Studies of 'Crater Capital' in the Baltics show impactful history

September 18 2017

An inside view of the larger Ilumetsa Crater. Credit: A. Losiak

Studies of craters in the Baltics (Estonia) are giving insights into the

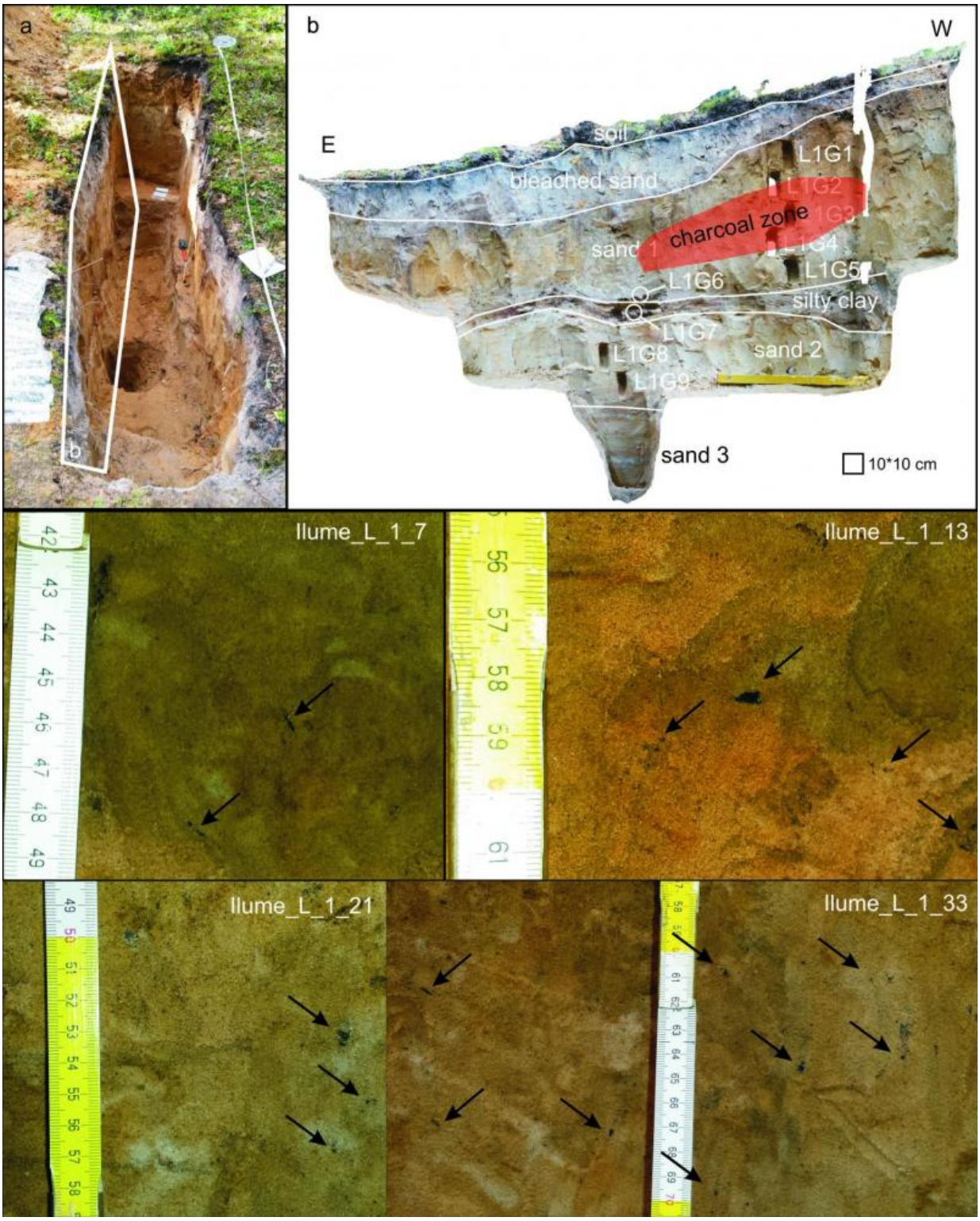
many impacts that have peppered the Earth over its long history. In southeastern Estonia, scientists have dated charcoal from trees destroyed in an impact to prove a common origin for two small craters, named Illumetsa. A third submarine crater located on the seabed in the Gulf of Finland has been measured and dated with with precision. Results will be presented by two teams of researchers at the European Planetary Science Congress (EPSC) 2017 in Riga, Latvia, on Monday, 18th September 2017.

Illumetsa are a pair of small craters in Põlva County, Estonia, that have recently been studied by a team led by Dr Anna Losiak, a young researcher at the Polish Academy of Sciences in Warsaw. The two craters are known locally as "Hell's Grave" and "The Devil's Grave", the biggest of the two being up to 80 metres in diameter at its widest point, and 12.5 metres deep. The study defined precisely the age of the two structures using a new technique.

Losiak explains: "During the impact, small pieces of charcoaled tree fragments were buried in the material expelled from the crater, called the ejecta blanket. These small pieces were found about 10 metres from the rim, at a depth of around 60 centimetres. We have established their age by carbon-14 dating. We found that both craters were formed between 7,170 and 7,000 years ago. A similar method had been used recently to date other craters in the region.

The fact that the two Illumetsa craters are the same age strongly supports the theory that they were formed in a meteorite impact. Losiak says: "Until now, the two craters had not been firmly proven to be of extraterrestrial origin: neither remnants of the projectile nor other identification criteria had been found up to this point. The lack of signs of high temperature and pressure is not surprising because such small craters are formed by relatively low energy impacts. The lack of pieces of meteorite fragments is more unusual, but not impossible. Most small

impact craters are produced by iron meteorites and you usually can find broken pieces lying around with the aid of a metal detector. Other kinds of meteorites, such as stony ones, produce impact craters only in very rare cases as they usually blow up in atmosphere – like the recent Chelabinsk meteor. However, there are exceptions and Illumetsa could have been formed by stony meteorites, not leaving any trace of the meteorite after thousands of years of weathering."



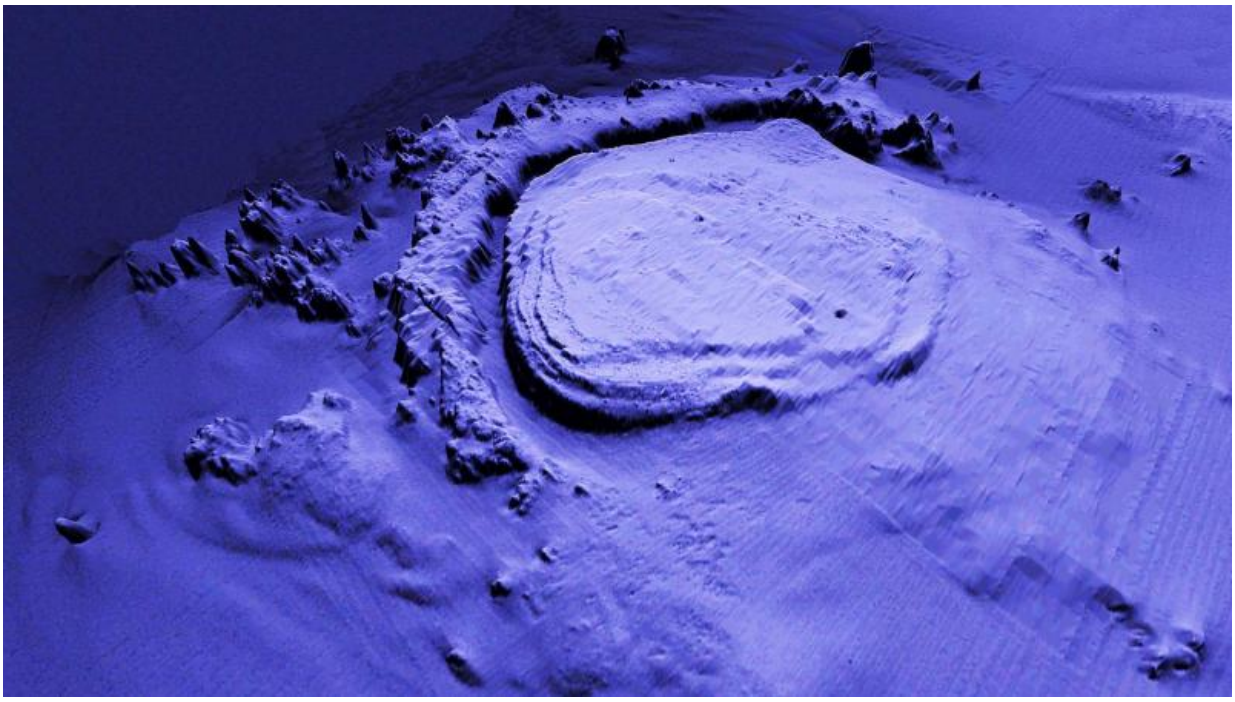
A cross-section through the ejecta blanket of the larger Ilumetsa crater, along with close-ups of the small pieces of charcoal used to date this structure. Credit:

A. Losiak

Further results were presented at EPSC about a submarine impact structure, called the Neugrund crater. The study was led by Dr Sten Suuroja, a researcher at the Geological Survey of Estonia. Neugrund is located on the bottom of the sea at the entrance to the Gulf of Finland, to the east of the Estonian island, Osmussaar. The crater is also called the "Tomb of Odin" because Osmussaar's name is derived from the Swedish, "Odensholm", which means the Island of Odin (a god in Germanic and Norse mythology). Distinctive structures like the central plateau and ring walls are at depths of just 2–30 metres, so are easily accessible for scuba divers.

The 20-kilometre diameter crater was discovered in 1995 through a co-operation between Estonian and Swedish geologists. The origin and development of its structural elements have been studied in numerous marine expeditions, but this new study reveals a fuller story.

Suuroja says: "We found that the Neugrund structure, was formed in an asteroid impact during the early Cambrian period some 535 million years ago. The body was about a kilometre in diameter and hit the sea where the depth was about 100 metres. After the impact, the crater was buried under sediments and remained covered until the Ice Age. As a result, it is probably the best preserved example of an undersea crater we have."

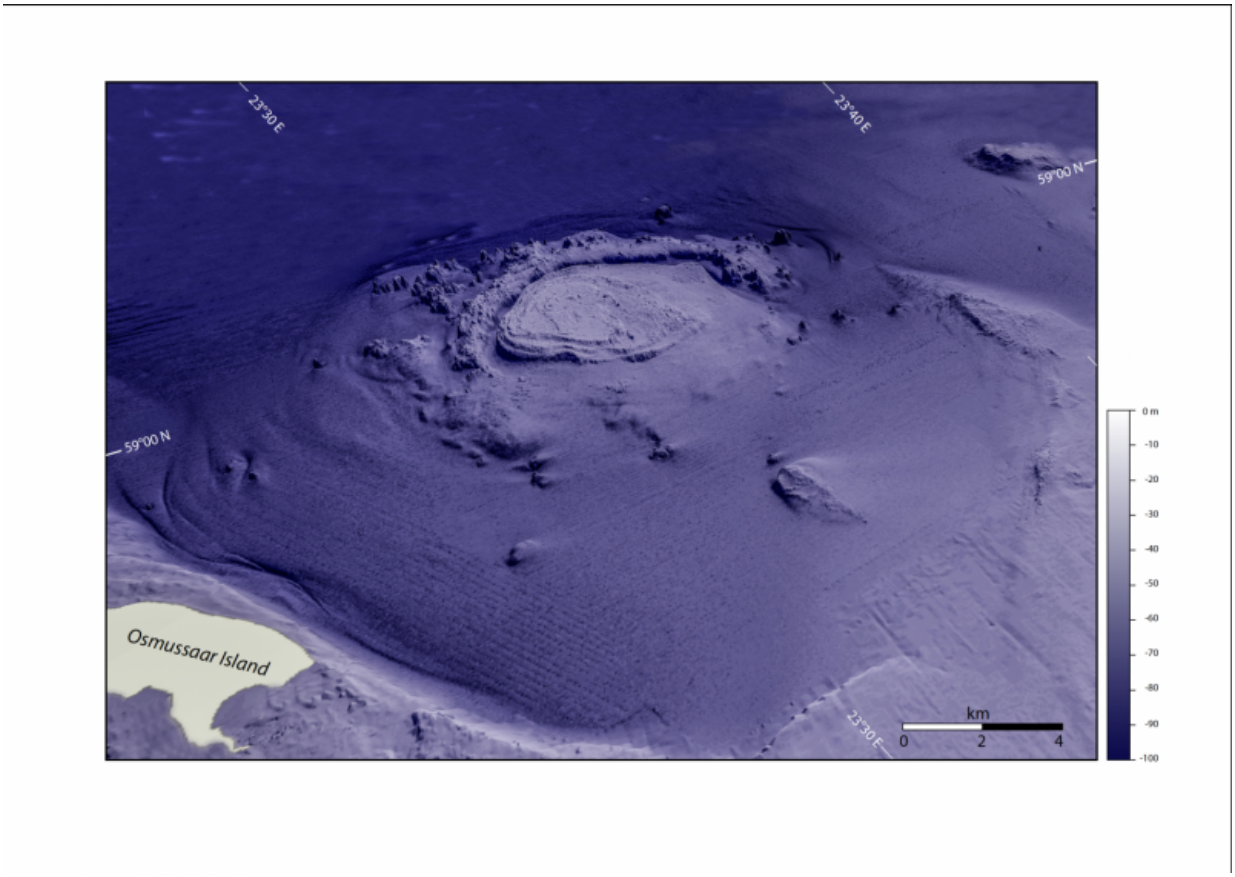


The seabed relief of the Neugrund crater area. Credit: Sten Suuroja

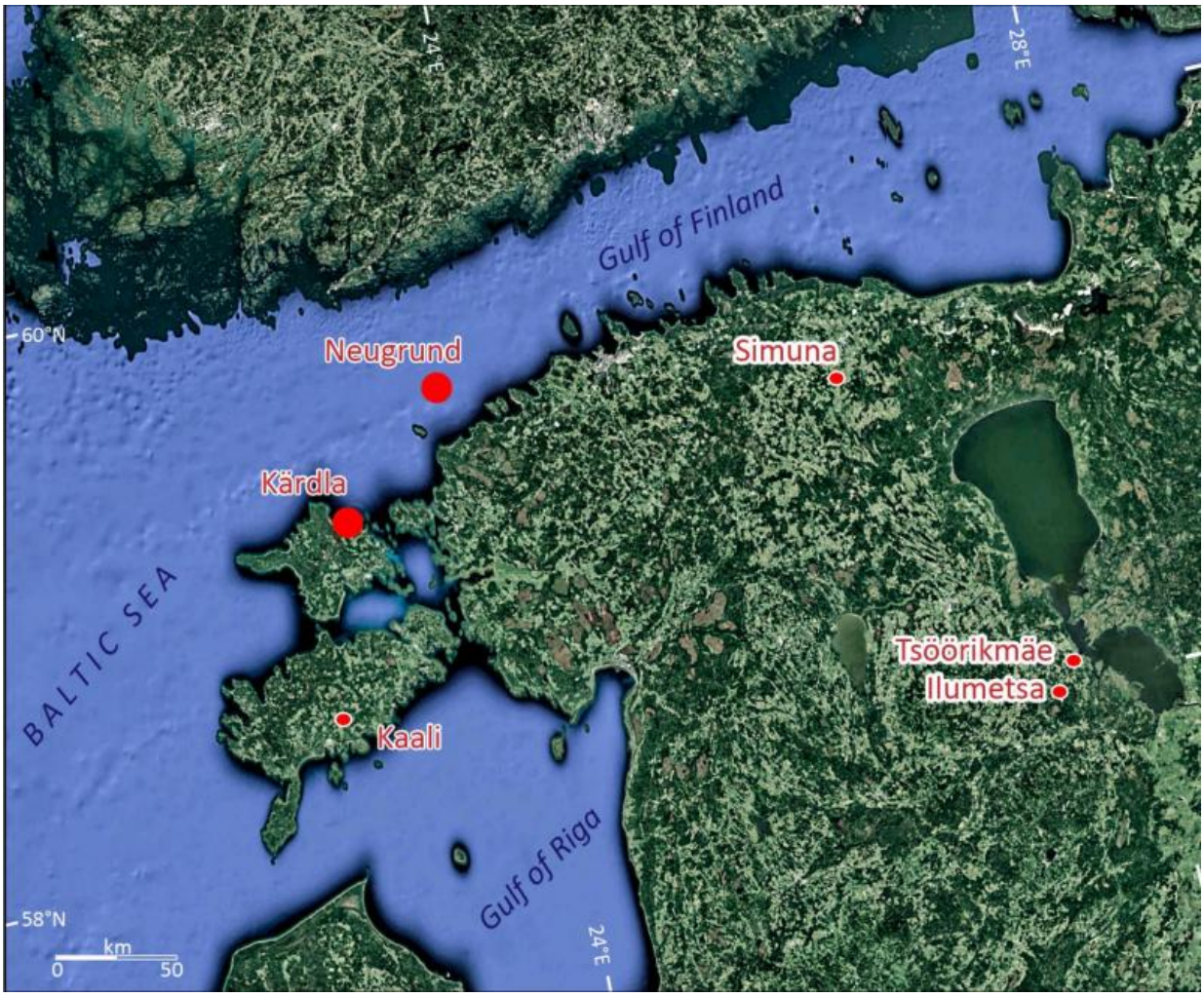
Glaciation dispersed impacted rocks, called Neugrund-breccia, from newly uncovered crater rims southwards to the Estonian mainland and archipelago, up to a distance of 170 kilometres.

"There are a total of 190 structures identified around the globe as meteorite craters. Estonia could claim to be the world's 'Capital of craters', being the country with the highest number per square kilometres. This record doesn't depend on the chances of being hit: every country has roughly the same probability of being impacted by an asteroid coming from space. But regions with older rocks, that have not experienced later intensive geological activity, such as mountain formation, have a higher chance of accumulating impacts with time. Many of the craters that can be found in the Baltic region are also related to local stories and legends. Some are sightseeing venues and have

become tourist attractions in recent years," says Suuroja.



The seabed relief of the Neugrund crater area, showing the locatin of Osmussaar Island. Credit: Sten Suuroja



Map showing location of Estonian meteorite craters. Credit: Sten Suuroja

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