Podcast Interview: Kerry Sieh

PNAS: Welcome to Science Sessions. I'm Paul Gabrielsen. From southern China to Australia and into the Indian and Pacific Oceans, people have for decades found oddly-shaped black glassy blobs. These range in size from microscopic to about the size of a soccer ball, and are called tektites. They are normally a sign of a meteorite impact, because the energy of the impact melts and launches into the air material that later solidifies into a tektite. So, where there are tektites, there is bound to be an impact crater, right? Except the crater that produced these "Australasian" tektites had proven elusive. In a recent PNAS study, Kerry Sieh at the Earth Observatory of Singapore and his colleagues assembled several lines of evidence pointing to the Bolaven volcanic field in southern Laos as the most likely site of the crater. Sieh recently spoke with PNAS. He recounts how he became interested in tektites.

Sieh: My partner and I were on a holiday, a little weekend holiday in Ho Chi Minh City back in 2011. And so we stepped into a store, and we saw these ugly black rocks on the back shelf and I asked, "What are those and why do you have them here?" She said they're tektites. And I had never heard the term before. She handed me one to hold and handed me a little abstract that had been photocopied probably 100 times. It explained that tektites were black molten blobs that had been strewn out of a hole in the ground somewhere in Asia. So I said "Where's the hole in the ground? I've never heard of this," and she says "Nobody knows." I thought, well, that's extraordinary. So when I got back to work in Singapore I immediately started reading all the literature I could find.

PNAS: Estimates placed the likely size of the crater at tens to hundreds of kilometers wide, with a known age of around 790,000 years and a probable location in mainland Southeast Asia. The tektites are largest in the adjoining portions of Laos, Vietnam, and Cambodia, and geochemists had figured out that they were made mostly of quartz-rich sandstone, which is common to bedrock of the region. They had also found hints of volcanic lava in the tektites.

Sieh: And yet they'd never put two and two together that there is a place in the region that has a big bunch of lava flows. So, lucky us.

PNAS: With that place, the Bolaven volcanic field, as a possible location, Sieh and his colleagues began to assemble evidence.

Sieh: So, if the crater is buried then all the lavas that we have on top of the alleged site have to be younger than the 790,000-year age of the impact. We did 37 dates, argon-argon dates. And all of the dates of the flows anywhere near the hypothetical site of our crater, all of them are younger. They range from barely prehistoric all the way up to right after the impact age. Sticking out from the toe of the volcanic field are quite a few flows we've dated that are older. Anywhere from a million years to about 16 million. And those flows, then, would have been there before the impact. So then we thought if in fact they were there before then we shouldn't just have quartz sandstone bedrock in the tektites, we should have melted also some basaltic volcanic rocks. And those are the first two tests.

PNAS: The third test employed precise gravimeters to measure gravity anomalies in the region.

Sieh: Anytime you blow a hole in the ground and fill it with something else, you're likely to have a different gravity signal as you go across that hole in the ground. And sure enough there's a gravity anomaly that's a low about the right dimension and about the right magnitude that we can model a crater filled with lighter density shattered debris that was broken up by the impact and fell back in.

PNAS: The researchers found boulders that had been shattered from being thrown from the impact and landing at velocities higher than the speed of sound – a fourth line of evidence. Fractures in quartz mineral grains, visible under a microscope, bolstered the hypothesis with a fifth. A sixth line of evidence concerned the amount of beryllium-10 in the tektites. Beryllium-10 is formed in the atmosphere by cosmic rays blowing apart oxygen and nitrogen and accumulates in soil, or in successive layers of weathered lava flows.

Sieh: Chemists had puzzled at why tektites had such an enormously high value of beryllium-10. The only way to explain that that we could come up with is if you have layers of sediment and they sit there, beryllium-10 rains down and gets caught up in the soil of that little deposit. Then another deposit comes in and fills it up another five meters. Well, that's exactly what the basalts do. They were erupted for millions and millions of years before the impact.

PNAS: Sieh says that a viable location for the impact crater enables further investigation. Moreover, he says, additional studies of the products of such a young impact will provide important clues about the effects of a future large meteorite impact.

Sieh: We have very little quantitative understanding of what would happen if a big meteorite, something the size of this one, if it were to strike the earth. We already know there are charred logs and deposits in Thailand associated with this impact. We know there are death assemblages of large animals like elephants. A systematic survey now of what the actual environmental impact was as you go out 10 kilometers, 20 kilometers, 30 kilometers, 500 kilometers, that's going to be more meaningful now that we know where the source is. From that sort of study over the next decade or so, I would bet we could put together a pretty good quantitative idea of what to expect in terms of blast effects, in terms of levels of heat. So, things that would pertain to us understanding what would happen if a similar sized meteorite were to hit the earth again.

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