Impact craters may have been cradles of life

February 26 2013

(Phys.org)—Even comparatively small meteorite impact craters may have played a key role in the origin and evolution of early life on Earth, according to a researcher at The University of Western Australia.

Geologist Martin Schmieder, a research associate in UWA's School of Earth and Environment, said study results suggested that heat generated by an asteroid impact took at least several hundred thousand years to dissipate.

Dr Schmieder, the lead author of an article published this month in the prestigious journal Geochimica et Cosmochimica Acta, said as impact craters cooled, they provided an ideal environment for microbial life to thrive.

He and fellow researcher Dr Fred Jourdan, Director of the Western Australian Argon Isotope Facility at Curtin University, are experts in the study of rocks and minerals from craters produced by the hypervelocity impact of incoming asteroids and comets (termed meteorites once they have hit the Earth's surface). Impact craters are common features in the solar system.

"As a case study, we analysed impact-molten rock samples from the 23km-diameter and 76-million-year-old Lappajärvi crater in Finland, and were quite surprised by the results," Dr Schmieder said.

Temperatures during an impact event can reach several thousand degrees Celsius, capable of melting portions of the target rock. Smaller to medium-size impact craters less than 30km across represent the largest crater population on Earth and other planetary bodies, compared with giant impact basins such as those on the Moon that are visible to the naked eye on a clear night.

Earlier estimates for the duration of cooling in smaller impact craters were based on theoretical simulations and suggested a relatively short cool-down period of about 10,000 years after the impact. Drs Schmieder and Jourdan used the so-called argon-argon dating technique based on the natural radioactive decay of potassium to argon to measure the age of different minerals formed on impact.

"Our new argon-argon data tell us that the Lappajärvi crater did not cool down as rapidly as expected but within at least several 100,000 years, and perhaps more than a million years," Dr Jourdan said.

"Cooling impact craters are hot natural laboratories in which hot hydrothermal fluids circulate. We think they provided ideal starting conditions for the origin and evolution of microbial life on early Earth more than two billion years ago."

Dr Schmieder said of the 185 meteorite impact structures recognised on Earth, 29 were in Australia, and new impact sites were discovered worldwide nearly every year.

"Although usually associated with massive havoc and destruction, asteroid impacts also acted as extraterrestrial boosters of life in the past," he said.

"A prime example is the giant Chicxulub impact that helped wipe out the dinosaurs 66 million years ago and eventually paved the way for mammals and mankind."

The researchers believe the large Acraman impact in South Australia more than 500 million years earlier probably had a major influence on the evolutionary radiation of the first multicellular life forms during the Ediacaran, a geologic time period named after the fossil-bearing Ediacara Hills in Australia's Flinders Ranges, when complex life started to blossom.

Drs Schmieder and Jourdan are currently carrying out a government-funded global research project on a number of terrestrial impact craters, some of them located in Australia.

"Large meteorite impacts are outstanding and fascinating geologic events, and we will soon investigate other ancient impact craters on all continents to more deeply explore their geologic age and potential role in the history of life on Earth and possibly Mars," Dr Schmieder said.

More information: www.sciencedirect.com/science/ … ii/S0016703713001105