

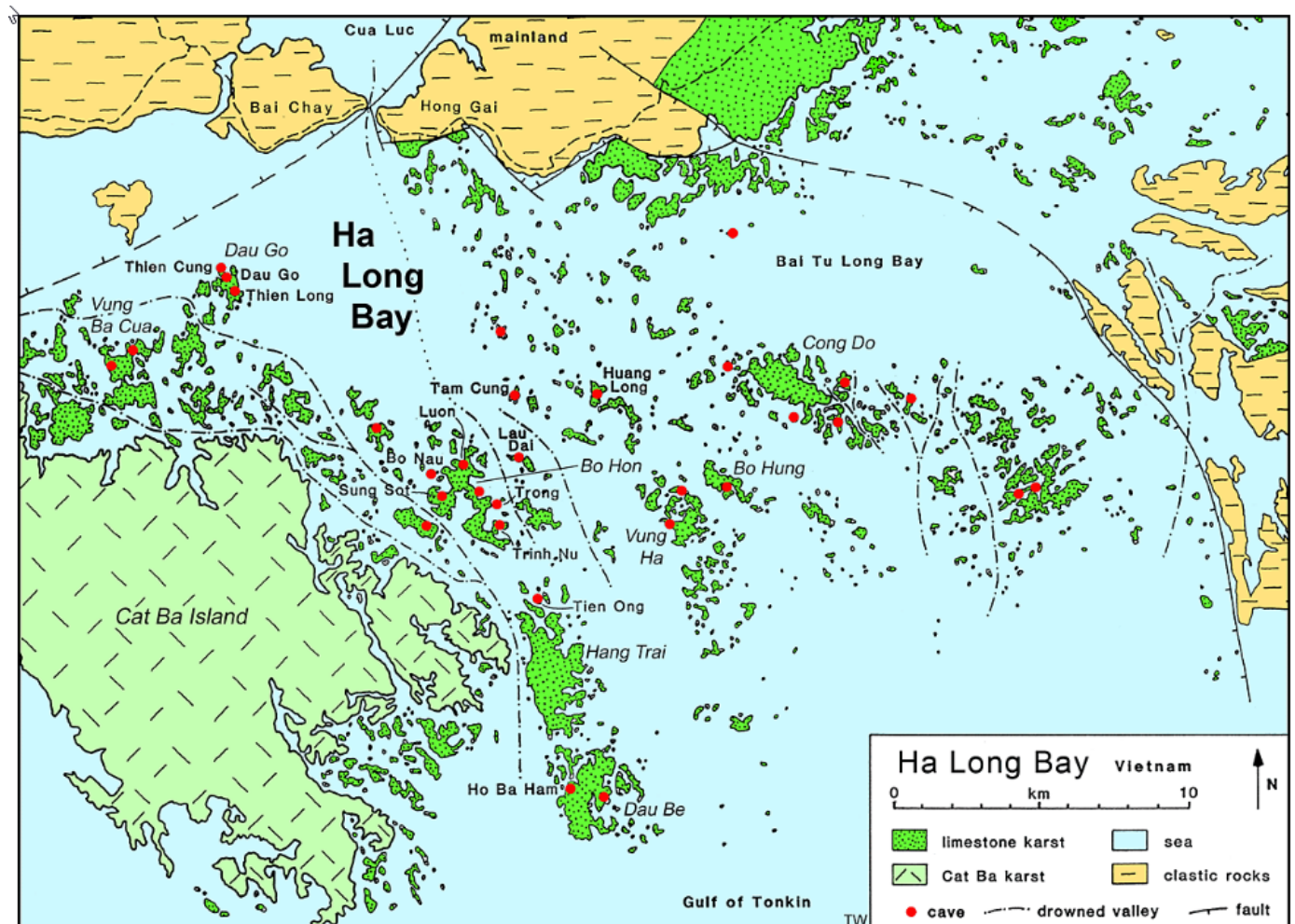
A Visit to Some Karst Areas of Northern Vietnam

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In January this year Gabriel Crowley and I visited two karst areas in Vietnam. I had long wished to see Ha Long Bay and Trang An, both World Heritage areas in the north of that country. Vietnam has a rapidly developing economy in which tourism is a very important component. Urban expansion is very evident along all of the major highways leading out of Hanoi and is juxtaposed with rice fields. Quarrying of limestone, primarily for cement production, is unsurprisingly very widespread. In this article we provide a brief summary of our experiences and make some comments on cave and karst management of these World Heritage areas.

Bai Tu Long Bay

This is located in northern part of Ha Long Bay in the Quảng Ninh province, and the major urban centre nearby is Hong Gai (or Ha Long). This archipelago of limestone islands is one of the world's most important areas of *fenglin* or karst peak clusters. It covers an area of about 65,000 ha and includes over 1000 islands. The World Heritage area was inscribed initially in 1990 and was significantly extended in 2000 and 2023. Concerns were raised by UNESCO in 2009 about marine pollution and potential destruction of coral reefs throughout the area, leading to an earlier classification as World Heritage in Danger. This has now been removed after action by the Vietnamese government. These environmental impacts have been described by Moore (2018) and the karst geomorphology has also been described by Waltham (2005).



Above: Fig 1. Map of Ha Long Bay



Left: Fig 2. Karst tower with sea level solution notch.

The islands of Bai Tu Long Bay are developed in the Carboniferous and Permian limestones of the Bac Son and Cát Bà formations, each several hundred metres thick.

The karst is an alternation of *fengcong* (peak or tower cluster) and *fenglin* (cone karst completely pitted by closed depressions) karst types, with intervening solution dolines or depressions of tectonic origin flooded by the sea. Most towers reach 50-100 m height and are partially covered by vegetation that hides the sharp vertical karren underneath.

At sea-level marine notch caves are created by the solution process, where sea water acts on the limestone through mixing corrosion and also erodes the base of the cliffs with wave action. Many of these notch caves extend right through the limestone hills into drowned dolines, forming tidal lakes or *hong*. At higher levels much older caves include relict notches, related to Last Interglacial sea levels, and more extensive horizontal maze caves (Waltham, 2005).

In response to the concerns of UNESCO the authorities of Quảng Ninh province have restricted high speed motorboats in the area and have relocated fishing families living in flooded villages. Demographic change is also leading to abandonment of these villages, as children move to the cities for work and only elderly people are left there. The problem of waste disposal has been partially addressed by local volunteer groups and by a strict ban on the use of single-use plastic products such as water bottles in the Bay area. However, the expansion of large tourist hotels, port facilities and retail areas has proceeded unabated and so there have been dramatic changes in the coastal environment and inevitably declines in water quality.

Right: Fig3. Floating fishing village on Tuyen Cheo island.

We visited Bai Tu Long Bay, the northern part of the World Heritage area, aboard one of the cruises offered by Indochina Junk. The 'Dragon Legend' junk had spacious self-contained cabins and excellent meals. Excursion options included sea kayaking, caves and visits to fishing villages. The guides onboard were also excellent and very knowledgeable about local geology and wildlife.



Bai Tu Long is much less visited than the main southern part of Ha Long Bay and we only saw three or four other boats, compared with the very heavily trafficked area around the urban centre of Hong Gai where hundreds of tourist boats gather.



Left: Fig 4. Entrance to the tidal lake on Tuyen Cheo island.

Below: Fig 5. The Indochina Junk 'Dragon Legend' with karst towers at Hon Co island.



Thien Canh Son Cave (literally, Paradise Cave) is a self-guided cave about 50 m above sea level on Hon Co Island. The passages show phreatic and epiphreatic cross-sections and solutional scalloping. The cave is completely lit, and lights remain on all day. Power is supplied by a diesel generator on the beach. Thus, there is much evidence of lampenflora and little has been done to treat it. Given the marine environment, electrical fittings are robust and simple, but the placing of the lights could be much, much better.



Left: Fig 6. View of chamber in Thien Canh Son Cave, with basic lighting and exposed cables.

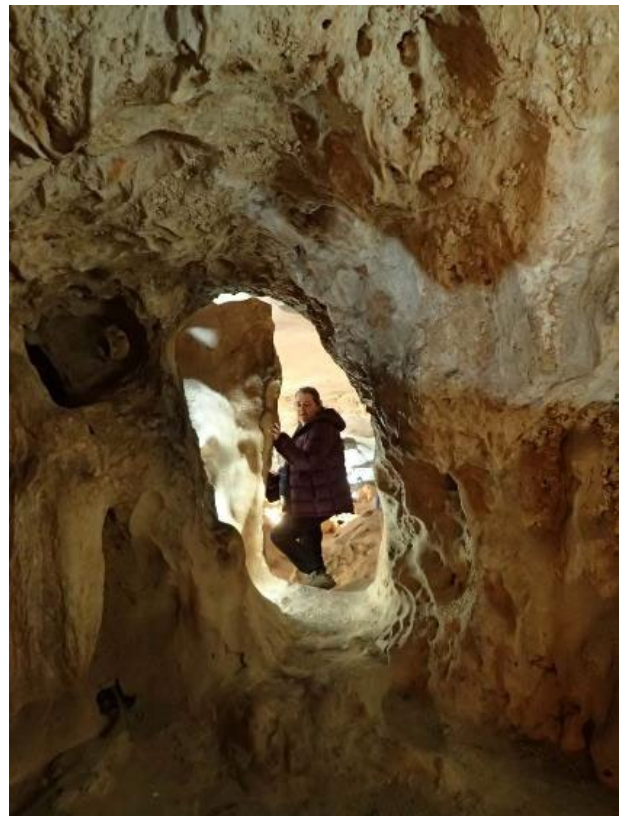
Trang An Landscape Complex WHA

This World Heritage area is located west of Ninh Bình City, in Ninh Bình Province, at the southern edge of the Sông Hồng Delta about 85 km south of Hanoi. The Trang An complex, covers about 6000 km², and was inscribed in 2014. It is about three hours' drive south of Hanoi on the motorway.

Right: Fig 7. Solution tube in Thien Canh Son cave.

This spectacular landscape complex consists of *fengcong* karst towers rising 100–200 m from a network of navigable freshwater lakes and rivers, which lie less than 5 metres above sea level. Though the Trang An-Tam Coc karst has been surrounded by the sea in the past, a recent rapid and massive deposition of fine alluvial sediments around the karst towers has created a mainland karst locally known as the "dry Hạ Long Bay". The height of the tower karst descends to the south from over 200 m high in the Truong Yen area to about 100 m near Tam Coc, where the main WHA visitor centre and boat jetties are located.

Below: Fig 8. Karst tower in Trang An Landscape Complex



At the end of the Carboniferous–Permian, about 300–280 million years ago, this whole area subsided along vertical faults-oriented northwest–southeast. This permitted Triassic (250–200 million years ago) seas to cover the region and form limestones, resulting in an alternation of synclines and anticlines now replicated at the land surface in 10 to 15 km wide valley and ridge landscapes. North of Tam Coc and west of Ninh Binh is a Triassic island of about 100 km², extending north to the city of Truong Yen, with a similar valley and ridge pattern.

In the Tràng An area two main types of caves can be seen: the remnants of old phreatic caves and old karstic notch caves. The old phreatic caves include Nguoi Xua Cave and Dong Tien Ca. Nguoi Xua Cave is a sub-horizontal cave, about 100 m long with large passages at 50 m above sea level. Dong Tien Ca cave is located southwest of Tam Coc. It is a through cave with three entrances and about 150 m of passages developed parallel to the current mountainside.

The notch caves are like those in Ha Long Bay but formed by the freshwater streams flowing along the base of the cliffs. Many of these caves extend through the limestone towers into flooded depressions. One such cave located near Dong Tien Ca extends for about 250 m, reaching the other side of the mountain. In the Tràng An area, a series of eight caves are developed at or near the water surface, about 5 m above mean sea level, extending through karst towers developed in thick-bedded limestones. The rocks dip at 45° which results in either A-shaped or horizontal ceilings.

Right: Fig 9. Visitors approaching a cave in bamboo boat.

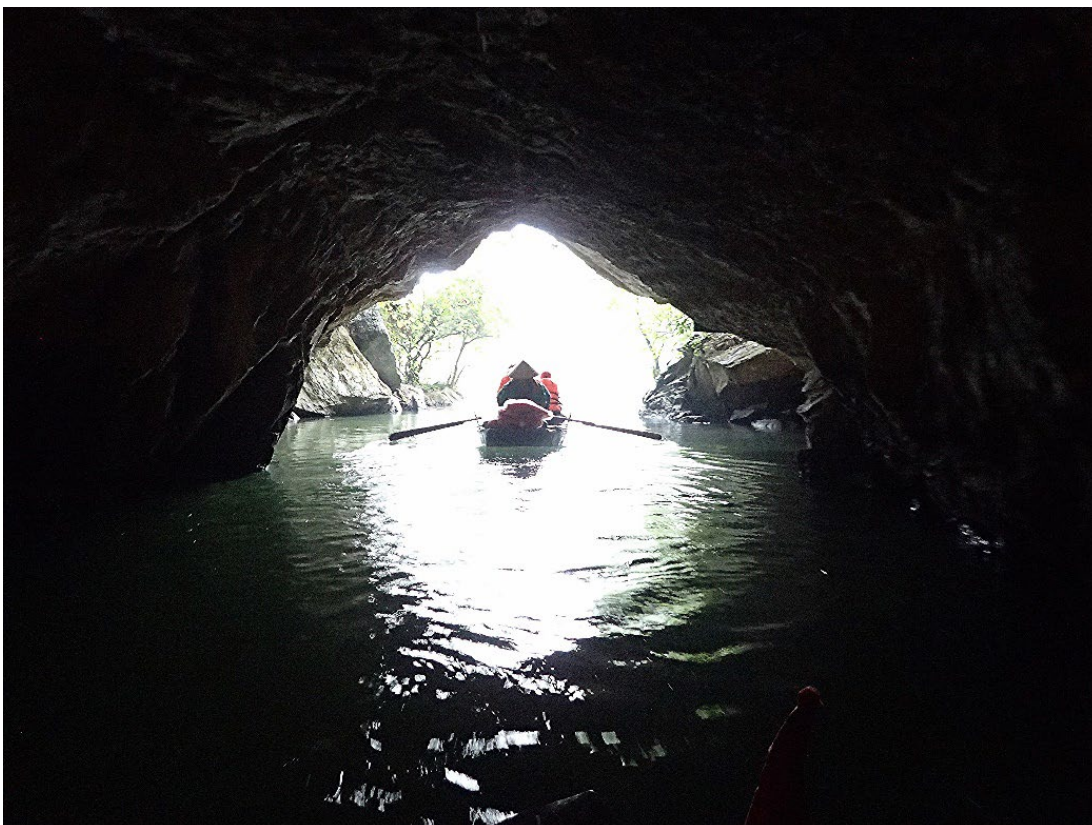
At the World Heritage centre near Tam Coc town, there is a large visitor centre with very good interpretive displays and restaurants. From here visitors can board bamboo boats paddled by local people and traverse one of three routes through the karst.

We chose a route which visited nine caves and two temples. The longest cave was about 600 m and many had electric lighting, supplied by hopefully waterproof cables. Headroom was at a premium in some caves and one had to remain alert.

The two temples were well maintained with no rubbish, although I have never seen a Coke machine in a temple before. The embarkation jetty was well organised like a taxi rank and several hundred boats were waiting for visitors. The area is now receiving about three million visitors annually and large bus tours arrive daily in the afternoons. So, the impacts will need very careful management if environmental degradation is to be avoided. To the west of Tam Coc is a small National Park which houses a rescued bear sanctuary. These poor animals had been illegally captured and their gall bladders removed for Chinese medicine, fetching a premium price on the international market.



Left: Fig 10. Emerging from Son Duong Cave.



We stayed at An's Eco Garden Lodge, west of Ninh Binh and located in a polje with extensive excavated fishponds and freshwater lakes. The lodge is surrounded by limestone cliffs and has an eclectic range of accommodation. From there it was easy and cheap to get to the Trang An area by local taxi.



Left: Fig 11. An's Eco Garden Lodge, west of Ninh Binh.

Below: Fig 12. Modified Russian truck from the Ho Chi Minh trail, turned into a guest caravan.

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Indochina Junk cruises <https://www.indochina-junk.com/cruise-packages/>

An's Eco Garden Resort <https://anecogarden.com/>



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