Cartography beyond the Planimetric
Alaska Trek, Hang Son Doong, and El Capitan

Martin Gamache
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ALASKA TREK

March 2011
Circling Alaska in 176 Days

Nobody had ever done it before: hike, ski, and raft 4,679 miles through eight national parks, dozens of mountain ranges, and the length of the Yukon Territory. Then along came Andrew Sharma.

DEHALLI NATIONAL PARK, APRIL 27, 2010

Skiing over this unexcised pass made me nervous,” says extreme trekker Andrew Sharma. “I was dreaming about an avalanche due to the warm and sunny spring weather.” With 1,120 miles behind him, he still had 3,519 to go.
ALASKA THE LONG WAY

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Map note 2
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Map note 3
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How Andrew travelled
ALASKA DAY BY DAY

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What Andrew Carries
Average Pack Weight: TK pds
Pack Raft and paddle: TK pds
Tent: TK pds
Pack: TK pds
Sleeping gear: TK pds
10 days of Food: avg TK pds max TK pds

Mapping it out
This is a note about all the maps Andrew prepared and used to navigate and keep his journal.

Heavy carry
The Brooks Range is isolated, requiring 20 days between resupply packages and heavy packs.

Speed
Rowing at 6 miles an hour on the TK river and covering 500 miles in 11 days nearly doubled his pace.
DAY-TO-DAY CHALLENGE

“This trip wasn’t a race. It was 178 back-to-back marathons,” Andrew Skurka says. “Some miles whizzed by, like when I was rafting the Yukon River. Others seemed to go on forever, such as when I was wallowing in rotten snow and tangled up in alder in the Alaska Range. I learned quickly that I couldn’t force it. If nature had other plans, I had to adjust.”

How Skurka traveled
Andrew was self-prepared the whole way, whether skiing, paddling, or hiking. Occasionally he hiked into towns off his route to stock up on supplies.

- **Skiing**: 1,577.3 miles
- **Paddling**: 1,293.3 miles
- **Hiking**: 2,092.3 miles

Total: 4,962.9 miles

- Food or gear resupply
- Rest day

Average daily temperature (°F) along Skurka’s route

<table>
<thead>
<tr>
<th>Day of trek</th>
<th>March 14</th>
<th>April 1</th>
<th>May 1</th>
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<td>Months</td>
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<td>Coldest temperature 20°F (-7°C)</td>
<td>14 hrs</td>
<td>15 hrs</td>
<td>15.5 hrs</td>
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<tr>
<td>Longest distance hiked in one day</td>
<td>124 miles</td>
<td></td>
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<tr>
<td>Longest distance walked in one day</td>
<td>28.5 miles</td>
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<tr>
<td>Hours of daylight</td>
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HOW SKURKA’S GEAR MEASURED UP

<table>
<thead>
<tr>
<th>GEAR WEIGHT (POUNDS)</th>
<th>SUMMER</th>
<th>WINTER</th>
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<tr>
<td>Clothing worn &amp; footwear</td>
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<td>Sleeping gear</td>
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</tr>
<tr>
<td>Shelter</td>
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<td>1.2</td>
</tr>
<tr>
<td>Sieve or pack raft equipment</td>
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<td>7.3</td>
</tr>
<tr>
<td>Other gear in pack</td>
<td>8.5</td>
<td>11.6</td>
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<tr>
<td>Total</td>
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</tr>
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One day of food (all seasons): 2.1 pounds; 4,760 calories

MAPPING IT OUT

“We floated 1,100 miles under a magical full moon,” Skurka said on a map of the Copper River (left), one of 249 he used to plan his route.

Heavy load
In this final 1,700 miles, Skurka passed and two roads and a few villages, forcing him to carry more than 30 pounds of food.

Speddy rafting
Skurka covered 50 miles on the Yukon River in just ten days, easily doubling his average pace for the trip.

Risky coastline
His route along the sandy coast was “mostly easy walking punctuated by moments of terror,” Skurka says. The most dangerous part: paddling across open ocean bays.

Eispadro Trail
Getting off on skis, Skurka endured mostly below-freezing temperatures, the thermometer at the Eispadro Trail. As spring arrived, the snowpack turned wet and rotten.
HOW SKURKA TRAVELED

Andrew was self-propelled the whole way, whether skiing, paddling, or hiking. Occasionally he hitchhiked into towns off his route to stock up on supplies.

Date: March 14
Day: 1

Bars show each day's estimated mileage.

33.1 mi.

Touch icon along route to see photos.
LARGEST CAVE

Hang Son Doong
Vietnam

January 2011
CONQUERING AN INFINITE CAVE

There’s a jungle inside Vietnam’s mammoth cavern. A skyscraper could fit too. And the end is out of sight.

A team made up of 200 strong cavers could fit inside this stretch of Hang En’s entrance, which may be the world’s biggest epigenetic cave system. In startlingly large scale, a climber ascends a shaft of sunlight.
The largest caves in the world

Hang Son Doong, Vietnam

Garden of Eden
(Sarawak Chamber superimposed)

Caves of southern Mulu, Sarawak

Carlsbad Caverns, USA
Hang Son Doong
(Cave of the Mountain River)
Bo Trach District
Quang Binh Province
Peoples Republic of Vietnam
Grid Ref: 637256E: 192975N
Map Sheet: Co Trach, So Hue 62431
Surveyed Length: 6481m
Vertical Range: +13.6, -156.4m
BCRA Grade 5c
Explored & Surveyed by "Vietnam 09"
Surveyed using M.I.L. Lasertrace 100
All passage cross sections drawn at double scale
Dashed lines indicate passage walls not fully explored
Hang Son Doong
(Cave of the Mountain River)
Bo Trach District
Quang Binh Province
Peoples Republic of Vietnam

Grid Ref: 672515E, 593275N
Map Sheet: Co Trach, So Hieu 62431
Surveyed Length: 8441m
Vertical Ranges: +13.6 to -168.4m

Surveyed using M.O.L. LaserScan 300

Explored & Surveyed by "Vietnam 09"

Map North 1:50000

Detailed information package notes not fully explored.
PATH OF A RIVER CAVE

In April 2009 a British-Vietnamese team began exploring Hang Son Doong, or “mountain river cave” (below). Beneath the rain forest along the Vietnam-Laos border they discovered a cavernous limestone passage more than 2.5 miles long and in places over 600 feet high, carved by a subterranean river two to five million years ago. Expeditions have found more than 150 caves in this area since 1940, mapping nearly 90 miles of passages.

A MEGA-SINKHOLE OPENS

The cave’s Garden of Edom sinkhole owes its size to its location: Another passage entered the main cave here. When the ceiling collapsed at this junction, it opened a pit 1,500 feet deep, with a 650-foot-wide opening.

Dissolving

2 million to 3 million years ago
A karst-terranean chamber (A) forms as water flowing along fractures (D) dissolves the limestone.

Expanding

With continued erosion and collapse (C), debris accumulates faster than it can be removed by the flowing water (D).

Collapse and colonization

Within the past million years
The chamber’s roof collapses, opening the cave to the sky. Ferns and trees colonize the exposed debris cone (B).

Canvas for Caves

Vast formations of limestone, in places thousands of feet thick, were deposited across this region 250 to 350 million years ago. Tectonic action uplifted and fractured the rock. Rivers followed these fractures underground, dissolving networks of cave passages.

Viewpoint of photo in 3D

South entrance discovered in 2009

Dark section of passage

Head of Dog

North entrance discovered in 2010

Pearl Harbor

Great Wall of Vietnam

Garden of Edom

Watch Out for Dinosaurs

The whimsically named sinkholes later in light and rain, which seeps into the river now carving new passages beneath the cave floor.

Dark passages

With light entering the relatively straight cave through its entrances and sinkholes, only a few stretches lie in pitch darkness.

North entrance covered by rain forest in 2010

Two discharge systems, the Vina and the Phong Ha, channel subterranean waters that have carved two remarkable cave networks.
Two drainage systems, the Vom and the Phong Nha, channel subterranean waters that have carved two namesake cave networks.
Two drainage systems, the Vom and the Phong Nha, channel subterranean waters that have carved two namesake cave networks.
South entrance
Flowing into the cave, the Rao Thuong River soon vanishes into the limestone. High water makes exploration too dangerous in summer's rainy season.

Watch Out for Dinosaurs
The whimsically named sinkhole lets in light and rain, which seeps into the river now serving new passages beneath the cave floor.

Garden of Eden
In the larger and older of the cave's two sinkholes, a forest of 100-foot trees covers an 800-foot debris cone.

Dark passages
With light entering the relatively straight cave through its entrances and sinkholes, only a few stretches lie in pitch darkness.

Great Wall of Vietnam
Scaling this calcite wall, caverns found a north entrance in 2010. The muddy maze called Passchendaele is watered by an internally rising stream.

Empire State Building at same scale for comparison.
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KINGKANG.DAT - Cave Editor 32

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Cell: 3,1 | Shots: 152 | Modified: No | Errors:

Enter: Meters
South entrance
Flowing into the cave, the Rao Thuong River soon vanishes into the limestone. High water makes exploration too dangerous in summer’s rainy season.

Watch Out for Dinosaurs
The whimsically named sinkhole lets in light and rain, which seeps into the river now serving new passages beneath the cave floor.

Garden of Eden
In the larger and older of the cave’s two sinkholes, a forest of 100-foot trees covers an 850-foot debris cone.

Dark passages
With light entering the relatively straight cave through its entrances and sinkholes, only a few stretches lie in pitch darkness.

Great Wall of Vietnam
Scaling this calcite wall, cavers found a north entrance in 2010. The muddy maze called Passchendaele is watered by an internally rising stream.

Empire State Building at same scale for comparison.

Viewpoint of photo is T14.

North entrance discovered in 2010.

Passchendaele

Pearl Harbor
**A MEGA-SINKHOLE OPENS**

The cave’s Garden of Edam sinkhole owes its size to its location: Another passage entered the main cave here. When the ceiling collapsed at this junction, it opened a pit 1,500 feet deep, with a 650-foot-wide opening.

**Dissolving**

*2 million to 5 million years ago*

A subterranean chamber (A) forms as water flowing along fracture lines (B) dissolves the limestone.

**Expanding**

With continued erosion and collapse (C), debris accumulates faster than it can be removed by the flowing water (D).

**Collapse and colonization**

*Within the past million years*

The chamber’s roof collapses, opening the cave to the sky. Ferns and trees colonize the exposed debris cone (E).
passage is extra-wide, and ceiling is faulted.

stoping collapse (from below)

sinkhole & forest
DEEP GREEN: VIETNAM'S SON DOONG CAVE MAY CONTAIN THE WORLD'S LARGEST CAVE PASSAGE

KARST LANDSCAPE EXPLORATION

This is a note about the limestone plateau, the quantity of caves and the history of exploration. A map key will accompany this note.

AREA ENLARGED

Cave Profile

This is a note about the length nature of the cave forming along fault. This note should also describe that light can often be seen in the cave due to the multitude of openings. The note will discuss why this is considered the largest cave passage in this section.

Evolution of the Garden of Edam

Tiankeng/Doline/Sinkhole

This is a note about the area and description of the other formerly known as the Doline. The dolines have dome collapse due to erosion, internal fault and fault weaknesses. These dolines are similar to Tiankeng/Dolines, a type of large collapse previously described in China but in the US usually known as a sinkhole. That term however does not describe vegetation-filled, rock cliff-lined open pits.
DEEP GREEN:
VIETNAM’S SON DOONG CAVE MAY CONTAIN
THE WORLDS LARGEST CAVE PASSAGE

KARST LANDSCAPE
EXPLORATION

CAVE PROFILE

Evolution of the Garden of Edam Tiankeng
PATH OF A RIVER CAVE

In April 2009 a British-Vietnamese team began exploring Hang Son Doong, or “mountain river cave” (below). Beneath the rain forest along the Vietnam-Laos border they discovered a cavernous limestone passage more than 2.5 miles long and in places over 600 feet high, carved by a subterranean river two to five million years ago. Expeditions have found more than 150 caves in this area since 1940, mapping nearly 90 miles of passages.

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1. Dissolving
2. Expanding
3. Collapse and colonization

Vast formations of limestone, in places thousands of feet thick, were deposed across this region 250 to 350 million years ago. Tectonic action uplifted and fractured the rock. Rivers followed these fractures underground, dissolving networks of cave passages.

Watch Out for Dinosaurs

The whimsically named sinkhole later in light and rain, which seeps into the river now carving new passages beneath the cave floor.

Garden of Eden

In the larger and older of this cave’s two sinkholes, a forest of 100-foot trees covers an 850-foot-deep debris cone.

Dark passages
With light entering the relatively straight cave through its entrances and sinkholes, only a few stretches lie in pitch darkness.

Great Wall of Vietnam
Sealing this estate wall, covers found a north entrance in 2010. The mudslide called Phong chanddle is watered by an internally running stream.

Networks of caves

Two drainage systems, the Men and the Phong Ma, channel subterranean waters that have carved two impassable cave networks.

For more information, contact

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Martin.Crocken@noac.gat
Website: www.noac.org

The National Speleological Society
www.speleo.org