

Sulfur speciation in soft tissues from a Jurassic ornithischian dinosaur

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Diverse non-avian theropod dinosaurs from the Middle Jurassic to Early Cretaceous preserve evidence of feathers and feather-like structures. Despite this, many aspects of feather evolution remain poorly understood, including the nature and significance of filamentous integumentary structures and unusual feather types that do not correspond to feather morphotypes in modern birds. Previous studies of these tissues have lacked insights from tissue ultrastructure and chemistry. Here we use synchrotron X-ray fluorescence and X-ray near-edge absorption spectroscopy to investigate the preserved chemistry of diverse integumentary structures – scales, monofilaments, and compound feather-like structures – in the neornithischian dinosaur *Kulindadromeus zabaikalicus*, a basal neornithischian dinosaur from the Jurassic of Siberia. Our results reveal that different tissue types can be discriminated on the basis of their trace element chemistry and, in particular, sulfur speciation chemistry. These data provide a new mechanism to determine the nature of evolutionarily important tissue types in feathered dinosaurs and will help constrain scenarios for the evolution of feathers.