Mountain-building process much faster - and cooler - than previously thought

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New 'cold crust' model may help explain other Earth-shaping events

Geologists at Queen's University have discovered that the time it takes for mountain ranges to form is millions of years shorter than previously thought.
This controversial finding could have implications for our understanding of other geological processes that shaped the Earth, says Professor James Lee and postdoctoral fellow Alfredo Camacho of Queen's Geological Sciences and Geological Engineering Department.
The study will appear in the June 30 edition of the international journal *Nature*.

Other members of the team are Bastiaan J. Hensen from University of New South Wales, and Jean Braun from Université de Rennes, France.

Using state-of-the-art techniques to measure the age of rocks, the researchers deciphered a pattern of ages within single crystals from rock remnants that survived continental collision. Their measurements show a 13-million-year cycle in which rocks are buried to 60 km depth, then returned to the surface. This occurred 425 million years ago during a large-scale mountain-building event called the Caledonian Orogeny.

"We were excited to be able to show, for the first time, that the duration of an orogenic' cycle [burying, then bringing rocks to the surface] is much shorter than was previously believed – only 13 million years in this case," say Drs. Camacho and Lee. "Geologically speaking, that is a very short period indeed – a mere drop in the bucket of the Earth's history." The duration of many geological processes that shape the Earth has been thought to last for hundreds of millions of years.

The study also suggests that the buildup of heat previously thought to be widespread during mountain building may instead be related to short-term events caused by either pulsed injection of hot fluids and/or friction on faults, with the overall crust remaining relatively cool. The study focused on the Caledonian Orogeny in Norway, where injections of hot fluids caused rapid fracturing of this cool crust, producing deep-seated continental earthquakes.

"By coupling geochronology with fundamental physical and mathematical principles and computer modeling, we can assess the durations of a variety of geological processes for the very first time," says Dr. Lee. "The new quantitative technique that we developed allows us to measure the duration of thermal disturbances at all scales, from small-scale intrusions of molten rocks into the crust (e.g. volcanoes) to large-scale orogenic cycles."

This unique "cold-crust" model stems from a new quantitative technique integrating geo-chronology, mathematics, physics, and basic geological principles. "It neatly explains many previously puzzling geological observations and may be relevant to other mountain-building events around the world," says Dr. Lee.

Source: Queen's University