A diver in a blue wetsuit and mask is shown underwater, cleaning an ancient human skull with a brush. The skull is resting on a black circular platform. The diver is wearing a blue wetsuit, a black diving mask, and blue gloves. The background is dark with some light particles.

First Humans in  
the New World:  
Ice Age Discoveries  
Deep Beneath the  
Yucatan

Dominique Rissolo, Ph.D.

UC San Diego  
Cultural Heritage  
Engineering Initiative

[drissolo@ucsd.edu](mailto:drissolo@ucsd.edu)

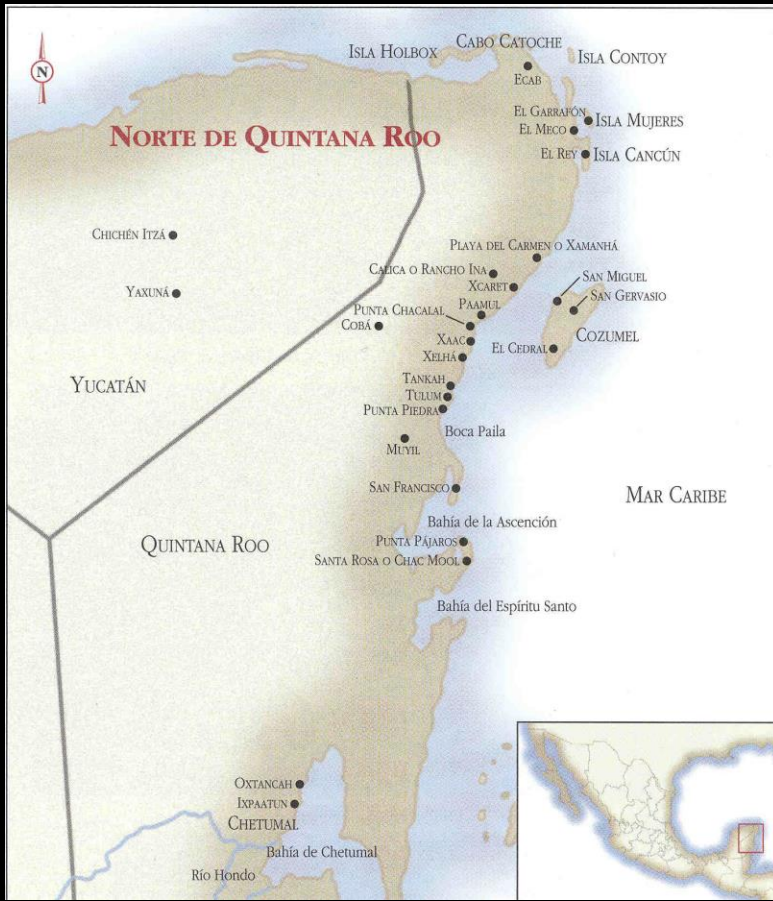
## Science and Survey Team



Pilar Luna

Alejandro Alvarez  
Fabio Esteban Amador  
Diana Arano Recio  
Joaquin Arroyo-Cabrales  
Yemane Asmerom  
Franco Attolini  
Helena Barba Meineke  
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Susan Bird  
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James C. Chatters  
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Shawn Collins  
Andrea Cucina  
Brendan Culleton  
Fred Devos  
Yolanda Espinosa Morales  
Ruben Herrera  
Ann Jaskolski  
Corey Jaskolski  
Brian Kemp  
Douglas Kennett

Shawn Kovacs  
Christophe Le Maillot  
Eric Lo  
Pilar Luna Erreguerena  
Ripan Malhi  
Luis Alberto Martos López  
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Sam Meacham  
Jacob Mellor  
Shanti Morell-Hart  
Alberto Nava Blank  
Vid Petrovic  
Victor Polyak  
Patricia Quintana Owen  
Marco Ramirez Saloman  
Daniel Riordan Araujo  
Eduard Reinhardt  
Dominique Rissolo  
Blaine Schubert  
Michael Shepard  
Thomas W. Stafford  
Vera Tiesler  
Sabrina Trinh  
Chris Widga

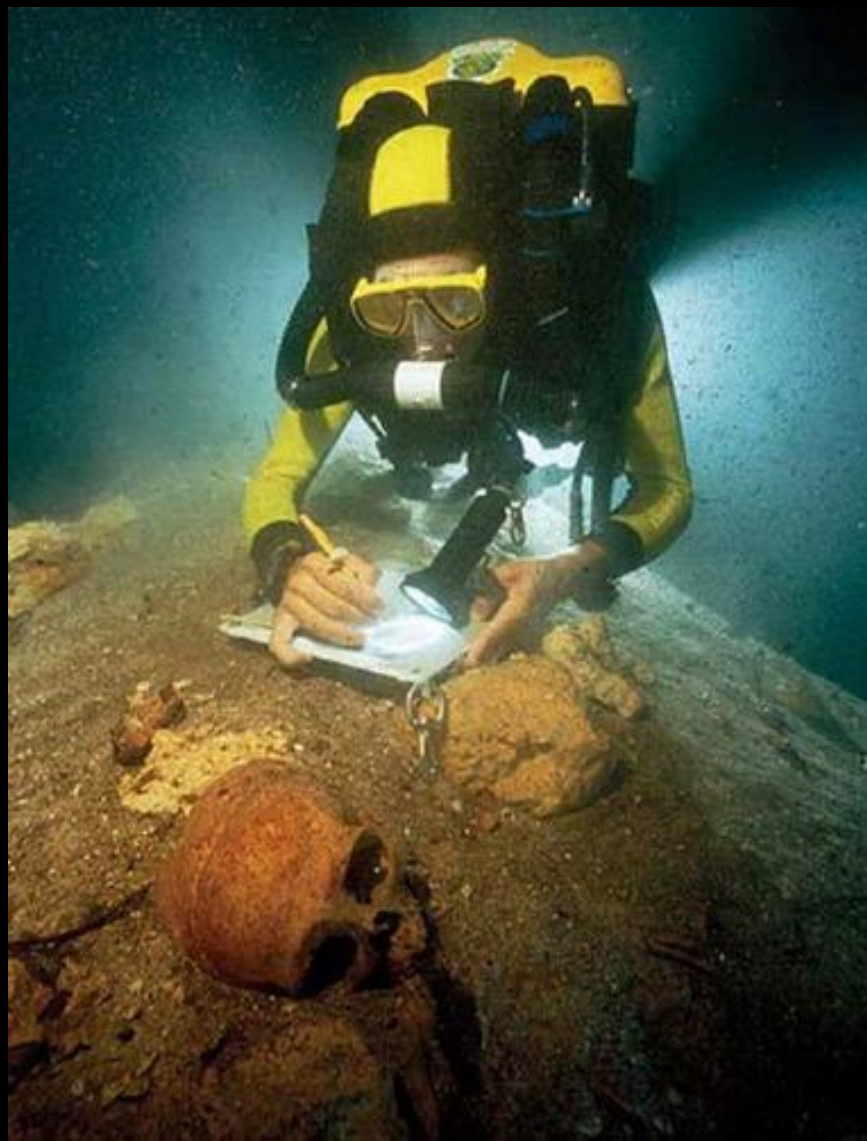












# Naharon (Cenote Cristal)

368 m horizontal  
22.6 m depth

Tom Young and  
Jim Coke, 1988





# Hoyo Negro

## Sistema Aktun Hu

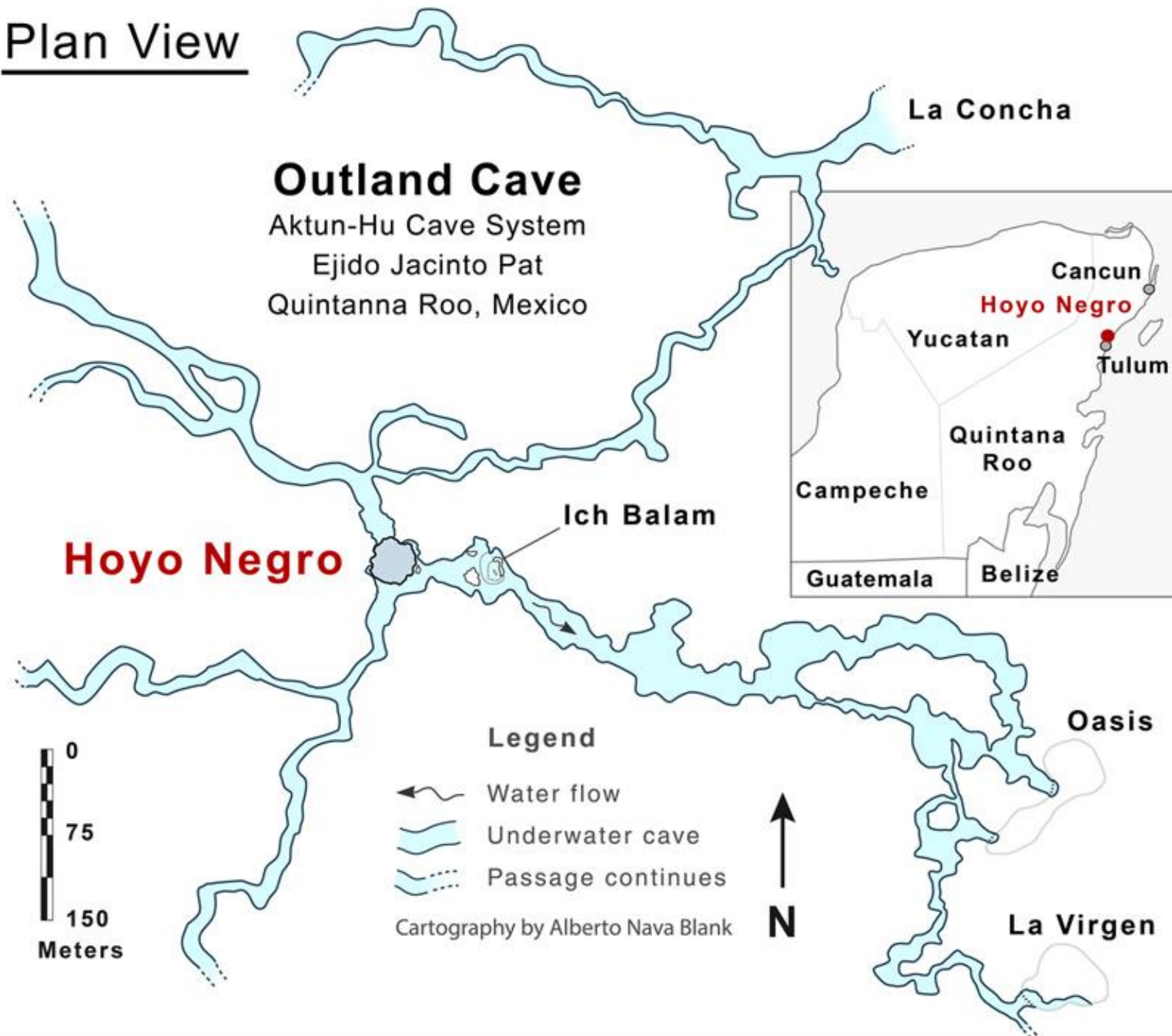
1,200 m horizontal  
43 m depth

Alberto Nava Blank,  
Alejandro Alvarez,  
and Franco Attolini,  
2007

Proyecto Espeleológico Tulum

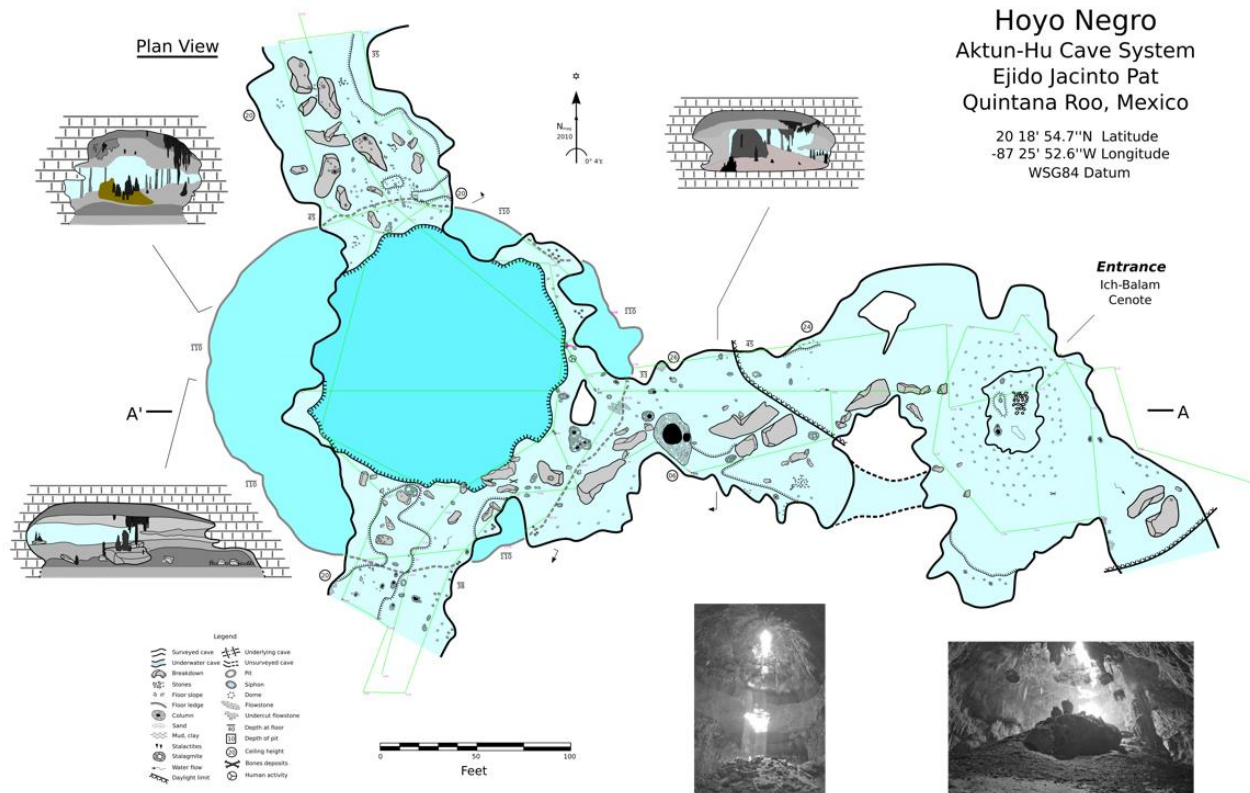
Subdirección de Arqueología  
Subacuática del INAH

# Plan View



# Hoyo Negro Aktun-Hu Cave System Ejido Jacinto Pat Quintana Roo, Mexico

20 18' 54.7"N Latitude  
-87 25' 52.6"W Longitude  
WGS84 Datum



Shallow tunnels and A-A' profile surveyed  
January 2011 to December 2011  
by  
Alex Alvarez  
Franco Attolini  
Alberto Nava  
Roberto Chavez  
Gideon Liew  
Jacob Mellor  
Sam Meacham  
Susan Bird  
Christophe Le Maillot













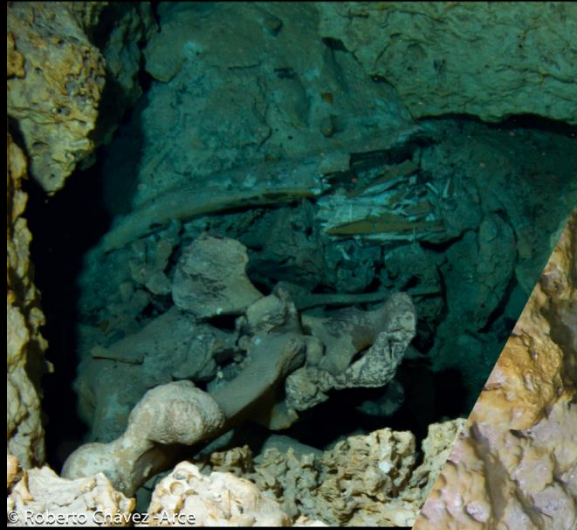




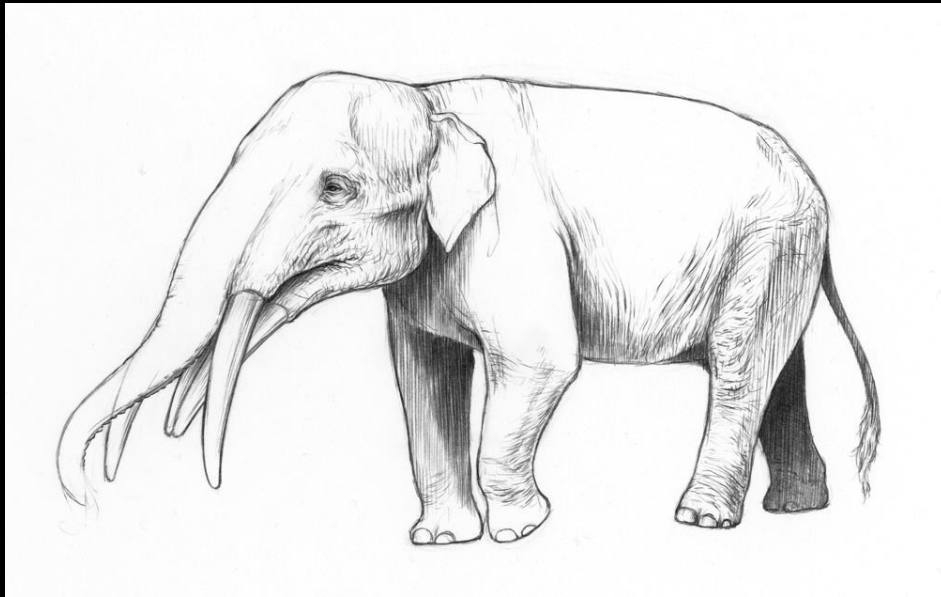
*Mammuth americanus*  
P. MAMMUTHUS AMERICANUS

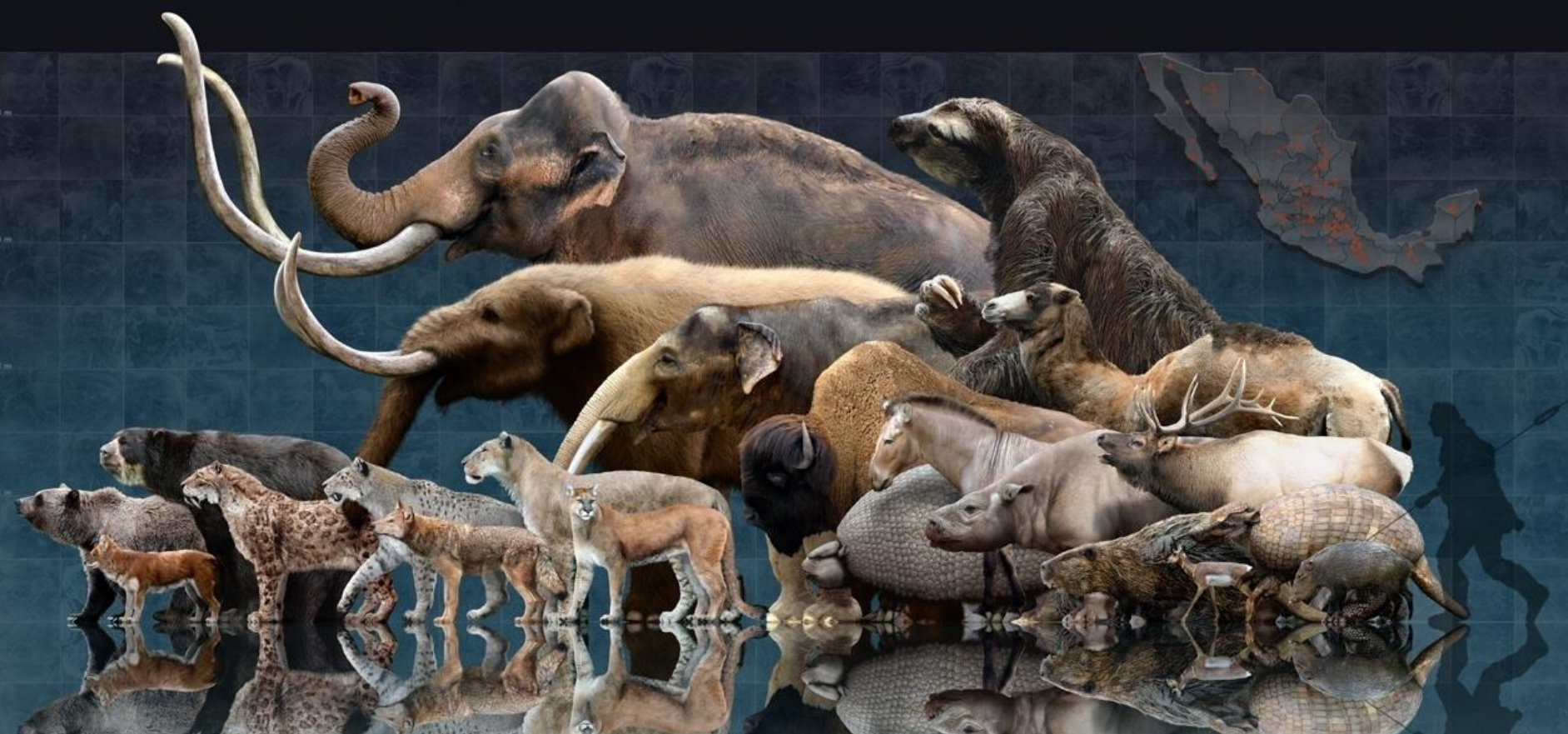
*Mammuthus columbi*  
P. MAMMUTHUS COLUMBI

*Cuvieronius tropicus*  
P. MAMMUTHUS COLUMBI



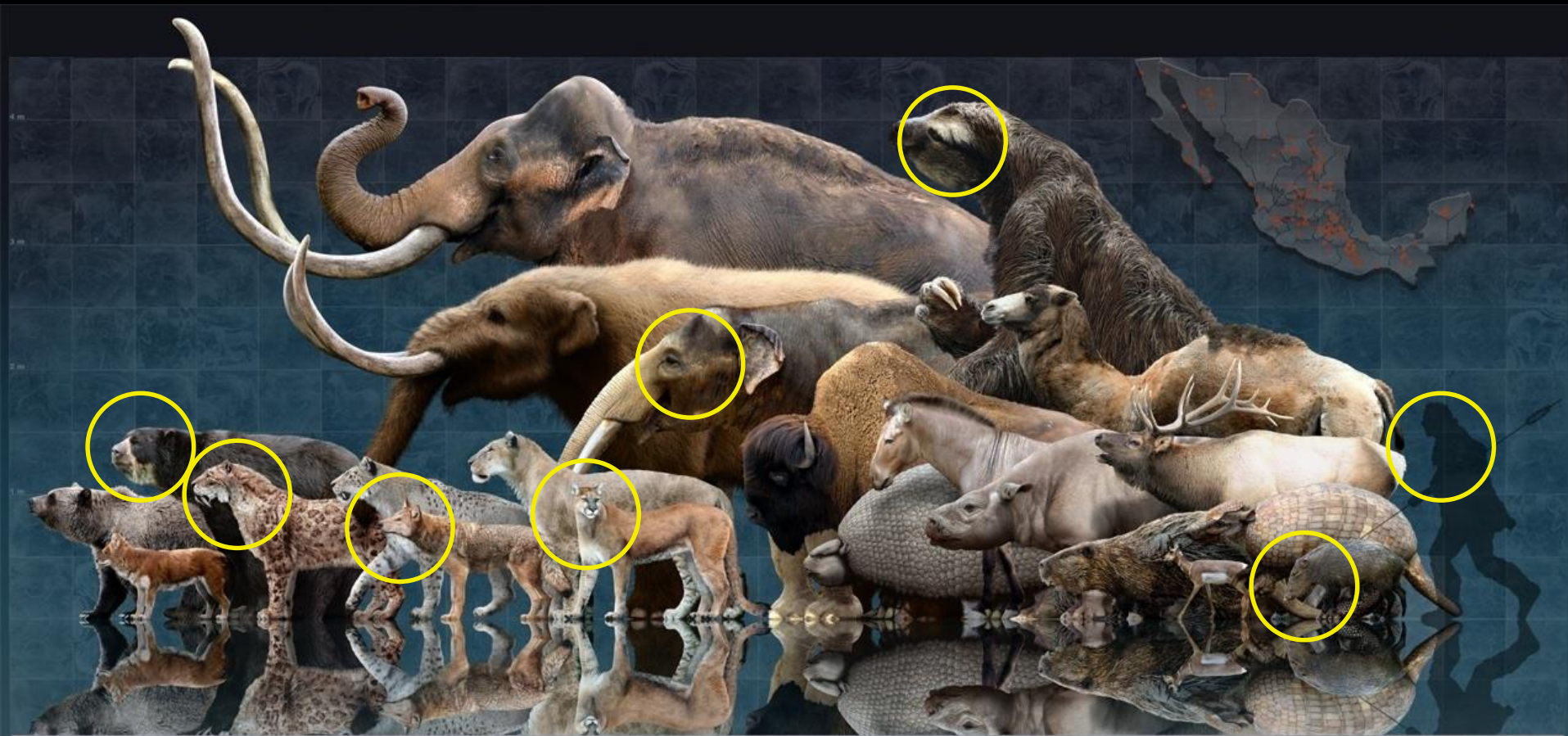
© Roberto Chavez-Arce





oso gris <i>(Ursus arctos horvathi)</i>	coon <i>(Coon alba)</i>	osa cholo <i>(Arctodus sima)</i>	dientes de sabote <i>(Homotherium sinuati)</i>	dientes de cimbara <i>(Homotherium sinuati)</i>	lobo terrible <i>(Canis dirus)</i>	león americano <i>(Panthera leo atrox)</i>	chilla americano <i>(Miacromys burman)</i>	maldonado <i>(Mammuth americanus)</i>	mamut <i>(Mammuth columbi)</i>	gorillero <i>(Cerviceros trochilus)</i>	bisonte antilop <i>(Bison antelope)</i>	glyptodonte <i>(Glyptotherium)</i>	caballo americano <i>(Equus mexicanus)</i>	leopardo leonado <i>(Esmotherium laurifer)</i>	mixotodon <i>(Mixotodon laevis)</i>	castor gigante <i>(Castoreum gigante)</i>	pequeña antilocabra <i>(Capromeryx nitens)</i>	camello americano <i>(Camelops bolsoni)</i>	wapiti <i>(Cervus elaphus)</i>	armadillo gigante <i>(Mylodon darwini)</i>	pecari cabeza plana <i>(Hesperomys concoloratus)</i>

ARRIYO CABRALES, J., PELÁEZ, O. J. y JOHNSON, E. 2005.  
 La mastofauna del cuaternario tardío de México.  
 Instituto Nacional de Antropología e Historia.  
 Bases de datos ENH-CONABIO proyecto No. G012. México, D.F.



oso gris ( <i>Ursus arctos rextoni</i> )	cuon ( <i>Cyon alpinus</i> )	oso chico ( <i>Ursus spelaeus</i> )	dientes de sabie ( <i>Smilodon barthi</i> )	dientes de cimbarra ( <i>Hemidictyon saoi</i> )	lobo terrible ( <i>Canis dirus</i> )	león americano ( <i>Panthera leo atrox</i> )	chita americano ( <i>Mioceryx trapani</i> )	mastodonte ( <i>Mastodon americanus</i> )	mamut ( <i>Mammuthus columbi</i> )	gorfotero ( <i>Cervosus hypiacus</i> )	bradote ardiqú ( <i>Bradypus</i> )	glóbote ( <i>Glyptodon</i> )	caballo americano ( <i>Equus mexicanus</i> )	perceoso terrestre ( <i>Desmostelion australis</i> )	maxedron ( <i>Maxeodon lentus</i> )	castor gigante ( <i>Castoreoides ohioensis</i> )	pequeña antilocapra ( <i>Capromeryx minor</i> )	carriello americano ( <i>Camelops texensis</i> )	wapiti ( <i>Cervus elaphus</i> )	armadillo gigante ( <i>Dasypus septemcinctus</i> )	pecari cabeza plana ( <i>Pleurosternon</i> )
---	---------------------------------	--	--	--	---	---	--	--	---------------------------------------	---	---------------------------------------	---------------------------------	---	---	--	---	--	---	-------------------------------------	---	---

ARROYO CABRALES, J., POLACO, O. J. y JOHNSON, E. 2005.  
 La mastofauna del cuaternario tardío de México.  
 Instituto Nacional de Antropología e Historia.  
 Bases de datos SNIH-CONABIO proyecto No. 0012. México, D.F.







gávez -Arce 2012





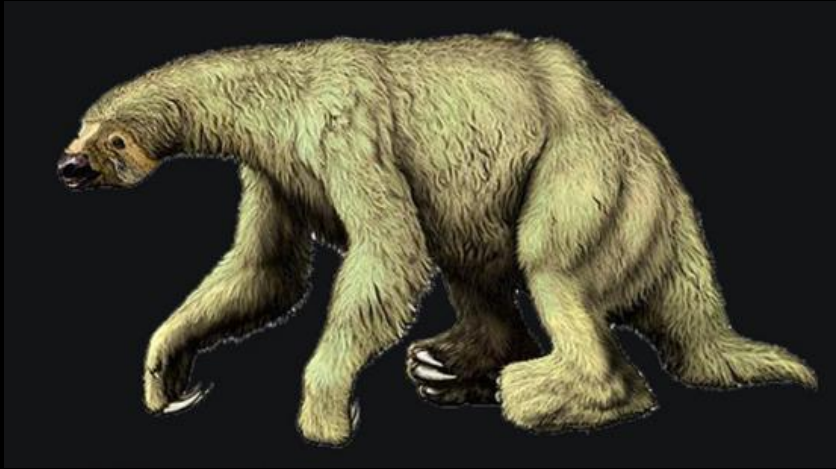




© Roberto Chávez-Arcé 2011



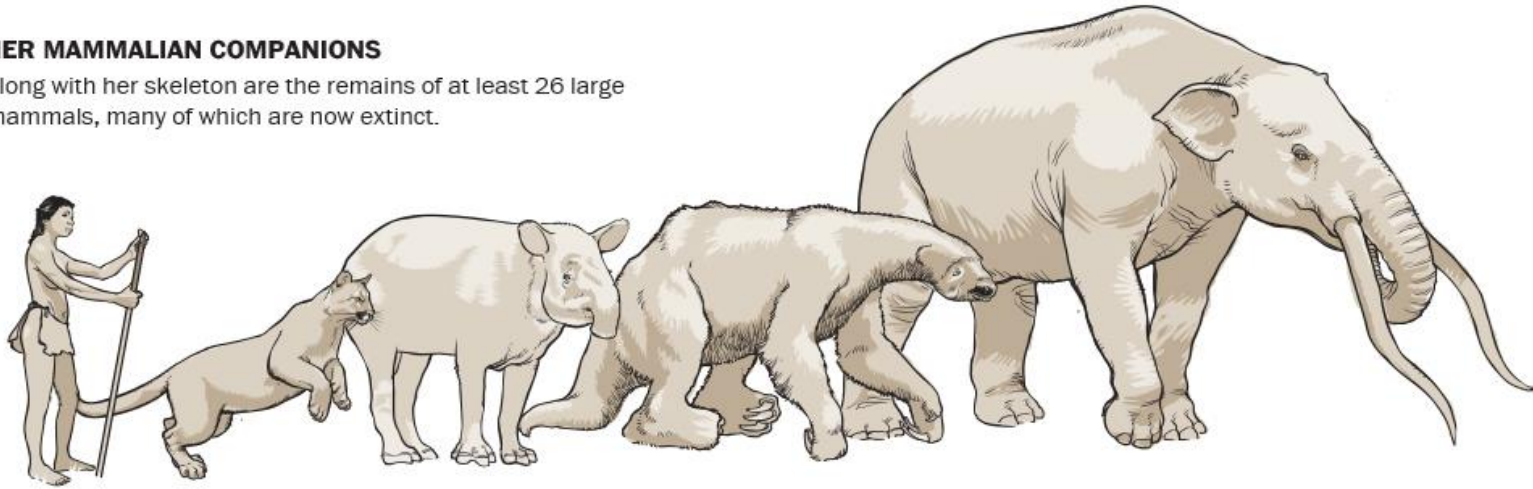
© Roberto Chávez-Arcé 2011



Roberto Chávez -Arce

## HER MAMMALIAN COMPANIONS

Along with her skeleton are the remains of at least 26 large mammals, many of which are now extinct.



**Human**  
(*Homo sapiens*)

**3 cougars**  
(*Puma concolor*)

**2 tapirs**  
(*Tapirus*)

**2 Shasta ground sloths**  
(*Nothrotheriops shastensis*)

**2 gomphotheres**  
(*Cuvieronius*)



**2 saber-toothed cats**  
(*Smilodon fatalis*)

**2 peccaries**  
(*Pecari tajacu*)

**1 sloth**  
(*Megalonychidae*)

**6 tremarctine bears**  
(*Tremarctos*)

**1 white-nosed  
coati**  
(*Nasua narica*)

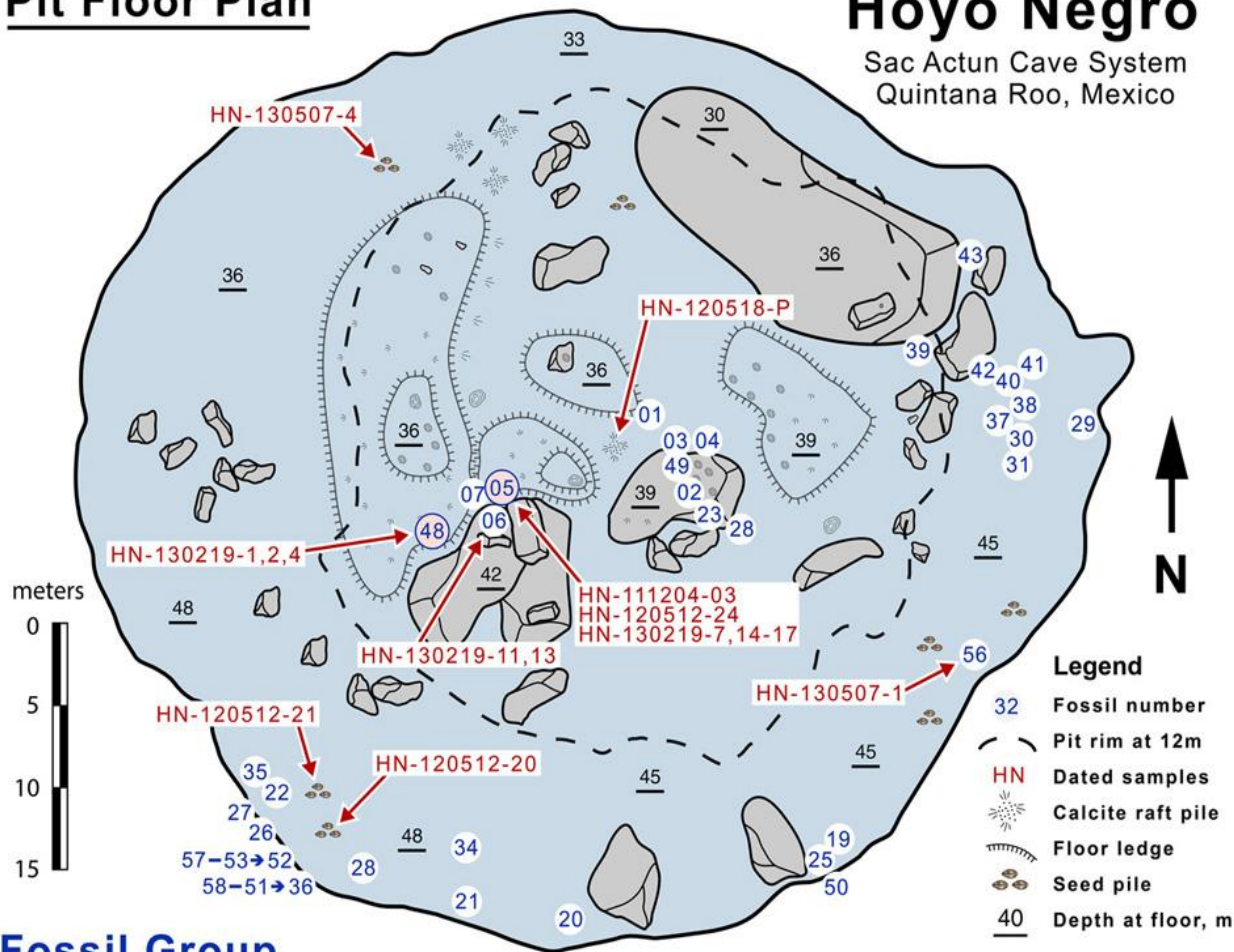
**2 bobcats**  
(*Lynx rufus*)

**2 coyotes**  
(*Canis latrans*)

# Pit Floor Plan

# Hoyo Negro

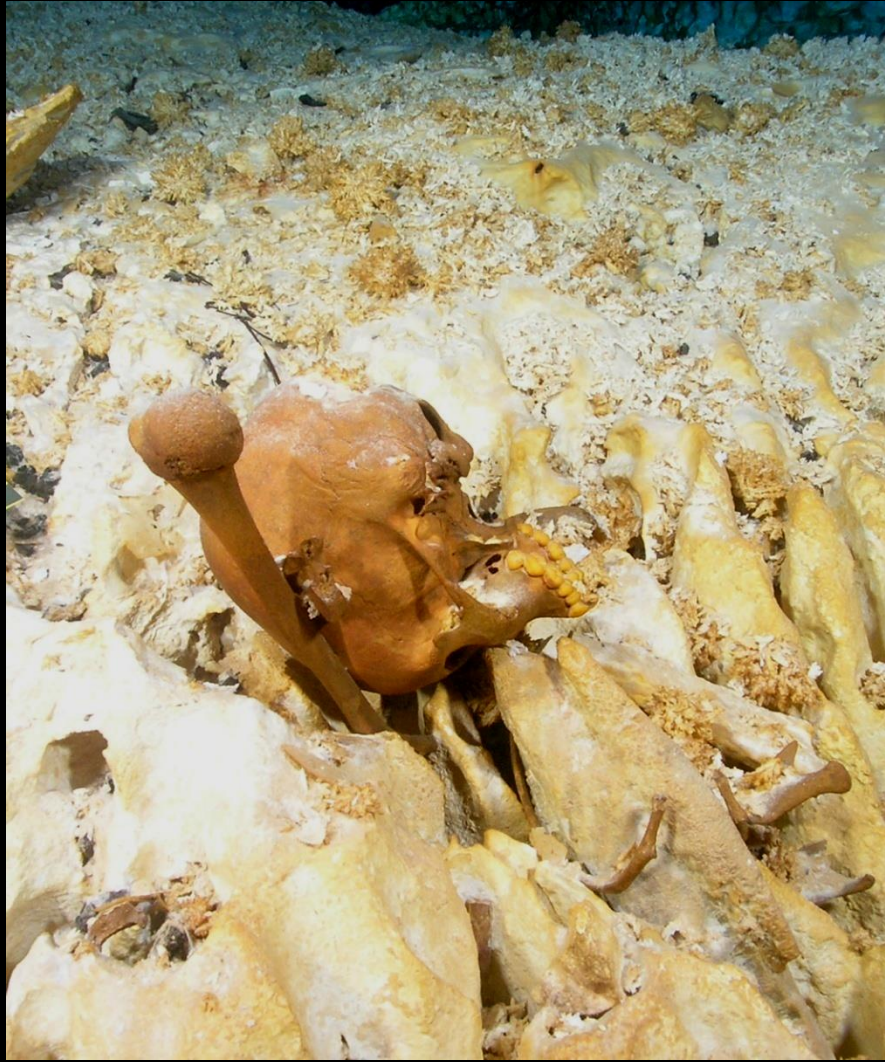
Sac Actun Cave System  
Quintana Roo, Mexico

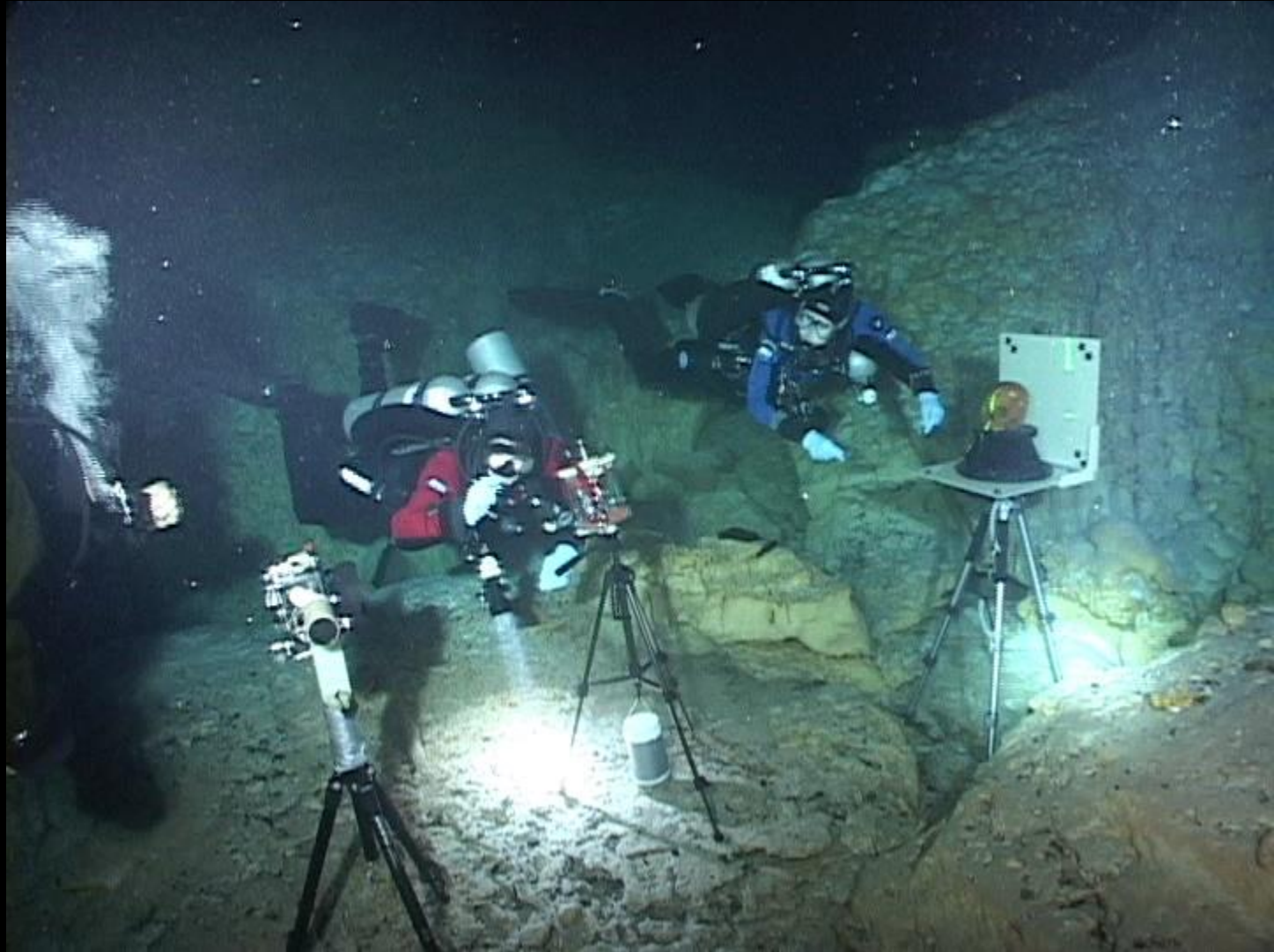


## Fossil Group

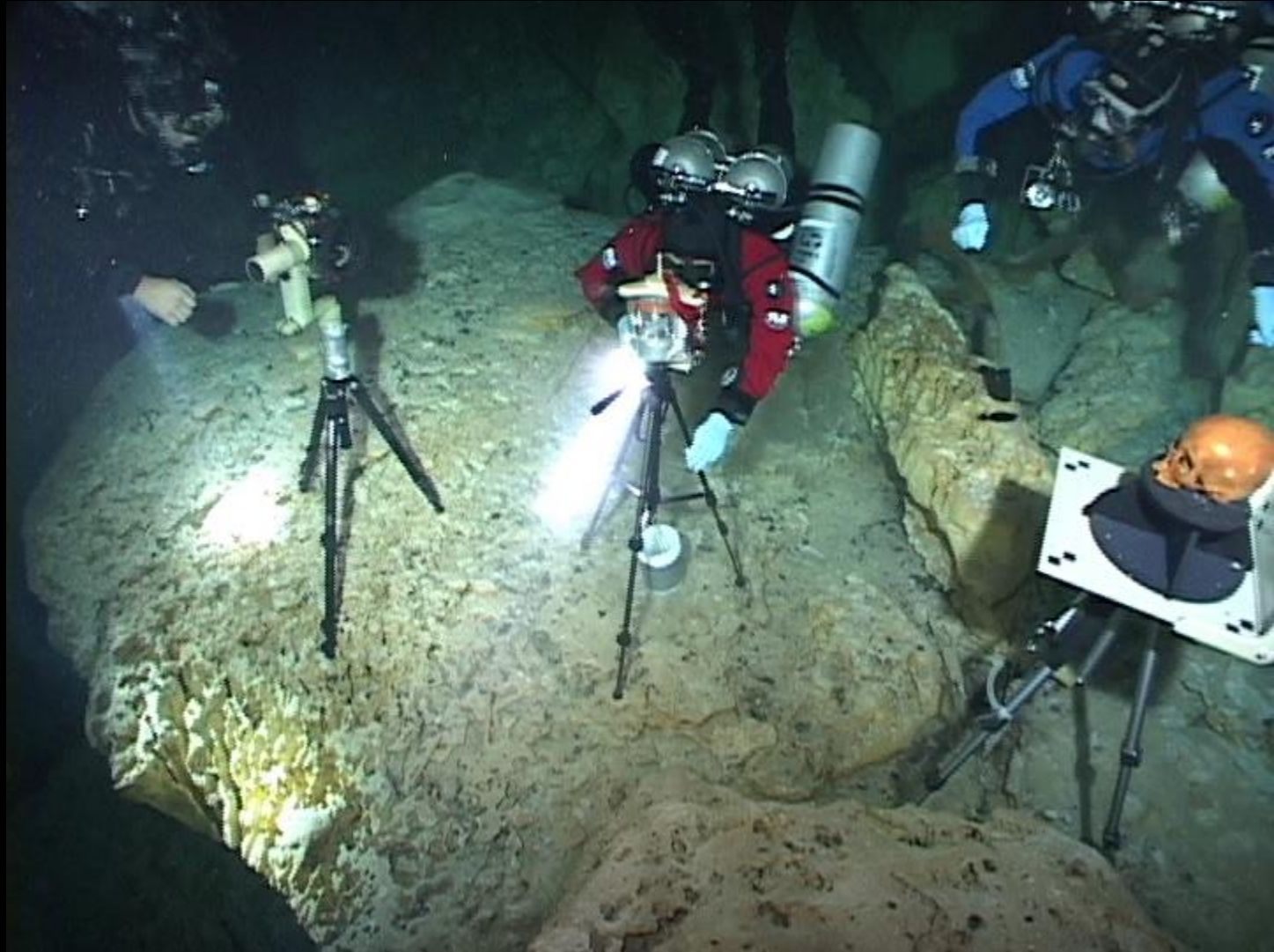
- |                                       |                                       |                                    |
|---------------------------------------|---------------------------------------|------------------------------------|
| 01 <i>Nothrotheriops shastensis</i> 2 | 26 <i>Puma concolor</i> 1             | 40 <i>Tremarctos</i> sp. 4         |
| 02 <i>Cuvieronius</i> 2               | 26 <i>Smilodon fatalis</i> 1          | 42 <i>Nasua narica</i>             |
| 03 <i>Cuvieronius</i> 2               | <i>Tayassu tajacu</i> 1               | 43 <i>cf Tapirus</i> 2             |
| 04 <i>Cuvieronius</i> 2               | 27 <i>Nothrotheriops shastensis</i> 1 | 48 <i>Homo sapiens</i>             |
| 05 <i>Homo sapiens</i>                | 28 <i>Cuvieronius</i> 2               | pelvic girdle                      |
| skull, arms, torso                    | 29 <i>Puma concolor</i> 2             | 49 <i>Cuvieronius</i> 2            |
| 06 <i>Cuvieronius</i> 1               | 30 <i>Tremarctos</i> sp. 1            | 50 <i>Puma concolor</i> 3          |
| 07 <i>Cuvieronius</i> 1               | 31 <i>Tremarctos</i> sp. 2            | <i>Nothrotheriops shastensis</i> 1 |
| 19 <i>Puma concolor</i>               | 32 Megalonychidae                     | 51 Megalonychidae 1                |
| 20 <i>Nothrotheriops shastensis</i> 1 | 34 <i>Xenarthra</i> unident.          | 52 Megalonychidae 1                |
| 21 <i>Nothrotheriops shastensis</i> 1 | 35 <i>Nothrotheriops shastensis</i> 1 | 53 <i>cf Lynx rufus</i>            |
| 22 <i>Nothrotheriops shastensis</i> 1 | 36 <i>Xenarthra</i> unident.          | 56 <i>Tremarctos</i> sp. 5         |
| 23 <i>Tapirus cf bairdii</i> 1        | 38 <i>Tremarctos</i> sp. 3            | 57 <i>Canis latrans</i>            |
| 24 <i>Cuvieronius</i>                 | 39 <i>Smilodon cf fatalis</i> 2       | 58 <i>Tayassu tajacu</i> 2         |

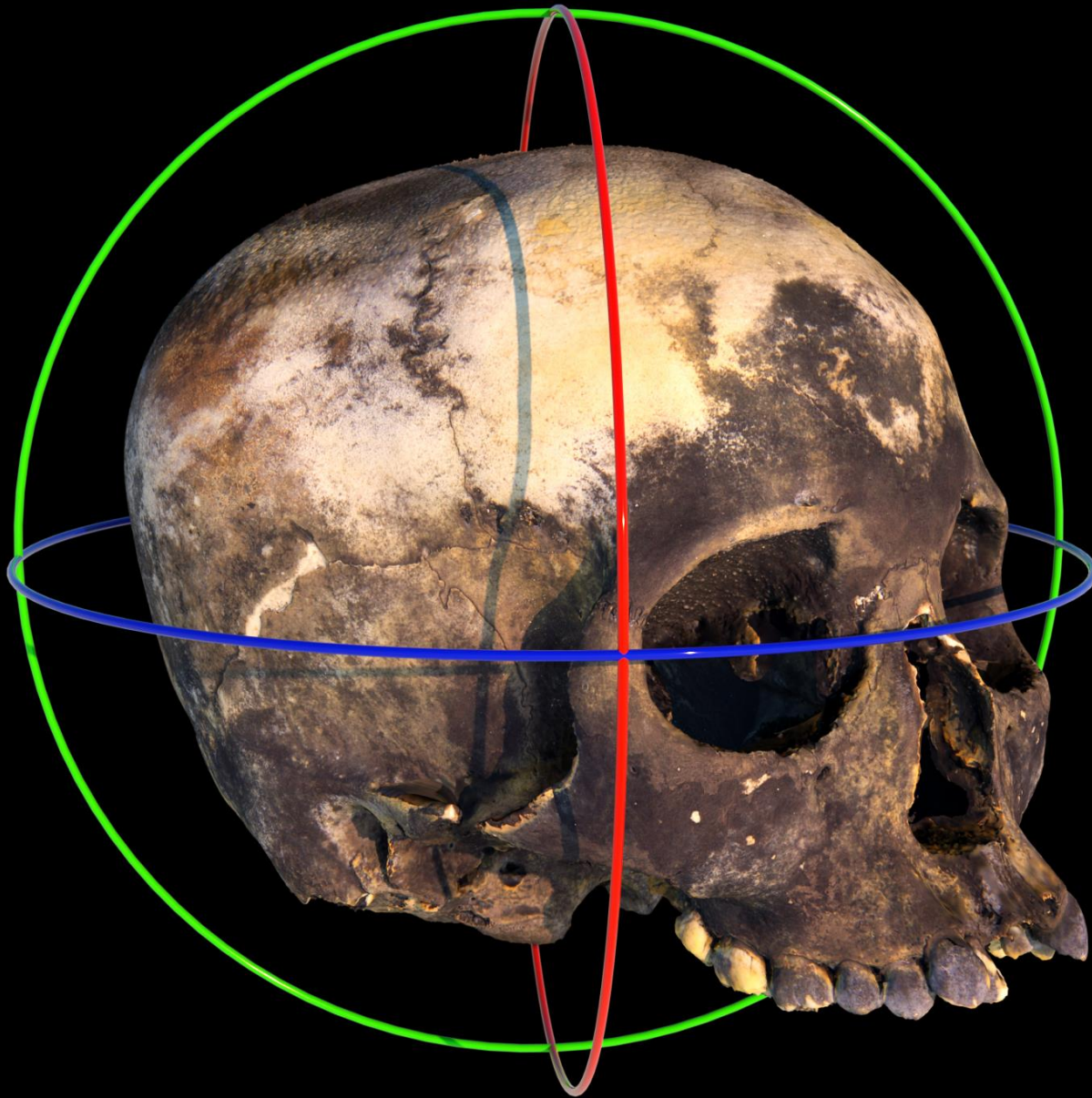


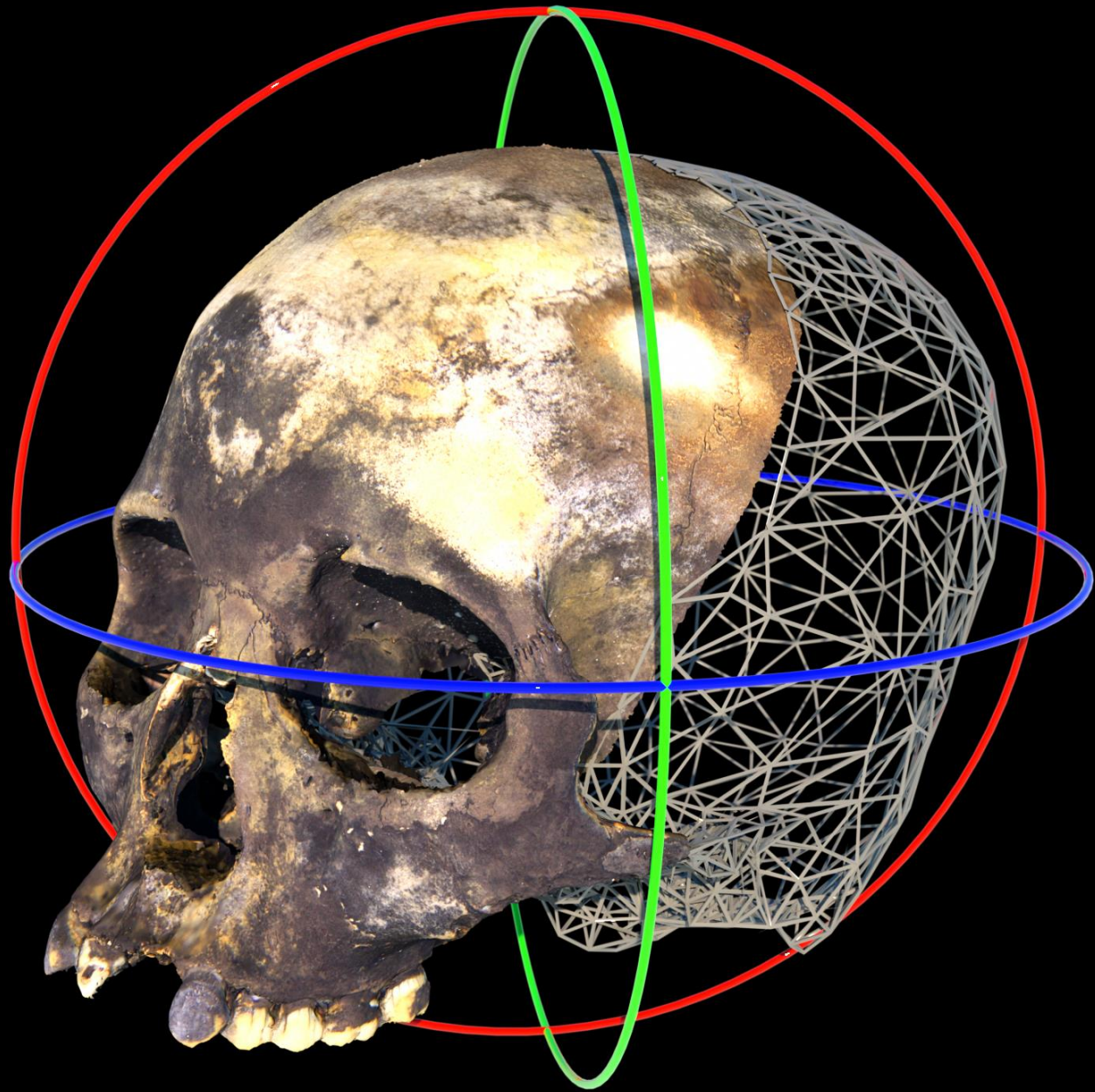






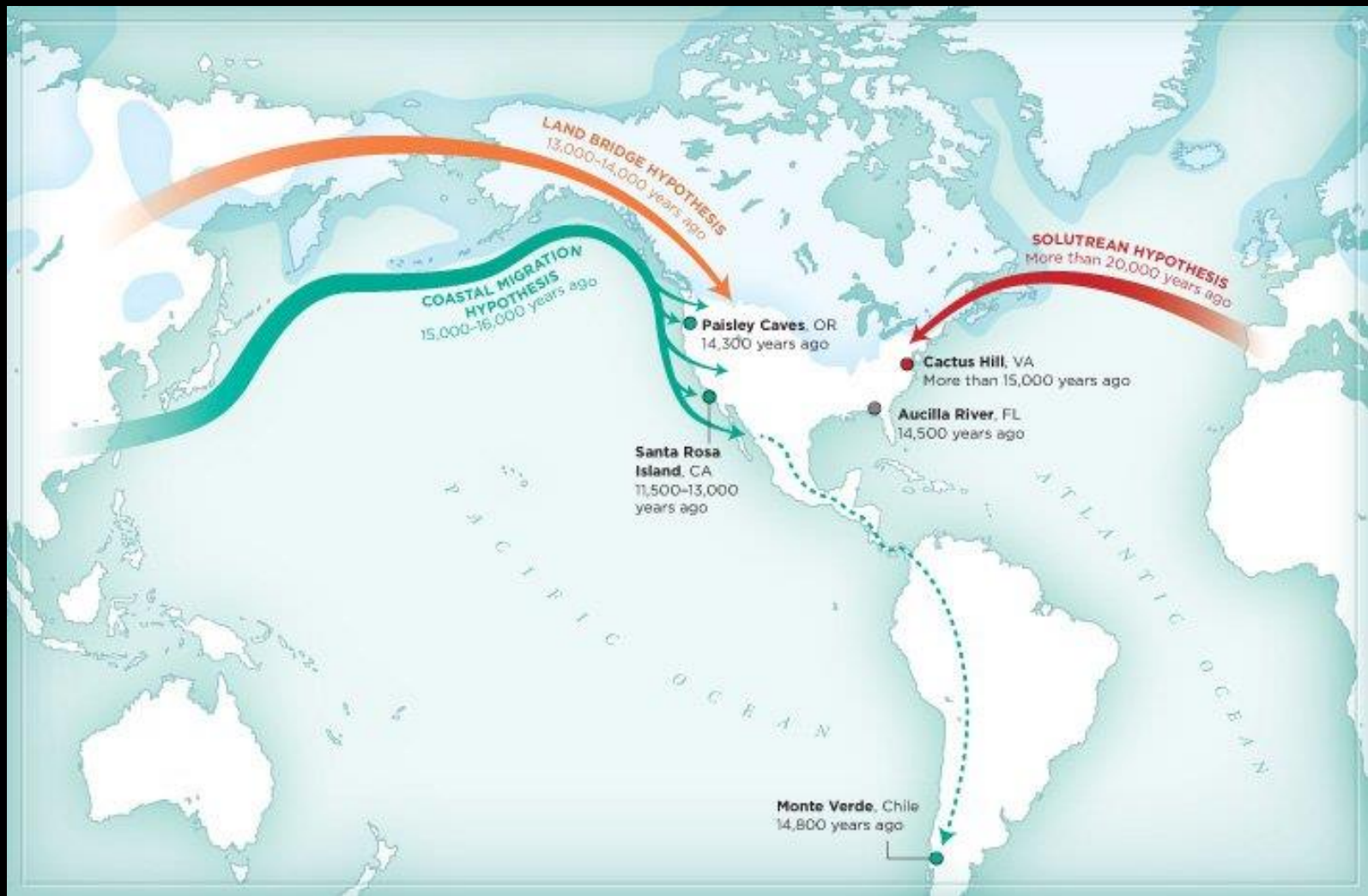














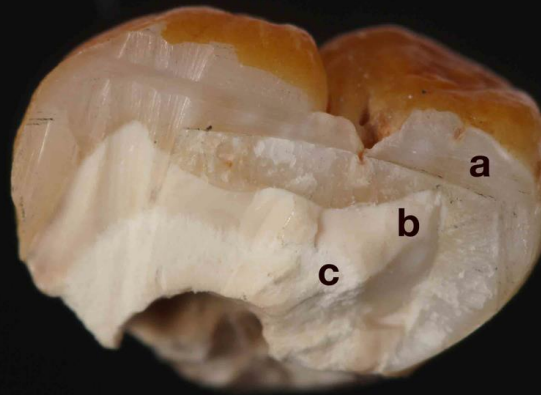
SR-8205  
Hoyo Negro, Mexico  
RM<sup>3</sup>



5 mm



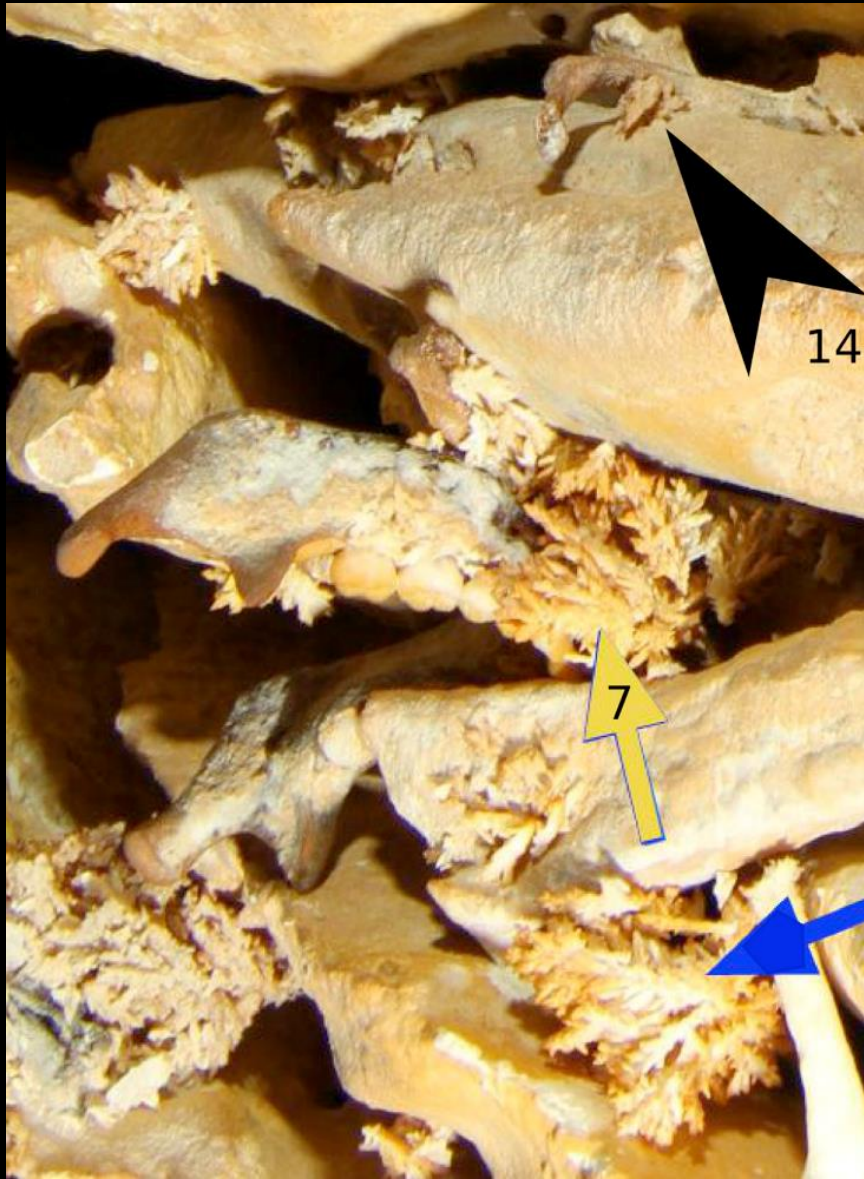
SR-8205  
Hoyo Negro,  
Mexico  
RM<sup>3</sup>

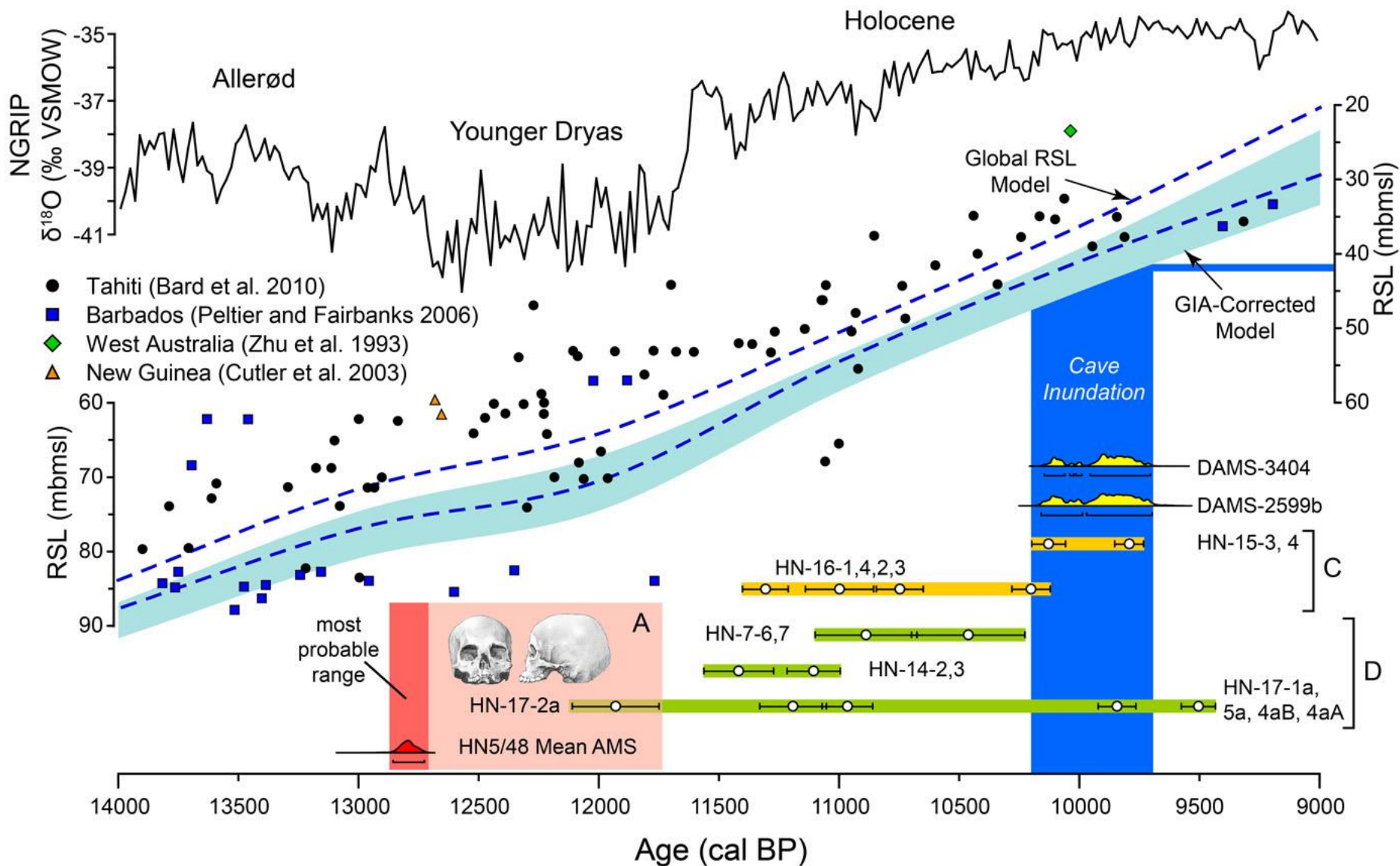


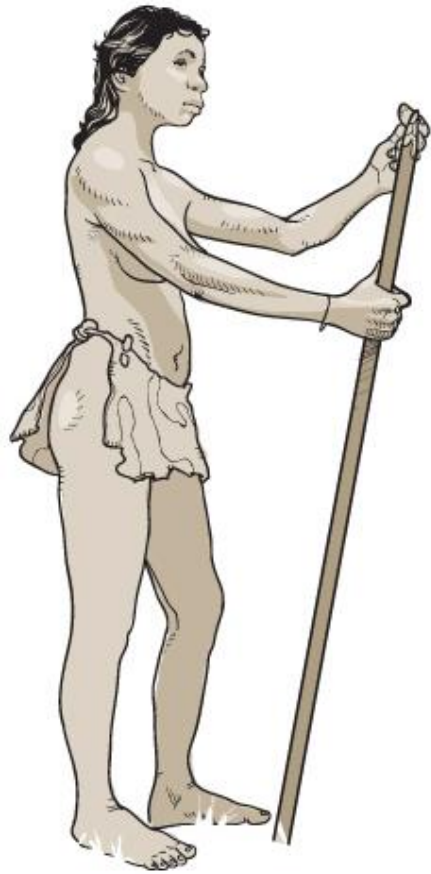
5 mm





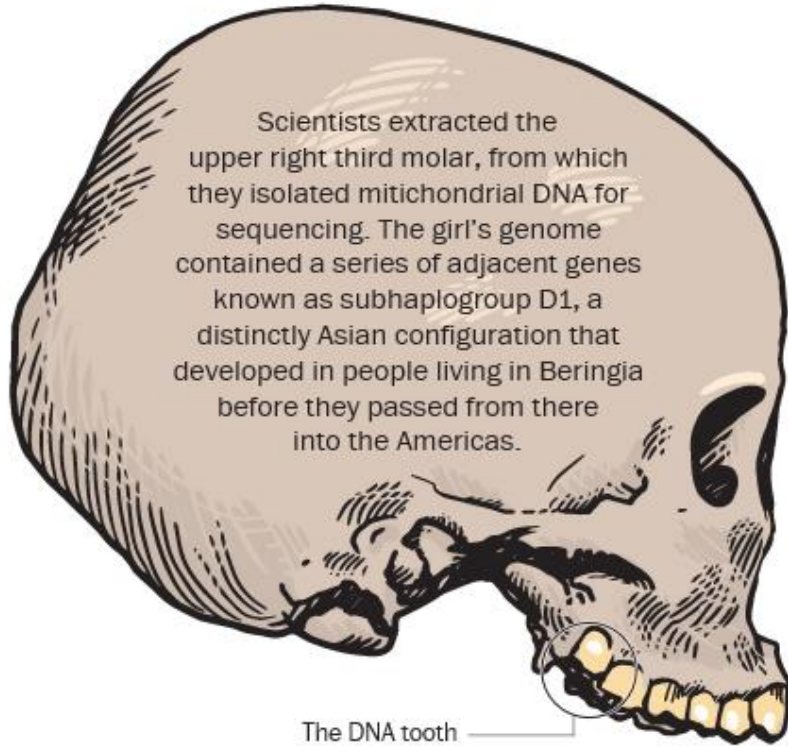






### THE DNA TRUTH IS IN THE TEETH

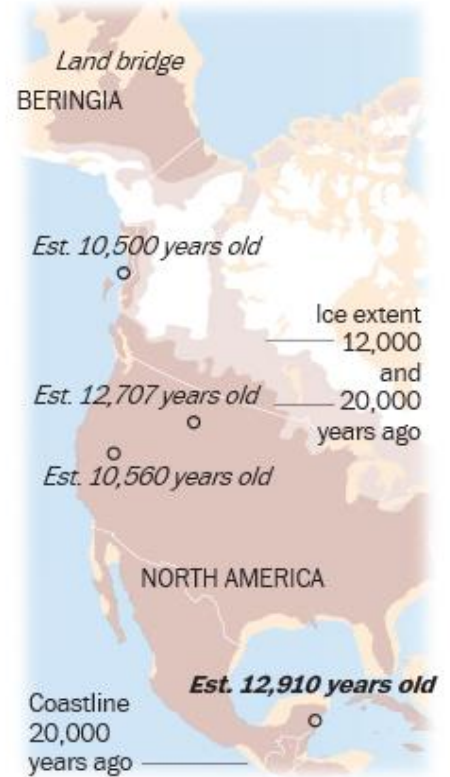
The skeleton was found in Hoyo Negro, a Yucatan cave far to the southeast of where other ancient American remains — from which DNA has been analyzed — have been found.



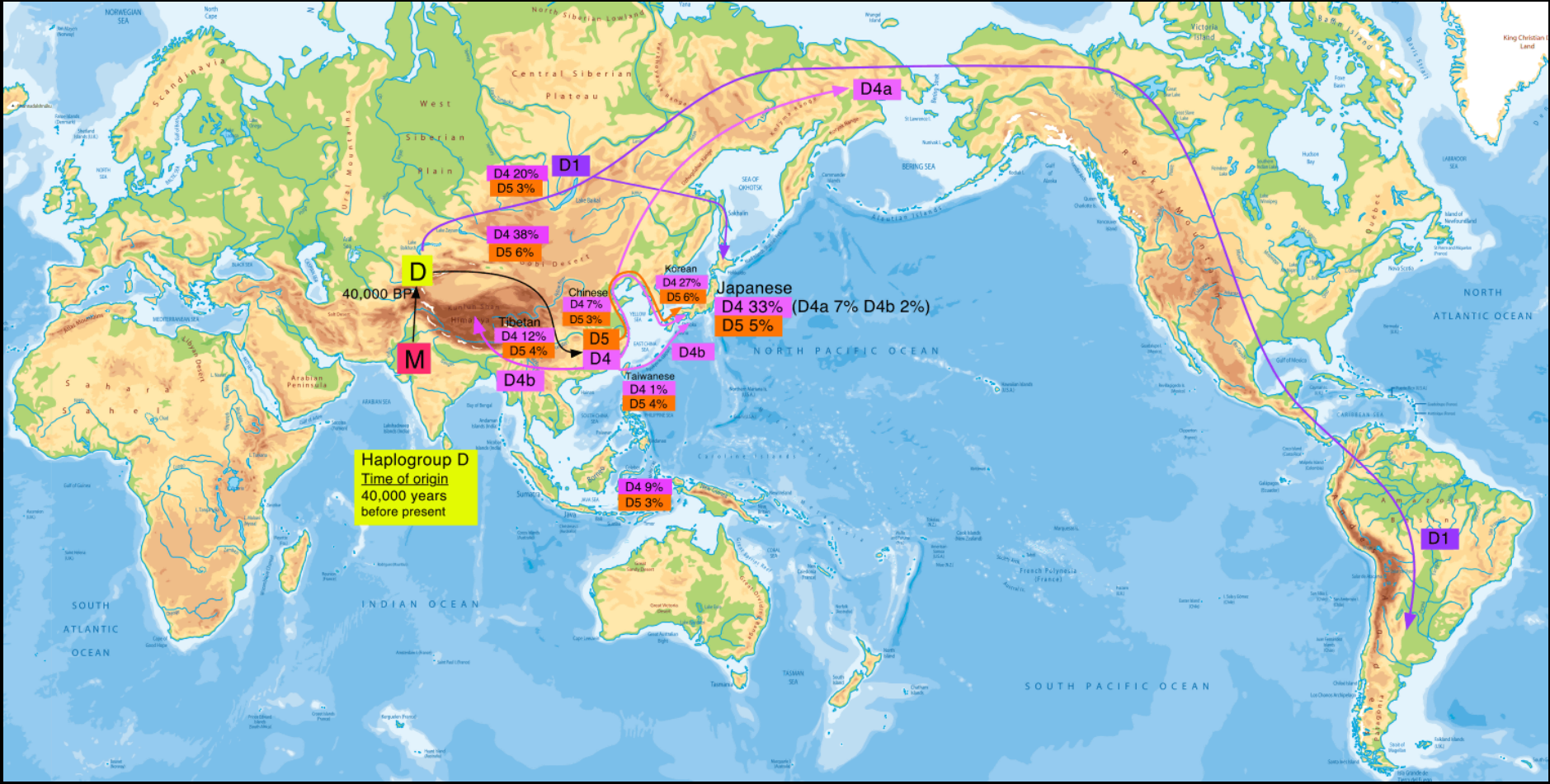
Scientists extracted the upper right third molar, from which they isolated mitochondrial DNA for sequencing. The girl's genome contained a series of adjacent genes known as subhaplogroup D1, a distinctly Asian configuration that developed in people living in Beringia before they passed from there into the Americas.

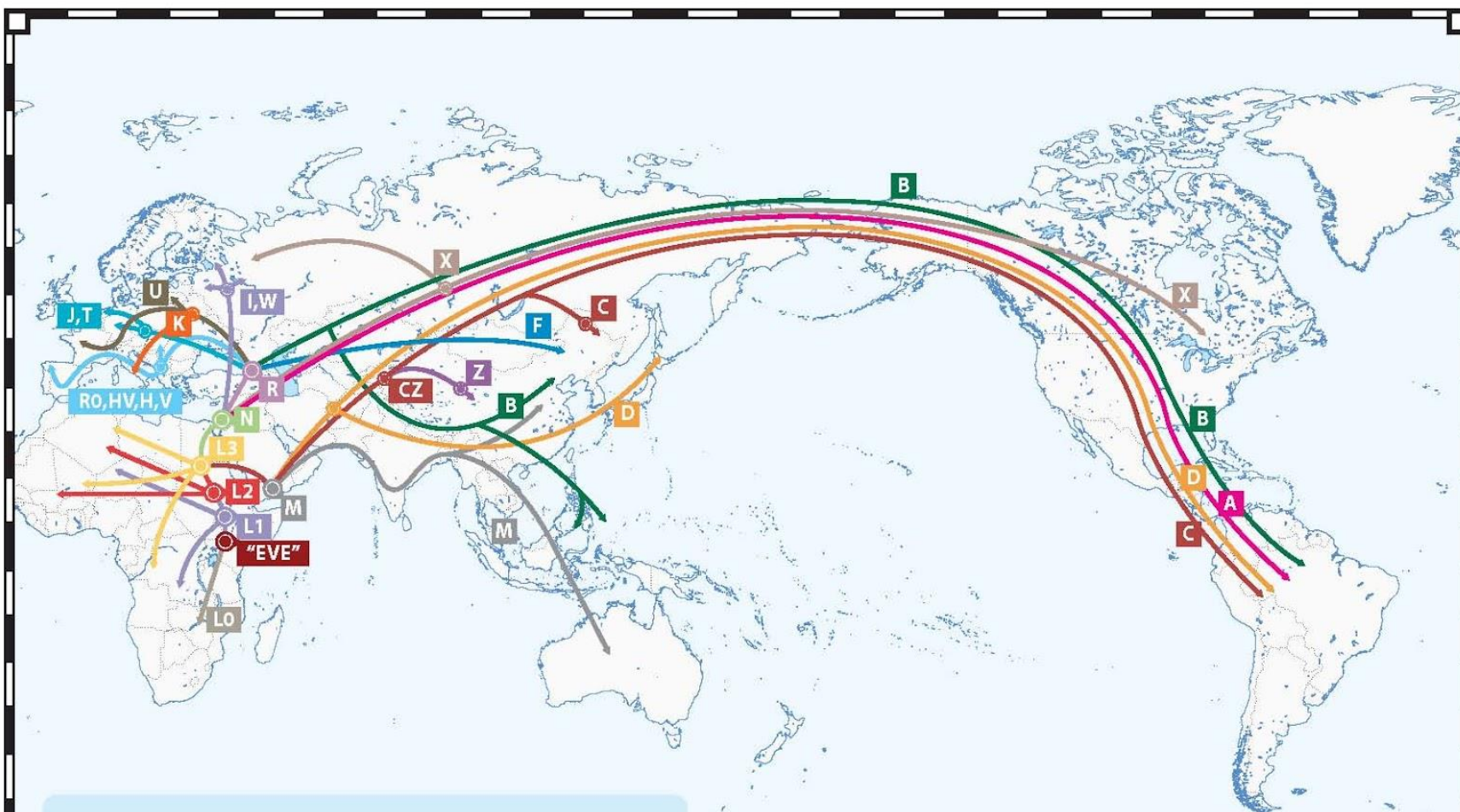
The DNA tooth

- Remains of Paleoamericans with recovered DNA



### A CAVE OF PALEONTOLOGICAL WONDERS





mt-DNA Human Migration  
Thousands of Years Ago

<span style="color: magenta;">█</span> A	30	<span style="color: cyan;">█</span> J	40	<span style="color: purple;">█</span> R	50
<span style="color: green;">█</span> B	50	<span style="color: orange;">█</span> K	25	<span style="color: lightblue;">█</span> RO	30
<span style="color: brown;">█</span> C	20	<span style="color: grey;">█</span> L0	>100	<span style="color: cyan;">█</span> T	20
<span style="color: orange;">█</span> D	25	<span style="color: purple;">█</span> L1	>100	<span style="color: cyan;">█</span> U	50
<span style="color: green;">█</span> F	50	<span style="color: red;">█</span> L2	80	<span style="color: cyan;">█</span> V	15
<span style="color: cyan;">█</span> H	30	<span style="color: yellow;">█</span> L3	70	<span style="color: purple;">█</span> W	20
<span style="color: cyan;">█</span> HV	30	<span style="color: grey;">█</span> M	60	<span style="color: brown;">█</span> X	30
<span style="color: purple;">█</span> I	15	<span style="color: green;">█</span> N	50	<span style="color: purple;">█</span> Z	30



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ENCUENTRAN EN HOYO NEGRO NUEVAS POSIBILIDADES PARA ESTUDIAR EL ORIGEN DEL HOMBRE AMERICANO

15 MAY

INAH

El esqueleto humano descubierto en el sitio arqueológico Hoyo Negro, ubicado dentro de una cueva inundada de Quintana Roo, ha sido estudiado desde hace casi tres años por especialistas nacionales y

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Ancient bones provide glimpse of the New World's earliest inhabitants.



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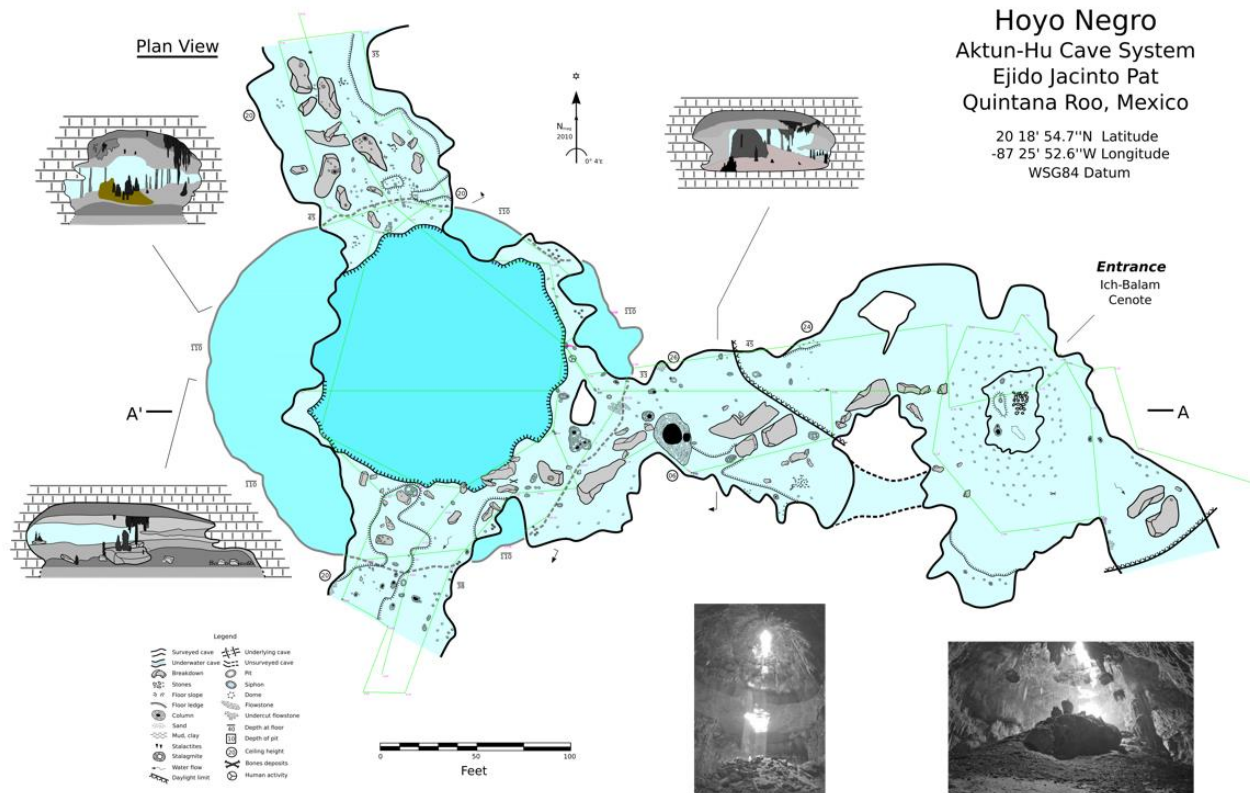
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milk life



# Hoyo Negro Aktun-Hu Cave System Ejido Jacinto Pat Quintana Roo, Mexico

20 18' 54.7" N Latitude  
-87 25' 52.6" W Longitude  
WGS84 Datum



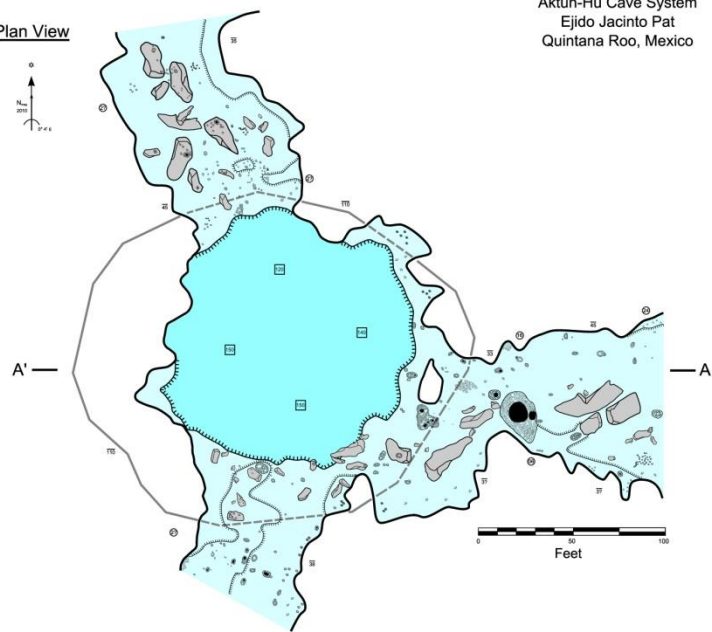
Shallow tunnels and A-A' profile  
surveyed  
January 2011 to December 2011

by  
Alex Alvarez  
Franco Attolini  
Alberto Nava  
Roberto Chavez  
Gideon Liew  
Jacob Mellor  
Sam Meacham  
Susan Bird  
Christophe Le Maillot



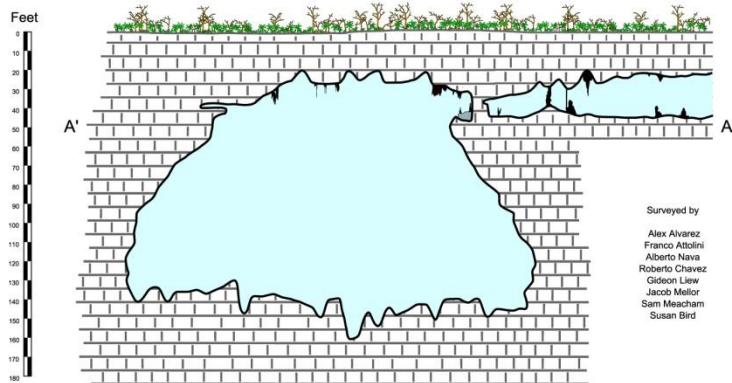
Hoyo Negro  
Aktun-Hu Cave System  
Ejido Jacinto Pat  
Quintana Roo, Mexico

Plan View



- Legend
- Surveyed area
  - Underlying cave
  - Breakwater
  - Stone
  - Floor slope
  - Floor ledge
  - Column
  - Sand
  - Mud, clay
  - Stalactite
  - Ceiling height
  - Depth
  - Underlying cave
  - Pit
  - Sphere
  - Cone
  - Flowstone
  - Underwater flowstone
  - Water
  - Water, seasonal
  - Depth at floor
  - Depth of pit
  - Passage continues
  - Water flow

Profile View



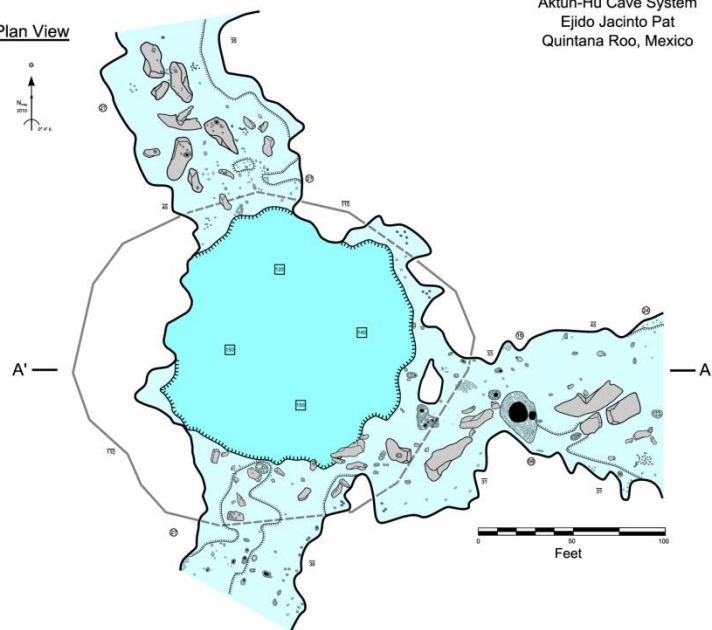
Surveyed by  
Alex Alvarez  
Franco Attolini  
Alberto Nava  
Roberto Chavez  
Gideon Law  
Jacob Mellor  
Sam Meacham  
Susan Bird

Cartography by  
Alberto Nava Blank



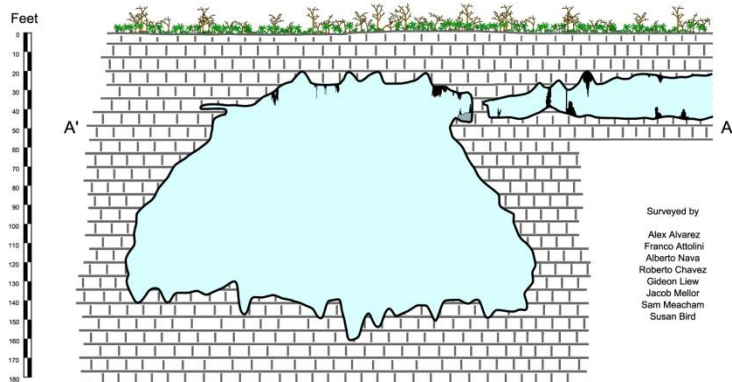
Hoyo Negro  
Aktun-Hu Cave System  
Ejido Jacinto Pat  
Quintana Roo, Mexico

Plan View



- Legend
- Surveyed area
  - Underlying cave
  - Breakdown
  - Bones
  - Floor ledge
  - Column
  - Spiral
  - Mud, clay
  - Stalactite
  - Ceiling height
  - Depth
  - Underlying cave
  - Pit
  - Passage
  - Floor
  - Flowstone
  - Limestone
  - Water
  - Water, seasonal
  - Depth of floor
  - Depth of pit
  - Passage corridors
  - Water flow

Profile View



Surveyed by  
Alex Alvarez  
Franco Attolini  
Alberto Nava  
Roberto Chavez  
Gideon Law  
Jacob Mellor  
Sam Meacham  
Susan Bird

Cartography by  
Alberto Nava Blank

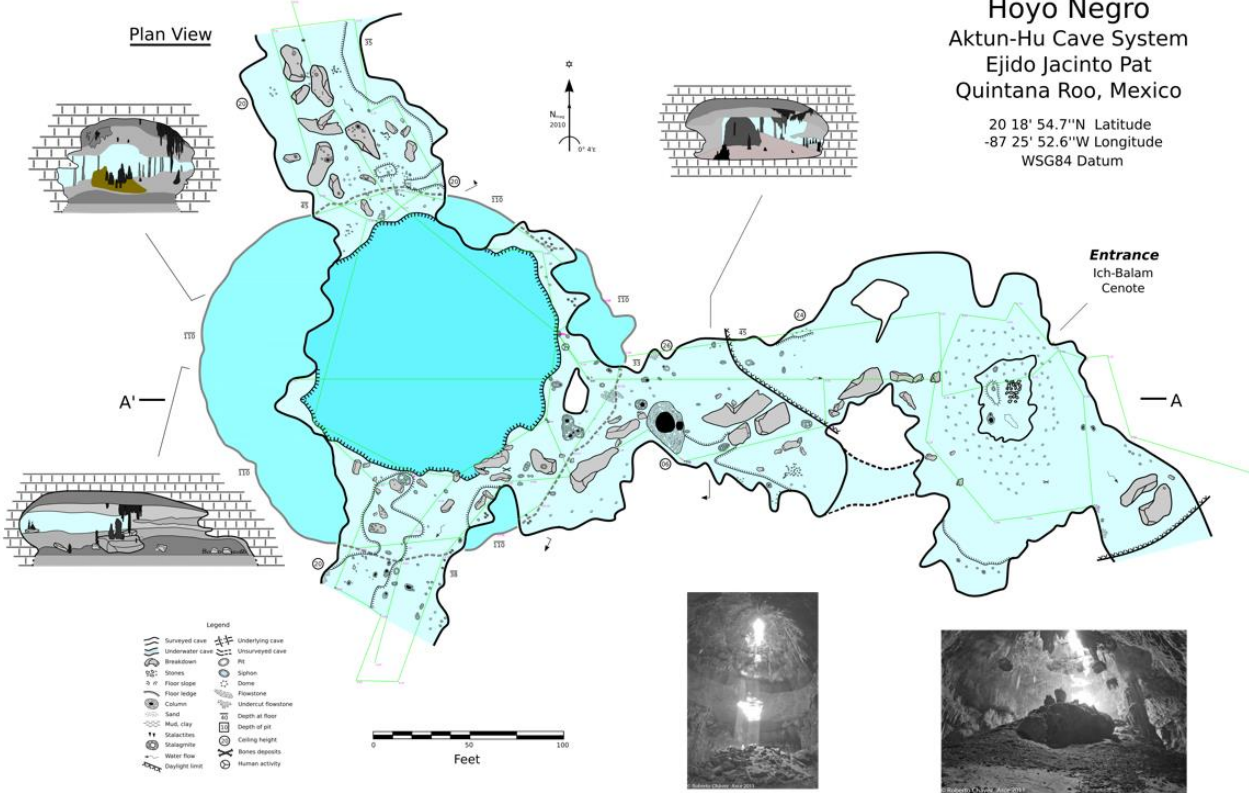


© Daniel Riordan Araujo 2007

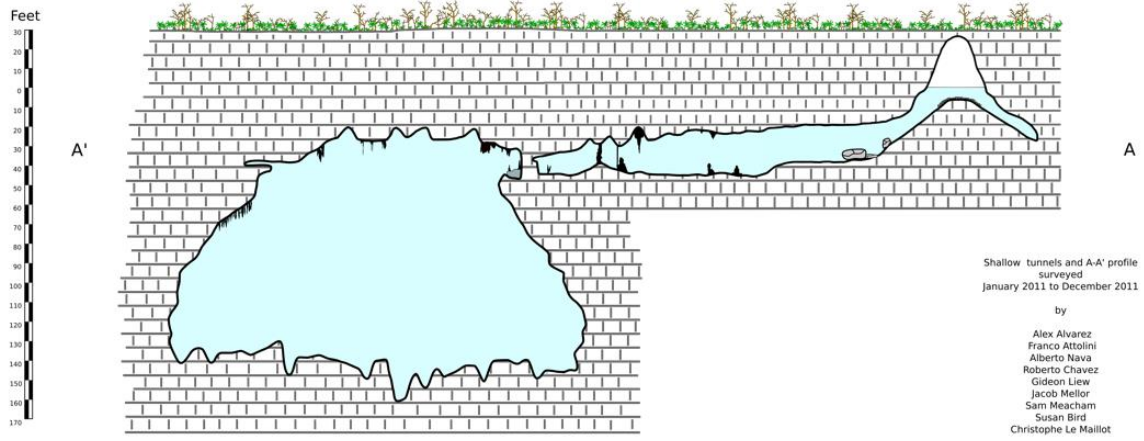


Hoyo Negro  
Aktun-Hu Cave System  
Ejido Jacinto Pat  
Quintana Roo, Mexico

20 18' 54.7"N Latitude  
-87 25' 52.6"W Longitude  
WGS84 Datum



Profile View



Ich-Balam Debris Cone

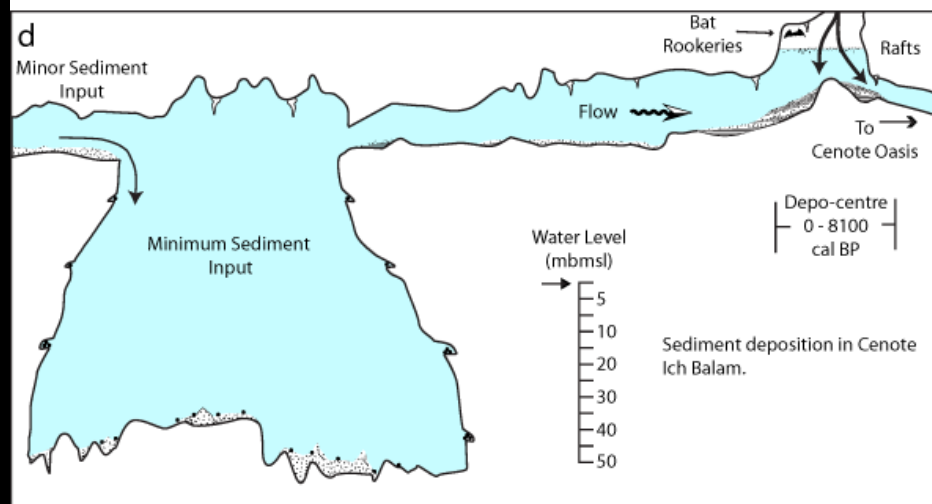
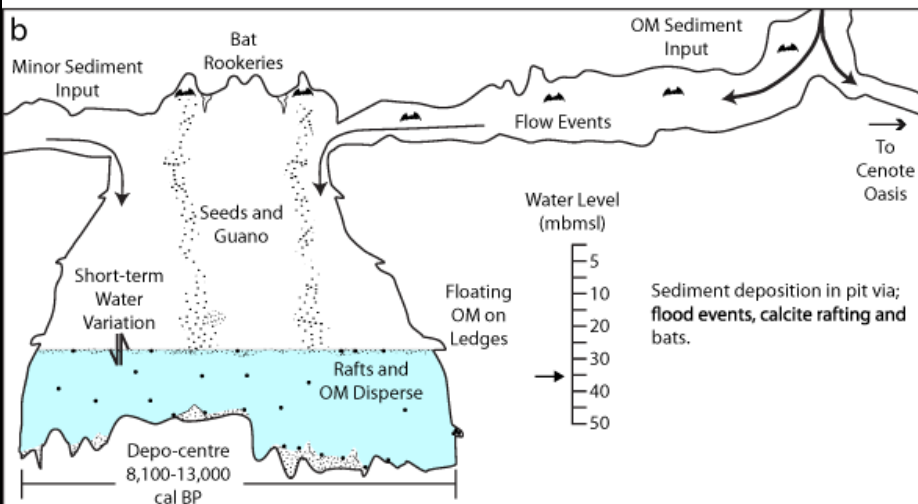
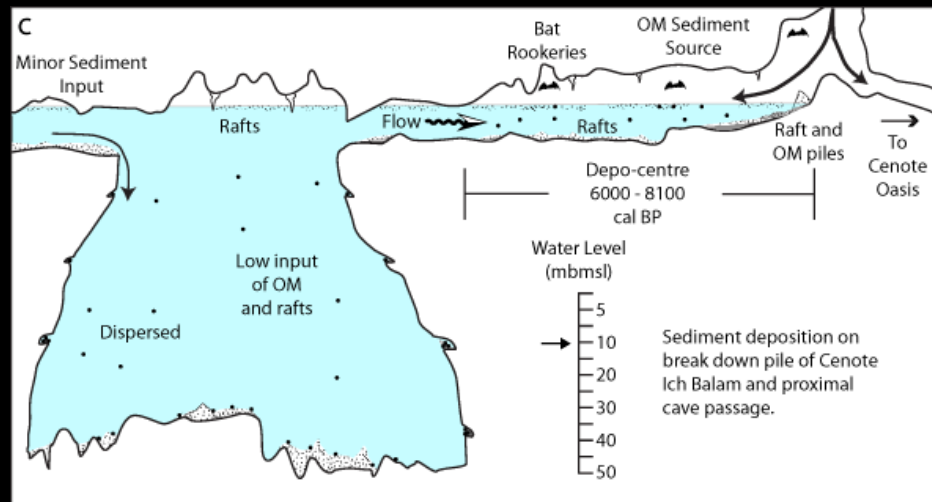
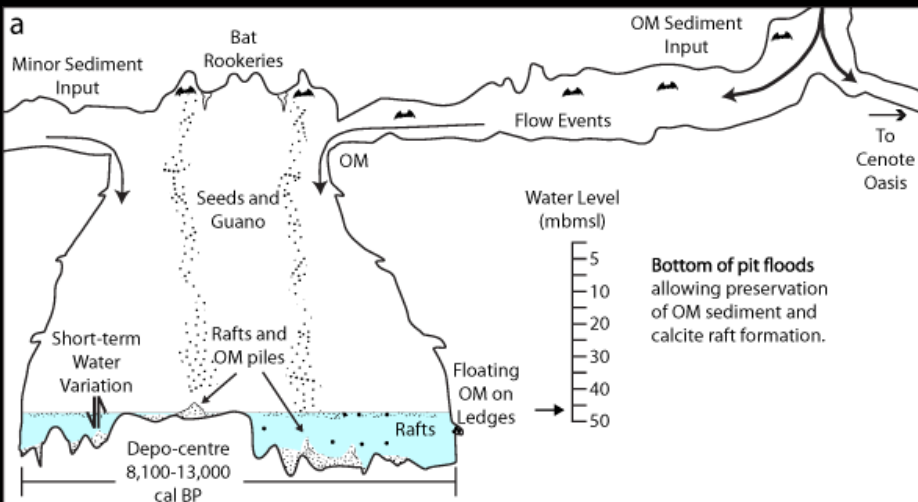


Ich-Balam Debris Cone

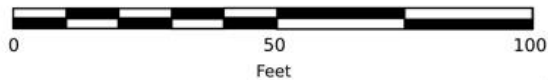


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Shallow tunnels and A-A' profile  
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Christophe Le Maillot



# Hoyo Negro Aktun-Hu Cave System Ejido Jacinto Pat Quintana Roo, Mexico



005 007 006



005



002



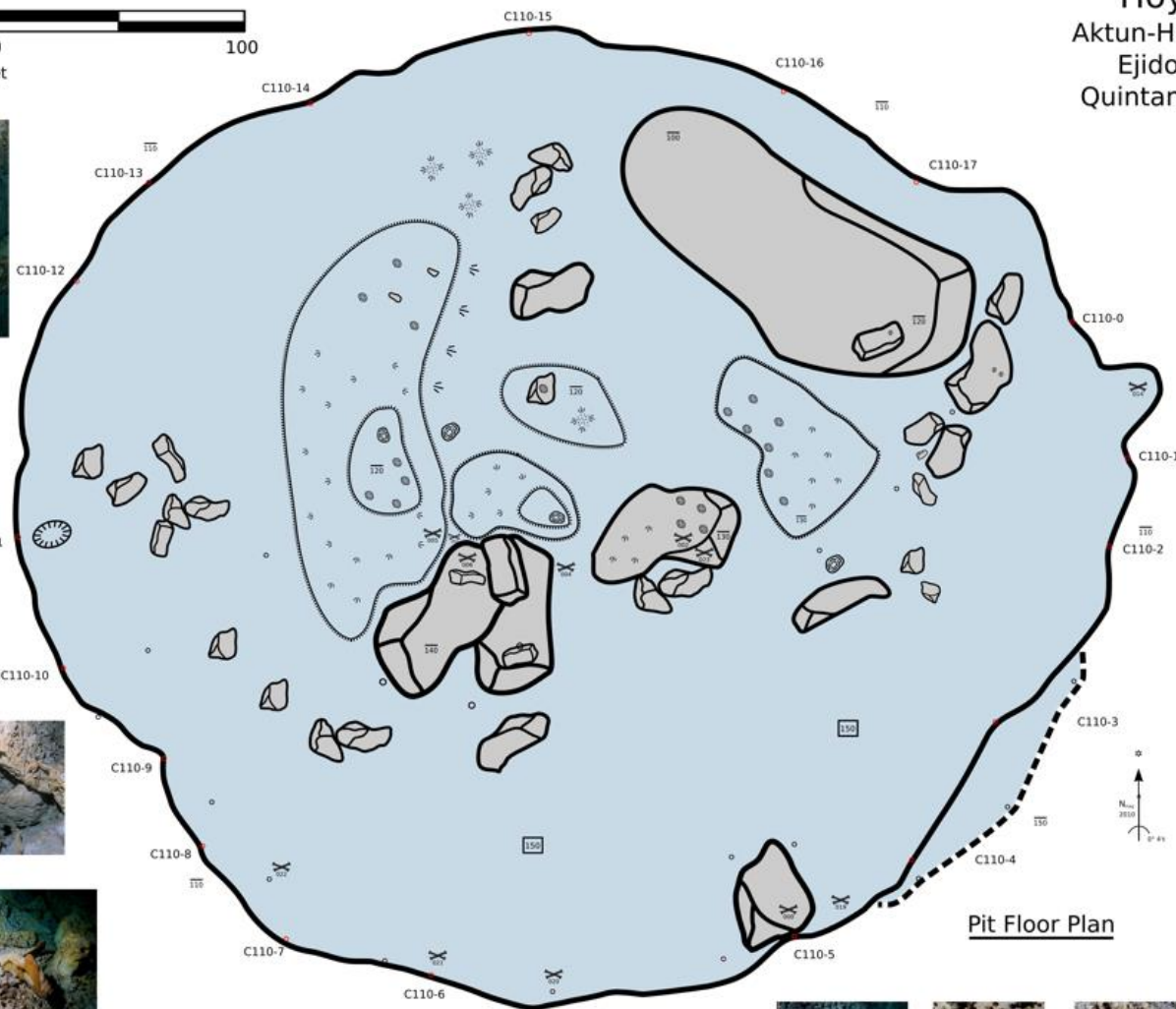
004



022



006



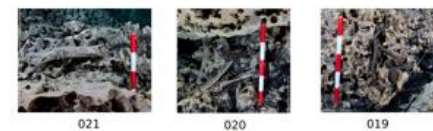
014

- Legend
- Underwater cave
  - Breakdown
  - Stones
  - Floor slope
  - Floor ledge
  - Column
  - Sand
  - Mud, clay
  - Stalagmite
  - Pit
  - Depth at floor in feet
  - Depth of pit in feet
  - Ceiling height in feet
  - Bones deposits



Pit Floor Plan

Surveyed by  
 Alex Alvarez  
 Franco Attolini  
 Alberto Nava  
 Roberto Chavez  
 Jacob Mellor  
 Sam Meacham  
 Susan Bird  
 Christophe Le Maillot  
 Daniel Riordan  
 Fred Devos

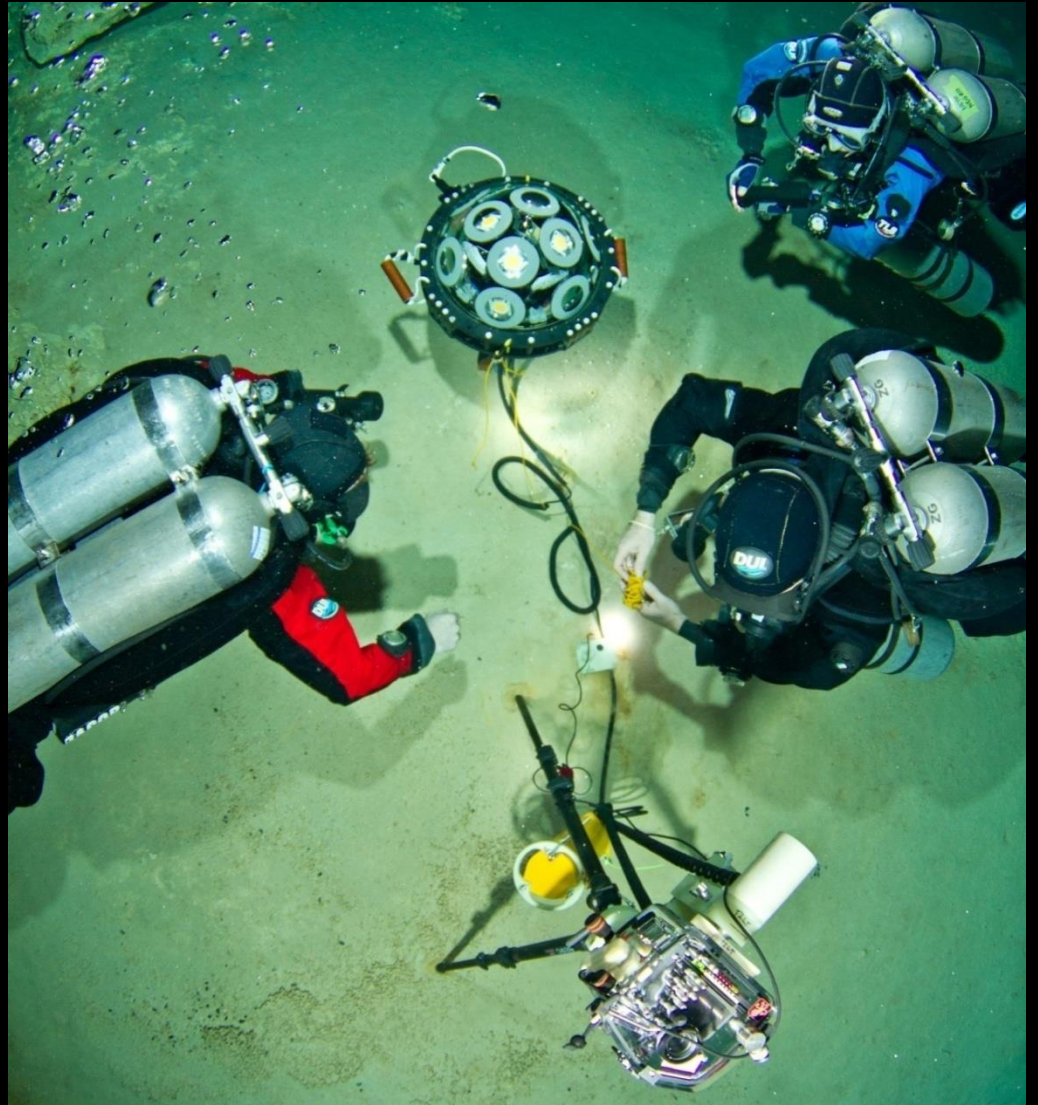


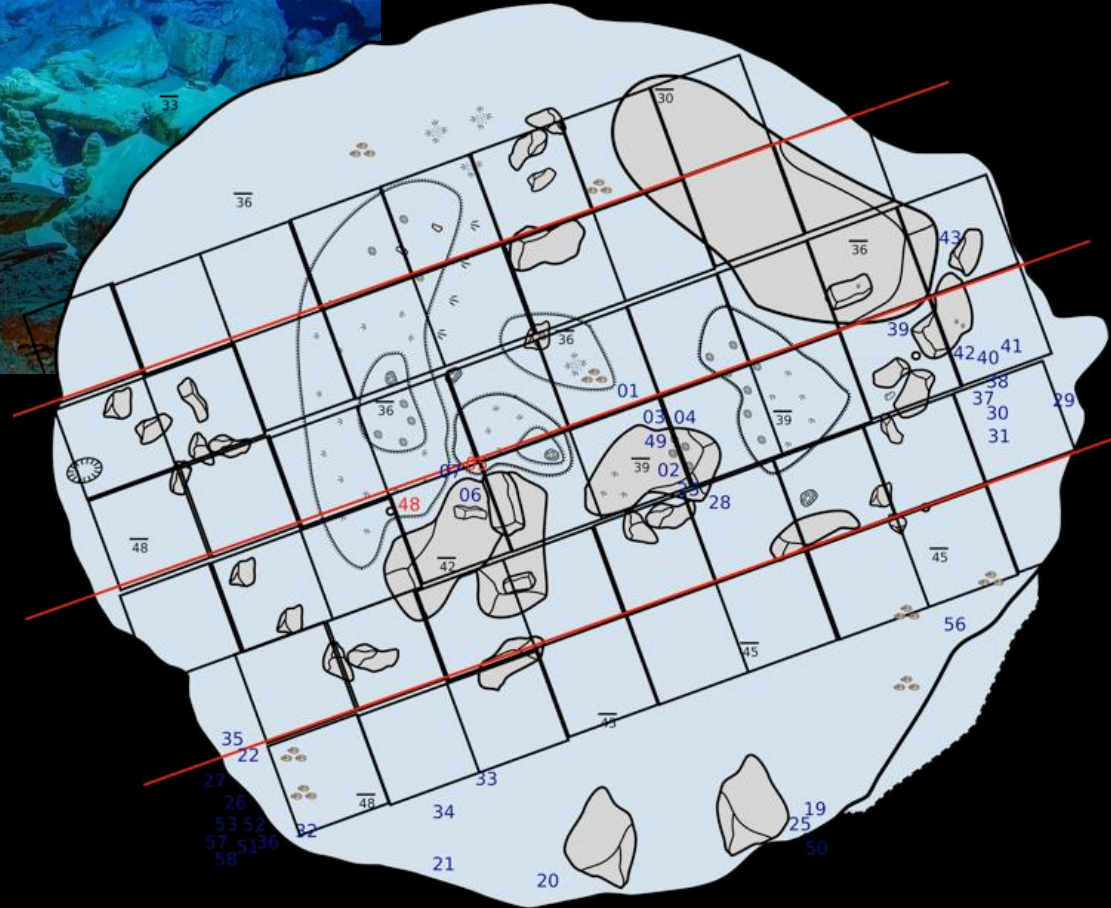
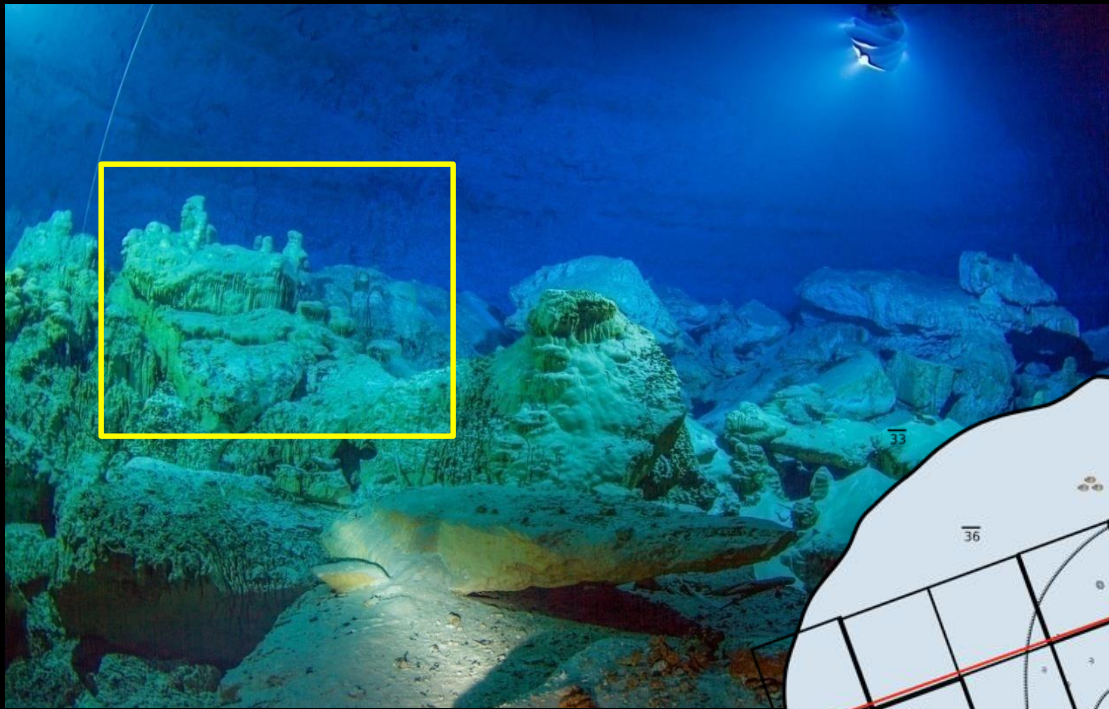
021

020

019

Map is a combination of traditional survey and survey by video documentation.  
 Video surveyed 2007,  
 compass and tape surveyed Feb-May 2011







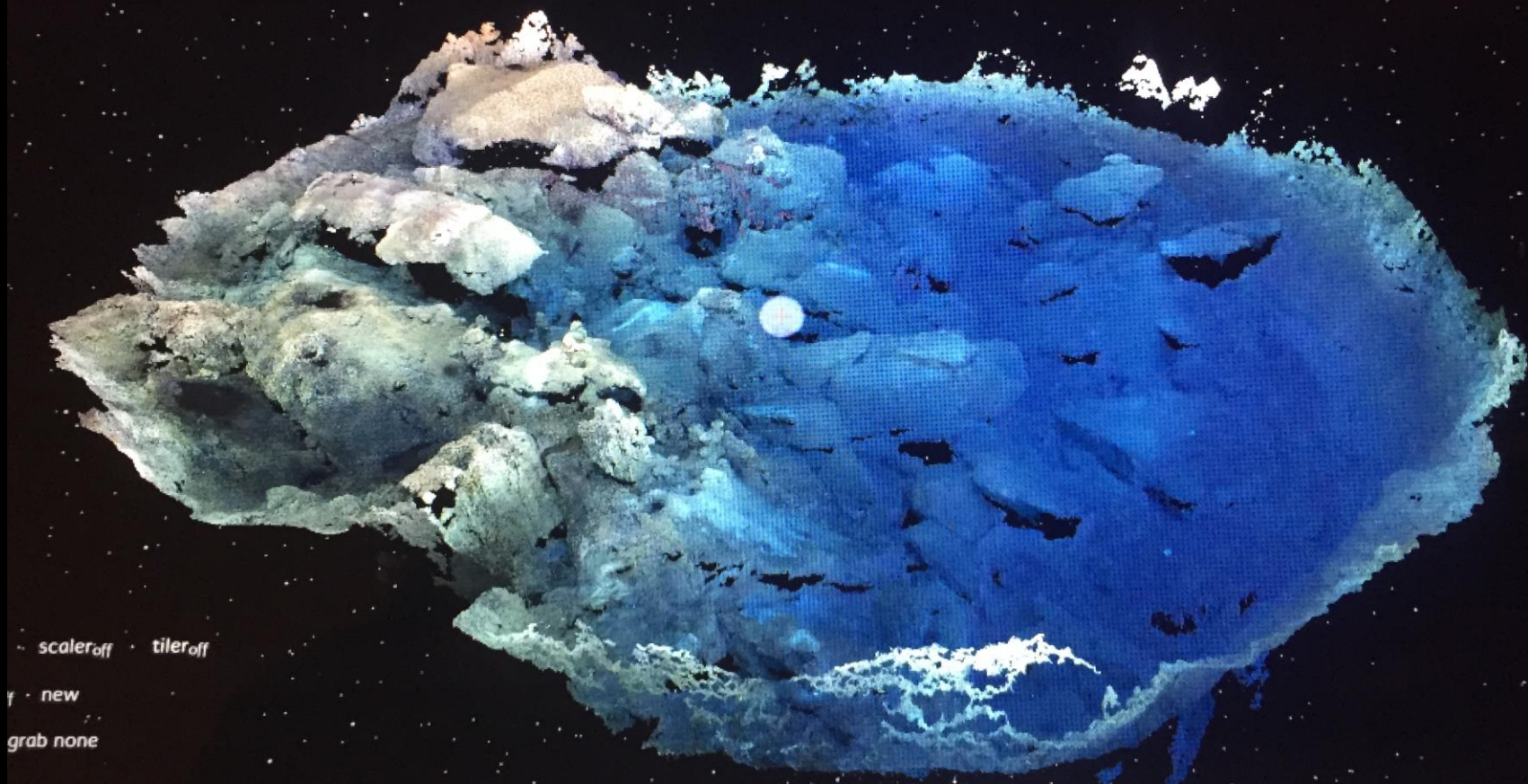
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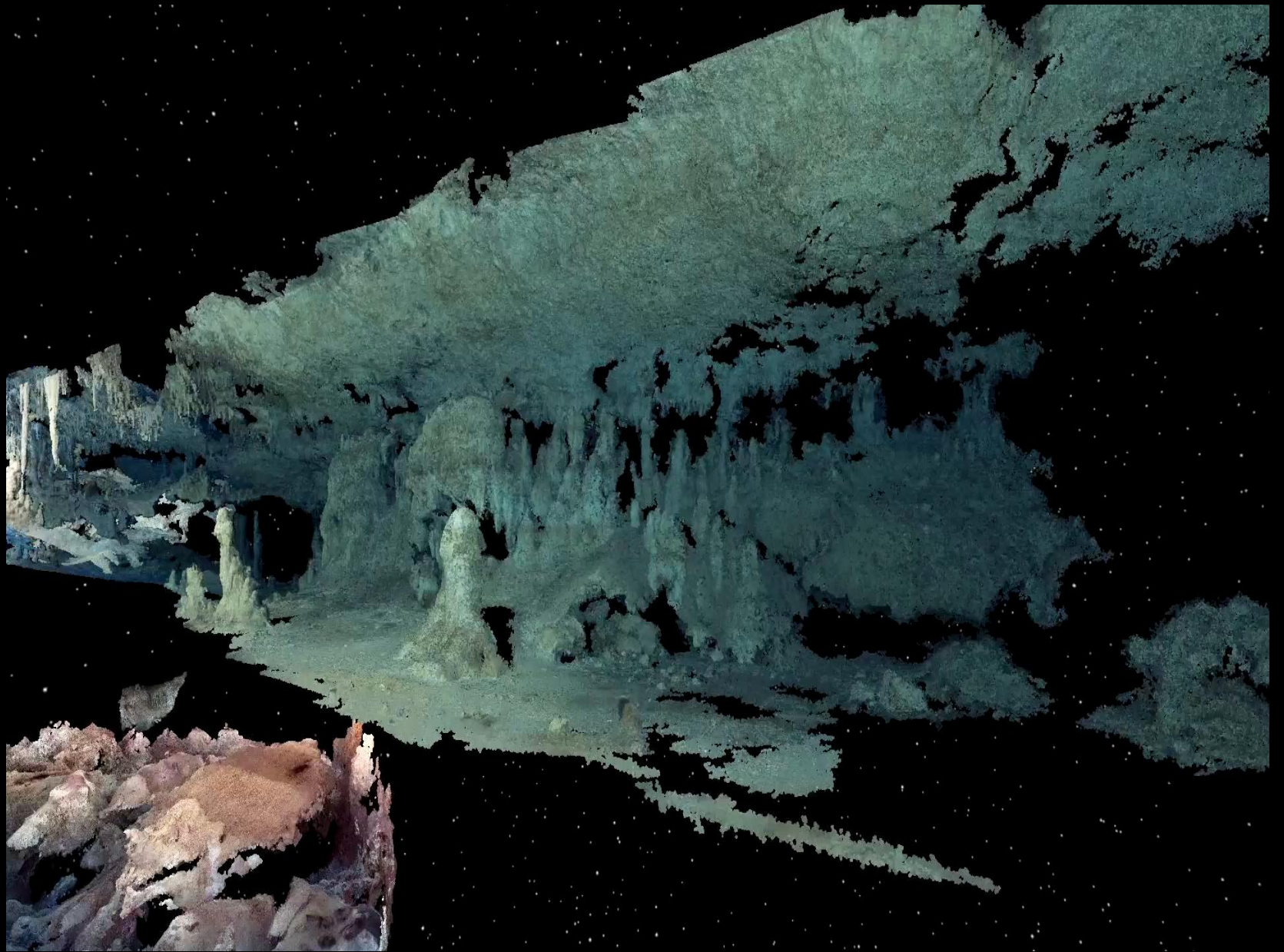


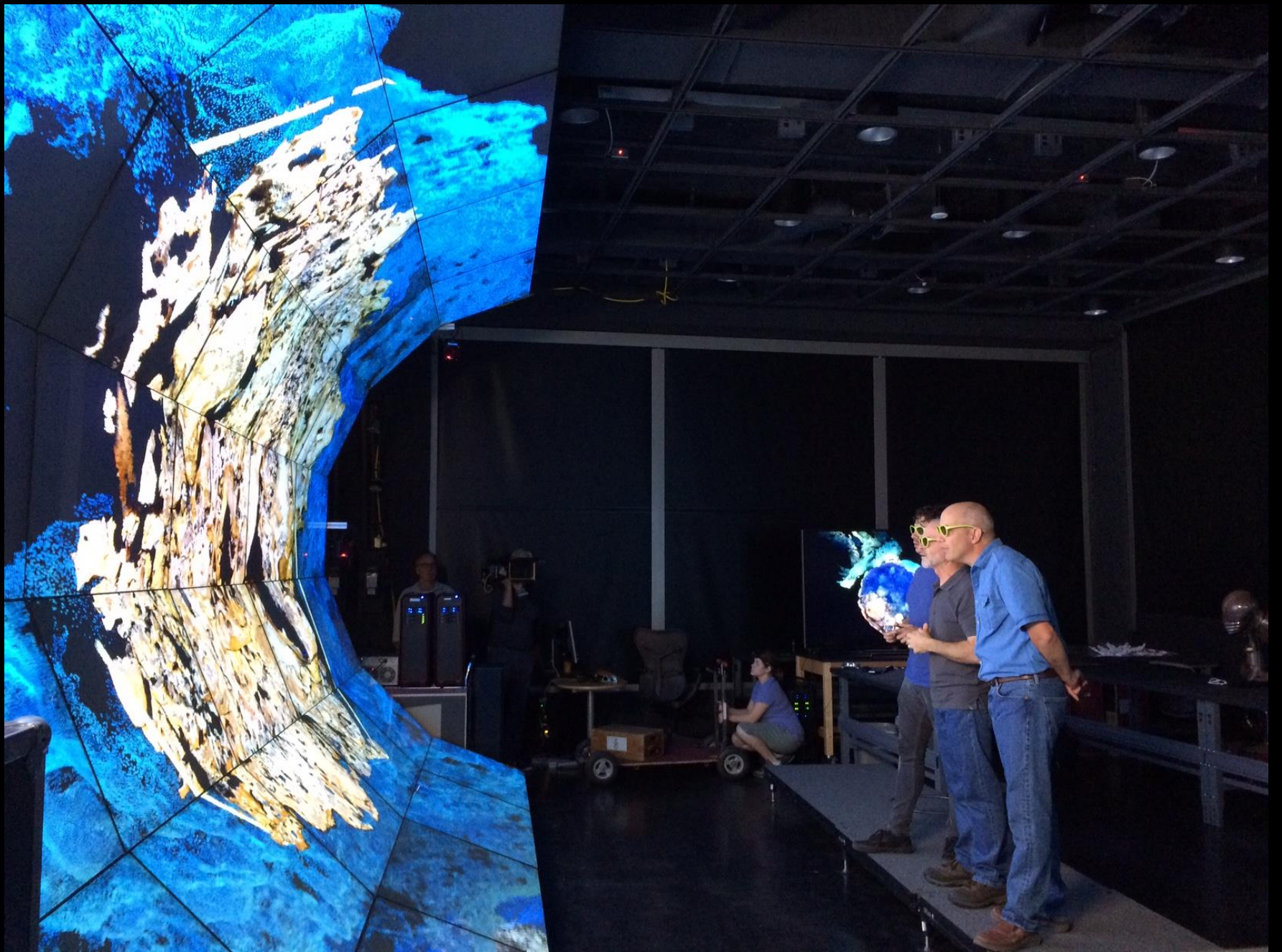


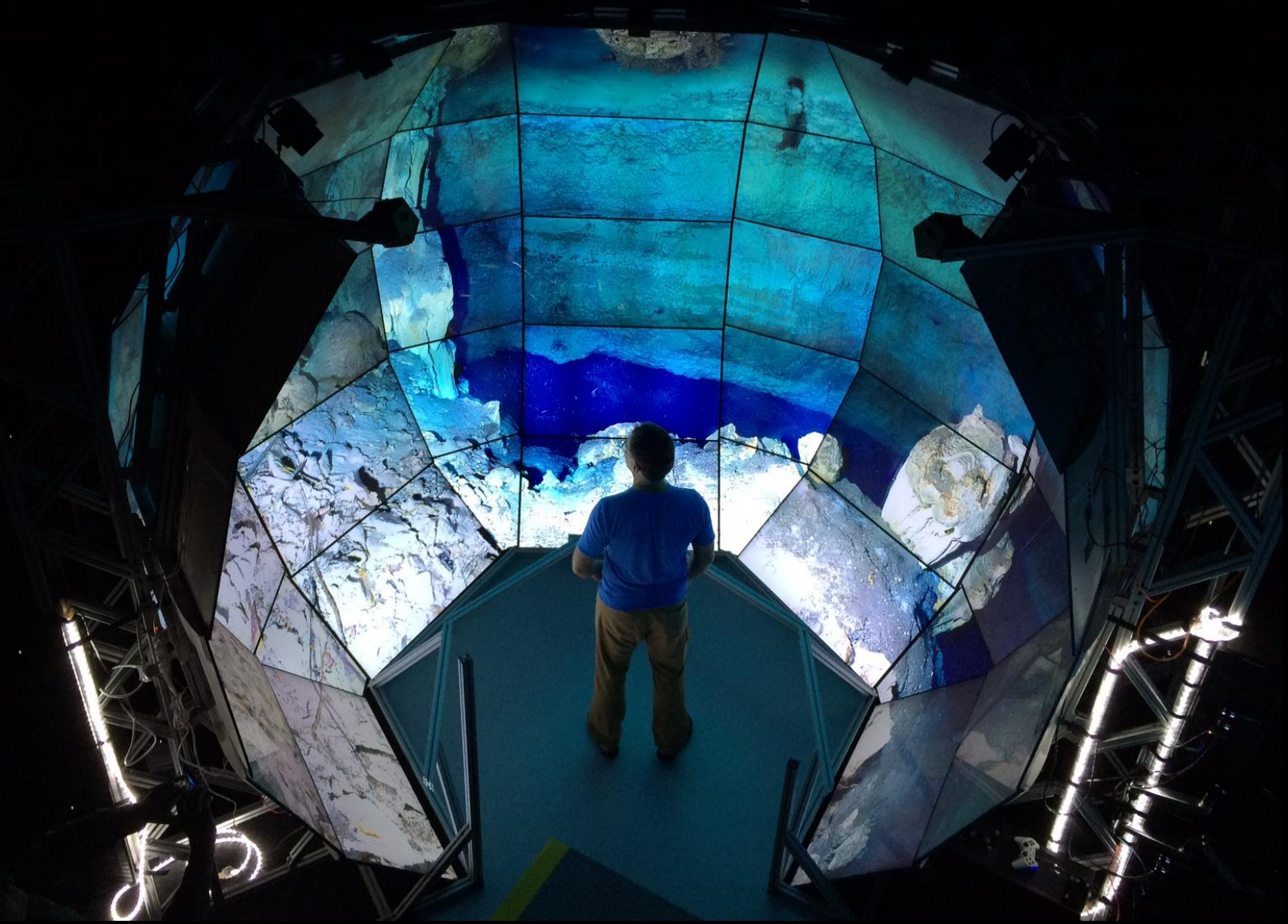
X



- scaler<sub>off</sub> · tiler<sub>off</sub>  
· new  
grab none













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UADY UNIVERSIDAD AUTÓNOMA DE YUCATÁN

UC San Diego Jacobs School of Engineering



Strauss Family Fund for Mesoamerican Studies Vid Petrovic , Eric Lo, Dominique Meyer, Chris McFarland, and Falko Kuester







COMING SOON

## First Face of America

Discover remains of a 13,000 year-old teenager in an underwater cave in Mexico. Airing February 7, 2018 at 9 pm on PBS

Search...

To learn more about Dominique's work, watch NOVA's "First Face of America" on PBS February 7, 2018. Check local listings for correct time.



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### Program Description

One unlucky day 13,000 years ago, a slight, malnourished teenager missed her footing and tumbled to the bottom of a 100-foot pit deep inside a cave in Mexico's Yucatán. Rising seas flooded the cave and cut it off from the outside world—until a team of divers chanced upon her nearly complete skeleton in 2007. Intricate detective work reveals

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