armadillo *Chaetophractus villosus* and the southern three-banded armadillo *Tolypeutes matacus*, both showing the characteristic ~3 mm diameter 'flea bite' holes in the external surfaces of the osteoderms.

For BSE SEM [Zeiss EVO-MA10] samples were studied before and after treatment with sodium hypochlorite bleach to remove residual adherent soft tissue and contaminant soil or dust particles, washed, dried and imaged uncoated at 20kV, 50Pa chamber pressure.

For x-ray microtomography (XMT: QMUL MuCat2 system, 90kV), larger samples consisting of many adherent osteoderms were supported with Araldite, cut to isolate regions containing the bony lesions and imaged at 10 micron voxel resolution. 3D rendering was performed using Drishti software.

3D BSE-SEM showed resorption pits characteristic of those made by osteoclasts. Lesions involved both the syndesmoses (sutures) between adjacent bones and the centres of bones. Many lesions showed extensive repair by infilling with new bone.

We conclude that the *Tunga* neosome creates a local host response which causes bone resorption, creating the space in which it can grow. Owing to the superficial location of the lesions, we speculate whether this might constitute a useful experimental/observational model in the future.



Many stages of formation and repair of the flea 'bite' holes were observed, from extensive osteoclastic resorption of both Sharpey fibre bone and internal remodelled osteonal and trabecular bone in expansion phases to new bone formation and filling of cavities during repair.

