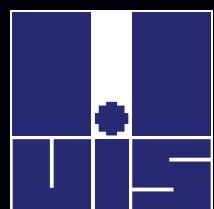
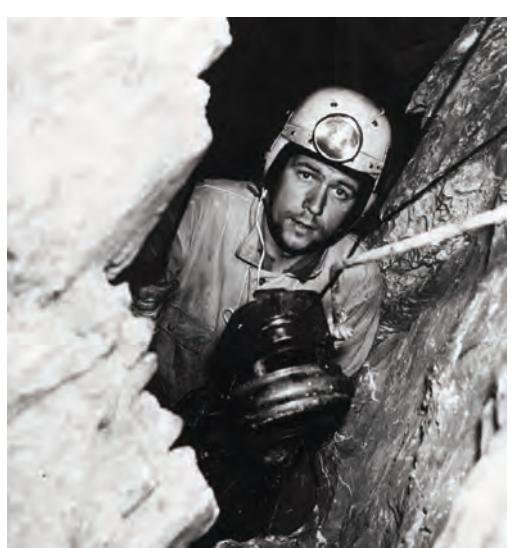


16th INTERNATIONAL CONGRESS OF SPELEOLOGY

Proceedings

VOLUME 1



Edited by
Michal Filippi
Pavel Bosák

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OF SPELEOLOGY**
Czech Republic, Brno
July 21–28, 2013

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KATALOGIZACE V KNIZE - NÁRODNÍ KNIHOVNA ČR

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Cover photos (some photos were adjusted/cropped)

Top left – José Bidegain, on his way for the recovery Marcel Loubens' body. Author unknown. For details see the paper by A.A. Cigna.

Top right – “Walking Mammoth” – a prehistoric drawing from the Kapova Cave, Russia. Photo by O. Minnikov. For details see the paper by Y. Lyakhnitsky et al.

Bottom left – “Astronaut” David Saint-Jacques (CSA) collecting microbiological samples for the scientific programme of the ESA CAVES course. Photo by V. Crobu. For details see the paper by Bessone et al.

Bottom right – The long-legged cave centipede *Thereuopoda longicornis* – a typical species of Lao caves. Photo by H. Steiner. For details see the paper by H. Steiner.

THE DISCOVERY OF CAVES IN KHAMMOUANE, LAOS (1991–2013)

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No less than 26 campaigns of cave exploration, mapping and studies have brought a deep insight into the previously almost unknown karst of Khammouane. This 290×40 km wide area of highly diagenetized permo-carboniferous carbonate area in Laos has revealed no less than 90 caves to our team, totalling some 170 km of development. The most extensive cave in Khammouane is so far 29 km long and we reached a +467 m relative elevation in another cave. Perhaps the largest cave opening in the world (215 m wide), a dozen of large chambers, giant passages and world-class through rivers were also studied. Scientific work encompasses geology, karst organization and characteristics, hydrogeology, biology, ethnospelaeology, ecotourism and other topics. This overview of this lifetime work on karst (23 years) is presented within its historical framework. Human aspects are taken into account and recommendations, including contract writing, are given.

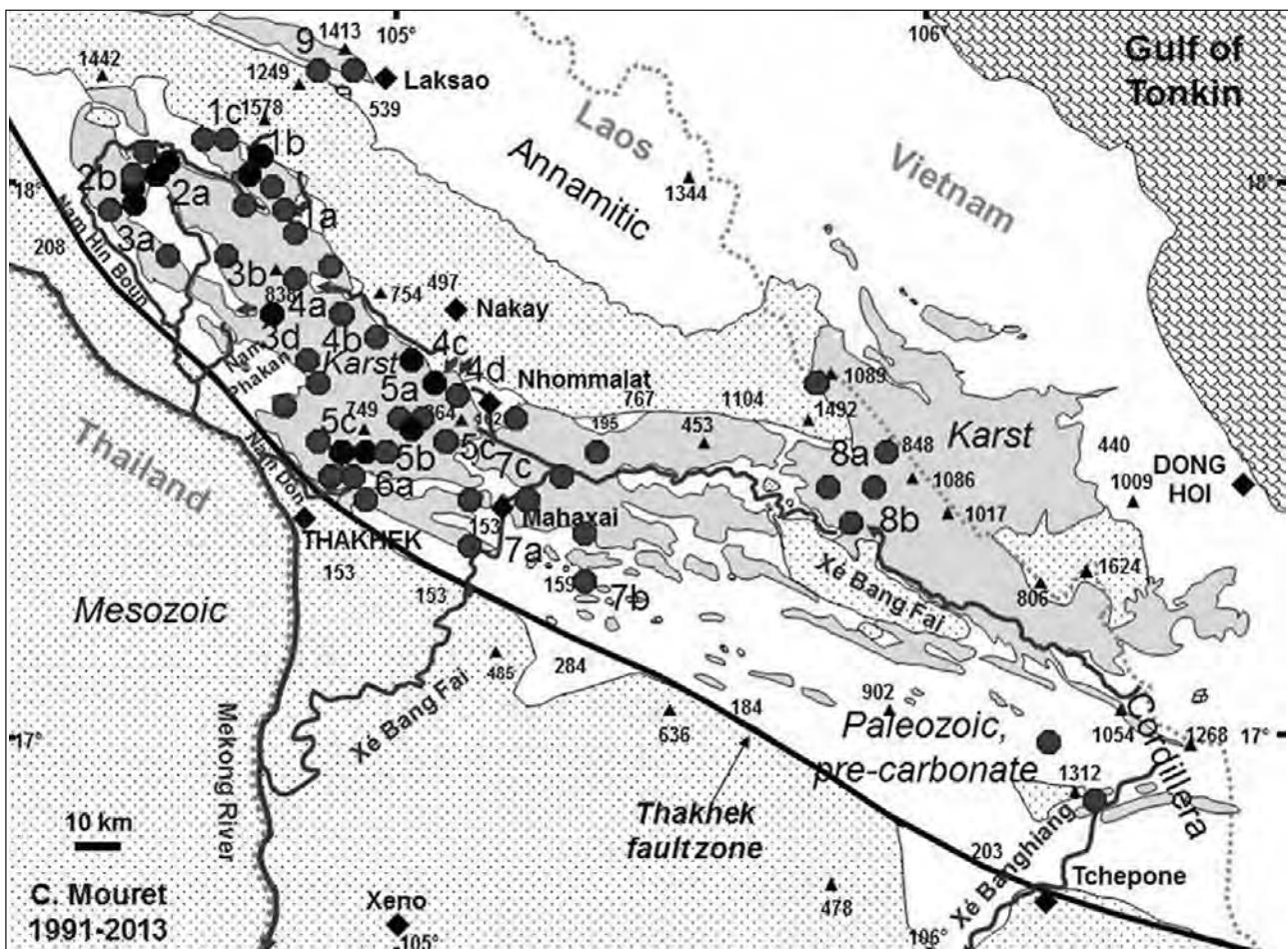


Figure 1. Simplified map of the karst of Khammouane in Laos and its continuation in neighbouring Vietnam. Dots represent the main areas that we investigated. Numbering of dot areas refers to text: a number may correspond to several nearby caves.

1. Introduction

As from 1991, systematic explorations and geological studies of the Khammouane karst area were initiated by the first author. In 1992, the first detailed cave mapping work was performed by the two authors (Mouret et al. 1993). Since, both of them have continuously cooperated until today, over no less than 26 exploration campaigns.

The team had a variable size, from two to 15 persons. Altogether, no less than 40 persons came with us, from France, Germany, America, Romania and Laos, of course.

We warmly welcomed all cavers willing to participate in the explorations and a number of scientific speleologists joined us. However, the system proved to reach a critical point when a few of the invited persons behaved as challengers, then left without sharing their results (e.g., surveys) acquired with the team, despite their promises.

Since the end-2009, we have been remapping those parts of caves which were diverted from the results of our team. Despite it is very time- and money-consuming, this work helps us in better understanding scientific aspects of the karst of Khammouane. We also continue mapping newly discovered passages.

This paper stresses the key periods of the 1991 to 2013 explorations, a view of the results achieved and some of the overwhelming difficulties we had to overcome.

2. A global approach to the karst

Since the beginning, our approach to the karst has always been global, as our goal consists of understanding the large tropical karst of Khammouane (290 × 40 km) in its natural and human setting (Mouret 2001, 2004). This large scale approach has been prepared by a previous similar approach to other karst areas and by a long experience of cave studies and geology in many areas throughout the world.

The global approach that we set up requires an adequate sampling and selection of caves to be explored and a careful recognition of karst phenomena and characteristics which can be original, never-described, nor interpreted. In addition, concentrating the mind on global karst organisation is of paramount importance, rather than focusing on unrepresentative or marginal details. A major breakthrough has been made on the karst hydrology, including the mapping of underground flows and the correction of more than once erroneous flow directions on the topographic maps (Mouret et al. 2003). We have been able to reconstruct the karst hydrogeological organisation of a substantial part of the large Khammouane karst.

The global approach had to permanently adapt to a variety of constraints and pressures, including human aspects.

It is worth also mentioning that speleology in Laos requires compulsory official specific authorizations.

3. A thorough search for caves and characteristic karst features

As our goal was a global approach to the karst, we first had to identify the most significant areas after a selection work based on scarce old speleological literature, more than 60 years old geological studies and modern investigations by the first author and other geologists, satellite imagery (Landsat at the time), morpho-geology (morphology and geology tied by their common logic), hydrogeology and other features of interest.

Search for caves in the field was systematically performed, mainly by the two authors. Together, more than 1,000 km of walk under variably difficult conditions were used to look for caves and another 2,000 km of walk for access to prospection areas. Most of the search was made along cliffs, as the karst surface is in many areas extremely rugged and very hardly accessible, with sheer cliffs, tsingy morphology and fengcong landscape.

The first author (team leader) often arrived in advance and was the last to leave, in order to look for more new caves and passages. The rule he applied was: **never finish an exploration campaign without knowing what the team would have to explore during the next campaign**.

Altogether, 460 days were spent in Laos by CM and 340 by JFV, i.e. far more than any other team member.

Cave mapping is only a part of our work, but it illustrates

the gradual and almost regular progress globally made at every new campaign (see Fig. 3). Cave drawing was performed by several persons. The first author has been by far the main mapper and the second has highly participated in most of the surveys made by the team. Their cave maps on gridded paper have been shown to the team at every campaign. From the extremely difficult conditions in 1991 to the present day far easier explorations in Laos, we followed a long path, permanently improving the things, including the logistics, based on Mr Vannivong's deep experience and CM's years-long experience of field work in difficult remote areas elsewhere in Southeast Asia.



Figure 2. A surface view of Khammouane showing rugged morphology with tsingy, as seen from one of the upper outlets of Tham Phiseua. At the location, vegetation is nil to scarce and xerophytic. Photo by C. Mouret.

4. Main caves discovered and mapped

Altogether, 90 caves were explored and mapped. Out of them, 26 exceed a 1 km length, ten exceed 5 km, six are over 10 km, and three over 15 km and one is above 25 km. **All these caves are still under study by us.**

Here below, references such as 1b or 5a refer to Figure 1.

Tham Nam Non: 1b. Major temporary flowing resurgence. Giant passages. Two large chambers. Discovery by the first author (CM) on Landsat imagery, then confirmed on old geological maps. Investigations in: 1994 (the two authors and B. Collignon), 1997, 1999 (21 km), 2004, 2005 (25 km), 2010, 2011–2. The 55 m long final sump was dived in 2010 by others (what we learned afterwards), just after our publication on the cave: it is connecting Tham Nam Non with Tham Song Dang, both already mapped by us (Mouret et al. 2009). Total known length is **over 29 km**.

Tham Koun Dôn – Tham Houay Sai (the downstream part of what we called the **Nam Dôn System**, which includes sinking points several kilometres away). 5c.

Koun Nam Dôn is the karst spring (resurgence) of the Nam Dôn. The two main cave outlets flow during flood periods. Discovered in 1997 at the initiative of CM, after his geological investigations that followed the discovery of Tham Houay Sai (a different cave which is a temporary sinking point – see further down, 5b) and the discovery of Tham Kagnung by the two authors and J. Lordon in 1996 (Tham Kagnung is a subperennial sinking river cave, 5a).

1997 (0.5 km), 1998 (6.5 km), 2000 (7 km), 2004, 2005 (11 km), 2006, 2010, 2011 a, b, c, 2012 (**17 km**). Three large chambers.

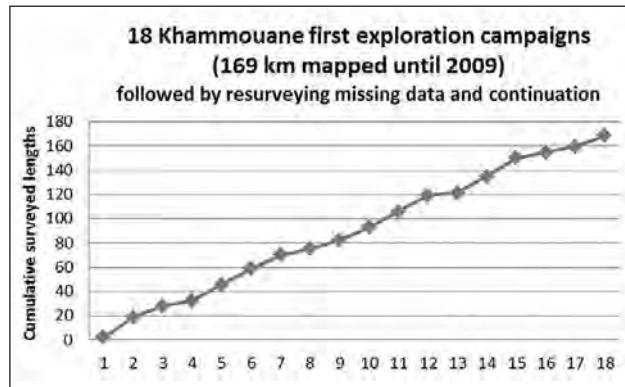


Figure 3. Progress of cave mapping during the 18 first campaigns, until Year 2009 included (n°18). After that, persons-related problems forced us to remap a part of the caves. Campaign 13 in 2004 was devoted mainly to archaeology and related surveyed length is short.

Tham Xé Bang Fai: 8b. Through cave with one of the largest underground rivers in the world (6.3 km long through-river). One large chamber.

First investigations by local fishermen, at least during the very early 20th Century (probably even before) then full crossing by Macey's team on a bamboo raft in 1904. 1995 (the authors, B. Collignon and C. Lagarde, in the difficult context of an ordnance-rich area due to previous wars) (9.1 km); 1996: car failure creating impossibility to reach the cave, then area closed to foreigners for nearly a decade; 2007: 1.5 km added; 2008: another 1 km; 2009 (the two authors alone for remapping). New length: **15.1 km** (Mouret et al. 2010).

Tham Nam Hin Boun, now largely called **Tham Konglor**: 1a. Through-cave with a large river (7.5 km through) used by villagers since the 19th Century at least. First western crossing by P. Cupet and H. Counillon in 1892. Sketch map by Macey (1908). Resurvey by the two authors and B. Collignon in 1994 (11 km). Additional investigations out of the river in 1997, 1999, 2004, 2005, 2006, 2011 (**13 km**). Giant galleries. Two large chambers.

Tham Phiseua: 5c. Discovered in 1996 by A. Gregory's team (1 km). Kind written authorization to continue exploration obtained from him by CM. 1998: reconnaissance inside by CM. 2000: Mapping starting at the entrance (J.M. Ostermann and CM) (1.3 km); 2002 (5 km, +315 m), 2003, 2004 (+376 m), 2005 (8 km, +465 m), 2006 (11 km), 2010, 2011, 2012 (**+467 m**, see below).

Sloping maze cave (Mouret et al. 2001) along dipping strata. Hollow stalagmites discovered by CM for the first time in Khammouane.

Tham Houai Sai (in the polje of Ban Vieng): 5b. Sinking temporary flowing river belonging to the Nam Dôn watershed. One large chamber. Discovery by Jean-François Vacquié (JFV) and C. Ferron in 1996. 1996 mapping mainly by the authors (2.5 km); 2000, 2001 (with X. Noguès) (9.9 km), 2011 (**10.1 km**).

Tham Lô: 5a. Two-level fossil cave in a cliff in the polje of Ban Vieng. Giant passages. One large chamber. Cave

learnt in 2001 from Ban Vieng villagers at CM initiative. 2001 mapping by CM, X. Noguès, J. Lordon and C. Noiriel (1.5 km), 2002 (3 km), 2004, 2005, 2006 (**8 km**).

Tham Thon: 2a. Temporary flowing sinking streams leading to resurgence in the Nam Hin Boun valley. Information gathered in 1991 by CM. 1997: CM initiative to go there and mapping together with F. Brouquisse (2 km). 1998, continuation by the same mappers and L. Deharveng (**8 km**). The cave was subsequently explored by a team led by FB without us and connected in 2001 to a cave already explored by captain Jouan's team in 2000. The new investigations covered the central part of the system only (total length: ca. 15 km).

Tham Song Dang: 1b. Multiple sinking points of Nam Non, followed by giant passages. First mapped by the authors and Y. Dreybrodt in 2003 (4.5+ km). Additional mapping in 2004. Total length: **over 5 km**.

Tham Boumlou: 4a. Sinking point of upper Nam Pakan at the end of a narrow, 12 km long, blind valley. First reached in 2002 with JFV (see below). 2004 (**ca 5 km**).

Tham Kwan Ha: 1c. Temporary flowing sinking river. Discovered in 2009 by the two authors, and mapped. 2010, 2011, 2012 (**4 km+**, **work in progress**).

16 caves currently have a measured length between 5 and 1 km including: **Tham Kwan Ha** (CM, JFV, 2009); Grotte Sans Nom, i.e. **Nameless Cave**, **3 km** (1b. Discovery CM, JMO in 2004); **Tham En** in Phon Thiou area (**2.7 km**) (discovery CM in 1991, 3a); **Grotte Marie Cassan** (4d. Cassan, 1948; CM, 1991, 2003; 2004); **Tham Phu** (4a. discovery CM, 2004); **Tham Ene** near Tham Xé Bang Fai (8b. Discovery CG in 2007); **Tham Heup** (2b. Macey, 1908; CM-FB-JFV, 1998), **Tham Koun Houay Feuang** (CM, FB, 1997; topo 2002, 2006. 5a); **Tham Lom**, **Tham Thê** (CM, JL, LD, AB 1998. 2b); **Tham En** near Thakhek, (6a. CM and JFV, 1992, **1.98 km**, giant entrance); **Tham Deua** (CM-CG-JFV, 2003. 4d); **Tham Khamouk** (CM-CG, 2003. 4d); **Tham Kagnung** (CM, JFV, JL, 1996. 5a), **1.5 km**, head of Nam Dôn System), **Tham Lom** (CM, JR, 2005.5c. Mapping by JMO in 2006); **Tham Phuhung** (CM-FB, 1997.1a);

Other caves of specific interest: Tham Nam Thieng, Tham Nong Ka, Tham Pa Fa, Tham Phanoi.

5. Main discoveries and results on karst

Geology: thickness of the Permo-Carboniferous carbonate, petrography, palaeontology, stratigraphy, sedimentology and depositional environments, petrophysical properties, tectonics, geohistory (palaeoburials and erosion depths, using a variety of methods), mineral seams crossed through by cave passages, phosphate and guano deposits.

Palaeokarst: discovery and interpretation of buried palaeokarst morphologies below Liassic red beds deposited under continental environments.

Cave maps: more than 170 km surveyed.

Karst systems: main types of cave systems, including subhorizontal active and fossil networks, sloping mazes (up to + 487 m), sunken passages, global organization.

Giant underground volumes: discovery of more than a dozen of giant chambers, of wide-sized passages (up to 120 m wide).

Cave sediments: studies of a number of fossil and present day sediments, with importance for the interpretation of cave genesis.

Hydrology: identification of the main, binary and unary, karst watersheds in Khammouane, identification of the sinking points, springs and many of their mutual relations, study of floods and of low waters, characteristics of flooding effects at surface.

Water chemistry: studies of chemical and physical characteristics of karst waters.

Cave meteorology: repeated measurements in a number of caves at different seasons.

Earthquake effects: the March 2011 Fukushima major earthquake was felt in a gallery located at the end of a funnel-shaped large chamber in the Nam Dôn System. Exceptional sonic phenomena were observed there.

Speleothems: among others, discovery of hollow stalagmites, pseudowallmites, rims, giant cave pisoliths, shields, circles of calcite, black circles, phosphate crusts, gypsum and moonmilk, giant speleothems such as pillars, rimstone pools, etc.

Cave mineralogy: sequential discrete sampling (a few tens of grams) in relation with cave organisation and geology, X-ray analyses, interpretation of thin sections, speleothem fabric.

Archaeology: study of two caves with respectively 229 (Mouret et al. 2005) and more than 100 Buddha statues and other artefacts. Cave wall drawings and paintings (Ostermann et al. 2003).

Biospeleology: study of cave macrofauna (buffaloes, wild boars, wild goats, snakes, rats, birds, bats, fishes, worms, crabs, the largest spider in the world and other arthropods) and microfauna. New species and genera.

Palaeontology: discovery of rhinoceros bones (now extinct in the area) and of wild goats.

Ethnospaleontology: burial caves, hidden “treasures” related to Buddhism, cave use during Vietnam war, Buddhist caves, modern cliff and cave wall drawings, hunting and fishing in caves, caves as a link between villages, “cave is money” aspects.

Cave and karst protection: respect for caves, selection of permanent paths for progression, recommendations, guidelines for protecting caves open to visitors, assistance to Tourism Authority of Khammouane and to provincial Government. Active participation in UNESCO meeting for selecting new World Heritage areas in Asia and setting guidelines and recommendations for this.

Photography and videography: comprehensive sets of photographs realized. Movies, shown at German TV.

Promotion of ecotourism: promotion of selected caves for tourism. Tham Konglor, mapped by us in 1994 and after, is now one of the world landmarks for tourists. This has contributed to the large economic development of the valley. Guidelines for officials on caves and karst value.

6. Publications

Despite not everything has been published yet, we have produced more than 60 papers on our explorations (Mouret 2001) and results. A comprehensive work is in progress. A

significant number of papers was published in proceedings of previous International Speleological Congresses and in Spelunca, among others. Publications have been made despite not all parts of the surveys of our team were made available to us and despite heavy pressure put on our persons. We obviously had also to care of our time-consuming professional work and heavy responsibilities and activity in national and international speleological federations. Co-autorship has been given to team members who put their surveys “in the pot”.

50 km of cave maps have been published with detail and another 28 km has been published as simplified maps. In the final work, full data (maps, longitudinal sections and cross-sections) will be given.



Figure 4. A fossil passage formed horizontally alongstrike of dipping carbonate beds, in Tham Phiseua. The slightly incised passage floor is covered with moonmilk and gypsum crust. For purpose of protection and respect, we walked only on the rocky shelf. Photo by J.-F. Vacquié.

7. Welcoming new team members

We welcomed all persons who expressed their interest in exploring caves of Khammouane with us. The conditions were co-signing publications and complementarity in everybody's speciality. Logically, no duplication of somebody else's work was permitted. Newcomers had to respect previous work and to bring something new and useful to the team: techniques, knowledge or – at least – participation to the team effort and friendship.

Every year, the team leader (the first author) proposed the caves and passages to be explored. In the field, he did not hesitate to give briefings on the current knowledge, to show the maps already drafted on gridded paper and to explain the objectives of the exploration.

Newcomers were taught of caves newly discovered (see Chapter 3). They were made aware of unexplored passages in caves under study and even guided, when necessary, by the authors up to the starting point of the survey of virgin galleries. Often, they were helped in such virgin passages by JFV, even for mapping. This was a major real proof of our deep consideration for them, by providing them with easy-to-make discoveries.

The knowledge of unexplored galleries given to newcomers was largely the result of previous intense cave mapping work (see Chapter 3), as parts of passages under survey were left for the next campaigns.



Figure 5. A fossil passage in Tham Nam Non, with multistory rimstone dams. Photo by J.-F. Vacquié.

The purpose of this was to maintain motivation in the team. In addition, this allowed us better exploring and studying a cave, thanks to knowledge gained in others. We will see that this way of doing is not satisfactory because it generated unwelcomed consequences. For instance, a minor one is that a couple of persons lacked politeness by complaining that the virgin passages were “not good enough for them”. They refused admitting that the discoveries offered to them could easily have been kept by us for our own use. A major one is that they subsequently did not communicate any of their surveys.

We feel that a few persons brought heavy disturbance and tried to “kill” our explorations and take them over, based on what they learnt from our knowledge. Recently among them, one or two never came with us in speleology.

8. Six periods of exploration

8.1. First period: pioneering (1991 to 1995)

In 1991, CM started studying the geology of Palaeozoic and Mesozoic strata in Khammouane. A good number of cave entrances were located in the field or learnt of, e.g., Tham En in Phon Thiou area, Tham Thon, Grotte Marie Cassan, also the characteristic polje of Ban Vieng. Roads were rare, narrow and unsurfaced, so access to sites was extremely difficult. Ongoing guerrilla rendered body guards compulsory. No foreigner can imagine today what Laos was at the time, as so much good progress has been made since.

In 1992, the first author managed to set up a first exploration campaign, under difficult conditions. Perhaps the widest cave entrance known in the world (215 m across) was discovered. 1993 was a period of political instability and no exploration was allowed – except two reconnaissance campaigns by CM. In early 1994, the authorization to explore caves was obtained again.

Immediately in 1994, then in 1995, we re-explored, after precursors a century ago, and accurately mapped with detail two major world-class river caves, Tham Konglor and Tham Xé Bang Fai through-caves (see above). We started exploring the gigantic Tham Nam Non and clearly established its large potential (it is currently the longest in Laos – over 29 km). 30 km of passages had already been surveyed in Khammouane by us as per 1995.

8.2. Second period: normal explorations (1996 to 1998)

The team was enlarged. In 1996, the Nam Ngo springs area near the Vietnam border proved disappointing and the Xé Bang Fai could not be accessed because of vehicle failure. J.F. Vacquié discovered the Tham Houai Sai dry sinking stream. With CM, he discovered and started exploring Tham Kagnung, the only perennial sink in the polje of Ban Vieng. CM geological studies then indicated two spots to be checked in a large karst valley on the opposite side (SW) of the massif: they might be the resurgence(s) of Tham Kagnung and possibly Tham Houai Sai streams. This was the beginning of the knowledge of the Nam Dôn System.

In 1997, Tham Nam Non was continued. The resurgences deduced from the study of Tham Kagnung were effectively discovered, including the spring of the major Nam Dôn, not shown on the then available 1:100,000 topographic map. CM surveyed the beginning of these three caves. Based on 1991 data, Tham Thon was spotted by CM and FB and mapped for over 2.5 km (FB drawer).

In 1998, the area of Ban Nakhok was investigated (Tham Heup, Tham Thê, Tham Nam Thieng...). Tham Thon was mapped up to 8 km length. The Nam Dôn caves (Tham Houay Sai and Tham Koun Dôn) were mapped to over 7 km and CM wrote that their system would be no less than 25 km long.

8.3. Third period: so many worries (1999 to 2004)

FB refused to join the team in 1999, despite our repeated invitations. He claimed he wanted to write papers with no co-author. Our focus was placed on Tham Nam Non, bringing the cave survey to over 21 km. After the 1999 campaign, we had already surveyed 60 km in the karst.

In 2000, a newcomer (JMO) was invited by CM. Mapping Tham Houai Sai (in the polje of Ban Vieng) and Tham Houay Sai (in the Nam Dôn valley) was significantly pushed further and Tham Phiseua was mapped from the entrance over more than 1.3 km. Tham Nong Kha showed at the ceiling the painting of a man.

In 2001, Tham Houai Sai was pushed to 10 km. The fossil Tham Lô was discovered after CM questioned villagers, and mapped with three other colleagues. Tham Koun Houay Feuang (1997 CM-FB discovery) was surveyed.

In 2002, Tham Phiseua, Tham Lô and the Nam Pakan valley (Tham Boumlou was first reached by JFV and three other colleagues) were studied. More wall drawings, including further human representations were discovered and studied. The karst of Lak Sao was investigated for the second time after 1991. More than 90 km had already been mapped in Khammouane by our team as per 2002.

During the period, we suffered a number of problems: FB, then a national speleological body official, continued Tham Thon, with a team he set up on purpose, and joined it with another cave mapped in 2000 by captain Jouan's team. In this way, a part of our work was diverted, as for two other caves discovered by CM. In 2001, FB mapped a passage in Tham Phiseua which branches from our 2000 discoveries without him. In 2002, he explored the resurgence of Nam Pakan that we had officially declared to a national speleological body as one of our objectives.

In 2003, partly with a newcomer invited by JFV: CG, CM resurveyed (after Cassan 1948) “Grotte Marie Cassan” up to the final sump. We mapped other caves in the same area (Tham Khamouk, Tham Deua...). With Y. Dreybrodt, the two authors accessed the sinking point of Nam Non and mapped Tham Song Dang over some 4.5+ km, this just after further mapping in Tham Phiseua. We were then at 105 km all together surveyed in the karst.

In 2004, we went to Tham Phiseua; then we continued Tham Boumlou, while a team led by a national speleological body official was trying to push up from the resurgence. A sump prevented them “invading” the upstream part of the cave that we were exploring. We mapped Tham Phu discovered by CM; then we continued Tham Lô.



Figure 6. The entrance to fossil Tham Lô (tree for scale). Photo by C. Mouret (2006).

8.4. Fourth period: apparent peacefulness or the wolf in sheep's clothing (2004 to 2005)

Again in 2004, after the discovery of Tham Pa Fa by a villager, CM was invited by the Tourism Authority of Khammouane to study the cave and he asked CG to join. In 2005, we focused on Tham Nam Non, Tham Phiseua and especially the Nam Dôn System. Many results remained unavailable to us despite repeated promises.

8.5. Fifth period: new big worries (2006 to 2009)

2006 was a good year for exploration and a bad one for human relations in the team. A group of four persons that we, JFV or CM, had invited to join our team, one in 2000, one in 2003 and two in 2004 were especially aggressive. CM had invited for 2006 a team of divers abandoned by their leader, who was with us in 2005 upon invitation by CM. The Nam Dôn System was further mapped, as was Tham Phiseua and Tham Lô. A dozen of kilometres were surveyed, but many of them are not available to us.

In 2007, focus was placed by CM on the Xé Bang Fai, which was newly accessible again. In 2008, two of the aggressive team members tried to take over the leadership using a number of disputable ways. The Xé Bang Fai area was on focus again and, upon CM's proposal, further work in the Grotte Marie Cassan area. Later on, we realised that, as in 2006, we were not told all the truth.

For 2009, CM put on the program further work in the Nam Non area. As so many surveyed kilometres were concealed by a few team members, it was decided that the latter would map separate caves, in order that our own work be not jeopardized. The two authors both discovered Tham Kwan Ha after a long prospection and operated a large part of the mapping work. They were unduly overtaken in the cave by two other team members while doing so. This latter behavior resulted, together with the long-concealed surveys, in a serious explanation.

A few months later, the team split, due to said unwillingness to work together. Subsequently, “the other team” used all diverted results as a capital to attract new and many people around them.

8.6. Sixth period: remapping missing parts (2009 to 2013)

The two authors understood that they would never receive the missing parts of the surveys that they asked for so many times during six years: 49 km altogether, probably a world record, this from a few persons only! Therefore, our publications were blocked and a part of our own surveys had become useless, due to lack of link with more proximal parts of caves. So, we decided to resurvey the missing parts, in order to publish.

At the end of 2009, the two authors resurveyed and checked enough data of the Xé Bang Fai to produce a paper in Spelunca Bulletin. In 2010, together with Terry Bolger, they further explored Tham Nam Non and Tham Koun Dôn – Houay Sai in the Nam Dôn System, making a very good mapping breakthrough in a giant maze area. Meanwhile, “the other team” went partly to caves already under advanced mapping by us, partly to caves started by them in 2009 and largely to a major cave about which they told us in 2008 that there was no continuation, after we taught them the entrance.

In 2011, the authors and Jacques Rolin resurveyed missing passages mainly in Tham Nam Non, Nameless Cave, Tham Kwan Ha, Tham Phu and in the Nam Dôn System. CM wrote that the length of the latter was likely to be over 50 km long. During that campaign, the authors made the bitter experience to find out that “the other team” had also been mapping the Nam Dôn System, after the publication of our report on 2010 work. At the next 2011 peak dry season, the two authors further explored and mapped the System, as well as Tham Phiseua, Tham Houai Sai (>10 km), studied Tham Phanoi and made further studies in Tham Heup and Tham Nam Thieng. They went again into the karst at the end of Year 2011, pushing the Nam Dôn System, Tham Phiseua and the Tham Nam Non mapping.

In 2012, “the other team” returned to the Nam Dôn System in February, our usual period of exploration. Therefore, the authors and J. Rolin could go there at the end of the dry season only. The previous elevation of Tham Phiseua (+465 m, a figure based on GPS control by CG in 2005 and checked by us with GPS and Google Earth in 2012) was revised by us to a lower value, but we gained another +24 m and now accept a +467 m value.

Our mentor and excellent friend in Laos, Mr. Vannivong

Soumolphakdy, passed away no long after this 25th campaign, after having organised for us the Laotian part of the logistics since 1994, in close co-operation. At the end of 2012, we payed respects to our friend's ashes, then we continued the Nam Dôn System, Tham Kwan Ha and other caves, as he liked, until the first days of 2013. We continue our work in Khammouane in his honour. Early 2013, more caves we are exploring are being investigated by "the other team".

9. Relations with other teams

On our own, our wish was (and still is, despite adversity) to maintain good relations with people. We had no special problem with teams from other countries and a few teams from our country.

However, we have to face the paramount problems arisen from persons that we kindly invited and trusted. They came with us, learnt about the caves we discovered and explored, collected scientific knowledge and contacts from us, including the way how going through in the country and a good picture of our ideas and program. Now they use our elective time period during the dry season and all our usual facilities. They continue, on their own and with a very large team, the exploration of caves which were started mapping by our team and regularly continued by us until today, rather than to look for unexplored caves, still so numerous in such a large karst.

In this way, we are dispossessed from a large part of our investment in time, money, effort and knowledge, and of our results by persons that we welcomed and soon **did not respect the rules of the team**. Among the so many persons who came with us, many have been very correct.

10. Conclusion: protecting our work and proposal for written contracts

Despite clear mention to newcomers of the way how the team works, a few (though too many!) persons did not respect the rules and cheated the rest of the team, with 49 km of diverted mapped passages.

No less than eight caves that we discovered, mapped and studied (black dots on Figure 1) have been continued to be explored by "others" without our approval, despite our many publications and clear statements that they were under study. 1.5 month after the printing of our paper on Tham Nam Non, others dived inside without informing us. We continued and continue exploring all caves we discovered during our 26 campaigns over a time span of 23 years already, a lifetime investment which, we feel, has been deliberately jeopardized by invited persons.

Our experience may happen to other speleologists, especially when good results are achieved.

So, requesting any team member, especially newcomers, **signing a full written contract is nowadays a must and our deep recommendation**, with all aspects duly documented. Changing world and mentalities have largely moved traditional respect, friendship, trustfulness and verbal agreements into the abysses of a past lost for ever. It

is preferable facing the future with a re-adjusted behavior designed to better fit today's reality.

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Our exploration campaigns have been possible thanks to the help of Mr. Claude Vincent, then of Mr. Vannivong Soumolphakdy. We cherish their memory and continue our explorations in their honour.

Nothing would have been possible without our many friends and our families.

Definitely, we have loved Laos since our first contact and we do appreciate the wonderful people and magnificent nature. Seeing the country changing permanently toward a good and fascinating future is a great pleasure.

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