CAVE SCIENCE AND SUSTAINABLE CAVE TOURISM IN SRI LANKA 2008-2014

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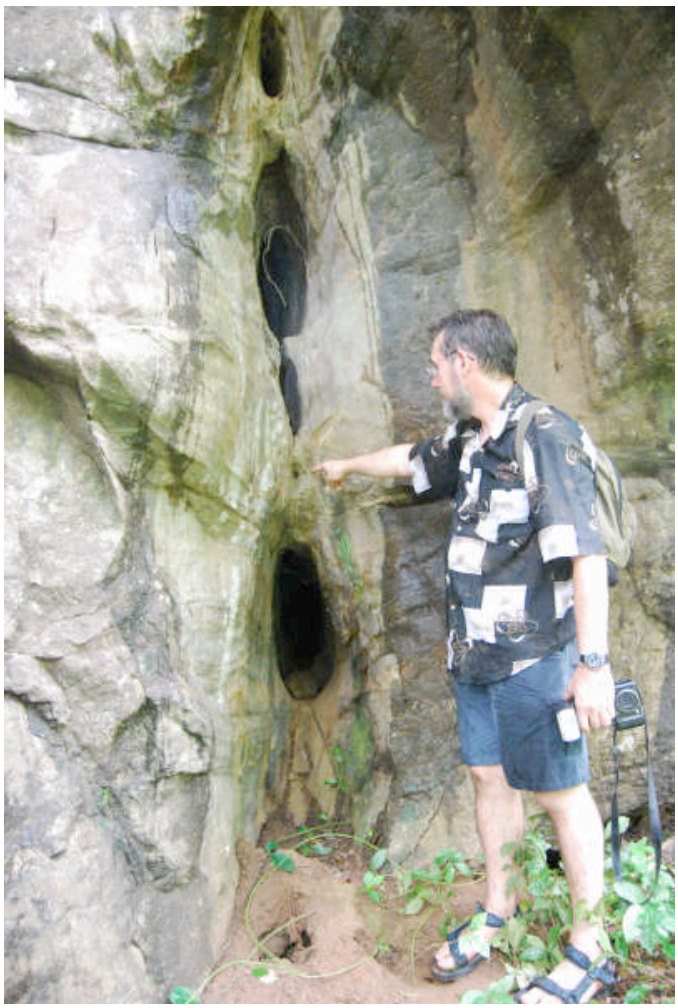
Sri Lanka is a tiny tear-shaped blob of Gondwana hanging from the southeast corner of the Indian sub-continent. It is an island of tea, spices, gems, ancient civilizations, Palaeolithic archaeological sites and legends. It is still recovering from a thirty-year civil war and the 2004 tsunami.

Nothing was further from my mind than Sri Lanka when in October 2008 I received a forwarded email from Dr Weliange (Weli) of the Postgraduate Institute for Archaeological Research (PGIAR) in Colombo asking for assistance in establishing cave science research in Sri Lanka. I thought Gondwana fragment, Proterozoic rocks, could be a good place to look for very old caves so I put my hand up. After a few emails it became clear that there was not just no cave science in Sri Lanka, there were also no cavers to explore and map the caves and cave locations were poorly known.

The available literature consisted of references to nitre caves in an 1820's English colonial book, an extensive data base produced entirely from library research by a German scholar which lists caves alphabetically by name and which has never been field checked and a very few reports from visiting European cavers. So locating caves was going to be difficult and as our German friend had discovered, many caves had the same name (usually bat cave or women's cave referring to a local legend) and some caves had twenty or more names. Locating and determining the name of a cave when found remains a problem.

There was a need to develop cave science training for archaeologists as many of their important sites were in caves. All available literature suggested that the caves were developed in Proterozoic marble so it should not be too hard to apply existing ideas about karst caves to Sri Lanka.

In June 2009 I made a four-day reconnaissance trip to Sri Lanka on my way home from a hypogene cave conference in the Ukraine, this set the stage for all that has ensued since. All but one of the caves seen appeared to be entirely developed in highly-deformed gneiss of granitic composition, while the presence of what looked like carbonate stalagmites suggested something else was going on. The best-known cave in Sri Lanka, Vavulpane Bat Cave (also called "oldest cave") turned out to be developed in a tufa mound, with the tufa deposition continuing from a spring rising out of a joint in entirely siliceous gneiss. Whatever was happening in Sri Lanka it was clearly not conventional karst cave formation in marble.



Many international karst experts have been fooled by this image. No, its not a solution tube in limestone, the bedrock is gneiss!
Photo: Wasantha Weliange

The lack of local cavers was solved by Dr Weliange. He collected a team of young people including architects, archaeologists, a geo-archaeologist and a geography teacher who were willing to give caving and cave mapping a go. Their caving ability and mapping has improved greatly over the last five years and they are now foundation members of the just incorporated Lanka

No, north is this way, cave mapping training,
Sthreepura Cave, August 2010
Photo: Wasantha Weliange

Institute for Cave Science (limited by guarantee) (LICAS), which will apply for membership of the International Speleological Union as its conference in western Sydney , New South Wales (Penrith Panthers) in 2017.

The four days in June destroyed all my plans; there would be no course development until a completely new science of Sri Lankan caves had been developed from scratch. So with no funding, lots of local encouragement and Weli's old Nissan Patrol, the local team set out to locate explore and map caves that looked interesting, while I scratched up odd money and used my own pocket to make nine trips to Sri Lanka from June 2009 to May 2014 to help with training, give lectures to local archaeologists, geology academics and students and drive the science.

There appeared to be a number of types of caves in the gneiss, large arch caves often converted into temples, elongate tunnel caves with an elliptical cross-section, block breakdown caves with a striking resemblance to breakdown chambers in limestone caves, mass movement caves, and boulder caves, some with quite large dimensions. But what processes were excavating the arch and tunnel caves and what was being removed to drive the breakdown?

One clue to emerge in the first visit was a strange feature at Kukuluwa Kanda Rajamaha Viharaya rock temple, an elliptical mass of altered gneiss surrounded by unaltered gneiss. It became of greater interest when the local monk informed us that he was planning to dig out the altered material to make a new meditation cave so his temple was not filled up with American "spiritual" tourists. Perhaps the legends about a caste of tunnellers who made caves was true, but it did direct our thinking towards rock phantomization and removal as one likely mechanism for cave formation. The site retains intact today because, unfortunately for the monk, the phantom rock has developed a strong secondary ferruginous cement, making excavation very difficult.

While caves developed entirely in marble have been found to be uncommon, many caves are developed mostly in gneiss and partly in marble. This has confused previous investigators. Some caves really are the spaces left behind after the marble has been dissolved away, but most are more complex with indications of direct solution of gneiss and phantom rock processes as well.

If the caves themselves are unusual, the cave sediment and some of the speleothems are very strange indeed. The floors of many caves are covered with organic silt from guano, not at all unusual until you look at your trouser legs and see they are sparkling from mica plates

Above left. Looking out from Fa-Hien Lena, an arch cave
Above right. Phantom rock filling a cave-shaped "cavity" in unaltered bedrock at Kukuluwa Kanda Rajamaha Viharaya.
Photos: Armstrong Osborn

Is it alive? Dr Weliange with black spongy flowstone
Photo: Armstrong Osborn

that apparently fall from the cave ceiling. In addition to apparently normal carbonate speleothems, small silica stalactites and large silica flowstones, there is strange soggy black flowstone with calcite sheets covering that looks distinctly alive.

By April 2012 we were in the position to start assembling out thoughts in an introductory paper with help from Ross Pogson (Australian Museum) on the cave minerals (that is on the samples I was prepared to take on a plane and attempt to get through quarantine in Sydney). After some financial misadventures in Europe our paper came out in 2013: *Osborne, R.A.L., Weliange, W.S., Jayasingha P., Dandeniya A.S., Algiriya, A.K.P.P. & Pogson, R.E., 2013. Caves and karst-like features in Proterozoic gneiss and Cambrian granite, southern and central Sri Lanka: an introduction. Acta carsologica 42(1): 25-48.*

Since 2012 a phantom rock maze cave, two very large chamber caves, an unusual cave in dolomitic marble and stream-sink cave taking water into gneiss, have been investigated. In 2013 we made our first trip to the "security zone" near Jaffna to rediscover the karst features in the Miocene limestone, described by Czech scientists in the 1970s, which had not been accessible for thirty years due to the civil war and the tsunami.

Apart from still active minefields, the main threat to this extensive karst area is rapid clearing of scrub and destruction of the case hardened zone on the top of the limestone to create agricultural land. Our most recent visit (April 2014) revealed why it was so difficult to find caves in this very large karst area. The cave entrances open after heavy rainfall. These are 6m deep and about 1m in diameter. The local community quickly fills them to prevent small children from falling in. If caves are to be conserved than a non-destructive means of quickly making these shafts safe needs to be developed.

During 2013 local interest extended to the development of an organized, environmentally and socially sustainable cave tourism industry in Sri Lanka. Leading this is the Director General of the Central Cultural Fund, responsible for managing Sri Lanka's World Heritage archaeological sites. So far seven sites suitable for a range of tourism development have been identified. These range from installation of protective hardware in a small cave shown by a local guide, through various levels of self-guided caves, to one very large block breakdown cave with a lake and stalactites which is suitable for full-scale show cave development. Our caving architects have prepared draft plans for one self-guided cave, so Weli was right in recruiting architects to caving.

The science is continuing with action being taken to recruit three Sri Lankan PhD students to work on gneiss caves, marble caves and cave sediments. LICAS is negotiating to establish a special cave and karst collection in the PGIAR library so Sri Lankan cavers, students and researchers will have access to the difficult to obtain literature of caves and karst. I will be donating my duplicate material and donations of suitable material are very welcome. In 2015 for the first time a major archaeological research project from PGIAR will investigate the caves in which the sites are located as a standard part of its program.

Similar Proterozoic rocks to those in Sri Lanka with caves are found in southern India, so Sri Lankan cave science may soon become international. With the very large amount of cavernous limestone in Southeast Asia, environmental aspects of karst are certain to become major issues in the areas to our north. Sri Lankan cave scientists will be well placed to meet this demand. While thinking about capacity in geological aspects of cave science it is worth pointing out that among Gondwana fragments (excluding the Bohemian Massif in the Czech Republic) the greatest strength in cave and karst science is in Brazil, which also has some of the world's strictest cave conservation laws. With the state of cave and karst science in Australia, don't be surprised if the next generation of researchers at Jenolan Caves come from Sri Lanka or Brazil or are Sri Lankan or Brazilian trained.