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TERRESTRIAL 3D LASER SCANNING TO REBUILD SON DOONG CAVE (HANG SON DOONG)

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3DSCAN VIETNAM®

HANG SON DOONG

CONTENT

- Introduction about Hang Son Doong
- A survey trip to Hang Son Doong in 2014 – 2015
- Project results
- Sample of Hang Son Doong deliverable


HD
NHK WORLD
Phong Nha–Ke Bang National Park

Hidden in rugged Phong Nha – Ke Bang National Park near by the border Vietnam – Laos, the Hang Son Doong is part of a network of 150 or so caves and many still not surveyed, in the Annamite Mountains

HANG SON DONG OVERVIEW

Rare caves pearls fill dried-out terrace pools near The Garden of Edam in Hang Son Doong. This unusually large collection of stone spheres formed drip by drip over the centuries as calcite crystals left behind by water layered themselves around grains of sand, enlarging over time.

HANG SON DONG OVERVIEW

Why did Hang Son Doong get so big? The perfect formula was: Huge volumes of water, it was tropical and the river followed a narrow fault line.

HANG SON DONG OVERVIEW

Huge of stalactites inside Hang Son Doong combined an enormous shaft of sunlight plunges into the cave like a waterfall

Dolines are created when the cave ceiling collapse inwards allowing daylight to stream in and create new & unique ecosystems right inside Hang Son Doong. The plant under dolines also changes to adapt to the environment. In and hour we may see spectacular view from any direction of the cave.

Hang Sơn Đoòng

From Wikipedia, the free encyclopedia

Coordinates: 17°27'25"N 106°17'15"E

Sơn Đoòng Cave (Vietnamese: *Hang Sơn Đoòng* ([haːŋ ʂəːn ɗɔŋ]); 'cave of the mountain river'[1] or 'mountain cave of Đoòng [village]' in Vietnamese),[disputed – discuss] is a solutional cave in Phong Nha-Kẻ Bàng National Park, Bố Trạch District, Quảng Bình Province, Vietnam. As of 2009 it has the largest known cave passage cross-section in the world,[2][3] and is located near the Laos–Vietnam border. Inside is a large, fast-flowing subterranean river. It was formed in Carboniferous/Permian limestone.[4]

Contents [hide]

Discovery [edit]

Hang Sơn Đoòng was found by a local man named Hồ Khanh in 1991. The whistling sound of wind and roar of a rushing stream in the cave heard through the entrance as well as the steep descent prevented the local people from entering the cave. Only in 2009 did the cave become internationally known after a group of cavers from the British Cave Research Association conducted a survey in Phong Nha-Kẻ Bàng from 10 to 14 April 2009.[1] Their progress was stopped by a large, 60-metre (200 ft) high calcite wall,[1] which was named the Great Wall of Vietnam. It was traversed in 2010 when the group reached the end of the cave passage.

Description [edit]

According to the Limberts, the main Sơn Đoòng cave passage is the largest known cave passage in the world by volume – 38.4×10^6 cubic metres (1.36×10^9 cu ft). It is more than 5 kilometres (3.1 mi) long, 200 metres (660 ft) high and 150 metres (490 ft) wide. Its cross-section is believed to be twice that of the next largest passage, in Deer Cave, Malaysia.[5][6] The cave runs for approximately 9 kilometres (5.6 mi) and is punctuated by 2 large dolines, which are areas where the ceiling of the cave has collapsed. The dolines allow sunlight to enter sections of the cave which has resulted in the growth of trees as well as other vegetation.[7]

The cave contains some of the tallest known stalagmites in the world, which are up to 70 m tall. Behind the Great Wall of Vietnam were found cave pearls the size of baseballs, an abnormally large size.[8]

Hang Sơn Đoòng

Sơn Đoòng Cave

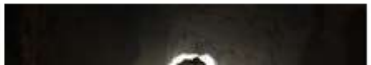
View approaching the second doline

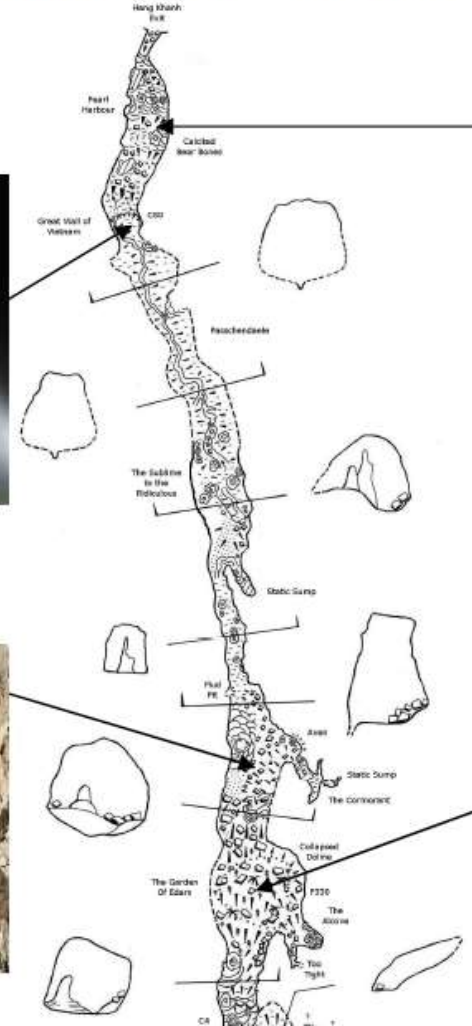
https://en.wikipedia.org/wiki/Hang_S%C6%A1n_%C4%90o%C3%B2ng

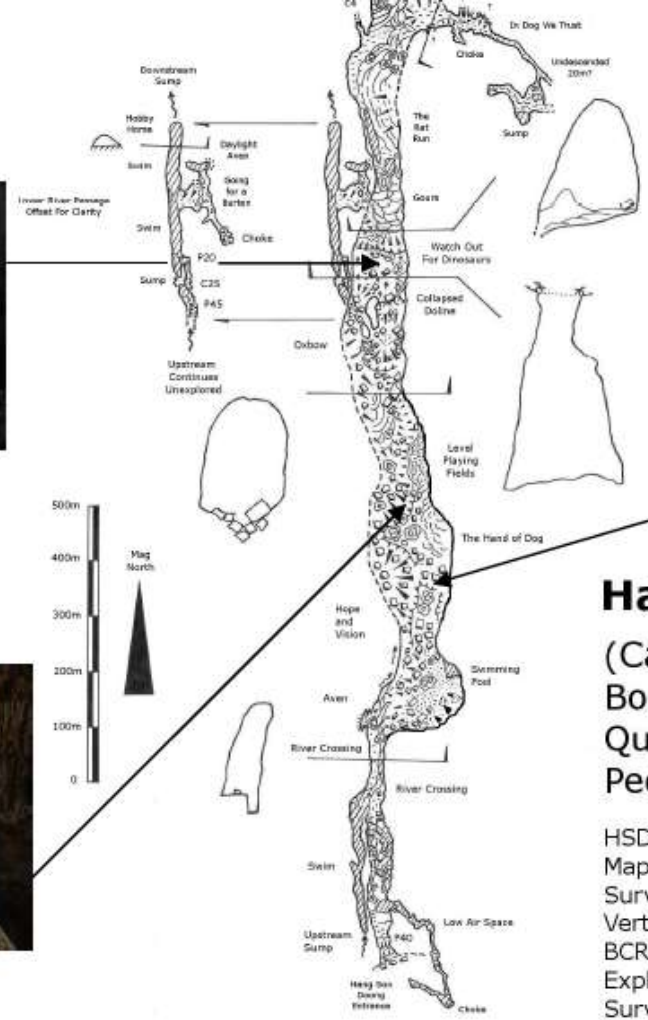
SON DOONG CAVE INFORMATION (Before 2010)

- The best data for Hang Son Doong surveyed since 2010
- General survey information since 2010
  - Location: Hang Son Doong, Bo Trach district, Quang Binh Province, Viet Nam
  - UTM topographic map: No. 62431 UTM
  - Survey length: 7,678 m
  - Elevation: 449 m
  - Internally elevated: + 280.6 m & -168.4m
  - Survey equipment: M.D.L Laserace 300
- Handheld laser rangefinders were used for field survey
- Based on some surveyed points & interpolated to modeling

Hang Son Doong Survey 2010







Hang Son Doong

(Cave of the Mountain River)
Bo Trach District
Quang Bin Province
Peoples Republic of Vietnam

HSD Entrance Grid Ref: 637258E; 192975N
Map Sheet: Co Trach; So Hieu 62431
Surveyed length: 7678m: Surveyed depth: 449m
Vertical Range +280.6m; -168.4m
BCRA Grade 5C
Explored & Surveyed by "Vietnam 09 & 10"
Surveyed using M.D.L. Laserace 300

All passage cross sections drawn at double scale
Dashed lines indicate passage walls not fully explored

SON DOONG CAVE 3D MODEL

HANG SON DOONG SURVEY IN 2014 - 2015

- Purposes:
  - Rebuild exactly 3D model of Hang Son Doong with 3D laser scanning technology
  - Calculate Hang Son Doong numbers (such as volume, widest, highest cross section etc.)
  - Modeling for filming purpose
  - Data sharing for professional study
- Survey equipment:
  - 3D laser scanning
  - Reference from another projects
  - Accurate and resolution
- Schedule:
  - First trip: From 30 August 2014 to 9 September 2014
  - Second trip: From 18 January 2015 to 20 January 2015

HANG SON DONG

- Survey equipment
  - 3D laser scanner Leica ScanStation C10 (350 m)
  - 3D laser scanner FARO FOCUS S130 (130 m)
  - 3D laser scanner FARO FOCUS X330 (130 m)
  - Handheld laser rangefinder: Trupulse 360R
  - 360 spherical camera: NCTech Istar
  - Computers, Software & Team of 3 tecnicians

ScanStation C10
350m

FARO FOCUSX130
130m

NCTech Istar
Spherical Pano

Handheld Laser
Rangefinders

Ruggedized
Field Computers

High performance
Mobi-workstation

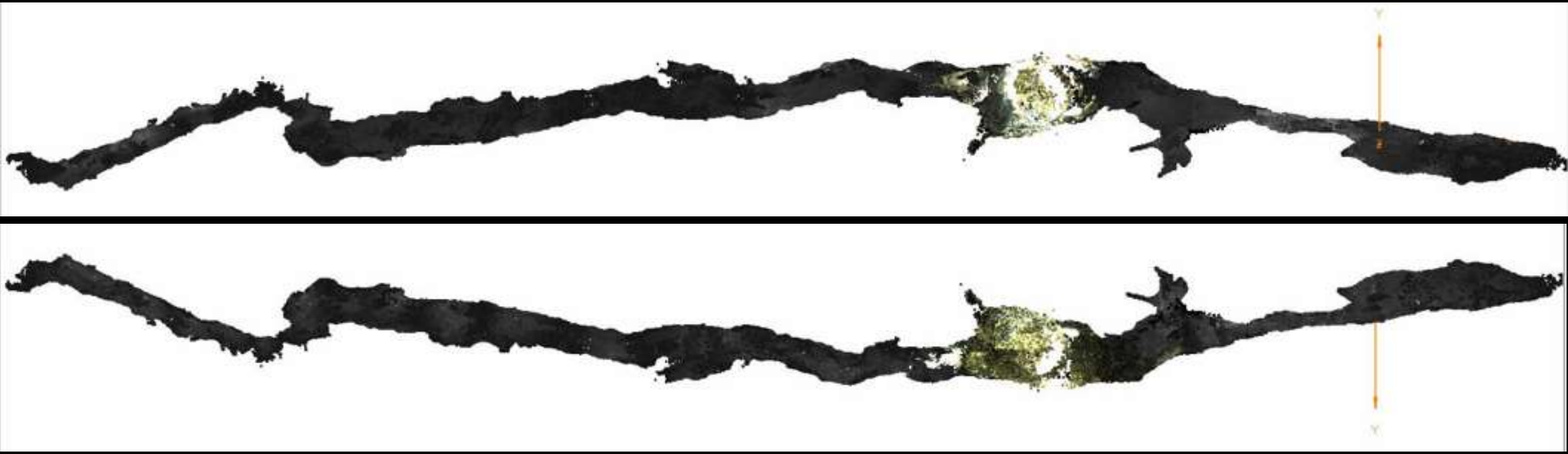
HANG SON DONG TRIP

FIELD SURVEY & POST PROCESS RESULTS

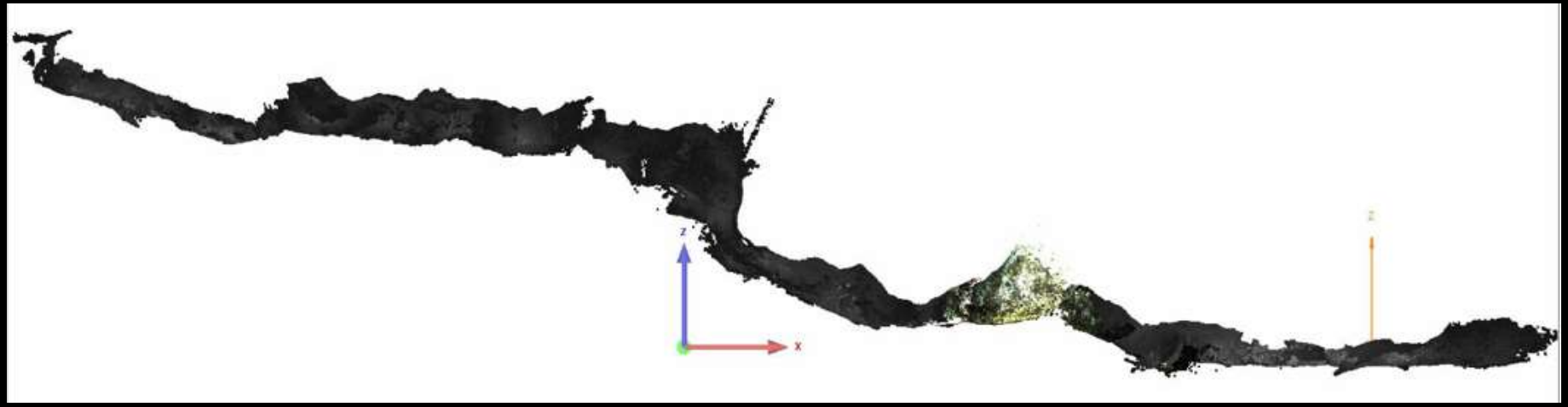
- Total scan station: 98
- 3D point cloud Hang En
- 3D point cloud Hang Son Doong
- Solid model of Hang Son Doong (AutoCAD modeling)
- Cross sections for Hang Son Doong
- Volume & Internally elevation calculation
- 3D clip for filming (Vietnam Television)
- Student, geological, tourism etc. purposes

HANG DON DOONG (Length & Shape)

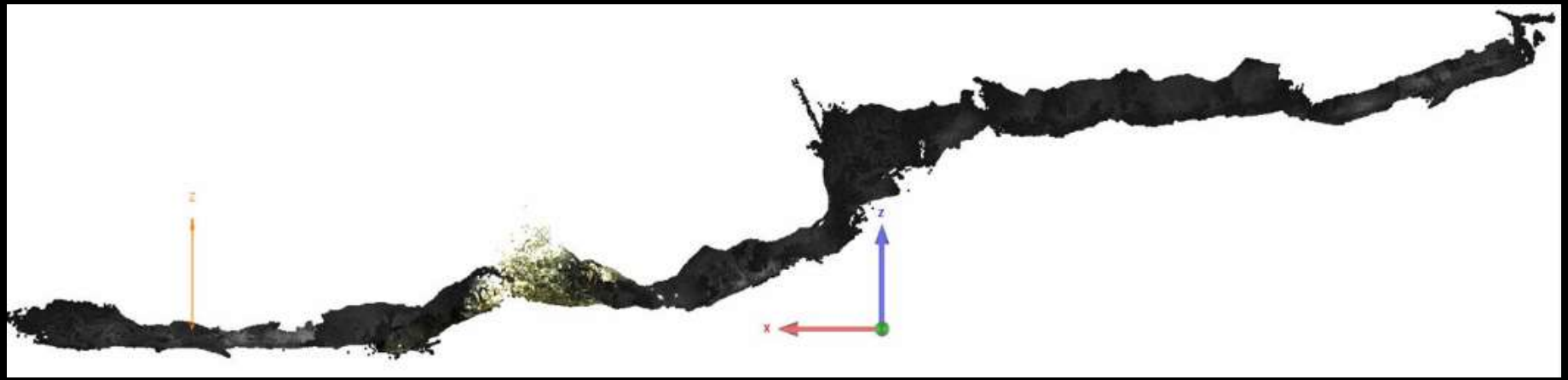
HANG SON DOONG – Top view



HANG SON DONG – Front view



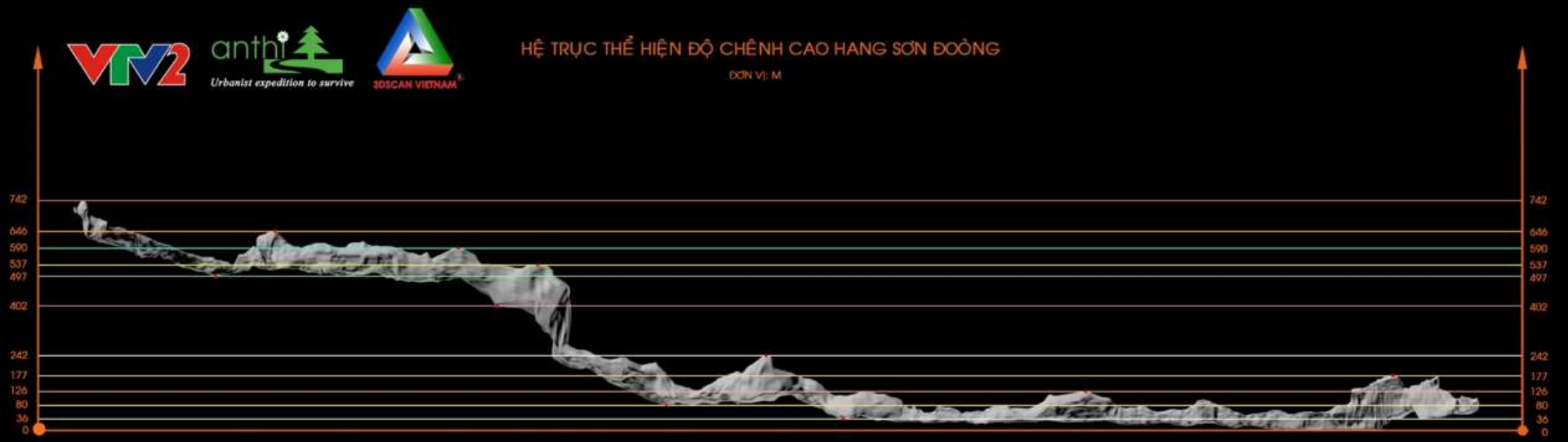
HANG SON DOONG – Back view



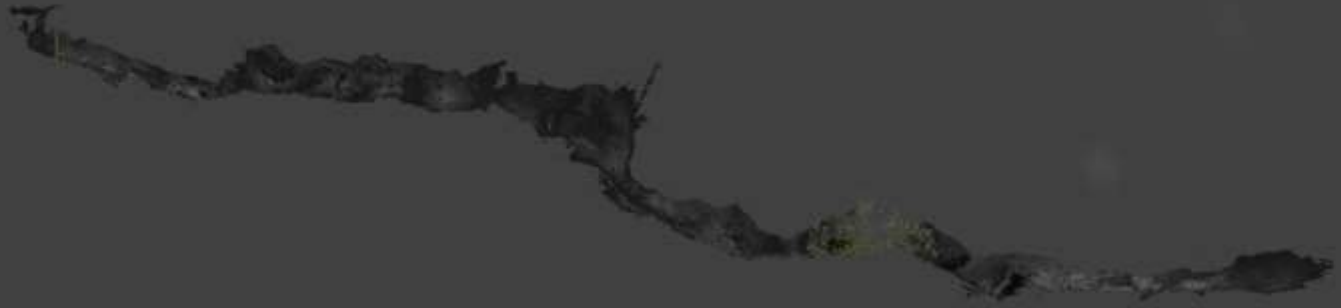
HANG SON DOONG
Left view

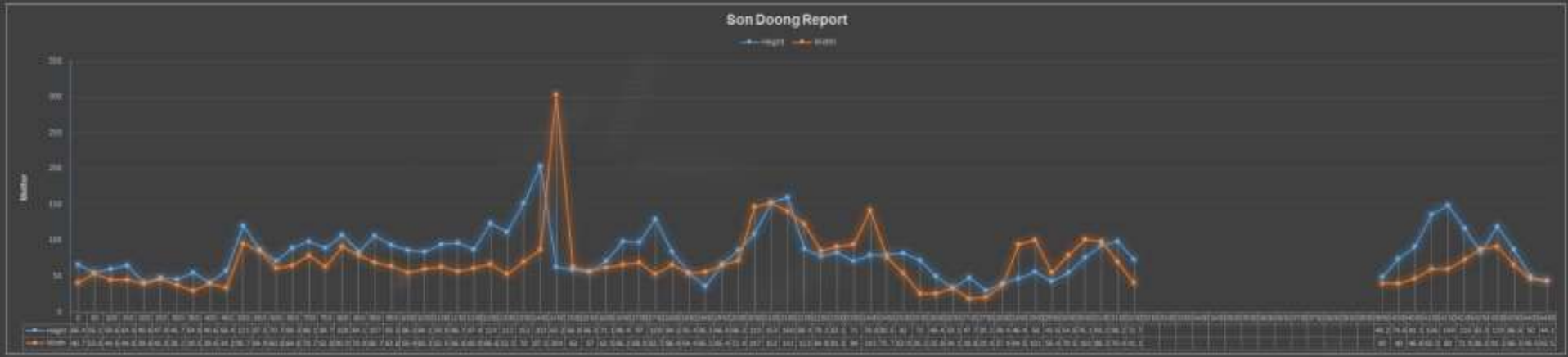
HANG SON DOONG
Right view

HANG SON DOONG (Internally elevated)

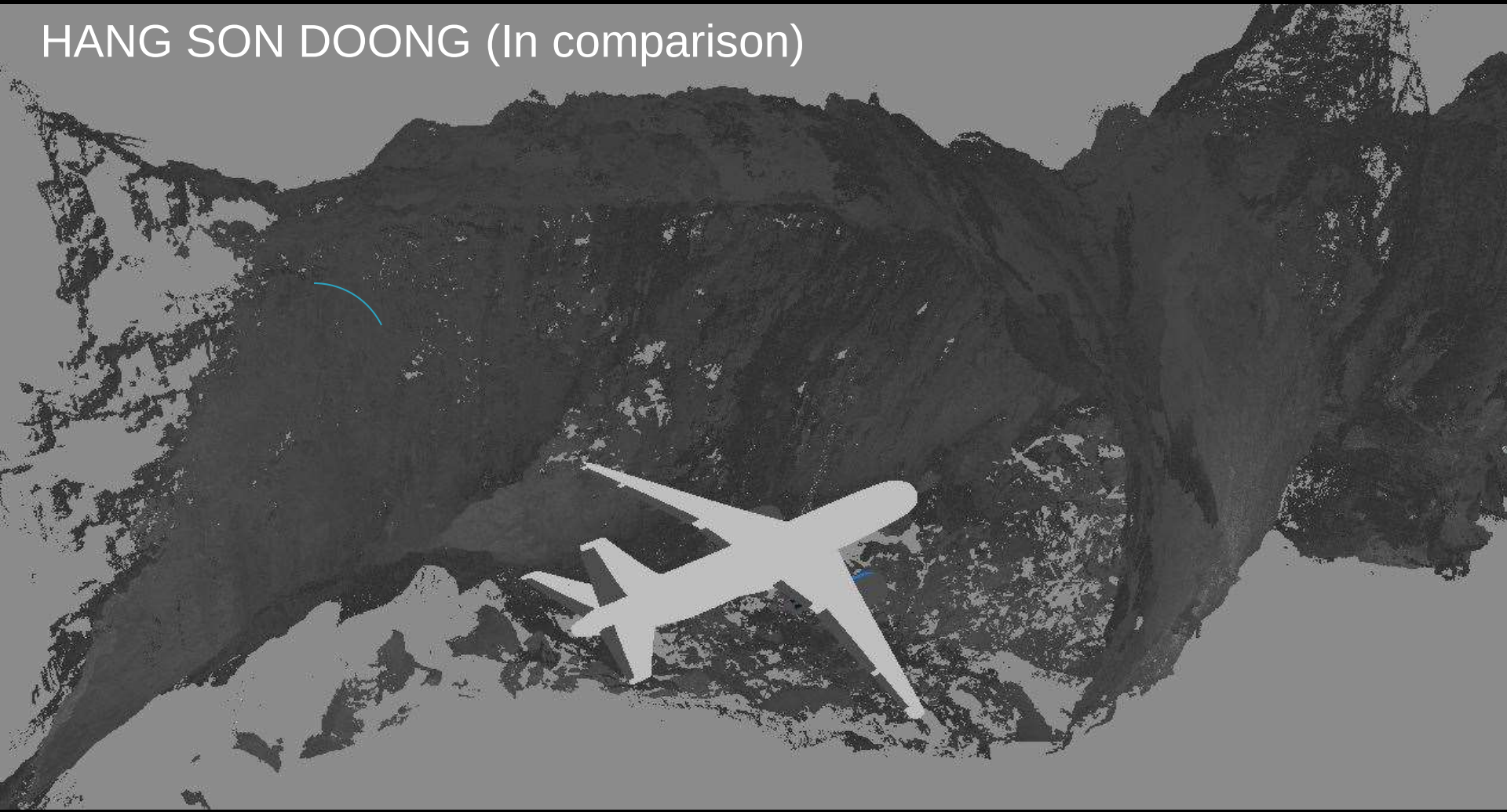


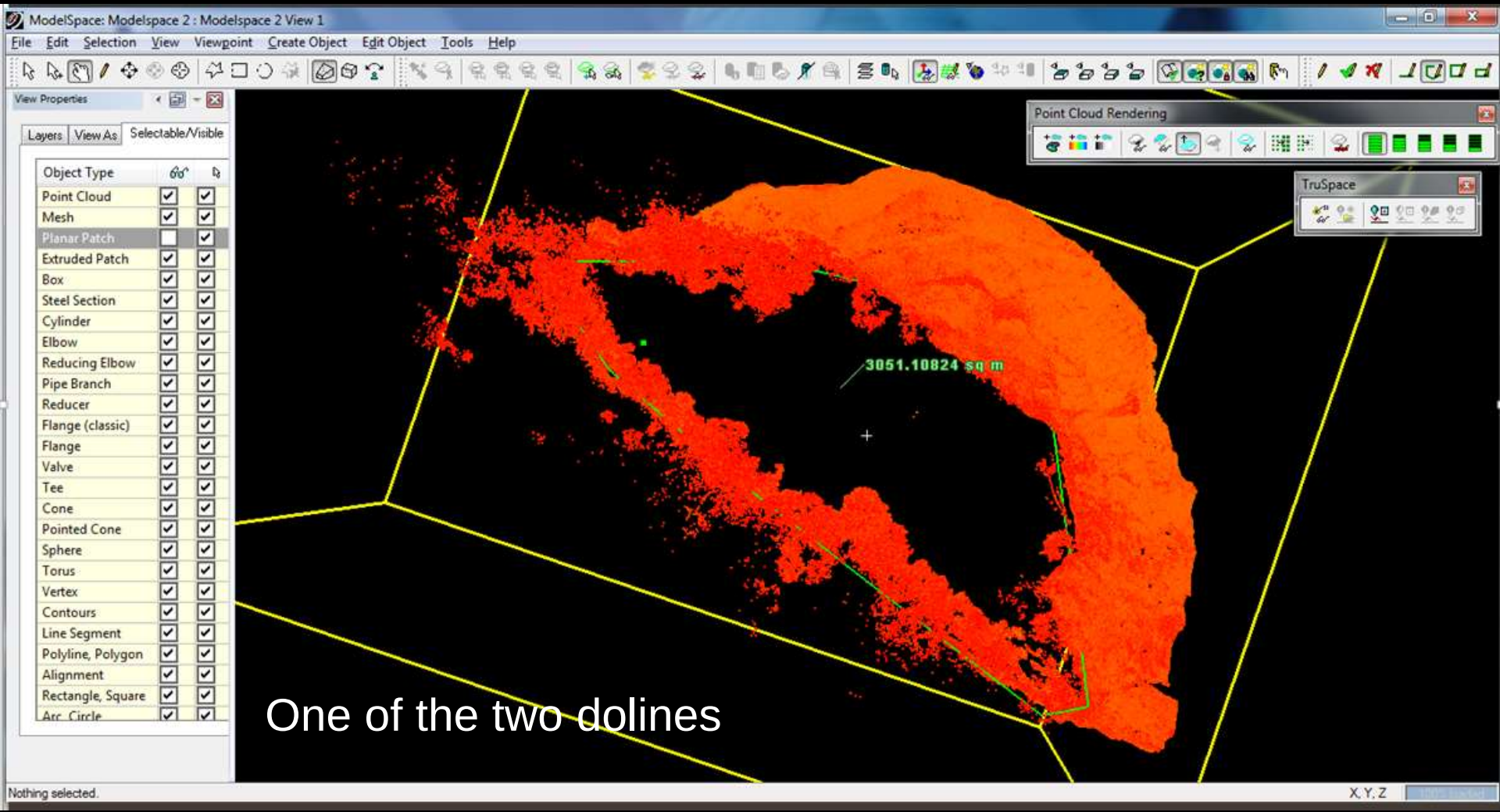
HANG SON DOONG HEIGHT & WIDE GRAPH



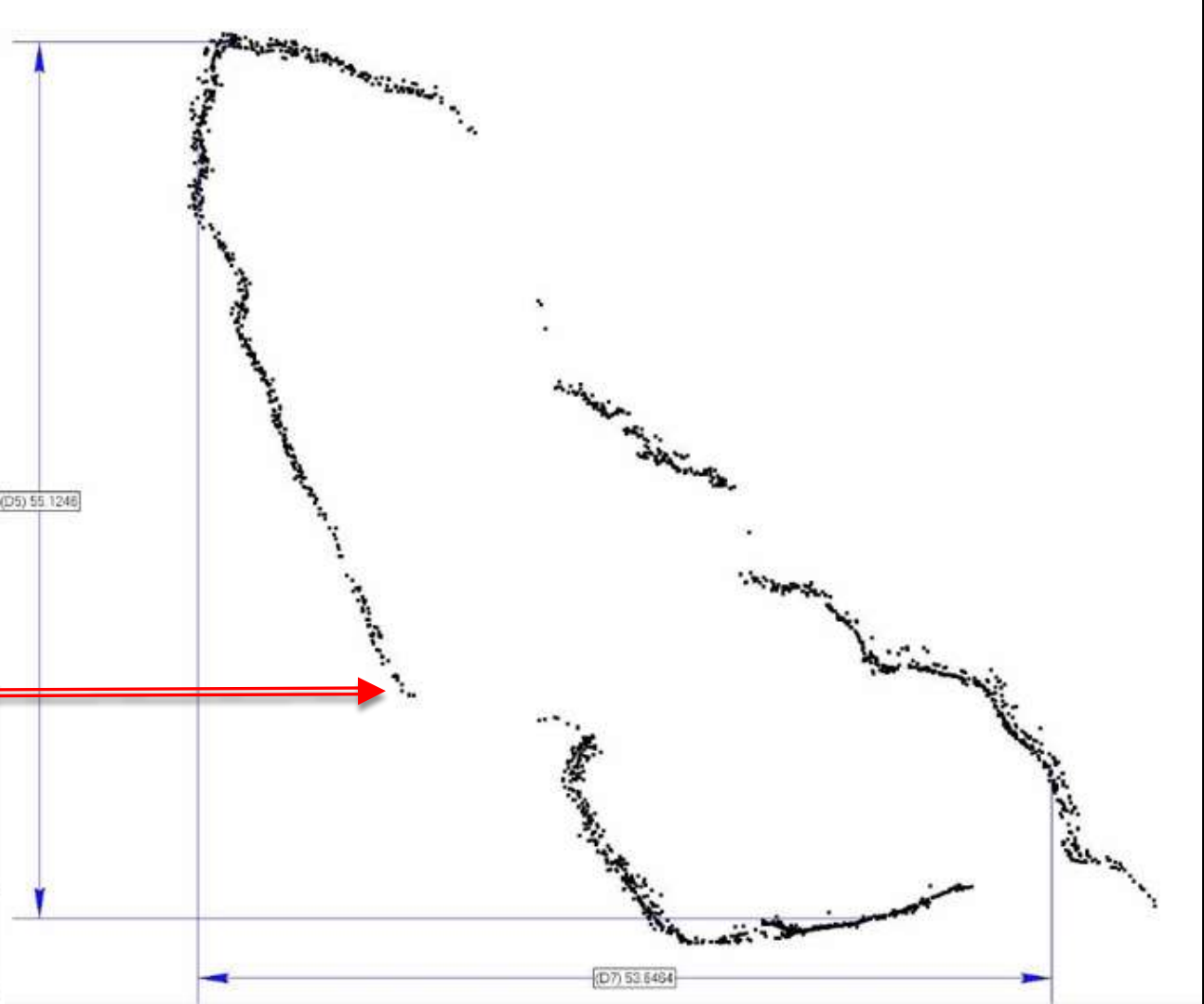


HANG SON DOONG (In comparison)

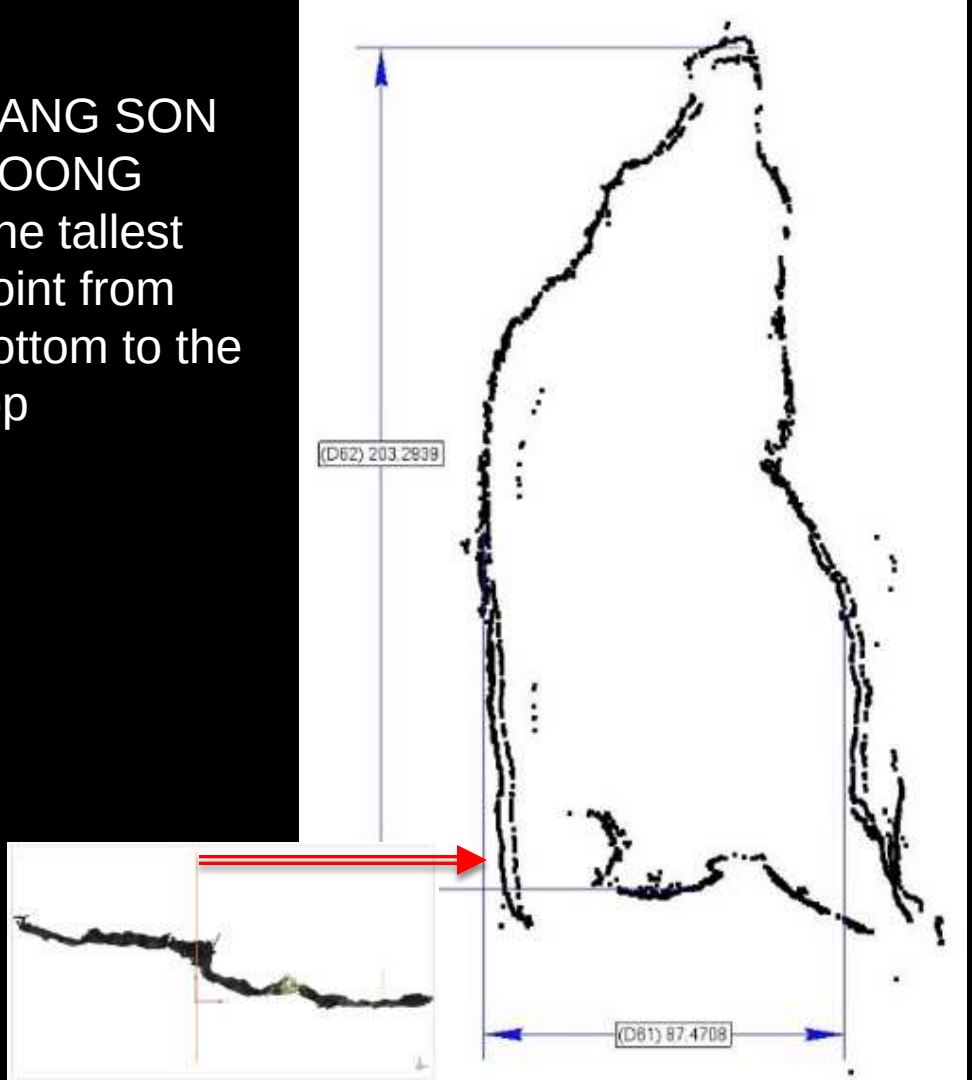



ModelSpace: Modelspace 2 : Modelspace 2 View 1
File Edit Selection View Viewpoint Create Object Edit Object Tools Help
View Properties
Layers View As Selectable/Visible
Object Type
Point Cloud
Mesh
Planar Patch
Extruded Patch
Box
Steel Section
Cylinder
Elbow
Reducing Elbow
Pipe Branch
Reducer
Flange (classic)
Flange
Valve
Tee
Cone
Pointed Cone
Sphere
Torus
Vertex
Contours
Line Segment
Polyline, Polygon
Alignment
Rectangle, Square
Arc, Circle
Point Cloud Rendering
TruSpace
3051.10824 sq m
One of the two dolines
Nothing selected.
X, Y, Z

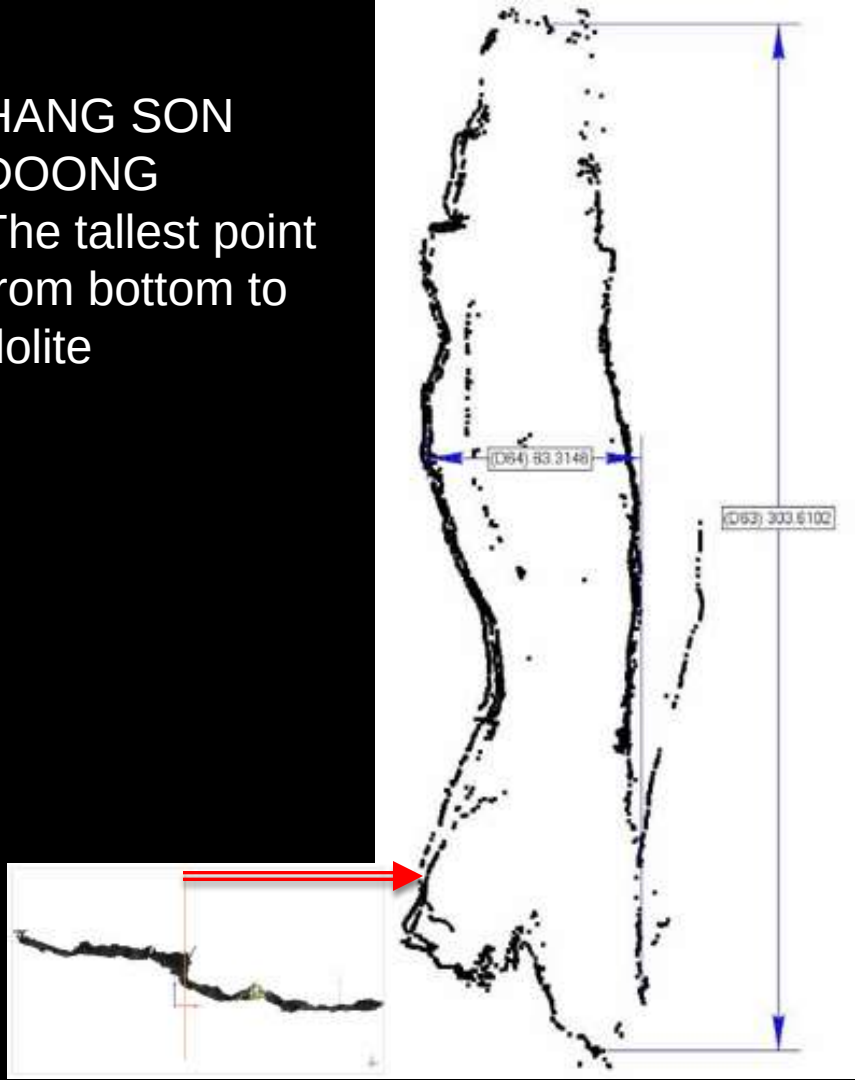
HANG SON DOONG
Entrance Passage



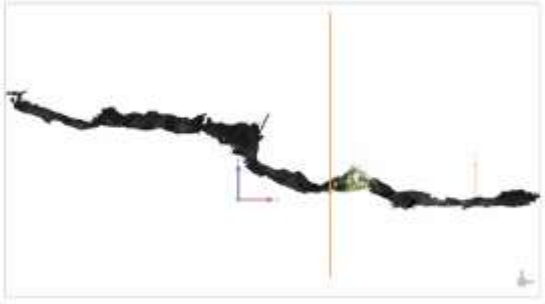
HANG SON DOONG
The tallest point from bottom to the top

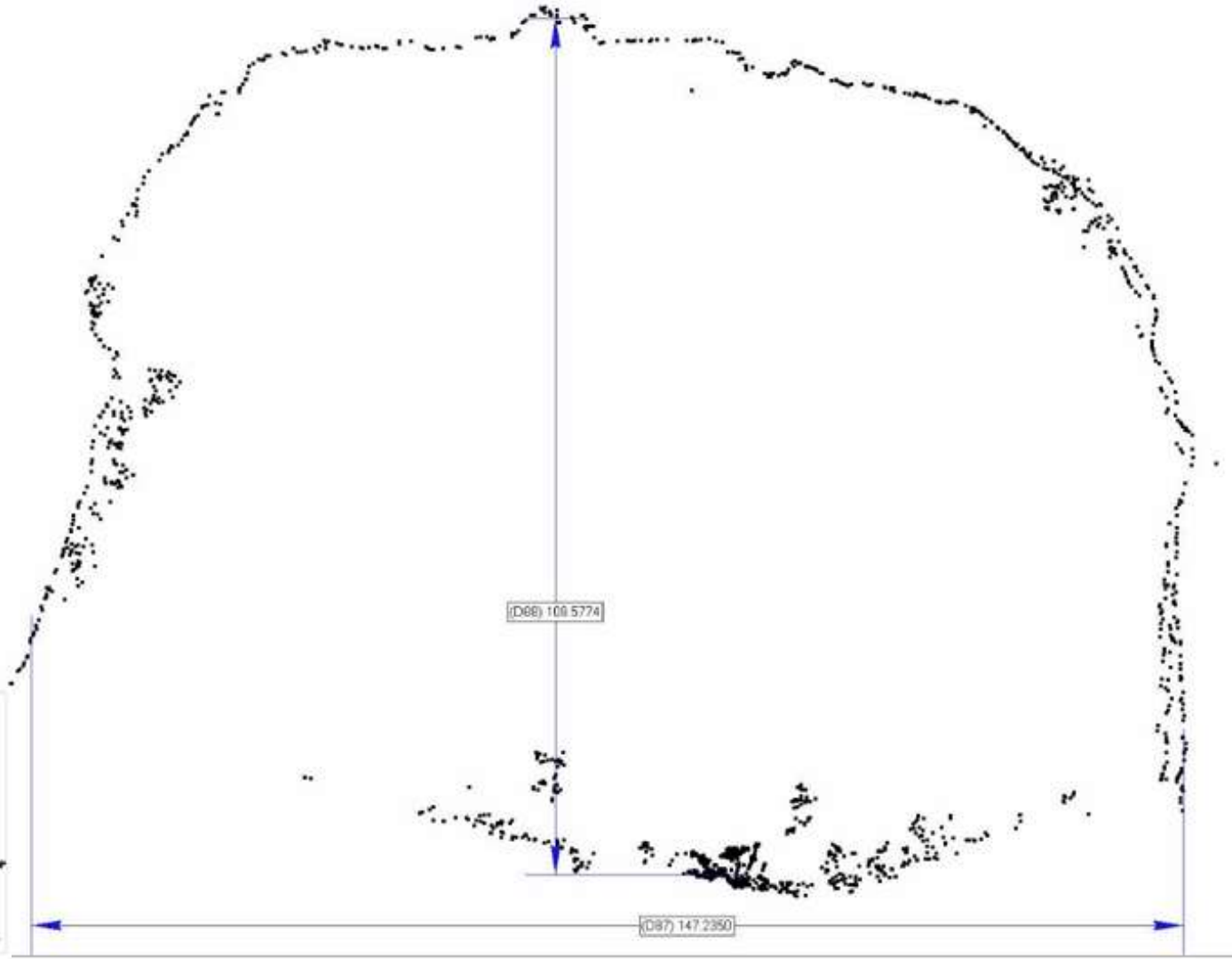


HANG SON DOONG
The tallest point from bottom to dolite

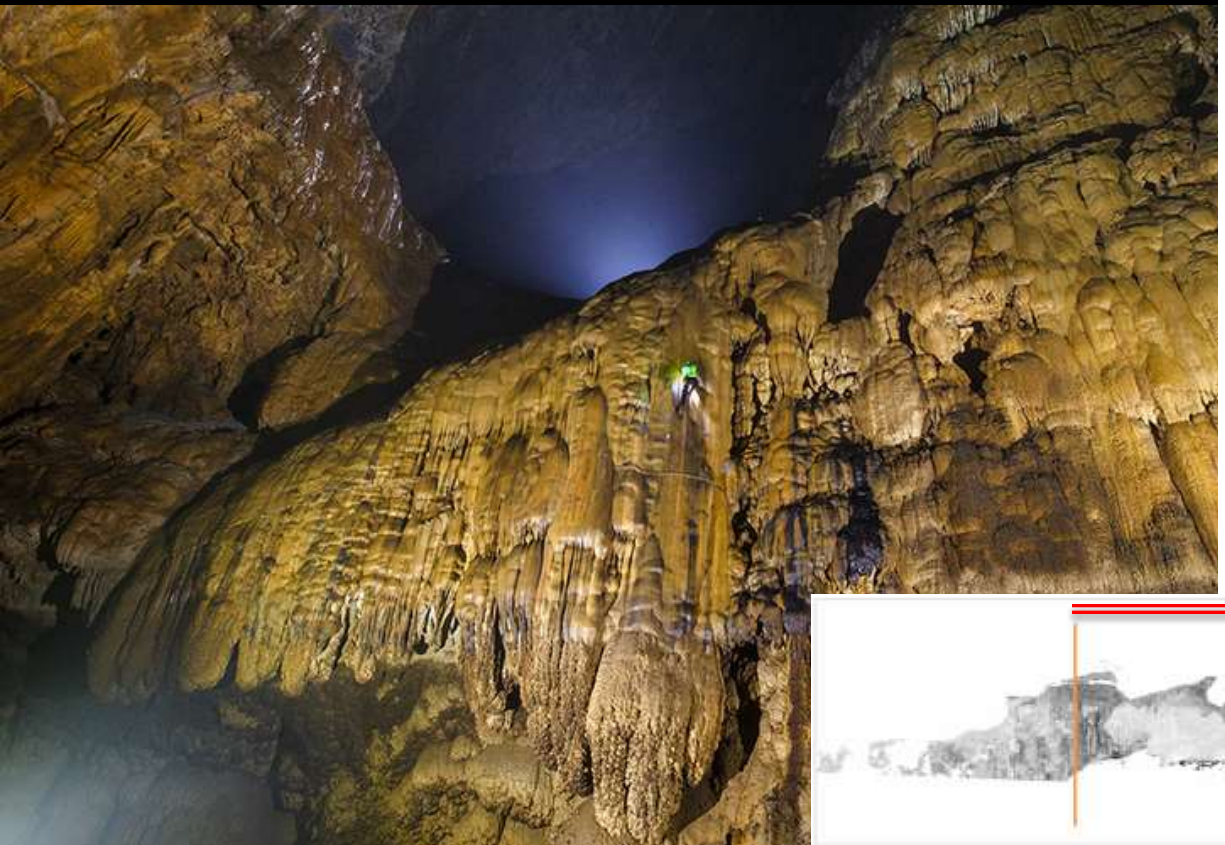


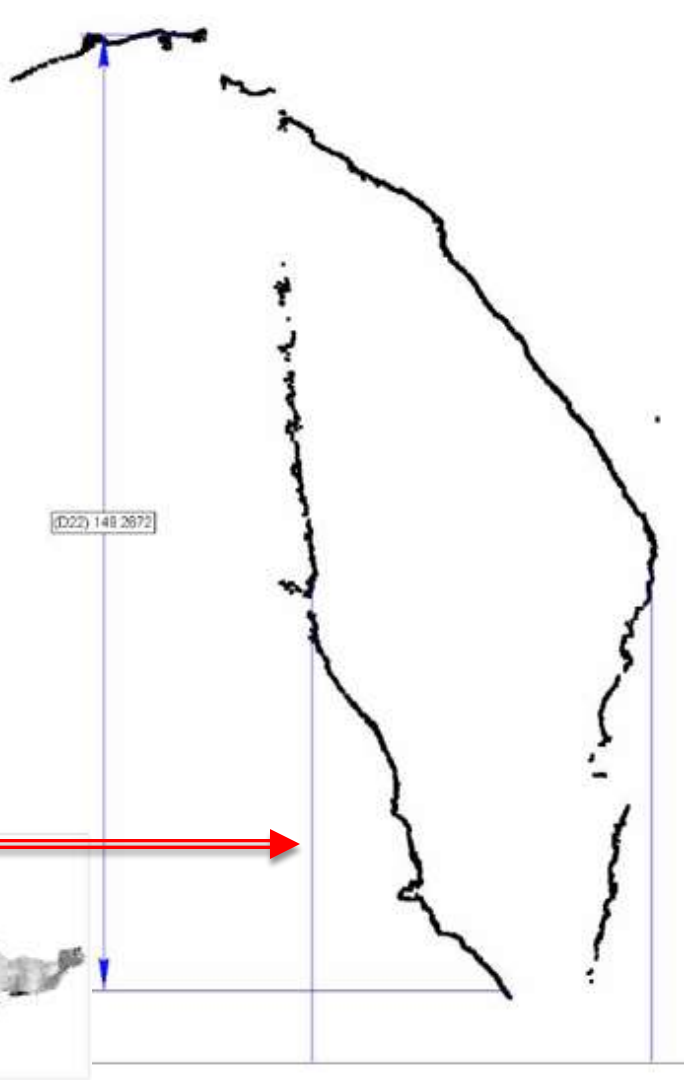
HANG SON DOONG
The widest cross section



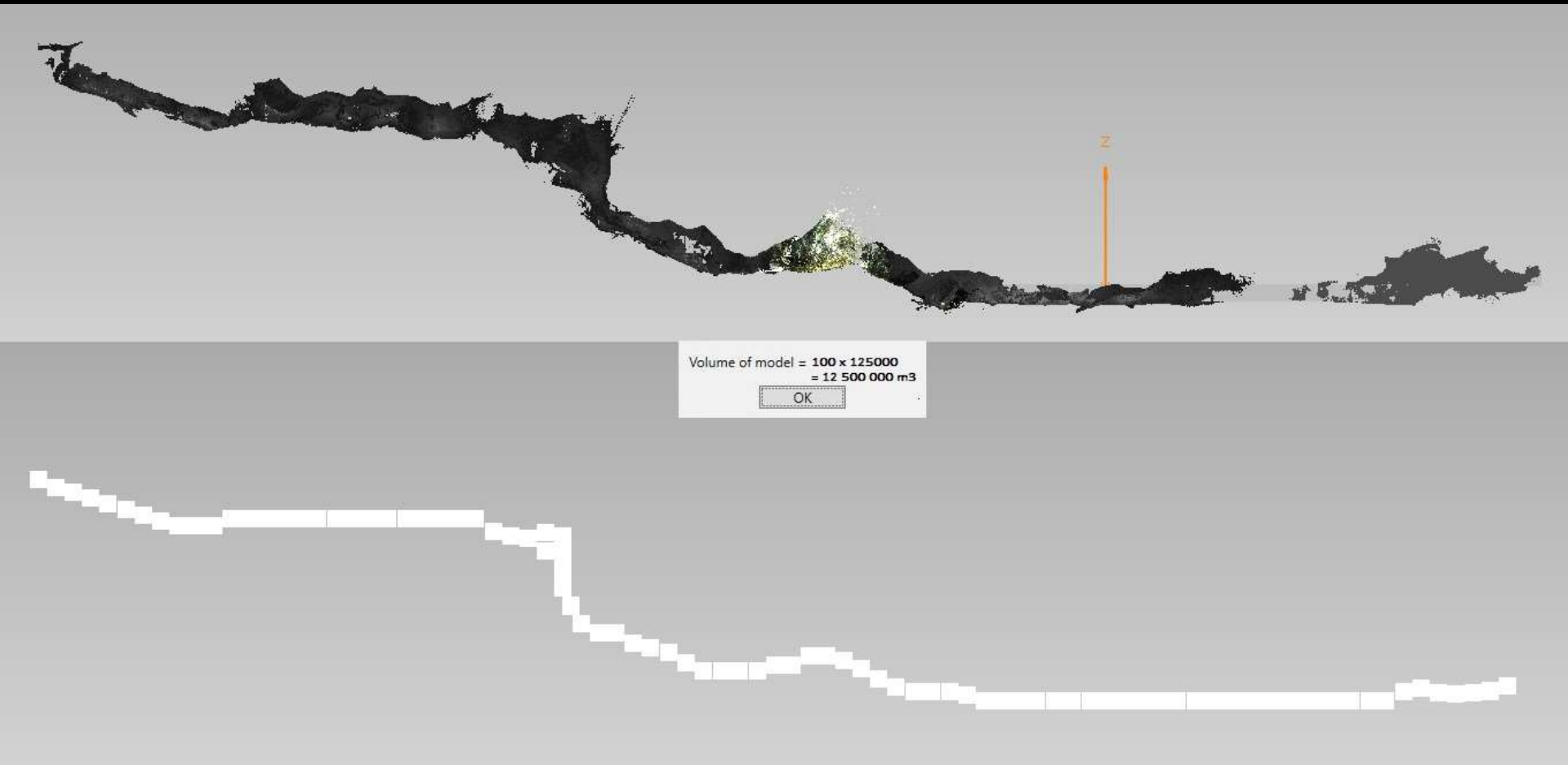


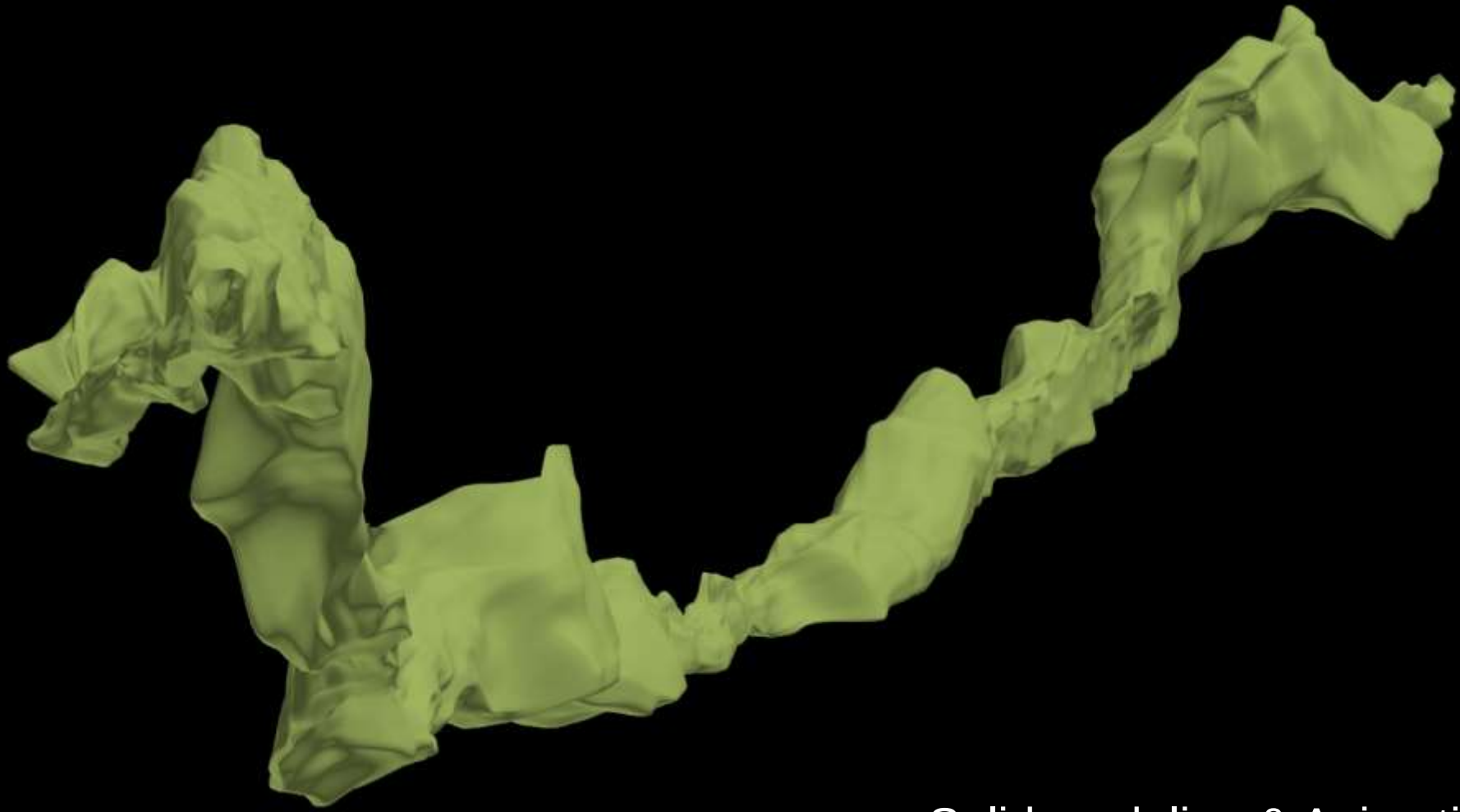
HANG SON DOONG
The Great Wall of Vietnam



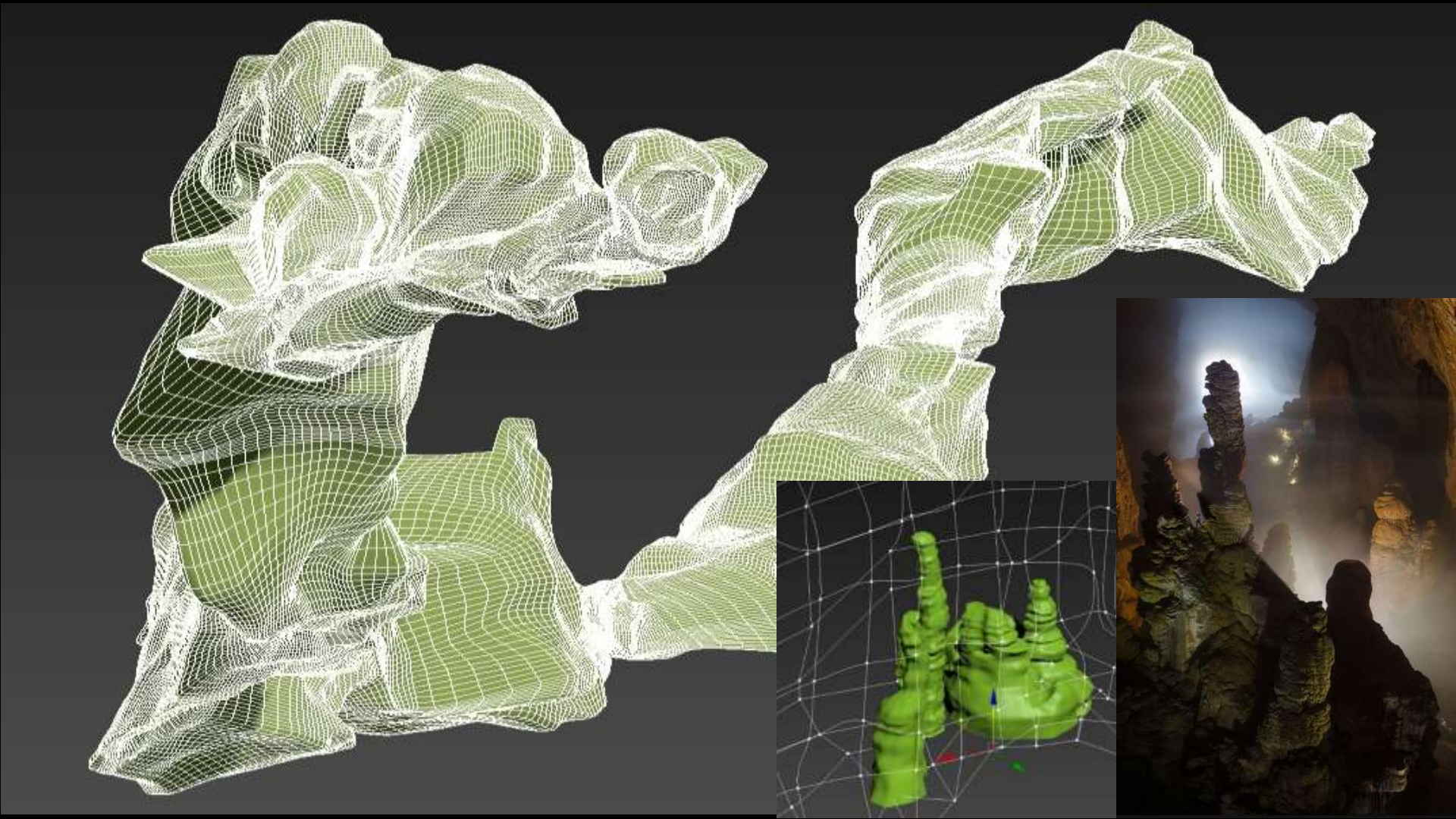


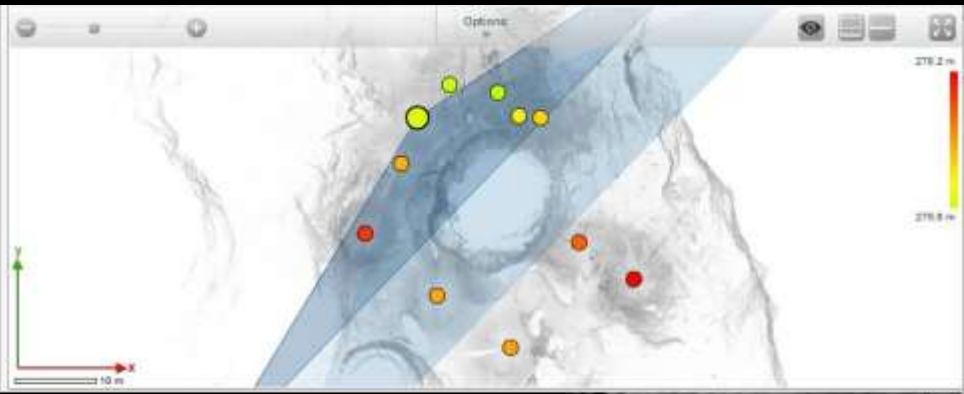
HANG SON DOONG – Volume calculation





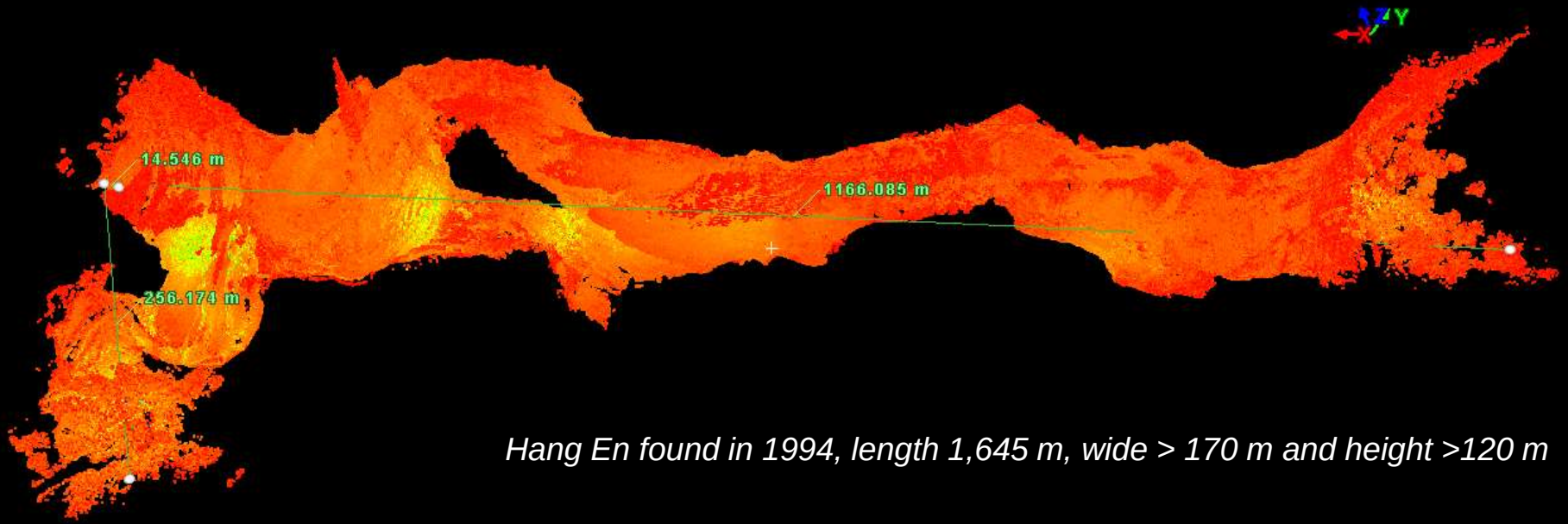
Solid modeling & Animation



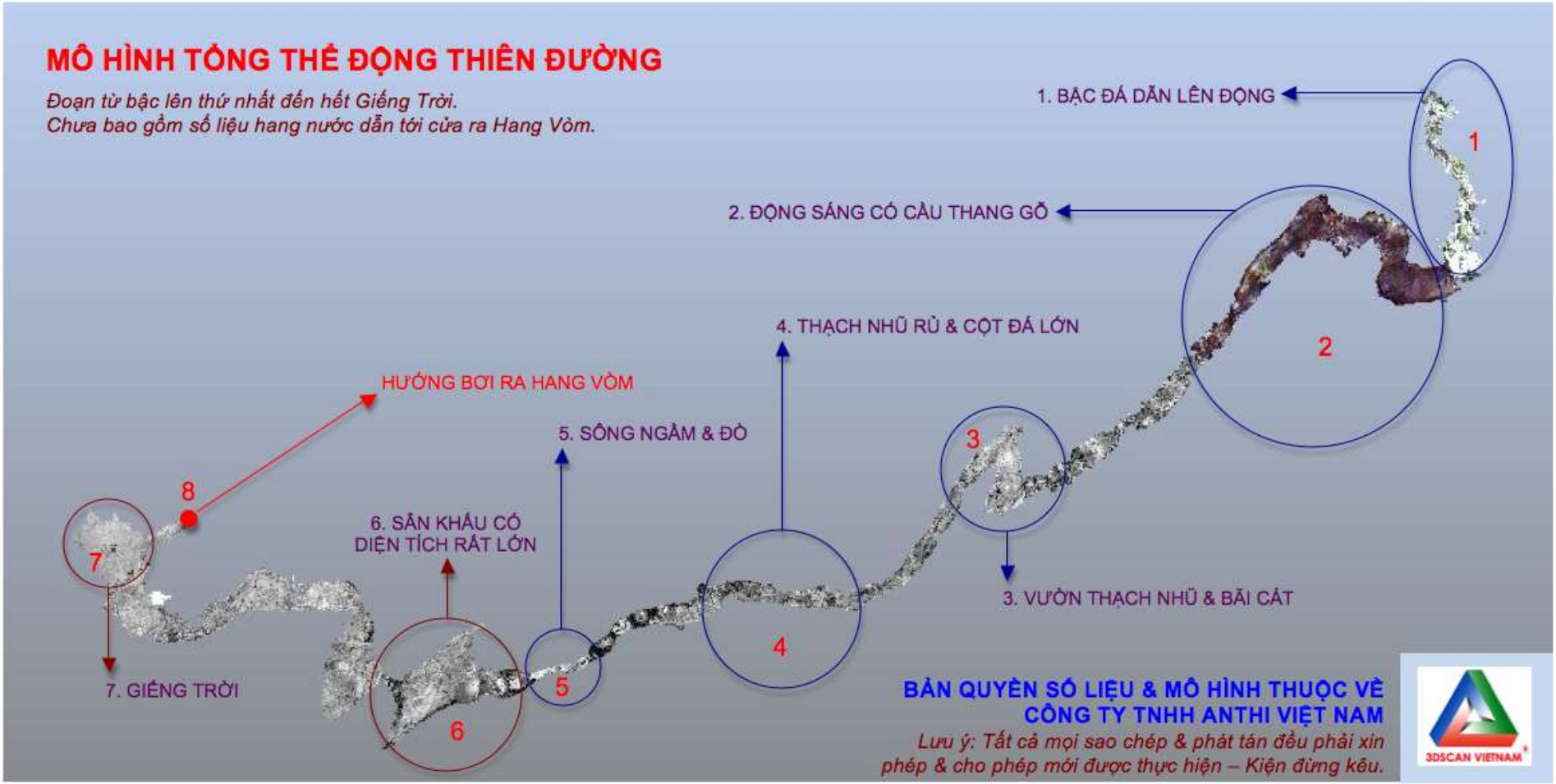


Sharing of scanned data

HANG EN (On the way to Hang Son Doong)



Hang En found in 1994, length 1,645 m, wide > 170 m and height >120 m



Hang Thien Duong length more than ten km, also a spectacular cave in Quang Binh rebuilt by 3D laser scanning

THANKS FOR YOUR ATTENTION!

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Q & A