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Ironstone Bonebed Near Arches National Park Reveals a New Armored Dinosaur From the Dawn of the Cretaceous

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Just outside the northern boundary of Arches National Park in southeastern Utah, paleontologists excavating a 138-to-141-million-year-old site called the Ironstone Bonebed have uncovered at least four dinosaur groups -- including a new species of tank-like armored dinosaur that lived during the recovery from a mysterious end-Jurassic extinction [1, 2] .

Breaking Ground at the Ironstone Bonebed Near Moab

In the rugged red-rock badlands of Grand County, Utah -- on Bureau of Land Management (BLM) public land just north of Arches National Park -- a team of paleontologists from the Utah Geological Survey (UGS) has opened a major new fossil quarry known as the Ironstone Bonebed [1, 2] . Led by Utah State Paleontologist Dr. Jim Kirkland and Assistant State Paleontologist Don DeBlieux, the excavation is already yielding dozens of well-preserved dinosaur bones locked inside rust-colored rock nodules [1, 2] .

The star of the quarry is what appears to be a brand-new species of ankylosaur -- a low-slung, four-legged plant-eating dinosaur protected from head to tail by a heavy shield of bony armor plates and spikes [1, 3] . Because the fossil bones are encased in hard, iron -rich mineral crusts called ironstone concretions (natural rock shells that form around buried organic material before sediment can flatten it), the skeletons have survived in remarkable three-dimensional detail for roughly 138 to 141 million years [1, 4] . Once laboratory preparation and formal anatomical comparisons are complete, Kirkland plans to name the new armored dinosaur in honor of DeBlieux, who is retiring after a 25-year partnership discovering some of Utah's most famous prehistoric creatures [1] .

The Missing Chapter: What Happened After Stegosaurus and Allosaurus Vanished?

To appreciate why the Ironstone Bonebed is generating so much excitement among scientists, it helps to look at the layers of rock stacked across eastern Utah like the pages of a history book [3, 4] . For well over a century, the American West has been famous for the Morrison Formation , a Late Jurassic rock layer formed about 156 to 147 million years ago. That Jurassic landscape was ruled by household-name giants: long-necked sauropods like Apatosaurus , Diplodocus , and Brachiosaurus , the roof-plated herbivore Stegosaurus , and the apex predator Allosaurus [1, 3] .

Right at the end of the Jurassic Period, however, global climates shifted, inland seas retreated, and a major extinction pulse swept across North America [1, 4] . Iconic dinosaurs like Stegosaurus and Allosaurus disappeared completely. Even more frustrating for paleontologists, erosion stripped away or prevented sediment from accumulating for roughly 8 to 12 million years across much of the western United

States -- creating a missing gap in the rock record that geologists call an unconformity [3, 4] . When rock deposition finally resumed in the Early Cretaceous Period to form the Yellow Cat Member of the Cedar Mountain Formation , an entirely different cast of dinosaurs had taken over [3, 4] . Positioned near the very bottom of the Yellow Cat Member, the Ironstone Bonebed offers one of the oldest and clearest snapshots of how life rebounded right after the Jurassic extinction [1, 4] .

| Ecosystem Feature | | Late Jurassic World (Morrison Formation) | | The Missing Gap (Jurassic-Cretaceous Boundary) | | Early Cretaceous Recovery (Ironstone Bonebed, Lower Yellow Cat Member) |

| Age (Millions of Years Ago) | | ~156 to 147 million years ago | | ~147 to 141 million years ago (~6-12 Myr rock gap) | | ~138 to 141 million years ago (Berriasian-Valanginian) |

| Armored Plant-Eaters | | Stegosaurus (tall back plates & tail spikes) | | Stegosaurs go extinct in North America | | New Ironstone Ankylosaur & Gastonia (flat bony armor shields & shoulder spikes) |

| Other Herbivores | | Apatosaurus , Diplodocus , Camptosaurus | | Major turnover in giant sauropod lineages | | Early iguanodont ornithopods & surviving titanosauriform sauropods |

| Meat-Eating Predators | | Allosaurus , Ceratosaurus , Torvosaurus | | Large allosaurids vanish from the region | | Diverse small-to-medium theropod predators & early dromaeosaurs ("raptors") |

| Fossil Preservation Style | | River-channel sandstones & floodplain mudstones | | Erosional surface (unconformity) & fossil soils | | Floodplain mudstones sealed inside protective rust-red ironstone nodules |

How Armored Ankylosaurs Replaced the Plated Stegosaurs

Both Stegosaurus and ankylosaurs belong to a broader group of shield-bearing herbivores called thyreophorans (meaning "shield-bearers"), yet they evolved very different strategies for defending themselves against predators [3, 5] . While the Jurassic Stegosaurus carried two rows of tall, thin vertical plates along its arched spine and swung a four-spiked tail (the "thagomizer"), the Early Cretaceous ankylosaurs that replaced them built low-profile, tank-like bodies [5] .

Embedded directly inside the skin of these Early Cretaceous ankylosaurs were hundreds of fused bony plates called osteoderms (the same kind of skin-bone armor seen in modern crocodiles and armadillos) [5] . The new dinosaur emerging from the Ironstone Bonebed appears to belong to the polacanthid ("many-spined") branch of the ankylosaur family tree, closely related to Utah's famous spiky dinosaur Gastonia [3, 5] . Instead of a heavy tail club -- which evolved tens of millions of years later in Late Cretaceous cousins like Ankylosaurus -- early Cretaceous armored dinosaurs wore chainsaw-like rows of sharp, triangular spikes projecting outward from their shoulders and flanks, paired with a fused bony shield over their hips [5] . If a predator tried to bite a crouching ankylosaur, it met an impenetrable wall of solid bone and horn.

A Complete Early Cretaceous Community Locked in Rust-Red Stone

What makes the Ironstone Bonebed especially valuable is that the new armored dinosaur did not die alone [1, 2] . So far, the Utah Geological Survey crew and volunteers have identified fossils belonging to at least four distinct dinosaur groups buried together in the ancient wetland deposit [1, 2] :

* The New Armored Dinosaur (Ankylosauria): Represented by skeletal elements and distinctive dermal armor plates currently being freed from rock at the Utah Geological Survey preparation lab in Salt Lake City [1] .

* Iguanodont Plant-Eaters (Ornithopoda): Large, bulky herbivores capable of walking on either two or four legs and grinding tough fibrous plants with batteries of tightly packed cheek teeth [1, 3] .

* Meat-Eating Dinosaurs (Theropoda): Shed teeth and bones from agile, two-legged carnivores that patrolled the Early Cretaceous floodplains [1, 3] .

* Long-Necked Dinosaurs (Sauropoda): Evidence that giant long-necked herbivores persisted alongside the new wave of armored and ornithopod dinosaurs [1, 3] .

Excavating the site requires heavy rock saws, jackhammers, and painstaking chisel work because the ironstone rock is nearly as hard as concrete [1, 2] . Once large blocks of rock (wrapped in protective plaster-and-burlap "field jackets") are hauled out of the desert, fossil preparators use miniature pneumatic air scribes -- tiny vibrating needles that work like dental drills under a microscope -- to flake away the red ironstone grain by grain [1] . As preparation continues over the coming months, the Ironstone Bonebed promises to reveal how a new generation of armored survivors rebuilt North America's dinosaur ecosystems at the dawn of the Cretaceous Period [1, 4] .

References & Primary Sources

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