Fla. ridges' mystery marine fossils tied to rising land, not seas

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Sea level has not been as high as the distinctive ridges that run down the length of Florida for millions of years. Yet recently deposited marine fossils abound in the ridges' sands.

Now, a University of Florida geologist may have helped crack that mystery.

In a paper appearing June 1 in the June edition of the journal *Geology,* Peter Adams, a UF assistant professor of geological sciences, says his computer models of Florida's changing land mass support this theory: The land that forms the sandy Trail Ridge running north to south from North Florida through South Georgia, as well as lesser-known ridges, was undersea at the time the fossils were deposited -- but rose over time, reaching elevations that exceeded later sea level high stands.

"If you look at the best records, there's no evidence that global sea level has come close to occupying the elevation of these fossils since the time of their emplacement," Adams said, referring to Trail Ridge's elevation today, nearly 230 feet above modern sea level. "The only thing that explains this conundrum is that Trail Ridge was underwater, but later rose to an elevation higher than subsequent sea levels."

At the heart of the phenomenon are Florida's unique weather patterns and geology, Adams said.

The state's abundant rain contains a small amount of carbon dioxide, which forms carbonic acid in lake and river water. This slightly acidic water slowly eats away at Florida's limestone bedrock, forming the karst topography for which Florida is so well known, replete with pockmarks, underground springs and subterranean caverns. The surface water washes the dissolved limestone out to sea, over time significantly lightening the portion of the Earth's crust that covers Florida.

A mass of slow-moving mantle rock resides 6 to 18 miles below the crust. As the Florida land mass lightens, this mantle pushes upward to equilibrate the load, forcing Florida skyward, Adams said. The process is known as isostatic rebound, or isostatic uplift.

"It's just like what happens when you get out of bed in the morning. The mattress springs raise the surface of the bed back up," Adams said, adding that the uplift is similar to what takes place when glaciers retreat, with Maine and Norway, for example, also gaining elevation.

Glaciers melt off the land surface to drive isostatic uplift. But in Florida, varying rainfall rates during different periods have slowed or quickened the karstification just below the land. This has in turn slowed or quickened the mantle's push up from below. Additionally, sea level high stands do not always return to the same elevation, which creates a complex history of which beach ridges are preserved and which aren't, Adams said.

For instance, during periods when sea level rose quickly, some pre-existing ridges were overtaken and wiped out. During other periods, however, when sea level rose slowly or did not reach a certain ridge's elevation, a beach ridge was preserved. In effect, Trail Ridge, Lake Wales Ridge and other lesser-known ridges are the remains of isostatically uplifted land that was kept out of harm's way, Adams said. The ridges carry with them the marine fossils that are the evidence of their lowly early beginnings.

Today, the land surface of Florida is rising at a rate of about one-twentieth of a millimeter annually, far more slowly than sea level rise estimated at approximately 3 millimeters annually. Adams noted that Florida's rise is not nearly rapid enough to counteract sea level rise - and that society should be mindful that low-lying coastal areas are threatened.

Neil Opdyke, a UF professor emeritus and a co-author of the recent paper, first proposed the uplift process in a 1984 paper. Adams tested it using computer models that matched known information about sea levels dating back 1.6 million years with historic rainfall patterns, karstification rates and mantle uplift. The models concluded that Trail Ridge is approximately 1.4 million years old -- and has been preserved because of uplift and the fact that sea levels have not reached the ridge's elevation since its formation. In addition, Florida's one-twentieth of a millimeter rise is twice as fast as previously thought.

"The neat thing about this paper is, it combines many different systems that people work on. There are people who work on uplift, people who work on erosion of karst, people who work on precipitation and paleoclimate," Adams said. "And I knew just enough about all these things to be dangerous. So I said. 'Let's take what we know from the literature and put it together in a simple mathematical model to see how the whole system responds.'"

Provided by University of Florida

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