

# サハラ砂漠の先史岩壁画に魅せられて

英 隆行 (はなふさ たかゆき)

<http://hanafusa.info/>

<https://hanafusa.info/docs/Hanafusa240927.pdf>



京都大学大サハラ学術探検隊 (1969, 木村重信) フジTV 『大サハラ』

森本哲郎 タッシリ・ナジェール (1969) 『サハラ幻想行』

上温湯隆 サハラ横断に失敗して渴死(1975) 『サハラに死す』

ヨーロッパの学生にサハラ縦断を含むアフリカ縦断旅行が流行





オラン南部地域

4時間 29分  
365 km

4時間 27分  
366 km





アイン・スフィファ 1979





アイン・スフィシファ 1979





ザッカードル 1979



algérie

les guides bleus

Jean-Dominique Lajoux

# Tassili n'Ajjer

art rupestre du Sahara préhistorique



Chêne 1977 (1962)



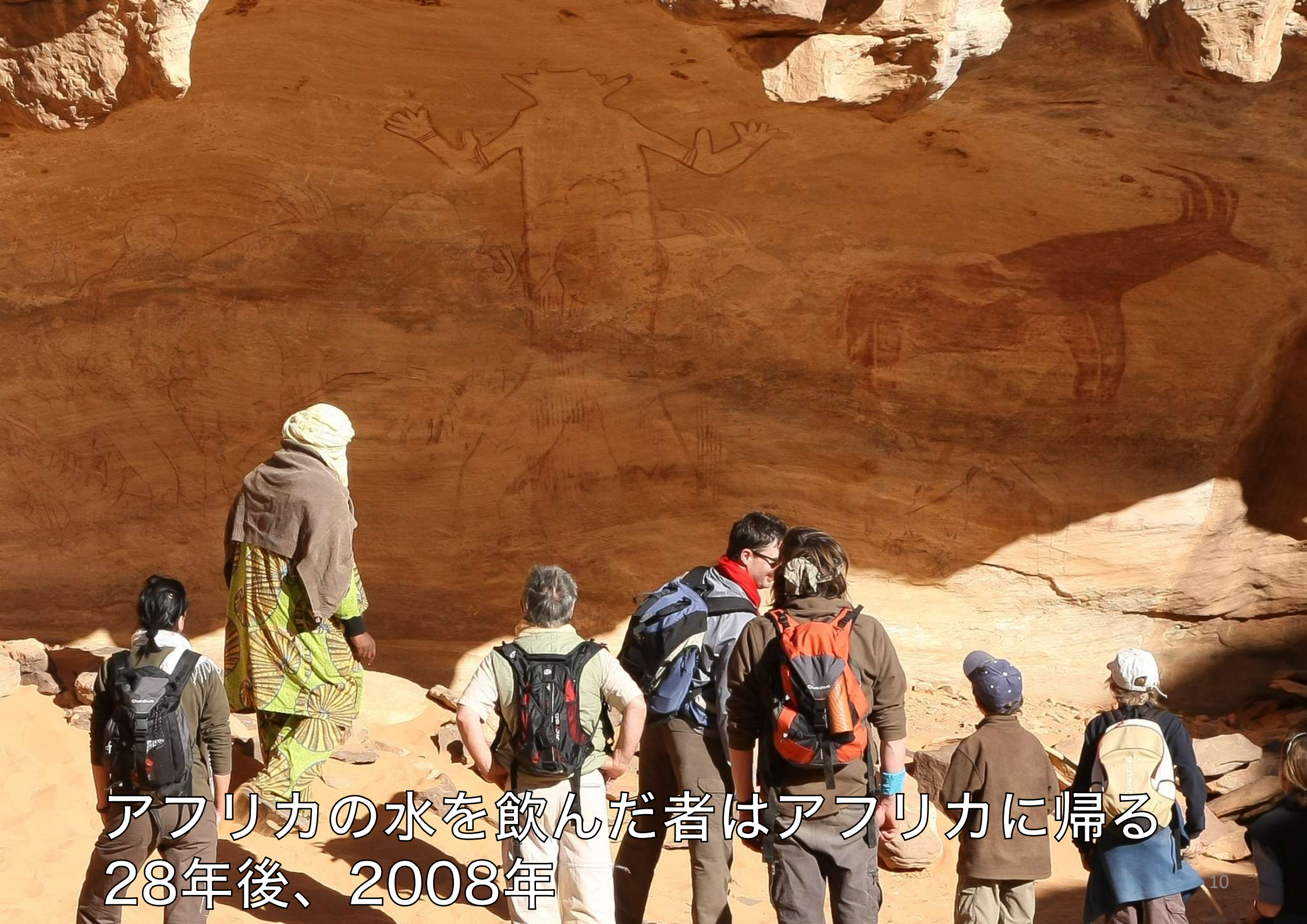


タッシリ・ナジェール 1980









アフリカの水を飲んだ者はアフリカに帰る  
28年後、2008年



アルジェリア

リビア

タッシリ・ナジェール

Tadrast  
Tahilahi Idaren  
Iheren  
Tin/Telmest  
Tikadiouine

Assadjou Ouan Mellen  
Assakao pass top  
Tilleline  
Assakao pass start  
Ait Talwaten / Ait Talwaten  
Tin Tekelt  
Ouan Bender  
Oasis DJANET  
Tan Ze-maitak  
Akba Tafilalet (start)  
Aouenrhet  
Ozanehare  
Aouenrhet

Tanaout  
Tanaout  
Tin Aressou  
Tin Aressou  
Tin Akaham  
Tin Akaham  
Tin Hanakaten  
Oued In Djerane  
Oued In Djerane  
Tin Uded  
Tin Uded  
Ouan Tabarakat  
Ouan Tabarakat  
Ua-n-Seklem  
Abri Freulon  
Aman Smerdin  
Menkhor  
Menkhor





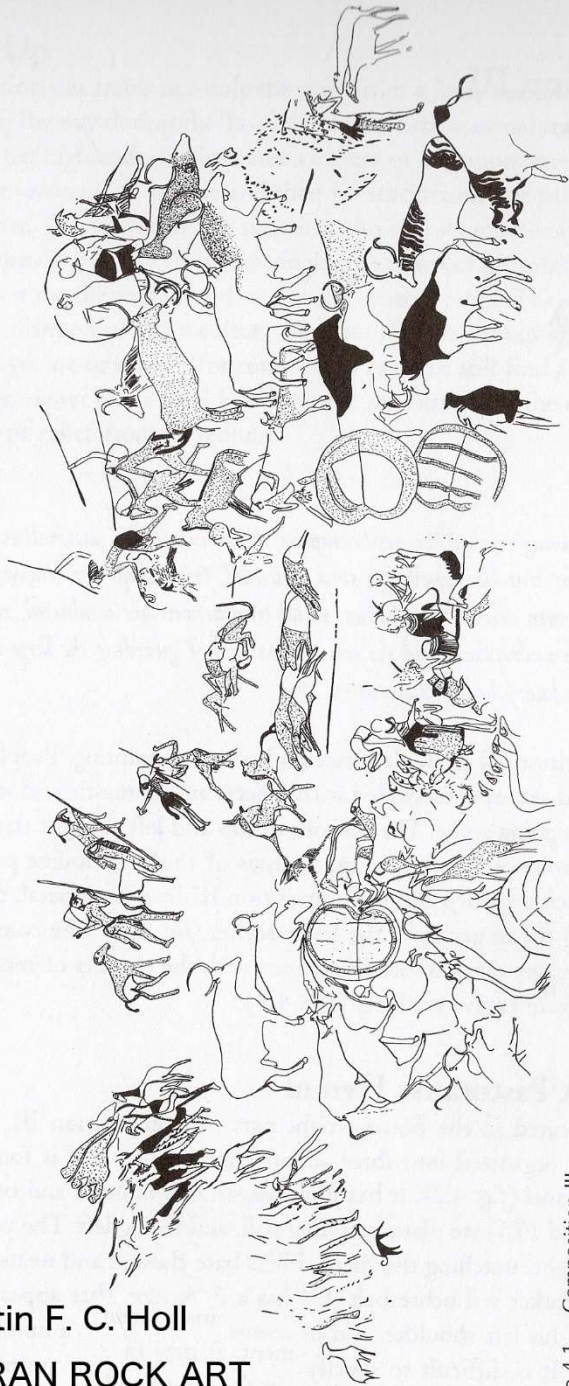
イヘーレン岩壁画 2009





**SAHARA**  
Exhibition catalog  
Cologne City Museum, 1978





Augustin F. C. Holl  
SAHARAN ROCK ART  
2004

Figure 4.1. Composition III

Table 4.1. General Distribution of Motifs in Composition III

Scene	Humans				Domestic Animals				Objects	Total
	Infant/ Child	Male	Female	Other	Cattle	Sheep/ Goat	Dog	Wild Animals		
Scene 1	1	—	—	2	6	2	—	—	1	12
Scene 2	—	1	2	—	7	—	—	—	1	11
Scene 3	—	9	—	—	1	10	—	1	9	30
Scene 4	4	4	3	—	—	14	—	—	4	29
Scene 5	1	2	1	1	15	6	—	—	2	28
Total	6	16	6	3	29	32	—	1	17	110

Note: Some motifs are not numbered on the figures.

The young shepherd has an elaborate hairdo with the protruding feather-like features we've seen elsewhere. He is framed within a space delineated at the top and left by intersecting horizontal and vertical lines. The enclosed space depicts a shepherd playing a "pastoralist hymn" to interested sheep. The remaining image of action set I consists of an oversized, human-shaped creature (178) with a tinted beard and long, upward-pointing, rabbit-like ears. The superhuman creature, whose



Figure 4.2. Composition III: Scene 1





フランス国立自然史博物館倉庫に眠る H. ロート隊模写 (J-D. Lajoux, 2012)





イヘーレン 2013





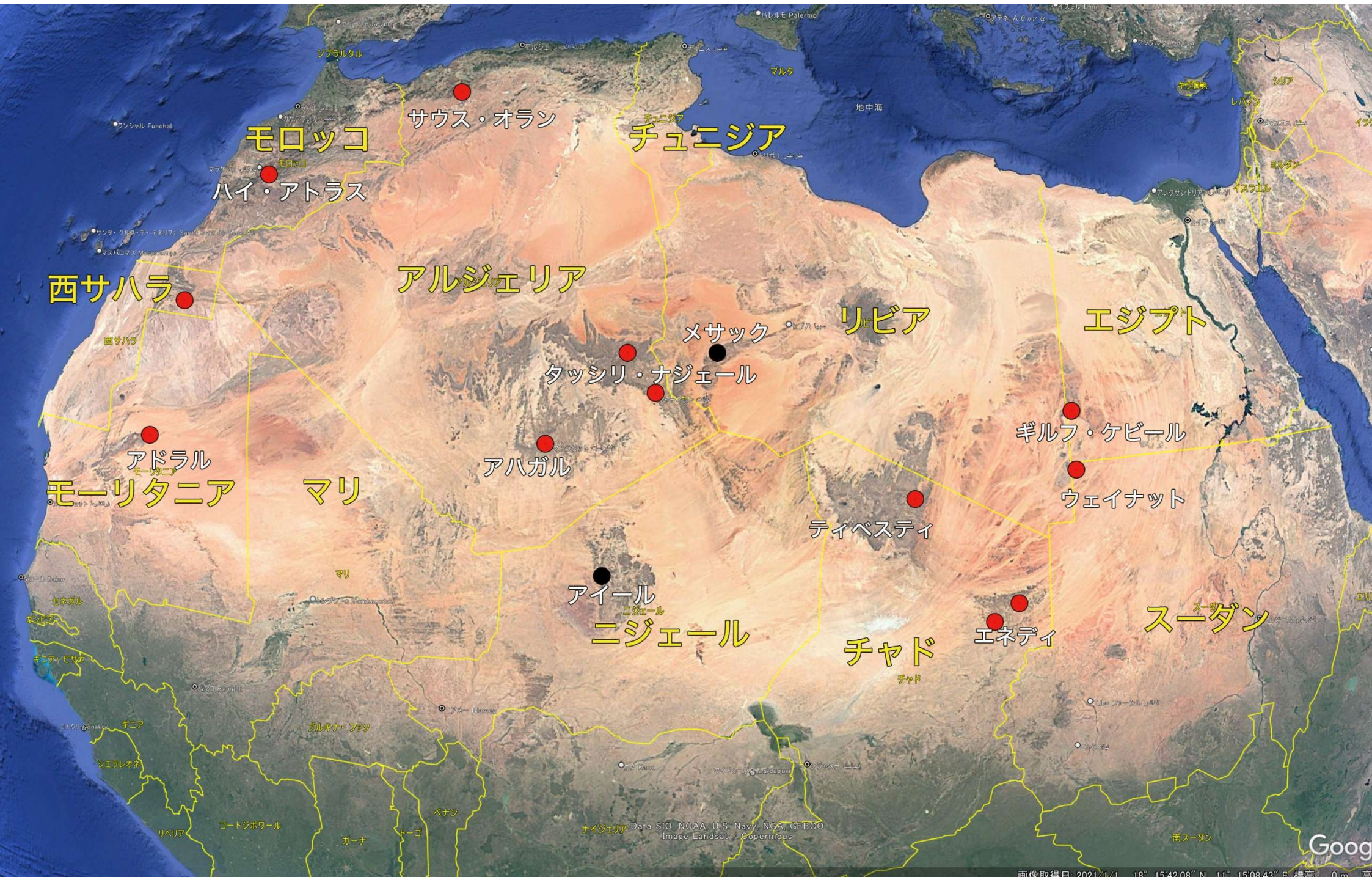




イヘーレン岩壁画  
5000年の時を超え、緑のサハラが甦える  
2014/9-10, 東京、京都



# SAHARAN ROCK ART MAP





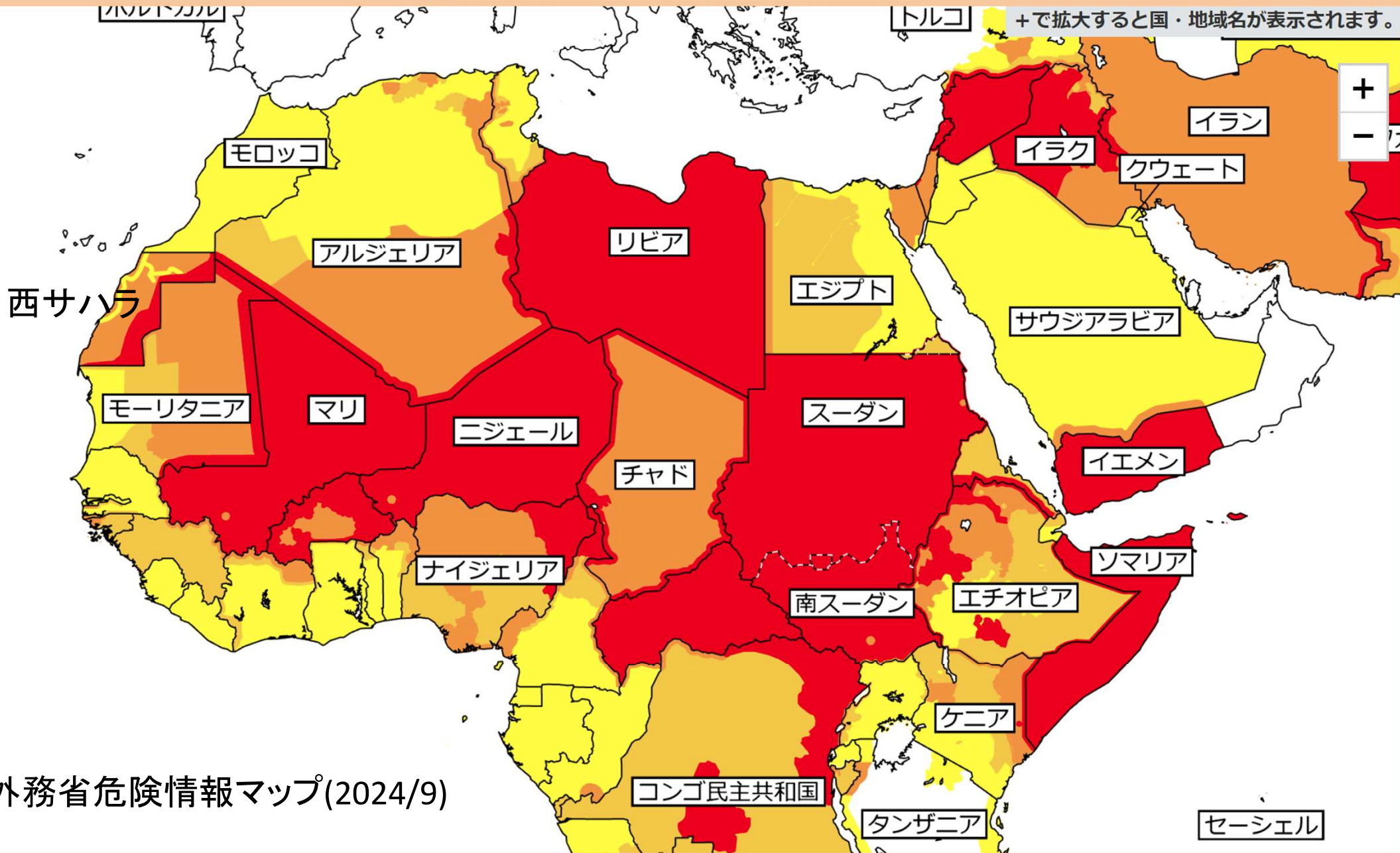
確認したい国・地域をクリックしてください。

- レベル1 十分注意してください。
- レベル2 不要不急の渡航は止めてください。
- レベル3 渡航は止めてください。(渡航中止勧告)
- レベル4 退避してください。渡航は止めてください。(退避勧告)

### 危険情報

### 感染症危険情報

+で拡大すると国・地域名が表示されます。



外務省危険情報マップ(2024/9)



# LE SAHARA AVANT LE DÉSERT (AU SUBBORÉAL) ET L'ÉVOLUTION DU CLIMAT DEPUIS 23.000 ANS

d'après Henri J. Hugot, *Le Sahara avant le désert*, éd. des Hespérides, Toulouse 1974



Fond de carte : [https://commons.wikimedia.org/wiki/File:Africa\\_relief\\_location\\_map.jpg?](https://commons.wikimedia.org/wiki/File:Africa_relief_location_map.jpg?)

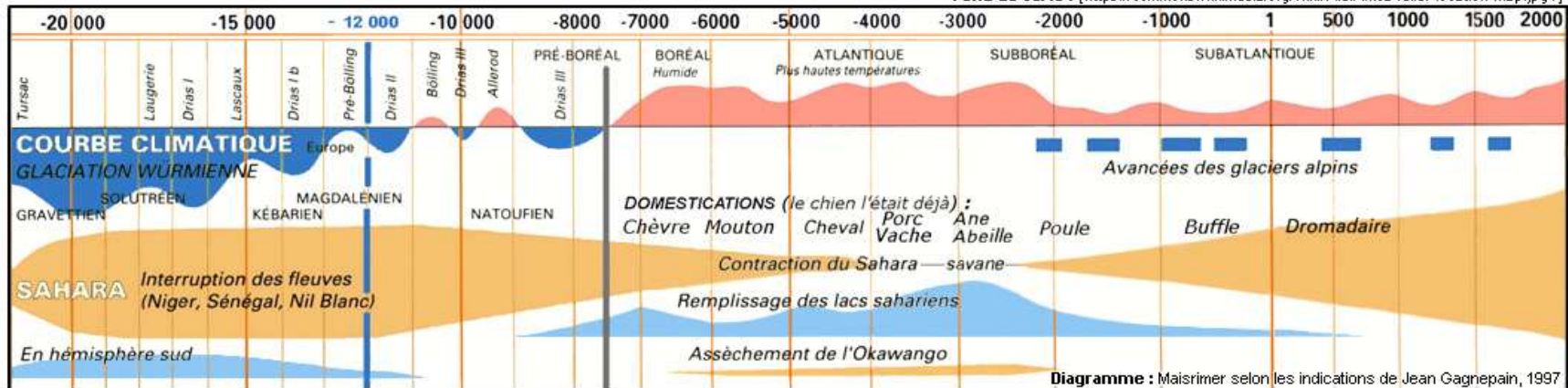


Diagramme : Maisrimer selon les indications de Jean Gagnepain, 1997



# ミランコビッチサイクルと気温周期

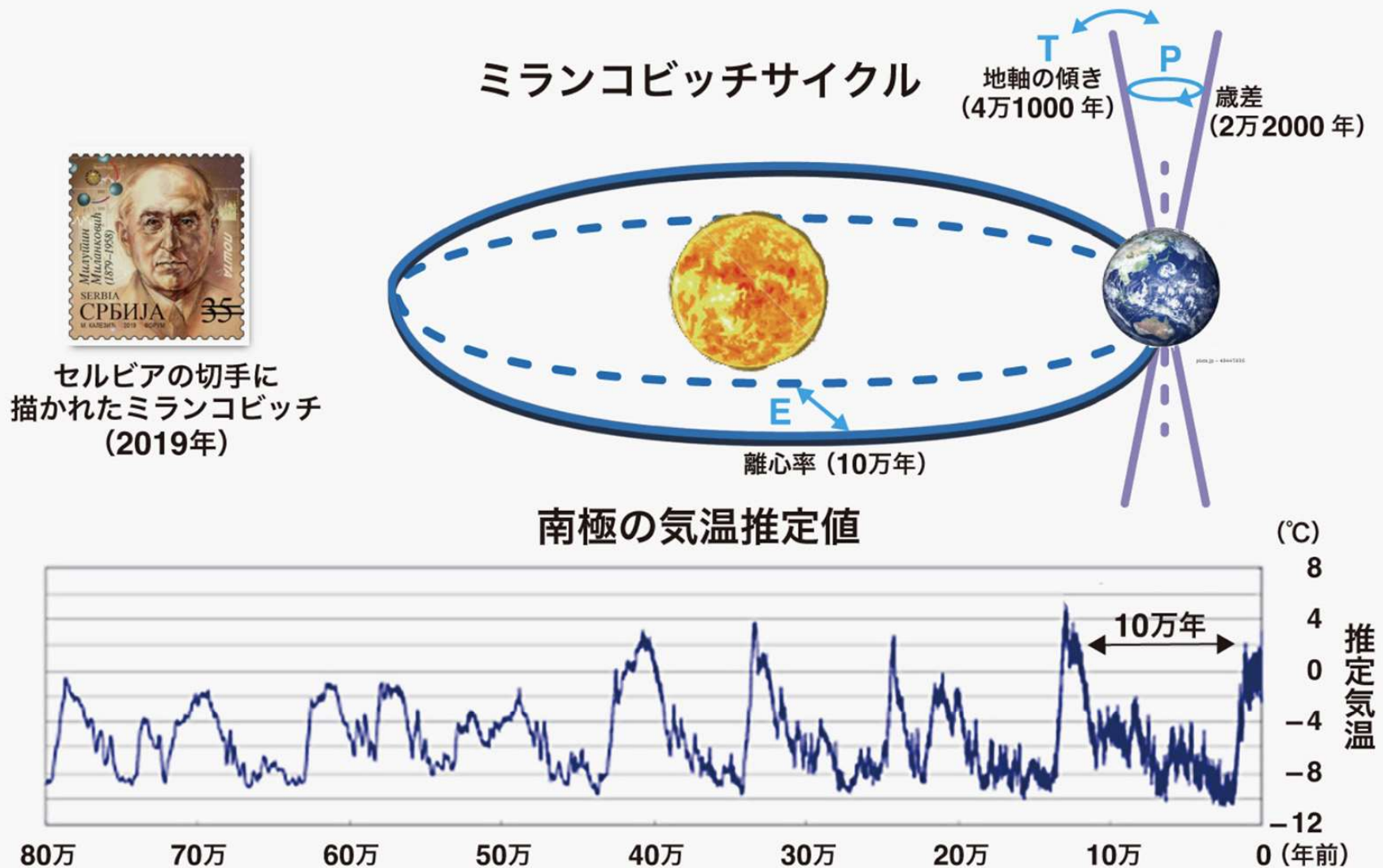
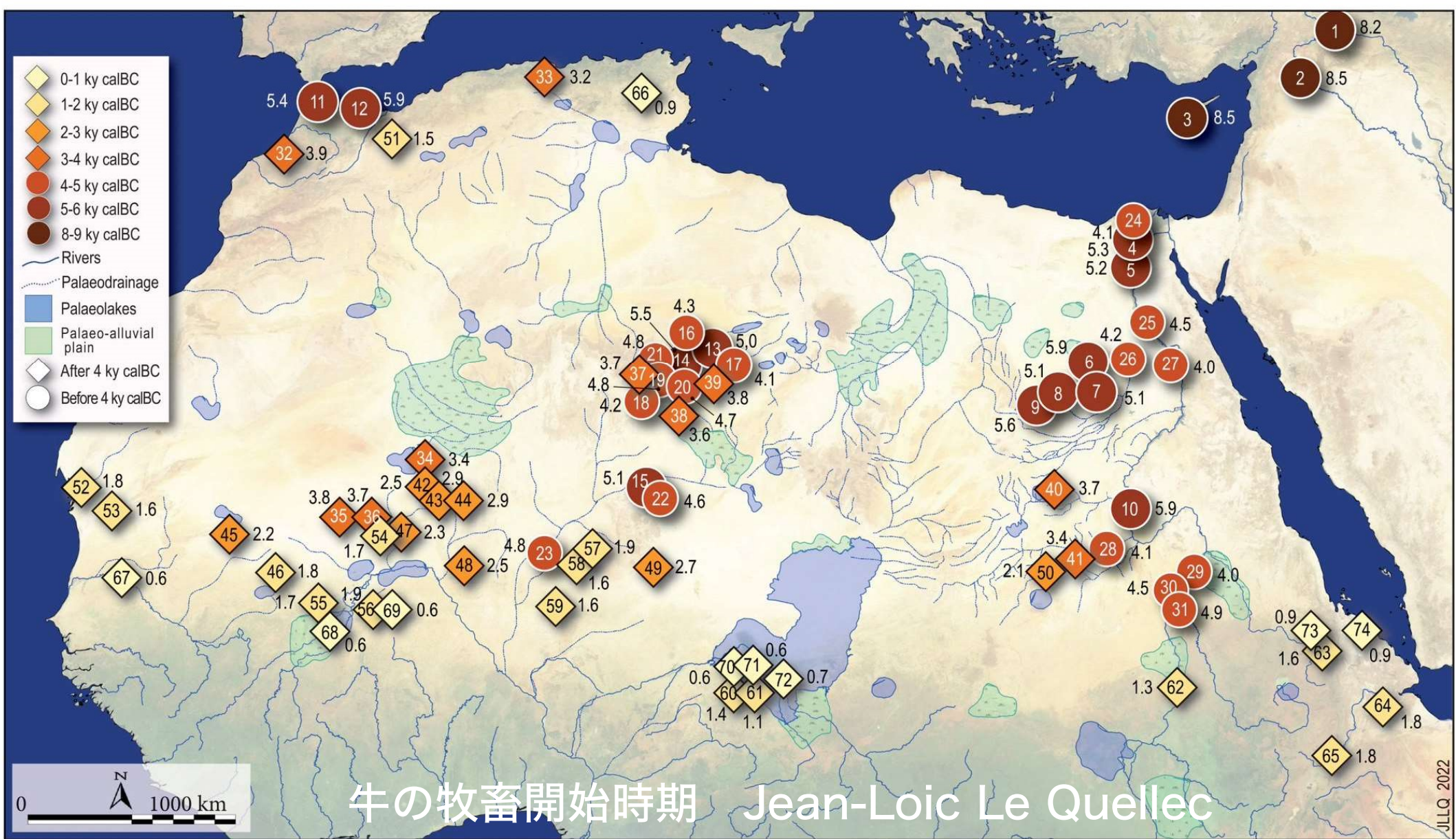


図3：ミランコビッチサイクルと気温周期。

(出所：国立環境研究所「ココが知りたい地球温暖化」を参考に作成)

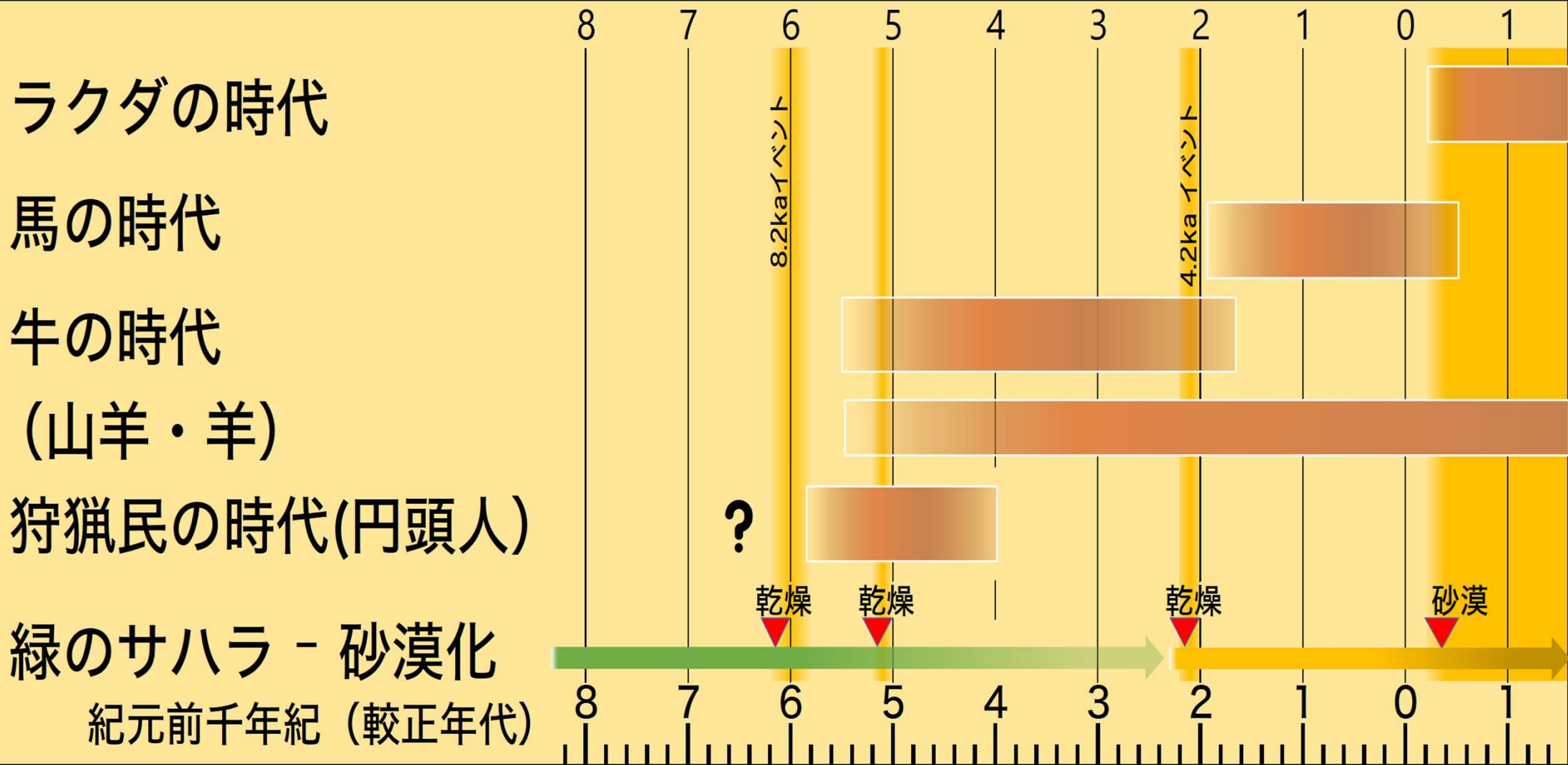




North African sites with earliest presence of cattle. Ky CalBC ages reported in brackets (e.g.: 5.2 = 5200CalBC). 1: Çayönü (8.2). 2: Dja'de el-Mughara (8.8–8.3). 3: Shillourokambos (8.7–8.3). 4: Merimde Beni-Salame (5.4–4.9). 5: Qasr El Sagha IX/81 (5.7–5.0; 5.4–5.2). 6: Dakhla (6.1–5.7). 7: Estpans (5.2–4.9). 8: Abū Ballaṣ scarpland. site 95/2-1 (5.3–4.9). 9: Wādi Baḥt (6.4–4.9). 10: al-Barga (6.0–5.7). 11: Kaf Taḥt el Ghār (5.6–5.2). 12: Ifri-n-Armas (6.0–5.8). 13: Ti-n-Einesnis (5.2–4.7. 4486–4355). 14: Wa-n-Muḥjā (5.6–5.4). 15: Adrar Būs a (5.8–4.5; 5.6–4.5). 16: Bedis (4.4–4.3; 4.3–4.0; 4.1–3.9; 4.3–4.0; 4.3–4.0; 4.3–4.0). 17: Murzuq 2 (4.2–3.9). 18: I-n-Relidjem (4.5–3.9). 19: Djanet (5.3–4.4). 20: Wa-n-Telokat (4.9–4.5); Taḥarḥūri (4.3–4.0). 21: Ti-n-Torḥa Nord (4.9–4.7). 22: Adrar Bus b (5.7–3.6). 23: Takene Bawat 2 (5.3–4.3). 24: Saīs (4.2–3.9). 25: Badari district (4.5). 26: Kharga KS43 (4.4–4.0). 27: El-Khattara (4.2–3.8). 28: Wādi Howar (4.8–3.5). 29: Kadada (4.3–3.7). 30: Shaheinab (4.3–4.0). Kadero (4.3–3.9). el-Kenger (4.6–4.3). Zakiab (4.6–4.3). el-Nofalab (4.6–4.0). 31: Umm Direiwa (5.2–4.7). 32: Kaf el-Barūd (4.2–3.6). 33: Geldaman Cave (3.6–2.9). 34: I-n-Arhata MK42 (3.7–3.6; 3.5–2.8). 35: Hassi el-Abiod MN10 (4.0–3.2). MN 27 (3.9–3.7). MN 35 (3.7–3.6). 36: Ti-n-Gettai (3.9–3.6). 37: Sefar (4.4–3.0). 38: Manḥor (3.9–3.3). 39: I-n-Habeter Illa (4.0–3.6). 40: Wādi Shaw (3.7). 41: Abū Tabari (3.6–3.3). 42: I-n-Kusamen (2.8–2.1). 43: Tesalit (3.3–2.6). 44: Anezrouft MN51 (3.1–2.8). 45: Tichitt site 46 el-Rhimiya (2.6–1.9). 46: Bū Ḥzēmma DN4-BKH-S5 (2.0–1.7). 47: Bū Djehaba MN24 (2.5–2.2). 48: Karkarichinkat Nord KN2 (2.6–2.4). 49: Gobero (2.9–2.6). 50: Gebel Tagerū (2.8–1.4). 51: Wādi al-Hay (1.9–1.2). 52: Chami (2.1–1.5). 53: Khatt Lemaiteg (2.1–1.0). 54: Elb el Moueilha MN25 (2.0–1.5). 55: Kobadi (1.9–1.5; 1.8–1.4). 56: Winde Koroji I (2.2–1.751; 1.8–0.8). 57: I-n-Tuduf (2.2–1.5). 58: Chin Tafidet (2.3–0.9). 59: Kolima (1.8–1.5). 60: Bukarkurari (1.6–1.3); Gajiganna A (1.3–1.0). Gajiganna B (1.4–0.7). Gilgila (1.2–0.9). Kariari (1.5–1.3). NA 93-36 (1.5–1.2). 61: Kursakata (1.4–0.8). 62: Eheima (1.6–1.0). 63: Danei Kawlos (1.7–1.5; 1.7–1.5). 64: Asa Koma (1.8–1.4). Wakrita (2.0–1.6). 65: Lake Besaka (2.5–1.1). 66: Althiburos (1.0–0.8). 67: Walaldé W1/1-1 (0.8–0.5). 68: Dia Shoma Horizon I (0.8–0.5). 69: Zampia tumulus (0.9–0.4). 70: NA93/10 (0.7–0.4). 71: Zilum (0.8–0.5). Mege (0.9–0.7). 72: Daima (0.8–0.3). Ngala (0.8–0.5). 73: Godebra (1.1–0.8). 74: Laga Oda (1.2–0.5).



# 中央サハラの子表



Jean-Loïc Le Quellecの編年に基づいて作成





リビア

エジプト

ギルフ・ケビール







Cave of Swimmers 泳ぐ人の洞窟 2014





泳ぐ人と頭のない獣





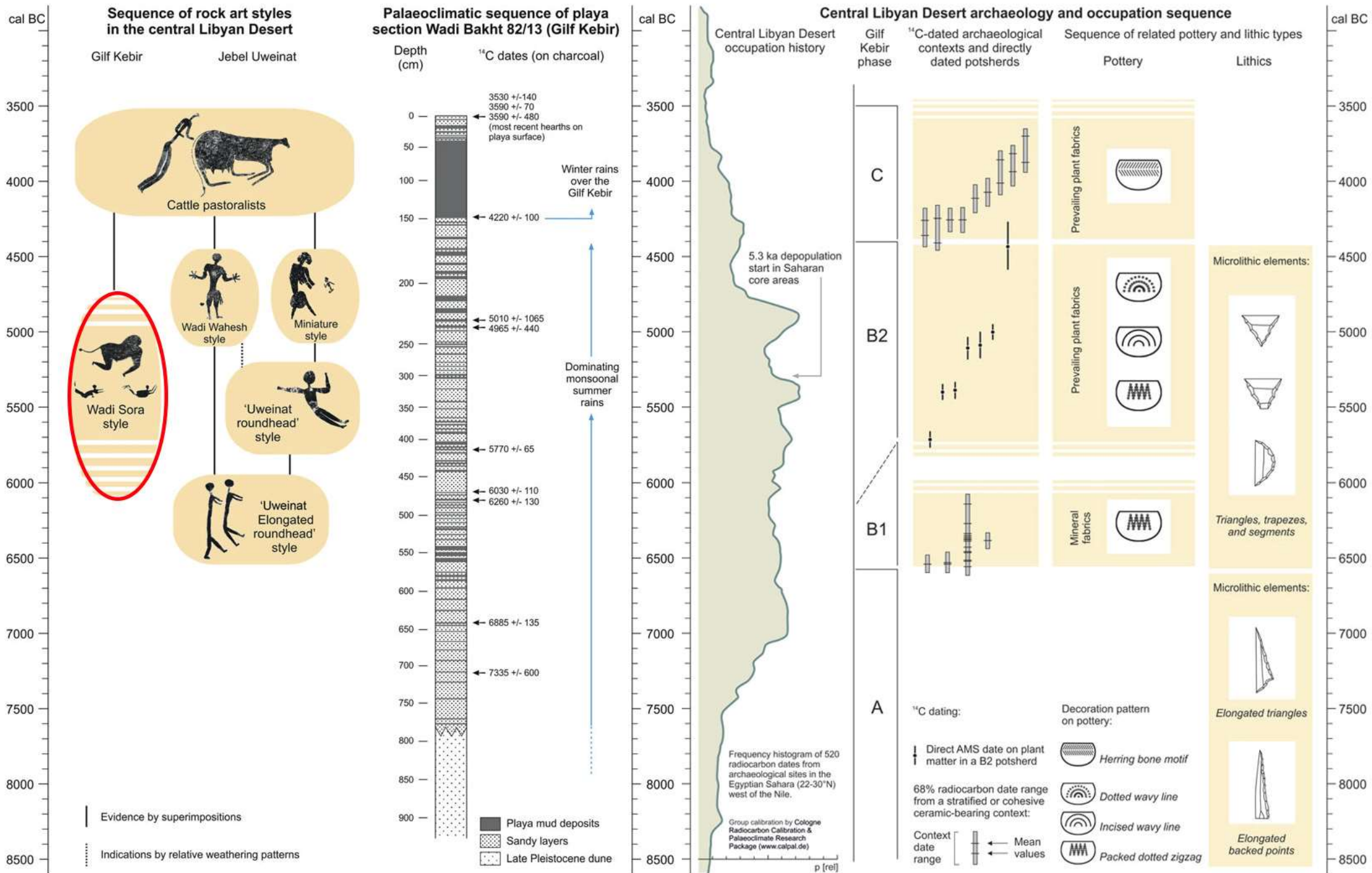
Cave of Beasts 獣たちの洞窟





泳ぐ人と頭のない獣





Outline of the Holocene cultural and climatic chronological sequences in the central Libyan Desert. © Antiquity Publications Ltd, 2017 Heiko Riemer et al.



# エジプト

●  
ギルフ・ケビール

●  
ウェイナット

# スーダン

スーダン

紅海

ポート・スーダン

エリトリア





















































西サハラ 2018



# モロッコ

# ハイ・アトラス

震源地







ハイ・アトラス 2019



# サハラ先史岩壁画の特徴と魅力

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- 1,000万km<sup>2</sup>の広大な土地に散在。地域性の豊かさ。
- 6,000年以上にわたる人々の営み。中石器、新石器、鉄器。
- 人々の到来、交流、移動。狩猟民、牧畜民。黒人、白人。
- 豊富な題材と技法
  - サバンナの動物、家畜（犬、牛、山羊、羊、馬、ラクダ）。
  - 日常生活 狩り、牧畜、団らん、舞踊、演奏、移動、戦争など。
  - 精神世界 巨人、死後の世界、半獣半人、想像上の生き物など。
  - 技法 彩色画、線刻画。輪郭線、遠近法、戯画など

## 多様性



# PANORAMIC PHOTOGRAPHY FOR ROCK ART

Real size reproduction of large rock paintings

**Takayuki Hanafusa**

<http://hanafusa.info/project/saharan-rock-art/>



# IHEREN – TASSILI N'AJJER, CENTRAL SAHARA

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# EXHIBITED PHOTO OF IHEREN

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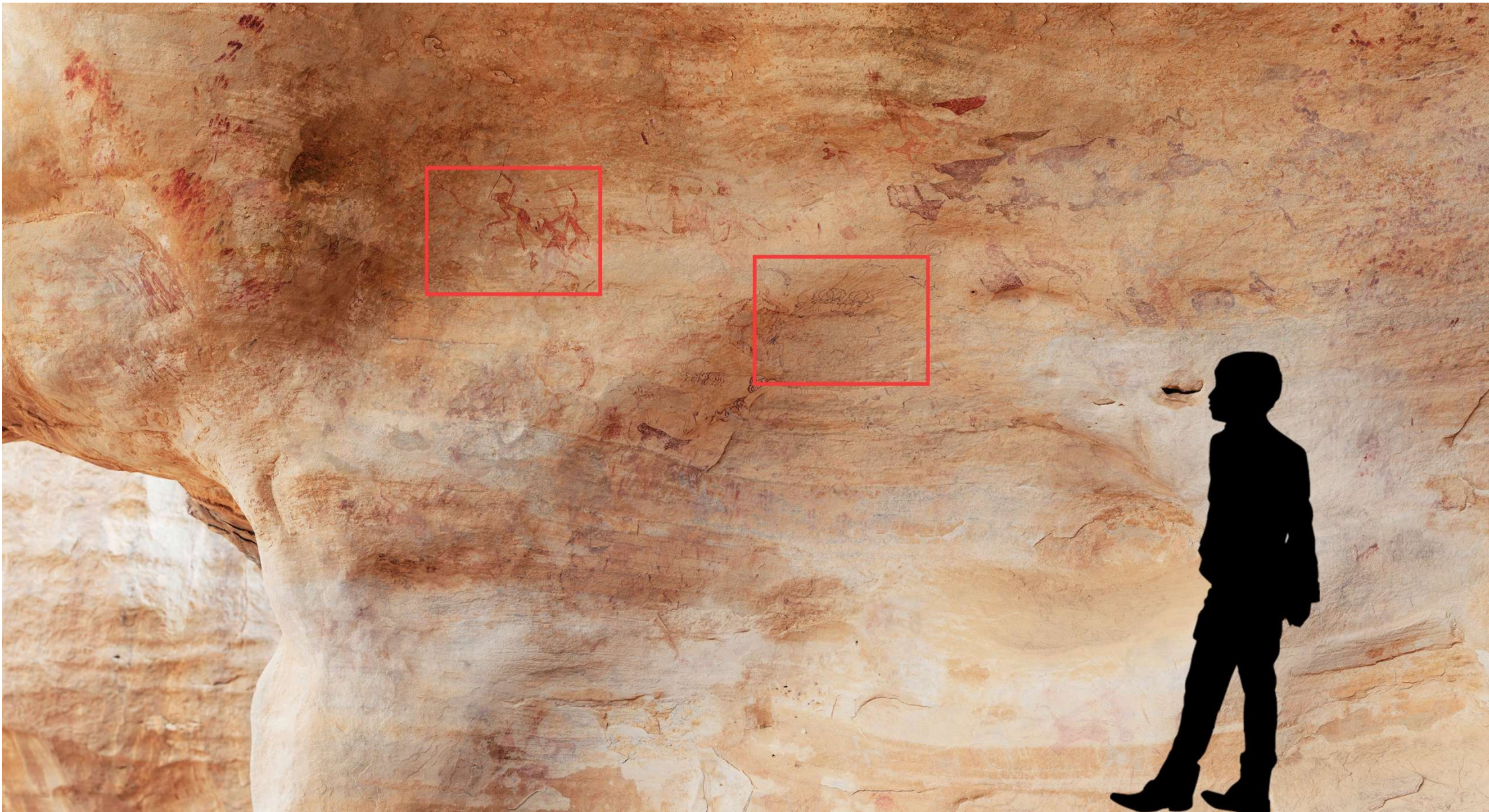
## SAHARAN ROCK ART

October 2022

Meguro Art Museum, Tokyo



# EXHIBITED PHOTO OF IHEREN



Actual size (=printed size) : 9.6m wide x 3.1m height

53,700 x 17,400 pixels, file size of 2.6GB **Giga Pixel Panorama**









700 x 470mm



# PANORAMIC PHOTO FOR ROCK ART

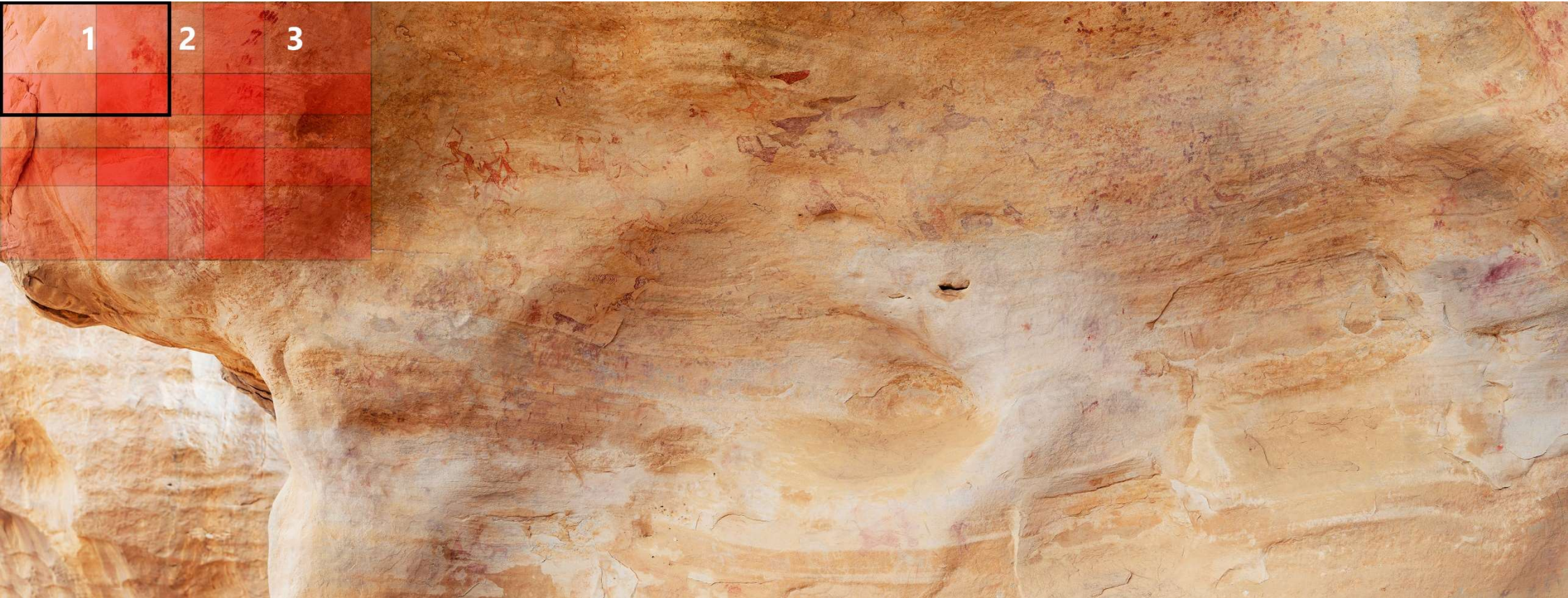


Photo taken in Nov. 2014

- Camera: Canon 1D Mk4 4,896 x 3,264 pixels  
one shot 882 x 588mm at 141dpi
- EF70-200mm lens at 148mm - *f* 8.0 (1/320")
- 136 shots with overlap of 35% for 9.6m x 3.1m
- Printing resolution of 141 dpi



Robotic camera mount  
GIGAPAN EPIC Pro



# PANORAMIC PHOTO FOR ROCK ART

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Robotic camera mount  
**GIGAPAN EPIC Pro**

Fully automatic  
Large wall over 100 shots  
Giga Pixel Panorama



Manual camera mount  
**Nodal Ninja4**

Manual movement  
30-100 shots (5-8m wide)  
Giga pixel & 360° panorama



Hand held

Over 100mm lens(no nodal point issue)  
over 50% of overlaps  
good light conditions



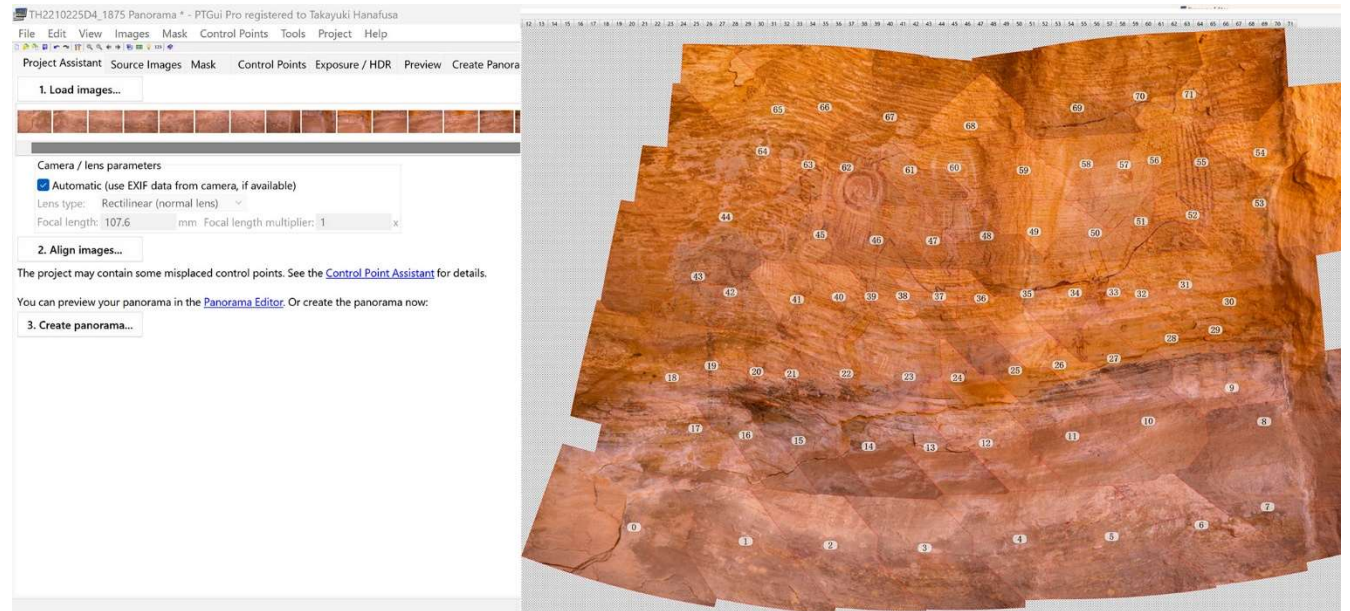
# IMPORTANT POINTS FOR PANO PHOTO

- Conditions of rock paintings in caves
  - No extreme unevenness of the rock surface (generally within 100cm)
  - Good place for tripod with a right distance to the object
  - Good uniform video lighting (no flash lighting)
- Printing resolution: preferably over 100dpi for fine details
- Field of View (FoV) for reproducing 100% with 100dpi  
Canon 5DMk4: 6,720x4,480pxl → 1,707x1,139mm > Actual frame → Resolution > 100dpi
- Shooting distance with the following focal lengths for FoV 100% with 100 dpi:  
80mm: 3.9m 100mm: 4.9m 120mm: 5.7m 140mm: 6.7m
- Aperture setting: at least f8, preferably f11  
Depth of Field (DOF, **good focus range**)  
DOF **f8** for FoV 100%/100dpi w/t 5DMk4: **47/60cm (near/far)**  
DOF **f11** for FoV 100%/100dpi w/t 5DMk4: **65/80cm (near/far)**
- Lighting
  - Uniform video lighting (no flash lighting)
  - Duration of 1-2 hours



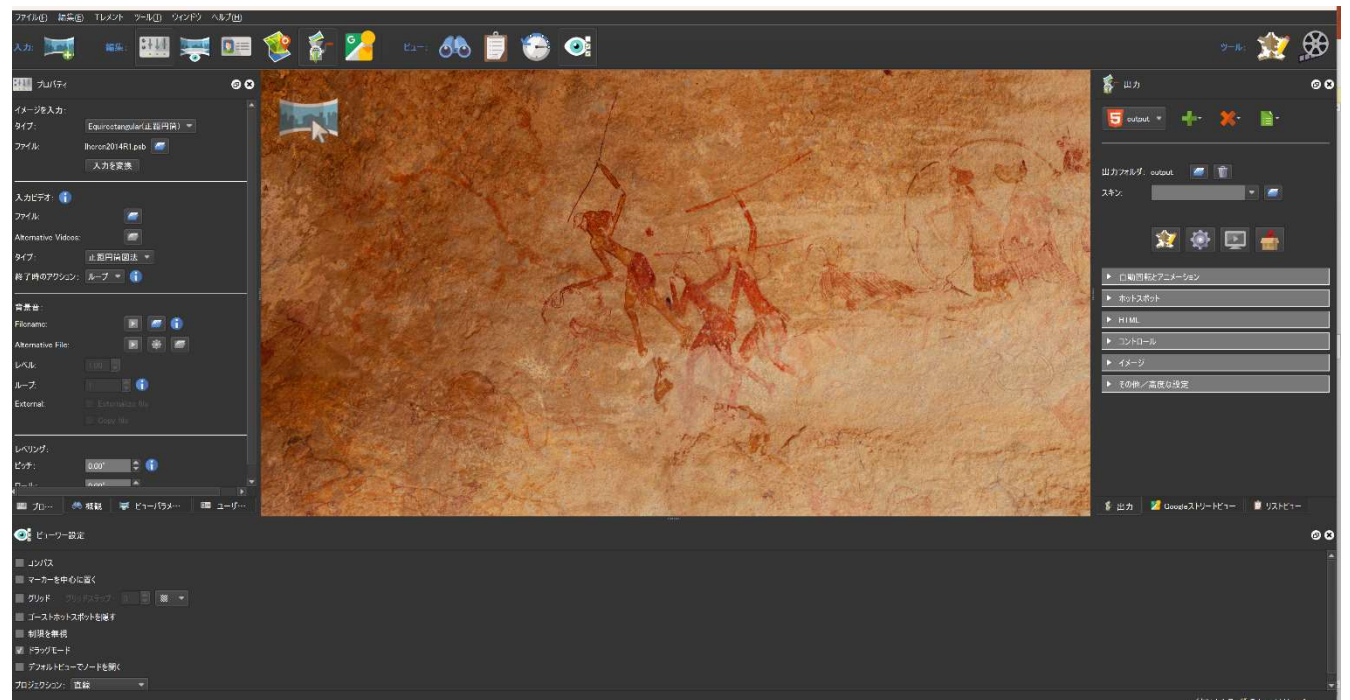
# PANORAMIC PHOTO FOR ROCK ART

## Stitching software PTGui



## Virtual Reality software for Web browsing Pano2VR

<http://hanafusa.info/RockArt/Iheren2014/>





# PANORAMIC PHOTO FOR ROCK ART

## Giga pixel Panorama

<http://hanafusa.info/RockArt/GrandDieu/>



## 360 ° Panorama

<http://hanafusa.info/RockArt/GrandDieu360/>

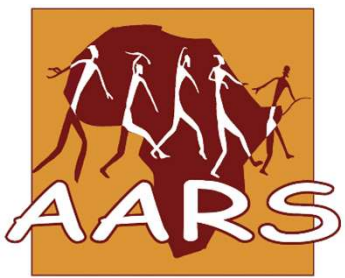


## 3D Scan SCANIVERSE

<https://scaniverse.com/scan/diuuvjy3oystl2x3>







Association des Amis de  
l'Art Rupestre Saharien

# Test plan of a Modified DSLR Camera for Wide Spectral RGB/IR Imaging



Takayuki Hanafusa  
<http://hanafusa.info/>



# Visibility problem with Saharan Rock Art

	Cave Art(Lascaux, etc.)	Saharan Rock Art	Solutions for better visibility
Nature of Rock	Limestone Caves	Sandstone Shelters	
Visibility	Mostly Good	Often Bad	
Erosion	Very little?	Often Bad, Wind/Sand/Rain	Dstretch (limited by remaining pigments), HSI
Eflorescence	Calcite (CaCO3)	Plaster (CaSO4)	Dstretch (limited by thickness), HSI
Wet/Dry condition	Mostly Wet	Dry	<b>Wetting is very efficient but prohibited</b>



Jean-Dominique Lajoux



Le miracle de l'éponge (Henri Lhote)



# DStretch

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Original image to open  
with Photoshop



Open DStretch-YBK  
enhanced image and  
copy it



Paste it on the original  
and change its blending  
mode from “normal”  
to “luminosity”





# For DStretch Comparison

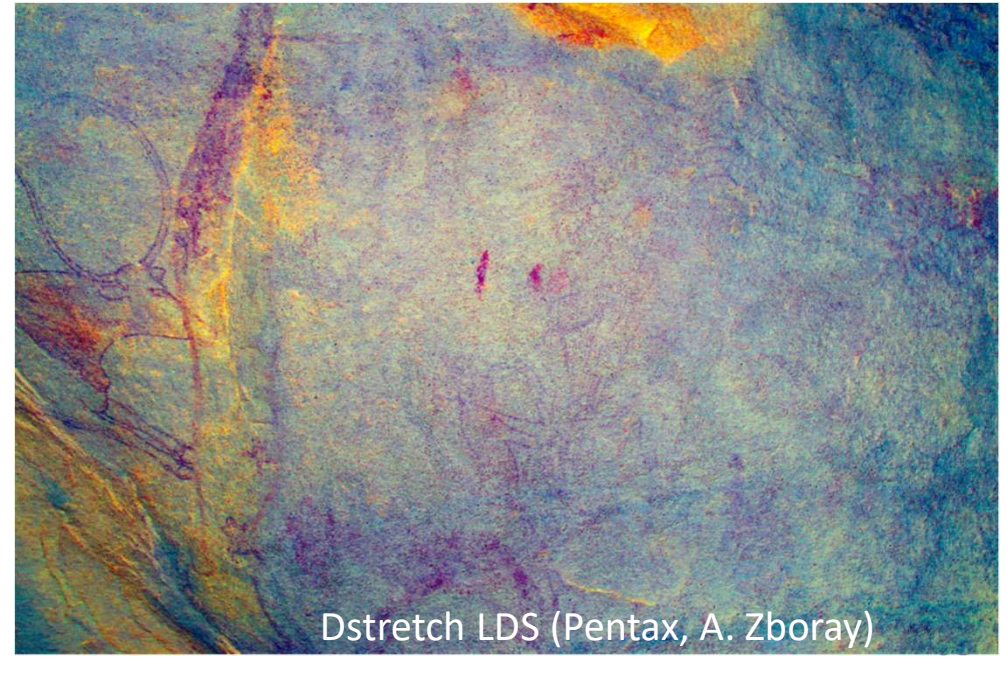
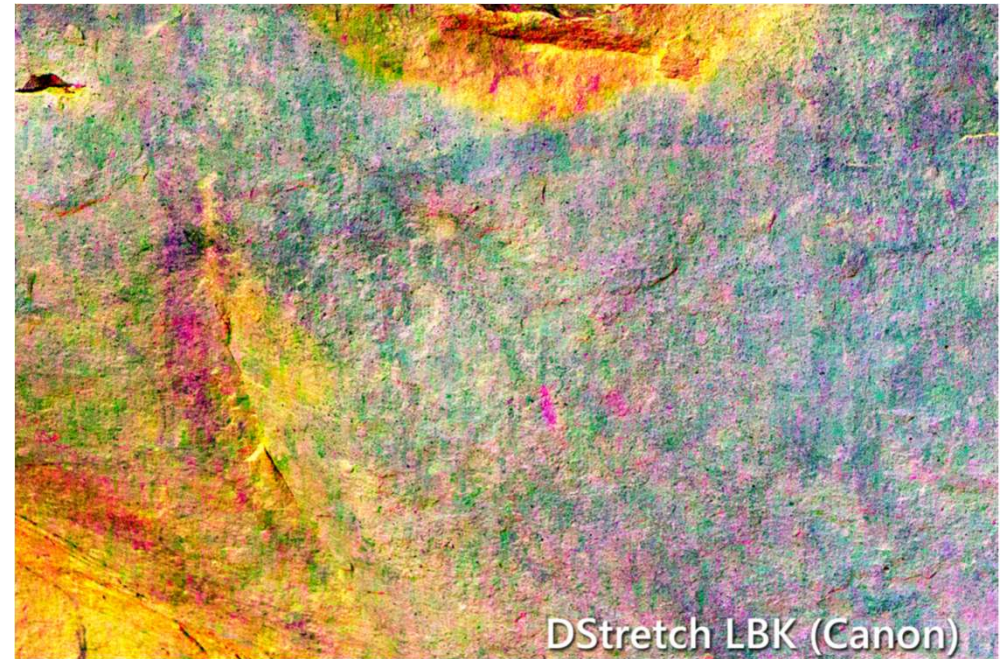
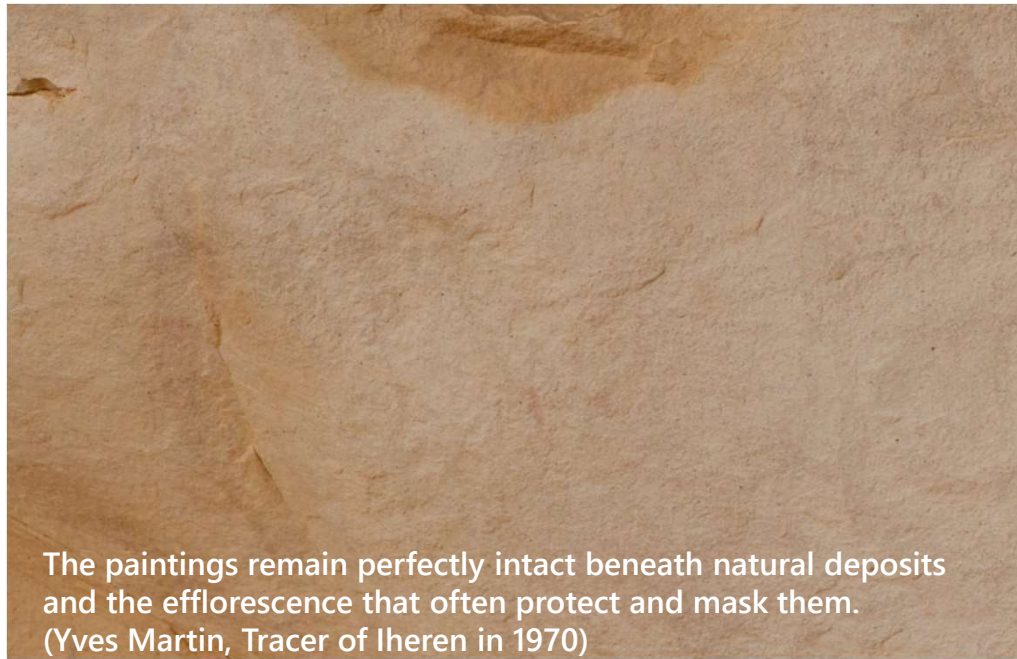
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**Grand Fresco of Iheren**

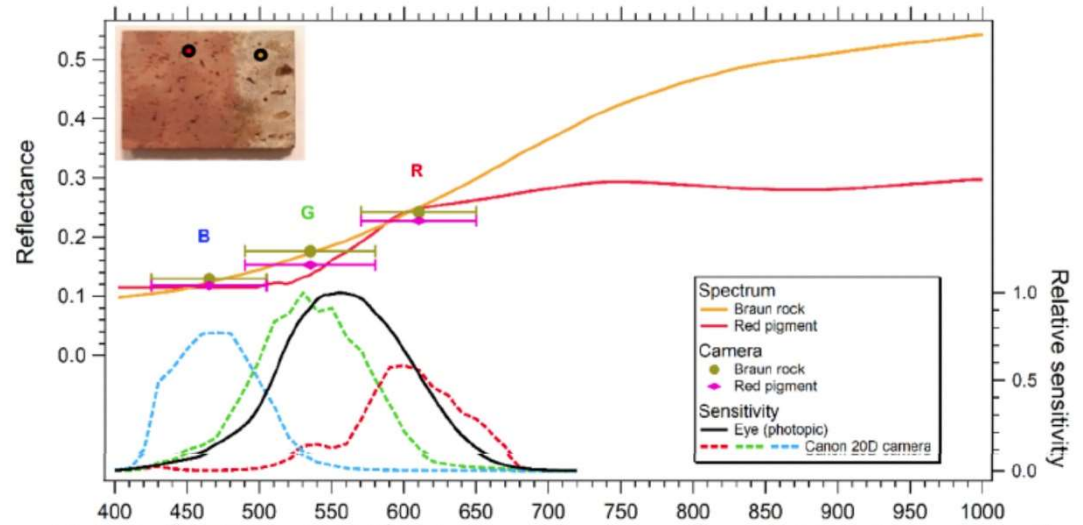


# Comparison of Wetting/DStretch Results

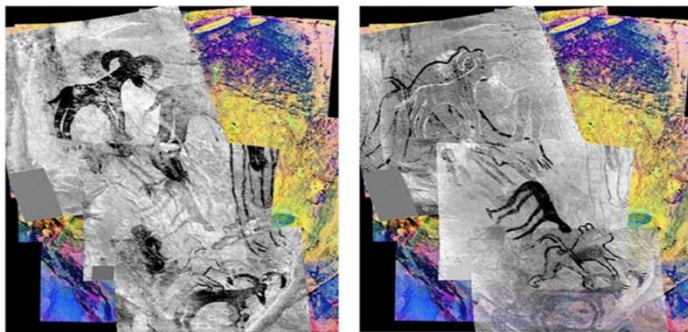
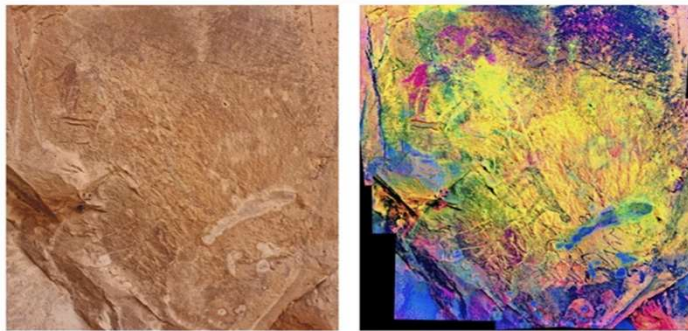




# Hyperspectral Imaging (HSI)



Bernard Schmitt<sup>1\*</sup>, Zahira Souidi<sup>2</sup>, Frédérique Duquesnoy<sup>3</sup> and Frédéric-Victor Donzé<sup>4</sup>  
 Comparison between spectra of VNIR hyperspectral imaging and signal of classical RGB camera for typical rock painting pigments.



## HSIのメリット

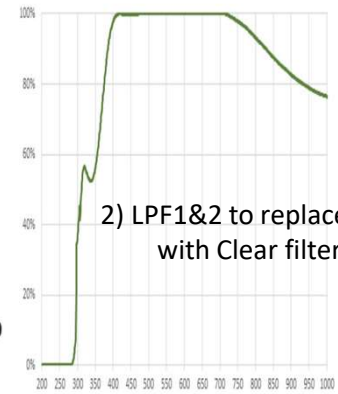
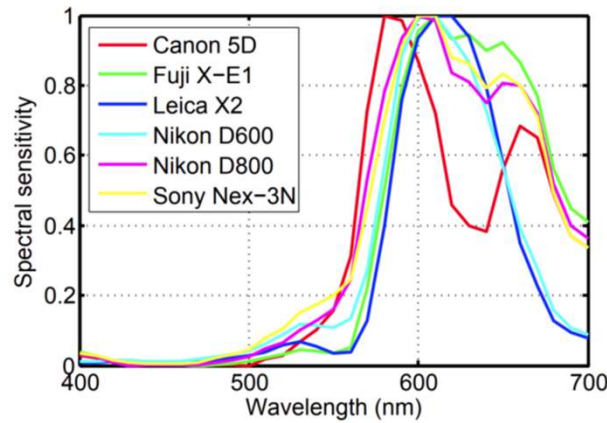
- 微量の残存顔料に反応
- 近赤外線領域での反射率のコントラスト
- 近赤外線による透視効果

## HSIのデメリット

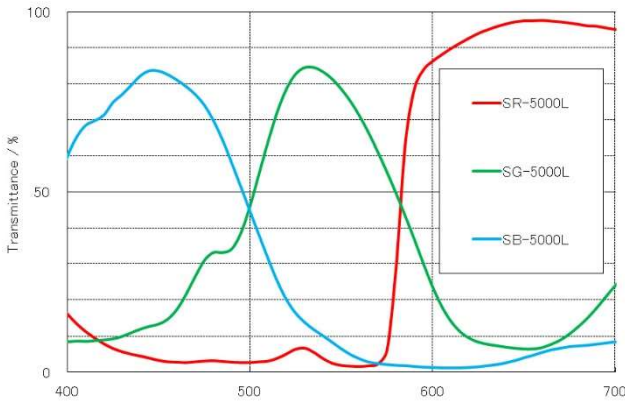
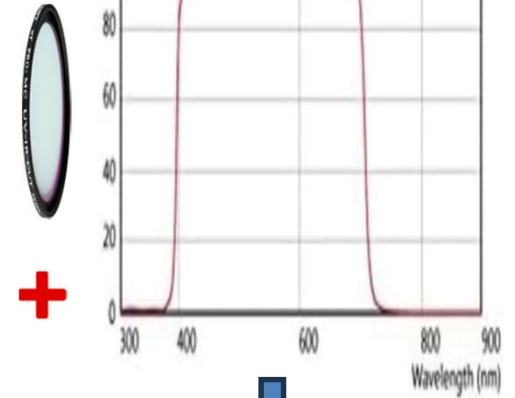
- 専用機材。移動性の制約
- RGBカメラと互換性がない
- 専用カメラ \$20K、高額ソフトウェア



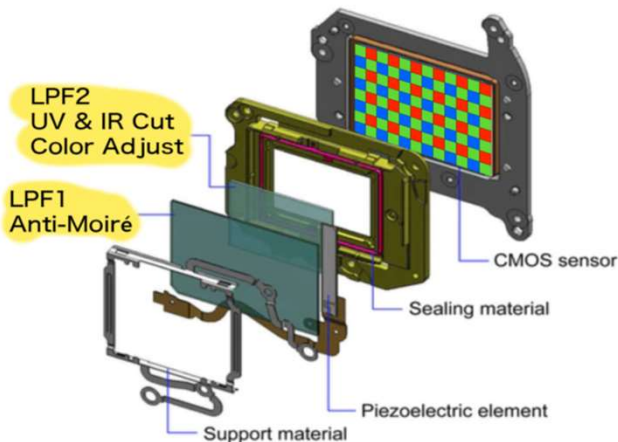
# Astrophotography Modification



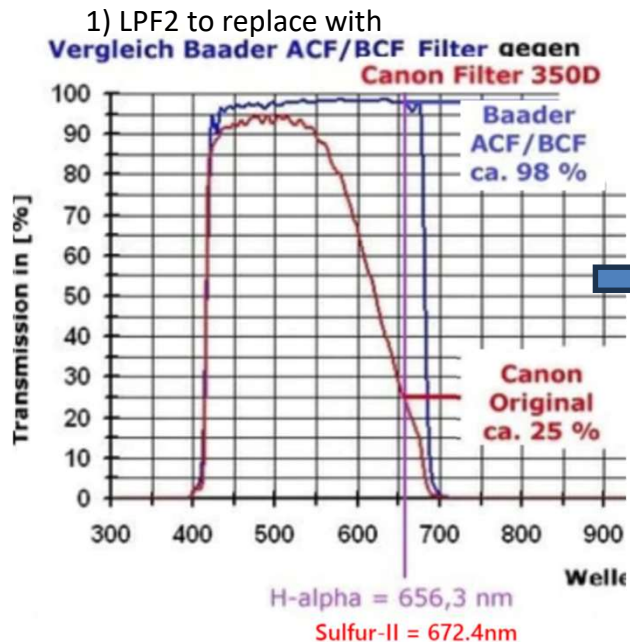
UV & IR Cut (Red enhanced)



COLORFILTERS FOR CMOS IMAGE SENSOR (FUJI)  
SENSOR FILTERS ASSEMBLY DIAGRAM



(a) Red channel  
Seung Wug Oh et al. 2016



Standard Camera

After Astro modification

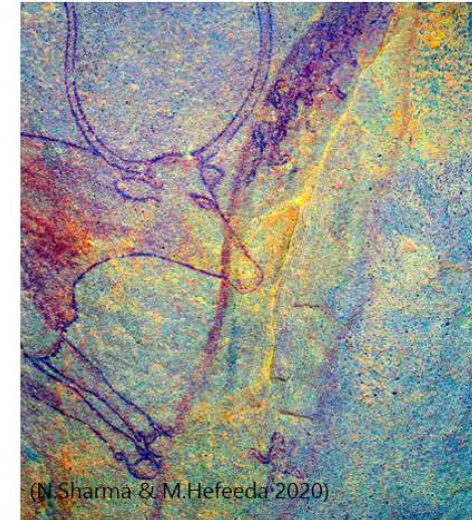
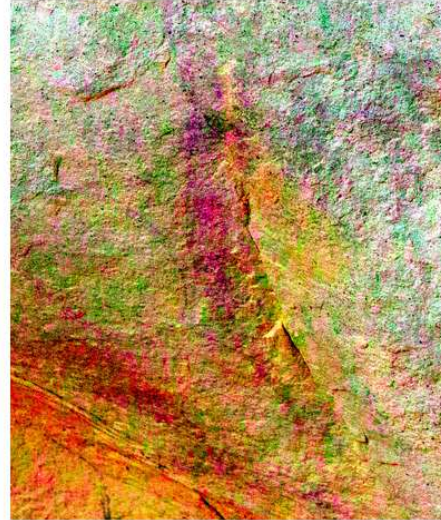
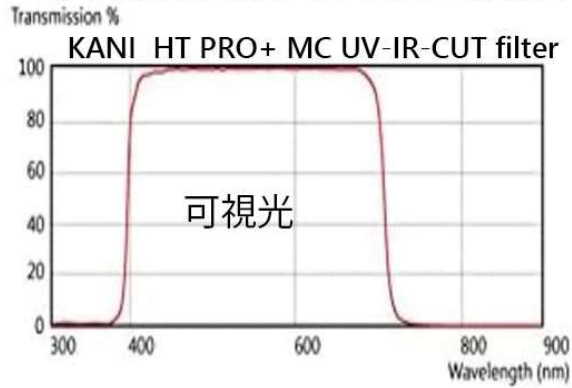
<https://www.astrogear.net/blogs/guides/astro-conversion-types-guide>



# MODIFICATION OF DSLR CAMERA FOR WIDE SPECTRAL IMAGING

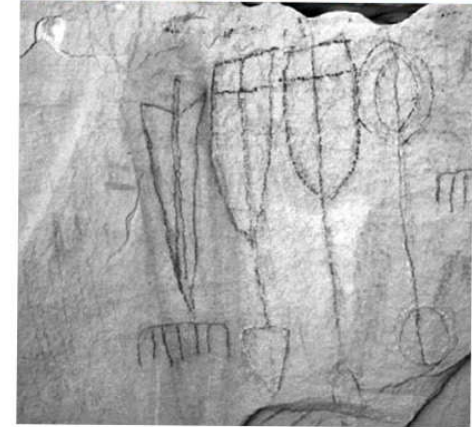
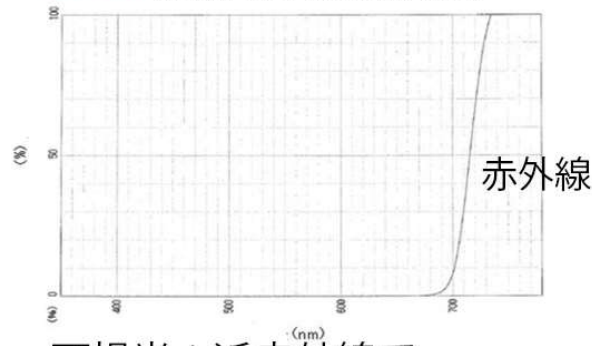


赤色領域改善でDStretch改善



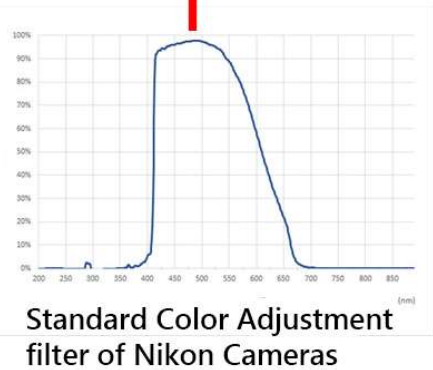
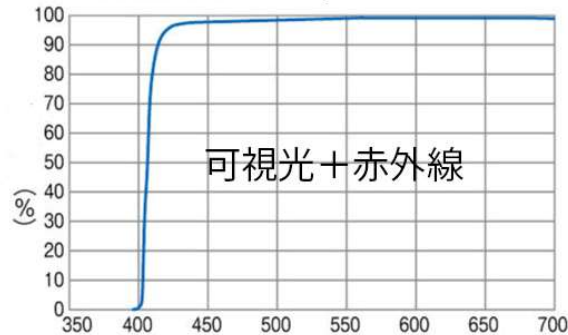
近赤外線撮影で透視効果  
反射率の差でコントラスト

PRO1D R72 Pro1D R72 infrared filter



可視光+近赤外線で  
透視効果とコントラスト

— Zéta UV L41 UV cut/Protect filter





# ベルニファル洞窟

テクティフォルム

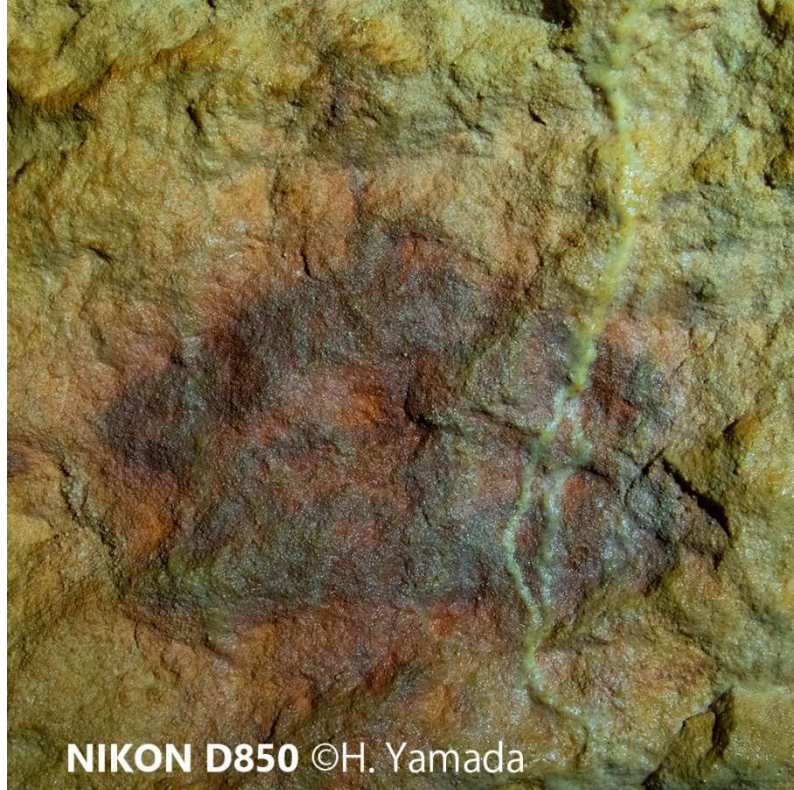
(五角形の記号)

表面が方解石(CaCO<sub>3</sub>)の  
被膜に覆われている

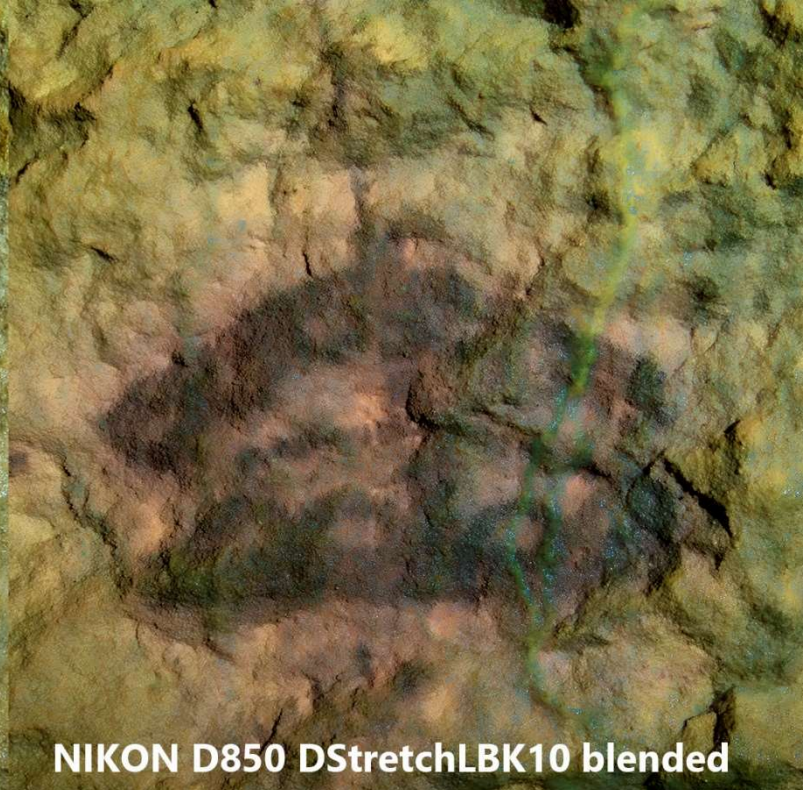
Nikon D850

標準仕様

400-650nm



NIKON D850 ©H. Yamada



NIKON D850 DStretchLBK10 blended

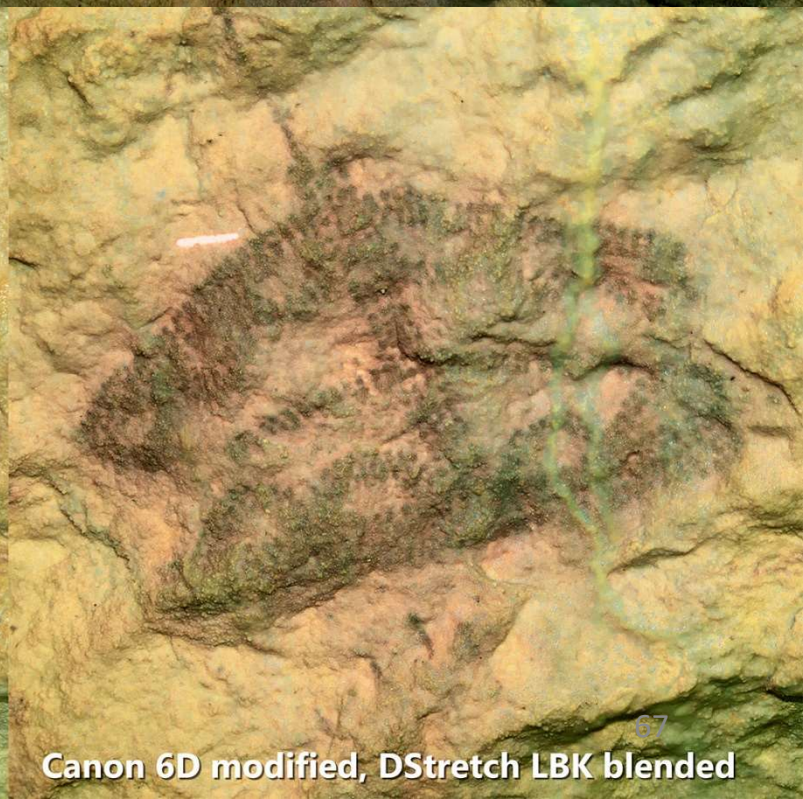
Canon 6D

フルスペクトル改造

400-1,000nm



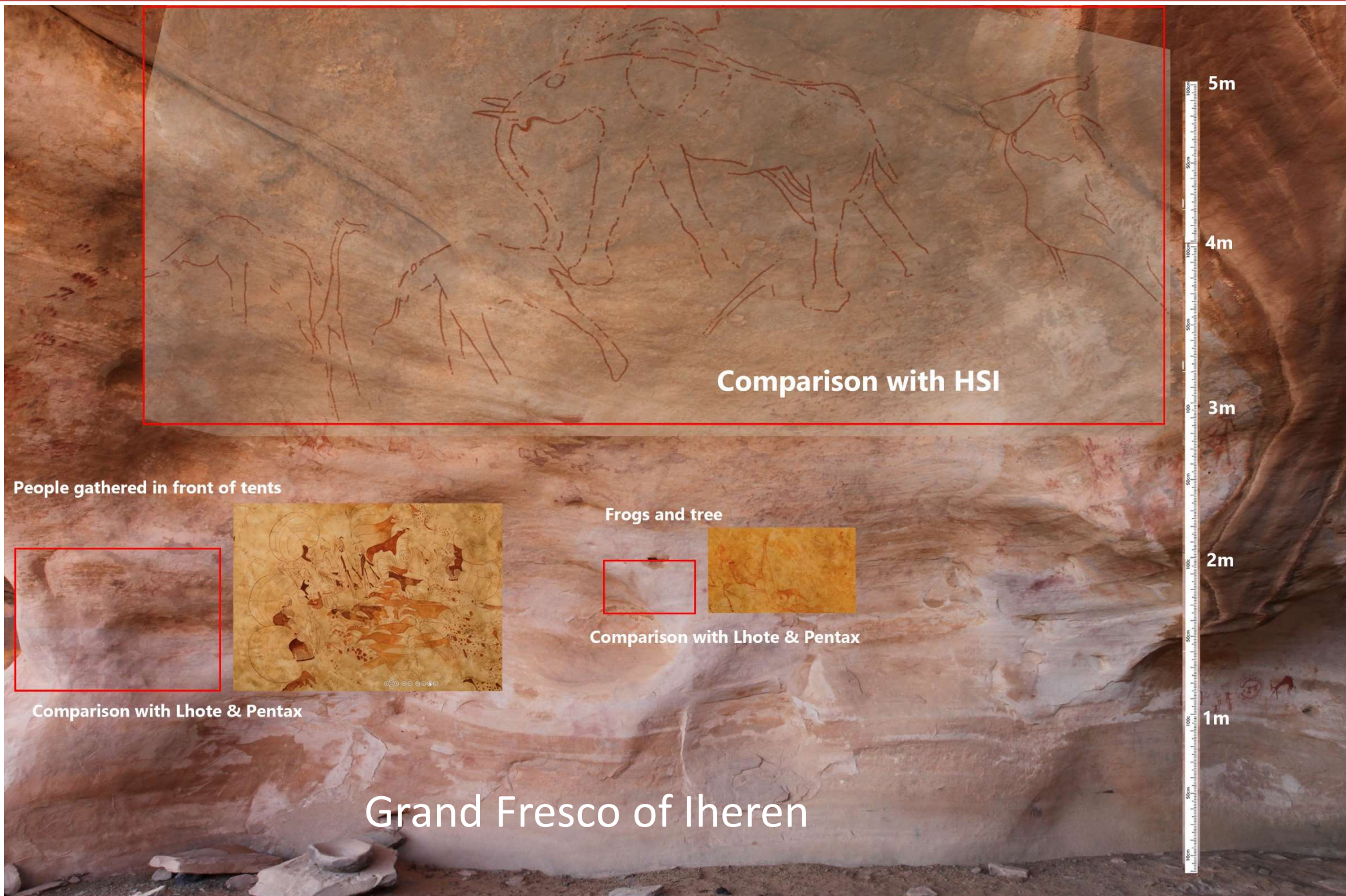
CANON FULL SPECTRUM 6D (modified)



Canon 6D modified, DStretch LBK blended



# Comparison tests for Modified Camera



Comparison with HSI

People gathered in front of tents



Comparison with Lhote & Pentax

Frogs and tree



Comparison with Lhote & Pentax

Grand Fresco of Iheren





**ご清聴ありがとうございました**