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Curtin scientists question impact history of the Moon

MEDIA RELEASE

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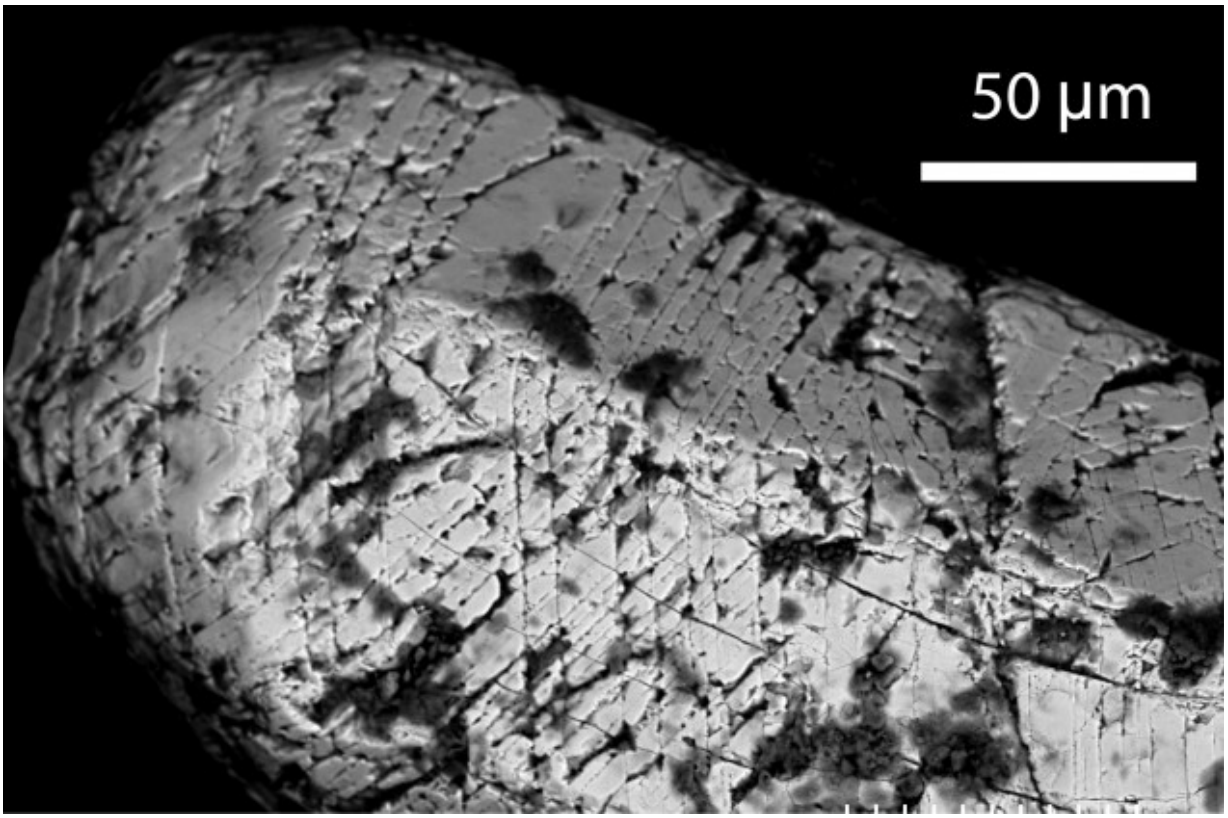
Curtin University researchers have cast doubt on a widely accepted method for dating some of the solar system's most cataclysmic events – information which in turn could change our understanding of when Earth became habitable.



A detrital shocked zircon from the Vaal River in South Africa. This grain of zircon sand was eroded from shocked rocks at the Vredefort impact site. The tell-tale fractures formed during impact are visible in this backscattered electron image. Image credit: Aaron Cavosie.

Incredibly durable crystals known as zircons, retrieved from the Moon during NASA's Apollo missions, are regarded as one of the best isotopic clocks for

dating geological processes billions of years old, and are one method used to date lunar impacts.

However an international study, led by Dr Aaron Cavosie of the Curtin WA School of Mines and published in the journal *Geology,* questions how reliable zircons are for dating such impacts.

Dr Cavosie said that reconstructing the early impact history was critical for determining the timing, duration and intensity of meteorite bombardment in the inner solar system. Dating huge craters on the Moon, some visible from Earth, was key to establishing when Earth transitioned into a life-sustaining planet.

“Earth’s early impact history has been erased, so we look to the Moon as a proxy for understanding when Earth was impacted,” Dr Cavosie said.

“Lunar zircons are ‘ex situ’ grains, meaning they lack context – they are in jumbled up rocks made up of broken pieces of hundreds of other rocks. Extracting impacts ages from them is complicated because their original rocks are unknown.”

The new study – conducted by Dr Cavosie and colleagues from Curtin University including Professor Steven Reddy, Dr Nick Timms, Dr Cristina Talavera and PhD candidate Timmons Erickson – found that dates from ‘ex situ’ shocked zircons on Earth usually do not record impact age. Instead, they record when the zircon crystallized from magma.

The researchers dated ‘ex situ’ zircons from the giant Vredefort impact in South Africa, whose age is known, and used the electron backscatter diffraction laboratory at Curtin University to identify nano-scale diagnostic shock microstructures caused by impact. They found that once separated from source rocks, even zircons with bona fide impact evidence did not record the two billion year-old Vredefort impact event.

“Instead, they record crystallisation about three billion years ago,” Dr Cavosie said.

“Most lunar zircons did not show unambiguous evidence of shock deformation, and based on the researchers’ results, the few that did preserve shock features were unlikely to record impact ages.

“These results demonstrate that most lunar zircons likely record crystallisation ages, a finding that questions the accuracy of the impact history of the Moon as recorded by zircon,” Dr Cavosie said.

“This influences our thinking about when Earth may have become habitable. For instance, if many large impacts occurred over a short time interval, it would have

been difficult to preserve habitable environments. However, if the impact history was more prolonged, early formed habitats may have been preserved in different places on Earth at different times, allowing early life to survive.

“To recreate an accurate impact history will require future sample return missions, as the best samples to analyse are sitting on the surface of the Moon right now. But in the meantime, more focused and careful studies of Apollo zircons may yield ages of lunar impacts, in cases where a strict criteria is applied that targets unique features in zircon known to record impact ages,” Dr Cavosie said.

The full research paper, *A terrestrial perspective on using ex situ shocked zircons to date lunar impacts* can be found online at http://geology.gsapubs.org/ (http://geology.gsapubs.org/)

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